



**Composite Technologies**

## **INSTALLATION GUIDE**

**Flexpipe™**  
**Flexpipe™ High Temperature**  
**Flexcord™**

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## Revision 4.1 Changes

Minor changes from the previous revision of the Flexpipe Installation Guide (R4.0) include the following.

- Rebranded from Shawcor to Flexpipe.
- Added Note highlighting the requirement for 1m of straight pipe adjacent to all fittings.
- Updated pull force limits in Table 10 and Table 15.

## Revision 4.0 Major Changes

Major changes from the previous revision of the Flexpipe Installation Guide (R3.3) include the following.

- Addition of Larger Diameter equipment guidance
- Addition of 5" FP601 HT installation guidance
- Updated guidance regarding:
  - new equipment models or variants
  - new equipment and part colors
  - details on inspecting pipe and fittings for damage
  - pipe deployment methods
  - pipe installation methods including surface, trenched, plowed, risers, and conduit pulls
  - equipment operation and installation in cold weather
  - information on the Contractor Training Program
- The inclusion of the following Flexpipe bulletins:
  - 06-0676 – Pipe Reel Heating Procedure (R6)
  - 06-4016 – Compatibility of FC601 and FC801 Products (R2)
  - 06-4026 – Field Pressure Testing of New and Existing Pipelines (R12)
  - 06-4045 – Fittings Wrapping (R6)
  - 06-4064 – Inserting Pipe into Fittings Additional Guidance (R1)
  - 06-4068 – Fitting Sleeves with Engraved Crimp Line (R1)
  - 06-4072 – Cold Temperature Operating and Hydrotesting of FlexCord (R1)
  - 06-4076 – Additional Fitting Installation & Post-Crimp Inspection Guidance (R2)
  - 06-4079 – Pipe Clamp Torque Specification (R1)
  - 06-4081 – Technical Bulletin for 5" FP601 HT Product (R1)
  - 06-4089 – Liner Pulls (R1)
  - 14-4130 – Equipment Warm Up Procedure (R2)
- Updated figures and tables throughout with current product data
- Updated documentation and data sheets in the Appendices
- Updated document format to match current Flexpipe technical documents

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**Forward**

In order to provide useful product information, Flexpipe makes available a two part document:

**Part 1 – Technical Manual**

This part is mainly addressed to engineers, supervisors and procurement personnel. It is intended to present a general description of Flexpipe products' materials, construction, qualification, performance, installation, operation and reliability.

**Part 2 – Installation Guide**

This part is mainly addressed to field personnel and is intended to provide general guidance on Flexpipe products' handling, jointing, installing and testing.

Each part emphasizes particular aspects of the Flexpipe product application. Familiarity with the both parts is recommended for a broader perspective. Flexpipe bulletins are also issued or updated between revisions of the three documents in order to provide timely updates. These bulletins are also available at [www.flexpipesystems.com](http://www.flexpipesystems.com). The information contained in the bulletins supersedes the information in the Technical Manual and Installation Guide.

This document is intended solely as a reference for use by persons of technical competence. It is the responsibility of the pipeline operator to ensure the suitability of Flexpipe products for any specific pipeline application. While the information contained in this document is believed to be correct as of the date of issue, under no circumstances will Flexpipe, or any of its subsidiaries, be liable in any way for any loss, damage or injury of any kind (whether direct, consequential, punitive or otherwise) incurred as a result of any omissions in this document or as a result of reliance on any information contained in this document. This document does not contain any warranty, express or implied.

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## 1. Introduction

Flexpipe (“Flexpipe”) has created this installation guide to assist in the installation of its corrosion-resistant, coiled, continuous pipe and crimp fittings. This document will guide contractors and installers of Flexpipe Spoolable Products (“Flexpipe Spoolable Products”) through the installation process in order to ensure that their clients receive a high-quality pipeline for a competitive price that will last for many years of service.

The nature of pipelining has certain inherent risks and Flexpipe is committed to the safety of its employees and all those handling our product by mitigating the risk of personnel injury and property damage. Key information pertaining to the safe and efficient installation of Flexpipe Spoolable Products is highlighted throughout this document in the following forms:

### WARNING!



Warnings identify hazards that can cause personal injury or damage to equipment. When performing steps that have a warning in them, the hazards discussed in the section should be discussed in a safety meeting before the work is performed.

### CAUTION!



Cautions identify a procedure that if done incorrectly can damage the Flexpipe Spoolable Products or crimp fitting. Particular care and ability is required to reduce the chance of damaging the pipeline which costs time and additional materials to repair.

### NOTE!



Notes provide additional clarification or installation methods specific to certain geographical areas or working conditions. This advice is added to help streamline the installation process and provide additional information that may be useful knowledge while installing.

Flexpipe offers 24-hour support for all products. We also offer support through field personnel which can be on-site to oversee the installation of our products.

### CONTACT US!



If you have any questions about handling, installation or the products themselves, please contact us through our toll-free number:

**+1 888 FLX PIPE (+1 888 359 7473)**

[www.flexpipesystems.com](http://www.flexpipesystems.com)

## 1.1 Product Description

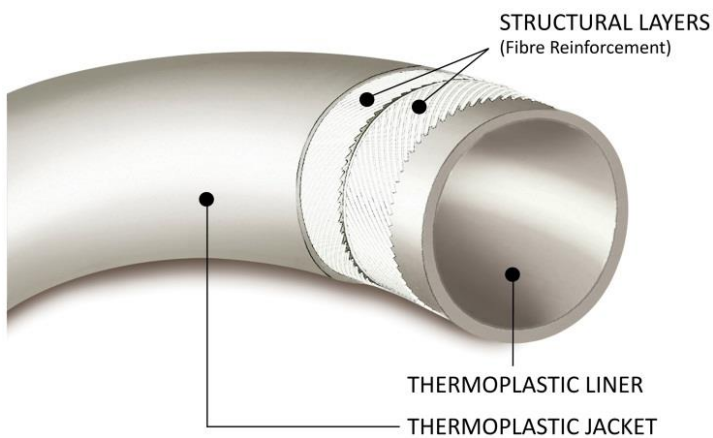
Flexpipe is capable of manufacturing 2", 3", 4", and 5" nominal pipe sizes (NPS) of Flexpipe (FP), Flexpipe High Temperature (FP HT), and Flexcord (FC) with 150, 300, 600, and 900 ANSI ratings. All pipe is manufactured in Flexpipe's state-of-the-art 13,000 square meter (140,000 square foot) facility located in Calgary, Alberta, Canada. The pipe consists of three layers and is described for each product type in the following sections.

### 1.1.1 FP and FP HT

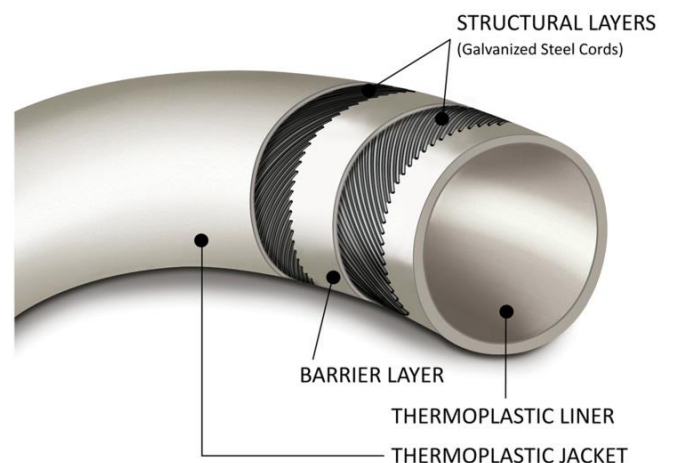
- The outer jacket is a protective barrier made of bimodal high density polyethylene (HDPE). FP product comes with a standard white jacket and FP HT has a standard gray jacket. Other colors are available by special order.
- For FP and FP HT the middle layer consists of dry glass fiber reinforcement strands and provides the pipe's strength.
- The inner liner serves as a conduit for the fluid and is also made of HDPE making it immune to corrosion.

### 1.1.2 FC

- The outer jacket is a protective barrier made of bimodal high density polyethylene (HDPE). FC products come with standard white jacket. Other colors are available by special order.
- For FC, the middle layer consists of galvanized steel cord reinforcement and provides the pipe's strength.
- As with FP, the inner liner serves as a conduit for the fluid and is also made of HDPE making it immune to corrosion.



**Figure 1: FP and FP HT Layer View**



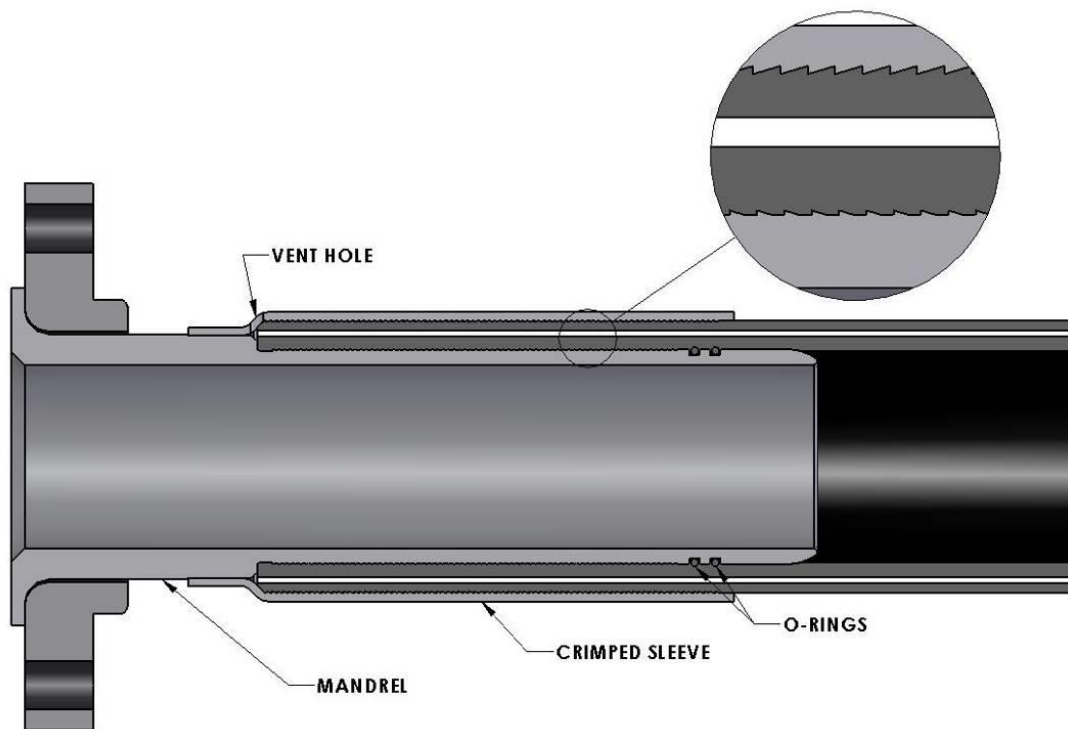
**Figure 2: FC Layer View**

### 1.1.3 Product Data

Specifications and dimensions of Flexpipe Spoolable Products, Reels and Coils are tabulated in Appendix A. The specifications in Appendix A are referred to throughout the document as it contains much of the dimensional information about the pipe, reels, and fittings.

### 1.1.4 Fittings

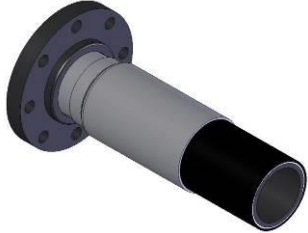


Fittings are required to connect lengths of Flexpipe Spoolable Products to each other and equipment. Flexpipe Spoolable Products are inserted between the mandrel and the sleeve to complete a connection. The sleeve is then crimped onto the Flexpipe Spoolable Products to create clamp pressure on the inside and outside of the pipe as demonstrated in **Figure 3**. Custom made crimp fittings with a stainless steel mandrel can also be provided.



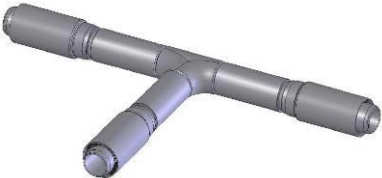
**Figure 3: Cutaway View of a Flexpipe Crimp Fitting**

The following types of fittings and flow joints are available from Flexpipe:

**Table 1: Stock Flexpipe Systems Fittings**

	<p><b>Flange End Fitting:</b> Used to connect Flexpipe Spoolable Products to other flanged connections using a standard lap joint flange. Flange End Fittings are available with 150, 300, 600 and 900 ANSI flanges. Gaskets, bolts and studs are not included.</p> <p>✔ This is a regular stock item.</p>
	<p><b>Coupling Fitting:</b> Used to join two ends of Flexpipe Spoolable Products together making the product suitable for long length pipelines by joining reels and reconnecting pipe where cuts are made for pipeline crossings.</p> <p>✔ This is a regular stock item.</p>
	<p><b>Weldneck Fitting:</b> Used to connect Flexpipe Spoolable Products to steel pipe and transition fittings such as steel to poly or steel to fiberglass. Enables the tie-in to existing pipelines of a different material or the use of steel risers if desired.</p> <p>✔ This is a regular stock item.</p>

**Table 2: Specialty Flexpipe Systems Flow Joints**

	<p><b>90 Degree Elbow Flow Joint:</b> Used to make tight radius corners typically on lease by combining two weldnecks and a short radius 90 degree elbow.</p> <p> Not a stock item. Allow minimum 3-6 weeks for delivery.</p>
	<p><b>T Flow Joint:</b> Used to tie-in a Flexpipe Spoolable Products branch line into a Flexpipe Spoolable Products trunk line by combining three weldnecks and a Tee. Available in a combination of sizes.</p> <p> Not a stock item. Allow minimum 3-6 weeks for delivery.</p>
	<p><b>Y-Lateral Flow Joint:</b> Used to tie-in a Flexpipe Spoolable Products branch line into a Flexpipe Spoolable Products trunk line and allow for pigging through all lines in the direction of flow by combining three weldnecks and a Y-lateral fitting.</p> <p> Not a stock item. Allow minimum 3-6 weeks for delivery.</p>

## 1.2 Packaging

### 1.2.1 Reels

Flexpipe Spoolable Products can be provided in reels. Finished product is rolled onto a 3.7 meter (12 foot) diameter reel and will vary in length. For example, 3-inch and 4-inch FP and FP HT reels typically vary from 780 to 700 meters (2,560 to 2,300 feet) and FC reels typically vary from 615 to 525 meters (2,018 to 1,722 feet). Each reel of Flexpipe Spoolable Products is spray painted with a large number indicating the actual length (in meters) on the reel. General reel lengths and weights are available **Appendix A**.



**Figure 4: Finished Reels of Pipe Ready for Shipment**

As Flexpipe Spoolable Products are rolled onto the reel, the protective jacket will have small indentations because of the reel. The indentations do not impact the functionality of the pipe and are acceptable for use. Sometimes the inside layer of Flexpipe Spoolable Products which rests against the inside hub of the reel is oval shaped. An oval shaped pipe on the inside layer of the Flexpipe Spoolable Products reel is still acceptable for use.

### 1.2.2 Coils

Flexpipe Spoolable Products can be provided in coils. Pipe is removed from the reel and wrapped into a coil for storage and shipping. The coils are held together by banding and vertical structural supports and set on a pallet for transportation, storage and deployment. As Flexpipe Spoolable Products are secured by banding, the protective jacket will have small indentations. The indentations do not impact the functionality of the pipe and are acceptable for use. General coil lengths, sizes, and weights are available in **Appendix A**.

### 1.2.3 Fittings

Fittings for Flexpipe Spoolable Products are packaged to protect the fittings depending on the method of shipping. Fittings are packaged either in wooden crates or strapped to pallets. Fittings packaged in crates are held in place by wood supports and surrounded by foam for protection from damage. When shipped on pallets fittings are wrapped in cardboard, secured with banding and wrapped with plastic shrink wrap.

## 1.3 Marking

### 1.3.1 Pipes

Pipes are marked with the application of a print string. Applying a print string to the product allows every reel of Flexpipe Spoolable Products to be uniquely identified. Every run of Flexpipe Spoolable Products is stamped at regular intervals with a print string that consists of the following:

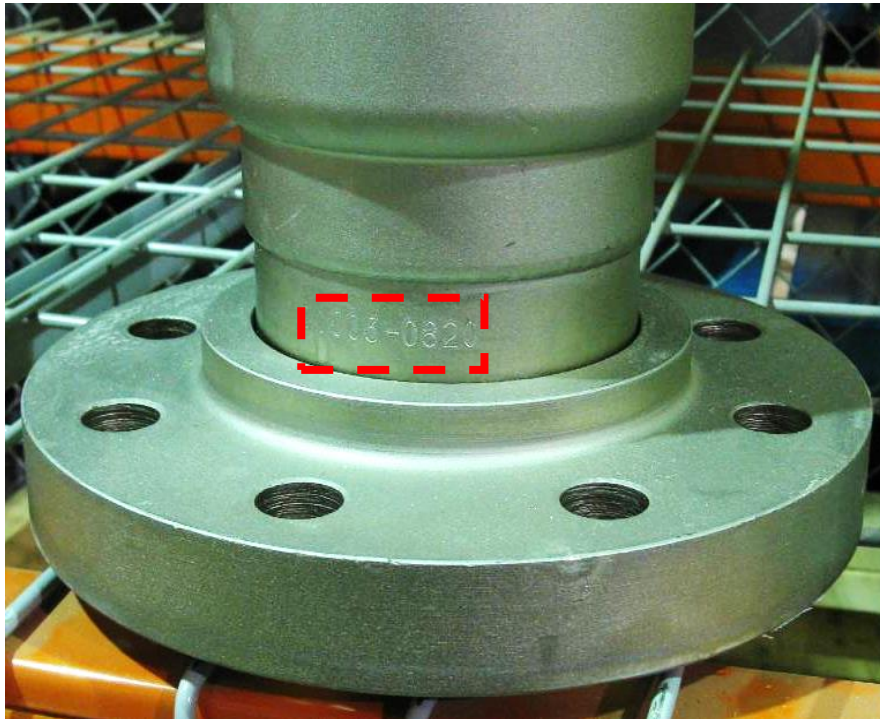
- Running Length (the meters of pipe that have gone past the printer; when unwinding Flexpipe Spoolable Products in the field, this will show the number of meters remaining on the reel/coil)
- Run (Batch) Number
- Flexpipe Logo
- Product Identification (For example: 3" FP301 or 4" FC901)
- Color Designation (For example: W, Y, GY)
- Date Manufactured
- "Made in Canada"



**Figure 5: Applying the Print String to Finished Pipe**

## 1.3.2 Fittings

Each fitting has a unique serial number that can be traced back to the manufacturer and the batch number.



**Figure 6: Location of Serial Number on Fittings**



**Figure 7: Location of Serial Number on Fitting Stickers**



## 1.4 Rental Equipment

The following rental equipment for installation is available for rental through Flexpipe. Note that there are differences such as crimp kit contents and weights between the 2"-4" and the 5" Flexpipe Spoolable Products equipment. More information on working with rental equipment can be found in **Section 4**.

### 1.4.1 2"-4" Crimp Kit

The 2"-4" crimp kit is packaged in a wooden crate for shipping and storage. The crate weighs approximately 550 kg (1200 lbs) and will fit in the back of a full size pick-up truck. The kit may be heavier if there are additional materials included such as pull tools, additional fittings, etc. See **Figure 8** below for the list of standard contents. For more detail on crimp kits and for operating the crimp kit equipment, refer to **Section 8.2**.



**Figure 8: Crimp Kit Manifest**

- |   |  |
|---|--|
| 1. Crimper  | 18. Four-inch FP150 Pipe Clamp   |
| 2. Hydraulic Pump Unit                            | 19. Two-inch FP301 Pipe Clamp  |
| 3. Mandrel Insertion Press                        | 20. Three-inch FP301 Pipe Clamp  |
| 4. 3-Position Remote Valve                        | 21. Four-inch FP301 Pipe Clamp   |
| 5. Hydraulic Hose Set                             | 22. Two-inch FP300/FP601/FC901 Pipe Clamp  |
| 6. Four-Inch Cup for Reamer                       | 23. Three-inch FP300/FP601/FC901 Pipe Clamp  |
| 7. Three-/Four-Inch Reamer with Three-Inch Cup    | 24. Four-inch FP300/FP601/FC901 Pipe Clamp   |
| 8. Two-Inch Reamer with Two-Inch Cup              | 25. Two-inch Fitting Adapter Clamp   |
| 9. Synthetic 5W-30 Engine Oil                     | 26. Three-inch Fitting Adapter Clamp   |
| 10. Hydraulic Oil or Automatic Transmission Fluid | 27. Four-inch Fitting Adapter Clamp  |
| 11. White Lithium Grease                          | 28. Two-inch Pipe Centering Tool   |
| 12. Petrolatum Paste                              | 29. Three-inch Pipe Centering Tool   |
| 13. Two-inch Crimper Dies                         | 30. Three Pelican Cases (Crimper Die Kits)   |
| 14. Three-inch Crimper Dies                       | 31. Large Pelican Case (Repair Kit, Field Installation Manual, Equipment Manuals and Outgoing Form, Wetness Meter) |
| 15. Four-inch Crimper Dies                        |  |
| 16. Press End Fitting Adapter                     |  |
| 17. Three-inch FP150 Pipe Clamp                   |  |



**Figure 9: Complete Crimp Kit Packed Up**



**Figure 10: Crimp Kit Loaded in Truck**

## 1.4.2 Large Diameter Crimp Kit

The large diameter crimp kit is packaged in a wooden crate for shipping and storage. The crate weighs approximately 669 kg (1475 lbs) and will fit in the back of a full size pick-up truck. The kit may be heavier if there are additional materials included such as pull tools, additional fittings, etc. See Figure 11 below for the list of standard contents. For more detail on crimp kits and for operating the crimp kit equipment, refer to **Section 8.2**.



**Figure 11: Large Diameter Crimp Kit Manifest**

Shown Above:

1. Remote Valve and Hose
2. Large Diameter Mandrel Insertion Press
3. Hydraulic Pump Unit
4. Large Diameter Crimper

Not Pictured:

5. Eight Crimper Dies
6. Die Bolts
7. Motor Oil
8. AW-46 Hydraulic Fluid
9. Denso Paste

10. Motor Assembly Grease
11. External Pipe Clamp
12. Press Integrated Pipe Clamp
13. Pipe Beveller
14. Large Pelican Case (Wetness Meter, Calcheck Device, Wet Fibers Bulletin, 9V battery)
15. Small Pelican Case (18 Die Bolts)
16. Small Pelican Case (Male & Female Quick Connectors, 5 1/16" Allen Key, Pins, Shoulder Bolts, Swivel Nut) Documents & Manuals

### 1.4.3 A-Frame



**Figure 12: A-Frame Supporting a Reel**

Flexpipe Spoolable products on reels are placed into an A-Frame which is capable of supporting the reel off the ground. The A-Frame allows the reel to rotate and safely deploy the pipe.

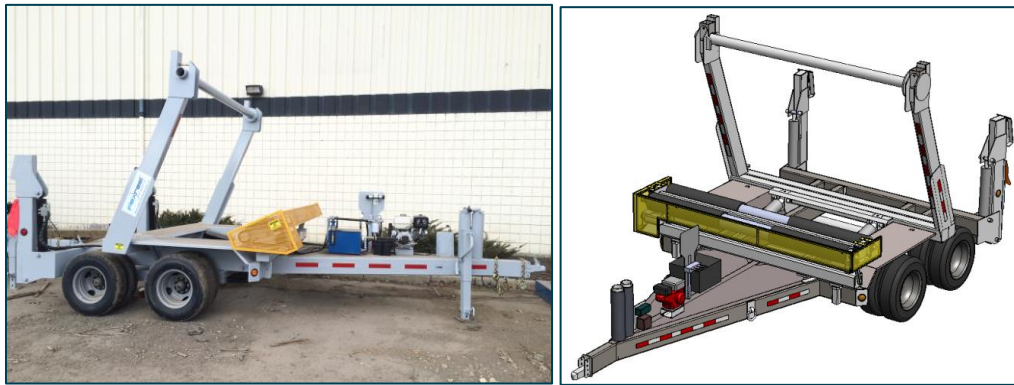
### 1.4.4 Deployment Trailer



**Figure 13: Deployment Trailer**

Flexpipe Spoolable products on reels can be placed onto a Deployment Trailer for deployment in the field. A loaded Deployment Trailer can be pulled by a  $\frac{3}{4}$  ton pick-up truck. The trailer can deploy 4' and 8' reels of spoolable products.

## 1.4.5 Respooling Trailer



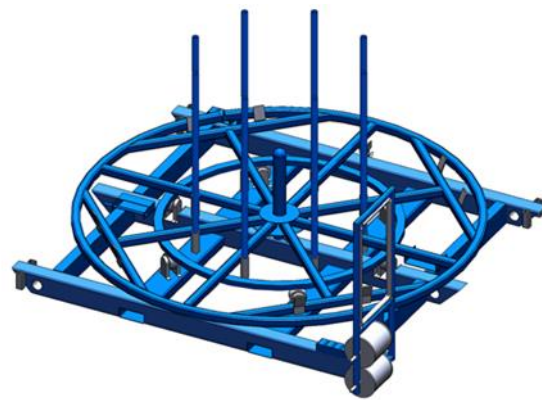
**Figure 14: Respooling Trailer**

Flexpipe Spoolable Products can be recovered and respooled using the Respooling Trailer, which is equipped with hydraulic mechanisms to rotate the reel and respool the pipe back onto it. The trailer can be moved with a  $\frac{3}{4}$  ton pick-up truck.

## 1.4.6 Turntable



**Figure 15: Packaged Coil**



**Figure 16: Coil Turntable**

Flexpipe coiled products are placed onto a turntable which is capable of supporting the pipe coils off the ground. The Turntable allows the coil to rotate and safely deploy the pipe. A lifting device is placed in the center of the coil and attached to the pallet underneath the coil. This allows the coil to be safely lifted from the top onto the Turntable.

## 1.4.7 Coil Assembly Lifting Device

To lift coils of Flexpipe products the Coil Assembly Lifting Device is required.

**NOTE!**



Flexpipe Coil Assembly Lifting Device is custom designed to ONLY pick up Flexpipe Systems coil assembly.



**Figure 17: Coil Assembly Lifting Device**

**CONTACT US!**



If you require replacement or additional equipment for your rental kit, or need any Standard Operating Procedure for rental equipment, please contact a Field Operations representative through our toll-free number:

**+1 888 FLX PIPE (+1 888 359 7473)**

[www.flexpipesystems.com](http://www.flexpipesystems.com)

## 1.5 Riser Chutes

Flexpipe spoolable pipelines can be brought to surface and supported by a steel riser chute mounted onto pilings. The purpose of the riser chute is to prevent unnecessary shear or tensile loads on the pipe that could be caused by settling of backfill and earth movement. Riser chutes are available in 45 and 90 degrees or as an S-bend.



**Figure 18: Steel Riser Chute**

## 1.6 Consumables

The following common items may be required for the pipeline installation and can be purchased from Flexpipe:

- **Anode Kits**  
Anode kits provide cathodic protection from corrosion for metal fittings. Anode kits are optional for Flexpipe fittings, depending on local regulations
- **12-Gauge Tracer Wire**  
Tracer wire is required for buried installations to allow for future location of the pipe. The tracer wire should be installed simultaneously with the pipe and checked for electrical continuity along the entire length immediately after installation. The wire termination points should be secured and clearly marked at readily accessible locations above ground.



**Figure 19: 12-Gauge Tracer Wire**

- **Custom Pigs**  
Standard medium-density foam bullet pigs are available. Custom polyurethane pigs are also available.
- **Petrolatum Paste**  
Wax based anti-corrosion paste.
- **Petrolatum Tape**  
Petrolatum tape is used for the protection of buried or above grade fittings from external corrosion.
- **Pipeline Tape**  
Pipeline Tape provides exterior protection for the metallic Flexpipe pipe fittings.
- **Heat Shrink Cap**  
Plastic heat shrink caps are used to cover the pipe ends and protect them during storage.

## 1.7 Contractor Provided Tools

The following tools are required and must be supplied by the installation contractor:

- Reciprocating Saw – with a fine tooth blade minimum 7” long for cutting FP or FP HT
- Demo Saw – with a minimum 16 inch diamond coated steel wheel for cutting FlexCord steel cords
- Angle grinder – with a diamond blade for cutting FlexCord steel cords
- Cordless or electric drill capable of inserting a 12 mm (½-inch) diameter rod
- Cordless impact or ½” drive ratchet with a 7/8” deep socket
- Marking pen
- Spray paint (to highlight any damage found)
- Measuring tape

## 1.8 Contractor Training Program

A two-day session of Flexpipe Installation Training is available for presentation to a minimum of 2 and a maximum of 6 participants per instructor. Additional personnel will require an extra Trainer. The Course will be completed once the mandatory Field Training is complete. The duration of the Field Training will be dependent on the number of participants and the activity level at the time.

During the field training portion, the Flexpipe trainer will be required to witness or discuss the following process and procedures relating to installing Flexpipe Products: Receiving Product and Equipment, Deploying and Handling all Flexpipe Products Safely, Rental Equipment, Risers and witness 2 fittings being installed by each trainee. Field Training follow-up is required within 90 days of completion of theory.

The Contractor Training is valid for one year.

### CONTACT US!




To register for the Contractor Training Program, please contact a Field Operations representative through our toll-free number:

**+1 888 FLX PIPE (+1 888 359 7473)**

[www.flexpipesystems.com](http://www.flexpipesystems.com)

## 2. Working with Reels


**WARNING!**



The nature of pipelining work can be dangerous. When installing any pipe, personal protective equipment must be used. This equipment includes safety glasses with side shields, safety toe boots, and work gloves.

If you or any worker is unsure about the work being performed or have concerns about safety, then the work should be stopped until everyone is aware of the procedure and comfortable with the safety level. The safety of the entire crew is the responsibility of everyone on site.

**WARNING!**



FlexPipe has a memory that makes the pipe that has been strung out want to coil back similar to the shape that it was on the reel. Precautions should be taken to restrain the pipe at the location where a cut is to be made.


The pipe may also have stored energy that will cause it to want to straighten while on the reel. This could cause the pipe and/or reel to shift unexpectedly if not properly restrained. The amount of energy stored varies with the ambient temperature. This is particularly important when beginning the unspooling process by removing the restraint on the end of the pipe.

### 2.1 Shipping Reels

Flexpipe Spoolable Products may be packaged on reels for transport, storage, and deployment. The reels are either 1.2 m (4 ft) or 2.4 m (8 ft) wide and 3.7 m (12 ft) in diameter. The hub diameter is large enough to ensure the pipe wraps around with ease, without kinking or bending tighter than the minimum bend radius.


Usually, two 1.2 m (4 ft) wide reels are put side by side or a single 2.4m (8 ft) wide reel per row is transported on a drop deck trailer. A trailer can typically carry up to six - 1.2 m (4 ft) wide reels or three - 2.4m (8 ft) wide reels, although some longer trailers can be configured to carry up to eight - 1.2 m (4 ft) wide reels or four - 2.4m (8 ft) wide reels. Refer to **Appendix A: Product Data Sheets** and **Appendix B: Flexpipe Trucking Policy** for additional information.

**NOTE!**



A step-deck trailer has an approximate height of 4.75 m (15'-7") when loaded with a 3.7 m (12'-0") Flexpipe reel. Consult your local regulatory body to confirm hauling restrictions. Weight restrictions may change seasonally in some areas.

**CAUTION!**



5" FP HT pipe and fittings weigh more than other FP HT products. Caution must be taken when loading, unloading and handling the pipe, fittings, and reels. Only appropriately rated equipment should be used. Lifting equipment, team lift, and proper lifting techniques should be utilized when handling fittings.



## 2.2 Loading Reels

Follow the below guidelines to load and secure reels onto the trailer:

- Always load the reels starting from the nose of the trailer working your way towards the rear.
- Reels must be secured using chains attached to the steel reels not the pipe.
- Chains should be wrapped around the outer flange at least halfway up the reel then run across the opposite side of the trailer (i.e. cross chained).
- Straps can be used for additional support but must not be strung over the pipe.
- Secure the reel using wooden chock blocks under the reel rims both before and after the reel.



**Figure 20: Reels Secured on Trailer**



**Figure 21: Improper Strapping of Pipe**

### CAUTION!



Chains and or straps should never be applied directly on the pipe products, as this may result in the pipe being kinked or cracked by the pressure applied onto the pipe; or the plastic cover of the pipe can get worn through the rubbing caused by the vibration created during transport.

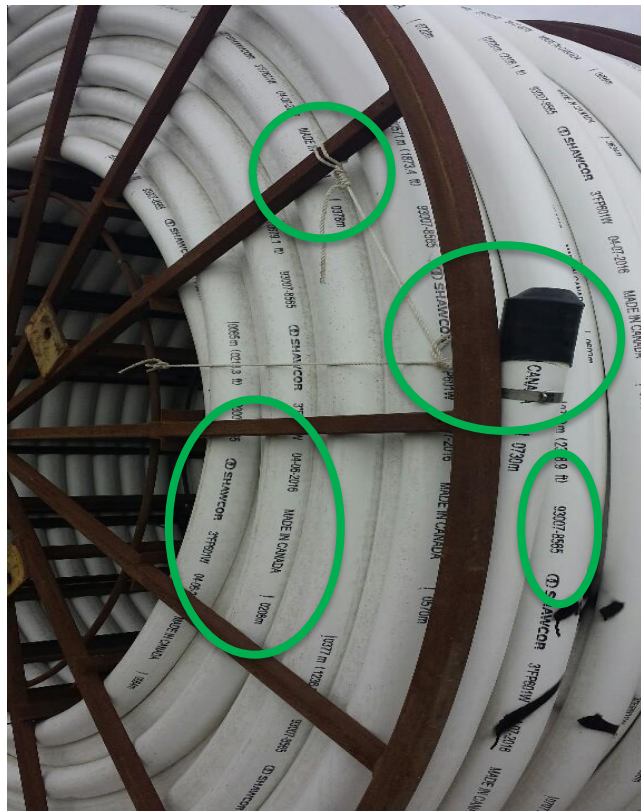
## 2.3 Inspecting Reels After Shipment

### 2.3.1 General

When the shipment of Flexpipe Spoolable Products arrives on site it should first be inspected. Refer to the Materials Arriving Checklist (see Appendix C: Field Forms). Check the Flexpipe Spoolable Products for the following:

- The pipe diameter, pipe grade, pipe length and pipe batch number are as recorded on the packing slip.
- The pipe end is securely tied to the reel, as shown in **Figure 22**.
- Both pipe ends are adequately sealed using a heat shrink cap, as shown in **Figure 22**.

Report any non-conformances to Flexpipe and quarantine any pipe that has been damaged.



**Figure 22: Pipe Reel Inspection Items**

**CONTACT US!**



If you find any damage to the pipe caused by shipping, please contact a Field Operations representative through our toll-free number:

**+1 888 FLX PIPE (+1 888 359 7473)**

[www.flexpipesystems.com](http://www.flexpipesystems.com)

## 2.3.2 Checking for Damage

Check the Flexpipe Spoolable Products for damage.

- Inspect every reel received
- Look for gouges, scratches, kinks, or exposed fibers.
- Be aware that there may be damage at the bottom of the reel
- Check where reel flanges may have overlapped

Record and mark any damage observed, take pictures, and contact Flexpipe. Damaged pipe should not be used. All damaged areas need to be cut out and not be included as part of the pipeline.

While unloading, make note of any damage or other issues on the waybill. If damage is visible in the outer layers of the pipe, be extra attentive while visually inspecting underlying layers of pipe. If further damage is discovered after unloading, make note of it on the packing slip. These records are important, since they may later be used by Flexpipe to conduct an in-house investigation into the cause of the damage.

This piece of pipe has been damaged and will need to be replaced.



**Figure 23: Damaged Pipe**

Minor scratches, indentations, and ovaling of the pipe caused by the reel are normal and do not require replacement.



**Figure 24: Normal Indentations and Scratches**

### 2.3.2.1 Checking for Scratches

See the table below for the maximum scratch depths used to determine whether a scratch is acceptable.

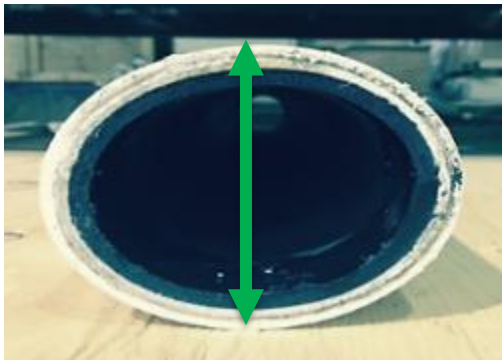
**Table 3: Acceptable Scratch Depths**

Flexpipe NPS	Maximum scratch depth	
	mm	inch
2"	1.5	1/16
3"	1.9	5/64
4"	2.4	3/32
5"	3.2	1/8

**Note:** A tire tread depth gauge or a digital caliper is recommended for accurate measurements.

### 2.3.2.2 Checking Flattened Pipe

Minor indentations and ovalization of the pipe from manufacturing the pipe onto the reel is normal. The method of installation may also cause pipe indentations or ovalization. Pipe that has been flattened up to 50% of the original outside diameter is acceptable during installation because the line will relax back into round shape. Pipe that has been flattened beyond 50% of the original outside diameter must be cut out. Please refer to Figure 25 and Figure 26, as well as the ovality % calculation below.



**Figure 25: Acceptable Ovalization**

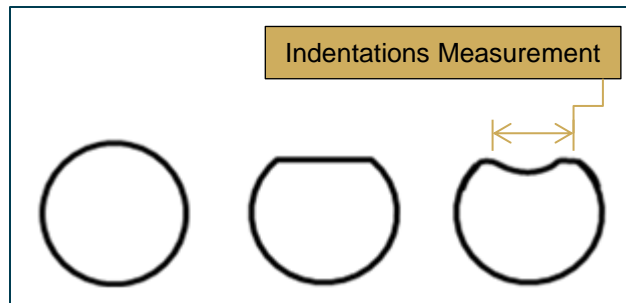


**Figure 26: Unacceptable Ovalization**

$$Ovality \% = \frac{(Max\ OD - Min\ OD)}{Nominal\ OD} \times 100$$

*Max OD:* the widest outer diameter  
*Min OD:* the smallest outer diameter  
*Nominal OD:* the pipe OD as manufactured

If the pipe has concave indentations such as seen in the third case in **Figure 27** below, the distance between inflection points (the place on the pipe where it changes from being round or convex to concave as you run your finger around in circumferentially), must be measured. If the width exceeds that found in **Table 4**, the pipe section containing the indentation must be cut out.



**Figure 27: Indentations Diagram**

**Table 4: Maximum Acceptable Width of Indentation**

Flexpipe NPS	Concave Indentation Width	
	mm	inch
<b>2"</b>	38.1	1.5
<b>3"</b>	63.5	2.5
<b>4"</b>	69.9	2.75
<b>5"</b>	76.2	3.0

### 2.3.3 Checking for Wet Reinforcements

Ensure the ends of Flexpipe Spoolable Products are protected from the environment. At the factory both ends of the pipe are sealed with heat shrink end caps. The end caps should be inspected to confirm they are in good condition. If the end caps are damaged or the end of the pipe is exposed it must be checked for wet reinforcements as per **Section 5**. After cutting out any wet sections, protect the dry pipe end from the environment by capping as described in **Section 5**.



**Figure 28: Heat Shrink Cap Installed On Pipe End**

## 2.4 Unloading Reels

### WARNING!



Reels containing Flexpipe Spoolable Products support a large amount of weight. They have a high center of gravity and a relatively narrow base footprint, so care must be exercised during handling and unloading to avoid overturning the reel, which could result in damage to the pipe or, even worse, human injury.

### CAUTION!

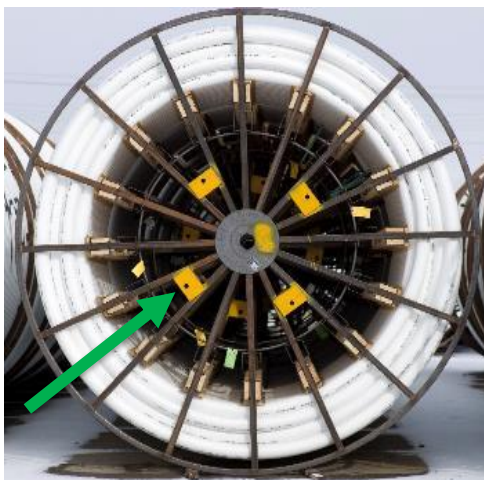


Reels should always be in the vertical position. Laying full or empty reels horizontally will damage the reel and will forfeit your reel deposit. Never lift or drag the reel by attaching to the pipe itself – the weight of the reel will damage the pipe.

### 2.4.1 Lifting Reels

Reels should be loaded and unloaded using an adequately sized lifting unit. It is important that the operator understands that reels of Flexpipe Spoolable Products weigh significantly more than reels of HDPE pipe. General guidelines for reel weights are available in **Appendix A**.

The designated lift points (yellow or green lift plates) must be used for attaching slings and rated chains. The lift plate hole diameter is 38 mm (1.5 in).



**Figure 29: Designated Yellow Lift Plates**

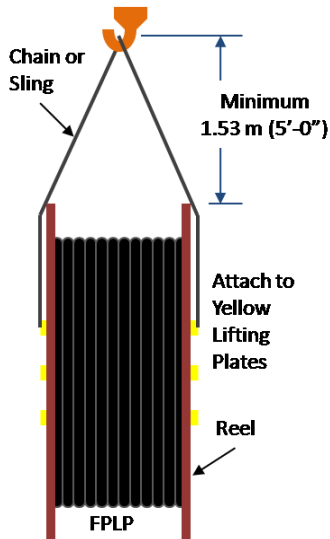


**Figure 30: Connected to Lift Plates**

Use one of the below recommended methods for rigging and lifting a reel of Flexpipe Spoolable Products:

**Method 1:**

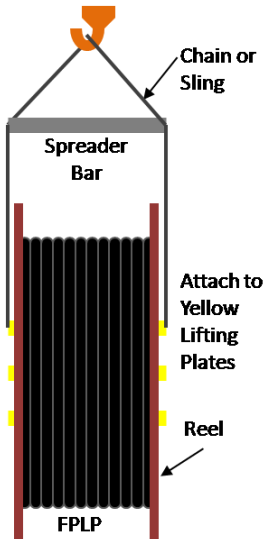
This is the default method recommended to lift Flexpipe Spoolable pipe reels. It requires that the rated slings or chains be long enough to prevent the load from crushing the reel, with a minimum length of 3.5 m (12 ft) each. Clevis's/shackles are also required to lift. Observe the minimum clearance distance in the below figure. Attach the rated chain or sling to the yellow lifting plates with a clevis.



**Figure 31: Chain/Sling Lifting without Spreader Bar**

**Method 2:**

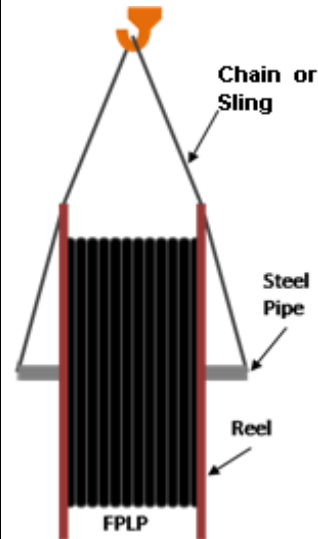
Use a 1.2 m (4 ft) or 2.4 m (8 ft) wide spreader bar (dependent on reel width) and slings or rated chains. The rated chain or sling should be attached to the yellow lifting plates with a clevis.



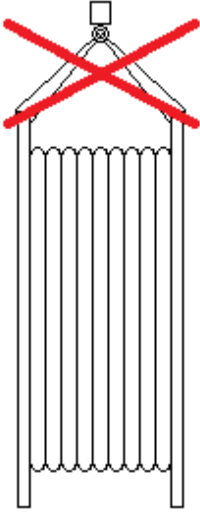
**Figure 32: Chain/Sling Lifting with Spreader Bar**

**Method 3:**

Place a steel pipe through the center hole of the reel, then run rated chains through the pipe and connect to a crane hook. This requires a 9 m (30 ft) rated chain for 1.2 m (4 ft) wide reels, or a 10 m (34 ft) rated chain for 2.4 m (8 ft) reels.



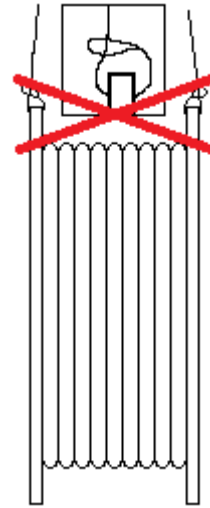
**Figure 33: Steel Pipe and Chain/Sling Lifting**



**Figure 34: Not Recommended Lifting Technique, Lifting with Rated Chain**



**Figure 35: Proper Lifting Technique**



**Figure 36: Not Recommended Lifting Technique, Lifting with Slings**

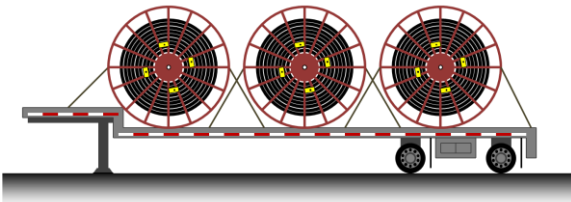
### 2.4.2 Unloading Tight Reels

To unload a trailer that has two 1.2 m (4 ft) wide reels side by side, you will have to roll the first reel back to hook onto it and lift it. Follow the procedure outlined below to remove the first reel.

#### STEP #1



Make sure that the trailer is level.



**Figure 37: Leveled Loaded Trailer**



## STEP #2

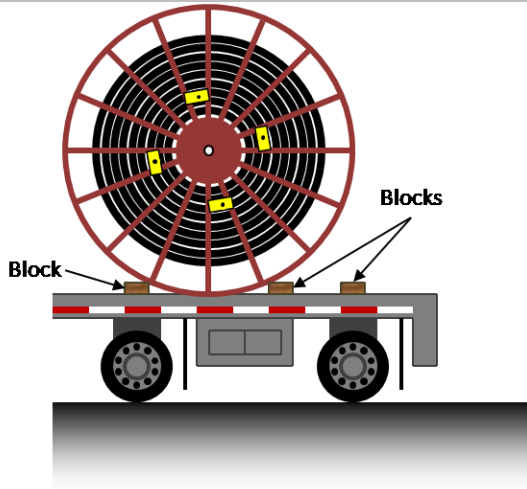


Figure 38: Blocked Reel

Place a block of wood behind each side of each reel so they cannot roll uncontrolled. Place a second block of wood 2 feet behind the first in the direction that the reel will be rolled. Remove the straps securing the reel.

## STEP #3

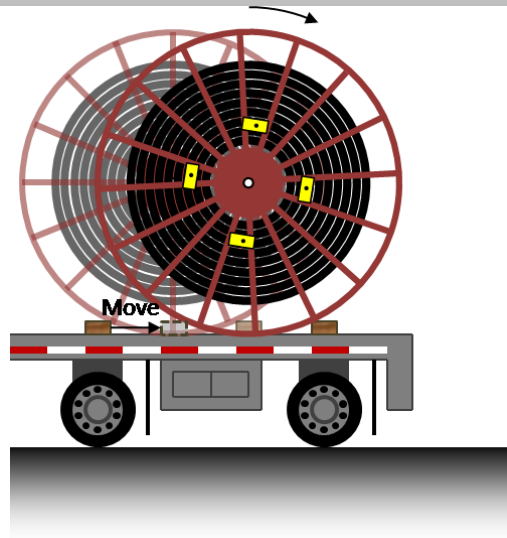


Figure 39: Rolling the Reel

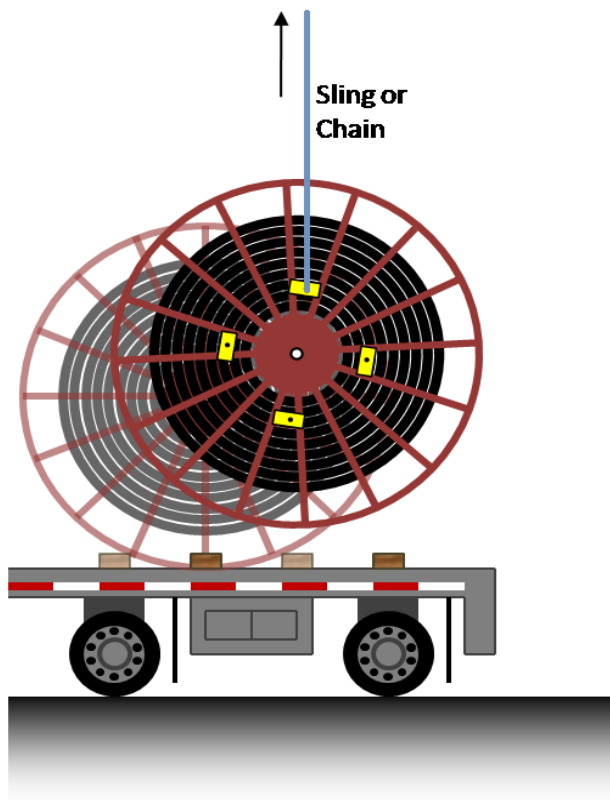
Remove the block against the side that you wish to roll towards and roll the reel back until it rests against the second block. Slide the block on the opposite side up against the reel again.

### CAUTION!



Rolling a reel in field conditions will damage the reel and the pipe. Only attempt rolling a reel while it is on the deck of the trailer.

## STEP #4

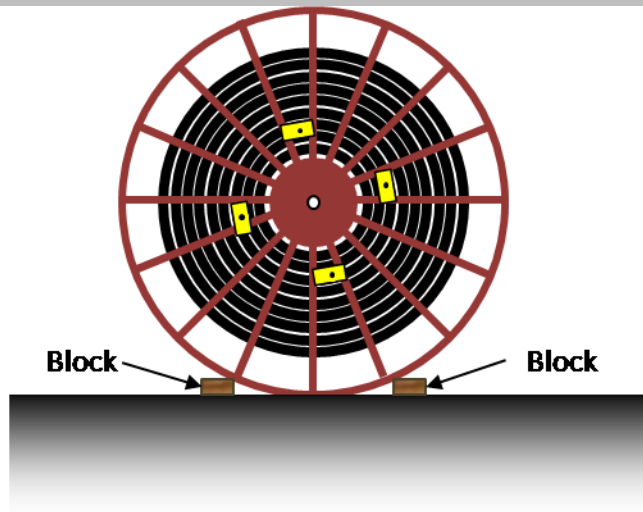


Attach a 3.7 m (12'-0") sling or rated chain to each of the yellow lift plates of the reel and lift the reel off the trailer.

If the top yellow lifting plate is not accessible, hook the sling or rated chain to the exposed (outermost) yellow lift plates of the reel and slowly rotate the reel in place by carefully lifting the sling or rated chain. Once the yellow lifting plates connected to the sling or rated chain are in the vertical position, lift the reel off the trailer.

**Figure 40: Lifting Reel**

## STEP #5



Place the reel on the ground, blocking it on both sides so it can't roll away or sink into the ground.

**Figure 41: Unloaded and Blocked Reel**

### 2.4.3 Unloading Reels Using a Forklift

Reels can be offloaded using a forklift. A minimum fork length of 2.75 m (9 feet) is required to safely lift the reels.



**Figure 42: Forklift Unloading a Reel**

## 2.5 Storage of Reels

Reels of the Flexpipe Spoolable Products should be safely stored on level, flat surfaces to prevent unintentional movement of the reels. Reel flanges should be blocked with wood or a similar object to prevent them from rolling. Even on flat ground, the wind can cause reels to roll.

There should be no objects protruding from the ground that could damage the pipe. In situations where reels are placed on soft surfaces, it is recommended that support pieces (i.e. wooden pipeline skids) be placed on the ground to prevent the rims of the reel from sinking into the ground.

Ensure the ends of Flexpipe Spoolable Products being stored are capped properly.

## 3. Working with Coils

### 3.1 Shipping Coils

Flexpipe Spoolable Products can be packaged in coils for transport, storage, and deployment. The FP and FC coils are 3.7 m (12 ft) in diameter and between 1.9 m (6.3 ft) and 2.4m (7.9 ft) in height. Usually up to 4 coils are transported on a flat deck or drop deck trailer. A coil lifting device is required to lift the coils from the shipping trailer. Refer to **Appendix A: Product Data Sheets** for additional information.

Coils shipped by boat will have steel C-channels along two of the open sections of the pallet. The C-channels are secured to the pallet by steel banding. These C-channels act as fork extenders enabling the safe handling of the coils using forklifts with short forks.

## 3.2 Loading Coils

Follow the below guidelines to load and secure coils onto the trailer:

- When loading a trailer with coils, always load starting from the nose of the trailer working your way towards the rear.
- Coils must be secured using straps over the blue corner protectors (supplied by Flexpipe).
- Straps should be ran up the side of the coil then down through the center to the opposite side of the trailer.
- Chains may not be used to secure coils due to the damage that can be caused from the chains rubbing against the pipe.



**Figure 43: Coil loaded and secured on trailer**

## 3.3 Inspecting Coils After Shipment

### 3.3.1 General

When the shipment of Flexpipe Spoolable Products arrives on site it should first be inspected. Check the Flexpipe Spoolable Products for the following:

- The pipe diameter, pipe grade, pipe length and pipe batch number are as recorded on the packing slip.
- The outer pipe end is securely strapped to the coil.
- The outer pipe end is adequately sealed using a heat shrink cap.

Report any non-conformances to Flexpipe and quarantine any pipe that has been damaged.

### 3.3.2 Checking for Damage

Check the Flexpipe Spoolable Products for damage:

- Inspect every coil received
- Look for gouges, scratches, kinks or exposed fibers.
- Be aware that there may be damage at the bottom of the coil

Potential damage causes include:

- Damage from the coil straps
- Damage from the shipping straps
- Damage from the wood pallet

Record any damage observed, take pictures, and contact Flexpipe.

While unloading, make note of any damage or other issues on the waybill. If damage is visible in the outer layers of the pipe, be extra attentive while visually inspecting underlying layers of pipe. If further damage is discovered after unloading, make note of it on the packing slip. These records are important, since they may later be used by Flexpipe to conduct an in-house investigation into the cause of the damage.

## 3.4 Unloading

Flexpipe coils can be offloaded from the trailer by either using a lifting device or a forklift.

### 3.4.1 Unloading Using Coil Assembly Lifting Device

#### 3.4.1.1 Required Equipment and Tools

The following is required:

- Staging Area requires a minimum of 15 feet on ALL sides of Truck Flatbed.
- Lifting shackle: 7/8" x 1" shaft with 9.5 ton capacity
- Lifting Chain: Capacity 9.5 ton and 4 foot length
- Lifting straps for loading / unloading turntable and lift device recommended length 20'
- Flexpipe Coil Assembly Lifting Device
- 30 ton track hoe with a lifting height of 30 feet or a 10 ton Crane

#### **NOTE!**



A lifting shackle and a 4 ft lifting chain are required for lifting coils with Coil Assembly Lifting Device. For details on coil assembly weights, please refer to Appendix A: Product Data Sheets.

#### **CAUTION!**



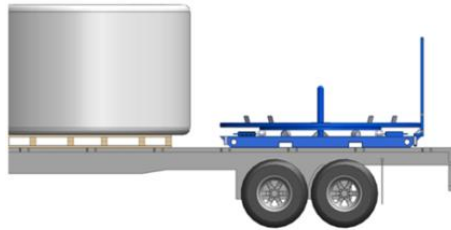
The use of the Coil Assembly Lifting Device is mandatory for unloading coil. Alternatively, a forklift can be used if unloading from a truck. Do not lift the coil by wrapping slings around the coils – this will damage the pipe.

### 3.4.1.2 Unloading Procedure

Proceed as follows:

#### 1. Preparing the coil

- Remove all 4" Trucking Straps.
- Remove all Corner Protectors & store them in the rental crimp kit.
- Do not remove the straps that hold the coil layers together.

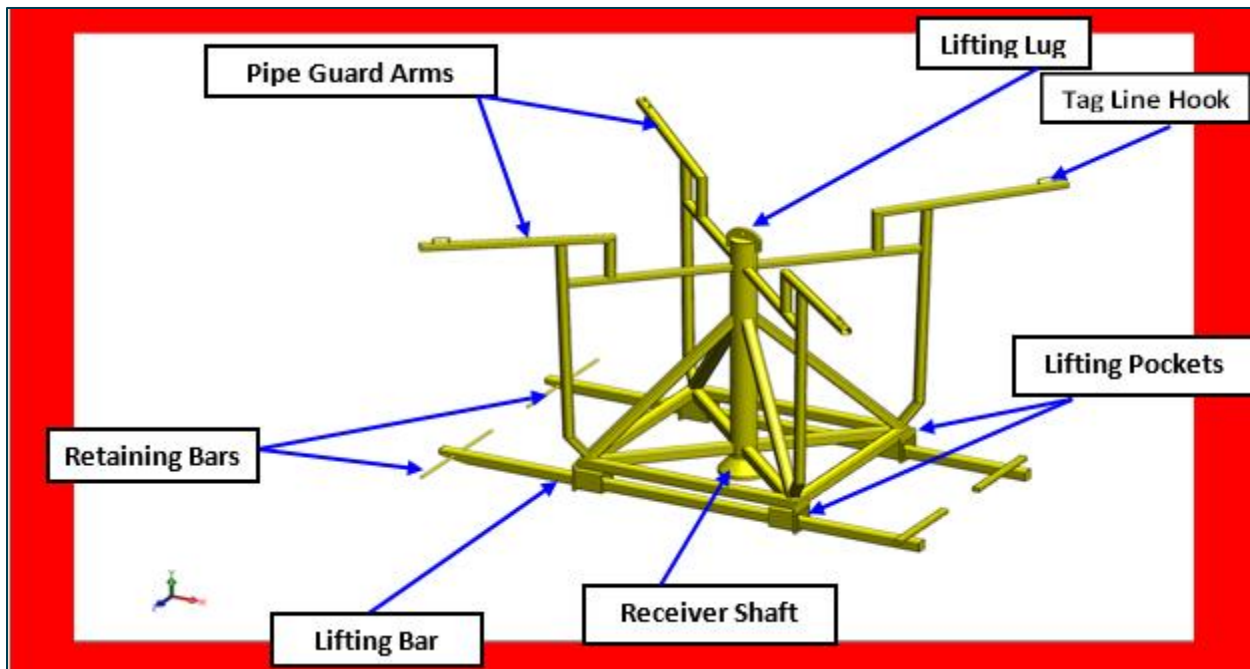


**Figure 44: Pipe on Flatbed Trailer**

**NOTE!**



When unloading coils with overseas packaging using the Coil Assembly Lifting Device, remove the steel banding, the C-channels and the associated wood pieces off the pallet prior to inserting the Coil Assembly Lifting Device into the coil.



Overall Dimensions of Coil Assembly Lifting Device			
Height	Width	Length	Overall Weight
8'9"/2.67m	5'2"/1.57m	11'8"/3.56m	1600lbs/726kg

**Figure 45: Coil Assembly Lifting Device**

## 2. Preparing the Coil Assembly Lifting Device

- There is a total of two (2) small retaining bars that prevent the lifting bars from sliding out of the lifting device and pallet.
- Each retaining bar has a locking pin that prevents the retaining bar from sliding out of the lifting bar.
- Slide the pin out to enable removing the retaining bar off each of the lifting bars. Pull the two lifting bars out of the pockets of the Coil Assembly Lifting Device.
- Connect the lifting shackle and lifting chain from the crane or track hoe to the Coil Assembly Lifting Device's lifting lug.
- Attach two tag lines to the Coil Assembly Lifting device for extra control during lifting.



**Figure 46: Attaching Device to Backhoe**



**Figure 47: Lowering Device into Coil**

## 3. Inserting the Coil Assembly Lifting Device into the coil

- Once connected, raise the Coil Assembly Lifting Device and slowly lower into the center of the coil.
- Align the pockets at the bottom of the Coil Assembly Lifting Device with the openings on the wood pallet.
- Use the two tag lines to help with guiding the Lifting Device into the coil.

### CAUTION!



Lower the Coil Assembly Lifting Device with caution and ensure the pipe guard arms and lifting pockets do not contact the coil.

### NOTE!



In order to make sure the pockets on the lifting device are aligned with the openings on the wood pallet, make sure you can see through the lifting pockets from the open end of the pallet, as seen in **Figure 49**.



Figure 48: View Through Lifting Pockets



Figure 49: Unloading Coil from Flatbed

#### 4. Securing the Coil Assembly Lifting Device

- Slide the two lifting bars into the pallet openings and through the lifting pockets of the Coil Assembly Lifting Device. The lifting bars must pass through both lifting pockets of the lifting device. **Figure 49.**
- Insert the retaining bars into the ends of the lifting bars.
- Secure the retaining bars by sliding in the locking pins.
- The Coil Assembly Lifting Device is now ready to lift the coil assembly.

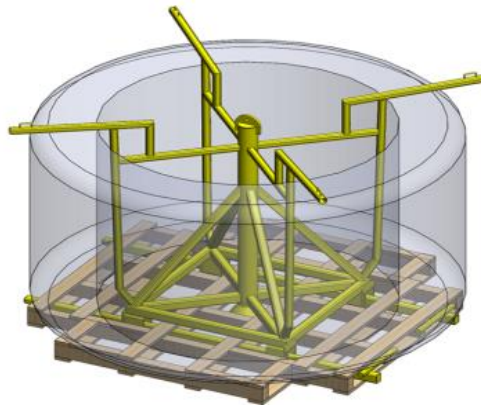


Figure 50: Isometric View Of Coil With Lift Device

#### 5. Unloading the coil

- Slowly lift the Coil Assembly Lifting Device, coil, and pallet off the trailer and place on solid ground.



### 3.4.2 Unloading using a Forklift

Coils can also be unloaded using a forklift. The forklift must have at least 4 m (13ft) long forks. Any shorter forks will damage the coil or the pallet. The forklift must also have adequate weight lifting capacity. Refer to the coil data sheet in the Appendix.

Unloading procedure:

- Insert the forks into the openings of the pallet.
- Ensure the forks run underneath the entire pallet.
- Lift the pallet and coil slowly and deposit on flat ground.

The forklift can also be used to unload the Coil Assembly Lifting Device. Position the forks underneath the arms on top of the Coil Assembly Lifting Device. Lift the Coil Assembly Lifting Device slowly and lower carefully on a flat surface.

## 3.5 Inspecting Coils Before Installation

### CONTACT US!



If you find any damage to the pipe caused by shipping, please contact a Field Operations representative through our toll-free number:

**+1 888 FLX PIPE (+1 888 359 7473)**

[www.flexpipesystems.com](http://www.flexpipesystems.com)

### 3.5.1 Checking for Damage

Perform a more thorough inspection of the pipe. Mark any damaged areas. Damaged pipe should not be used. All damaged areas need to be cut out and not be included as part of the pipeline. Just as when inspecting reels, check coils for scratches and cut out any areas with scratches exceeding the acceptable depths listed in **Table 3**.

### 3.5.2 Checking for Wet Reinforcements

Ensure the ends of Flexpipe Spoolable Products are protected from the environment. At the factory both ends of the pipe are sealed with heat shrink end caps. The end caps should be inspected to confirm they are in good condition. If the end caps are damaged or the end of the pipe is exposed it must be checked for wet reinforcements as per **Section 5**. After cutting out any wet sections, protect the dry pipe end from the environment by capping as described in **Section 5**.



**Figure 51: Heat shrink cap installed on a pipe end**

## 3.6 Storing Coils

- Coils must be safely stored on level, flat surfaces to prevent unintentional movement.
- There should be no objects protruding from the ground that could damage the pipe.
- Ensure pipe ends are properly sealed. Refer to **Section 5**.



**Figure 52: Pipe Coil with Corner Protectors on Pallet**



**COLD WEATHER Storage** - for temperatures below 0°C (32°F)

For below-freezing temperatures, install four (4) – 4x4 wooden spacers underneath Pipe Coils Pallets to minimize freezing of pallets to ground.



**Figure 53: Picture of Winter Storage of Pipe Coils.**

## 4. Working with Fittings, Rental Equipment, and Consumables

### 4.1 Shipping

#### 4.1.1 Fittings

Fittings are typically packaged either in wooden crates or strapped to pallets. Fittings packaged in crates are held in place by wood supports and surrounded by foam for protection from damage. When shipped on pallets, fittings are wrapped in cardboard, secured with banding and wrapped with plastic shrink wrap. Fittings can be shipped on a flatbed trailer, enclosed trailers or pick-up trucks. **Individual loose fittings should be secured during transport.** International shipments may also include desiccant material.

#### 4.1.2 Riser Chutes

Riser chutes are shipped on flat bed trailers with Flexpipe Spoolable Products. Riser chutes are shipped with U-bolts, rubber pipe pad, plastic half-moons, extensions, and installation instructions in an attached container. Care is taken to make sure the additional items are attached and shipped with the riser chute.

#### 4.1.3 Rental Equipment

##### 4.1.3.1 Crimp Kit

Crimp Kit is packaged in a wooden crate for shipping and storage. The 2"-4" crimp kit crate weighs approximately 550 kg (1200 lbs) and the large diameter crimp kit crate weighs approximately 669 kg (1475 lbs). Each will fit in the back of a full size pick-up truck and can be shipped in any manner requested. The hydraulic pump unit is shipped with proper engine oil level and proper hydraulic fluid level. The mandrel insertion press, the 3-position remote valve and the portable crimper tool also contain hydraulic fluid within the hoses, cylinders and pistons when shipped.

**NOTE!**

The installation contractor is responsible for providing gasoline for the hydraulic pump unit.

##### 4.1.3.2 A-Frame

The A-Frame is typically shipped on a flatbed trailer with Flexpipe Spoolable Products.

##### 4.1.3.3 Deployment Trailer

The Deployment Trailer must be shipped on a flatbed trailer and can be combined with a partial load of Flexpipe Spoolable Products.

##### 4.1.3.4 Respooling Trailer

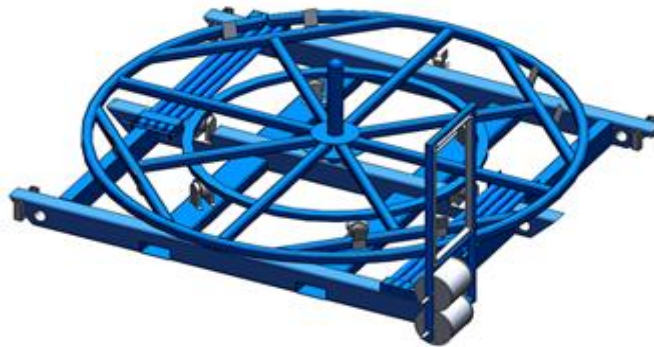
The Respooling Trailer can be shipped on a flatbed trailer and can be combined with a partial load of Flexpipe Spoolable Products.



**Figure 54: Respooling Trailer Ready to Ship**

#### 4.1.3.5 Turntable

The Turntable is typically shipped on a flatbed trailer with Flexpipe Spoolable Products.



**Figure 55: Coil Turntable**

#### 4.1.3.6 Coil Assembly Lifting Device

The Coil Assembly Lifting Device is shipped on flat bed trailers. When transporting the Coil Assembly Lifting Device, always load it standing up and secure the lifting bars with a trucking strap so they do not move during transport.



**Figure 56: Transporting the Lifting Device**

## 4.1.4 Consumables

Consumables ordered from Flexpipe are packaged in cardboard boxes or wooden crates as appropriate for each shipment.

## 4.2 Unloading

### 4.2.1 Fittings

Fittings shipped in crates or on pallets require a forklift, crane, track hoe, or picker truck to unload them from the flatbed trailer. When receiving the fittings, check that the crate is in good shape and not damaged. Also check the fitting quantities, type and that the fittings match the pipe grade.

### 4.2.2 Rental Equipment

#### 4.2.2.1 Crimp Kit

The wooden crate with rental equipment weighs approximately 550 kg (1200 lbs) for the 2"-4" kit, or 669 kg (1475 lbs) for the large diameter kit, and should be unloaded using a forklift, crane, track hoe or picker truck. The wooden crate can be put into the back of a pick-up truck to facilitate accessibility and storage during pipe installation.

#### 4.2.2.2 A-Frame

The A-Frame has forklift pockets and can also be lifted off the shipping trailer using a sling directly connected to the A-Frame body. Do not lift the A-Frame from the 4" shaft. Weights are found in Table 5 below.



**Figure 57: Unloading the A-Frame**

**Table 5: A-Frame Weights**

		4 ft A-Frame	8 ft A-Frame
A-Frame Only Weight	Metric (kg)	656	931
	Imperial (lbs)	1,444	2,050

### 4.2.2.3 Deployment Trailer

The Deployment Trailer has lifting lugs to be used for connecting to when lifting the Deployment Trailer off the shipping trailer. A loaded Deployment Trailer weights 1905 kg (4200 lbs). Refer to the Deployment Trailer Operating Manual for more detailed instructions.

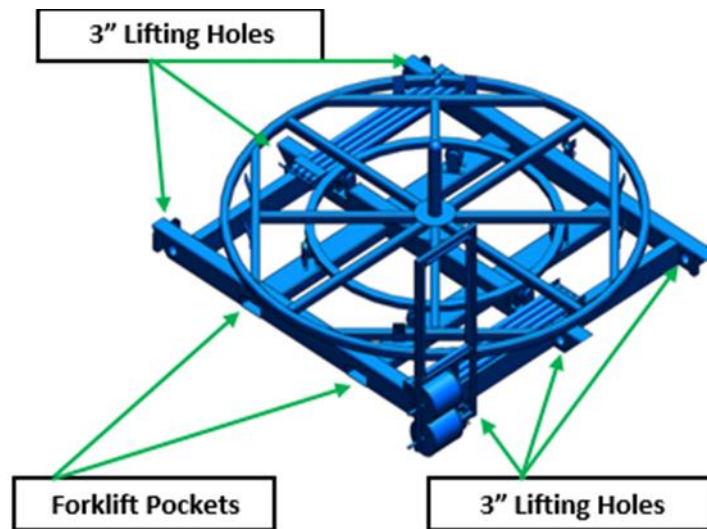
### 4.2.2.4 Respooling Trailer

The Respooling Trailer has lifting lugs to be used for connecting to when lifting the Respooling Trailer off the shipping trailer. The Respooling Trailer weights 1400 kg (3085 lbs).

### 4.2.2.5 Turntable

The Turntable can be lifted using either of the two following methods:

- Method 1 – Chain/Sling Through 3” Fixed Turntable Lifting Holes.
- Method 2 – Using a forklift through the Fixed Forklift Pockets



**Figure 58: Turntable lifting points**

The Turntable weighs 1,600 kg (3,500 lbs), with the following dimensions: width 3.7 m (12 ft), length 3.7 m (12 ft), height 2.6 m (8ft. 6in) (including coil assembly lifting device).

### 4.2.2.6 Coil Assembly Lifting Device

Refer to **Section 3.4.1** for guidance on unloading the Coil Assembly Lifting Device.

### 4.2.3 Consumables

Consumables are typically packaged in cardboard boxes and can be unloaded manually.

### 4.3 Inspecting

All Flexpipe supplied fittings, rental equipment, and consumables should be inspected upon receipt of shipment. This is to confirm all items have been received in proper working condition suitable for use and installation. Immediately document any nonconformance/damage and report to Flexpipe.

#### 4.3.1 Fittings

Fittings can become damaged if handled improperly. Check carefully for the following:

- Dents – If there are any dents in the fitting then that fitting should not be used.
- Missing O-rings – Each mandrel should have two O-rings. Extra O-rings are shipped inside the corresponding Pelican die kit found in the crimp kit.
- Chipped coating – Check the inside surface for chipped nickel coating (if coating was ordered). Check the coating inside the mandrel, around the nose of the mandrel for damage or scratches. The coating on the outside surface of the fitting may chip off as it does not get prepared before the coating is applied and flash surface rust may be present on the sleeves surface. This is normal and is not the sign of a defective coating. The outside surface of the fitting will be protected after install by corrosive resistant wrapping and corrosive resistant paste on the vent hole.
- Dirt and debris – Care should be taken to ensure that the fittings remain clean. If the fitting has been dropped in the mud, you will have to make sure that it is completely clean and dry before use. Flexpipe recommends pressure washing fittings to clean them.
- Mandrel – Check that the mandrel is properly positioned in the center of the sleeve as illustrated in the figure below.



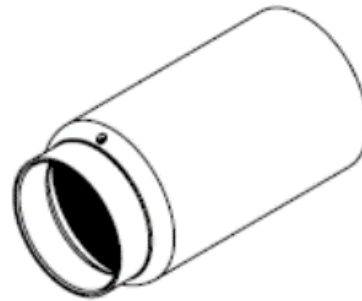
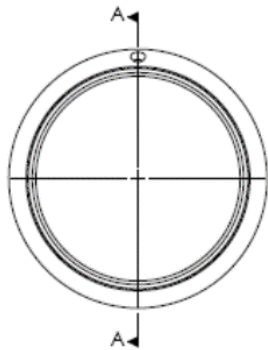
**Figure 59: Correct Positioning of Sleeve on Mandrel**



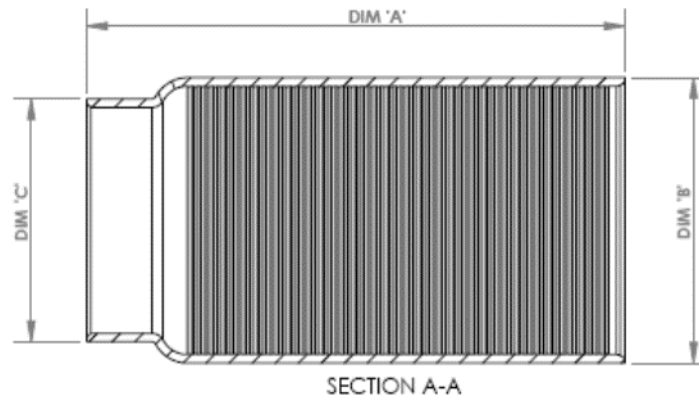
**Figure 60: Incorrect Positioning of Sleeve on Mandrel**

- Confirm each flange or weldneck has a vent hole. Each coupling should have two vent holes.
- The fittings crate contains the correct type, size, grade and quantity of fittings compared to the packing slip. Ensure that the fitting matches the size and grade

of the pipe (i.e.: FP150, FP301, FP601, FC901, FP301HT and FP601HT). This can be verified with the sticker on the sleeve of the fitting or by comparing to the dimensions that follow:



**Figure 61: Crimp Sleeve End View    Figure 62: Crimp Sleeve Isometric View**



**Figure 63: Crimp Sleeve Cross-Section and Dimensions**

The following tables include dimensions that apply to the fitting sleeve before crimping.

**Table 6: Crimp Sleeve Dimensions - Standard Fittings**

NPS/Type	Dim. A		Dim. B		Dim. C	
	inches	mm	inches	mm	inches	mm
<b>2" FP301</b>	5.37	136.4	3.21	81.5	2.46	62.5
<b>2" FP300/FP601</b>	5.37	136.4	3.35	85.1	2.46	62.5
<b>3" FP150/FP301</b>	8.25	209.6	4.36	110.7	3.58	90.9
<b>3" FP300/FP601</b>	8.25	209.6	4.55	115.6	3.58	90.9
<b>4" FP150/FP301</b>	10.00	254.0	5.50	139.7	4.60	116.8
<b>4" FP300/FP601</b>	10.00	254.0	5.68	144.3	4.60	116.8



**Table 7: Crimp Sleeve Dimensions – EL Fittings**

NPS/Type	Dim. A		Dim. B		Dim. C	
	inches	mm	inches	mm	inches	mm
2" FP301 EL	8.07	205.0	3.21	81.5	2.46	62.5
2" FP601 EL	8.07	205.0	3.35	85.1	2.46	62.5
3" FP301 EL	9.65	245.1	4.36	110.7	3.58	90.9
3" FP601 EL / FC901 EL	9.65	245.1	4.55	115.6	3.58	90.9
4" FP301 EL	12.10	307.3	5.50	139.7	4.60	116.8
4" FP601 EL / FC901 EL	12.10	307.3	5.68	144.3	4.60	116.8
5" FP601 EL	15.49	393.4	7.34	186.4	7.34	186.4

<p><b>CONTACT US!</b></p> 	<p>If you have any questions about the condition of your fittings, please contact a Field Services representative through the toll-free number:</p> <p style="text-align: center;"><b>+1 888 FLX PIPE (+1 888 359 7473)</b></p> <p style="text-align: center;"><a href="http://www.flexpipesystems.com">www.flexpipesystems.com</a></p>
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### 4.3.2 Rental Equipment

Check through the Crimp Kit Inspection Form shipped with the equipment to ensure that all equipment has been received. The form will be included in the paperwork that arrives on-site with the equipment and a blank form can be found in **Appendix D: Rental Equipment Inspection Form**.


### 4.3.3 Consumables

Each shipment should be reviewed with the shipping documents to confirm all the consumables have been received and the packaging is intact.

## 4.4 Storing

### 4.4.1 Fittings

Fittings are to be stored in their original packaging in a dry environment protected from the elements and physical damage. In particular the O-rings are susceptible to UV weathering if not protected.

<p><b>CAUTION!</b></p> 	<p>When handling fittings care must be taken to prevent any damage to the fittings and the internal coatings. All fittings must be inspected per <b>section 4.3.1</b>.</p>
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## 4.4.2 Crimp Kit

The crimp kit is to be stored in the crimp kit crate, with the lid on. The equipment in the crate should be stored dry and clean.

### WARNING!



**Crimp Kits can operate at pressures up to 10,000 psi. Damaged equipment could cause injury. Ensure the equipment is inspected prior to use every time.**

**Crimp Kits contain sharp and heavy equipment which may shift during transport creating pinch points. Adequate personal protective equipment such as safety glasses, approved steel-toed footwear, work gloves, and FR clothing should be worn at all times. Proper lifting practices, which may include a mechanical lifting device, should be observed when loading, unloading and handling equipment and accessories.**

## 4.4.3 A-Frame, Turntable, Deployment Trailer

Store the equipment on flat terrain in a safe and secure location.

## 4.4.4 Consumables

Consumables are to be stored in a clean dry environment until used.

# 5. Wet Reinforcements

## 5.1 Wet Fibers

Glass fiber reinforcements used in the structural layer of FlexPipe (FP) and FlexPipe High Temperature (FP HT) products are affected by prolonged direct contact with water. If the glass fibers are exposed for a length of time to water, they would become wet and saturated thus reducing the structural integrity and performance capabilities of the pipeline section with the wetted fibers. Water ingress from exposed glass fibers at the cut pipe ends during pipe storage and/or installation is the most likely cause of wet glass fiber reinforcements. Another potential path for water ingress is through the vent hole of an improperly wrapped fitting. See **Section 9.6.3** for more information on properly wrapping fittings to protect from water ingress.

To reduce the likelihood of water ingress past the fitting wrapping, a maximum of 3 feet of water depth above the vent hole is allowed. If the installation has more water depth than this, the open vent hole must be eliminated. Discuss options to accomplish this with Flexpipe Engineering.

Due to encapsulation between the polyethylene layers, wet glass fibers in FP and FP HT typically remain wet for a very long period after the water exposure event. Wet fibers will typically be detected even if checked long after the removal of the water contact.

**NOTE!**



The use of wetness meters is not applicable to FlexCord as wetness meters do not work with the steel cords of FlexCord.

## 5.2 Wetness Meter

The wetness of the glass fiber reinforcements shall be checked using the wetness meter General Model # MMD4E. The MMD4E wetness meter is provided as part of the crimp kits of Flexpipe.

**NOTE!**



As part of product installation training and certification, Flexpipe offers training of installation personnel on the use of the MMD4E wetness meter. Please contact Flexpipe to book a product installation training session.

**NOTE!**



Flexpipe currently uses the MMD4E as the default wetness meter. Other models of the wetness meters previously recommended by Flexpipe include: BLD 5360 and BLD 5365. These models are still valid and may still be used. Contact Flexpipe for guidance on the use of the previous meter models.

The General Wetness Meter Model MMD4E is available in two models:

- The MMD4E with yellow sides, shown in **Figure 64**.
- The MMD4E with black sides, shown in **Figure 65**.



**Figure 64: Wetness Meter Model #MMD4E - Yellow Sides**



**Figure 65: Wetness Meter Model #MMD4E - Black Sides**

### 5.2.1 Use of the Wetness Meter

The below instructions are written to apply to both the MMD4E with yellow sides and the MMD4E with black sides. The unit is supplied with a manual that should be used for reference.

#### 5.2.1.1 Introduction

- Keep a backup of 9V batteries as the battery life in these devices may be short.
- While not in use, the MMD4E wetness meter is resistant to extreme environmental temperatures. However, during operation, the temperature of the wetness meter should be kept within the range from 10°C to 30°C (50°F to 86°F) for correct functioning. Outside this range, the wetness meter may not operate, or may generate erroneous results.
- Immediately prior to use, condition the wetness meter to a temperature between 10°C to 30°C (50°F to 86°F) for 10 minutes, e.g. by keeping the meter in a temperature controlled vehicle. While in use, limit any duration of exposure of the wetness meter to temperatures outside the range of 10°C to 30°C (50°F to 86°F) to as short as practically possible.

#### 5.2.1.2 Meter Calibration

- Turn the meter on.
- Ensure that the meter digital display shows the wood setting. If the display does not show the wood setting, depress the material selection/mode button a single time. The screen should then show the wood setting.
- Remove the gray cap at the top of the device that is protecting the electrode pins.
- Check the meter calibration by using either the small black reference standard shipped along with the meter or the cap of the MMD4E with black sides. When the meter pins are placed across the calibration check tool, the meter display should show a digital reading of 18±2. Confirm the meter produces a result within this

range. Disregard the calibration range of  $18\pm 1$  mentioned on the meter reference standard and meter documentation.

- If the meter does not produce a result within the required range, let the meter acclimatize in a dry environment at  $10^{\circ}\text{C}$  to  $30^{\circ}\text{C}$  ( $50^{\circ}\text{F}$  to  $86^{\circ}\text{F}$ ) for 10 minutes.
- Re-check whether the meter produces a result within the required range. If not, please have the meter replaced.

### 5.2.1.3 Measuring Wetness

**NOTE!**



If the pipe end has been left unprotected for a length of time and has potentially been exposed to liquid water (e.g. rain, snow, etc.), cut-off one meter (3 feet) from the pipe end prior to checking for wetness.

- Prior to every use of the meter, ensure the meter is calibrated as per the above section.
- Please note that the probes may be sensitive to any surface moisture near the measurement site. It is necessary to dry off the pipe jacket / pipe end prior to inserting the probes into the pipe.
- Hold the meter parallel to the pipe. Push the electrode pins firmly into the reinforcement layer at the end of the cut pipe in-between the jacket and liner. Allow the probes to be inserted for 5 seconds prior to taking the reading.



**Figure 66: Dry and Wet Measurements**

- To check the wetness of a pipe end, perform at least three measurements around the pipe cut end.
- For the MMD4E with yellow sides, **a reading of “11.9” or lower indicates dry pipe**. Any higher numerical reading should be considered a wet pipe and that pipe section should be cut-off and disposed of.
- For the MMD4E with black sides, a reading of “---“ with no light, or a reading equal to or lower than “11.9” indicates dry pipe. Any higher numerical reading, or a “---“ with red light should be considered a wet pipe and that pipe section should be cut-off and disposed of.
- If wetness is detected, cut-off one meter (3 feet) from the pipe end and re-check for wetness.
- Continue checking and cutting-off any wet pipe until all readings indicate dry pipe.

**NOTE!**



In order to reduce the possibility of having wet fibers, always ensure the pipe has adequate end caps, the jacket is free from through wall damage and the crimped fittings are properly wrapped.

**NOTE!**



In some instances, wet readings may be the result of condensation that occurred on the pipe surface rather than a true indication of wet fibers. Where environmental conditions may be conducive to condensation (for example cold pipe undergoing rapid warm-up), consider acclimatizing a cut pipe section that showed a wet reading in a temperature controlled vehicle for 10 minutes and recheck for wetness.

## 5.2.2 Guidance for Frozen Pipe

- If working at or below freezing temperatures, it can be assumed that any water that may be present in the pipe has frozen into ice. The wetness meter is unable to detect frozen water. If the pipe was exposed to temperatures below 5°C (40°F) overnight, warm the pipe prior to inspection.
- The use of an infrared temperature gun may help in deciding if the water in the pipe could be frozen.
- Heat the pipe section to be inspected with a low flame tiger torch (or similar) for a few minutes, using a sweeping motion, to a temperature of hand warm (and / or less than 60°C/140°F).
- Inspect for wetness as per the standard procedure.

## 5.3 Wet Cords

Cord reinforcements used in the structural layer of FlexCord (FC) products are affected by prolonged direct contact with water. If the cords are exposed for a length of time to water they would become wet and start corroding, thus reducing the structural integrity and performance capabilities of the pipeline section with the wetted cords. Water ingress from exposed cords at the cut pipe ends during pipe storage and/or installation is the

most likely cause of wet cord reinforcements. Another potential path for water ingress is through the vent hole of an improperly wrapped fitting.

If there is a reason to suspect the cord reinforcements of FlexCord are wet (missing end cap, unprotected pipe end left exposed, etc.), check the cord wetness as follows:

1. Cut open a window in the jacket of the suspect pipe that is 30 cm (1 ft) long from the pipe end to expose the cords, using a diamond cutting blade.
2. Cut open a window in the liner of the suspect pipe that is 25 cm (10 in) long from the pipe end to expose the cords, using a Sawzall. This should be at or near the same area the jacket is exposed.
3. Check for any signs of wetness on the cords, evidenced by water droplets or cords rust.
4. Check for any signs of wetness on the inside of the jacket or liner sections cut out.
5. If wetness is found, cut out a length of 10 feet of the line, take an additional pipe sample and check for wetness as above.
6. Repeat the above steps until no wetness is found.



**Figure 67: Checking Wetness on FC**

**NOTE!**



If the pipe end has been left unprotected for a length of time and has potentially been exposed to liquid water (e.g. rain, snow, etc.), cut-off one meter (3 feet) from the pipe end prior to checking for wetness.

**NOTE!**



Due to the electrical conductivity of the cord reinforcements, the wetness meters cannot be used to detect wetness of the cord reinforcements in FC.

## 5.4 Capping Pipe Ends

The heat shrink cap is the recommended method for protecting the reinforcements of the cut pipe end from becoming wet. For short term protection (up to a duration of several days), the alternative method using pipeline tape, as described below, may be used. For long term storage, a Flexpipe heat shrink cap must be installed. Pipeline tape or heat

shrink caps are intended to keep out rainwater and condensation. For underwater submersion up to 3 feet of water or for burial, installation of a crimp fitting with proper wrapping per **Section 9.6.3** is recommended.

## 5.4.1 Installing a Heat Shrink Cap

- Check the pipe reinforcement layer for wetness.
- Clean the jacket at the pipe end over a length of approximately 30 cm (12”).
- Seal the reinforcement layer at the pipe cut end with Denso paste.
- Install the cap by placing it over the end of the pipe and pushing the cap until it won't slide forward any further.
- Uniformly heat the shrink cap with a heating blanket or tiger torch, until the glue liquefies and can be seen. Refer to **Figure 68**.



**Figure 68: Heat Shrink Cap**

- Continue to heat the rest of the cap evenly until it closes around the pipe creating the proper watertight seal.
- Allow the cap to cool down for 10 minutes.
- Check the quality of the capping by verifying:
  - The cap is free from physical damage
  - The cap is securely sitting on the pipe end
  - The glue is fully melted (see end of the cap for sign of glue)

## 5.4.2 Alternative Method for Sealing the Pipe End

- Check the pipe reinforcement layer for wetness.
- Clean the pipe jacket at the pipe cut end over a length of approximately 30 cm (12”).
- Seal the reinforcement layer at the pipe cut end with Denso paste. Refer to **Figure 69**.
- Cover the pipe cut end with a plastic bag (e.g. garbage bag). Refer to **Figure 70**.
- Secure the plastic bag in place using pipeline tape. Refer to **Figure 71**.



- Crisscross cut sections of pipeline tape at various angles over the bore area until the area covered by the plastic bag is also covered by pipeline tape. Refer to **Figure 72**.
- Wrap pipeline tape over the pipe end till the pipeline tape extends by around 15 cm (6") beyond the plastic bag. Refer to **Figure 73**.



**Figure 69: Apply Protective Paste**



**Figure 70: Plastic Bag**



**Figure 71: Secure the Bag**



**Figure 72: Crisscross Sections**



**Figure 73: Sealed Pipe End**

## 6. Deploying Flexpipe Spoolable Products

**WARNING!**



While Flexpipe Spoolable Products are wrapped on a reel or in a coil, it contains potentially dangerous stored energy. When releasing restrained pipe for un-spooling, ensure the pipe ends are restrained. Exercise caution and clear personnel and equipment from the energy release path.

### 6.1 Pipe Preparation

FP and FP HT contain fiberglass strands that when wet will lose some of their structural integrity. FC contains metal cords that are prone to corrosion when wet. The pipe ends must be kept clean and dry. Flexpipe recommends covering the exposed ends of the pipe with heat shrink end caps when the pipe is not being worked with to avoid fluid or dirt getting into the annulus of the pipe. Refer to **Section 5.4** for pipe end capping procedures.

**CAUTION!**



The cut ends of FC contain loose sharp strands of steel cable. These metal strands can puncture through work gloves. Extra care must be taken while handling the ends of FC to avoid grabbing directly over areas with exposed metal strands.

### 6.2 Attaching to Pipe

The following sections list the preferred methods of attaching to pipe for deployment, as well as how to use each method.

If the pipe will be deployed in a wet, muddy, or similar environment, or is pulled through a bore or flooded conduit, it is required to use a pull tool and to fully seal it to protect the pipe reinforcement layers. How to seal each pull tool is detailed below. Refer to **Section 5** for more information on protecting the pipe reinforcements from moisture.

**NOTE!**



Each pull tool requires a shackle for pulling. The table below provides a list of recommended shackles for all pull tools listed. Flexpipe stocks the various types of pull tools for use on Flexpipe Spoolable Products. Each pull tool has specific applications for which it is best suited.

**Table 8: Shackle Sizing for Pull Tools**

<b>2-inch Pull Tool</b>	1/2" Shackle
<b>3-inch Pull Tool</b>	5/8" Shackle
<b>4-inch Pull Tool</b>	3/4" Shackle
<b>5-inch Pull Tool</b>	1" Shackle

<p><b>CONTACT US!</b></p> 	<p>To determine the suitability of a pull tool that is not supplied by Flexpipe, please contact a Field Operations representative to discuss the details of your installation through our toll-free number:</p> <p style="text-align: center;"><b>+1 888 FLX PIPE (+1 888 359 7473)</b></p> <p style="text-align: center;"><a href="http://www.flexpipesystems.com">www.flexpipesystems.com</a></p>
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## 6.2.1 Methods of Attachment

When pulling FP, FP HT, or FC from a reel or coil, the preferred methods of attaching to the pipe are as follows, listed in order of preference:

1. Road Bore Pull Tool: Refer to **Section 6.2.2.**
2. Internal Pull Tool: Refer to **Section 6.2.3.**
3. External Pull Tube: Refer to **Section 6.2.4.**
4. Smiley: Refer to **Section 6.2.5.**
5. Sling Wrap: Refer to **Section 6.2.6.**

### NOTE!



For FC, a pull tool or sling wrap is recommended. Drilling holes in FC is labor intensive as the drill bit pulls on the cords rather than cutting through them. Cutting a “smiley” in FC is also labor intensive.

## 6.2.2 Road Bore Pull Tool

Shown to the right is a 3-inch Road Bore Pull Tool. It is supplied with a marking sleeve used to mark where to drill the holes on the Flexpipe Spoolable Products. When the pull tool is slid inside the pipe, the holes for attaching the screws will line up. The screws are inserted through the drilled holes and attached to the pull tool. The pipe end must be sealed to prevent the ingress of water and other debris. The end can be sealed using pipeline tape.

Note that the road bore pull tool and marking sleeve come in various sizes designed specifically for each size and pressure rating combination of Flexpipe Spoolable Products. The advantage of using the road bore pull tool is that it clears away debris when you are pulling FP – an especially useful trait when pulling through road bores.



**Figure 74: Road Bore Pull Tool**

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**Road Bore Pull Tool**

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**Figure 75: Slide Sleeve Over Pipe**

Slide the marking sleeve over the pipe end and make sure it is fully inserted.



**Figure 76: Mark and Drill the Holes**

Mark the drill holes. Remove the marking sleeve and drill holes where the template markings indicate.



**Figure 77: Apply Paste to Protect Fibers**

Apply Denso paste to the end of the pipe to protect the fibers from water ingress.



**Figure 78: Insert Pull Tool and Install Bolts**

Insert the pull tool into the end of the pipe and line up the bolt holes with drilled holes made earlier. Install the bolts and tighten until they are flush with the pipe.



**Figure 79: Apply Denso Tape to Protect Fibers**

Apply Denso tape to the end of the pipe and wrap back to cover the bolts. This will protect the fibers from any water ingress during the pull.



**Figure 80: Apply Polyethylene Tape**

Wrap the pull tool end with polyethylene tape to protect the Denso tape and pipe end.

## 6.2.3 Internal Pull Tool

An Internal Pull Tool is a device which slides into the end of the pipe and expands so that it grips into the inner liner. Because the Internal Pull Tool only grips the liner, it is required that some screws are screwed through the pipe wall to make sure the tool pulls on all layers of the pipe. The Internal Pull Tool is compatible with all FP, FP HT and FC.



**Figure 81: Internal Pull Tools**

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### Internal Pull Tool Installation

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**Figure 82: Mark Tool Length on Pipe**

Lay out the pull tool next to the pipe, get a measurement as to where the end of the pull tool is going to stop when inserted into the end of the pipe, mark with a paint pen or a permanent marker.



**Figure 83: Inserting Internal Pull Tool**

Slide the pull tool into the end of the pipe to where the nut is still accessible with a pipe wrench. With two pipe wrenches, tighten the nut as tight as possible to expand the dies on the inside of the pipe.



**Figure 84: Securing Pipe with Screws**

Once the pull tool has been inserted and tightened, run 15 to 20 1" screws all the way around the pipe behind the mark made. This will ensure all three layers (inner HDPE, reinforcement, and outer HDPE) are pulled without separation.

- The screws need to be 1 inch or longer
- To avoid creating shear lines, you need to stagger the screws around the circumference of the FP, FP HT and FC.



**Figure 85: Denso Paste on Pipe End**

After the pull tool has been inserted, apply Denso paste to the pipe end to seal off the internal pipe layers and prevent water ingress in the fiberglass reinforcement layer.



**Figure 86: Denso Tape Over Screws and Pipe End**

Once the Denso paste has been applied, use Denso tape to wrap from the screws to the pipe end and pull tool, to seal off the internal pipe layers from water ingress.



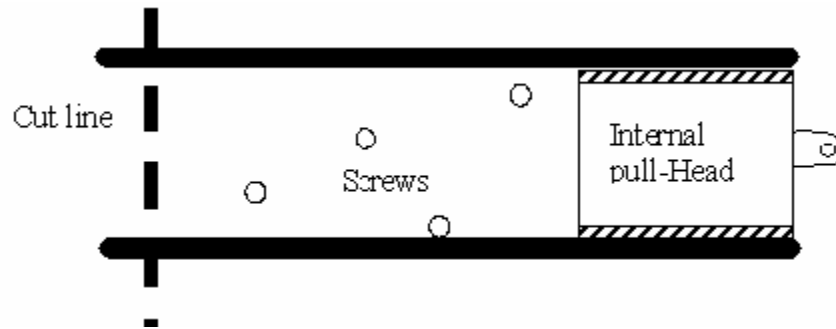
**Figure 87: Wrap Pipe and Seal Pipe End**

Tape over the screws and to the end of the pull tool sealing off any openings and threads from mud, fluid, or debris filling the end of the pipe. Not only will this keep the pipe clear of mud but will also make the clean-up and removal of the pull tool easier.

**CAUTION!**



Not drilling in staggered screws around the circumference of the pipe could cause the liner to be pulled out from the jacket. If the liner is pulled out from the pipe, the section of affected pipe is damaged and must be cut out.



**Figure 88: Screw Locations for Internal and External Pull Tools**



**COLD WEATHER INSTALLATION** - for temperatures below 0°C (32°F)

For below-freezing temperatures, heat the inside of the pipe before installing the Internal Pull Tool so that it is warm to touch. If the pipe is not sufficiently warmed, the Internal Pull Tool may not grip the inside of the line. Over-heating the liner would result in melting the HDPE which will also prevent proper grip on the liner.



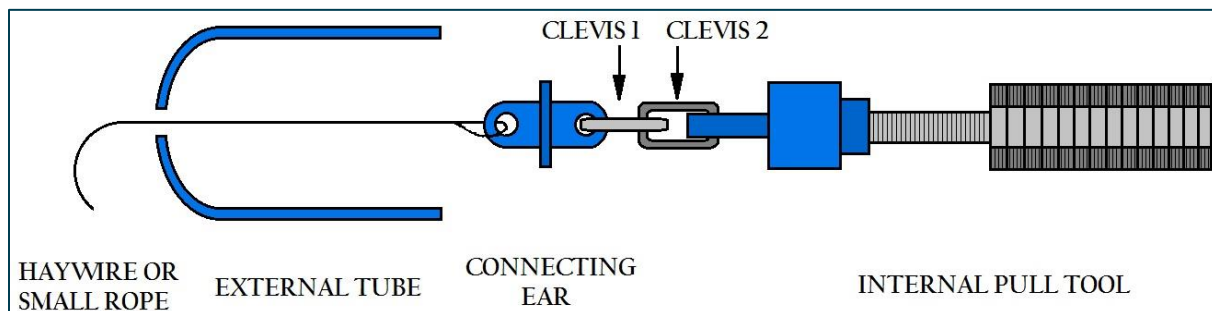
## 6.2.4 External Pull Tube

External Pull Tubes are used in combination with the internal pull tool. The tubes have the advantage of protecting the pipe from damage as it is drawn through rough soil, as well as preventing dirt from entering the open end of the pipe. **Figure 89** shows the assembled two pieces of the pull tube (the pull tube itself, the connecting ear, and two clevises).

Note that this pull tube does increase the required diameter of the bore hole, so it is best suited for applications where space is not a major issue. Also note that two clevises are needed for connecting as there isn't enough room to fit the tool and ear through a single clevis. Seal the pull tool to prevent water ingress as per the sections above.



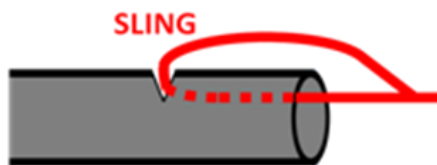
**Figure 89: External Pull Tube**



**Figure 90: External Pull Tube Diagram**

## 6.2.5 Smiley

Cut a “smiley” about 150 mm (6 inches) from the end and hook a chain or sling through the smiley. The smiley should be used for short, straight pulls only. Seal the opening to prevent debris and or water entering the pipe.



**Figure 91: Cutting a Smiley**



**Figure 92: Sealed Smiley Opening**

## 6.2.6 Sling Wrap

A 3" or 4" sling may be wrapped around the pipe for deployment as seen below. The sling must be wrapped around the pipe for 12", and the wrap must be monitored while the pipe is being pulled. If used for deployment, cut 1.5m (5 ft) back from where the pipe was wrapped after pulling. If any kinks, bulges, or wrinkles are found after pulling and the sling wrap is not used at the pipe end, repair according to the kink repair procedure.



**Figure 93: Sling Wrap on Pipe**

## 6.3 Handling Reels

### CAUTION!



All assembled reels, empty or full, should always be kept in a vertical position.

### 6.3.1 Putting Reels onto A-Frames

The reel used in transportation and deployment of pipe must be inspected to ensure its structural integrity and ensure it will fit into the available A-Frame or Deployment Trailer. The rims and hubs of the reel must be in satisfactory condition to ensure the safety of personnel. Inspection of lifting plates and rigging is required prior to lifting. The center hole must be suitable for the shaft mechanism utilized in the A-Frame or the Deployment Trailer.

Flexpipe reels have a 120.7 mm (4.75 in) bore for insertion of a 4 inch NPS (114.3 mm / 4.50 in OD) shaft.



**Figure 94: Reel Loaded into A-Frame**

The reel of pipe should be loaded in a manner such that the Flexpipe Spoolable Products can be un-spooled from the bottom of the reel. That way, it lays the pipe down with its natural bend (due to spooling) facing up.

A 4 inch NPS Schedule 160 steel pipe is placed in the center of the reel and then the reel is lowered onto the A-frame (using a hoe or a picker) and locked in place. Inspect and replace the 4" steel pipe if it shows signs of wear or is of the incorrect wall thickness (0.531 in).

**CAUTION!**



Always use a spacer on the shaft on BOTH sides of the reel so the reel won't rub against the A-Frame. Wooden supports on hybrid reels (metal with wood inserts) can catch on the A-frame causing damage to the reel and pipe.

A-Frames are available from Flexpipe for rent or purchase.



**Figure 95: 2.4 meter (8 foot) A-Frame**



**Figure 96: Large and Small A-Frame Spacers**

**CONTACT US!**



If you would like to build your own A-frame, please contact a Field Operations representative and ask for a free set of blueprints and a parts list through our toll-free number:

**+1 888 FLX PIPE (+1 888 359 7473)**

[www.flexpipesystems.com](http://www.flexpipesystems.com)

### 6.3.2 Moving Reels in the Field

Reels are moved in the field using an A-Frame or Deployment Trailer. Both are capable of supporting the reel off the ground. The A-Frame or Deployment trailer must also allow the reel to rotate in a controlled fashion as the Flexpipe Spoolable Products are being deployed.

A-Frames can be transported on a flatbed trailer pulled by a truck. Deployment Trailers are typically pulled behind a truck.



**Figure 97: Moving an A-Frame on a Trailer**



**Figure 98: Transporting with a Self-Loading Trailer**

## 6.4 Stringing Methods

Flexpipe does not recommend loading the 8 ft. shaft on an A-Frame with two 4 ft. reels on any of the products. This can overload the shaft. Please contact Flexpipe Engineering for guidance. There are three ways of unspooling Flexpipe Spoolable Products:

- Stringing from a moving A-Frame or a moving Deployment Trailer
- Stringing from a stationary A-Frame or a stationary Deployment Trailer
- Stringing from a coil.

Flexpipe has found that Flexpipe Spoolable Products can be installed with Right of Ways as narrow as 7m (23ft). These installation methods are discussed in the following sections. Stringing from a moving A-Frame or a moving Deployment Trailer is the preferred method of stringing Flexpipe Spoolable Products. Always allow the pipe end to

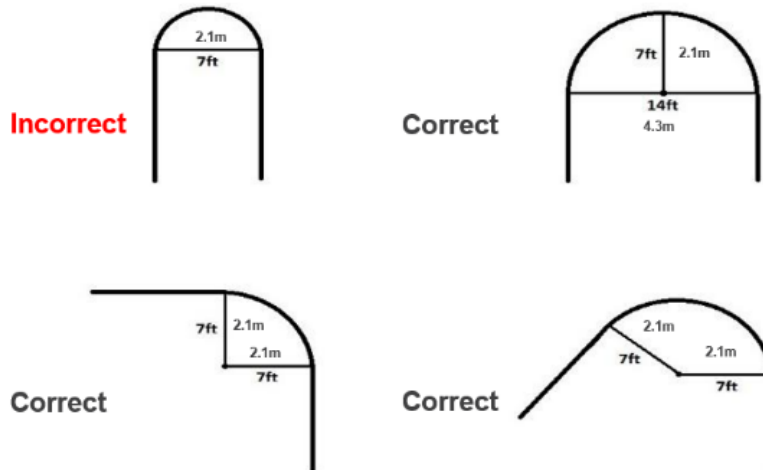
freely rotate during handling, such as using a swivel. During stringing, the minimum bend radius outlined in **Table 9** of Flexpipe Spoolable Products must be observed.

**Table 9: Minimum Operation and Handling Bend Radius**

Flexpipe Spoolable Products	Minimum bend radius OPERATION		Minimum bend radius TRANSPORT & HANDLING	
	(m)	(ft)	(m)	(ft)
2"	1.2	4.0	0.8	2.5
3"	1.8	6.0	1.0	3.3
4"	2.1	7.0	1.3	4.2
5"	3.05	10.0	1.4	4.5

**Note:** The minimum radius does not apply to fittings/couplings. These joints need to be kept straight to avoid point loading at the end of the fitting. There should be no bends within 1.8 meters (6 feet) from a fitting.

The bend radius is the same for all sizes FP, FP HT, and FC products. Refer to the figure below for examples on properly measuring the bend radius.



**Figure 99: Correctly Measuring Bend Radius**

**CAUTION!**



Bending Flexpipe Spoolable Products past its minimum handling bend radius could kink the pipe, requiring that the section of the pipe be cut out and replaced.

Some general pointers about bending Flexpipe Spoolable Products:

- Use the reel as a guide – the rims have a radius of 1.8 meters (6 feet)
- The pipe is handled and installed much like HDPE pipe. The uncoiling behavior and bending stiffness of the pipe will be very similar to that of SDR 11 HDPE pipe.
- Like HDPE pipe, the bending stiffness will increase at low temperatures, thus requiring additional care.

**Table 10** outlines the maximum pull-force with or without fittings, that can be exerted on Flexpipe Spoolable Products without risk of damaging the pipe:

**Table 10: Maximum Pull Force**

Flexpipe NPS	Kilogram-Force	Newtons	Pound-Force
2"	1,134	11,121	2,500
3"	2,223	21,976	4,900
4"	3,266	32,027	7,200
5"	5,103	50,042	11,250

**Note:** It is Flexpipe’s recommendation to use an inline tensile load measuring device for all bore and liner pulls. After the pull is complete, the section that was pulled on should be cut back at least 1.5 meters (5 feet) from the pull point and discarded.

**Note:** Pull forces are for pulling with or without fittings attached.

**Note:** The maximum pull forces are based on a pipe temperature of 23°C at the time of pull using an Internal Pull Tool. Contact Shawcor engineering to discuss maximum pull force loads for higher pipe temperature pulls.

**CAUTION!**



Exercise caution when pulling on Flexpipe Spoolable Products, being sure not to pull beyond the guidance in **Table 10**. Pulling one reel at a time is recommended. It is suggested that Flexpipe is consulted before pulling multiple lines at a time to review your unique pipelining conditions. Watch for signs of stretching or potential to create deep scratches.

**NOTE!**



The hotter the ambient temperature, the more likely the pull tool is to pull out from the pipe. If the “smiley” or drilled-hole method is used to pull the pipe, it will usually rip before the pipe stretches to the point of permanent damage.

When stringing Flexpipe Spoolable Products, ensure that the bore of the pipe is not filled with dirt and/or debris.



**COLD WEATHER INSTALLATION** - for temperatures below 0°C (32°F)

Refer to **Section 6.5** for cold weather stringing guidance.

**CAUTION!**



Spacers must be used on all A-frames and deployment trailers. The spacers centralize the reel on the frame, preventing the wood on the hybrid reels from catching on the frame arms and preventing the steel reels from interfering with the A-frame or deployment trailer.

## 6.4.1 Stringing from Moving A-Frame / Deployment Trailer



**Figure 100: Unspooling from a Moving Deployment Trailer**

Flexpipe Spoolable Products can be un-spooled from a moving A-Frame or Deployment Trailer by anchoring the free end of the pipe to a stationary object. Ensure that:

- Corners are navigated properly
- Uneven ground that could cause the top-heavy reel to tip is avoided
- The truck pulling the reel is started and stopped slowly to minimize the build of slack on the reel.
- The reel is moved away in a controlled fashion at average walking speed of 5 km/hr (3 mph)

Stringing from a moving A-Frame or moving Deployment Trailer is best used when there are:

- bends in the right of way, or
- rocky surfaces

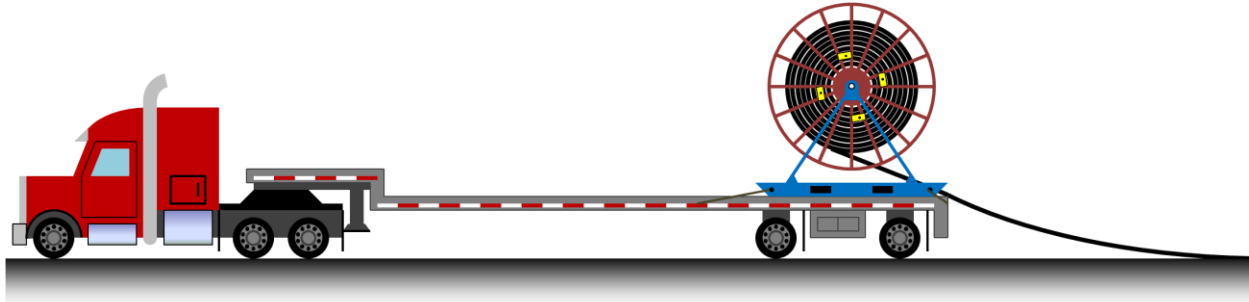
### 6.4.1.1 Using Flat-Bed Trailers in the Field

Ensure the flat-bed trailer that is rated for the weight of the pipe, reel and frame. Weights for the reels, Flexpipe Spoolable Products, and frames are listed in Appendix A. As a safety precaution, the trailer that the A-Frame sits on should be as close to the ground as possible.

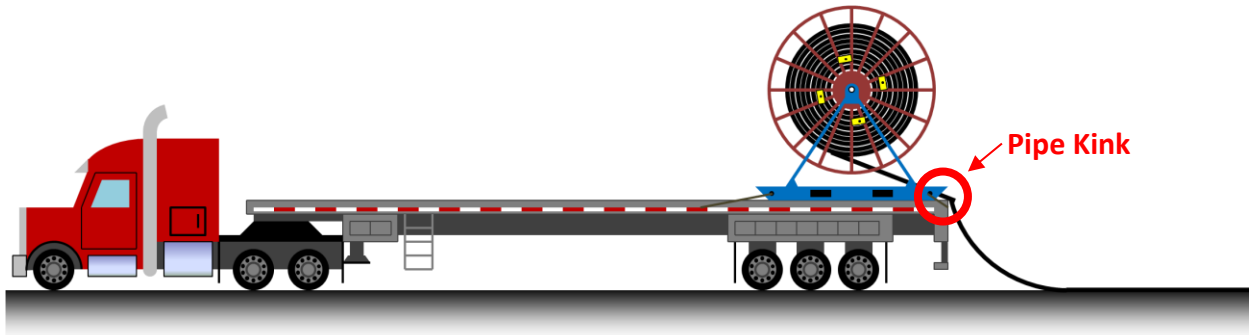
#### CAUTION!



Use a trailer with a deck height as low as possible, such as a drop-deck (step-deck). Using a high-boy can cause kinking as demonstrated in **Figure 102**.



**Figure 101: Stringing with a Drop-Deck Trailer**



**Figure 102: String with a High-Boy Trailer Causing Kinking**

Further information about identifying kinked pipe is discussed in **Section 6.6**.

**WARNING!**



Ensure that the A-frame is securely attached to the trailer with chains before loading the reel and moving the trailer. Flexpipe reels have a high center of gravity so limit your speed, particularly around corners.

Be mindful of overhead obstructions that could get damaged or damage the pipe and/or reel. Contact with overhead power lines can cause serious personal injury or death. Proper measures should be taken to ensure adequate setbacks from power lines are maintained for transporting reels just like any other equipment.



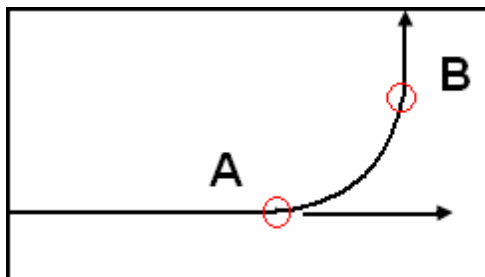
## 6.4.2 Stringing from Stationary A-Frame / Deployment Trailer



**Figure 103: Pulling Pipe from a Stationary A-Frame**

Flexpipe Spoolable Products can be un-spooled from a stationary A-Frame or a stationary Deployment Trailer by securely attaching the pipe end to a piece of equipment. Ensure that the Flexpipe Spoolable Product is un-spooled in a controlled manner at a maximum walking speed of 5 km/hr (3 mph).

It is recommended that when pulling more than 300 meters (900 feet) of Flexpipe Spoolable Products around a corner that the procedure outlined in the below **Figure 104** be followed to minimize excessive pull force on the pipe. It may be necessary to coordinate a multi-point pull around a corner. Cradles are recommended to make this process easier.



**Pull at B, while also pulling at A to create slack between A and B**

**Figure 104: Pulling Flexpipe Spoolable Products Around a Corner**

Pulling the Flexpipe Spoolable Products from the stationary A-Frame or stationary Deployment Trailer is usually advantageous when there are:

- soft ground conditions
- steep side slopes
- slippery surfaces to pull the pipe along
- several line crossings along the pipeline right-of-way

More equipment is required to string out pipe with this method unless it is a very straight pull. This method is not recommended for rocky terrain as this can lead to deep scratches in the jacket.

### 6.4.3 Stringing Coils

Coils should be unspooled using a turntable. A turntable can accommodate both **Stringing from a moving frame** and **Stringing from a stationary frame**. This can be done as described in **sections 6.4.1** and **6.4.2**.

#### 1. Prepare the Turntable

- Position the Turntable in the direction of deployment. Lock the Turntable using the locking device so that to ensure the turn table does not rotate while the coil and lifting device are placed in position.

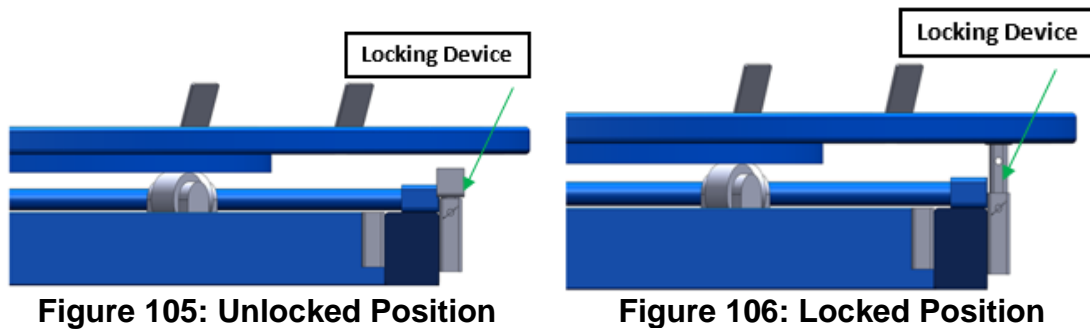


Figure 105: Unlocked Position

Figure 106: Locked Position

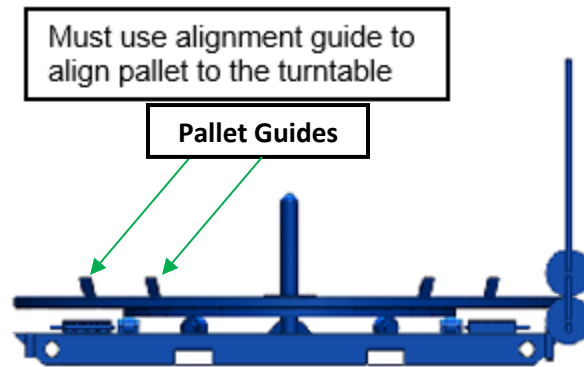


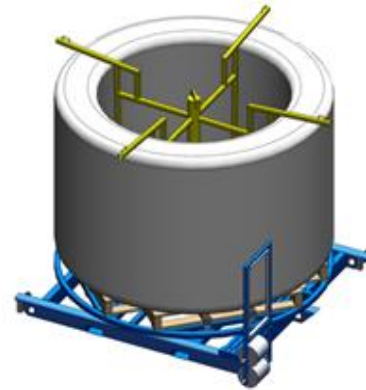
Figure 107: Pallet guides

#### 2. Coil and Turntable Alignment

- There are two alignment methods that ensure the coil is in the right position.
- First, the vertical center alignment shaft of the turntable must be inserted into the receiver shaft of the Coil Assembly Lifting Device.
- Second, the pallet must be positioned in between the pallet guides shown in **Figure 107**.



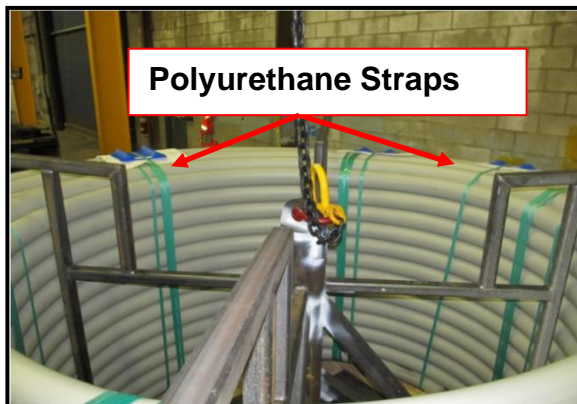
**Figure 108: Mounting Coil on Turntable**



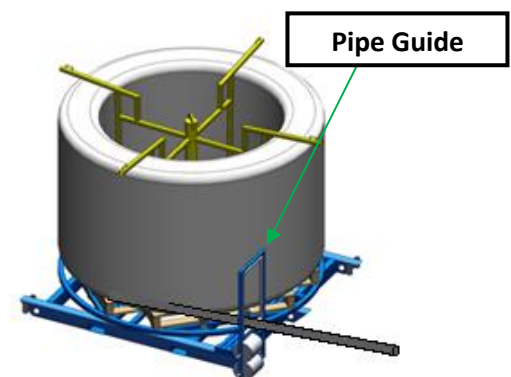
**Figure 109: Coil mounted on Turntable**

### 3. Mount the coil on Turntable

- Keep the pipe coil on the wooden pallet and load the pipe coil, wooden pallet and the lifting device onto the turn table.
- Remove all Corner Protectors & store them in the rental kit.
- Do not remove the polyurethane straps that hold the coil layers together.



**Figure 110: Polyurethane Straps**



**Figure 111: Pipe Guide**

### 4. Pipe Guide

- The Pipe Guide is used to keep the pipe above the pallet while the turntable base frame is rotating during pipe deployment.
- Without the pipe guide, the pallet and turntable frame may damage the pipe during deployment.

#### CAUTION!



The Turntable is a rotating piece of equipment. Please stand clear of the rotation envelope.

**NOTE!**



The lifting bars must stay in the pallet during deployment.

## 5. Pipe Deployment

- Deploy the pipe slowly.
- One person must attend to the turntable to ensure the polyurethane coil straps are removed as the pipe is deployed.
- Visually inspect the pipe for damage as the pipe is deployed from the turntable.
- Ensure the pipe is deployed through the pipe guide as per **Figure 111**.
- The final two layers of the coil have 6 vertical structural supports (VSS) that are banded in with axial and circumferential banding. Before deployment of the last two layers of the coil, cut the banding of the 6 VSS and pull the 6 VSS out.
- Proceed with the deployment of the before last layer of the coil.
- The 1st, 2nd and 3rd wraps at the top and bottom of the final layer of the coil are banded together, these bands should be removed just prior to deployment of the last layer of the coil. Refer to **Figure 113**.

**CAUTION!**



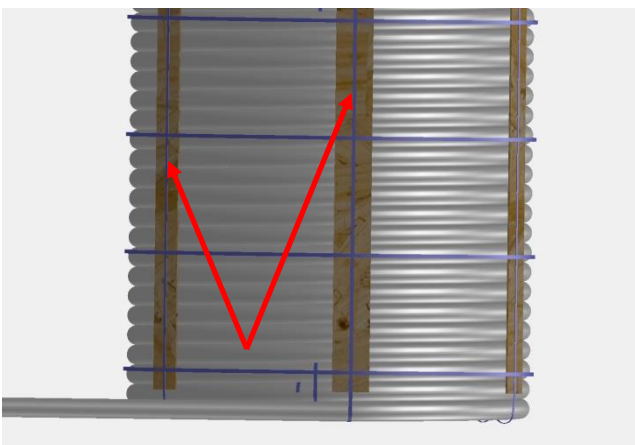
During coil deployment, Flexpipe recommends cutting the polyurethane coil straps by individual layers. This maintains the coil assembly for a later use or partial pipe return, and easy storage.

**NOTE!**

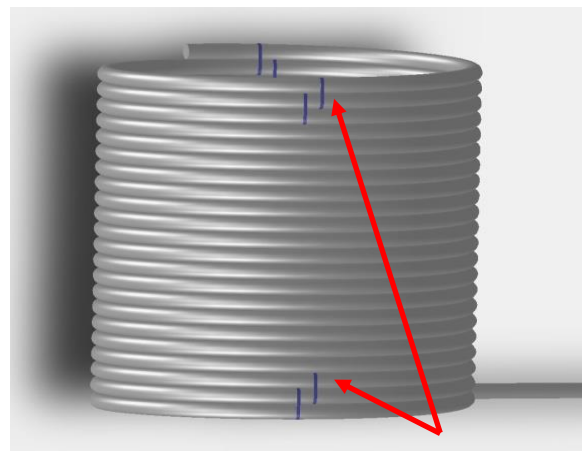


If the last two layers of the coil are not being deployed, leave the Vertical Support Structures in place to improve the stability of the partial coil.

If the bottom wraps of the last layer of the coil are not being used leave the banding in place in order to improve the stability of the partial coil.



**Figure 112: VSS with Banding**



**Figure 113: Top & Tail Banding**



**Figure 114: Coil Being Deployed**

## Securing Partial Coils



**Figure 115: Partial Coil**

- The pipe end must be tied off to the pallet before cutting the pipe.
- Seal the pipe end to protect it from water and dirt, as per **Section 5.4**

### 6.4.3.1 Shipping Partial Coils

Prior to shipping partial coils, mount corner protectors on top of the coil to prevent pipe compression from shipping straps. Secure the shipping straps over the corner protectors.

## 6.5 Cold Weather Deployment



### Guidance for temperatures below 0°C (32°F)

The HDPE in Flexpipe Spoolable Products becomes stiff in cold weather. Certain steps need to be taken to ensure proper installation of Flexpipe products in cold weather conditions. This section will outline the steps and guidelines for cold weather deployment.

The temperature limits listed are based on the temperature of the pipe. Therefore, wind chill conditions do not apply. Consideration must also be given to the difference between the ambient temperature and the actual pipe temperature. FP, FP HT, and FC have very low thermal conductivity (i.e. the pipe cools down or heats up very slowly). Therefore, if pipe is stored outside overnight, the pipe may be much cooler than the ambient temperature the next day.

The stiffness of the pipe is increased at lower temperatures therefore caution should be taken to ensure that the pipe is securely restrained prior to cutting to prevent it from whipping. Extra care should be taken when deploying (un-spooling) or plowing the pipe to avoid rapid reverse bending or over bending the pipe.

### 6.5.1 Pipe Temperatures Down to -25°C (-13°F)

The pipe may have a tendency to be stiff and kink when first unspooling from the reel or coil, typically at about 8 meters (25ft) from the end being pulled (e.g. **Figure 117**). To avoid this, pull the pipe off slowly and under tension (back tension at the reel can be useful). This will keep the end that is being pulled closer to the ground which should reduce kinking due to stiffness. Another good practice is to keep the A-frame on the ground (vs. up high on a truck deck) to keep the pipe close to the ground. If the pipe does develop a kink, mark the kink and keep pulling until the reel is strung out and then cut out the kink vs. cutting the kink out right away as it may kink again 8 meters (25ft) from the end being pulled.

Keeping the pipe in a heated space (eg.in a building or temporary tarped enclosure) until just before it is unspooled will help speed up the unspooling process and avoid the difficulties associated with handling cold pipe.

Flexpipe Spoolable Products can be directly deployed at pipe surface temperatures down to -25°C (-13°F). For below freezing temperatures, the pull speed should be lowered to no more than 2 km/hr (1.3 mph). Pipes with surface temperatures lower than -25°C (-13°F) will need to be heated prior to deployment.

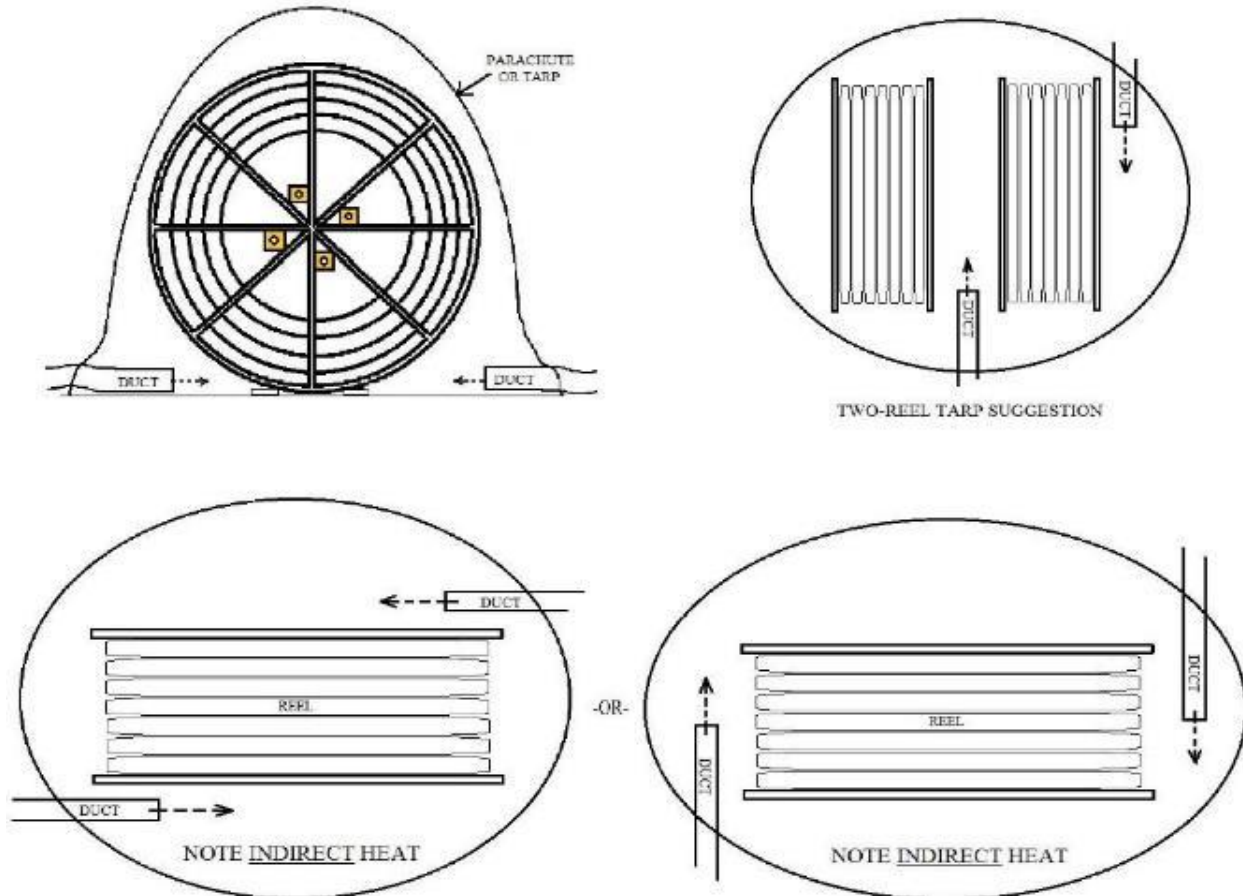
### 6.5.2 Pipe Temperatures Below -25°C (-13°F)

Certain situations may cause uneven heating of a reel and should be avoided. These situations include improper heating procedures and exposure to sunlight which heats only one side of the reel. Uneven temperatures may lead to differences in stiffness that may result in kinking of the warmest part of the wrap when the pipe is unspooled.

### 6.5.3 Pipe Heating Procedure

The following heating procedure is recommended:

1. Enclose the reel within a structure of tarps, ideally insulated. The greater the insulating layer the less time the pipe will take to heat. Creating space between the insulating structure and the pipe will allow for more uniform heating of the outer wrap. Tarping in 2 or 3 reels together will create more air space which will promote even heating.
2. Heat the enclosed space with portable heaters of sufficient size, generally 400,000-500,000btu (see recommended setup below). Care must be taken to ensure that heat is not applied directly to the surface of the pipe and that no portion of the pipe exceeds 60°C at any point during the heating process. It is critical to monitor pipe surface temperature throughout the heating procedure and ensure that precautions are taken to ensure that the enclosure does not ignite.
3. Monitor the temperature of pipe with a suitable surface temperature measurement device until the required pipe temperature is achieved throughout the reel. Monitor the pipe temperature in several locations and heights; both sides of the reel, the outer wraps and inner wraps.
4. Document the process of heating the reel; date and time, ambient conditions, pipe run number, air stream temperature, and log the times and temperatures of the monitoring as the pipe warms.
5. The pipe may be colder than the air temperature within the tarp enclosure and that the temperature of the pipe may vary due to location on the reel. Assume that the temperature in the middle of the pipe wraps is the same as the coldest ambient temperature recorded during the preceding 48hrs. As an example, if the daytime temperatures are -25°C but overnight temperature is -35°C, assume that the most insulated layers of the reel will be at -35°C prior to beginning the heating process. Wind speed also has a significant effect on heating time and effectiveness.
6. Once heating has begun, it is recommended to heat all measurable surfaces to above 0°C.



**Figure 116: Recommended Tarp Setups for Heating**

The intent of this procedure is to heat the entire reel of pipe evenly. Therefore, the enclosure and heaters should be arranged to achieve optimum circulation of heated air inside the enclosure.

If using a parachute with a hole in the center, arrange the hole roughly at the top center of the enclosure. Place one heater exhaust to blow along one side and under the reel (not close enough to overheat the pipe), with a second exhaust on the opposite side of the reel, to promote air circulation. Care must be taken to ensure that the exhaust is not placed too close to the pipe. Heaters may need to be moved during the heating process to ensure even warming. Failure to evenly heat pipe throughout the reel may result in significant temperature differences within a single wrap of pipe. This can cause variances in pipe stiffness throughout the reel, potentially resulting in kinking.

#### 6.5.4 Consumables in Cold Weather

Supplies such as grease, pipeline tape and all Denso products should be stored in a heated environment, such as the cab of a truck, for several hours prior to installation.



## 6.6 Pipe Inspection

After deployment, it is required to inspect the pipe for any damage. This includes ensuring any scratches don't exceed the scratch depths listed in **Section 2.3.2.1**, ensuring that flattened pipe doesn't exceed the criteria listed in **Section 2.3.2.2**, and that the pipe is not kinked as described below.

### 6.6.1 Pipe Kinks

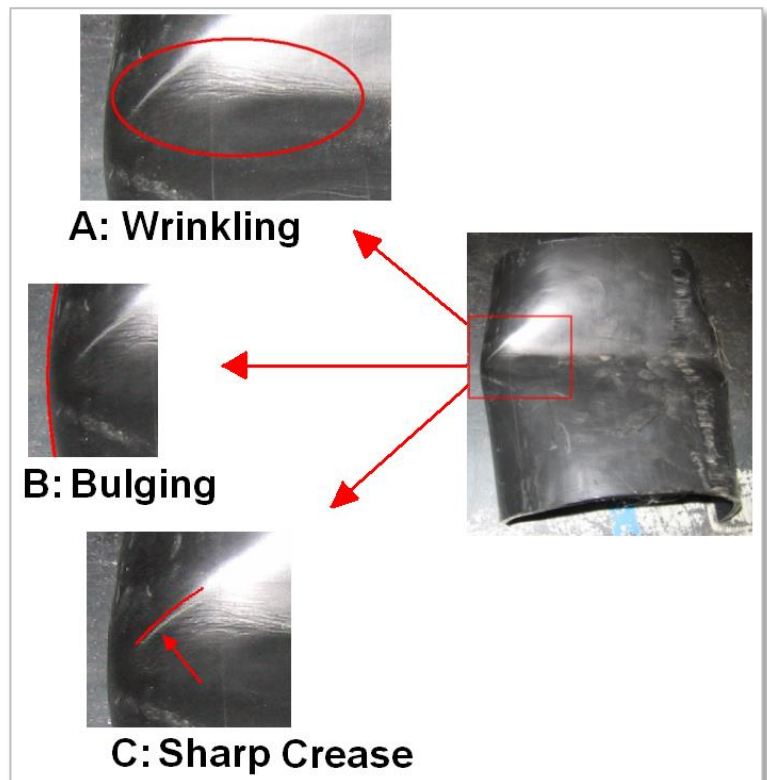
If handled improperly, Flexpipe Spoolable Products may kink which will damage the reinforcements. If the pipe is known to have been kinked, or if there is evidence of wrinkling, bulging, or sharp creases as illustrated below, then the product has been kinked and must be cut out.

In order to avoid kinking pipe, always observe the minimum transportation & handling bend radius for Flexpipe Spoolable Products listed in **Table 9**. Particular attention and caution should be exercised when performing the following tasks:

- Plowing – see **Section 7.2**
- Over-bending the Flexpipe Spoolable Product to install a fitting in a tight situation
- Lifting the pipe from a single point with a sling or chain
- Deploying the pipe from the top of the reel or from an elevated reel



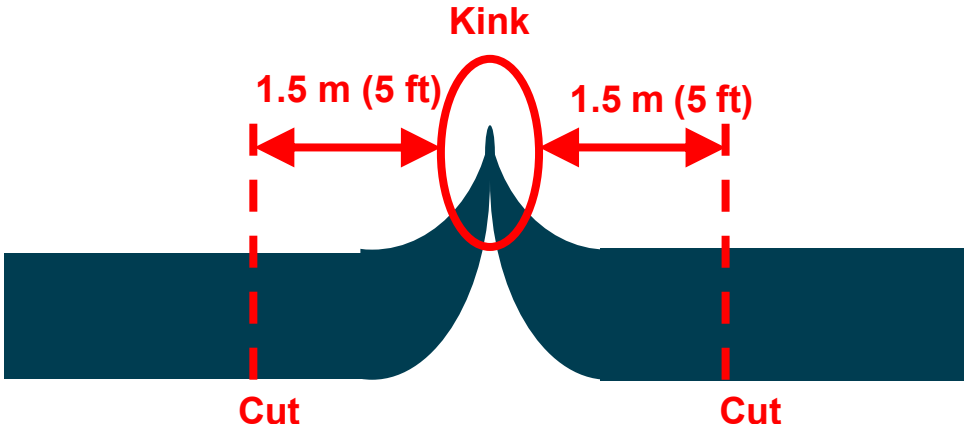
**Figure 117: Kinked FP**

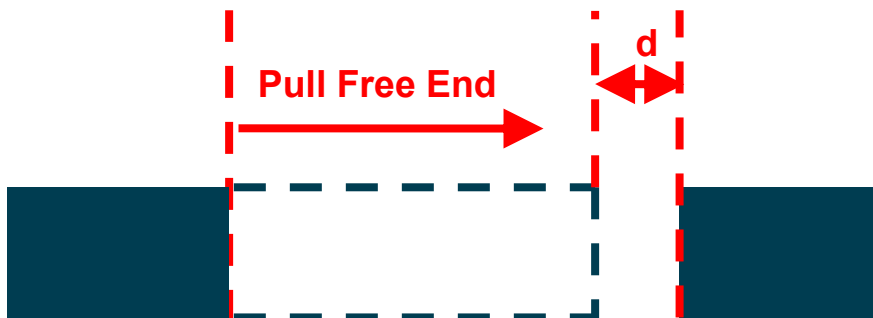


**Figure 118: Identifying Kinked Pipe**

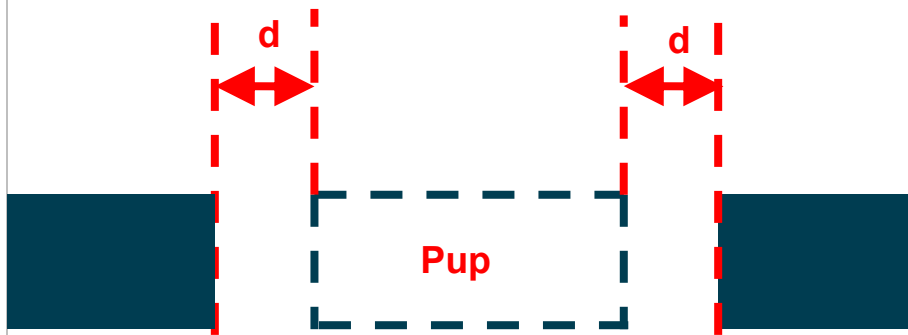
### 6.7 Repairing Kinked Pipe

To repair a known or suspected kinked pipe, the section of the line with the kink must be cut-out as per the following steps. More information on repairing pipe can be found in **Section 14 - Tying Into and Repairing Existing Pipelines**.

STEP #1	
 <p><b>Figure 119: Cutting Out Kinked Pipe</b></p>	<p>Cut out the section of pipe with kink in it; cutting back by a length of 1.5 meters (5 feet) in each direction.</p>

STEP #2a	
 <p><b>Figure 120: Lining Up Pipe</b></p>	<p>Discard the cut out kinked section.</p> <p>If possible, pull back or unroll enough Flexpipe Spoolable Products from the spool so that a pipe-to-pipe coupling can be attached between the pipe ends.</p> <p>Leave a distance of about 100 mm (4 in) between the ends when pulling the pipe together – dimension “d” in <b>Figure 120</b>.</p>

## STEP #2b



**Figure 121: Creating a Pup**

As an alternative to pulling back pipe (step #2a), you can cut a short pup to insert between the two cut ends. Note that this will require two (2) pipe-to-pipe couplings instead of just one (1) for the repair. The pup should be at least **3 m (10 ft)** in length.

Cut a pup that is about 200mm (8 inches) shorter than the gap between the ends to allow for two fittings. Each dimension “d” in **Figure 121** is 100 mm (4 in).

## STEP #3

**Figure 122: Crimping the Connection with Pup**



**Figure 123: Crimping the Connection of Pulled Pipe**

Crimp on the pipe-to-pipe coupling as described in **Section 9.3** of this manual.

### NOTE!



If you need a Flexpipe Spoolable Products pup shorter than 3 meters (10 feet), crimp a pipe-to-pipe coupling to the end of a long section of pipe (such as a reel) before cutting the pup to the desired length. Shorter pup lengths may push the liner out of the pipe when a pipe-to-pipe coupling is inserted into the Flexpipe Spoolable Products with the Mandrel Insertion Press.

## 6.8 Capping the Pipe Ends

After deploying the pipe, cut 1.5 meters (5 feet) from the end of the pipe that has been pulled, to remove any pipe section that is damaged or has exposed reinforcements. Protect the pipe cut end by capping using the procedure described in **Section 5.4**.

## 6.9 Tracer Wire



Because FP, FP HT, and FC are not electrically conductive, it is strongly recommended that the Flexpipe Spoolable Products be installed with tracer wire or other locatable product for buried applications in order to locate the pipe later. Flexpipe stocks 12-gauge tracer wire.

Canadian CSA regulations require that each buried pipeline has its own tracer wire, i.e. if there are three pipelines buried in the same ditch, then there must also be three tracer wires.

**Figure 124: 12-Gauge Tracer Wire**

## 7. Installation

### CAUTION!



Similar to other components in sour service which have fugitive emissions, due consideration should be given to the potential accumulation of H<sub>2</sub>S around the vent hole of the Flexpipe fittings, including accumulation in confined spaces such as valve cans and pump or header buildings. H<sub>2</sub>S is heavier than air and can settle in low areas.

### CAUTION!



Water entering the fitting vent hole will wet the reinforcements and reduce the pipe pressure capability. Properly wrapped fittings using Petrolatum Paste (e.g. Denso Paste), Petrolatum Tape (e.g. Denso Tape), and Pipeline Tape (e.g. Polyken) are mandatory for all fitting installations. Flexpipe requires limiting the external water column on all fittings to a depth of no more than **1 m (3 ft)**. If the project requires a greater depth, contact Flexpipe engineering.

### NOTE!



Flexpipe recommends the use of the daily field report for traceability and quality control on all installations. It is recommended for end users and installation contractors to take pictures of each installed fitting and include them in the daily field report. Uploading the daily field reports and photos can also be done through the Flexpipe iLine portal. For information on the Flexpipe iLine portal, please contact your Flexpipe representative.

**NOTE!**



All Flexpipe Spoolable Products pipe ends intended for future tie-ins must be crimped to properly wrapped flanges or weldnecks before being backfilled. Heat shrink end caps are to be used during pipe transportation/storage only and should not be buried.

## 7.1 Trenching

**CAUTION!**



Sharp rocks or any rocks larger than 51 mm (2 in) in diameter must be removed if protruding from the bottom of the trench. Ensure the pipe is laid on a smooth trench bottom and that it is not bent over any rocks.

### 7.1.1 Conventional Trenching

Trenches must be constructed properly prior to lowering the pipe into the trench. The following guidelines should be followed:



**Figure 125: Crimping a Fitting in the Ditch**

- Trenches must be wide enough to accommodate the Flexpipe Spoolable Products. Use proper bell hole sizes following local regulatory requirements wherever work is to be done. (e.g. crossing, tie-in points, etc.)
- Where the trench follows a curve, the bend should be gradual and must not be smaller than the operational bend radius for that particular pipe. Note that Flexpipe has flow joints (Tees, Y-Laterals, and Elbows) that allow more options for installation.
- Ensure that the trench floor is as uniform as possible so that it does not cause any unnecessary point loads on the Flexpipe Spoolable Products.
- Typically, Flexpipe Spoolable Products are strung out beside the trench and lowered into the trench manually. Normal lowering procedures can be followed (Flexpipe Spoolable Products can be lowered using a sling or a cradle).
- When lifting Flexpipe Spoolable Products near a fitting, lift the fitting, rather than directly lifting the pipe. Support the pipe as required.
- Inspect the trench bottom and ensure it is free from large rocks that may impinge on the pipe. In general, it is recommended to remove any rocks larger than 51 mm (2 in) in diameter.

After deploying Flexpipe Spoolable Products in a trench, refer to **Section 11 – Backfilling**. Ensure a minimum of 12 m (40 ft) of pipe is left exposed for any fitting installations. If the pipe ends are left exposed for hydrotesting, some pipe twist upon pressurization is expected.

### 7.1.1.1 Multiple Lines in the Same Trench

Multiple Flexpipe Spoolable Products may be installed in the same trench. Where possible, Flexpipe recommends maintaining approximately 4” between pipelines in the same trench. It is recommended to have at least 1 vertical foot of dirt padding between the crossing lines. Follow the minimum distance between pipelines as required by applicable local regulations.

Where possible, do not lay CPS products or other pipes on top of each other. Use sandbags or other means to prevent contact where possible. Multi-line bores or liner pulls are exempt from this restriction as the contact is continuous and this lessens the contact impingement.



**Figure 126: Lines Laid Incorrectly Across Each Other**

#### NOTE!



Selection of reels with the appropriate length and pulling Flexpipe Spoolable Products under crossings can minimize the number of pipe-to-pipe couplings required for the project.

#### CAUTION!



The reinforcement layer of Flexpipe Spoolable Products must be kept dry. When pipe is in the ditch (prior to backfilling or tie in), the pipe ends must be properly protected as per **Section 5.4**. If the reinforcement layers become wet, the strength of the reinforcement layer is compromised and must be cut back until a dry section is reached. If there is a risk of having the bell hole or ditch fill with water, the pipe end must either have a crimped fitting installed and wrapped or be supported to remain above potential water level.

## 7.1.2 Chain/Wheel Ditcher

For longer pipelines with minimal crossings, Flexpipe Spoolable Products can be installed quickly by mobilizing a chain ditcher or wheel ditcher to site.



**Figure 127: Chain Ditcher**



**Figure 128: Wheel Ditcher**

## 7.2 Plowing

The plowing method consists of the use of a pipeline plow to trench, install, and cover the pipe in a single pass operation. When plowing in Flexpipe Spoolable Products, consider these requirements:

- The plow itself must have sufficient capacity to bury Flexpipe Spoolable Products to the required depth.
- A line crossing will require a bell hole and one coupling.
- A road crossing will require two bell holes and up to two couplings.
- All plowed Flexpipe fittings must be wrapped following Section 9.6.3. Special attention to the anode direction (if used) and tape wrap direction is key for a smooth installation. More information on wrap direction for plowing is found in Section 9.6.4.
- A chute large enough to accommodate the pipe-to-pipe coupling with wrapping is required, unless the couplings are installed after plowing, in which case bell holes will be necessary. Please refer to Table 29 in the Fittings Protection section for fitting dimensions after wrapping.
- Ensure fitting wrapping isn't damaged or displaced during the plowing process.
- To prevent pipe and fitting damage as it exits the chute, the chute discharge opening must be horizontal (i.e. parallel to the ground).



**Figure 129: Plowing in a Coupling**

Flexpipe recommended plow chute dimensions are as below.

**Table 11: Minimum Recommended Plow Chute Dimensions**

Fitting Grade	FP150/FP301/FP601/FC901			
Fitting Type	Standard or EL			
Flexpipe NPS	Minimum Chute Opening Internal Diameter & Channel Width		Minimum Chute Curvature Radius (20x Chute ID)	
	mm	inch	mm	inch
2"	150	6	3050	120
3"	180	7	3550	140
4"	200	8	4060	160
5"	250	10	5080	200

\*Note: For any other chute designs or dimensions, check with Flexpipe engineering.

**Table 12: Coupling Length**

Fitting Grade	FP150/FP301/FP601/FC901	
Fitting Type	EL	
Flexpipe NPS	Coupling Overall Length	
	mm	inch
2"	493	19.4
3"	592	23.3
4"	729	28.7
5"	941	37.1

When plowing in Flexpipe Spoolable Products, particular consideration must be given to the method of feeding the pipe into the chute and the plowing itself to avoid kinking the pipe. If a kink happens when you are plowing, follow the instructions in **Section 6.7**. Be mindful of the following operations as they are the most common source of kinked pipe during plowing installation:

- **Stubbing In and Out** - The plow operator must be careful not to come out of the ground too quickly or go in too fast as this process may damage or kink the pipe.
- **Backing Up** - If the plow must back up (even for a very short distance), the pipe is assumed to be damaged and must be cut out and replaced.
- **Hard Terrain** - In hard or rocky terrain, a dozer must pre-rip the ground to reduce the chance of needing to back the plow up. (In very hard terrain, dozers might pre-rip a couple of times.) The pipe cannot sit on or under a large object (such as large rocks) that will impinge on the pipe.
- **Plow Wiggle** - Aggressive movement of the plow chute can kink the pipe. When this occurs, the pipe must be cut out and replaced.
- **Sharp Elevation Changes** - Abrupt elevation changes can kink the pipe. When this occurs, the pipe must be cut out and replaced.





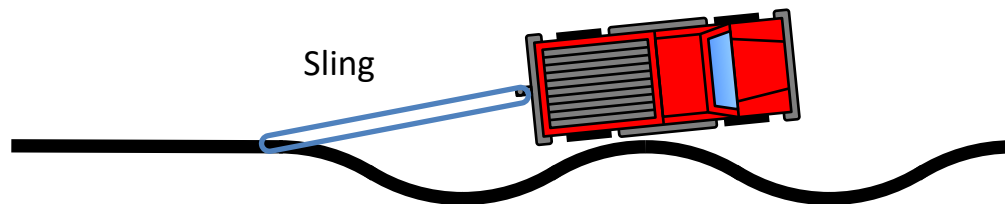
## **COLD WEATHER DEPLOYMENT** - for temperatures below 0°C (32°F)

The stiffness of the pipe is increased at lower temperatures therefore caution should be taken to ensure that the pipe is securely restrained prior to cutting to prevent it from whipping. Extra care should be taken when deploying (un-spooling) or plowing the pipe to avoid rapid reverse bending or over bending the pipe. Refer to **Section 6.5** for cold weather guidance.

### 7.2.1 Pre-stringing Pipe for Plowing

Pre-stringing Flexpipe Spoolable Products and installing the couplings can minimize plow time. With the pipe strung out and the coupling fittings installed, a plow can bury the entire line without stopping after every reel. Be careful to avoid excess slack when stringing out the pipe which will cause kinks when plowing.

To remove excessive slack from the pre-strung pipe, a pickup truck can be used to pull out the slack as demonstrated in the following **Figure 130**.



**Figure 130: Pulling Out Slack from Flexpipe Spoolable Products**

1. Drive ahead of the plow - usually to the end of the reel, or to the first bend.
2. Connect a sling to the pipe. Pull short lengths to minimize the choke force from the sling.
3. Carefully pull excess slack away from the plow. It is a good idea to have a spotter watching beside the pick-up truck to make sure you don't run over or kink the pipe.

### 7.2.2 Loop Plowing a Pre-Strung Pipe

The Loop Plowing method involves looping the pipe from the side of the plow into the chute as demonstrated in **Figure 131** and **Figure 132**.


**Figure 131: Loop Plowing – Rear View**

**Figure 132: Loop Plowing - Side View**

To avoid kinking while loop plowing:

- Control the slack so the loop doesn't get too tight or too big
- The closer the loop is kept to the plow, the less chance there is of kinking. (i.e. Keep the loop vertical, rather than strung-out too far horizontally)
- Ensure that the plow has a support for the loop

### 7.2.3 Plowing with an Attached Trailer

This method involves attaching a Deployment Trailer or a trailer with an A-Frame that will be pulled behind the plow to unspool the pipe while it is being plowed in.


**Figure 133: Plowing with an Attached Trailer**

### 7.2.4 Reverse Bend Plowing with Pre-Strung Pipe

The reverse bend plowing with pre-strung pipe method involves routing the pipe over the plow and into the chute, as illustrated in the below **Figure 134**.



**Figure 134: Reverse Bend Plowing with Pre-Strung Pipe**

To avoid kinking while reverse bend plowing, ensure:

- There is enough slack so that the bend radius doesn't get too tight above the chute
- There is a guide above the cab of the unit to keep the pipe from rubbing on or falling off the plow

### 7.2.5 Reverse Bend Plowing Using a Mounted Reel

This method involves attaching the pipe reel to a mount on the plow to unspool the pipe over the plow and into the chute.



**Figure 135: Reverse Bend Plowing with a Mounted Reel**

### 7.2.6 Winch Plowing

Winch plowing can be combined with any of the above four methods of plowing. This technique provides increased traction from the blade of the winching unit to achieve deeper burial depths or wider plow chutes to accommodate plowing multiple lines in one pass.



**Figure 136: Winch Plowing**



**Figure 137: Winch Plowing Multiple Lines**

## 7.3 Support Spacing

For elevated support of Flexpipe Spoolable Products, a continuous tray which is wide enough to allow for the expected thermal expansion and snaking is recommended.

Flexpipe Spoolable Products may also be supported using individual (non-continuous) pipe supports or hangers, as long as the expected thermal expansion can be accommodated. The pipe should be allowed to rest in a rounded cradle, with a length approximately equal to or greater than the nominal diameter of the pipe being supported. Supports should have rounded edges that will not cut into the pipe. In order to prevent excessive sag between supports, Flexpipe recommends spacing the supports no farther than the distances given in **Table 13**.

**Table 13: Recommended Maximum Support Spacing**

Flexpipe NPS	Liquid Service		Gas Service	
	m	ft	m	ft
<b>2"</b>	1.1	3.5	1.2	4
<b>3"</b>	1.2	4	1.5	5
<b>4"</b>	1.5	5	1.7	5.5
<b>5"</b>	1.5	5	1.8	6

## 7.4 Buoyancy Considerations

Flexpipe Spoolable Products will float in water, swamp or muskeg if not weighted or buried in a clay base. If conditions are suitable, the pipe may be plowed into the clay base of muskeg areas without weighting. The suitability of the conditions may be evaluated based on existing pipelines in the area and consultation with a Flexpipe Field Services Representative or plow installation contractors.

If pipe submersion is required, it is recommended to plan on spacing reel lengths to avoid fitting submersion. If the fitting installation area has more than 3 feet of water, contact Flexpipe for alternative options for fitting wrapping or blocking the fitting vent holes. Otherwise, Flexpipe fittings must be wrapped as per **Section 9.6.3** before installing into wet areas.

If there is a concern that the pipe may float, Flexpipe Spoolable Products can be weighted during installation. The weights should not have sharp edges that could cause a point-load or cut the pipe protective jacket. Sand-filled saddlebag weights are recommended. If concrete pipe weights are used, then installing rock guard between the weight and the pipe is mandatory.

When weights are used, it is extremely important that the pipe is handled and lowered into the ditch by lifting on the weights directly. Lifting on the pipe may cause the pipe to kink or be damaged by the weights.


The recommended net sand bag weight per unit length of pipe is shown in **Table 14**. The data is based on a fluid density of 1,121 kg/m<sup>3</sup> (70 lb/ft<sup>3</sup>) for muskeg and is valid for **FP, FP HT, and FC**.

**Table 14: Recommended Weighting Down of Flexpipe Products**

		Pipe weight per length		Pipe OD		Recommended Weights <sup>a</sup>		Recommended Maximum Spacing	
		(kg/m)	(lbs/ft)	(mm)	(in)	(kg)	(lb)	(m)	(ft)
FP150	3"	2.5	1.7	95	3.75	100	220	8.9	29.2
	4"	4.0	2.7	122	4.80	100	220	5.3	17.4
FP301/ HT	2"	1.7	1.1	69	2.73	27	60	5.2	17.1
	3"	3.0	2.0	97	3.80	100	220	9.1	29.9
	4"	4.9	3.3	124	4.89	100	220	5.6	18.4
FP601/ HT	2"	2.5	1.7	73	2.86	27	60	5.9	19.4
	3"	4.3	2.9	101	3.96	100	220	10.3	33.8
	4"	6.9	4.6	130	5.11	200	440	12.1	39.7
	5"	11.79	7.92	165	6.51	100	220	4.0	13.0
FC901	3"	4.3	2.9	101	3.96	100	220	10.3	33.8
	4"	6.9	4.6	130	5.11	200	440	12.1	39.7

<sup>a</sup> Dry sandbag weight. These weights already include the recommended safety factor of 1.1 to ensure the pipe remains submerged.

**CAUTION!**



Spacing between sandbags/saddlebags should be small enough to prevent the unrestrained pipe between the sandbags/saddlebags from rising. Long sections of unrestrained buoyant pipe could kink the Flexpipe Spoolable Products and/or cause it to rise to the surface.

**CONTACT US!**



To confirm sandbag/saddlebag weighting or if you would like some assistance in developing a strategy for weighting a Flexpipe Spoolable Products pipeline, please contact a Field Operations representative through our toll-free number:

**+1 888 FLX PIPE (+1 888 359 7473)**

[www.flexpipesystems.com](http://www.flexpipesystems.com)

## 7.5 Crossings

Design of road, railway, water, and highway crossings, as well as line crossings, must be in accordance with the regulations of the governing body, local authority, railway company, or highway department. Burial depth refers to the depth of soil above the top of the pipe, sometimes referred to as depth of cover. Burial depth shall be adequate to protect pipelines from freezing where applicable. Greater depths may be required in areas where ground frost and heavy traffic is expected. Any backfill embedment material shall have a soil modulus of 1000 psi or greater. As a minimum, see the guidance provided below.

### 7.5.1 General Areas

General areas along the pipeline right of way and including oil and gas lease areas, shall have depth of cover not less than 2 feet (0.6m).

### 7.5.2 Line Crossings

The pipeline owner shall evaluate each lease area to ensure the specific equipment used is able to safely cross and that any line crossings are taken into account.



**Figure 138: Line Crossing**

### 7.5.3 Roads & Heavy Traffic

Roads or areas with heavy traffic shall have depth of cover not less than 4 feet (1.2 m), or the pipeline shall be properly cased for protection against external loads.

### 7.5.4 Water Crossings

Water crossings, including run off paths for temporary flood and drainage crossings, shall have backfill depth of cover not less than 4 feet (1.2m). In addition, Flexpipe strongly recommends casing the bore for water crossings.

### 7.5.5 Cased Crossings

Each bore is unique and therefore it is the responsibility of the installation contractor to assess the soil conditions and the need for casings. Steel casings may be required by regulations. Protection and support are to be provided for the pipe at entry and exit points of the casing to prevent unacceptable shear and bending loads that could develop from

settlement and embedment consolidation. A well-compacted trench bottom and bedding, exit and entry sand bagging, or other suitable protection should be provided. See **Section 7.6.2** for detailed guidance on protecting Flexpipe spoolable products with casing.

Cathodic protection (CP) of a steel casing is not required unless requested by the local authority, railway company or highway department. If it is required, CP can be provided by installing sacrificial anodes on the casing.

## 7.6 Pipe Bores and Conduit Pulls

The maximum pull-force for Flexpipe Spoolable Products is shown in **Table 15** below. The pull load applied to the pipe must be measured and recorded for all bore and conduit pulls. Each pull should consist of either a straight run or have a single continuous curve that doesn't curve tighter than the minimum bore/conduit bend radius in **Table 16** below. A single pull with multiple curves or turns is not recommended.

After a bore or conduit/liner pull, ensure the pipe is checked for damage such as scratches or indentations as described in **Section 2.3.2**. Pipe that has been flattened up to 50% of the original outside diameter is acceptable during installation because the line will relax back into round shape. Pipe that has been flattened beyond 50% of the original outside diameter must be cut out. To assist in sizing the bore or conduit for pulls involving fittings, refer to **Table 29: Approximate Fitting Dimensions After Wrapping**, which shows approximate fitting dimensions after wrapping.

**Table 15: Maximum Pull Force**

Flexpipe NPS	Kilogram-Force	Newtons	Pound-Force
2"	1,134	11,121	2,500
3"	2,223	21,976	4,900
4"	3,266	32,027	7,200
5"	5,103	50,042	11,250

**Note:** It is Flexpipe's recommendation to use an inline tensile load measuring device for all bore and liner pulls. After the pull is complete, the section that was pulled on should be cut back at least 1.5 meters (5 feet) from the pull point and discarded.

**Note:** Pull forces are for pulling with or without fittings attached.

**Note:** The maximum pull forces are based on a pipe temperature of 23°C at the time of pull using an Internal Pull Tool. Contact Shawcor engineering to discuss maximum pull force loads for higher pipe temperature pulls.

**Table 16: Bore/Conduit Minimum Bend Radius**

Flexpipe NPS	Bore/Conduit Minimum Bend Radius	
	m	ft
2"	3	10
3"	3.5	11.5
4"	4	13
5"	5	16.5

## 7.6.1 Pulling Through Bores

Bores need to be reamed well so that Flexpipe Spoolable Products can be pulled through easily. Casings are recommended for all bores but are not always required. Flexpipe Spoolable Products are most vulnerable to damage when dragging the pipe through long, rocky or unstable bores where soil collapse is likely. Reaming twice in unstable soil conditions may be helpful.



**Figure 139: Swivel Attached to Pipe**

When pulling Flexpipe Spoolable Products through bores a swivel is required to prevent pipe from twisting. It is recommended to always pull a 10 meter (33 ft) test piece through a new bore before installing Flexpipe Spoolable Product to ensure nothing will damage the line.

Flexpipe recommends limiting the use of water or drilling mud to only what is necessary for the boring procedure. Excess fluid can weaken the bore as well as form a seal around the pull head. Low pressure is formed behind the sealed pull head when the pipe is dragged through the bore and can contribute to collapsing the bore onto the Flexpipe Spoolable Product.

It is recommended to pull an additional 10 meters (30 feet) beyond the bore exit as the pipe may tend to shrink back. Allow the pipe to rest and spring back to its original shape. Inspect the pipe for any damage. Any kinks or creases with HDPE stress whitening must be cut out. Pipe that has been flattened beyond 50% of the original diameter must be cut out.

**Table 17: Minimum Recommended Bore Hole Sizing**

Flexpipe NPS	Pipe only	Pipe and Coupling
	mm (inch)	mm (inch)
2"	100 (4)	130 (5)
3"	150 (6)	180 (7)
4"	200 (8)	230 (9)
5"	250 (10)	280 (11)

**NOTE!**



Centering guides or spacers are not required for installing Flexpipe Spoolable Products in metal casing or conduit pipe. Allowing the pipe to move inside the casing or conduit will accommodate pipe expansion and contraction during installation and operation.





1. Use a reamer with a diameter that is double the nominal pipe size as shown in **Table 17**.
2. The pipe must be supported (by sandbags or other means) on both the entrance and exit of bores to prevent shear forces from damaging the pipe.
3. Use Flexpipe Road Bore Pull Heads. (They tend to clear debris as the pipe is being pulled through the road bore. Internal pull tools with external tubes may also be used.)

## 7.6.2 Liner Pull Through Conduit Pipe

### 7.6.2.1 Conduit and Casing Compatibility

In situations where the existing pipeline has failed, Flexpipe Spoolable Products can be used as a remedial line or free-standing liner. In these applications there must be adequate clearance between the outer diameter of the Flexpipe Spoolable Products, and the inner diameter of the conduit. There cannot be obstructions in the existing conduit that could damage the Flexpipe Spoolable Products. The conduit pipe must also be clean. See **Table 18** below for guidance on compatibility of Flexpipe Spoolable Products with conduit pipe sizes. This guidance assumes round pipe and a straight line. Pulling with ovalized pipe off the reel, pulling through bends, etc. should be evaluated by the installation contractor to determine potential maximum pull lengths.

**Table 18: Steel Conduit Piping Compatibility Chart**

Conduit FP	3" Steel		4" Steel			6" Steel					8" Steel				
	0.188" wall	0.120" wall	Sch. 40	0.188" wall	0.125" wall	Sch. 80	Sch. 40	0.188" wall	0.156" wall	0.125" wall	Sch. 140	Sch. 120	Sch. 100	Sch. 80	Sch. 40
2" FP301/HT	P	P	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF
2" FP601/HT	N	P	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF
3" FP150	N	N	P	P	P	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF
3" FP301/HT	N	N	N	P	P	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF
3" FP601/HT	N	N	N	N	P	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF
3" FC801/FC901	N	N	N	N	P	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF
4" FP150	N	N	N	N	N	P	P	PF	PF	PF	PF	PF	PF	PF	PF
4" FP301/HT	N	N	N	N	N	P	P	PF	PF	PF	PF	PF	PF	PF	PF
4" FP601/HT	N	N	N	N	N	P	P	PF	PF	PF	PF	PF	PF	PF	PF
4" FC801/FC901	N	N	N	N	N	P	P	PF	PF	PF	PF	PF	PF	PF	PF
5" FP601HT	N	N	N	N	N	N	N	N	N	N	P	P	PF	PF	PF

N = Not compatible    P = Compatible for pipe without fittings    PF = Compatible for pipe with coupling fittings

The Flexpipe Spoolable Products cannot be pulled through any fittings or bends that have a radius tighter than what is listed in **Table 16**. These fittings or tight bends will have to be cut out and can be either replaced with conduit using the proper bend radius or a bell hole can be introduced.

Before installation of the Flexpipe Spoolable Products a sizing plate should be run through the line. Flexpipe recommends pulling the sizing plate in the direction of the original flow

of the conduit pipe. A steel sizing plate with the dimensions listed in **Table 19** should pass through the conduit without damage. If excessive debris is present, multiple passes may be required to ensure the conduit is clear of obstructions. This will typically be performed by the wire line truck when the cable is blown through the line.

**Table 19: Minimum ID and Required Sizing Plate**

Flexpipe NPS	Minimum ID of Conduit	Sizing Plate
	mm (inch)	mm (inch)
2"	79 (3.125)	75 (2.90)
3"	105 (4.125)	101 (3.96)
4"	134 (5.250)	130 (5.12)
5"	172 (6.770)	166 (6.54)

Before committing to pulling a section, a 10 meter (33 ft) test piece of pipe should be pulled through to ensure that the inside of the conduit is obstruction-free. If the test segment of Flexpipe Spoolable Product successfully passes through the entire conduit line without damage or without excessive pull forces, the Flexpipe Spoolable Product can be pulled into place. The guidance in Table 19 is general in nature. The installation contractor should evaluate each installation and select the appropriate sizing plate dimensions based on all project variables.

### 7.6.2.2 Liner Pull Installation

Discussions between the pipeline end user and installation contractor regarding project and installation parameters are recommended. Flexpipe recommends a Flexpipe field technician, or contractor field personnel who have been through the Flexpipe Contractor Installation Training Course, be present any time Flexpipe Spoolable Products are being handled. A survey drawing with elevation profile or a reasonably accurate hand drawn map including bends, elevations, and crossings may be sent to Flexpipe Engineering for feedback.

If there are too many bends or crossings a long pull might not be achievable. Bends in the conduit will increase the drag force on the pulled pipe. A site visit may be necessary to confirm pull lengths. To ensure the success of the pull, restrictions must be minimized. This must include ensuring the line is clear of wax or deposits. Pigging is highly recommended.

Use the Flexpipe Internal Pull Tool for pulling through conduit pipe. A swivel is also required for conduit pulls. When pulling multiple lines through a conduit, each line should have a separate swivel, and the entire assembly should have an additional swivel to help prevent lines from wrapping around each other. Detailed pull tool guidance is found in **Section 6.2**.

When pulling Flexpipe Spoolable Products, the maximum pull force shown in **Table 15** must not be exceeded. The pull load applied to the pipe



**Figure 140: Swivel Head for Multiple Lines**

must be measured and recorded for all bore and conduit pulls. It is recommended to pull in the direction of the original flow in the conduit pipe. Lubrication such as canola oil or another readily available vegetable-based oil may be used to reduce friction forces while pulling.

**NOTE!**



It is Flexpipe’s recommendation to use an inline tensile load measuring device for all bore and liner pulls. After the pull is complete, the section that was pulled on should be cut back at least 1.5 meters (5 feet) from the pull point and discarded.



**Figure 141: Twisted Pipe from Pull Without Swivels**



**Figure 142: Canola Oil Lubrication in Liner Pull**

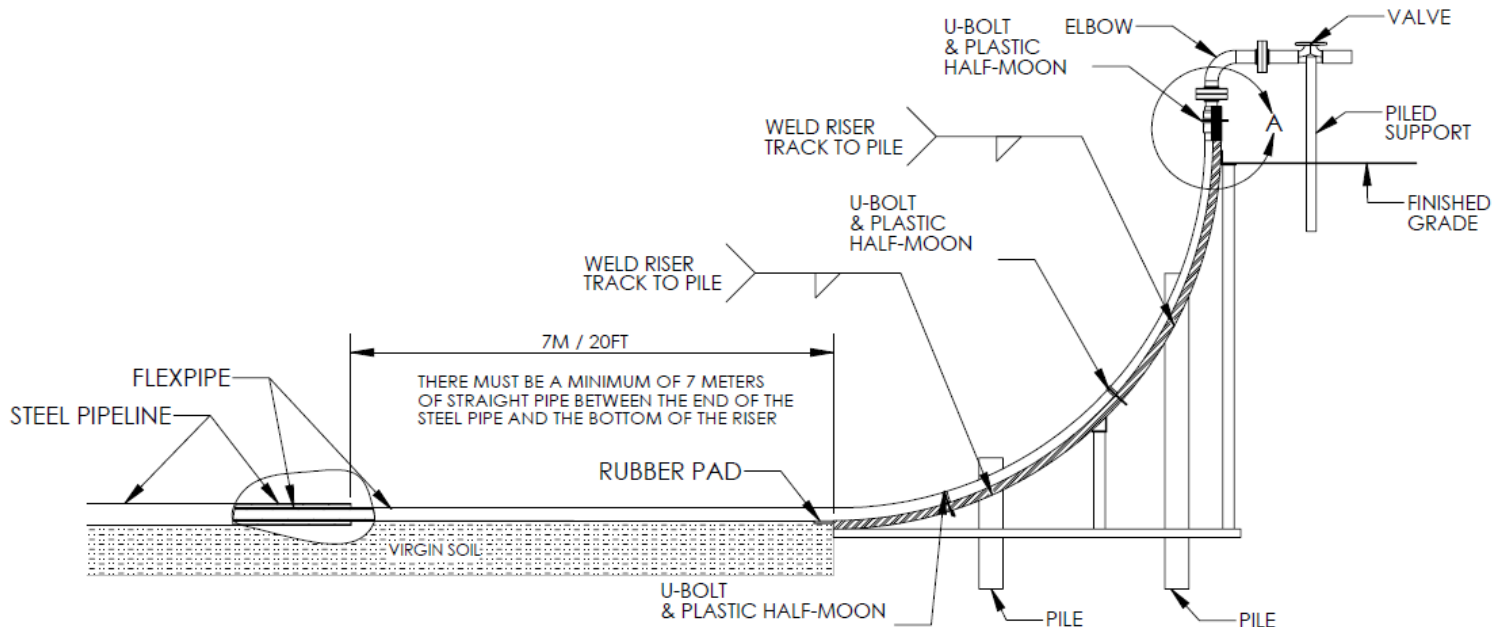
The bell holes should be dug at the pre-determined locations. There will be a minimum of one bell hole at each end of the line and depending on bends/lengths possibly more in between. When possible, accurately measure the distance of the line so that reel lengths can be chosen between bell holes to minimize the number of pulls. Where fittings are to be installed, the space between the two sections of the conduit must be at least 12 meters. This is the minimum space needed for a proper fitting installation. It is also required to leave enough spacing to allow 1 meter of straight pipe at each casing opening, and to have no bends within 1 meter from a crimp fitting.

Flexpipe requires terminating the liner pull underground and providing a minimum of 7 meters of uncased buried length before bringing the pipe to surface, as seen in Figure 143 below. This ensures any expansion or contraction concentrated inside the existing casing is restrained by ground friction before coming to surface. This is particularly important when thermal expansion is expected. For more information on thermal expansion, please see Flexpipe Technical Manual Section 5.11.

**NOTE!**



Centering guides or spacers are not required for installing Flexpipe Spoolable Products in casing or conduit pipe. Allowing the pipe to move inside the casing or conduit will accommodate pipe expansion and contraction during installation and operation.



**Figure 143: Liner Pull Termination With 90 Degree Riser**

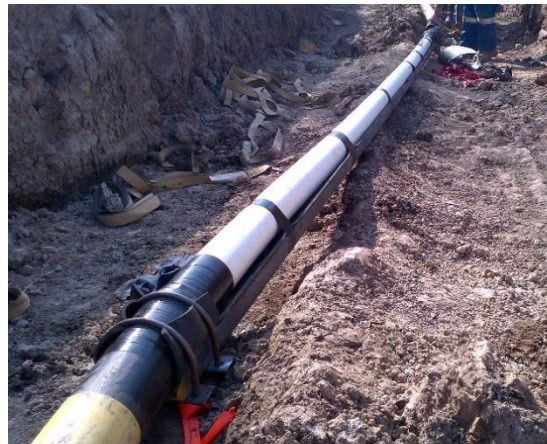
### 7.6.2.3 Pipe Support in Casing Transitions

At casing terminations or when there is space between separate conduit sections, continuous support of Flexpipe Spoolable Products is required. Proper support should remove any points of impingement, should ensure the minimum bend radius of the pipe is not exceeded, and should prevent the pipe from impinging on the entrance and exit edges of casing.

For continuous support, steel C-channel may be welded to the casing as seen below to provide a smooth transition either from casing to casing, or from casing to virgin ground.



**Figure 144: C-channel Welded to Casing Exit**



**Figure 145: Continuous C-channel Support**

Proper support may also include compacted sandbagging, virgin soil, or a compacted clay or soil bed to ensure the pipe is supported. If there are still open spaces or loose sandbags, more support is required. Additional considerations for pipe support and

transitions between grades or surfaces can be found in the Flexpipe Pipe Installation Guide section 10.



**Figure 146: Insufficient Sandbag Support**



**Figure 147: Continuous C-channel and Sandbag Support**

In muskeg conditions, additional pipe support will be needed to prevent floatation and to control movement from thermal expansion, such as U-bolts securing the pipe to steel channels, custom anchors, or weighted saddle-bags. Support spacing should be no more than 1.5 meters. Additional guidance on the use of U-bolts for support can be found in Section 7.6.5 and Section 10.4. Please see the Flexpipe Technical Manual section 6.3 for information on pipe buoyancy, net buoyancy calculations, and recommended weights for securing pipe. The suitability of the conditions and proper support techniques may be evaluated based on existing pipelines in the area and consultation with Flexpipe Engineering.



**Figure 148: Custom Pipe Anchor Example**



**Figure 149: C-channel Secured by U-Bolts**

### 7.6.2.4 Casing Ends

Flexpipe recommends that a steel slip on flange is welded on each end of the existing steel casing to ensure maximum flexibility for set up during the installation process. The steel slip on flange is also recommended to protect the Flexpipe Spoolable Product. The flanges may be required for the wire line truck to attach its lubricator to the pipeline for

the blow down process. An A-frame or Deployment trailer should be placed so that the pipe can deploy directly into the conduit as it is being pulled by the wire line cable.

To protect the pipe from possible shear forces or impingement at the casing edges, rubber padding is recommended, as well as a straight section of at least 1 meter of pipe going into the casing. For conduit with a diameter significantly larger than the pipe or without an attached flange, cutting back the edges such as seen in **Figure 151** may also be considered.



**Figure 150: Padding Examples At Casing Edges**



**Figure 151: Enlarged Casing Opening**

Compressive watertight seals such as that shown below are not recommended.



**Figure 152: Link-Seal at Casing End – NOT Recommended**

### 7.6.3 Bore and Conduit Pull Water Ingress Protection

It is important to ensure the jacket is free of through wall damage and that the pipe ends are adequately taped to prevent water ingress during installation and that the crimp fittings are adequately taped to prevent water ingress while in service. If the environment between the Flexpipe Spoolable Products liner and jacket becomes wet for any reason, this will lead to a reduced product life.


In order to prevent wetting the reinforcement layer of the pipe end during bore or conduit/liner pulls, ensure protective paste is applied to the cut pipe end and that petrolatum and pipeline tapes are applied over the nut and threads of the pull tool head. For detailed guidance on pipe and fitting water ingress protection, refer to **Section 6.2** and **Section 9.6**. It is required to follow the wrapping guidance in these documents. For high water table installations with water depths greater than 1 meter, contact Flexpipe Engineering for additional guidance.

<p><b>CONTACT US!</b></p>  <p style="text-align: center;"><b>+1 888 FLX PIPE (+1 888 359 7473)</b></p> <p style="text-align: center;"><a href="http://www.flexpipesystems.com">www.flexpipesystems.com</a></p>	<p>For any further information or consultation on a boring or conduit pull project, please contact a Field Operations representative through our toll-free number:</p>
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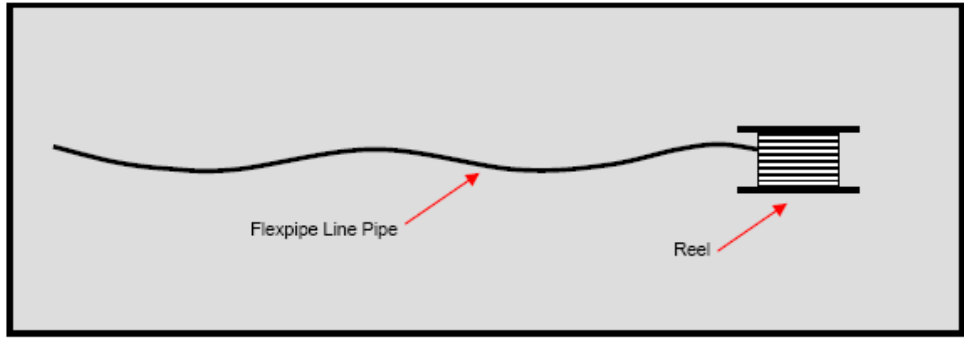
## 7.7 Surface Lines

### 7.7.1 Installation Considerations

**NOTE!**



Flexpipe Spoolable Products have a natural tendency to un-spool in a manner as outlined in the below Figure 153. This natural slack in the line will allow for pipe expansion and contraction as a result of pressure and temperature fluctuations in surface installations.



**Figure 153: Flexpipe Spoolable Products Unspooling**

Installations of Flexpipe Spoolable Products in surface applications should be supervised by a Flexpipe representative or other personnel with valid Flexpipe installation training and experienced in Flexpipe surface line installation. The installation should comply with the following recommendations to minimize the risks associated with pipe movement during operation:

1. Allow the end of the pipe to twist freely during the unspooling process. This can be achieved using a swivel link between the pipe end and the pulling equipment or anchor, or by other means deemed appropriate by field personnel. If sections from multiple reels are to be joined, each section should be fully strung out independently before joining, unless otherwise instructed by Flexpipe personnel.



**Figure 154: Surface Line Deployment with Strap**


2. Excessive slack beyond 1% of the total pipeline length is not recommended for surface installations. Avoid significant curves except as needed to change direction using an appropriate bend radius as outlined in **Table 9**.
3. After joining and installing the Flexpipe Spoolable Products, seal one end of the line with a blind flange and leave this end of the line unrestrained while performing a hydrotest, allowing the Flexpipe Spoolable Products to twist if necessary to a neutral position. Several loose slings can be used as necessary to limit sideways movement of the unrestrained end. Ensure all personnel maintain a safe distance to avoid being struck in case of rupture of the unrestrained pipe. The pressurization / depressurization rates should not exceed 1400 kPa/min (200 psi/min).
4. After successful completion of the hydrotest, remove the blind flange and complete the end connections.
5. Secure the line at all corners, bends, coupling fittings, and at intervals no greater than 150 meters (500 feet) in long straight stretches. The line should be secured by covering the pipe to a depth of 0.60 to 1.20 meters (2 to 4 ft) over a length of 3 to 8 meters (10 to 25 feet), or by other restraints such as sandbags, dirt piles, or anchors at corners and bends and at intervals along straight stretches, or as deemed appropriate by field personnel. Where trenching is used, a gradual slope should be used for entry and exit to avoid shear loading.





**Figure 155: Dirt Piles Used For Pipe Restraint**

Operational experience has shown that unrestrained Flexpipe Spoolable Products installed in surface line applications may experience undesirable pipe movement during operation. Excessive pipe movement may increase the risk of damage and/or reduce the Flexpipe Spoolable Product’s integrity.

<p><b>CAUTION!</b></p> 	<p>Pipe vibration or movement on a hard and rough surface may lead to jacket abrasion, reinforcement damage and potential pipe rupture. Where excessive pipe movement is expected, ensure the pipe is protected from abrasion by limiting pipe vibration/movement or protecting the jacket from hard and rough surfaces.</p>
--	--



**Figure 156: Pipe Damage from Abrasion Against a Solid Surface**

Flexpipe Spoolable Products must be supported when joining to surface equipment. **Figure 157** shows an unacceptable connection to surface equipment as there is no support for the FlexPipe when it leaves the ground. Kinks will eventually occur at the fitting unless proper support is used. **Figure 158** shows an unsupported line crossing over another pipeline. This can increase the risk of both kinking and abrasion damage.



**Figure 157: Unacceptable Unsupported FlexPipe on Surface**



**Figure 158: Unacceptable Unsupported Line Crossing**

### 7.7.2 Vehicular Crossing of Surface Lines

Flexpipe does not recommend driving over Flexpipe products with vehicles or equipment due to the possibility of causing damage to the pipe. Where rollovers are expected, Flexpipe products should be buried or cased.

### 7.7.3 Lines Crossing Other Lines

Pipe-on-pipe placement such as FlexPipe laying across either another FlexPipe line or across steel pipe can result in abrasion similar to that seen in **Figure 156**. Whenever crossing Flexpipe Spoolable Products over other pipelines is necessary, it is required to separate the pipe with a protective material such as sandbags. An example of proper sandbag placement for crossed pipelines can be seen in **Figure 159** below, and an example of improper placement of crossed pipelines can be seen back in **Section 7.1.1.1**.



**Figure 159: Multiple FlexPipe Lines Crossings Protected by Sandbags**

### 7.7.4 Additional Requirements for Temporary Surface Lines

Flexpipe endorses the use of Flexpipe Spoolable Products in temporary surface pipeline applications under the following conditions:

1. After each deployment of the Flexpipe Spoolable Products, and prior to pressurization, the pipe must be inspected for damage to the outer protective jacket. This inspection should identify any cuts, scrapes, or abrasion that have either:
  - a. penetrated the outer protective jacket exposing the pipe's reinforcement layer OR,
  - b. compromised the thickness of the outer protective jacket to the degree that the HDPE jacket has changed color due to strain whitening or a gouge has exceeded the guidance provided in **Table 3**.

Any portions of the Flexpipe Spoolable Products where damage has been identified must be clearly marked and cut out of the pipeline.

2. When unwinding and stringing or rewinding the pipeline, due care and attention must be given to proper handling procedures to prevent kinking or over-bending the pipe. Any occurrence of kinking or over-bending is considered damage to the pipe and must be clearly marked and cut out of the pipeline. When handling the pipeline, the installation crew must ensure that the pipe is properly supported at all times. Care should be taken to avoid pulling on the pipe with excessive force especially when pulling around tight bends.
3. After each deployment and after completion of an inspection for damage, the pipeline should be pressure tested as per **Section 12.1**. The pressure test operator must ensure that appropriate safety precautions are taken. As a minimum, these precautions should include evacuating personnel from the pipeline right-of-way and posting warning signs.

4. Flexpipe recommends that a temporary pipeline be limited to a maximum of 5 deployment cycles. A deployment cycle includes unwinding and stringing the pipeline along the right-of-way and rewinding or respooling the pipeline back onto the reel provided by Flexpipe. More deployment cycles may be possible if the pipe remains in good conditions. Due to handling concerns, only 2"-4" products can be re-deployed.
5. Surface pipelines are exposed to an uncontrolled environment and are therefore at a greater risk for external damage than a buried pipeline. The operator of a temporary surface pipeline must evaluate the potential hazards associated with the pipeline right-of-way.

### 7.7.5 Steep Hill Support

Flexpipe Spoolable Products must be properly supported in any application where the line is not completely buried. Surface applications are one such application where Flexpipe Spoolable Products may experience undesirable pipe movement or loads during operation.

In some applications Flexpipe Spoolable Products may be required to be installed on steep inclines where additional support will be needed. Considerations for the need for additional support include surface roughness, casing, ground conditions, etc. Flexpipe Spoolable Products must be securely supported on the incline to prevent movement and excess loads due to combined pipe and fluid weight.

The below diagrams detail one such solution for fixing Flexpipe Spoolable Products in place using equipment supplied by Flexpipe, however other solutions that provide equivalent or better support than shown may be used. For detailed information on riser chutes and riser assembly installations, refer to **Section 10**.

Materials:

- FlexPipe riser support extension (2", 3" or 4")
- Rubber pads
- Half-moon/U-bolt support (2", 3", or 4")
- U-bolt
- U-bolt nuts and jam nuts
- U-bolt base bar



**Figure 160: Riser Hardware**

1. A stake or support pounded/drilled into the ground capable of supporting the pipe must be installed. The riser support extension will be welded to the support (shown in red).



**Figure 161: Welding Location for Support**

2. Rubber pads are required to protect the pipe from the edges of the support.



**Figure 162: Rubber Pad Locations**

3. Pipe is laid into the support and fixed in place using the half-moon, U-bolt, nuts, and bar.



**Figure 163: U-Bolt Installation**

4. Tighten the nuts until they are snug and the pipe is seated to the bottom of the support.
5. Completed support. Ground level indicated in green. A small hole can be dug underneath the location of the U-bolt to facilitate installation.



**Figure 164: Completed Support**

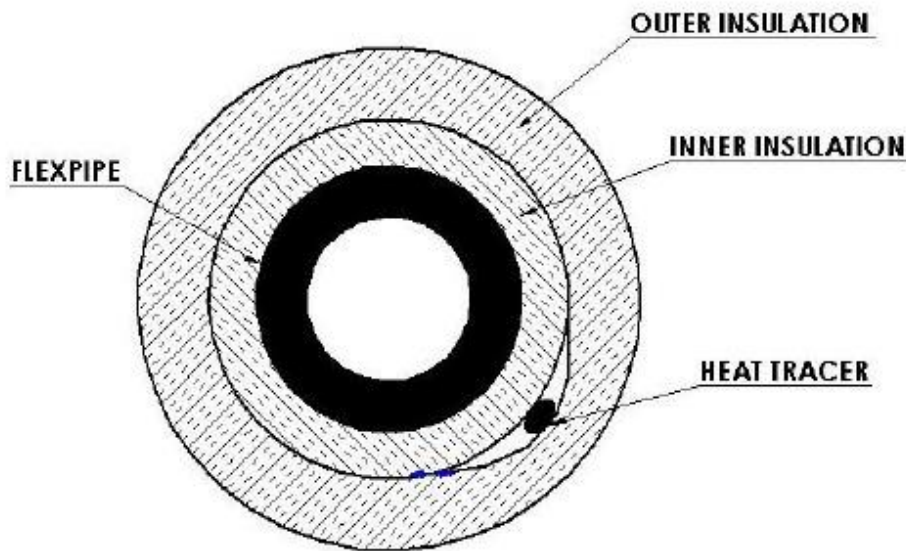
## 7.8 Heat Tracing

Flexpipe Spoolable Products may be heated by means of a heat trace wire to prevent freezing. The maximum operating temperature of FP and FC is 60°C (140°F) and the maximum operating temperature of FP HT is 82°C (180°F), therefore it is very important to regulate the amount of heat tracing to ensure the maximum operating temperature is not exceeded.

In cases where the heat trace wire is operating at a temperature below 60°C (140°F) for FP/FC or 82°C (180°F) for FP HT, the wire can be directly applied to the pipe jacket.

Because the pipe jacket materials are a very poor thermal conductor, concentrated hot spots may appear directly below the heat tracing wire. Where the possibility exists that the heat trace wire may exceed the maximum pipe service temperature, the heat tracer wire must be separated from the Flexpipe Spoolable Products by an insulation barrier to prevent concentrated hot spots or over-heating of the jacket.

In all cases, Flexpipe recommends applying an outer insulation layer to minimize heat loss. Refer to **Figure 165** for an example installation.



Sandwich Type Insulated Barrier Configuration

**Figure 165: Installing Heat Trace on Flexpipe Spoolable Products**

## 8. Operating Rental Equipment

### 8.1 Turntable

Refer to **Section 6.4.3** for turntable operating instructions.

## 8.2 Crimp Kit

**WARNING!**



Crimp Kits can operate at pressures up to 10,000 psi. Damaged equipment could cause injury. Ensure the equipment is inspected prior to every use. Contact Flexpipe Rentals for guidance if you experience equipment issues and before performing any repairs or maintenance.

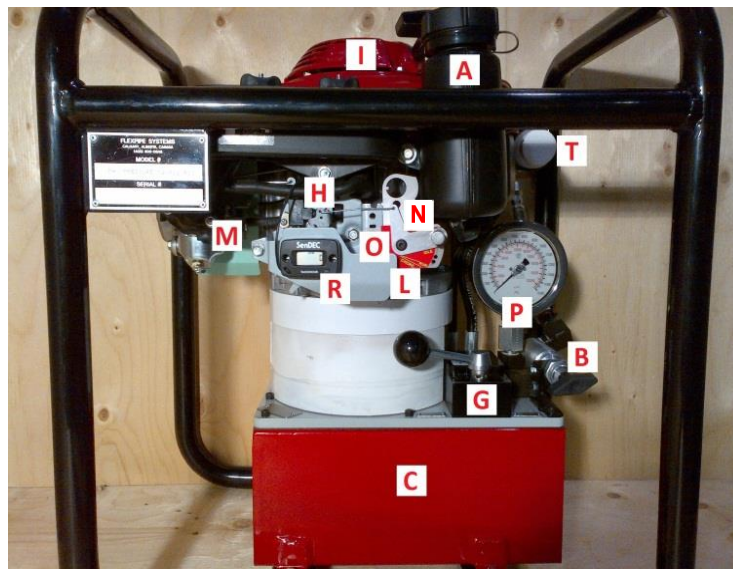
Crimp Kits contain sharp edges and heavy equipment which may shift during transport creating pinch points. Adequate personal protective equipment such as safety glasses, approved steel-toed footwear, work gloves, ear plugs, and FR protective clothing should be worn at all times. Proper lifting practices, which may include a mechanical lifting device, should be observed when loading, unloading, and handling equipment and accessories.

Check that the crimp kit received is complete and in good working condition. Use **Appendix D: Rental Equipment Inspection Form**, located in the large pelican case.

### 8.2.1 Hydraulic Pump, Remote Valve, and Hose

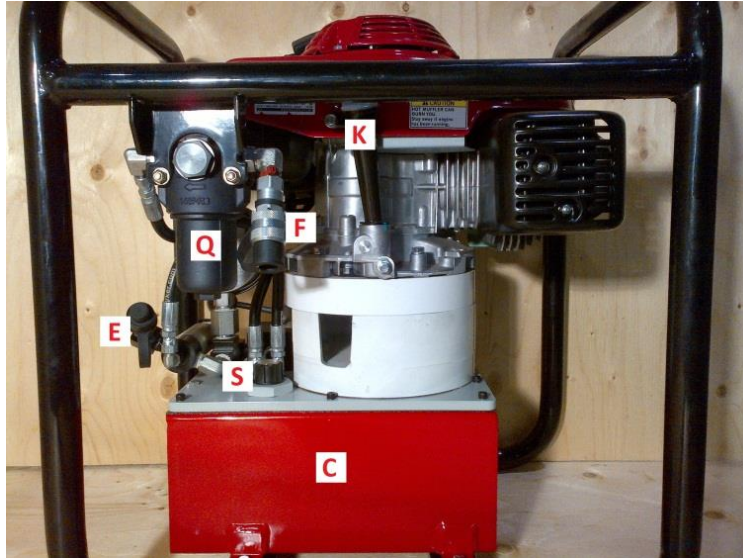
The Hydraulic Pump Unit manufacturer-supplied owner’s manual is located in the large pelican case included with the crimp kit.

The hydraulic pump unit consists of a gasoline engine, a hydraulic pump and a fluid reservoir. There is also a 3-Position Remote Valve and hose that is used in conjunction with the hydraulic pump unit. The major components and other important features of the equipment are listed below and are labeled in the following figures.

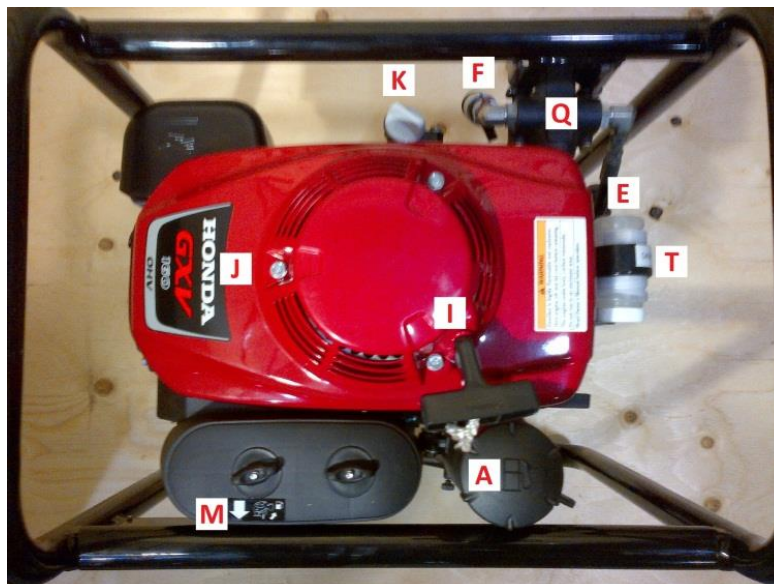


**Figure 166: Gen 2 Hydraulic Pump Unit - Front View**





**Figure 167: Gen 2 Hydraulic Pump Unit - Rear View**



**Figure 168: Gen 2 Hydraulic Pump Unit - Top View**

**A. Fuel Tank** - The pump engine runs on gasoline. It is recommended to use an unleaded premium fuel grade.

**NOTE!**



Gasoline for Hydraulic Pump Unit  
The engine will consume approximately one tank of gas per hour.

**B. External Pressure Relief Valve** – turn clockwise to increase the set pressure and counterclockwise to reduce the set pressure. The lock-nut on the base will lock-in the pressure setting when tightened.

**C. Hydraulic Fluid Reservoir**

**D. 3-Position Remote Valve and Hose** – The current design of the remote valve is enclosed in a housing. All remote valves come with a longer set and shorter set of hydraulic hoses attached to it. The longer hoses will be connected to the hydraulic pump unit. The shorter hose(s) will be connected to the mandrel insertion press or crimper. When connecting the shorter hoses to the mandrel insertion press, it is important that both shorter hydraulic hoses are connected to the mandrel insertion press. When connecting the shorter hydraulic hoses to the crimper, only the hose with the female quick-connector is connected to the tee of the quick-connector of the joined hoses of the crimper.



**Figure 169: 3-Position Remote Valve with Housing**

**E. Hydraulic Line** – high-pressure supply.

**F. Hydraulic Line** – low-pressure return.

**G. Selector Valve** – Advance-Neutral positions; pictured in neutral.

**H. Gen 2** – Switch Assembly, Engine Stop.

**I. Starter Pull Cord**

**J. Gasoline Engine**

**K. Engine Oil Tank Dip Stick** – if needed, add synthetic 5W-30 engine oil here.

**L. Choke**

**M. Fuel Valve**

**NOTE!**



To prevent equipment damage, make sure to turn off the Fuel Valve (M) when transporting the pump. Fuel can leak into the crankcase if the valve is not turned off.

**N. Throttle**

**O. 0 to 15,000 psi Pressure Gauge** – used to ensure the proper crimp pressure is achieved. This gauge must read 0 (zero) when the unit is off and pressure is relieved.

**P. Return Fluid Filter**

**Q. Hour Meter** – This digital gauge provides an hour reading for the engine when off and RPM readout for the engine when it is operating.

**R. Hydraulic Fluid reservoir tank level indicator** - (**green** = normal level - cylinders retracted/ **yellow** = normal level - cylinders extended / **red** = low Hydraulic Fluid level). Check the fluid level when the pump is warm and the cylinders are retracted. If needed, add Hydraulic Fluid here.

**NOTE!**



To prevent overfilling, the indicator (S) should be checked when the mandrel insertion press is in closed position. When the press is in open position, the Hydraulic Fluid level will drop substantially. If Hydraulic Fluid is added when the press is opened, the tank may overflow when the press closes again.

**NOTE!**



Crimp kits are equipped with different types of hydraulic fluids (AW 46 or ATF) depending on the environment the equipment will operate in. Consult the Crimp Kit Inspection Form for the specific type of hydraulic oil used in your particular crimp kit. Contact Flexpipe in case of doubt.

**S. Pressure Gauge Certificate**

**8.2.1.1 Inspecting the Hydraulic Pump Unit**

Make sure to inspect the following before use. Contact Flexpipe before performing any repairs:

1. Inspect all hosing for cracking, leaking, swelling and signs of abrasion.
2. Inspect all fittings for leaks. Tighten loose fittings and replace damaged ones.
3. Check fluid levels in the pump. Fill to proper levels if low using appropriate fluid type.
4. When replacing damaged or leaking quick connectors, the use of Teflon paste is preferred over the use of Teflon tape, as improperly applied tape can cause blockages.

**8.2.1.2 Inspecting The 3-Position Remote Valve**

Make sure to inspect the following before use Contact Flexpipe before performing any repairs:

1. Inspect all hoses for cracking, leaking, swelling, and signs of abrasion.
2. Inspect all fittings for leaks. Tighten loose fittings and replace damaged fittings.
3. Inspect condition of yellow housing and all button head bolts of the inner valve bracket; tighten as needed.
4. When replacing damaged or leaking hoses, the use of Teflon paste is preferred over the use of Teflon tape, as improperly applied tape can cause blockages.
5. Check the handle and valve for signs of damage and/or cracking. Ensure that the handle turns easily and smoothly in both directions. A distinct click should be felt at the neutral position.

### 8.2.1.3 Pump Start Up

After inspecting the equipment, start the pump by doing the following:

1. **Gen 2** - Ensure the Hydraulic Pump Unit selector valve (**G**) is in the neutral position.
2. **Gen 2** - Open the Fuel Valve (**M**).
3. **Gen 2** - Put the Throttle Lever (**N**) into the choke position.
4. **Gen 2** - Start the pump using the Pull Start.
5. **Gen 2** - Set throttle to high or run.

### 8.2.1.4 Relieving Pressure in the System

Before attaching or detaching any hydraulic lines follow these steps:

1. Set the selector valve and 3-position remote valve to the neutral position.
2. Turn the pump off.
3. Relieve pressure in the hydraulic lines by cycling the 3-Position Remote Valve through open-neutral-close positions several times.
4. Repeat the above step for the selector valve by cycling through the advance-neutral positions several times.
5. Verify that the pressure gauge indicates 0 (zero) pressure in the system. If the Pressure Gauge on the Hydraulic Pump Unit does not read 0 (zero) when the unit is off, then the gauge will need to be replaced. The gauge is inspected for proper calibration prior to shipment from Flexpipe.

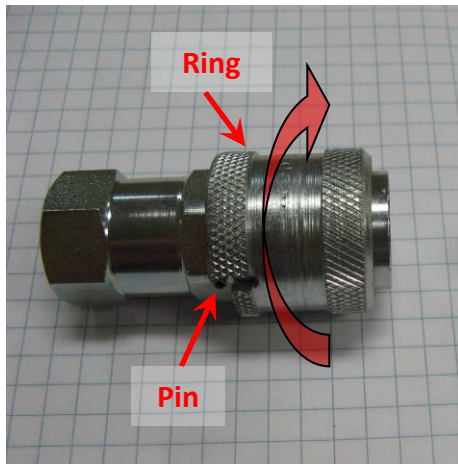


**Figure 170: Pressure Gauge on Hydraulic Pump Unit**

## 8.2.1.5 Connecting Hydraulic Hoses using Quick-Connectors

All hydraulic lines are color-coded with zip ties and use quick-connectors. The pressure in the system must be relieved before the quick-connector attachment can be made. Ensure the connector ends are clean before attachment. To attach hydraulic lines, turn the ring on the female quick-connector so that the slot in the ring lines up with the pin. Pull the ring back (away from the end of the line) and insert the male quick-connector into the female quick-connector. Release the ring on the female quick-connector, allowing it to spring back into position and then turn the ring on the female quick-connector to lock the ring in place.

A step-by-step visual of using quick-connectors is found in the following figures.



**Figure 171: Female Quick-Connector - Turning Ring**



**Figure 172: Pulling Back Ring on Female Quick-Connector**



**Figure 173: Inserting Male into Female Quick-Connectors**



**Figure 174: Assembled Quick-Connectors**

To detach a hydraulic line first ensure the pressure is relieved from the system (outlined in the previous **section 8.2.1.4.**) Twist the ring on the female quick-connector so that the slot in the ring lines up with the pin. Pull the ring back and pull out the male quick-connector from the female quick-connector.

## 8.2.1.6 Adjusting the Set Pressure on the Hydraulic Pump Unit

To adjust pump set pressure:

1. Unit must be off.
2. Disconnect both hoses from the hydraulic pump unit.
3. Set selector valve (**G**) in **Figure 166** to neutral.
4. Start pump engine (high idle).
5. Set selector valve to pump (pressurize).
6. Loosen the lock-nut of the valve spindle on the external relief valve.
7. Adjust the Valve Spindle by slowly turning the valve lever on the external relief valve until the gauge displays 8500 psi for standard length (FP150/FP301) fittings. Adjust external relief valve on the gauge to 9000 psi for FP300, FP601 or any Extended Length (EL) fittings. Turn counter-clockwise to decrease gauge pressure or clockwise to increase gauge pressure. Do not fully remove the Valve Spindle.
8. Tighten the lock-nut of the valve spindle on the external relief valve.
9. Turn selector valve to neutral, shut down motor, relieve pressure, and connect hoses.

### NOTE!



It is recommended to check the setting of the external relief valve before every crimp to ensure proper pressure setting.

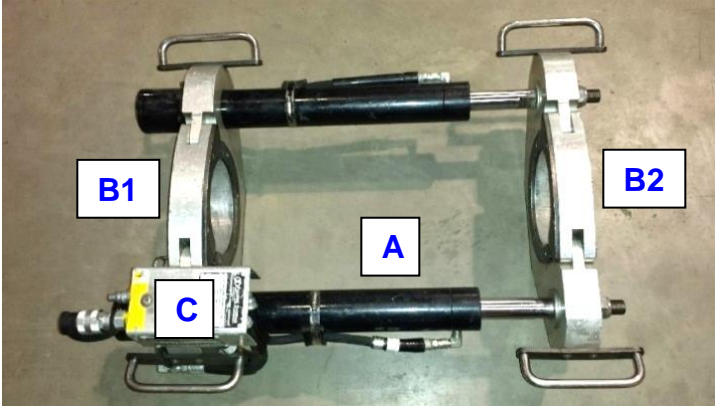
## 8.2.1.7 Pump Shut Down

To safely shut down the pump:

1. Ensure selector valve (**G**) on pump is in the neutral position.
2. Set throttle to idle.
3. Turn pump off.
4. Close fuel valve.

## 8.2.2 Mandrel Insertion Press

The mandrel insertion press is used to press Flexpipe Spoolable Products onto the mandrel of the fitting. This press is used for 2"-5" pipe sizes. The large diameter insertion press for 5" pipe is operated similar to the one for 2"-4" pipe.



**Figure 175: Mandrel Insertion Press**

- A.** Hydraulic cylinders
- B.** Press gates, with locking pins
- C.** Two internal relief valves

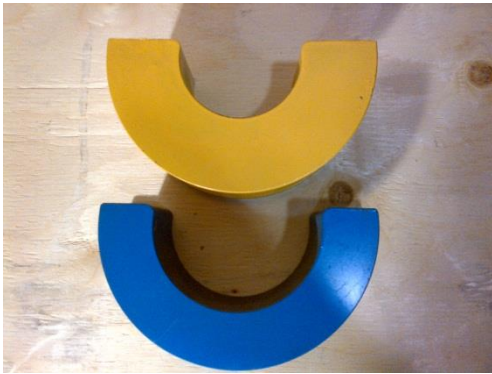
**NOTE!**



Press gates **B1** and **B2** from **Figure 175** can be used interchangeably. The Pipe Centering Tool will need to be moved to the pipe side of the press when pressing the other side of a pipe-to-pipe coupling fitting.

The following equipment is shipped with the Mandrel Insertion Press.

## 2"-4" Mandrel Insertion Press Components:



**Figure 176: Pipe Centering Tool**

### **Pipe Centering Tool**

Both 2" and 3" pipe require the use of a pipe centering tool. This tool is used to ensure that the pipe is in the center of the press and aligned with the fitting it is being inserted into. The pipe centering tool is inserted into press gates **B** from **Figure 175**.



**Figure 177: End Adapter**

### **End Adapter**

The End Adapter is used with the Flanged End Fitting only. The End Adapter is placed in press gate **B1** from **Figure 175**. The End Adapter is universal for 2"-4" pipe fittings. Flexpipe recommends that all 4" flanges be pressed using the **B2** gate to minimize pinch points and pressurized hoses.



**Figure 178: Fitting Adapter Clamp**

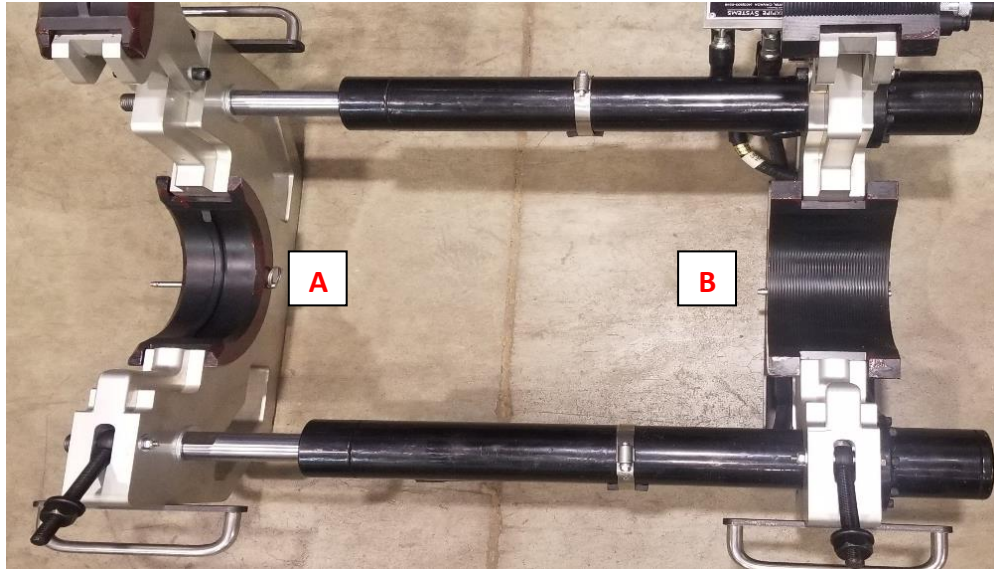
### **Fitting Adapter Clamp**

Used on Coupling Fittings (shown in **Figure 178**) and on Weldneck Fittings. The Fitting Adapter Clamp is positioned in conjunction with gate **B1** or **B2** from **Figure 175**.

Each size of pipe has a corresponding Fitting Adapter Clamp.



## Large Diameter Mandrel Insertion Press Components:



**Figure 179: Insertion Press Integrated Clamps**

### **Integrated Fitting Adapter Clamp**

Shown above in **Figure 179** side **A**, this is used on coupling, weldneck, and flange fittings.

### **Integrated Pipe Clamp**

Shown above in **Figure 179** side **B**, the Integrated Pipe Clamp functions the same as the standard 2"-4" pipe clamps with the exception that it fits within the Mandrel Insertion Press gate.

To operate the mandrel insertion press, first verify that the mandrel insertion press is in working order:

1. Inspect all fittings for leaks. All leaking fittings should be re-tightened, and all damaged fittings should be replaced before using the mandrel insertion press.
2. Inspect press cylinder rods. If any cylinders or rods are damaged call Flexpipe.
3. Start the pump and run the press by fully extending and retracting the press two times. Check the pressure relief valve by retracting the press completely and slowly increasing pressure. When properly connected, the pressure relief valves built into the press will not allow the pressure in the cylinders to exceed 3000 psi for the 2"-4" insertion press, or 5000 psi for the large diameter insertion press.

### **CAUTION!**



Ensure that both the supply and return remote hoses are connected to the Mandrel Insertion Press properly. If only one hose is connected, the Mandrel Insertion Press will not operate appropriately and could damage the hydraulic cylinders, or cause injury or death.

## CAUTION!



While operating the 3-Position Remote Valve, always stop at the neutral position before shifting from the open to close position and vice versa.

## NOTE!



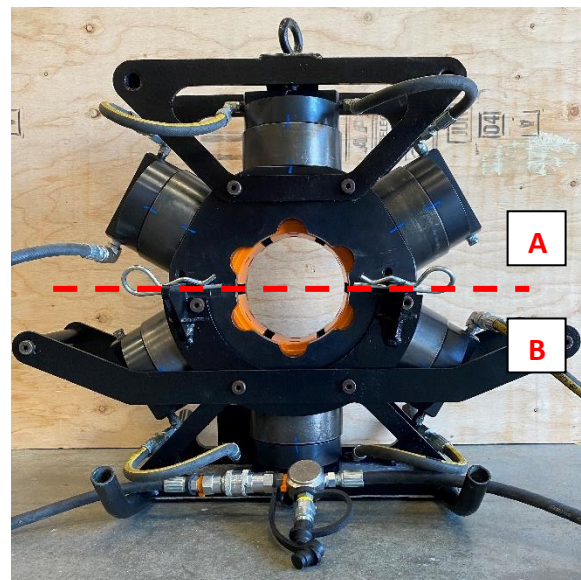
Ensure the selector valve is turned to the neutral position as soon as the press is fully opened or fully closed. Do not allow the press to keep running when it has reached its expansion/contraction limit.

### 8.2.3 Crimper

To operate the crimper, first verify that the crimper is in working order. Contact Flexpipe before performing any repairs:

1. Inspect all hoses for cracking, swelling, leaking and any signs of abrasion. Replace all damaged parts as necessary.
2. Inspect all fittings for leaks. All leaking fittings should be re-tightened, and all damaged fittings should be replaced before using the Crimper.
3. Inspect all crimping dies. These should be checked for chipping on the surface, and deformation of the die.
4. Ensure all six dies of the size corresponding to the size of the fitting are used.
5. Ensure the dies are firmly bolted into the crimper. Re-tighten these bolts if necessary.
6. Inspect for cleanliness. When needed, remove dies and clean. (The crimper is especially susceptible to damage or poor performance if it gets dirty.)

The crimper has an upper and lower section (**A & B**) as outlined in **Figure 180** to the right. Each half weighs about 68 kgs (150 lbs).



**Figure 180: Second Generation Crimper**

## 8.2.4 Crimp Kit Cold Weather Warm-up Procedure

### CAUTION!



Operating the equipment in cold weather before it is adequately pre-heated can cause a bad crimp or damage the equipment itself.

### NOTE!



The terms 'open position' and 'close position' used below for the 3-Position Remote Valve describe the change in the equipment gap of the mandrel insertion press and crimper.

'Open position' and 'close position' do NOT refer to the movement of the pistons and are NOT always synonymous with 'extend' and 'retract'.



### COLD WEATHER INSTALLATION - for temperatures below 0°C (32°F)

If the outdoor temperature is below 0°C (32°F), the equipment will need to be warmed up before it is operated. When equipment is operated without warming-up, occasional weeping of hydraulic oil may occur. Prior to attempting repairs or returning equipment, warm up the equipment as below and check for leaks again. See the Equipment Warm Up Procedure (Document # 14-4130).

#### 1. Pump Engine

- a. Set the selector valve on the hydraulic pump unit to the neutral position.
- b. Start the pump engine (Gen2-in choke position then into high idle).
- c. Run the pump engine with the selector valve in the neutral position until the engine is warm (5+ minutes).

#### 2. Hydraulic Fluid

- a. Set the selector valve on the hydraulic pump unit to the advance position.
- b. Allow the fluid to circulate through the pump until the fluid tank is warm to the touch.
- c. Set the selector valve on the hydraulic pump unit to the neutral position.

#### 3. Hoses

- a. Connect the Long Hoses of the 3-Position Remote Valve to the Hydraulic Pump Unit.
- b. Connect the Short Hoses of the 3-Position Remote Valve together.
- c. Set the selector valve on the hydraulic pump unit to the advance position.
- d. Set the 3-Position Remote Valve to the open OR close position.
- e. Allow the fluid to circulate through the hoses until the hoses are warm to the touch.
- f. Set the 3-Position Remote Valve to the neutral position.
- g. Set the selector valve on the hydraulic pump unit to the neutral position.
- h. Cycle the 3-Position Remote Valve through the open-neutral-close positions several times to relieve the pressure in the system.
- i. Ensure the pressure gauge reads zero.

## 4. Mandrel Insertion Press

- a. Connect the 3-Position Remote Valve to the mandrel insertion press.
- b. Set the selector valve to the advance position.
- c. Open and close the rams on the mandrel insertion press several times using short strokes (6" increments) by cycling the 3-Position Remote Valve to open and close. Do not build pressure in the system by leaving the 3-Position Remote Valve in open once the rams are fully extended.
- d. Repeat until the cylinders on the press are warm to the touch.
- e. With the press completely closed, set the 3-Position Remote Valve to the neutral position and the selector valve on the hydraulic pump unit to the neutral position.
- f. Cycle the 3-Position Remote Valve through the open-neutral-close positions several times to relieve the pressure in the system.
- g. Ensure the pressure gauge reads zero.
- h. Disconnect the short hoses from the mandrel insertion press.

## 5. Crimper

- a. Disconnect the crimper hoses, then connect the 2 3-Position Remote Valve quick connects to the 2 orange quick connects on the crimper.
  - b. Turn the selector valve to the advance position and the 3-Position Remote Valve to the open position. Depending on the crimper, either the bottom or top dies will extend and the other half will stay retracted. \*As soon as the gauge on the pump starts to pressure up, turn the 3-Position Remote Valve to neutral.
  - c. Turn the 3-Position Remote Valve to the opposite close position. Depending on the crimper, either the bottom or top dies opposite to the previous step will extend and the other half will stay retracted. \*As soon as the gauge on the pump starts to pressure up, turn the 3-Position Remote Valve to neutral.
  - d. Turn the selector valve to the neutral position, and 3-Position Remote Valve to open to allow ALL dies to retract.
  - e. Repeat steps b. through d. until the crimper hoses are warm to the touch and all dies are moving freely.
  - f. Reconnect the crimper hoses to the tee and connect just the supply line hose from the 3-Position Remote Valve to the tee.
  - g. Cycle the 3-Position Remote Valve through the open-neutral-close positions several times to relieve the pressure in the system.
  - h. Ensure the pressure gauge reads zero.
6. The equipment is now pre-heated and ready for use. If the equipment is not in continuous use, it may be necessary to repeat the warm-up procedure.



**Figure 181: HPU / 3-Position Remote Valve Circulation Diagram**

**CAUTION!**



While operating the 3-Position Remote Valve, always stop at the neutral position before shifting from the open to close position and vice versa.

**NOTE!**

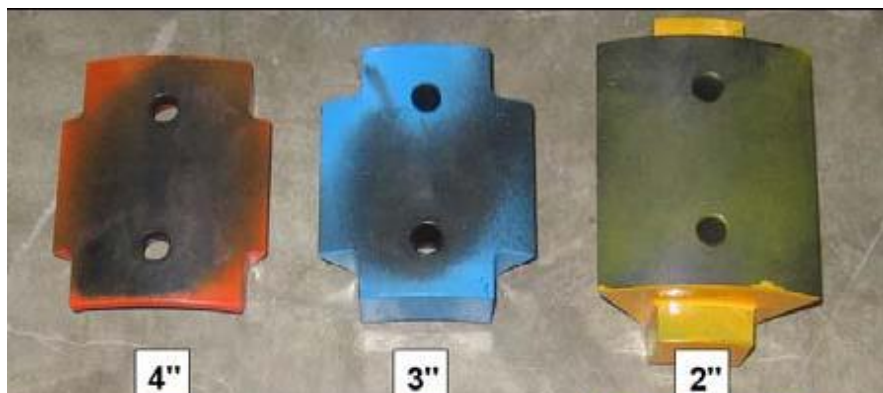


As the crimper will take the longest amount of time to pre-heat, it may be worthwhile to preheat the crimper before the mandrel insertion press. This can be done 15-30 minutes before you plan to crimp a fitting, such as during a safety toolbox meeting at the beginning of the day.

## 8.3 Accessories

### 8.3.1 Crimper Die Sets

For each size of fitting there are separate crimper die sets. Each crimper die set comes with 6 individual dies that fit into the crimper. Each die has two bolt holes beveled into the die. In order to easily distinguish the die sizes from one another, they are colored as shown in the following figures (2" – Yellow; 3" – Blue; 4" – Orange; 5" – Purple).



**Figure 182: 2"-4" Crimper Dies**



**Figure 183: 5" Crimper Die**

### 8.3.2 Crimper Die Fastening Bolts:

The following table lists the die bolt size for the respective crimper dies.

**Table 20: Crimper Die Fastening Bolt Sizes**

2" dies	3/8" UNC x 2" Long Socket Head Cap Screw
3" dies	3/8" UNC x 1 3/8" Long Socket Head Cap Screw
4" dies	3/8" UNC x 3/4" Long Socket Head Cap Screw
5" dies	3/8" UNC x 1 3/4" Long Socket Head Cap Screw

### 8.3.3 Reamer

The pipe reamer is either a drill attachment or a Cordless Die Grinder with Power Pipe Beveller. These are used to bevel the liner of the pipe end to accommodate the insertion of the fitting mandrel. Refer to **Section 9.1.7 - Reaming the Pipe**.

## 8.4 Contractor Provided Tools

### 8.4.1 Reciprocating Saw

An eight inch bi-metallic medium tooth blade should be used when cutting FP and FPHT to ensure the best results. Inspect the blade for damage, missing teeth or dullness and replace if necessary.

### 8.4.2 Chop Saw

The chop saw is a 16" circular saw used with a diamond tooth cutting blade to cut FlexCord pipe, found in **Section 9.1.4.1**. Refer to Flexpipe document # 14-4115 "Safety Inspection Checklist for Gasoline Powered Cut Saw" before use.

### 8.4.3 Maintenance

Contact Flexpipe before performing any maintenance or repairs to equipment. Flexpipe requires the use of the Hydraulic Pump Unit manufacturer-supplied manual for unit maintenance schedule and procedures. The manual is located inside the large pelican case included with the crimp kit.

## 9. Joining Pipes and Fittings

### 9.1 Preparing Pipes and Fittings

#### 9.1.1 Fitting Placement

It is required to have a minimum of 1 m (3 ft.) of straight pipe adjacent to all fittings. This requirement does not apply to end fittings that are within a Flexpipe riser chute.

## 9.1.2 Cleaning

Wipe all dirt, rocks, and debris from the Flexpipe Spoolable Products, and Flexpipe fittings using water or windshield washer fluid. Ensure that you have a dry, clean area or surface for the pipe and fitting while performing the entire crimping procedure.

### NOTE!



The plywood lid from the crimp kit makes a good surface for working on and will help ensure that the Flexpipe Spoolable Products and Flexpipe fitting do not require re-cleaning.

## 9.1.3 Inspecting the Fitting

### CAUTION!



Only use fittings that are designated for the specific pressure class of pipe being installed. Extended Length (EL) fittings are required for all FP HT and FC products.

### NOTE!



When inspecting couplings, make sure to check both sides of the coupling before installation.

1. Ensure that the fitting matches the size and grade of the pipe (i.e.: FP150, FP301, FP601, FC901, FP301HT and FP601HT). This can be verified with the sticker on the sleeve of the fitting or by comparing to the dimensions listed in **Section 4.3.1**.
2. Inspect all the O-rings on the mandrel to ensure they are free from debris, cuts, and damage. There are two (2) O-rings on each mandrel. Pipe-to-pipe coupling fittings have two mandrels and four (4) O-rings. If an O-ring is damaged, remove it from the mandrel and install a new O-ring, provided in the envelope inside the corresponding die kit within the crimp kit.



**Figure 184: Mandrel O-Rings Location**

3. Inspect the sleeves of the fitting to ensure they are centered on the mandrel. If the sleeve is not centered on the mandrel, the fitting must be marked and returned to Flexpipe.



Correct positioning of sleeve on mandrel



Incorrect positioning of sleeve on mandrel

**Figure 185: Checking Mandrel Sleeve Position**

4. Inspect the coating to ensure there are no flakes, nicks, or chips on the inside or nose of the mandrel. Scratches or flaking of the coating on surfaces other than the internal surface of the mandrel or nose does not compromise the intended corrosion resistance of the fitting.



**Figure 186: Defect-Free Internal Mandrel Surface**

5. Confirm each flange or weldneck has a vent hole as shown in the following two figures. Each coupling should have two vent holes, one on each sleeve.
6. Note down the fitting serial number, pipe serial number, and location.





**Figure 187: Verifying the Vent Hole**



**Figure 188: Close-Up of Typical Fitting Vent Hole**

## 9.1.4 Cutting Pipe

### 9.1.4.1 Equipment for Cutting Pipe

**Use a reciprocating saw or a hand saw to cut FP or FP HT.**





Cutting through the steel reinforcement layer of FC takes more effort than cutting through FP. Flexpipe recommends the use of a portable chop saw with a 16-inch diamond tooth blade to cut through the FC product. An angle grinder with a diamond blade can also be used to cut FC.

A reciprocating saw can cut FC but it is not the desired cutting method and requires significant time and effort. Several fine-tooth reciprocating saw blades should be on hand when performing cuts using this method as each cut may require a new blade.



**Figure 189: Chop Saw**

## 9.1.4.2 Procedure for Cutting Pipe

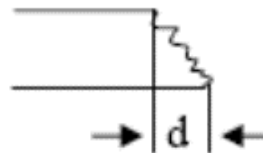
<p><b>WARNING!</b></p> 	<p>Hazards of cutting FC include binding and kickbacks. Be aware of the spinning blade and where it may travel while cutting to avoid contact causing personal injury. Consider the effects of a potential blade rupture and associated flying debris. Ensure that appropriate care is taken when handling the saw, that the operator has been trained in the use of the equipment, and that appropriate PPE is being worn.</p>
<p><b>WARNING!</b></p> 	<p><b>Sparking Hazard:</b> All workers should keep in mind that while cutting through FC, the metal cords will create sparks which could ignite flammable air-gas mixture or flammable liquids such as gasoline or diesel. Ensure that care is taken when dealing with flammable or explosive environments and that personnel have been trained appropriately.</p>
<p><b>CAUTION!</b></p> 	<p>Ensure that proper PPE for cutting through metal is worn while cutting FC. The appropriate PPE will be outlined in the equipment manufacturers manual.</p>
<p><b>CAUTION!</b></p> 	<p>If the pipe end is not properly capped or pipe reinforcements are exposed, check the reinforcements for wetness and cut the pipe back as needed following the guidelines of <b>Section 5</b>.</p>

To cut the pipe:

1. Ensure all PPE is properly worn.
2. Inspect the cutting equipment, manufacturers operation manual. For additional information, reference the safety inspection checklist (see appendix).
3. Secure the pipe. The pipe may move when you start to cut. It can be secured by having a second person hold the pipe in place. Ensure the surface to be cut is clean and dry.
4. Cut the pipe using a steady and firm motion of the cutting equipment.
5. The cut surface should be smooth and square. If the cut is not smooth or the distance "d" of is greater than 12mm (½ in), re-cut the pipe end.



**Figure 190: Square & Smooth Cut**



**Figure 191: Jagged or Uneven Cut**

6. The cut surface should then be wiped so that no cuttings are left on the surface.
7. Inspect the cut for the following:
  - a. Inconsistent wall thickness of pipe liner.
  - b. Significantly thin areas of the outer jacket.
  - c. Any defects in the pipe liner, reinforcements or cover.

Call Flexpipe if any pipe defects are noted.



**Figure 192: Acceptable Cut**

8. After the FC has been cut, use an appropriate tool to scrape away any slag from inside of the pipe that has built up from cutting. Failing to remove the slag could result in the mandrel O-rings being damaged during the insertion of the FC onto the fitting. Cut any cords that are protruding from the cut end such as those seen in **Figure 193**.



**Figure 193: Protruding Cords That Must Be Trimmed**

### 9.1.5 Checking for Wet Reinforcements

After the pipe is cut, the reinforcements at the pipe cut end shall be checked for wetness as explained in **Section 5**. Immediately after checking for wetness prior to fitting installation, it is recommended to write the moisture meter reading on the pipe using permanent marker 6" behind where the pipe clamp will be placed.



**Figure 194: Dry Wetness Measurement**



**Figure 195: Moist Wetness Measurement**

In order to reduce the possibility of having the pipe reinforcements get wet after being checked for wetness, immediately proceed with the fitting installation as described in the following sections.



## INSTALLATION IN THE RAIN

Fittings installation in the rain is generally not an issue. However, some prevailing environmental conditions such as excessive rain, high relative humidity, large temperature fluctuations, etc. may cause the cut surface of a perfectly dry pipe to provide a wet reading. In such environmental conditions:

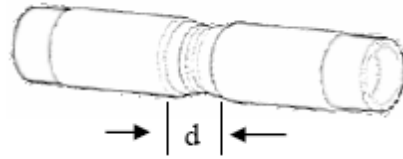
- Protect the pipe cut end from direct rain.
- Proceed with the installation of the crimp fitting immediately after the wetness check indicates dry pipe.

### 9.1.6 Cutting the Pipe to Length

Measure **d** on any Flexpipe fitting as shown in the next figures to determine any needed gaps prior to fitting installation. For couplings, **d** is the distance between each vent hole measured using the sides of the vent holes farther away from the middle of the coupling. For end fittings, **d** is the distance between the flange or weldneck fitting end face and the vent hole's farthest side.

## Coupling Fittings

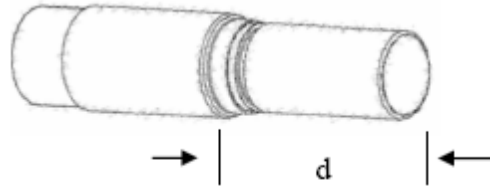
To install a coupling fitting, arrange the two pipe ends so that there is a space between the two ends as illustrated by distance **d** shown on the right.



**Figure 196: Measuring Gap on a Coupling Fitting**

## Weldneck Fittings

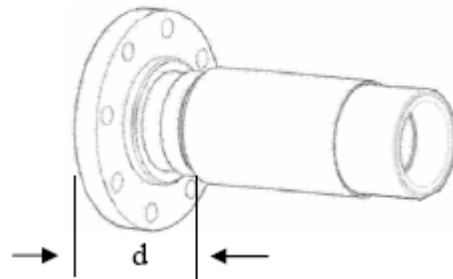
To install a weldneck fitting, arrange the pipe so that there is a distance **d** between the end of the Flexpipe Spoolable Products and the steel pipe.



**Figure 197: Measuring Gap on a Weldneck Fitting**

## Flanged End Fittings

To install a flanged end fitting, arrange the pipe so that there is a distance **d** between the end of the Flexpipe Spoolable Products and the face of the mating flange.



**Figure 198: Measuring Gap on an End Fitting**

### NOTE!



If the pipe end is oval, squeeze the end of the pipe back into round by positioning the pipe clamp over the oval end of the pipe. Align the clamp so that the center of each half contacts the short side of the oval, with the hinges and bolt aligned along the long sides of the oval.

The pipe may be pre-heated to reduce the stiffness. It is recommended that a portable heater be used to warm up the end of the pipe. Do not heat the pipe above a temperature that is comfortable to touch with a bare hand (maximum 60°C, 140°F). If the pipe is too hot to touch with a bare hand, allow it to cool prior to applying a pipe clamp or installing the fitting. A section of pipe approximately 1 m (3 ft.) long should be heated.

### 9.1.7 Reaming the Pipe

Once the pipe has been inspected, it must be reamed so that it can slide onto the mandrel without damaging the O-rings.

## 9.1.7.1 Using the Drill Attachment

The drill attachment can be used with any drill with a standard ½ inch chuck.

1. Insert the reamer into the chuck of the drill and lock in place.
2. Set the drill to rotate clockwise.
3. Secure the pipe by having someone hold the pipe in position
4. Engage the plastic only after the drill is rotating at full speed.
5. Ream the inside edge of the liner at the drill's full speed, removing about half of the thickness of the liner. Ensure the chamfered edge of the liner is smooth.
6. Wipe the end of the pipe clean so that no cuttings are on the surface or end of the pipe.



**Figure 199: Reaming Pipe**

## 9.1.7.2 Using a Cordless Power Pipe Beveller

A Bosch 18V Cordless Die Grinder with Reed's Cordless Power Pipe Beveller is also offered by Flexpipe for pipe end reaming. This tool uses a Reed RBIT1 15° router bit to safely and consistently bevel the internal liner, and it is required for 5" pipe reaming.

1. Review beveller manufacturer instructions before use, and verify all parts are accounted for and damage free.
2. Install the guide plate on the grinder, ensuring the router bit is set at correct depth of 5/8" (e.g. NO GAP between the bit and plate). Adjust the knob and tighten guide plate.
3. Insert the battery, checking that the bit is not in contact with anything. Point the tool away from the user and turn on the beveller to check that it is functioning properly.
4. Place the bit on the inside of the pipe end, making sure the guide is tight against the edge of the pipe.
5. Rotate the beveller in a clockwise direction, keeping the guide tight up against the pipe edge. More than one pass around the pipe liner may be required.
6. Turn off the tool, then inspect the pipe for a proper bevel. The bevel should look and feel smooth and even. Do not bevel more than half the liner thickness at the pipe end, otherwise the pipe end will need to be cut back and beveling repeated.
7. Wipe the end of the pipe clean so that no cuttings are on the surface or end of the pipe. Clean the pipe beveller off before returning it to the case.

## 9.1.7.3 Reamer Alternative

If there is no reamer available, an appropriate tool with a hard edge can be used to taper the inside edge of the liner.

1. Secure the pipe by having someone hold the pipe in position
2. Put a rag inside the pipe to catch the cuttings

3. Ream the inside edge of the liner using repetitive circular carving motions. Cut away approximately half of the thickness of the liner.
4. Make sure to smoothen the chamfered edge.
5. Wipe the end of pipe to remove cuttings from the surface or ends of the line.
6. Remove the rag from step 2.

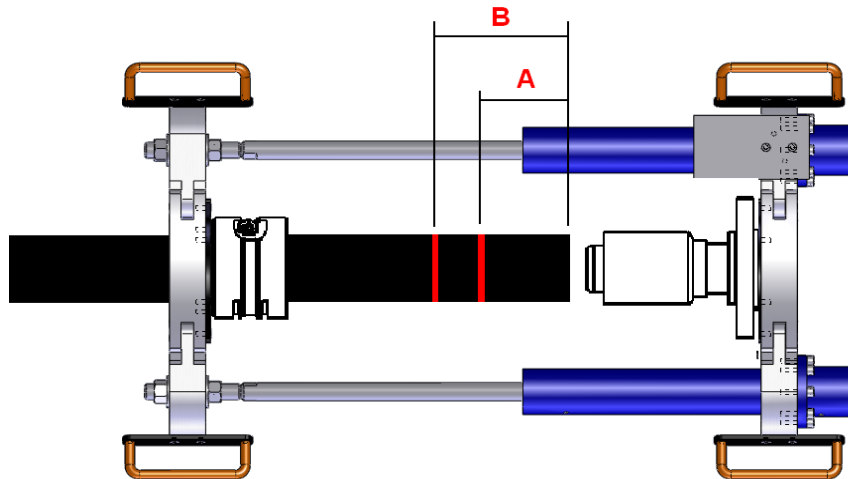
**CAUTION!**



Do not ream out more than half of the thickness of the internal liner. If too much material is reamed out of the liner, the damaged section of pipe will need to be cut back and discarded.

**9.1.8 Marking the Pipe End**

Trace the insertion mark **A** and the clamp mark **B** on the pipe end as per **Table 21** or **Table 22**. Insertion mark **A** indicates how far the pipe should be pushed into the fitting. Clamp mark **B** shows where to place the pipe clamp.



**Figure 200: Marking Distances**

**NOTE!**



If the cut is not square, measure and mark from the longest part of the pipe.

**Table 21: Marking Distances – Standard Fittings**

	Insertion Mark (A)		Clamp Mark (B)	
	inch	mm	inch	mm
2" (All fittings)	4 ¼	108	8 ¼	210
3" (All fittings)	6 7/8	175	10 7/8	276
4" (All fittings)	8 7/8	225	12 7/8	327

**Table 22: Marking Distances – EL Fittings**

	Insertion Mark (A)		Clamp Mark (B)	
	inch	mm	inch	mm
2" (All fittings)	7	178	11	279
3" (All fittings)	8 ¼	210	12 ¼	311
4" (All fittings)	10 ½	267	14 ½	368
5" (All fittings)	14 3/16	360	18 ⅛	460

### 9.1.9 Applying Protective Paste to Pipe End

Protective paste is used to protect the reinforcements at the cut end of the Flexpipe Spoolable Products from liquid water or contaminants. If the reinforcement layer of the Flexpipe Spoolable Product becomes wet, the integrity of that section of the pipe is compromised and needs to be cut out. Regular grease does not protect the pipe from wetness. Ensure that the correct temperature rated protective paste is used.

Liberally apply protective paste to the exposed reinforcements until no reinforcement fibers or cords are visible.



#### **COLD WEATHER INSTALLATION** - for temperatures below 0°C (32°F)

Keep protective paste warm. Freezing will not damage the paste but it must be warm in order to apply to the Flexpipe Spoolable Products.

### 9.1.10 Lubricating the Fitting

Apply a liberal amount of clean grease to the nose and outside surface of the fitting mandrel until just past the O-rings. Greasing the mandrel and reaming of the pipe end will help the Flexpipe Spoolable Product easily insert over the mandrel without damage to the O-rings. Ensure that O-rings are completely covered with grease. Keep grease clean of dirt and debris through the whole fitting installation. Do not use protective paste for lubrication.





**Figure 201: Properly Applied Grease to Mandrel and O-Rings**

## 9.2 Inserting the Pipe into the Fitting

### CAUTION!



The Mandrel Insertion Press that is used to push the Flexpipe Spoolable Product onto the fitting operates at up to 20,700 kPa (3,000 psi) and can push the pipe too far into the fitting if the directions are not followed. If this happens the vent hole will be blocked and the pipe will bulge outward between the pipe clamp and fitting sleeve. This will damage both that section of pipe and the fitting requiring them to be cut out and replaced.

### 9.2.1 Pipe Clamps

The Mandrel Insertion Press inserts the fitting into the Flexpipe Spoolable Product by pushing against the pipe clamp.

The 2"-4" pipe clamps may be provided either as one-piece clamps such as those seen in **Figure 202** or as a two-piece clamp with interchangeable inserts such as that seen in **Figure 203**.

For 5" pipe installation, either the 5" external pipe clamps (shown in **Figure 204 & Figure 205**) or the insertion press 5" integrated pipe clamp (shown in **Figure 206**) may be used.



**Figure 202: 2"-4" One-Piece Pipe Clamps**



**Figure 203: 2"-4" Two-Piece Pipe Clamp with Inserts**



**Figure 204: 5" External Pipe Clamp**



**Figure 205: 5" Two-Piece Pipe Clamp**



**Figure 206: 5" Integrated Pipe Clamp**

**Table 23: Clamps Color Coding**

<b>2"</b>	<b>3"</b>	<b>4"</b>	<b>5"</b>
Yellow	Blue	Orange	Purple/Maroon

## 9.2.2 Insertion Preparation

1. Check the fitting sleeve and mandrel for dirt and debris. Ensure the mandrel is centered and the vent hole is clear.
2. Check for sufficient bevel on the interior liner at the pipe end.
3. Check the length of the pipe to be inserted into the fitting. Refer to **Section 9.1.8**.
4. Apply Protective Paste to the exposed fibers or cords.
5. Use the appropriate adapter for the type of fitting that will be used.
  - a. For 5" fittings, each fitting uses the same adapter shown in **Figure 210**.
  - b. For a 2"-4" Coupling or Weldneck Fitting, install the 2"-4" Fitting Adapter Clamp onto the fitting (illustrated in **Figure 207**). Select the Adapter Clamp suited for the fitting size. Ensure that the Adapter Clamp is sitting in the slot on the fitting and the pin on the Adapter Clamp is fully inserted. This can only happen if the Adapter Clamp is properly positioned and properly closed.
  - c. For a 2"-4" Flange End Fitting, place the End Adapter (illustrated in **Figure 208**) in the press gate of the Mandrel Insertion Press. Place the End Adapter and fitting into press gate **B1** from **Figure 175** to avoid potential interference with the hydraulic cylinders.



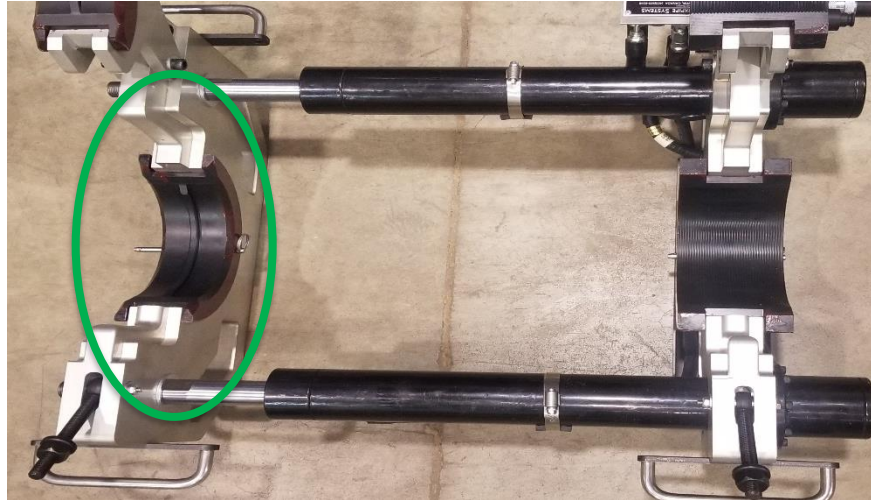
**Figure 207: Coupling Fitting and Adaptor Clamp**



**Figure 208: Flanged Fitting Adaptor**



**Figure 209: 2" and 3" Pipe Centering Tool**



**Figure 210: 5" Fitting Adaptor Clamp**

6. If working with 2" or 3" pipes, place the pipe centering tool (**Figure 209**) into the press. 4" pipes do not require a centering tool.
7. Fully extend the cylinders of the Mandrel Insertion Press. 2" pipe may not require full extension of cylinders.
8. Position the fitting and pipe in the press. Ensure that the fitting is centered and aligned with the pipe.
9. Close both press gates (**B1** & **B2**) of the Mandrel Insertion Press and pin them into position.

**NOTE!**



Ensure the remote valve is turned to the neutral position as soon as the press is fully opened or fully closed. Do not continue to apply pressure when the hydraulic cylinders are completely extended or contracted.

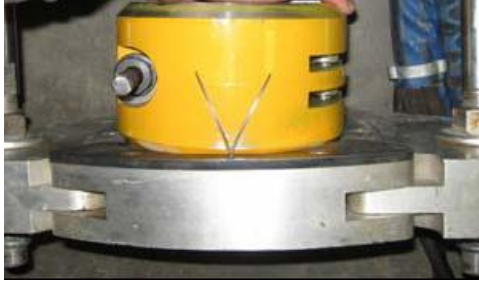
**NOTE!**



Orienting the vent hole in the vertical up/top position of the fitting allows verification that the vent hole isn't blocked, and ease of access during application of the protective wrapping. Vent hole orientation is not critical to operation of the pipeline.

### 9.2.3 Clamp Installation

1. Select the pipe clamp that matches the product size and series you are using.
2. Open the pipe clamp.
3. Orient the pipe clamp so that the one-way teeth grip the pipe for inserting the Flexpipe Spoolable Product into the fitting by ensuring that the point on the 'V' marking on the pipe clamp contacts the gate on the mandrel insertion press as per **Figure 211**.

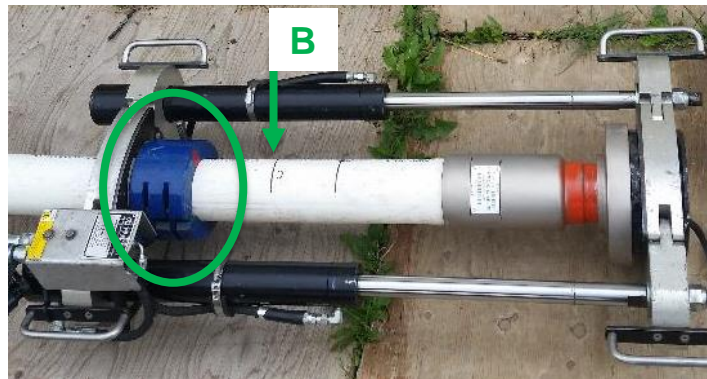


**Figure 211: Lining Up the 'V'**



**Figure 212: One-Way Teeth on the Pipe Clamp**

4. Set the pipe clamp so you can see mark **B** show in the figure below and as discussed in **Section 9.1.8**. This will allow you to see if the clamp has slipped during insertion. 5" pipe will require a two-stage insertion. Set the clamp 10" back for the initial press, follow steps for pipe insertion, then repeat with the clamp set at mark **B**.
5. If inserting a curved piece of pipe into a fitting, it is important to make sure the end of the pipe is centered and lined up straight onto the leading edge of the fitting mandrel prior to pipe insertion. If this is the case, initially set the pipe clamp back approximately 6" from the end of the pipe (shown in **Figure 214**), and proceed with the following steps to insert the pipe 2" into the mandrel, then repeat the steps in **Sections 9.2.3 & 9.2.4** to insert the pipe with the clamp set back at mark **B**.



**Figure 213: Pipe Clamp Set Past Mark B**



**Figure 214: Pipe Clamp Set Closer for Curved Pipe Insertion**



**Figure 215: 5" Integrated Pipe Clamp Set for Insertion**

6. If the clamp slips past mark **B** or closer than 4" to the fitting sleeve, the clamp must be repositioned.
7. Use the 7/8" or 1 1/16" deep socket (depending on the type of clamp) to tighten the pipe clamp until snug. Over-tightening the clamp may damage the pipe. If the pipe slips through the pipe clamp, an emery cloth can be used underneath the pipe clamp to grip the Flexpipe Spoolable Product. Optionally a torque wrench may be used to ensure proper clamp tightness. Refer to Table 24 below for recommended torque and clamp gap values, which are based on the pipe being clean, round, and dry, and an ambient temperature ranging from -25°C (-13°F) to 45°C (113°F). If a clamp continues to slip after reaching the maximum torque allowed, try another pipe clamp that is clean and in good condition.

**Table 24: Recommended Torque Values and Clamp Gap Dimensions**

Flexpipe NPS	Maximum Torque		Minimum Clamp Gap	
	kg-m	ft-lb	mm	inch
2"	2.1	15	4.8	3/16"
3"	2.8	20	12.7	1/2"
4"	3.5	25	12.7	1/2"

**CAUTION!**



Ensure that the correct pipe clamp is used for the appropriate pipe size and series. Using the wrong clamp on the pipe could damage the Flexpipe Spoolable Product and require replacement. Every 2"-4" crimp kit has all 8 sizes of pipe clamps included. The large diameter crimp kit includes all 5" pipe clamps.

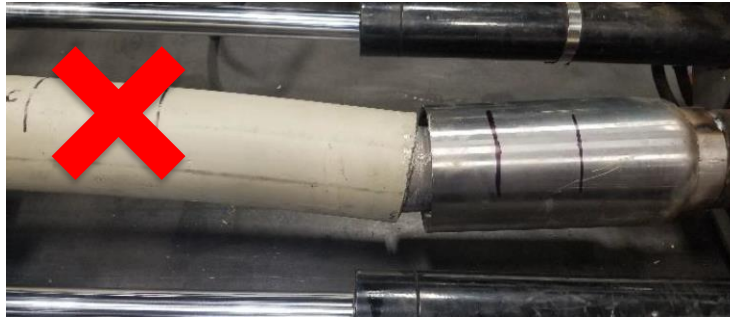
### 9.2.4 Inserting Pipe

If inserting a curved piece of pipe, several shorter insertions may be needed to ensure the pipe enters the fitting sleeve straight. An example of misaligned pipe that will need to be adjusted and may need several shorter insertions is seen in **Figure 216** below.

5" pipe requires two stages of pipe insertion, first pressing in 10" of pipe, then moving the clamp back and repeating the insertion process to get to the required insertion depth.

**Ensure that the pipe clamp never gets closer than 4” to the fitting sleeve end during the insertion process.**

1. Align the pipe with the fitting to ensure a straight insertion.



**Figure 216: Misaligned Pipe**

2. Engage Selector Valve on the HPU.
3. Turn the 3-Position Remote Valve to the ‘close’ position to close the press and begin inserting the pipe.
4. Ensure the pipe clamp does not slide past the clamp mark **B**.
5. Continue closing the Mandrel Insertion Press until the end of the crimp sleeve lines up with the insertion mark. The insertion mark should still be visible after the pipe has been inserted on to the fitting.
6. Set the 3-Position Remote Valve to neutral.

**CAUTION!**



After the pipe is inserted into the fitting using the Mandrel Insertion Press, the one-way teeth on the mandrel will not allow the pipe to be pulled out, the fitting cannot be reused and the pipe will be damaged if it is attempted to pull it out of the fitting.



**COLD WEATHER INSTALLATION** - for temperatures below 0°C (32°F)

Flexpipe Spoolable Products fittings at temperatures down to -25°C (-13°F) may be installed as is. White pipe does not heat up quickly with the sun which can lead to a harder, frostier jacket which may make it easier for the pipe clamp to slip during the fitting insertion step. Heating up the clamp and fitting area to hand warm can assist in keeping the pipe clamp in place during fitting insertion.

For fittings at temperatures lower than -25°C (-13°F), the fitting and pipe ends will need to be pre-heated prior to installation.

It is recommended that a portable heater be used to warm up the end of the pipe and the fitting to a temperature above -25°C (-13°F). Do not heat the pipe above a temperature that is comfortable to touch with a bare hand (do not exceed 60°C, 140°F). If the pipe is too hot to touch with a bare hand, allow it to cool down prior to installation of the fitting. A section of pipe approximately 1 m (3 ft) long should be heated. This pre-heating will ensure that the fitting properly seats to the pipe during installation.

## 9.2.5 Press Shut Down

When you finish with the Press you need to do the following before connecting to the Crimper:

1. To open the Press, switch the 3 Position Remote Valve to Open.
2. Open the gates on the Press.
3. Remove the pipe, pipe clamp and fitting.
4. Close the gates on the Press.
5. To close the Press, switch the 3-position remote valve to Close.
6. Switch the 3-Position Remote Valve to Neutral
7. Switch the Selector Valve on the HPU to Neutral
8. Turn the Pump off
9. Close the Fuel valve
10. Cycle the 3-Position Remote Valve between the Open and Close positions a few times to relieve the residual pressure in the hoses.
11. Disconnect hoses
12. Clean excess hydraulic fluid and any dirt/debris from the quick connect fittings and put rubber quick connector caps on.

## 9.3 Crimping Fittings

### 9.3.1 Installing Crimping Dies

To install dies on the crimper:

1. Open the crimper by sliding the top half (A) as denoted in **Section 8.2.3**.
2. Select the appropriate die sets by verifying that the color on the crimper dies correspond to the product size as shown in the below **Table 25**.

**Table 25: Crimper Dies Sizing**

Flexpipe NPS	Color on Dies	Die Bolt Length
2"	Yellow	2"
3"	Blue	1 1/4"
4"	Orange	3/4"
5"	Purple	1 3/4"

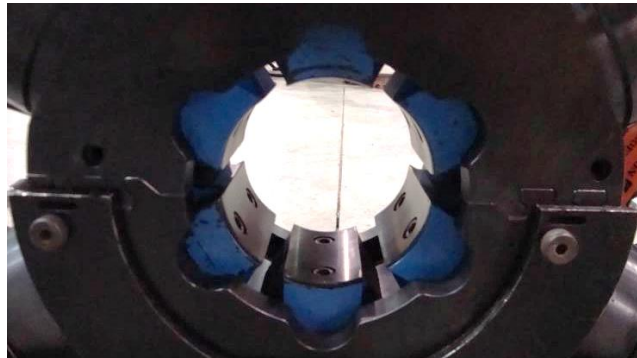
#### NOTE!



The heaviest and thickest dies are used for the smallest pipe size.

3. Make sure the dies are clean and free of defects. A wire brush can be used to clean them.
4. Select the length of bolts that correspond to the dies used from the corresponding die case.
5. Bolt all six (6) dies into place using a 5/16" Allen wrench. Make sure the bolts are firmly tightened and the faces of the bolts are recessed so that they do not extend past the surface of the dies.





**Figure 217: Dies (Blue) for 3” Fitting in Crimper**

### 9.3.2 Crimper Hose Setup

**Figure 219** displays the proper hose setup for the crimper. Only one hose from the 3-Position Remote Valve should be connected to the crimper: the supply line. This hose connects to the tee fitting, which directs the pressure into both halves of the crimper. The other hose from the 3-Position Remote Valve doesn’t attach to the crimper and should be capped.

**NOTE!**



See **Section 8.2.4 Crimp Kit Cold Weather Warm-up Procedure** if the outdoor temperature is below 0°C (32°F).

Ensure that the male end of the quick connector is properly seated into the female end and locked – refer to **Section 8.2** for quick connector connection procedure.



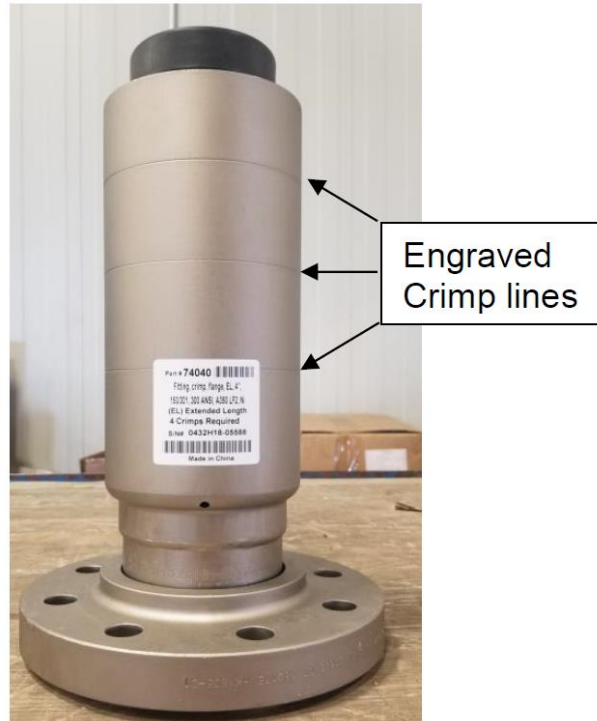
**Figure 218: Tee Fitting Crimper Connection**



**Figure 219: Crimper Connected to 3-Position Remote Valve**

### 9.3.3 Marking the Fitting

Based on the fitting size and grade, verify and mark the applicable crimp locations on the fittings as shown below. All distances are from the sleeve end on the pipe side. New EL fittings are supplied with engraved crimp lines around the circumference of the fitting sleeve. If necessary, to better see these crimp lines during crimping, the lines can be traced with a marker pen. Note that the flare on the sleeve end of 5" fittings after crimping may be smaller than other sizes of fittings.



**Figure 220: Fitting with Engraved Crimp Lines**

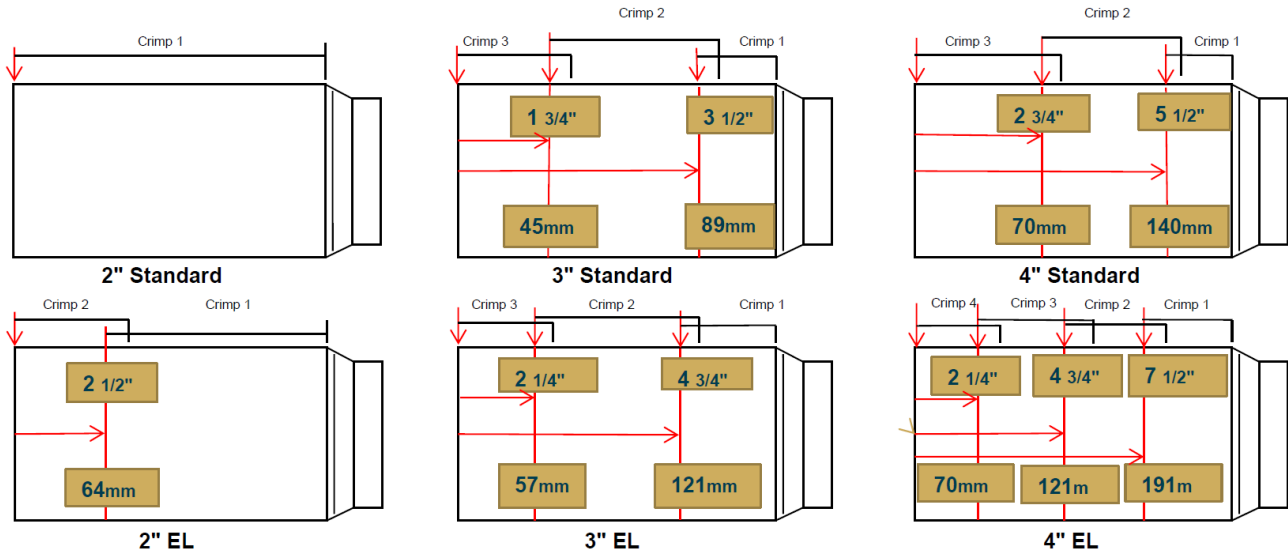
When installing a coupling fitting, mark or verify the crimp locations on both sleeves of the coupling.

**Table 26: Crimp Location Dimensions - Standard Fittings**

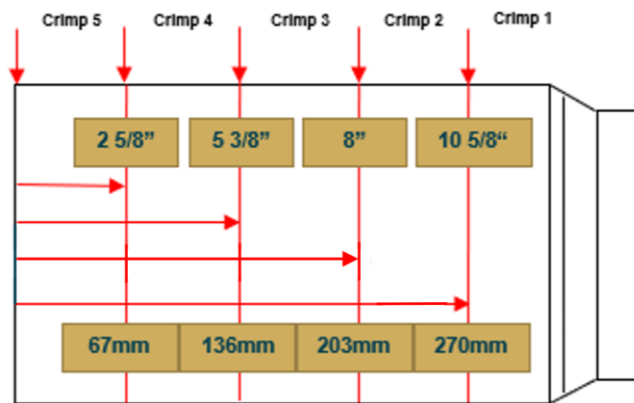
Flexpipe Fitting NPS	1 <sup>st</sup> Crimp		2 <sup>nd</sup> Crimp		3 <sup>rd</sup> Crimp	
	mm	inch	mm	inch	mm	inch
2" (1 Crimp)	End of sleeve		-		-	
3" (3 Crimps)	89	3 ½	45	1 ¾	End of sleeve	
4" (3 Crimps)	140	5 ½	70	2 ¾	End of sleeve	

**Table 27: Crimp Location Dimensions - EL Fittings**

Flexpipe Fitting NPS	1 <sup>st</sup> Crimp		2 <sup>nd</sup> Crimp		3 <sup>rd</sup> Crimp		4 <sup>th</sup> Crimp		5 <sup>th</sup> Crimp	
	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
2" EL (2 Crimps)	64	2 ½	End of sleeve		-		-		-	
3" EL (3 Crimps)	121	4 ¾	57	2 ¼	End of sleeve		-		-	
4" EL (4 Crimps)	191	7 ½	121	4 ¾	57	2 ¼	End of sleeve		-	
5" EL (5 Crimps)	270	10 ⅝	203	8	136	5 ⅜	67	2 ⅝	End of sleeve	



**Figure 221: 2"-4" Fitting Crimp Locations**



**Figure 222: 5" Fitting Crimp Locations**

### 9.3.4 Operating the Crimper

**CAUTION!**

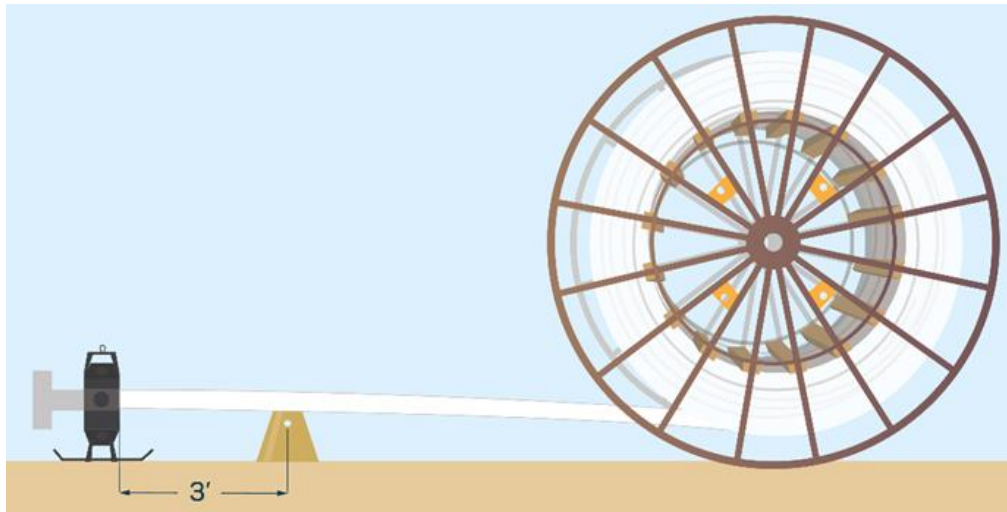
Ensure that the appropriate pressure relief valve setting on the hydraulic pump is used for the product line:

FP150/FP301: 8500 psi (58,600 KPa)

FP300/FP601/all EL fittings: 9000 psi (62,000 KPa)

Applying too much pressure could break the reinforcement layer and create a fitting failure.

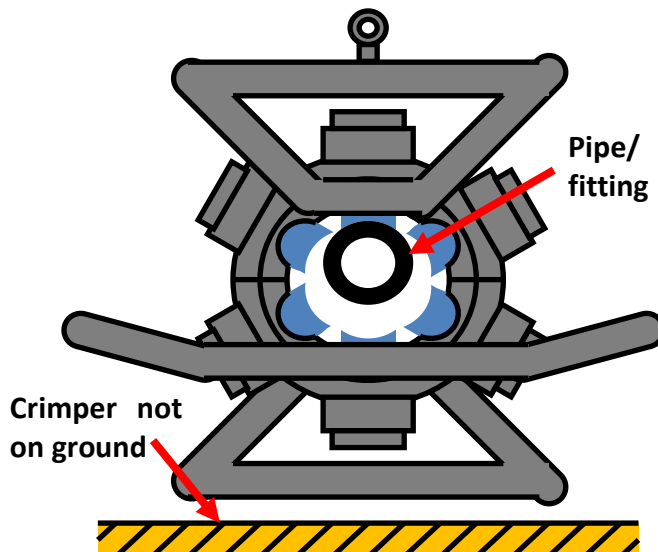
The pipe should be supported when installing end fittings or pull tools particularly when the connection is close to the reel. Support should be ~3' from the crimper. After installation, always support and lift the fitting to avoid kinking the pipe.



**Figure 223: Fitting Installation Pipe Support**

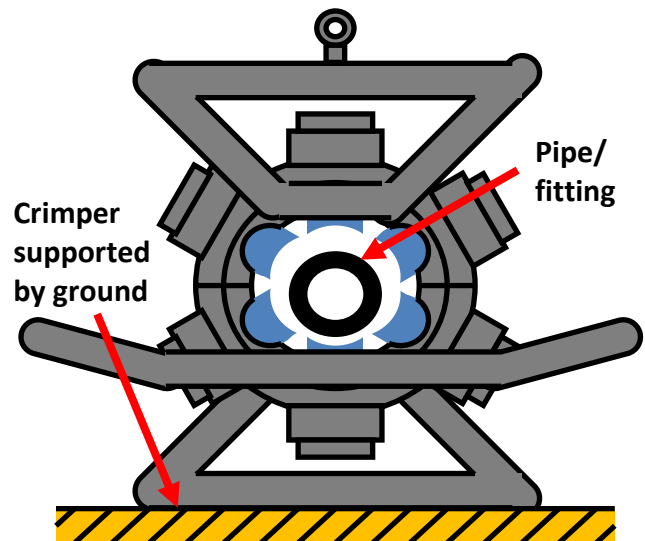
1. Cycle the crimper to ensure the crimper is functioning properly. If any dies fail to fully extend or if any leaks are found, contact Flexpipe.
2. Extend the crimper dies fully and verify that the pressure gauge on the hydraulic pump is reaching the required pressure. If it does not, contact Flexpipe.
3. Place the bottom half of the crimper under the pipe.
4. Slide the upper half of the crimper onto the bottom half and pin the two halves together. Ensure the crimper weight is supported by the ground or equipment such as a track hoe, and that the crimper is not resting its weight on the pipe and fitting.

**Improperly positioned crimper**



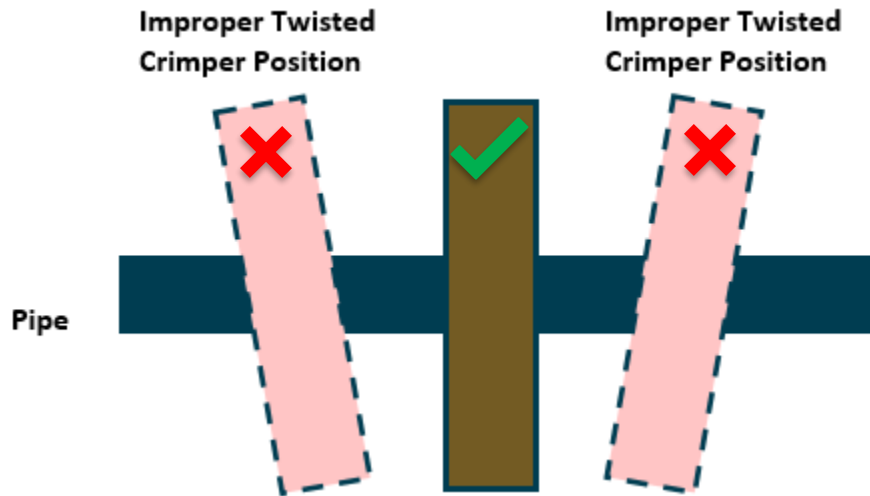
**Figure 224: Crimper Weight on Pipe/Fitting**

**Properly positioned crimper**



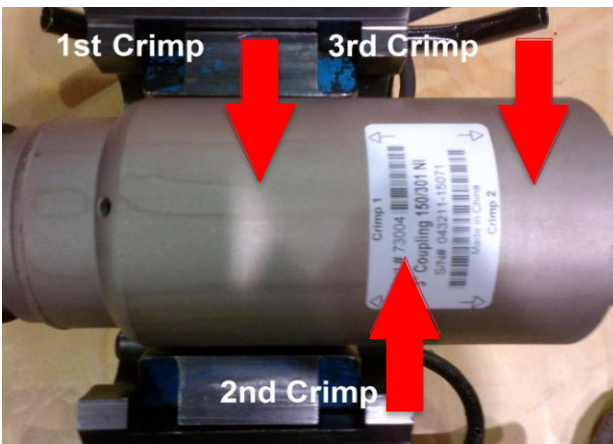
**Figure 225: Pipe/Fitting Resting in Crimper**

- Align the fitting so that it is concentric with the crimper. The fitting should be centered, parallel to the die faces, and perpendicular with the crimper. This is illustrated in **Figure 226** below.



**Figure 226: Proper and Improper Crimper Setup**

- Slide the crimper up onto the fitting to align the edge of the dies with the 1<sup>st</sup> crimp mark so that the crimp dies sit between the 1<sup>st</sup> crimp mark and the vent hole as shown below.



**Figure 227: 3" & 4" Standard Fitting Crimp Profile**



**Figure 228: Crimper Dies Aligned with Engraved Crimp Lines**

- To pressurize the crimper, turn the Selector Valve on the Hydraulic Pump Unit to Advance and then turn the 3-Position Remote Valve into the Close position. Once the unit has reached the required crimping pressure, hold the pressure for a minimum of 20 seconds.

**NOTE!**



It can take up to one minute before the hydraulic pump reaches the required pressure.

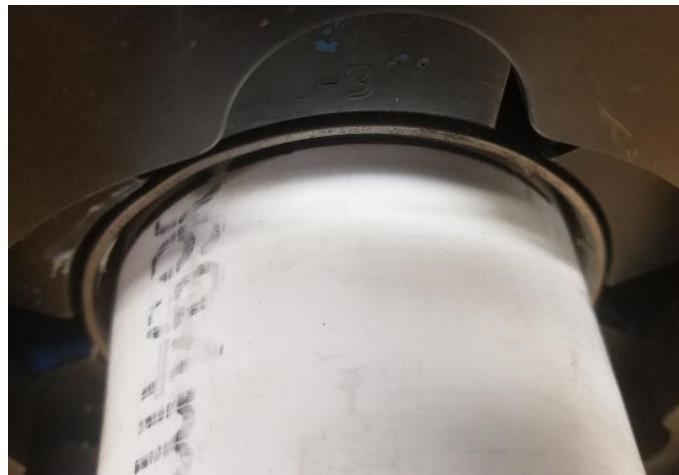
8. Set the 3-Position Remote Valve to the Neutral position.
9. Set the selector valve on the hydraulic pump to Neutral.
10. To release the pressure, turn the 3-Position Remote Valve into the Open position. Ensure that the dies are fully retracted before trying to move the crimper.

**NOTE!**



To retract the dies on the crimper, the selector valve on the hydraulic pump must be placed in Neutral and the 3-Position Remote Valve must be set to the Open position. This will allow the Hydraulic Fluid to drain from the crimper as the springs retract the crimper dies.

11. If additional crimps are needed, slide the crimper to align the crimper dies with the next crimp mark location and perform the crimp. Repeat until the required crimps as per **Section 9.3.3** have been completed.



**Figure 229: Dies Aligned to Sleeve Edge on Final Crimp**

**CAUTION!**



It is essential for the crimp fitting to have a curved flare at the end of the fitting sleeve. The crimp dies have a built in round edge to generate a flare at the end of the crimp. Prior to performing the final crimp, ensure the crimper dies side surface is aligned with the sleeve edge, so that a flare can be achieved. Do not allow the crimp dies to overhang beyond the sleeve end.

12. If crimping a coupling fitting, repeat steps 5 through 10 for the second sleeve of the coupling.
13. Turn the hydraulic pump unit off. Turn selector valve on the pump from the Advance to Neutral position, then cycle the 3-Position Remote Valve through the Open-Neutral-Close positions several times to relieve the pressure in the system.

14. Ensure the dies are fully retracted.
15. Disconnect the crimper from the hydraulic pump and move it away.
16. The fitting is now connected to the Flexpipe Spoolable Product and ready for evaluation and protective wrapping.
17. Flexpipe recommends the installation contractor to write (using permanent marker) the contractor company name and Flexpipe Training Number or name on the pipe next to the wetness reading.

## 9.4 Evaluating the Crimp

Visually inspect the fitting to ensure the crimps are uniform with each other, and that there are no unacceptable deformities on the crimped sleeve. If fitting deformities such as those shown in this section are found, the fitting must be replaced.

The crimps in **Figure 230** and **Figure 231** are acceptable quality crimps. Some unevenness of the sleeve is allowed.



**Figure 230: Proper Crimp**



**Figure 231: Acceptable Deformations**

### 9.4.1 Signs of Improperly Inserted Pipe

If a crimp section (die imprint on the sleeve) appears to be recessed too far inwards in relation to the other crimps, use a straight edge to inspect by laying it axially over the crimp sleeve as shown below. If the gap beneath the straight edge is large enough to allow a 0.050" feeler gauge (or a wire or a hex key) to pass through, the fitting must be replaced.

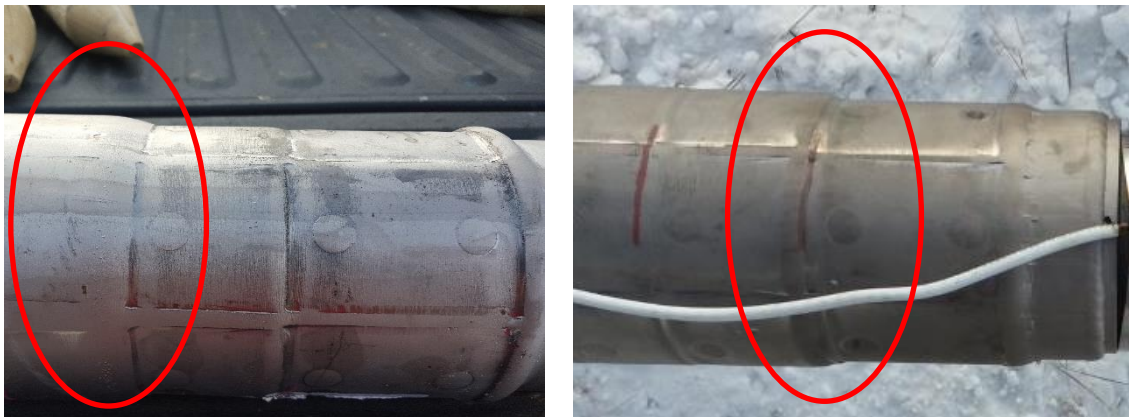


In the figure below, the bad crimp on the left should be evaluated with a straight edge. The crimp on the right appears to be good. The left impression is caused by pipe gouged during the insertion process.



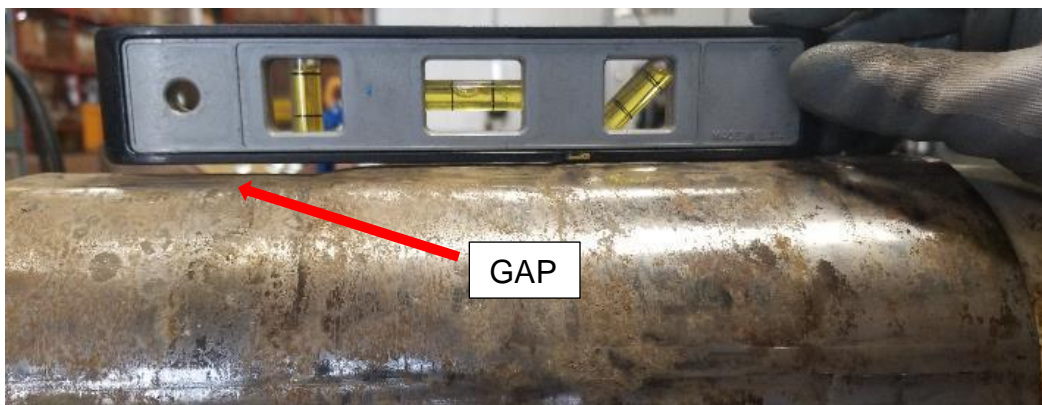
**Figure 232: Recessed Crimp Due to Liner Gouge**

Signs of pipe not pressed in fully or of liner pushback include significant size differences between crimping impressions, as shown in **Figure 233**.



**Figure 233: Recessed Crimp Due to Partial Pipe Insertion**

Use a straight edge to evaluate the crimp gap under the straight edge. The gap can be checked by passing through a 0.050" feeler gauge (or a wire or a hex key).



**Figure 234: Visible Crimp Gap**



**Figure 235: Crimp Gap Checked with Hex Key**

### 9.4.2 Misaligned Crimps

If the crimper and dies are not aligned with the fitting as per **Section 9.3**, the crimp impressions will be misaligned and can affect the quality of the O-ring seal. An example showing a difference in crimp angles is seen below.



**Figure 236: Misaligned 3<sup>rd</sup> and 4<sup>th</sup> Crimps**

The pipe liner example below illustrates a proper O-ring seal as well as an improper O-ring seal resulting from misaligned crimps, as seen after cutting apart test fittings.



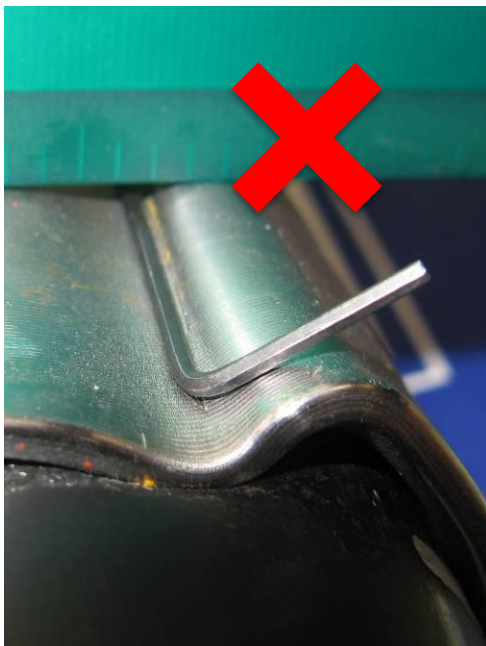
**Figure 237: Good O-ring Seal**



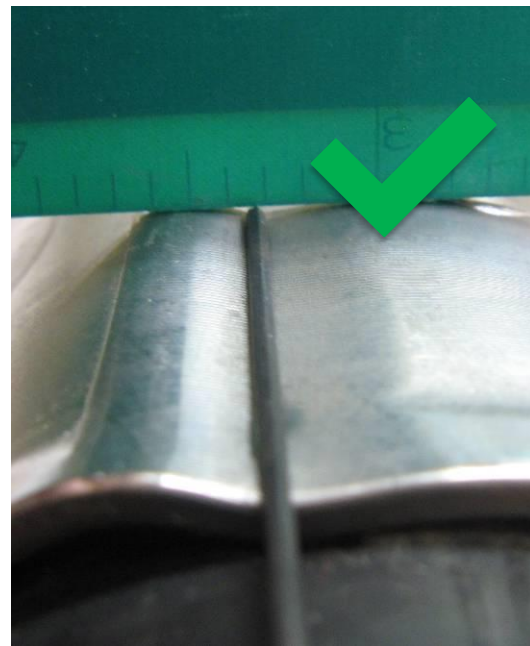
**Figure 238: Poor O-ring Seal**

### 9.4.3 Uneven Die Crimping

Some deformity and unevenness in the sleeve is permissible as long as the indentation does not create a point load on the pipe. This can be checked with a 0.050" feeler gauge (or a wire or a hex key) as shown below.



**Figure 239: Wire Passes, Unacceptable Crimp**

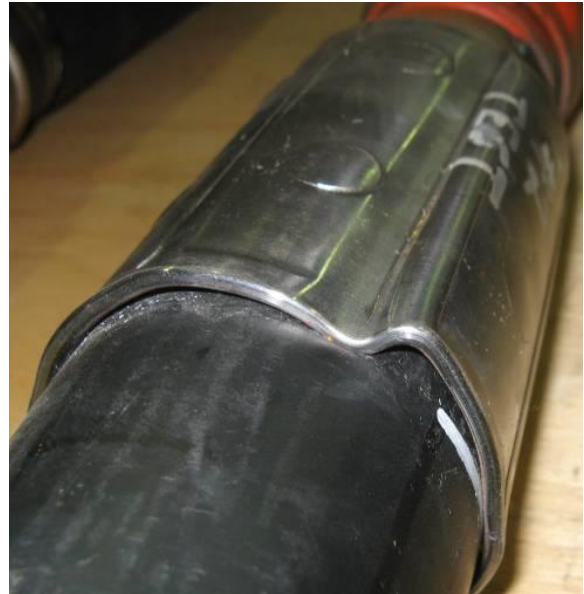


**Figure 240: Wire Cannot Pass, Acceptable Deformation**

The following figures show unacceptable crimps and obvious point loading on the pipe. This is often due to either the crimper weight resting on the fitting during crimping or stuck crimper dies. Such fittings must be cut out. The lack of flaring shown is due to incorrect location of the crimper dies and is unacceptable. More details on inspecting the sleeve end flare can be found in **Section 9.4.5**.



**Figure 241: Point Loading on Pipe and No End Flare**



**Figure 242: Severe Deformity and Pipe Point Loading**

#### 9.4.4 Die Bolt Marks

The proper die bolt size must be used with the corresponding die, and all six die bolts must be firmly tightened so that the bolts don't extend past the surface of the dies. The figure at the beginning of **Section 9.4** showing good crimps has proper die bolt impressions, while the impressions in **Figure 243** below are not acceptable due to the protruding die bolts.



**Figure 243: Improper Die Bolt Impressions**

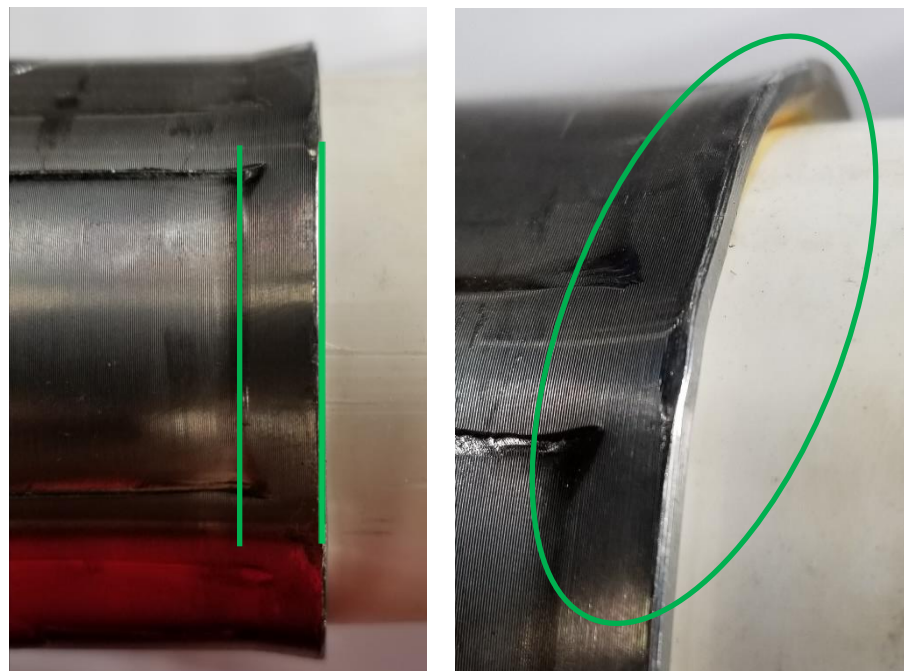
### 9.4.5 Final Crimp and Sleeve Flare

For the final crimp of the fitting, the die must be properly located during crimping to ensure a flare on the sleeve end. A lack of flare is due to incorrect die placement and creates an impingement on the pipe at the sleeve end. If there is no evidence of a flare, as seen in the figure below, the fitting must be cut out.

The flare should start to curl a minimum of 1/8" from the sleeve edge. If the flare starts to curl up more than 1/2" from the sleeve edge, then the final crimp of the fitting was too far back from the sleeve end and the final crimp must be re-crimped so that the flare is within the acceptable size, or replaced. A flare too far back from the sleeve end can lead to an improper O-ring seal.



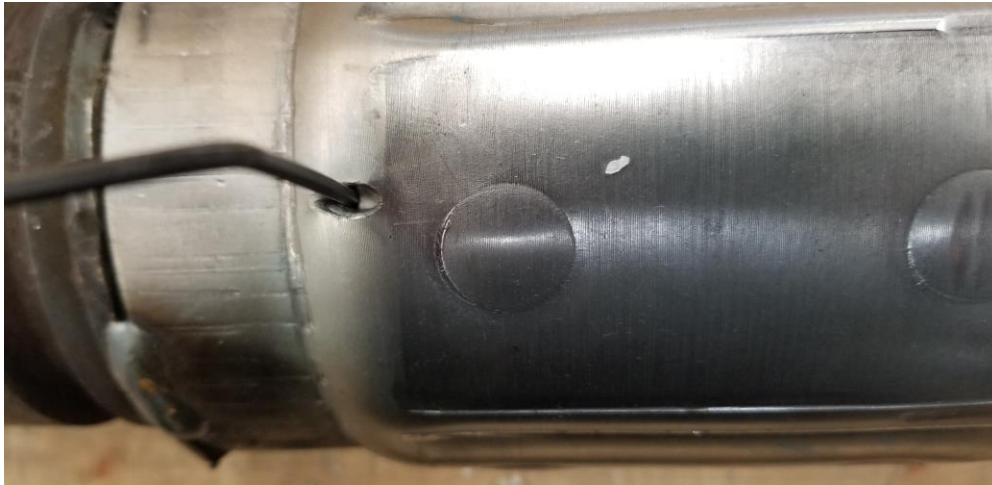
**Figure 244: No Visible Flare**



**Figure 245: Good Flare**

## 9.4.6 Vent Hole Blockage

A properly installed fitting has an open and unblocked vent hole. If the fitting vent hole appears to be partially blocked by the pipe jacket after crimping, check the unblocked gap between the inserted pipe and the vent hole using a 0.050" hex key. If the hex key doesn't fit, the fitting must be replaced. An example of acceptable partial blockage can be seen in the figure below.



**Figure 246: Vent Hole Showing Partial Blockage**

## 9.4.7 Pipe Clamp Marks

The minimum allowable distance between the pipe clamp and fitting sleeve at any time during insertion is 4". If there is evidence of a single clamp mark on the pipe jacket that is closer than 4" to the fitting sleeve, there is a risk of damage to the pipe and the fitting should be replaced.

It can be acceptable to have clamp impressions closer than 4" to the sleeve edge if the two-press insertion was used per **Section 9.2**.

## 9.5 Crimping Troubleshooting

Flexpipe crimping equipment has been designed to be as easy to use as possible; however, the following issues are known to cause or contribute to unacceptable crimps and should be addressed appropriately.

### 9.5.1 Troubleshooting the Crimp

#### Issue #1:

Crimper dies are not extending equally or with equal force.

#### Corrective Action:

- Ensure that the warm-up procedure from the field installation guide has been followed when the outside temperature is below 0°C (32°F).
- Ensure that the fitting and pipe are centered in the crimper when the crimp is being performed. Make sure that the crimper is being supported on a level base. The plywood crimper box top and/or wooden pipeline skids placed on level ground or ditch bottom make a good base to crimp on.

- Ensure that the fitting is aligned as straight as possible within the crimper when performing the crimp.
- Ensure the hoses on the hydraulic pump unit, 3-position remote valve, mandrel insertion press or crimper are not leaking, pinched or blocked by debris.
- Ensure that all hoses are properly connected and the quick connects are locked.

**Issue #2:**

Sleeve does not appear to be crimped with enough force.

**Corrective Action:**

- Check to ensure that the proper crimping pressures are being used for the grade of pipe.
  - **All EL & FP601: 9,000psi**
  - **FP150/FP301: 8,500psi**
- Verify that the crimp is being held at the specified pressure for a full 20 seconds.
- Re-crimp the fitting.

**CONTACT US!**

If you have any questions or if you experience repeated unacceptable crimps, please contact a Flexpipe Field Operations representative through our toll-free number:

**+1 888 FLX PIPE (+1 888 359 7473)**

[www.flexpipesystems.com](http://www.flexpipesystems.com)

## 9.5.2 Troubleshooting the Equipment

**Issue #1:**

Hoses won't connect because pressure has built up in the insertion press, the crimper, or the hose itself.

**Corrective Action:**

- If the hydraulic hose is not connected to equipment, relieve the pressure from the hydraulic hose by slowly unscrewing one of the quick-connect fittings from the hose.
- If the hydraulic hose is connected to the hydraulic pump, ensure that the Hydraulic Pump Unit is turned off. Relieve the pressure in the system by first cycling the selector valve on the Hydraulic Pump Unit between the advance and neutral positions several times to ensure that the pressure gauge is zeroed. Set the selector valve to the neutral position. Cycle the 3-position remote valve through all three open-neutral-close positions several times.
- If you are attaching to the mandrel insertion press or the crimper, relieve the pressure from the equipment by slowly unscrewing one of the quick-connects from the equipment. The quick-connect does not need to be entirely disconnected from the press or crimper in order to relieve the pressure in the system.

**WARNING!**



**Exercise caution when you release the pressurized Hydraulic Fluid. Hydraulic Fluid may shoot out of the lines as the pressure is being released and it may be hot. Take appropriate precautions to ensure there are no injuries or damage while performing this operation. Covering an end of the hose with a rag may be an appropriate safety measure to take while relieving pressure in the lines or equipment. Consider using a pan to collect any dripping oil.**

**Issue #2:**

Pump pressurizes beyond 2,500 psi but the crimper or press does not move.

**Corrective Action:**

- Check the hoses: the short hoses should be attached to the crimper or mandrel insertion press and the long hoses should be attached to the hydraulic pump unit.
- Check the quick connector fittings to make sure they are connected securely.
- Check that the gauge is working properly (see if it zeroes)
- Check the position of the selector valve on the pump to ensure it is the advance position.

**Issue #3:**

The hydraulic pump unit pressure gauge does not go to zero.

**Corrective Action:**

- Put the selector valve in the neutral position to depressurize the system.
- If the gauge does not zero, turn the Hydraulic Pump Unit off. Disconnect the hose from the equipment and relieve the pressure in the system by first cycling the selector valve on the Hydraulic Pump Unit between the advance and neutral positions several times.
- If the gauge does not zero carefully remove the gauge.
- If the gauge goes to zero, re-install the gauge and retry.
- If the gauge still does not zero, replace the gauge with a new gauge. Use Teflon paste on the threads when replacing the gauge. Do not use Teflon tape on the gauge threads.

**Issue #4:**

The hydraulic pump unit won't start.

**Corrective Action:**

- Check the gas level.
- Check that the fuel valve is in the open position.
- Check the oil level on the hydraulic pump unit. There is a low level shut-off on the hydraulic pump unit.
- Check the choke and adjust accordingly. Open the choke for cold start conditions and run until smooth operation of the engine before closing the choke.
- Move the Hydraulic Pump Unit to the warm cab of a truck or add some gas line antifreeze in case the gas line or carburetor has iced up.
- Ensure that the spark plug is producing a spark.



**Issue #5:**

Hydraulic pump unit won't hold constant pressure – keeps creeping upwards.

**Corrective Action:**

- Inspect upper and lower throttle speeds on the meter and adjust accordingly.

**Issue #6:**

Hydraulic Fluid is seeping out of hydraulic pump unit tank cap

**Corrective Action:**

- The tank is too full because it was filled when the insertion press or crimper was extended. Attach the mandrel insertion press to the hydraulic pump unit and fully retract the cylinders of the mandrel insertion press. This may cause more oil to spill from the tank cap. Ensure the overflowing oil is captured. Remove additional Hydraulic Fluid until the hydraulic pump unit tank is at recommended fill level.
- The tank is too full because the fluid has expanded as it is heated. Remove additional Hydraulic Fluid until the hydraulic pump unit tank is at recommended fill level. For subsequent use of the hydraulic pump unit, check the Hydraulic Fluid fill level to ensure it is set appropriately for the ambient temperature.

**Issue #7:**

3-position remote valve handle won't turn

**Corrective Action:**

- If the handle won't turn, try removing the screw on the handle and cleaning out any debris under the handle. Reassemble and try moving the 3-position remote valve handle.

**Issue #8:**

Mandrel insertion press leaks at pressure relief valve

**Corrective Action:**

- Check equipment to ensure that it is operating at the proper set pressure.
- The 3000 psi pressure relief valves are damaged, probably due to over-pressurization. This is typically caused by inserting only one hose into the mandrel insertion press and trying to operate the press. Replacing the pressure relief valves may remedy the problem.

**NOTE!**

If the above listed corrective actions do not address or resolve your equipment issue, please refer to the manufacturer-supplied owner's manual in the large pelican case for further information.

**CONTACT US!**

If you have any questions or if you experience repeated equipment issues, please contact a Flexpipe Field Operations representative through our toll-free number:

**+1 888 FLX PIPE (+1 888 359 7473)**

[www.flexpipesystems.com](http://www.flexpipesystems.com)

## 9.6 Fittings Protection

Flexpipe crimp fittings must be externally wrapped to prevent external corrosion, and to prohibit water ingress from reaching the pipe reinforcement. In jurisdictions requiring that a sacrificial anode kit be applied to buried metal components, an optional sacrificial anode can also be applied to the crimp fitting. In both buried and surface installations, it is mandatory to apply the tape wrapping on all crimp fittings. Only wrapping materials and methods approved by Flexpipe may be used.

To reduce the likelihood of water ingress past the fitting wrapping, a maximum of 1 meter (3 feet) of water depth above the vent hole is allowed. If the installation has more water depth than this, contact Flexpipe Engineering for options including plugging the vent hole or using enhanced water sealing protection such as WrapidBond®.

### 9.6.1 Anode Kit

An anode is a sacrificial metal ribbon which will corrode in lieu of the fitting material. Flexpipe offers anode kits that can be added to the fitting for corrosion protection. Flexpipe does not require the use of anode kits; however, anode kits may be mandated by local regulating bodies. The Anode Kit contains:

- 1 - Magnesium (Mg) ribbon anode (**2"-4" fittings**)
- 2 - Magnesium (Mg) ribbon anodes (**5" fittings**)
- 1 - Stainless steel hose clamp
- 1 - 1"x 50' Cloth tape



**Figure 247: Magnesium Ribbon Anodes**

Anode test posts and monitoring for buried steel couplings in composite pipelines are typically not required but can be added if they are located near other protected pipeline facilities.

#### **NOTE!**



Local regulations may mandate the installation of anode kits for all buried steel fittings (e.g. Alberta, Canada). Where anodes are mandated, one anode kit is to be used per fitting (whether a coupling, flange or weldneck). Custom Tee and Y assemblies will require anodes for each crimp fitting or a larger bag anode to passivate the assembly.

## 9.6.2 Wrapping Materials

Flexpipe requires the use of the following materials for all crimp fittings:

- **Protective paste:** a wax based anti-corrosion paste used to protect the pipe reinforcement layer from water and other contaminants, i.e. Denso paste.
- **Petrolatum tape:** a wax based anti-corrosion tape used to protect the fitting's external surface from water and other contaminants, i.e. Denso tape.
  - Prevents water from entering the vent hole and getting into the pipe annulus and reinforcement layers.
  - Provides long-term corrosion protection for the outer surface of the fitting.
  - Allows permeated gases exiting the vent hole to escape readily, to avoid gas pressure build-up within the pipe annulus.
- **Corrosion protective pipeline tape:** an adhesive backed polymer tape used to protect the petrolatum tape, i.e. Polyken #908 (black color), 3M Scotchrap Tape 50 (black color), 3M Preservation Sealing Tape 4811 (white color), or Patco 5400 (white color).
  - Always applied over petrolatum tape – provides mechanical protection to prevent the petrolatum tape from being torn or scraped off when plowing or pulling pipe along the ground.
  - Always applied to above ground fittings - the recommended white tape protects the fittings from overheating and/or severe thermal cycling due to solar radiation.
  - For all fittings – helps prevent water from entering the vent hole and allows permeated gases exiting the vent hole to escape readily, to avoid gas pressure build-up within the pipe annulus.

### NOTE!



Only white corrosion protective pipeline tape should be used on above-ground fittings to limit the effects of solar heating.


Petrolatum tape comes in 4-inch-wide rolls that is a standard length. The following table is a guideline of approximate coverage for fittings.

**Table 28: Estimated Tape Coverage**

Flexpipe NPS	Coupling	Weldneck Fitting	Flanged Fitting
2"	½ roll	½ roll	¼ roll
3"	1 roll	1 roll	¾ roll
4"	1 roll	1 roll	¾ roll
5"	1 ½ rolls	1 ½ rolls	1 roll

Note: Coverage is based on a 4-inch wide wrap.

**NOTE!**




Ensure that the wrapping materials being used are rated to function properly at the expected design service temperatures and conditions.

- For FlexPipe and FlexCord fittings, use regular protective paste, regular petrolatum tape and either 3M or Polyken corrosion protective pipeline tape.
- For FlexPipe High Temperature fittings, use high temperature protective paste, high temperature petrolatum tape and 3M corrosion protective pipeline tape or Patco 5400 Preservation & Sealing Tape. High temperature petrolatum tape may have a polyethylene backing. This backing is required to be left in place during the installation.

### 9.6.3 Wrapping Application

**NOTE!**



Ensure that the GPS location and serial number of the fitting are noted prior to applying the wrapping.

To ensure enough space is available for installations such as plowing or bore pulls, please refer to **Table 29** below:

**Table 29: Approximate Fitting Dimensions After Wrapping**

Flexpipe NPS	Coupling OD Size		Coupling OD After Wrapping	
	mm	inches	mm	inches
<b>2"</b>	90	3 ½	100	4
<b>3"</b>	115	4 ½	125	5
<b>4"</b>	140	5 ½	150	6
<b>5"</b>	185	7 ⅓	200	8

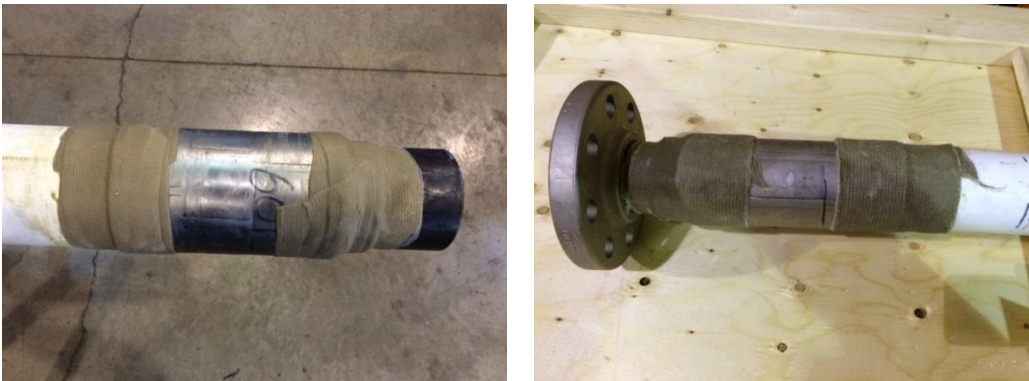
After the fitting is crimped, protect the fitting as follows:

1. Ensure the fitting is dry. Wipe away any wetness with a dry, clean rag if required.
2. Buff the sleeve to remove any loose rust and/or dirt. The exterior of the sleeve must be clean to ensure adequate electrical contact (in case the sacrificial anode is used).
3. Clean and dry 6" of pipe beyond the end of the sleeve. This is important to ensure a good seal between the pipe and the petrolatum tape.
4. Seal the vent hole with a generous application of protective paste.



**Figure 248: Protective Paste in Vent Holes**

5. Apply two overlapping layers of petrolatum tape over the vent hole area. On couplings wrap each vent hole individually, which will allow for a proper rub-down of the petrolatum tape and will remove air pockets and help achieve tight continuous contact with the outer surface of the fitting.
6. Apply overlapping layers of the petrolatum tape covering the transition edge from the fitting sleeve to the pipe. Rub-down the petrolatum tape to achieve a tight continuous contact with the outer surfaces of both the fitting and the pipe.



**Figure 249: Wrapped Vent Hole Area and Sleeve Ends**

7. If the use of an anode kit is required, proceed to step 8, otherwise proceed to step 11.
8. Fix the clamp of the anode kit on the exposed surface of the fitting sleeve between the areas covered by the petrolatum tape.



**Figure 250: Anode Fixed to Fitting Sleeve**

9. Secure the lead wire and ribbon anode to the Flexpipe Spoolable Product using the cloth tape provided in the anode kit. Tape the anode such that the majority of the anode is left uncovered.



**Figure 251: Anode Lead Wire Secured to Pipe**

10. Seal the anode wire with a generous application of protective paste in the area where the wire is on top of the petrolatum tape and a further 5 cm (2 in) onto the pipe.



**Figure 252: Protective Paste on Anode Wire**

11. Starting on the pipe about 10 cm (4 inches) away from the fitting end, apply two layers of petrolatum tape with 1-2cm (½ to 1 inch) overlap over the entire fitting.
  - a. For coupling fittings, wrap the entire fitting and 10 cm (4 inches) of pipe on each side.
  - b. For weldneck fittings, start on the pipe about 10 cm (4 inches) from the fitting, wrap the entire crimped area up to the external corrosion protection on the steel pipe (if applicable).
  - c. For flanged end fittings, start on the pipe about 10 cm (3 in) from the fitting, wrap the entire crimped area past where the sleeve is welded to the mandrel.
12. Rub-down the petrolatum tape to get rid of air pockets and to achieve a tight continuous contact with the anode wire, the fitting, and the pipe.



**Figure 253: Petrolatum Tape Applied Over Entire Fittings**

**NOTE!**



If using the anode kit, ensure the petrolatum tape is tight around the lead wire to prevent potential water ingress from reaching the fitting.

13. Apply the corrosion protective pipeline tape with 1-2 cm (½ to 1 in) overlap over the entire area covered by the petrolatum tape. Wrap the corrosion protective pipeline tape tightly.
  - a. For buried flanged connections, the bolted flange set should not be taped up until after the application of corrosion protective pipeline tape is done on the fitting sleeve. Follow pipeline owner practices for wrapping the buried flange connection.
  - b. If a flange will be supported in a riser chute it is required to tape the fitting completely before it is set in place on the chute. White corrosion protective pipeline tape should be used on above-ground fittings to limit the effects of solar heating.



**Figure 254: Fully Wrapped Fittings**



## EXTREME WEATHER INSTALLATION

For temperatures below 0°C (32°F) or above 30°C (86°F)

In cold temperatures, the petrolatum tape and corrosion protective pipeline tape can be difficult to work with as it becomes too firm to apply easily. In hot weather, the petrolatum tape and pipeline tape can be difficult to work with as it becomes too soft to apply effectively. Keep the petrolatum tape and corrosion protective pipeline tape in a dry environment at moderate temperatures such as the cab of a running truck.

Freezing or high temperature will not damage either tapes.

### NOTE!



Do not put the petrolatum tape or corrosion protective pipeline tape over the anode. The anode must be in direct contact with the earth in order to be effective.

### NOTE!



Do not apply heat shrink sleeves on Flexpipe fittings. Heating the fitting may impact the integrity of the fitting connection.

### NOTE!



In above ground installations, the tape wrapping may degrade as a result of environmental conditions. Inspect and replace the tape wrapping as required.

### NOTE!



The tracer wire is to be applied after the fitting wrapping is completed. The tracer wire should not be included within the fitting wrapping.

### NOTE!



The Flexpipe daily field report (**C.1: Daily Field Report**) can be used as per the Joining Inspection requirements of CSA Z662 in Canada.



## 9.6.4 Plowing Considerations

When installing the Flexpipe Spoolable Product by plowing, the anode will point away from the plow to enter the chute in the proper orientation. Be sure that the anode kit is installed on the side of the coupling which will enter the plow chute last with the anode located away from the coupling as shown below. When wrapping the pipeline tape over the coupling fitting, make sure to wrap towards the plow to ensure the edges of the tape enter the plow chute smoothly.

**This end of the taped coupling enters the plow chute first**



**Figure 255: Anode Attached to Fitting for Plowing**

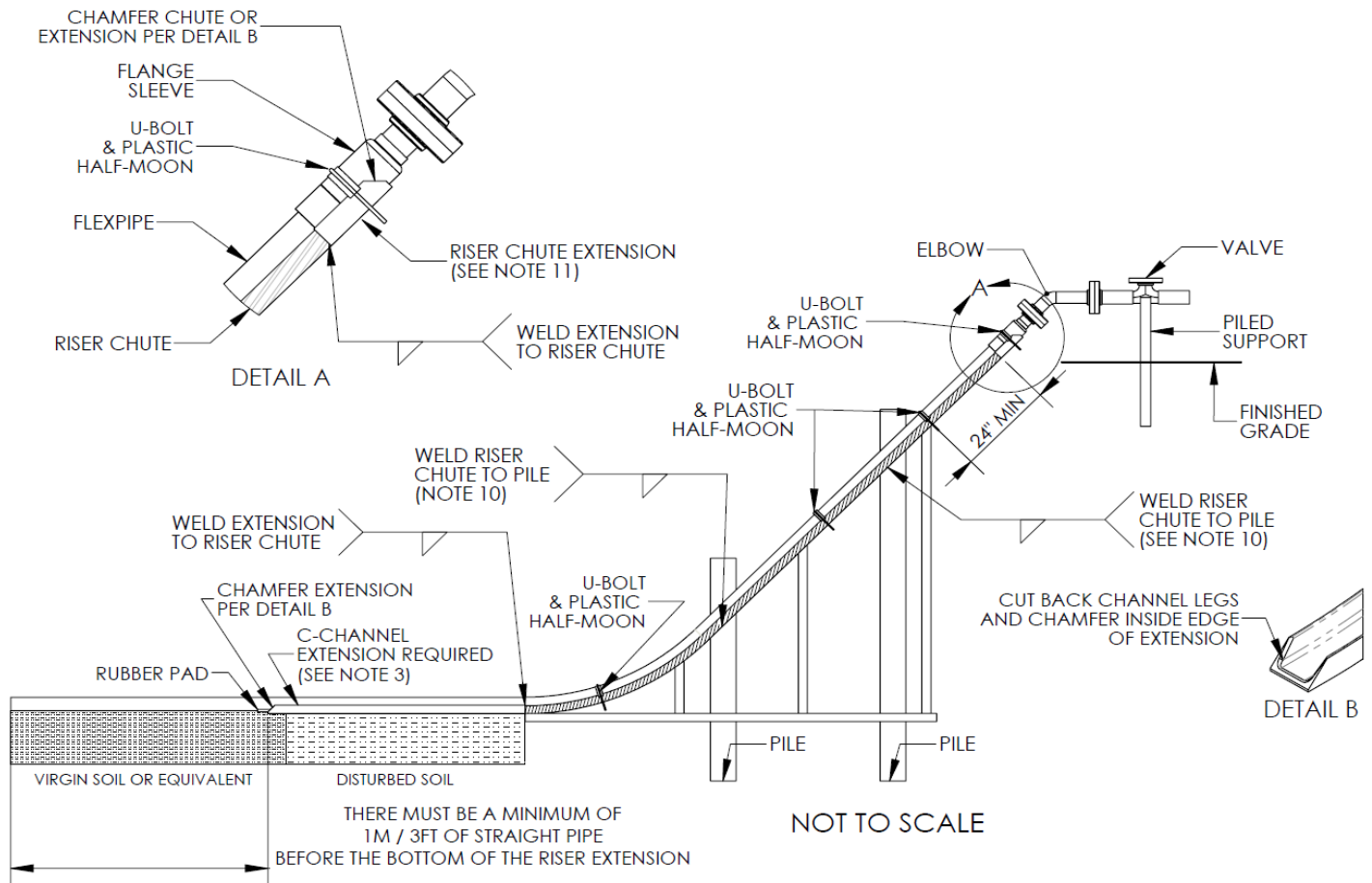
## 10. Flexpipe Riser Chute Installation

Flexpipe riser chutes are designed to protect Flexpipe Spoolable Products from ground movement caused by settlement, freezing and thawing cycles, etc. It is recommended to use a riser chute to transition Flexpipe Products from buried to an above ground connection. Riser chutes are available from Flexpipe.

Check with Flexpipe for the latest versions of the following riser drawings which includes sizing specifications and detailed notes on installation.

### 10.1 45-degree Riser Assembly

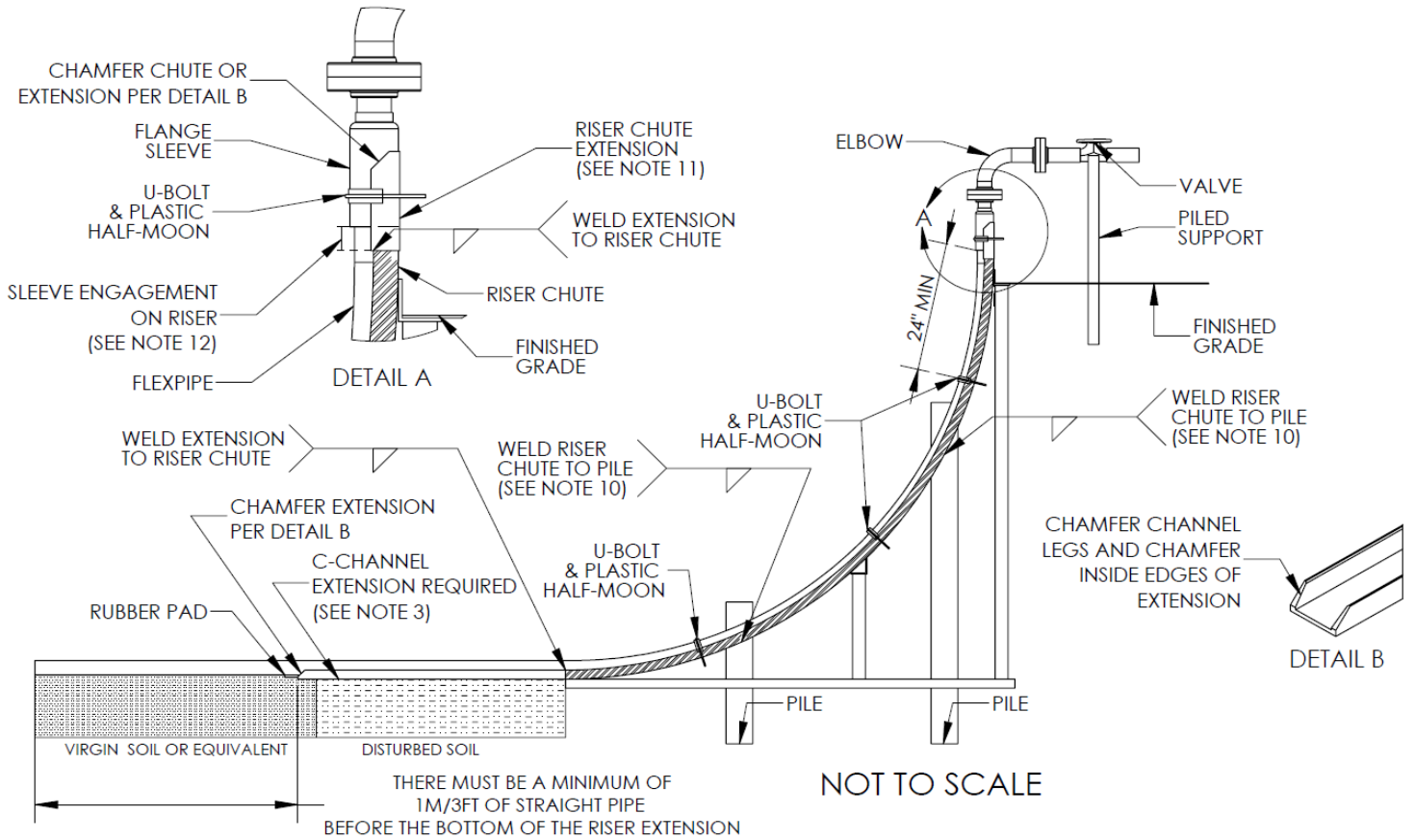
Source: IFS # 04-3380 rev. 18



**Figure 256: 45-degree Riser Assembly**

**10.2 90-degree Riser Assembly**

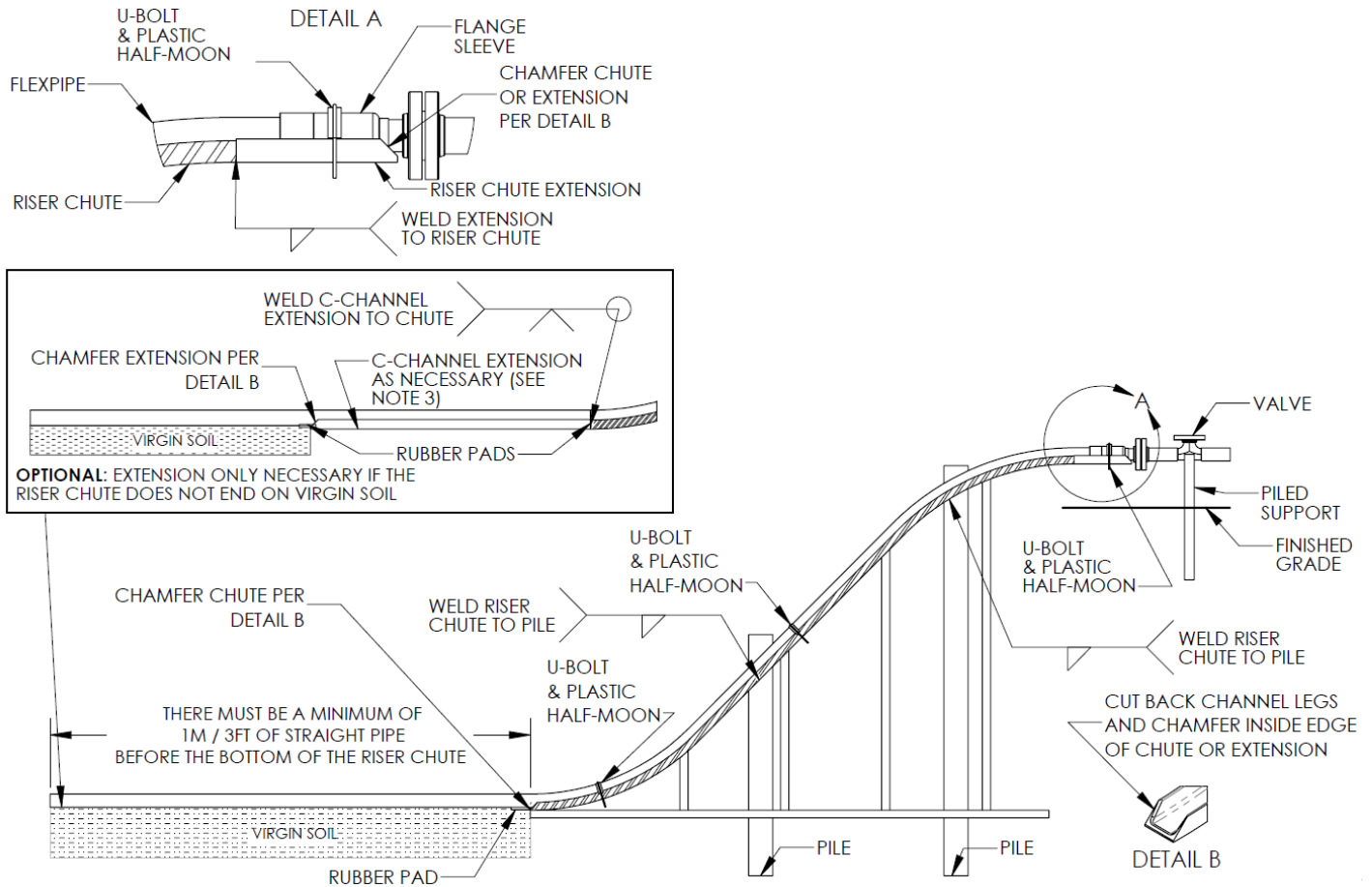
Source: IFS # 04-3052 rev. 17



**Figure 257: 90-degree Riser Assembly**

## 10.3 S-bend Riser Assembly

Source: IFS # 04-3385 rev. 13



**Figure 258: S-bend Riser Assembly**

## 10.4 Riser Assembly Installation Procedure

1. Install pilings to an appropriate depth determined by project parameters to ensure adequate support.
2. Position the riser chute and weld to pilings, with an approximately 2in wide spacer between the pile and riser to prevent pipe from contacting piles.
3. Ensure that there is a minimum of 1 meter (3 feet) of straight pipe leading into the riser chute.
4. Extend the riser chute ends with steel C-channel (not supplied) until it reaches virgin soil or equivalent support. If an extension is not used at the end fitting, ensure the fitting sleeve does not overlap the riser chute by more than 6in.
5. Chamfer extension ends at top and bottom as per "Detail B" seen in the riser assembly drawings.
6. Ensure that the fittings are wrapped as per **Section 9.6**.
7. Secure pipe to the riser chute with the use of temporary ratchet straps.
8. Place a rubber pad under the pipe at the riser chute end.

9. Place the plastic half-moons over the Flexpipe Spoolable Products at all locations that will be fastened with U-bolts.
10. Install U-bolts to secure Flexpipe Spoolable Products to riser chute and hand tighten nuts on U-bolts. Do not over-tighten, or use wrenches or other tools to tighten. The above-ground U-bolt should be installed over the sleeve of the Flexpipe fitting instead of on the pipe itself.
11. Remove the temporary ratchet straps.
12. If required, wrap the pipe and fittings with insulation. Refer to **Section 7.8**.
13. Where required, install cathodic protection to the riser chute.



**Figure 259: 45-degree Riser Assembly Installation**

Note that riser assemblies for 5" pipe will may have a small gap between the pipe and the C-channel, as well as a gap between the edge of the plastic half-moon and the pipe. It is also required to use the supplied square backing tube between the bottom of the riser chute and the U-bolt nuts.



**Figure 260: 5" Pipe Gaps and Square Backing**

Find more information related to attaching Flexpipe Spoolable Products to riser assemblies, including a list of materials needed, in **Section 7.7.5**.

**NOTE!**



Ensure that the pipe is protected from overheating during the weld process. Make sure the riser chute welds cooled down to below 60°C (140°F) and any slag in the riser chute is ground off. Ensure riser chute is clear of slag and debris before positioning the pipe into the chute. Failure to do so will result in damage to the line.

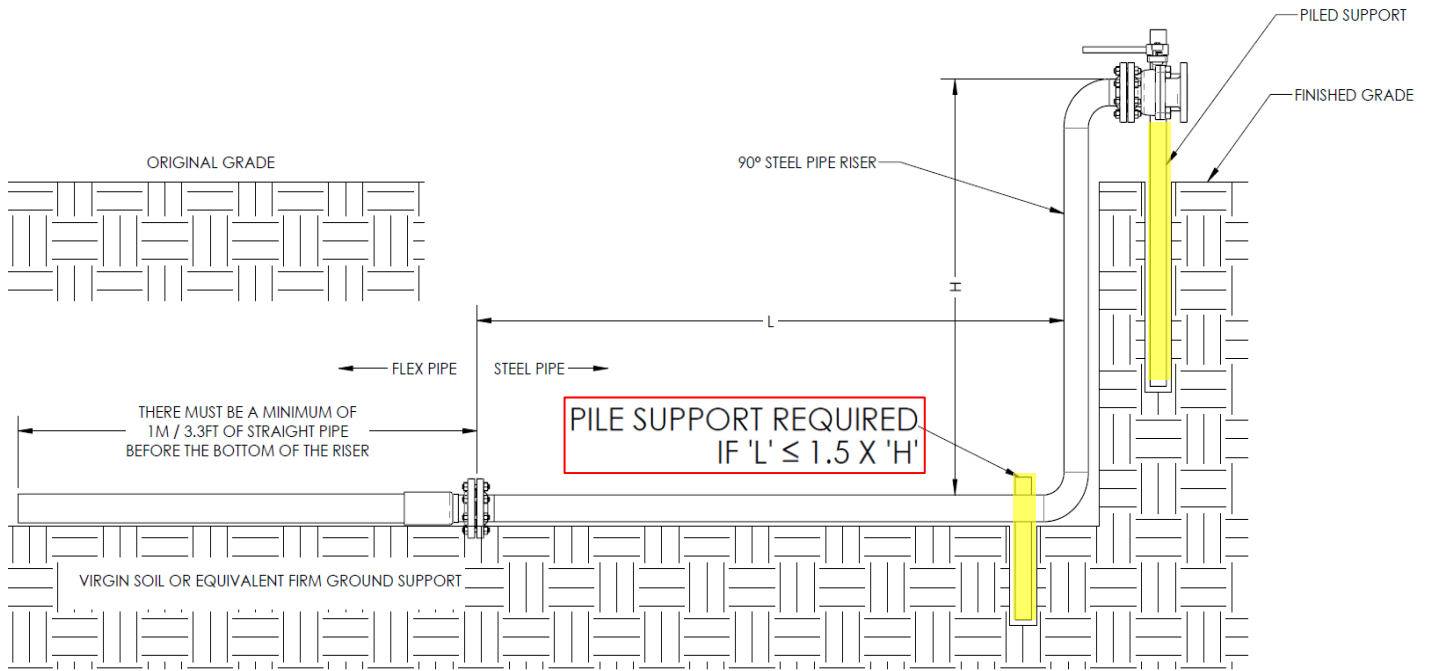
## 10.5 Steel Pipe Riser Installation

When connecting Flexpipe Spoolable Product to steel pipe risers, refer to **Figure 261 & Figure 262** for recommendations in addition to the following:

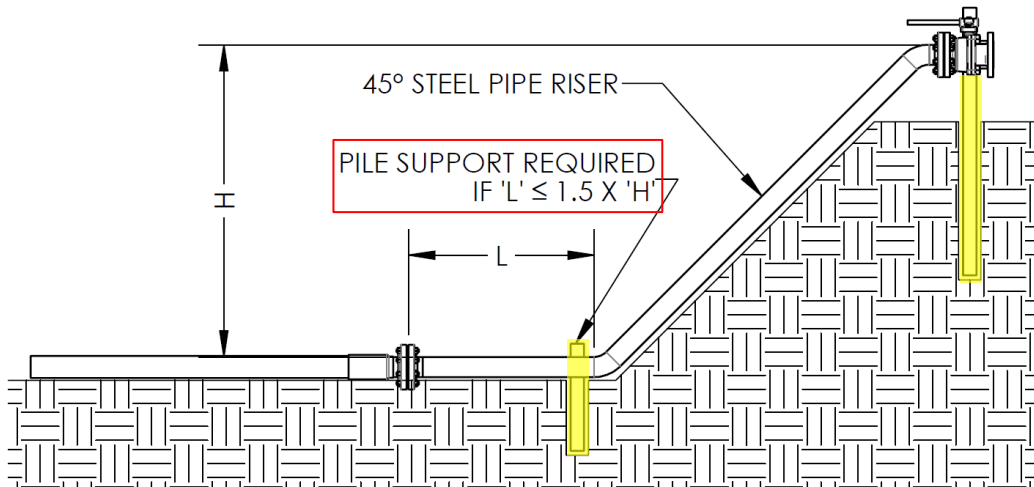
1. Where required, coat the steel pipe riser.
2. It is required to support the steel pipe riser independently by using pile supports or similar support, such that the steel riser will not add load to the Flexpipe piping or become displaced due to any movement of Flexpipe Spoolable Products (e.g. unrestrained pipe twisting during pressure testing). Suggested proper pile support placement is shown in **Figure 261 & Figure 262**.
3. If not using pile supports, ensure that the steel riser and Flexpipe piping are adequately supported by properly compacted backfill with a soil modulus of 1,000 psi or greater, over the entire length. The steel pipe riser length L must be greater than 1.5 x the steel pipe riser height H. This is to minimize potential relative displacement of the piping across the steel-to-FlexPipe connection (e.g. from differential settlement). If differential settlement is expected (e.g. from frost heave, soft soil, ground movement, etc.), then pile supports are required.

Refer to **Section 14.3.2 - Tying into a Steel Pipeline** for detailed guidance on connecting steel pipe and pipe risers to Flexpipe Spoolable Products.

Source: IFS # 04-4071 rev. 2



**Figure 261: 90-degree Pipe Riser**



**Figure 262: 45-degree Pipe Riser**

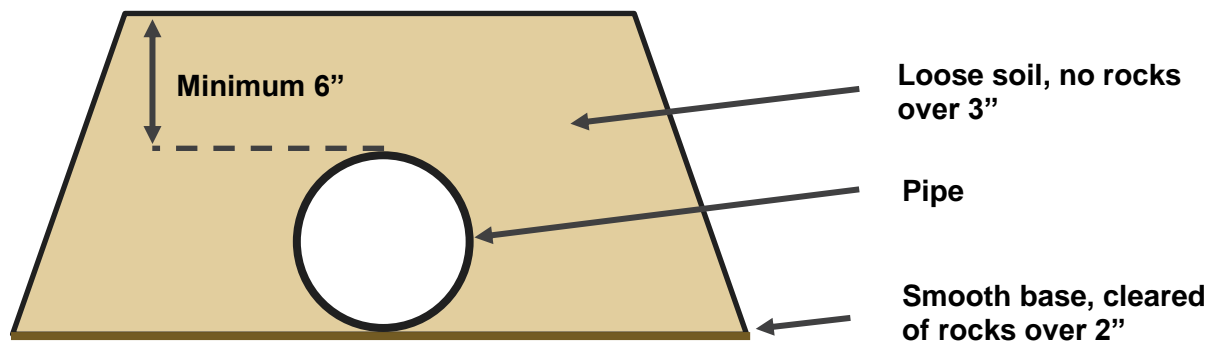
## 11. Backfilling

Flexpipe recommends performing a visual inspection of the line prior to backfilling. See **Section 6.6 - Pipe Inspection**.

If the connections can't be completed before backfilling, leave a minimum of 12 meters (40 feet) of exposed pipe where the fitting will be installed with a minimum of 2 meters (6 feet) on the short side of the fitting to allow adequate movement in the pipe to install the fitting. This is needed to allow enough flexibility for the pipe to be inserted into the fitting.

In general, backfilling procedures used for steel pipelines can be followed when backfilling a Flexpipe Spoolable Products pipeline, along with the following:

- Flexpipe Spoolable Products do not require having a compacted sand bed for pipe installation; however, gradual grade transitions are required and rocks larger than 50 mm (2 in) in diameter are to be removed if protruding from the bottom of the trench.
- It is required to screen and removed any rocks larger than 75 mm (3 in) in the backfill for a minimum of 150 mm (6 in) above the pipe.
- It is recommended that the backfill embedment material have a soil modulus of 1000 psi or greater. This generally includes all soils (including excavated soils) except muskeg. For muskeg, swamps, or other buried areas where the pipe may float upwards, see **Section 7.4**. For more information on Flexpipe Spoolable Products external loads and backfill materials, please refer to Flexpipe CPS Technical Manual.



**Figure 263: Typical Backfill Over Pipe**

It is recommended to use tracer wire or other pipe locating technology placed on or above the pipe prior to backfilling. Additional markers above fittings such as Omni Marker™ balls are recommended in case precisely locating fittings is required in the future.

### CAUTION!



In order to prevent water from potentially seeping in and wetting out the reinforcement layer, any pipe end that is intended for a future tie-in/connection is recommended to be connected to a crimped fitting before backfilling. The crimp fitting should also be blinded to protect the pipe bore from debris, and properly wrapped to protect from water ingress and external corrosion.



## 12. Pressure Testing

Flexpipe Spoolable Products are designed to accommodate the pressure testing requirements specified by regulatory standards and codes. Due to the safety factors built into the pipe design, there is no need to upgrade to a higher pressure rated pipe if testing is required above the stated MAOP. Field pressure testing requirements and recommendations for Flexpipe Spoolable Products may depend on whether the pipeline is a new installation, a tie-in, or repair job.

**NOTE!**



Some pipe twist upon pressurization is expected for buried pipelines with sections left exposed or for surface installations. It is recommended to either allow the pressure testing connection and Flexpipe end fitting to freely rotate, or if connected to a riser or other fixed connection, to ensure the end fitting and pipe is properly secured from movement.

### 12.1 General Guidance for Pressure Testing of New Pipelines

For pressure testing Flexpipe Spoolable Products, stabilization means a decaying (i.e. decreasing) pressure loss that levels off and approaches an asymptote such as seen in the 8 hour hold portion in **Figure 264** below.

The field hydrostatic hold test pressure depends on the type of the Flexpipe Spoolable product, the pressure rating of the Flexpipe Spoolable product, and the class of the metallic flanges being used. Flexpipe recommends that new pipelines that have not been commissioned into operation be subjected to a field hydrostatic hold pressure test as follows:

- For FP, FC, and FP HT test at 1.25xMAOP for 8 hours.

The test pressure and duration for the various pipe classes are shown in **Table 30**.

**Table 30: New Pipeline Hydrostatic Test Pressures and Durations**

Class	FP150	FP301 FP301 HT	FP601 FP601 HT	FC801	FC901
Hydrostatic Test Pressure and duration <sup>1</sup>	2,586 kPa (375 psi) / 8 hours	6,467 kPa (938 psi) / 8 hours	12,928 kPa (1,875 psi) / 8 hours	17,237 kPa (2,500 psi) / 8 hours	19,395 kPa (2,813 psi) / 8 hours
Maximum permissible pressure during testing <sup>2</sup>	3,103 kPa (450 psi)	7,757 kPa (1,125 psi)	15,513 kPa (2,250 psi)	20,684 kPa (3,000 psi)	23,270 kPa (3,375 psi)

1. Local regulations and requirements must be followed when pressure testing, including sour service pipelines. These requirements may supersede the above pressures and times.
2. Maximum pressure during testing relates to the pipe component only. Other system components or regulations may further restrict these values. For example, flange ratings may lower the maximum pressure permitted.

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***Flexpipe requires monitoring the pipe system carefully to ensure that the pressure does not exceed the maximum permissible pressure shown in Table 30 at any time during the hydrostatic test at any point along the pipeline including low points.***

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**NOTE!**

In some cases, company specifications or local regulations may require a specific test pressure. It is important to meet all local regulations when field testing Flexpipe Spoolable Products.

**WARNING!**

For safety reasons, pressure testing with a gas medium is acceptable for test pressures up to a maximum of 2900 kPa (420 psi), provided that the below conditions are considered. Pressure testing with air or gas above 2900 kPa (420 psi) is at the discretion of the engineering resources of the pipeline operating company.

Pressure testing with a gas medium is only acceptable for pressure tests up to 2900 kPa (420 psi) provided that:

- It is not prohibited by local regulations or standards;
- Appropriate precautions are taken to protect the pipeline from damage and minimize the risks associated with a pressure test failure.
- Follow the company procedures and safety measures for air testing.

Under no circumstances will Flexpipe be liable in any way for any loss, damage, or injury of any kind (whether direct, consequential, punitive, or otherwise) incurred as a result of the use of a gas medium for pressure testing.

To minimize the potential risk of injury or property damage in the unlikely event of a pressure test failure, a relatively incompressible liquid such as water is recommended as the pressurizing medium. Methanol is compatible with Flexpipe Spoolable Products and is commonly used as an additive to prevent water from freezing at low temperatures.

Where new Flexpipe pipelines have been hydro tested in sections, retesting of the entire pipeline system is not required after tying in, provided:

- Pipe sections used for tie-ins, repairs, or replacement are pre-tested as per Section 2.2.
- Joints of the tie-ins, repairs, or replacements are left exposed as the pipeline is brought into service and visually monitored for leaks for at least four hours, at the highest available operating pressure.

## 12.2 Procedure for Field Pressure Testing of New Pipelines

The following procedure applies to pressure testing new pipelines that have not begun normal operation and covers all classes of Flexpipe Spoolable Products. Service testing of pipelines that have already been commissioned into operation is covered in **section 12.3**.

1. Use a medium density foam pig to push the air out of the line when filling the Flexpipe Spoolable Products with test fluid. The test fluid should be pumped into the system at the lowest possible point while having the air pushed out at the highest possible point. If a foam pig cannot be used, it is recommended that the system be vented in accordance with good engineering and industry practices by using a center tapped blind flange, nipple, pressure indicator and ball valve to release the air from the system at the branch locations.

**NOTE!**



It is recommended to allow time for test fluid to equalize with surrounding temperature. This generally results in more consistent tests. This can be done during the conditioning phase.

2. Pressurize the pipe initially to the Conditioning Pressure shown in **Table 31** at a rate no faster than 1400 kPa/min (200 psi/min). Hold the conditioning pressure until the pressure stabilizes. A slight decrease in the conditioning pressure over this hold period is normal.

**Table 31: Conditioning Pressures**

Class	150	301	601	801	901
Conditioning Pressure	1,725 kPa (250 psi)	4,310 kPa (625 psi)	8,620 kPa (1,250 psi)	11,495 kPa (1,667 psi)	12,930 kPa (1,875 psi)

3. Pressure the line 1%-10% above the hydrostatic Test Pressure of the Flexpipe Spoolable Products. Do not exceed the maximum permissible test pressure in Table 1. Hold the pressure until it stabilizes. During this phase, the pressure can drop as much as 1,000 kPa (150 psi) in 15 minutes.
4. Increase the pressure to 1%-10% above the Test Pressure two more times. Hold after each pressure increase until the pressure stabilizes. Steps 2 through 4 (the conditioning phase) should be completed in no less than 1 hour, however typical time can take 4-8 hours. If the pressure is confirmed to have stabilized in less than 4-8 hours, the 8 hour test period can begin.

**NOTE!**



Longer lines at higher pressures may need a longer conditioning time as compared to short lines at lower pressures.

5. Pressurize the line once more back up to 1%-10% above the Test Pressure. This marks the beginning of the minimum 8 hour test period.
6. A decaying (i.e. decreasing) pressure loss that levels off and approaches an asymptote that is equal to or above the targeted hydrotest pressure for 8 hours can be considered a successful pressure test. This marks the end of the test period.

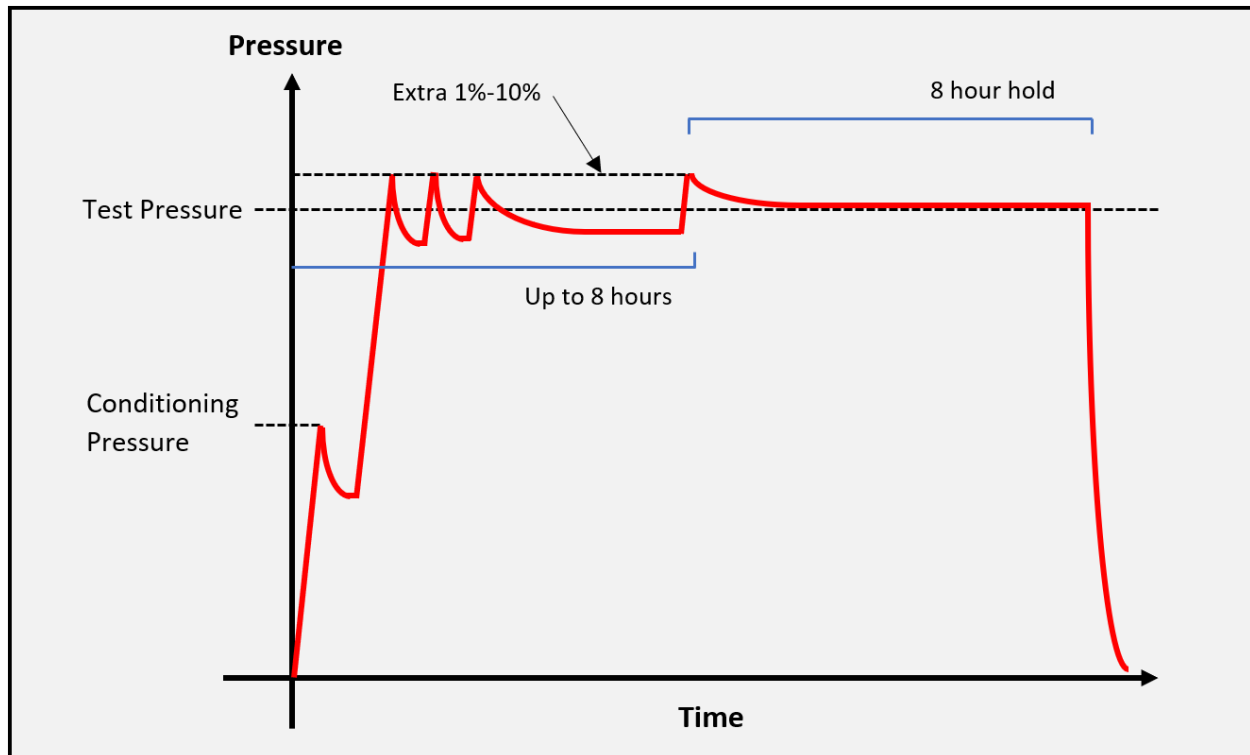
**NOTE!**



It is normal for a slight decrease in pressure to occur during the field test. This is due to pipe relaxation, which occurs in all reinforced thermoplastic pipes. A leak will result in continuous depressurization, while pipe relaxation results in a pressure reduction that levels off.

7. After the test period has been successfully completed, depressurize the pipeline in a slow and controlled manner. A depressurization rate no faster than 1400 kPa/min (200 psi/min) is recommended.
8. Following depressurization, de-water the pipeline as you would with other pipe systems and put into service.

The steps 2 through 8 discussed above are graphically represented in **Figure 264** below.



**Figure 264: Hydrotest Profile**

### 12.3 Field Service Testing of Existing Pipelines

When a cut out is replaced, a failure is repaired, or a tie-in is connected to a previously operating pipeline, the integrity of the new pipe section and the connections used to join or repair the pipeline is ensured by both of the following:

- The pipe section used for repairs, replacement or tie-ins is pre-tested as per Section 2.2.
- The repaired, replaced, or connected section is left exposed as the pipeline is brought into service and visually monitored for leaks for at least four hours, at the highest available operating pressure.

Frequent hydrotesting of a pipeline after it has been commissioned into operation is not recommended. Hydro testing pipelines to a pressure greater than MAOP is generally only appropriate prior to a new pipeline being commissioned into operation, for infrequent integrity testing, or infrequent testing after repairs. Hydrotesting pipelines up to MAOP is typical after pipeline tie-ins, for frequent integrity testing, or when reactivating a shut-in pipeline. Contact Shawcor Engineering for clarification as required.



#### **COLD WEATHER INSTALLATION** - for temperatures below 0°C (32°F)

In cold temperatures where there is a risk of the fluid freezing in the Flexpipe Spoolable Products, methanol (or other antifreeze agents compatible with HDPE) can be mixed into the test fluid to lower its the freezing point. Ensure that the fluid is not allowed to freeze in the pipeline as it will damage the pipe and require replacement of the affected section.

### 12.4 Pressure Test Troubleshooting

Certain conditions may lead to a stabilization period longer than the typical 4-8 hours. For example, colder environments or testing fluids may have a slower pressure drop. Other factors such as pipeline length or the ratio of liquids to gases in the testing fluid (e.g. air in the line) can affect pressure drop and testing time. It is also important to account for elevation changes and head pressure when determining test pressure. For more information, contact Flexpipe.


**CONTACT US!**



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[www.flexpipesystems.com](http://www.flexpipesystems.com)

### 13. Pigging

<p><b>CAUTION!</b></p> 	<p>Use only custom polyurethane pigs designed for use with Flexpipe Spoolable Products or use standard medium-density foam pigs. Pigs other than those recommended by Flexpipe may become stuck at fittings because of the ID restriction and/or may damage the pipe.</p>
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Flexpipe recommends that pigs be inspected to ensure they are fit for use. Refer to Appendix A product data sheets for fitting and pipe IDs to ensure the appropriately sized pig is selected.

#### 13.1 Foam Pigs




Standard medium-density foam pigs are typically used for watering / de-watering of pipelines, light cleaning, dry gas pipeline pigging and for initial pigging operations through new pipelines. Either blunt nose or bullet foam pigs are acceptable. For 5” pipe, use only 5.25” standard medium-density foam pigs.

#### 13.2 Custom Polyurethane Pigs

Custom polyurethane pigs designed for use with Flexpipe Spoolable Products provide more aggressive cleaning of the pipeline and require the presence of some liquid in the pipeline to provide lubrication. These custom polyurethane pigs should not be used in dry gas pipeline applications or new FP, FC, or FP HT pipelines that have not been in service.

Custom polyurethane pigs are available from Flexpipe in a variety of durometers (hardness ratings) and lengths to suit different pigging requirements. The pigs are color coded as follows:

**Table 32: Custom Polyurethane Pigs**

Durometer	65	75	85
Color	<p>Purple</p>  <p>(extended pig)</p>	<p>Green</p> 	<p>Yellow or Blue</p> 

Lower durometer pigs will require a lower differential pressure to push the pig down the pipeline; however, they will not clean the pipeline as aggressively. **Table 33** lists the differential pressure required to pass a custom Flexpipe polyurethane pig through a Flexpipe fitting.

**Table 33: Estimated Required Differential Pressures for Pigging**

Flexpipe NPS	ID of Fitting	Required Differential Pressure (In-Service Conditions)
2"	1.75"	10 psi
3"	2.50"	35 psi
4"	3.38"	45 psi
5"	4.20"	70 psi*

\*Typical field input shows 5" pigs require between 40-90psi depending on hardness of the pig and contents/condition of the line.

Flexpipe custom polyurethane pigs will work with 90 degree or 45 degree standard welded elbows. However thin-wall welded steel elbows (for example 3.2 mm / 0.125 in wall) may allow fluid to bypass the pig, which may in turn cause the pig to float and make slower progress than usual, though this will rarely result in a complete stoppage.

**CAUTION!** Flexpipe custom polyurethane pigs are not compatible with:

- Threaded 90 degree or 45 degree elbows
- Branch line of Tee fittings
- Trunk line of Tee fittings that do not have a bar stop

Extended length custom polyurethane pigs are available for pigging forged Y-lateral joints. Regular length pigs may allow fluid flow around the pig when it reaches the joint causing it to be held up in the fitting. Subsequent pigging down the same pipeline with an extended length pig should clear both pigs from the fitting and allow the pipeline to operate as normal.

Field-fabricated Y-lateral joints are not recommended as pigs of any length or durometer may become stuck as the dimensions of these fittings may not be consistent.

### 13.3 Pigging Tags



**Figure 265: Regular Temperature Pigging Tag**



**Figure 266: High Temperature Pigging Tag**


Flexpipe supplies tags to warn operators of the temperature limitations of the pipe and pigging restrictions. These tags are to be installed on every riser that attaches to Flexpipe


Spoolable Products. **Flexpipe supplies regular and High Temperature pigging tags, ensure the appropriate tag is installed.**


<p><b>CONTACT US!</b></p> 	<p>If you do not receive enough pigging tags, please contact your Flexpipe Project Coordinator to order additional tags through our toll-free number:</p> <p><b>+1 888 FLX PIPE (+1 888 359 7473)</b></p> <p><a href="http://www.flexpipesystems.com">www.flexpipesystems.com</a></p>
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## 14. Tying Into and Repairing Existing Pipelines

This section describes methods used to make repairs to Flexpipe Spoolable Products and how to connect to the pipe system.

<p><b>WARNING!</b></p> 	<p><b>Static Electricity Hazard</b></p> <p>Static Electricity can build up on plastic pipe by handling, stringing, during storage and when in service. A spark from contact with an electrically charged surface can ignite a flammable gas-air mixture. Ensure that all workers on site are aware of the danger and follow company procedures for static electricity safety and control.</p>
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<p><b>WARNING!</b></p> 	<p>Ensure that all pipelines that are being exposed are de-pressured. If the line is struck during excavation while the line is pressurized there is a high risk of environmental contamination, equipment damage, serious personal injury, and/or death.</p>
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<p><b>WARNING!</b></p> 	<p>Ensure that all pipelines that are to be cut to complete a tie-in or repair are safe to work on by de-pressuring, pigging clean and ensuring no hazardous fluids or gases are present. If the line is cut while the line is pressurized there is a high risk of environmental contamination, equipment damage, serious personal injury, and/or death. Utilizing a Lock Out/Tag Out program is recommended.</p>
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<p><b>CONTACT US!</b></p> 	<p>All pipe failures should be investigated by a Flexpipe representative to determine the cause of failure. At a minimum, Flexpipe should be notified of any failures or product quality incidents. Please call your Flexpipe Project Coordinator or your Field Operations representative to discuss any in-service or hydro test pipe failure or incident through our toll-free number:</p> <p><b>+1 888 FLX PIPE (+1 888 359 7473)</b></p> <p><a href="http://www.flexpipesystems.com">www.flexpipesystems.com</a></p>
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## 14.1 Exposing the Pipeline

Check the as-build drawings for information on the location and burial depth of the pipeline. Locate the pipeline using a technology able to detect the tracer wire. When excavating within 1 meter (3 feet) of a possible Flexpipe Spoolable Products pipeline location, hydro-excavation procedures should comply with industry best practices for the excavation of thermoplastic piping.

### CAUTION!



Do not use heavy equipment to directly excavate the pipeline as these may hit the pipeline and cause damage.

### CAUTION!



Hydro-excavation can damage Flexpipe Spoolable Products if proper techniques are not utilized. Never apply a constant spray directly on Flexpipe Spoolable Products. Continuously move the spray wand side to side to avoid damaging the pipe.

In order to protect the integrity of Flexpipe Spoolable Products while hydro-excavating, Flexpipe recommends the following:

- Shut-in wells or turn off pumps and de-pressure Flexpipe lines prior to and during hydrovac operation.
- Use protective tips (i.e. rubber, neoprene) on spray nozzles and suction hoses to avoid gouging.
- Use multi-jet nozzles with dispersing spray patterns. Do not use oscillating, rotating, or converging pattern nozzles.
- Use continuous movement of the spray wand while excavating.
- Maintain a distance of at least 30 cm (12 inches) between the spray nozzle and the Flexpipe Spoolable Product.
- Use spray pressures as low as practical, never exceeding 10,342 kPa (1500 psi).
- Keep water temperatures below 40°C (104°F).
- Inspect the exposed pipe thoroughly after excavation is complete
- Support the weight of exposed pipe at intervals not greater than those listed in **Section 7.3**.
- Take appropriate precautions to avoid impact or sustained pressure from sharp or heavy objects
- Exercise care during any mechanical excavation near Flexpipe Spoolable Products.
- Inspect all exposed Flexpipe Spoolable Products for external damage prior to backfilling.
- Replace any sections of Flexpipe Spoolable Products that are damaged during excavation/hydrovac.
- Ensure the pipe is adequately supported by compacted soil prior to backfilling.
- Use proper backfilling procedures, found in **Section 11**.



**Figure 267: Hydrovac Exposing a Buried Pipeline**



**Figure 268: Pitting and Abrasion Hydrovac Damage**

## 14.2 Repairing Leaking or Damaged Pipelines

Leaks from a flange set can be the result of the bolts being loose or a faulty gasket. If the flange bolts are loose, apply proper torque to re-tighten the nuts in the correct sequence. If the flange set is leaking due to the gasket, replace the gasket.

If a Flexpipe Spoolable Products fitting leaks, depressurize the pipeline, cut off the fitting and install a new fitting.

When enough damage to the body of pipe occurs, that section of pipe must be removed and replaced. It is recommended that a minimum length of 1.5 m (5 ft) on each side of the damage be cut out, with a total minimum exposed pipe length of 12 m (40 ft). Additional cut back length may be required if the reinforcements are wet. If the pipe is found to be kinked, refer to **Section 6.7**.

**NOTE!**



If the leaking or damaged pipe is buried, ensure a minimum of **12 m (40 ft)** of pipe is exposed for ease of repair and fitting installation.

Ensure the adjacent pipe is inspected for other physical damage. Once the unsatisfactory section has been cut out, a “pup” can be installed to replace the cut out section. When the pipe end is left unrepaired the end must be protected from liquid water as per **Section 5.4**.

**CAUTION!**



When connecting crimp fittings to an existing Flexpipe Spoolable Product pipeline, ensure the pipe bore is clear and free from deposits (wax, scale, etc.). The pipe bore may be cleaned using a rag and a suitable multi-purpose cleaner. Reinforcement layers must be checked for wetness prior to installing any fitting. Protect the pipe reinforcements at the pipe cut end with protective paste prior to using the multi-purpose cleaner.

**CAUTION!**



Fluids seeping from the vent hole during the crimping process are indicative of a wet reinforcement layer. The fitting will need to be cut off and replaced with a new fitting. When cutting into Flexpipe Spoolable Products to install a fitting, ensure that the reinforcement layer is dry. Refer to **Section 5**.

## 14.3 Tying into an Existing Pipeline

### 14.3.1 Tying into Flexpipe Spoolable Products

Each nominal Flexpipe Spoolable Product size has several pressure classes (i.e. FP150, FP300, FP301/FP301HT, FP601/FP601HT, FC801, FC901) which may look similar to each other, but which require different fittings in order to perform properly. Before cutting existing Flexpipe Spoolable Products for a tie-in, look for the print string indicating the pressure class. If you cannot locate a legible marking on the pipe to determine the pressure class of the pipeline, contact Flexpipe.

**CONTACT US!**



If you cannot locate a legible marking on the pipe to determine the pressure class of the pipeline, please contact your Flexpipe Field Operations representative to assist you in determining the pressure class of the exposed pipeline through our toll-free number:

**+1 888 FLX PIPE (+1 888 359 7473)**

[www.flexpipesystems.com](http://www.flexpipesystems.com)

### 14.3.2 Tying into a Steel Pipeline

Flexpipe Spoolable Products can be connected to steel pipe by using a weldneck fitting, flanged end fittings, or custom end fittings. If welding, Flexpipe recommends welding weldnecks to steel pipes before the weldneck is inserted to the Flexpipe Spoolable Product. When using a weldneck fitting:

- Ensure adequate spacing of at least 60 cm (2 feet) on either side of weldneck fittings and at least 30 cm (1 foot) below the fitting for welding and crimping equipment.
- Weld the Flexpipe weldneck fitting(s) to the steel piping before inserting the weldneck to the Flexpipe Spoolable pipe:
  1. Carefully remove the O-rings.
  2. Weld the weldneck to the mating steel pipe prior to inserting the Flexpipe Spoolable Product into the weldneck.
  3. Allow the weldneck to cool down to below 60°C (140°F).

4. Check that the O-rings are still in good condition and inspect for damage prior to installation. If needed, use the spare O-rings provided in the Pelican case in the crimp kit or contact Flexpipe for spare O-rings.
5. Install the O-rings onto the weldneck mandrel.
6. Insert and crimp the Flexpipe Spoolable Products.

While not recommended, if welding a weldneck that has previously been installed on Flexpipe Spoolable Products:

- Ensure the weldneck and the steel pipe are laid horizontally or with the weldneck at a higher elevation than the steel pipe. This is to have the welding slag flow away from the weldneck.
- Protect the Flexpipe Spoolable Products with welding blankets and/or wet rags during the welding process. This is to prevent slag and sparks from damaging the Flexpipe piping. If possible, use a water-soluble plug to protect the pipe bore from slag and sparks.
- Monitor the weldneck for excessive heat using a temperature gun during the welding process. Ensure the temperature of the weldneck sleeve remains below 60°C (140°F) for FP/FC and below 82°C (180°F) for FP HT.

## 15. Returning Materials

### 15.1 Empty Reel Returns

Empty reels must be returned to Flexpipe in good condition. Flexpipe will charge a deposit on them if the reels are not returned in compliance with the terms and conditions listed on the sales order acknowledgement.

#### CAUTION!



Do not lift the empty reels by the angle iron or wooden cross members as it can damage the reels. Follow proper lifting techniques outlined in **Section 2.2**.

To return empty reels:

1. Call the Project Coordinator or the Receiver for an RMA number (Return Materials Authorization number)
2. Book an unloading time
3. Consult Flexpipe Trucking Policy for shipping instructions (see **Appendix B: Flexpipe Trucking Policy**)
4. 8-ft hybrid reels can be returned either assembled or disassembled. All other reels must be returned assembled.
5. It is recommended to disassemble reels per Flexpipe document number 14-4199. Contact Flexpipe for the Reel Break Down SOP. Breaking down reels can significantly save on shipping costs.

## 15.1.1 Empty Assembled Reels

Flexpipe reels are available with either wood or metal traverse bars.

Empty assembled reels with wooden traverse bars must be loaded in a vertical manner due to safety reasons. Empty assembled reels with steel traverse bars may be loaded either vertically or horizontally on the trailer. A maximum of two assembled 4-ft reels with steel traverse bars can be horizontally stacked together.

Unassembled reels may not be stacked on top of empty assembled reels, or vice versa, due to safety reasons.



**Figure 269: Unacceptable Load of Empty Reels**  
(flanges on top of reels)



**Figure 270: Unacceptable Load of Empty Reels**  
(wooden traverse reels in wrong orientation)



**Figure 271: Acceptable Load Of Assembled 4' Reels**



**Figure 272: Acceptable Load Of Assembled 8' Reels**

## 15.1.2 Empty Unassembled Reels

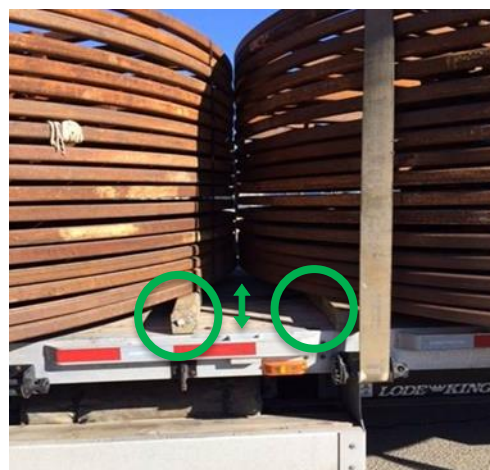
Empty unassembled reels have had the wood traverse bars taken out and the reel flanges must be laid down horizontally and stacked neatly up to 9 reels per stack. Steel flanges must be stacked on top of wood dunnage to allow unloading with a forklift. Unassembled reels should be loaded per the figure below. If the empty unassembled reels are not laid straight, warping and damage may occur. Any metal that protrudes from a flange must not interfere with other parts of another flange. Empty unassembled reels must not be returned to a Flexpipe facility in a vertical manner due to serious safety concerns during the unloading and handling processes. Return the reel flanges and steel traverses only. Wood traverses are not to be returned to Flexpipe.



**Figure 273: Acceptable Load of Unassembled Reels**



**Figure 274: Unacceptable Load of Unassembled Reels**



**Figure 275: Reels Stacked on Wood Dunnage**

## 15.2 Returning Reels with Remaining Pipe

The balance of Flexpipe Spoolable Products remaining on the reel may be eligible for refund. Consult the terms and conditions outlined on the sales order acknowledgement to determine if pipe returns meet the minimum length and/or timeframe eligible for refund/credit.

When returning reels that still have pipe on them, the reels must be transported in a vertical position. Reels of pipe that are returned in a horizontal position cannot be unloaded safely or without potential product damage at Flexpipe and will be refused unloading.

Prior to shipping the pipe, confirm the reinforcements at the pipe end are dry and then cap the pipe ends. Refer to **Section 5**. Returned pipe will be checked to confirm that pipe ends have been capped to prevent water ingress.

Flexpipe will not be liable for any extra costs incurred by the carrier or customer in the event that a truck is refused unloading due to material being returned in an inappropriate manner.

If pipe returns do not meet the minimum length requirement, a disposal fee may be assessed.



**Figure 276: Acceptable Load of Returned Pipe**



**Figure 277: Unacceptable Load of Returned Pipe**

## 15.3 Rental Equipment and Accessories Return

Refer to the Crimp Kit Inspection Form in the Large Pelican Case of the Crimp Kit to ensure that all equipment is included in the kit when it is being returned. There is also a copy of a blank form in the **Appendix D: Rental Equipment Inspection Form** of this guide for reference. Arrange the equipment inside the crate in the same manner as it was received.

If equipment needs to be inspected before returning, please contact Flexpipe for inspection forms.

If the rental equipment is returned with damaged or missing equipment, additional charges will be applied.



**Figure 278: Acceptable Rental Kit Return Condition**



**Figure 279: Unacceptable Rental Kit Return Condition**

## 15.4 Pipe Storage

A per reel storage and handling fee will be charged for any customer-owned pipe that is stored by Flexpipe and subsequently returned to Flexpipe. These fees will be deducted from the reel deposit. Consult the terms and conditions on the sales order acknowledgement for further information on storage and handling fees.



## 16. Glossary of Flexpipe Terminology

--- A ---

### A-Frame



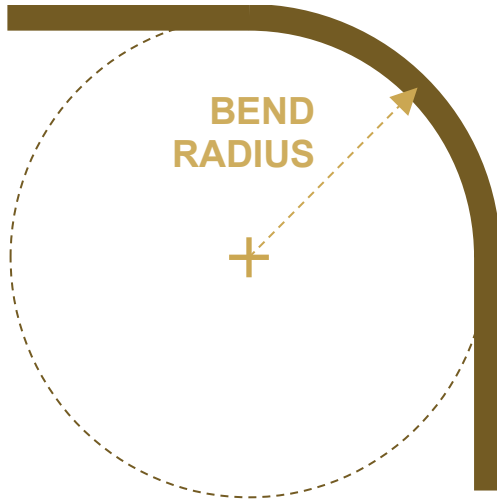
Flexpipe A-Frame is a piece of field equipment available for rental. When a reel of Flexpipe Spoolable Product is loaded into the A-frame, it allows for easy deployment of the pipe. A-Frames are available in 4-foot and 8-foot wide models. 4-foot reels can be mounted to 8-foot A-Frames with the use of the large spacers.

### A-Frame Spacers

Spacers are provided with every A-Frame and must always be used to center a reel of pipe onto the A-Frame unit. There are two sets of spacers provided with each 8-foot A-Frame: one short pair to mount an 8-foot reel onto the A-Frame and one long pair to mount a 4-foot reel onto the A-Frame. 4-foot A-Frames will only have the short pair of spacers.

--- B ---

### Bend Radius



The minimum bend radius is a measurement to ensure that the pipe is not bent too much which poses a risk of kinking and damaging the pipe. The bend radius is a measurement taken from the center point of the circle that the pipe is bent around to any point on the circumference of the circle. The tighter the bend the smaller the bend radius measurement.

### Burst Test

A short-term destructive test performed on Flexpipe Spoolable Products to verify the pressure capability of the product by pressuring the pipe up to burst. Every reel of Flexpipe Spoolable Products is burst tested to ensure that every reel of pipe is manufactured to its full pressure rating.

--- C ---

### Chain / Rated Chain

Chain that is used for securing loads for transport should be in good condition and rated appropriately for the service. Any chain that is used for lifting equipment must be in good condition, rated and certified for the anticipated load.

## Crimp Fittings

The Flexpipe crimp fitting is a steel connection used to attach one reel of Flexpipe Spoolable Product to another or to transition to steel piping. Standard crimp fittings are couplings, flanges, and weldnecks.

## Crimp

A process which involves radially deforming steel to secure a connection. Flexpipe uses a crimp-style of fitting to connect Flexpipe Spoolable Products to itself or steel piping. The crimp is performed by radially deforming a steel sleeve that compresses the pipe between a mandrel and the sleeve, both of which contain one-way teeth to ensure that the pipe cannot be pulled out from the crimped fitting.

## Crimper

A crimper is a piece of hydraulic equipment used at high pressure to radially deform the Flexpipe fittings to make a pipe joint.

## Coil(s)

Horizontally wound reel-less packaging of Flexpipe Spoolable Products used to transport pipe to site.

--- D ---

## Deployment Trailer



A Deployment trailer is a hydraulic trailer that can independently load a pipe reel. It is used to deploy or transport reels of Flexpipe Spoolable Products. Deployment trailers are available for rent or sale from Flexpipe.

## Drop-deck Trailer / Step-deck Trailer



A drop-deck trailer (also called a step-deck trailer) is a type of trailer with a low deck to allow for taller loads.

--- E ---

## EL Fittings/Extended Length Fittings

An acronym for Extended Length Fittings which are installed on all Flexpipe Spoolable Products, and are required on FC and FP HT. This term refers to the extended length fitting only, in contrast to a Standard Length Flexpipe fitting.

## Electroless Nickel Coating

Flexpipe uses an electroless nickel coating on all its carbon steel fittings (except for weldneck fittings) to protect the carbon steel against internal corrosion to complete the corrosion-free pipeline system. Nickel coating is found to be a very durable, corrosion resistant coating that withstands erosion well.

--- F ---

**FC**

An acronym for FlexCord. FlexCord has a steel cord reinforcement layer, and is suitable for service up to 60°C/140°F.

**Fibers / Fibres**

The fiber reinforcement layer in FP and FP HT is made up of glass filaments that are grouped together into strands. The fibers are used in FP and FP HT to provide the pressure capability of the product.

**FP**

An acronym for FlexPipe. FP has a fiber reinforcement layer, and is suitable for service up to 60°C/140°F

**FP HT**

An acronym for FlexPipe High Temperature. FP HT has a fiber reinforcement layer, and is suitable for service up to 82°C/180°F.

**FP150**

Designation for the family of Flexpipe products suitable for 150 ANSI (2,068 kPa / 300 psi) service up to 60°C/140°F. The FP150 product line is available in 3" and 4" NPS (nominal pipe size).

**FP300**

Designation for a discontinued family of Flexpipe products suitable for 300 ANSI (5,171 kPa / 750 psi) service. The FP300 product line was available in 2", 3" and 4" NPS before it was succeeded by the FP301 family of Flexpipe products.

**FP301**

Designation for the family of Flexpipe products suitable for 300 ANSI (5,171 kPa / 750 psi) service up to 60°C/140°F. The FP301 product line is available in 2", 3", and 4" NPS.

**FP301HT**

Designation for the family of Flexpipe products suitable for 300 ANSI (5,171 kPa / 750 psi) service up to 82°C/180°F. The FP301HT product line is available in 2", 3" and 4" NPS. The standard color is gray.

**FP601**

Designation for the family of Flexpipe products suitable for 600 ANSI (10,342 kPa / 1,500 psi) service up to 60°C/140°F. The FP601 product line is available in 2", 3" and 4" NPS.

**FP601HT**

Designation for the family of Flexpipe products suitable for 600 ANSI (10,342 kPa / 1,500 psi) service up to 82°C/180°F. The FP601HT product line is available in 2", 3", 4", and 5" NPS. The standard color is gray.

**FC801**

Designation for a discontinued family of Flexpipe products suitable for 13,790 kPa / 2,000 psi service up to 60°C/140°F. The FC801 product line was available in 3" and 4" NPS before it was succeeded by the FC901 family of Flexpipe products.

## FC901

Designation for the family of Flexpipe products suitable for 15,513 kPa / 2,250 psi service up to 60°C/140°F. The FC901 product line is available in 3" and 4" NPS.

## FC901 AB

Designation for the family of Flexpipe products suitable for 15,513 kPa / 2,250 psi service up to 60°C/140°F in shallow water applications. AB is an acronym for anti-buoyant. The FC901 AB product line is available in 2" NPS.

--- H ---

## Hybrid Reels

Hybrid Reels are used to transport Flexpipe Spoolable Products similarly to the standard steel reels. Hybrid reels use wooden traverses on the flanges and can be disassembled to decrease backhauling charges.

## Hydraulic Pump Unit (HPU)

A Hydraulic Pump Unit is a piece of equipment used to generate hydraulic pressure to power the installation equipment.

--- J ---

## Jacket

The outer protective HDPE layer of Flexpipe Spoolable Products protects the reinforcement layer from damage during shipment, storage, installation, and service.

--- K ---

## Kinks / Kinking

A kink is a severe localized deformation of the pipe including wrinkling, bulging, or sharp creases. Although there are a few different mechanisms that can result in kinking of pipe, a kink can occur to Flexpipe Spoolable Products when the minimum bend radius of the product is not adhered to. Kinking Flexpipe Spoolable Products is damaging to the pressure handling capability of the pipe and should be avoided.

--- L ---

## Lift Plates



Lift Plates are four yellow or green plates that are welded to each side of the reels. The lift plates serve as a secure attachment location for slings or rated chain to lift full, partial, or empty reels of Flexpipe Spoolable Products.

## Liner

The HDPE liner is the inner most layer of Flexpipe Spoolable Products. This layer acts as a conduit (bladder) to transport fluids and gases.

--- M ---

## Mandrel

The inner most section of the Flexpipe crimp fitting. The mandrel is inserted into the bore of Flexpipe Spoolable Products pipe to complete a connection.

## Mandrel Insertion Press (MIP)

The mandrel insertion press is a piece of hydraulic equipment that is used to insert the Flexpipe fitting into the pipe.

## Memory

A generic term which refers to all spoolable pipes' tendency to re-spool itself after it has been deployed. Flexpipe Spoolable Products' amount of memory, or force required to restrict the loose end to avoid re-spooling, is temperature dependent.

--- N ---

## Nominal Pipe Size (NPS)

NPS refers to a set of standard pipe sizes in non-specific terms and identifies the diameter of the pipe with a non-dimensional number

--- P ---

## Petrolatum Tape

A wax based anti-corrosion tape used to protect the fitting's external surface from water and other contaminants, i.e. Denso tape. This product is available in two grades: LT Tape (low temperature) and Hotline Tape (high temperature).

## Pipeline Tape

Also called corrosion protective pipeline tape. An adhesive backed polymer tape used to protect the petrolatum tape, i.e. Polyken #908 (black color), 3M Scotchrap Tape 50 (black color), 3M Preservation Sealing Tape 4811 (white color), or Patco 5400 (white color).

## Print String



The print string is printed directly on to every reel of Flexpipe Spoolable Products and displays information about the pipe such as remaining length on reel, pipe size, pressure class, manufacturing run number (also known as batch, lot, or serial number), and manufactured date.

## Protective Paste

A wax based anti-corrosion paste used to protect the pipe reinforcement layers from water and other contaminants, i.e. Denso paste HT (high temperature).

--- R ---

## Reel(s)

Reels are used by Flexpipe to spool its Flexpipe Spoolable Products to aid in delivery and deployment. Reels are made up of a center hub that the Flexpipe Spoolable Products are wrapped around and two flange ends (one on each side of the hub) to keep the Flexpipe Spoolable Products on the reel, provide lifting points, and to protect from damage.

## Remote Valve (RV)

The remote valve is the valve used to control the flow of the pressurized fluid from the hydraulic pump unit to the installation equipment.

## Riser Chute

Riser chutes are the steel frame that supports the Flexpipe Spoolable Products as it transitions from buried to above grade installation. The combination of the riser chute along with the piles and the Flexpipe Spoolable Products is referred to as the riser assembly.

--- S ---

## Sleeve

The sleeve is the part of the Flexpipe fitting that inserts over the Flexpipe Spoolable Products when the fitting is pushed onto the pipe. The sleeve is then crimped onto the pipe with use of the Flexpipe crimping equipment to complete a connection.

## Slings



Slings are typically available in a variety of lengths and lift ratings. Slings are the preferred method for lifting reels of Flexpipe Spoolable Products and are commonly available at most oilfield supply stores. Ensure that the proper length and rating is used for the task being performed.

## Steel Cord

Steel cord is utilized in FC construction. It is a series of galvanized strands designed for optimum performance and corrosion resistance.

--- T ---

## Three-Position Remove Valve

See "Remote Valve".

## Turn Table

A turn table is a piece of equipment used to rotate the coils horizontally to allow pipe deployment.

## Appendix A: Product Data Sheets

### A.1: FP and FP HT Product Data Sheet

MAXIMUM OPERATING PRESSURE		FP150		FP301 / FP301 HT			FP601 / FP601 HT			
		2,068 KPA / 300 PSI		5,171 KPA / 750 PSI			10,342 KPA / 1,500 PSI			
Nominal Size		3"	4"	2"	3"	4"	2"	3"	4"	5"
Outside Diameter	<i>mm</i>	95	122	69	97	124	73	101	130	165.3
	<i>inch</i>	3.75	4.80	2.73	3.80	4.89	2.86	3.96	5.11	6.5
Inside Diameter	<i>mm</i>	77	99	54	77	99	54	77	99	124.5
	<i>inch</i>	3.02	3.90	2.12	3.02	3.90	2.12	3.02	3.90	4.90
Weight	<i>kg/m</i>	2.6	4.0	1.7	3.0	4.9	2.4	4.3	6.9	11.8
	<i>lbs/ft</i>	1.7	2.7	1.1	2.0	3.3	1.6	2.9	4.6	7.8
Min. Bend Radius (Operational)	<i>m</i>	1.8	2.1	1.2	1.8	2.1	1.2	1.8	2.1	3.0
	<i>ft</i>	6	7	4	6	7	4	6	7	10
Length / Reel*	<i>m</i>	760	750	1,100	760	735	1,100	700	570	360
	<i>ft</i>	2,495	2,460	3,610	2,495	2,410	3,610	2,300	1,870	1,179
Reel Diameter	<i>m</i>	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
	<i>ft</i>	12	12	12	12	12	12	12	12	12
Reel Width	<i>m</i>	1.2	2.4	1.2	1.2	2.4	1.2	1.2	2.4	2.4
	<i>ft</i>	4/8 <sup>†</sup>	8	4/8 <sup>†</sup>	4/8 <sup>†</sup>	8	4/8 <sup>†</sup>	4/8 <sup>†</sup>	8	8
Reel Weight – Full*	<i>kg</i>	2,656	4,150	2,550	2,960	4,750	3,320	3,690	5,090	5,087
	<i>lbs</i>	5,855	9,150	5,620	6,530	10,475	7,320	8,135	11,210	11,215
Reel Weight – Empty	<i>kg</i>	680	1,150	680	680	1,150	680	680	1,150	912
	<i>lbs</i>	1,500	2,530	1,500	1,500	2,530	1,500	1,500	2,530	2,010
Fitting Outside Diameter	<i>mm</i>	110.7	139.7	81.5	110.7	139.7	85.1	115.6	144.3	186.4
	<i>inch</i>	4.36	5.50	3.21	4.36	5.50	3.35	4.55	5.68	7.34
Fitting Inside Diameter	<i>mm</i>	63.5	85.9	44.5	63.5	85.9	44.5	63.5	85.9	107.7
	<i>inch</i>	2.50	3.38	1.75	2.50	3.38	1.75	2.50	3.38	4.2

\*Lengths and reel weights are approximate as they may vary depending on the manufacturing run.

†Noted 8ft reels are used only for international shipments.

## A.2: FC Product Data Sheet

MAXIMUM OPERATING PRESSURE		FC901 AB	FC901	
		15,520 KPA / 2,250 PSI	15,520 KPA / 2,250 PSI	
Nominal Size		2"	3"	4"
Outside Diameter	<i>mm</i>	75.1	100	129
	<i>inch</i>	2.955	3.95	5.07
Inside Diameter	<i>mm</i>	53.8	77	99
	<i>inch</i>	2.12	3.02	3.90
Weight	<i>kg/m</i>	4.82	5.1	8.4
	<i>lbs/ft</i>	3.24	3.4	5.6
Min. Bend Radius (Operational)	<i>m</i>	1.2	1.8	2.1
	<i>ft</i>	4	6	7
Length / Reel*	<i>m</i>	750	615	525
	<i>ft</i>	2,460	2,018	1,722
Reel Diameter	<i>m</i>	3.7	3.7	3.7
	<i>ft</i>	12	12	12
Reel Width	<i>m</i>	2.4	1.2	2.4
	<i>ft</i>	8	4	8
Reel Weight – Full*	<i>kg</i>	4,778	3,817	5,560
	<i>lbs</i>	10,535	8,415	12,173
Reel Weight – Empty	<i>kg</i>	1,150	680	1,150
	<i>lbs</i>	2,530	1,500	2,530
Fitting Outside Diameter	<i>mm</i>	87.1	115.6	144.3
	<i>inch</i>	3.43	4.55	5.68
Fitting Inside Diameter	<i>mm</i>	44.5	63.5	85.9
	<i>inch</i>	1.75	2.50	3.38
Length / Coil*	<i>m</i>	750	-	-
	<i>ft</i>	2,460	-	-
Coil Weight*	<i>kg</i>	3,615	-	-
	<i>lbs</i>	7,970	-	-

\*Lengths and reel/coil weights are approximate as they may vary depending on the manufacturing run.



## A.3: FP Coil Data Sheet

Nominal Size	FP150		FP301			FP601			
	3"	4"	2"	3"	4"	2"	3"	4"	
Pipe Length / Coil	<i>m</i>	1200	770	1725	1200	770	1500	1100	700
	<i>ft</i>	3935	2525	5659	3937	2525	4921	3608	2295
Coil Height w/ Pallet	<i>m</i>	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
	<i>in</i>	95	95	95	95	95	95	95	95
Coil Outside Diameter	<i>m</i>	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
	<i>in</i>	144	144	144	144	144	144	144	144
Coil Inner Diameter	<i>m</i>	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	<i>in</i>	100	100	100	100	100	100	100	100
Pallet Height	<i>mm</i>	230	230	230	230	230	230	230	230
	<i>in</i>	9	9	9	9	9	9	9	9
Pallet Weight	<i>kg</i>	230	230	230	230	230	230	230	230
	<i>lbs</i>	510	510	510	510	510	510	510	510
Pallet & Coil Weight	<i>kg</i>	3341	3295	4114	3841	4000	5205	4977	4686
	<i>lbs</i>	7350	7250	9050	8450	8800	11450	10950	10310
Wraps Per Layer		22	17	21	22	17	21	22	17
Layers Per Coil		7	4	10	7	4	10	7	4

NOTE: Minimum Required Lifting Height for Coil Lifting Equipment is thirty feet (30' 0").

## A.4: FC Coil Data Sheet - Obsolete

		800 ANSI (FC801)	
		13,790 kPa 2,000 psi	
Nominal Size:		3"	4"
Pipe Length / Coil	Metric (m)	615	525
	Imperial (ft)	2017	1722
Coil Height w/ Pallet	Metric (m)	1.9	2.4
	Imperial (ft)	6.3	8
Coil Outside Diameter	Metric (m)	3.7	3.7
	Imperial (ft)	12	12
Coil Inner Diameter	Metric (m)	2.5	2.5
	Imperial (in)	100	100
Pallet Height	Metric (mm)	230	230
	Imperial (in)	9	9
Pallet Weight	Metric (kg)	230	230
	Imperial (lbs)	510	510
Pallet & Coil Weight	Metric (kg)	3356	4726
	Imperial (lbs)	7400	10420
Wraps Per Layer		14	17

## A.5: FP300 Product Data Sheet - Obsolete

Maximum Operating Pressure @ 60°C or 140°F		300 ANSI (FP300)		
		5,171kPa 750 psi		
Nominal Size:		2"	3"	4"
Outside Diameter	Metric (mm)	71	99	127
	Imperial (inches)	2.80	3.90	5.00
Inside Diameter	Metric (mm)	54	77	99
	Imperial (inches)	2.12	3.02	3.90
Weight	Metric (kg/m)	2.1	3.5	5.5
	Imperial (lbs/ft)	1.4	2.4	3.7
Min. Bend Radius (operational)	Metric (m)	1.2	1.8	2.1
	Imperial (ft)	4	6	7
Length / Reel*	Metric (m)	1,000	750	750
	Imperial (ft)	3,281	2,461	2,461
Reel Diameter	Metric (m)	3.7	3.7	3.7
	Imperial (ft)	12	12	12
Reel Width	Metric (m)	1.2	1.2	2.4
	Imperial (ft)	4	4	8
Reel Weight – Full*	Metric (kg)	2,767	3,331	5,261
	Imperial (lbs)	6,100	7,300	11,600
Reel Weight – Empty	Metric (kg)	680	680	1,134
	Imperial (lbs)	1,500	1,500	2,500
Fitting Outside Diameter	Metric (mm)	78.5	106.5	136.2
	Imperial (inches)	3.11	4.21	5.37
Fitting Inside Diameter	Metric (mm)	44.5	63.5	85.9
	Imperial (inches)	1.75	2.50	3.38
A-Frame Only Weight	Metric (kg)	656	656	931
	Imperial (lbs)	1,444	1,444	2,050
Full Reel with A-Frame Weight*	Metric (kg)	3,423	3,987	6,192
	Imperial (lbs)	7,544	8,744	13,650

## A.6: FC801 Product Data Sheet - Obsolete

		<b>800 ANSI (FC801)</b>	
Maximum Operating Pressure @ 60°C or 140°F		<b>13,790 kPa 2,000 psi</b>	
		Nominal Size:	
		3"	4"
Outside Diameter	Metric (mm)	99	128
	Imperial (inches)	3.91	5.03
Inside Diameter	Metric (mm)	77	99
	Imperial (inches)	3.02	3.90
Weight	Metric (kg/m)	5.1	8.6
	Imperial (lbs/ft)	3.5	5.8
Min. Bend Radius (operational)	Metric (m)	1.8	2.1
	Imperial (ft)	6	7
Length / Reel*	Metric (m)	615	525
	Imperial (ft)	2,018	1,722
Reel Diameter	Metric (m)	3.7	3.7
	Imperial (ft)	12	12
Reel Width	Metric (m)	1.2	2.4
	Imperial (ft)	4	8
Reel Weight – Full*	Metric (kg)	3,855	5,669
	Imperial (lbs)	8,500	12,500
Reel Weight – Empty	Metric (kg)	680	1,134
	Imperial (lbs)	1,500	2,500
Fitting Outside Diameter	Metric (mm)	115.6	144.3
	Imperial (inches)	4.55	5.68
Fitting Inside Diameter	Metric (mm)	63.5	85.9
	Imperial (inches)	2.50	3.38
A-Frame Only Weight	Metric (kg)	656	931
	Imperial (lbs)	1,444	2,050
Full Reel with A-Frame Weight*	Metric (kg)	4,511	6,600
	Imperial (lbs)	9,944	14,550

## **Appendix B: Flexpipe Trucking Policy**

Flexpipe will not assume responsibility for any damage if material is not loaded properly at origin/destination, or if it falls off a trailer due to proper tie down procedures not being followed. Contact Flexpipe for Flexpipe Carrier Policy 40-4080 for more details including proper loading of materials in order to avoid harm or injury.

A driver will not be loaded or unloaded unless they have a booked time at Flexpipe. To book a slot, please contact the appropriate department:

**Calgary, AB - 3501 54th Ave** - Inbound shipments: Receiving Department: (403) 539-8413

**Calgary, AB - 3501 54th Ave** - Outbound shipments: Shipping Department: (403) 539-8412

**Calgary, AB - 100th Ave** - Flex Flow Inbound/Outbound shipments: (403) 539-8412

**Grande Prairie, AB** - Inbound/Outbound shipments: (780) 402-4765

**Estevan, SK** - Inbound/Outbound shipments: (306) 861-0509

**Dickinson, ND** - Inbound/Outbound shipments: (701) 226-9505

**Grand Junction, CO** - Inbound/Outbound shipments: (970) 243-0067

**Myton, UT** - Inbound/Outbound shipments: (435) 722-4258

**Big Wells, TX** - Inbound/Outbound shipments: (830) 968-0099

**Ennis, TX** - Inbound/Outbound shipments: (214) 949-2897

**Midland, TX** – Inbound/Outbound shipments: (214) 949-2897

Trucks scheduled for outbound or backhaul shipments may also be pre-booked by Flexpipe Project Coordinators. In those cases, it is unnecessary to book another schedule. Unscheduled drivers will have to wait until there is an opening in the schedule. Any charges for waiting due to unscheduled trucks will not be incurred by Flexpipe.

## Appendix C: Field Forms

### C.1: Daily Field Report



FIELD OPERATIONS

Form #: 14-0010  
 Revision #: 12.2  
 Revision Date: September 12, 2019  
 PAGE: 1 of 3

Daily Field Report – North America

Customer Information										
Customer Name	Date			(m/ft) Installed						
Job Location	Sales Order #			Site Weather						
LSD	Customer Rep.			Pictures Taken			<input type="checkbox"/> YES <input type="checkbox"/> NO			
Produced Fluid	Contractor			Sketch Provided			<input type="checkbox"/> YES <input type="checkbox"/> NO			
Application (Flow Line, Transfer, SWD, etc.)				Crimp Kit #						
Fitting Protection & Checklist Reminder										Comments
Denso Tape Fittings	<input type="checkbox"/> Accept	<input type="checkbox"/> Decline	Any kinks have been repaired correctly				<input type="checkbox"/> YES	<input type="checkbox"/> NO		
Polyken Tape Fittings	<input type="checkbox"/> Accept	<input type="checkbox"/> Decline	All ends of pipe night capped				<input type="checkbox"/> YES	<input type="checkbox"/> NO		
Installed Anode Kit	<input type="checkbox"/> Accept	<input type="checkbox"/> Decline	Equip. Operates @ 9000 PSI				<input type="checkbox"/> YES	<input type="checkbox"/> NO		
Educated on Pigging Tags	<input type="checkbox"/> YES	<input type="checkbox"/> NO	Equip. Operates @ 8500 PSI				<input type="checkbox"/> YES	<input type="checkbox"/> NO		
Tracer Wire Used	<input type="checkbox"/> YES	<input type="checkbox"/> NO	Surface Lines are padded and secured				<input type="checkbox"/> YES	<input type="checkbox"/> NO		
Fitting Information										
#	Fitting Type	GPS/LSD (Format or Unit Used)	Wetness Checked %	Fittings Inspected (no damage, vent hole, correct size)	Pipe Insertion Distance (inches)	Crimp Locations (inches)	Pipe End Denso Pasted	Clamp min. of 4" from sleeve end	Run #, (m) Mark Pipe Desc.	Run #, (m) Mark Pipe Desc.
	Choose an item.			Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.		
Serial #:		Name of Installation Tech		Signature		Training #		Expiry Date		
	Choose an item.		Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.			
Serial #:		Name of Installation Tech		Signature		Training #		Expiry Date		
	Choose an item.		Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.			
Serial #:		Name of Installation Tech		Signature		Training #		Expiry Date		
	Choose an item.		Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.			
Serial #:		Name of Installation Tech		Signature		Training #		Expiry Date		
	Choose an item.		Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.			
Serial #:		Name of Installation Tech		Signature		Training #		Expiry Date		
	Choose an item.		Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.			
GPS Coordinates are not exact, they are usually between 3-15m/10-49ft										
Comments:										

Upon Completion email back to the Oil & Gas Company as well as Shawcor  
 Canada - [CompositeProductionFieldCA@shawcor.com](mailto:CompositeProductionFieldCA@shawcor.com)  
 US - [Dailyfieldreports@flexpipesystems.com](mailto:Dailyfieldreports@flexpipesystems.com)

## C.2: Materials Arriving Checklist



FIELD OPERATIONS

FORM #: 14-0014  
 Revision #: 3.2  
 Revision Date: June 1, 2020  
 PAGE: Page 1 of 1


<b>Title:</b>			Materials Arriving Checklist Per Shipment
<b>Company Name</b>			<b>Did the load arrive on time</b>
<b>Received By</b>			
<b>Arrival Date</b>			
<b>YES</b>	<b>NO</b>	<b>N/A</b>	<b>1. Pipe Arriving on Site</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Any <b>load securements (chains, straps, hooks, etc.) touching the pipe</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Correct <b>Print String &amp; Product Identification, Reel Length</b> – Matches Shipping Documents
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Any noticeable <b>kinks/gouges</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Any visible <b>scratches</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Reels</b> are in good condition; no damage to flange or welds
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>End capped</b> and caps in good condition
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Reels are <b>properly chocked/blocked</b> once unloaded
<b>YES</b>	<b>NO</b>	<b>N/A</b>	<b>2. Fittings Arriving on Site</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Correct <b>quantity</b> - Matches Shipping Documents
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Correct flange <b>ANSI</b> rating
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Fitting type</b> – matches the grade and size of pipe being installed. This can be verified with the sticker on the sleeve.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Sleeves</b> have no dents?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Coating Chipped</b> - check the inside surfaces for chipped nickel coating. Check the coating inside the mandrel, around the nose of the mandrel for damage or scratches.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Vent Hole</b> (two on couplers) - present & free of debris.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>O rings</b> (two beneath each crimp sleeve) – free of debris, cuts and damages
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Mandrel</b> - check that mandrels are properly positioned in the center of the sleeve.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is there (1) <b>pigging tag</b> per termination fitting ordered (weldneck/flange)
<b>YES</b>	<b>NO</b>	<b>N/A</b>	<b>3. Consumables &amp; Risers Arriving on Site</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Correct quantity of <b>Denso paste, Denso tape</b> and <b>pipeline tape</b> (Patco, Polyken, 3M, etc.) – Matches Shipping Documents
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Correct number of rolls of tracer wire
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Correct number of <b>anode kits &amp; correct size</b> (2", 3", 4" or 5")
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Correct number of <b>end caps</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Correct Riser Size and Type</b> (2", 3", 4" or 5" and 45 or 90 degrees)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	One <b>Hardware Set</b> per riser included
<b>YES</b>	<b>NO</b>	<b>N/A</b>	<b>4. Rentals Arriving on Site</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>All items received</b> match shipping documents – Crimp kit, A-frame, Pull Tools and/or Rental Trailer. Verify the <b>Outgoing Inspection forms</b> provided.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did <b>spacers</b> come with the A-frame/Trailer?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All rentals received in <b>good condition</b> ?
<b>YES</b>	<b>NO</b>	<b>N/A</b>	<b>5. Other Information to Consider?</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Contact your Shawcor CPS representative if you have any questions or if NO is checked on any line.



## Appendix D: Rental Equipment Inspection Forms


### D.1: Crimp Kit Inspection Form

	<b>32- Rentals</b>		
	<b>Crimp Kit Inspection Form</b>		
	Revision Date: 5-Sep-18	Document #: 32-4026	Revision #: 17
<b>Customer Order #:</b> _____			
<b>Pipe Size:</b> _____		<b>Customer:</b> _____	
<b>Outgoing By:</b> _____		<b>Date of Outgoing Inspection</b>	
<b>Verified By:</b> _____		<b>Date of Incoming Inspection</b>	
<b>Incoming By:</b> _____			
<b>Verified By:</b> _____			
<b>Generation 2 - Parts Checklist</b>			
	Motor Oil	Qty/Kit	Outgoing
	Hydraulic Fluid	1	Incoming
	Denso Paste	1	_____
	Motor Assembly Grease	1	_____
	2" Reamer and 2" Reamer Cup, ensure: sharp/tight/drill end not worn	1	_____
	3"/4" Reamer ensure: sharp/tight/drill end not worn	1	_____
	3" Reamer Cup, ensure: cup is in good shape	1	_____
	4" Reamer Cup, ensure: cup is in good shape	1	_____
<b>Clamps</b>			
Accessory	Press End Adapter	1	_____
2" Accessory	2" Crimp Adapter Clamp with Pin	1	_____
2" Accessory	<b>2" FC901 AB Crimp Adapter Clamp with Pin</b>	1	_____
2" Accessory	2" Pipe Centering Tool	1	_____
2" Accessory	2" FP601 Pipe Clamp	1	_____
2" Accessory	2" FP301 Pipe Clamp	1	_____
2" Accessory	<b>2" FC901 AB Pipe Clamp</b>	1	_____
3" Accessory	3" Crimp Adapter Clamp with Pin	1	_____
3" Accessory	3" Pipe Centering Tool	1	_____
3" Accessory	3" FP150 Pipe Clamp	1	_____
3" Accessory	3" FP301 Pipe Clamp	1	_____
3" Accessory	3" FP601 Pipe Clamp	1	_____
4" Accessory	4" Crimp Adapter Clamp with Pin	1	_____
4" Accessory	4" FP150 Pipe Clamp	1	_____
4" Accessory	4" FP301 Pipe Clamp	1	_____
4" Accessory	4" FP601 Pipe Clamp	1	_____
<b>Kit # 1: Spare Misc Kit- Gen 2</b>			
Envelope #1:	1-Jumper Hose, 1-Swing Eye Bolt & Swivel Flange Nut, 2-Quick Release Pins,	1	_____
	1-2" Reamer Cup Bolt, 1-3"&4" Reamer Cup Bolt, 2-Hair Pins, 1-Male&Female Quick Connector	1	_____
<b>DOCUMENTS</b>	Field Installation Manual Flexpipe Linepipe	1	_____
	Crimp Fittings Installation Reminder Checklist	1	_____
	Radial Piston Crimping Tool Mark 2 Manual	1	_____
	Hydraulic Pump Unit Manual	1	_____
	Mandrel Insertion Press / Refer to Field Installation Manual	1	_____
	4 Way Directional Valve Manual	1	_____
<b>Kit #2: 2" Die Kit - Gen 2 Crimper</b>			
	2" Dies	6	_____
	<b>2" Bolt:</b> 14 - 2" Die Bolts & Allen Key	1	_____
	<b>2" Mandrel O-Rings:</b> 6 - 2" O-Rings	1	_____
<b>Kit #3: 3" Die Kit - Gen 2 Crimper</b>			
	3" Dies	6	_____
	<b>3" Bolt:</b> 14 - 3" Die Bolts & Allen Key	1	_____
	<b>3" Mandrel O-Rings:</b> 6 - 3" O-Rings	1	_____
<b>Kit #4: 4" Die Kit - Gen 2 Crimper</b>			
	4" Dies	6	_____
	<b>4" Bolt:</b> 14 - 4" Die Bolts & Allen Key	1	_____
	<b>4" Mandrel O-Rings:</b> 6 - 4" O-Rings	1	_____


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1 of 2



		32-Rentals		
		Crimp Kit Inspection Form		
		Revision Date: 6-Sep-18	Document #: 32-4026	Revision #: 17
<b>Customer Order #:</b> _____	<b>Verify:</b>	<b>Outgoing</b>	<b>Incoming</b>	<b>Outgoing Weight</b>
<b>Crimper Serial #</b> _____		□	□	
<b>Pump Serial #</b> _____		□	□	
<b>Press Serial #</b> _____		□	□	
<b>Remote Hose Serial #</b> _____		□	□	
<b>Kit # 1: Spare Misc Kit- Gen 2 (Large Pelican Case)</b>		<b>Qty/Kit</b>	<b>Outgoing</b>	<b>Incoming</b>
Envelope #2: 2 Black or Yellow Sided Matching Wetness Meters		2	(B) (Y)	
MMD4E Attached Cap or Stick Calcheck Device		2		
WETNESS METER 06-4028 Wet Fibers Bulletin		1		
9V Battery (Battery Installed in Meters & 1 Spare)		3		
Wetness Meters and Calchecks Free of Cracks or Damage			Yes No	
Check Battery Voltage, <b>Operation</b> & Envelope is Sealed & Labeled			Yes No	
Envelope Opened				Yes No
<b>Generation 2 - Visual Inspection</b>		<b>Outgoing</b>		<b>Incoming</b>
	Equipment Cleaned	Yes	No	Yes No
	Crimper Free of Cracks or Damage	Yes	No	
	Frame Free of Cracks or Damage	Yes	No	
<b>CRIMPER</b>	Jumper Hoses Free of Cracks or Damage	Yes	No	
	Attached to Crimper 6 Dies & 12 Bolts	4" 3" 2"		Yes No
	Dies/Bolts Free of Damage	Yes	No	
	All Fasteners Tight	Yes	No	
	All Pins Attached	Yes	No	
	Top & Bottom Handles Attached	Yes	No	
	Free of Cracks or Damage	Yes	No	
<b>PRESS</b>	Cylinder Rods Free of Damage	Yes	No	
	Nuts on Cylinder Ends Tight	Yes	No	
	All Fasteners Tight	Yes	No	
	All Pins Attached	Yes	No	
<b>PUMP</b>	Engine Oil Level Checked & Topped Up <b>as needed</b>	Yes	No	
	Hydraulic Fluid Level Checked & Topped Up <b>as needed</b>	Yes	No	
	Fuel Level Checked & Topped Up <b>as needed</b>	Yes	No	
	Air Filter Checked & Changed <b>as needed</b>	Yes	No	
	Fuel Valve Closed	Yes	No	
	Inspect 15000psi Pressure Gauge	Yes	No	Yes No
	Pull Cord Assembly Check For Housing Cracks	Yes	No	Yes No
<b>REMOTE HOSE</b>	Free of Cracks or Damage	Yes	No	
	All Fasteners Tight	Yes	No	
<b>Generation 2 - Functional Testing</b>				
<b>PUMP</b>	Hour Meter Reading	_____		_____
	Gauge Serial #	_____		_____
	Gauge Certificate Matches Gauge # on Pump and is Valid	Yes	No	
	Engine Starts and Runs	Yes	No	
	Pump Holds Pressure	Yes	No	
<b>HOOK UP</b>				
<b>RUN PUMP &amp; PRESS</b>	Ends Parallel at Full Extension	Yes	No	
	Ends Parallel at Full Retraction	Yes	No	
	Check Relief Valve Settings - do not to exceed 3000 psi - open/close	Yes	No	
	Fittings Free of Leaks	Yes	No	
	All Dust Caps & Protectors in Place	Yes	No	
	All Valves Operate Correctly	Yes	No	
	Crimper has Full Range of Stroke and Full Pressure at Trial Crimp	Yes	No	
<b>HOOK UP</b>	Pressure Set at	_____		
<b>PUMP &amp; CRIMPER</b>	Leaks	Yes	No	


## D.2: A-Frame Inspection Form

	32-Rentals		
	<b>A-Frame Inspection Form</b>		
	Revision Date: 30-Aug-18	Document #: 32-4025	Revision #: 8

<b>Serial #:</b> _____	<b>Customer Order #:</b> _____	
<b>Outgoing By:</b> _____	<b>Customer:</b> _____	<b>Date of Outgoing Inspection</b> _____
<b>Verified By:</b> _____		<b>Date of Incoming Inspection</b> _____
<b>Incoming By:</b> _____		
<b>Verified By:</b> _____		

1441 lbs	4' A-Frame Inspection	Outgoing	Incoming
<b>Bar</b>	Bar on A-Frame in Saddle and Secured by Chains Bar is correct OD (4 1/2") and Length (68 1/2") Effects of wear allow 1/8" wear or 1/4" diameter	_____	_____
	Bar has Two End Flanges	_____	_____
	Bar is straight, no bends	_____	_____
	Bar is intact, no cracks, dents etc.	_____	_____
	Shaft Collars in Good Condition	_____	_____
<b>Spacers (Yellow)</b>	2-1 1/2" Short Spacers Present	_____	_____
	Free of Cracks or Damage	_____	_____
<b>Spacer Holder</b>	Spacers on Holder	_____	_____
	Safety Pin Present	_____	_____
<b>Top Gusset</b>	Free of Cracks or Damage	_____	_____
	Inspect Ratchet Load Binders Shackles & Hardware for tightness if Present	_____	_____
	Ratchet Load Binders attached and tight	_____	_____
	Chain in Good Condition	_____	_____
<b>Body</b>	Free of Cracks or Damage	_____	_____
	Alignment intact	_____	_____
	Welds intact	_____	_____
	Warning Label Attached and Legible	_____	_____
	Tracer Wire Bar intact	_____	_____
	1 or 2 Tracer Wire Bars	_____	_____
	Packing Slip	_____	Detached? _____
2046 lbs	8' A-Frame Inspection	Outgoing	Incoming
<b>Bar</b>	Bar on A-Frame in Saddle and Secured by Chains Bar is correct OD (4 1/2") and Length (128 1/2") Effects of wear allow 1/8" wear or 1/4" diameter	_____	_____
	Bar has Two End Flanges	_____	_____
	Bar is straight, no bends	_____	_____
	Bar is intact, no cracks, dents etc.	_____	_____
	Shaft Collars in Good Condition	_____	_____
<b>Spacers</b>	2-2" Short Spacers Present	_____	_____
	2-24" Long Spacers Present	_____	_____
<b>(Orange &amp; Blue)</b>	Free of Cracks or Damage	_____	_____
<b>Spacer Holder</b>	Spacers on Holder	_____	_____
	Safety Pin Present	_____	_____
<b>Top Gusset</b>	Free of Cracks or Damage	_____	_____
	Inspect Ratchet Load Binders Shackles & Hardware for tightness if Present	_____	_____
	Ratchet Load Binders attached and tight	_____	_____
	Chain in Good Condition	_____	_____
<b>Body</b>	Free of Cracks or Damage	_____	_____
	Alignment intact	_____	_____
	Welds intact	_____	_____
	Warning Label Attached and Legible	_____	_____
	Tracer Wire Bar intact	_____	_____
	1 or 2 Tracer Wire Bars	_____	_____
	Packing Slip	_____	Detached? _____

## D.3: Pull Tool Inspection Form

	32-Rental		
	<b>Pull Tool Inspection Form</b>		
	Revision Date: 30-Aug-18	Document #: 32-4027	Revision #: 4

Customer Order # : \_\_\_\_\_

Customer: \_\_\_\_\_

Outgoing By: \_\_\_\_\_ Date of Outgoing: \_\_\_\_\_

Verified By: \_\_\_\_\_

Incoming By: \_\_\_\_\_ Date of Incoming: \_\_\_\_\_

Verified By: \_\_\_\_\_

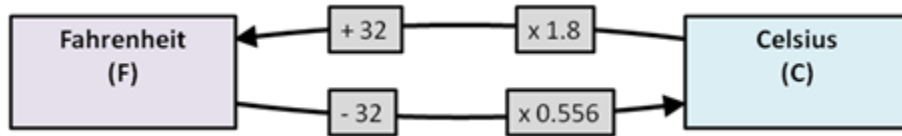
Weight if shipped separately from crate \_\_\_\_\_

Internal Pull Tool	Serial # _____	Outgoing	Incoming
	*3" Internal Pull Tool not compatible with FP150*	Y N	Y N
2" <input type="checkbox"/>	Mandrel in Good Condition	Y N	Y N
3" <input type="checkbox"/>	Slips in Good Condition	Y N	Y N
4" <input type="checkbox"/>	O-Rings Attached	Y N	Y N
	O-Rings in Good Condition	Y N	Y N
	Threads Good	Y N	Y N
	Tightening Nut Moves Freely	Y N	Y N
	Visible Damage	Y N	Y N
	Serial # Present & Legible on Internal Pull Tool	Y N	Y N
	Correct Size/Color for Job	Y N	Y N
Road Bore Pull Tool	Serial # _____	Outgoing	Incoming
	2" FP601 Hole Jig Required Only & For 3"/4" FP301 and FP601 Holes Jigs Required	Y N	Y N
2" <input type="checkbox"/>	4 Socket Cap Screws Attached to Road Bore Pull Tool	Y N	Y N
3" <input type="checkbox"/>	Socket Cap Screws Damaged	Y N	Y N
4" <input type="checkbox"/>	Visible Damage	Y N	Y N
	Serial # Present & Legible on Road Bore Pull Tool	Y N	Y N
	Serial # Present & Legible on Road Bore Sleeve	Y N	Y N
	Serial # on Road Bore Sleeve Matches Serial # on Road Bore Pull Tool	Y N	Y N
	Correct Size/Color for Job	Y N	Y N
Mandrel Pull Tool	Serial # _____	Outgoing	Incoming
	Verify the Correct Number of Sleeves are Provided	Y N	Y N
2" <input type="checkbox"/>	Verify the Correct Sleeve Size is Provided	Y N	Y N
3" <input type="checkbox"/>	Mandrel Teeth in Good Condition	Y N	Y N
4" <input type="checkbox"/>	Visible Damage	Y N	Y N
	Serial # Present & Legible on Mandrel Pull Tool	Y N	Y N
	Correct Size/Color for Job	Y N	Y N
External Pull Tube	Serial # _____	Outgoing	Incoming
	Handle is Present	Y N	Y N
2" <input type="checkbox"/>	Visible Damage	Y N	Y N
3" <input type="checkbox"/>	Serial # Present & Legible on External Pull Tool	Y N	Y N
4" <input type="checkbox"/>	Correct Size/Color for Job	Y N	Y N

**Comments:** \_\_\_\_\_

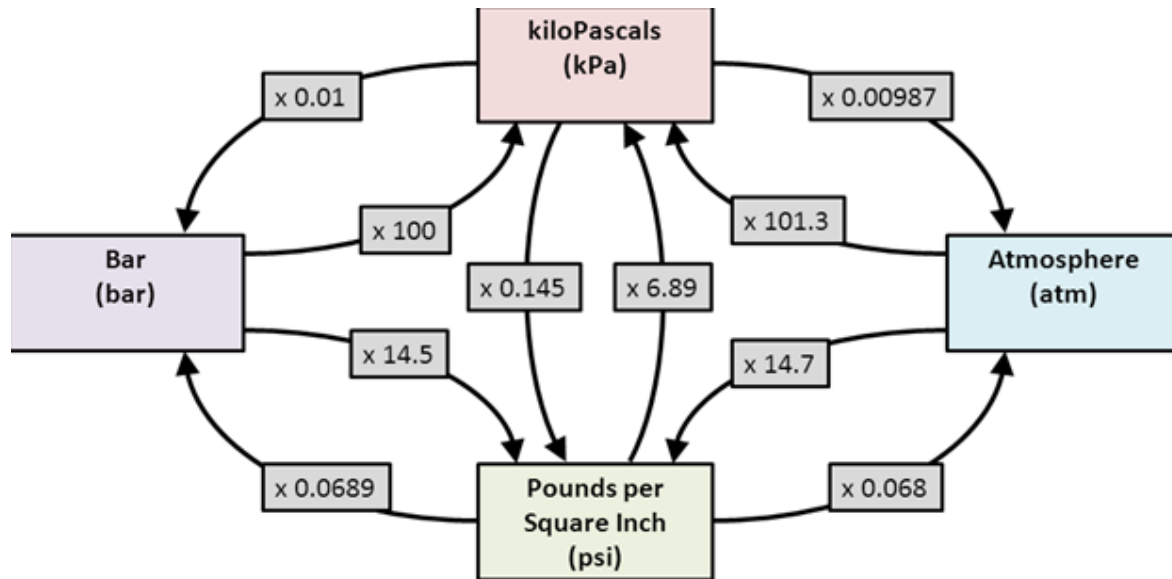
## Appendix E: Standard Unit Conversions

### E.1: Temperature Conversions



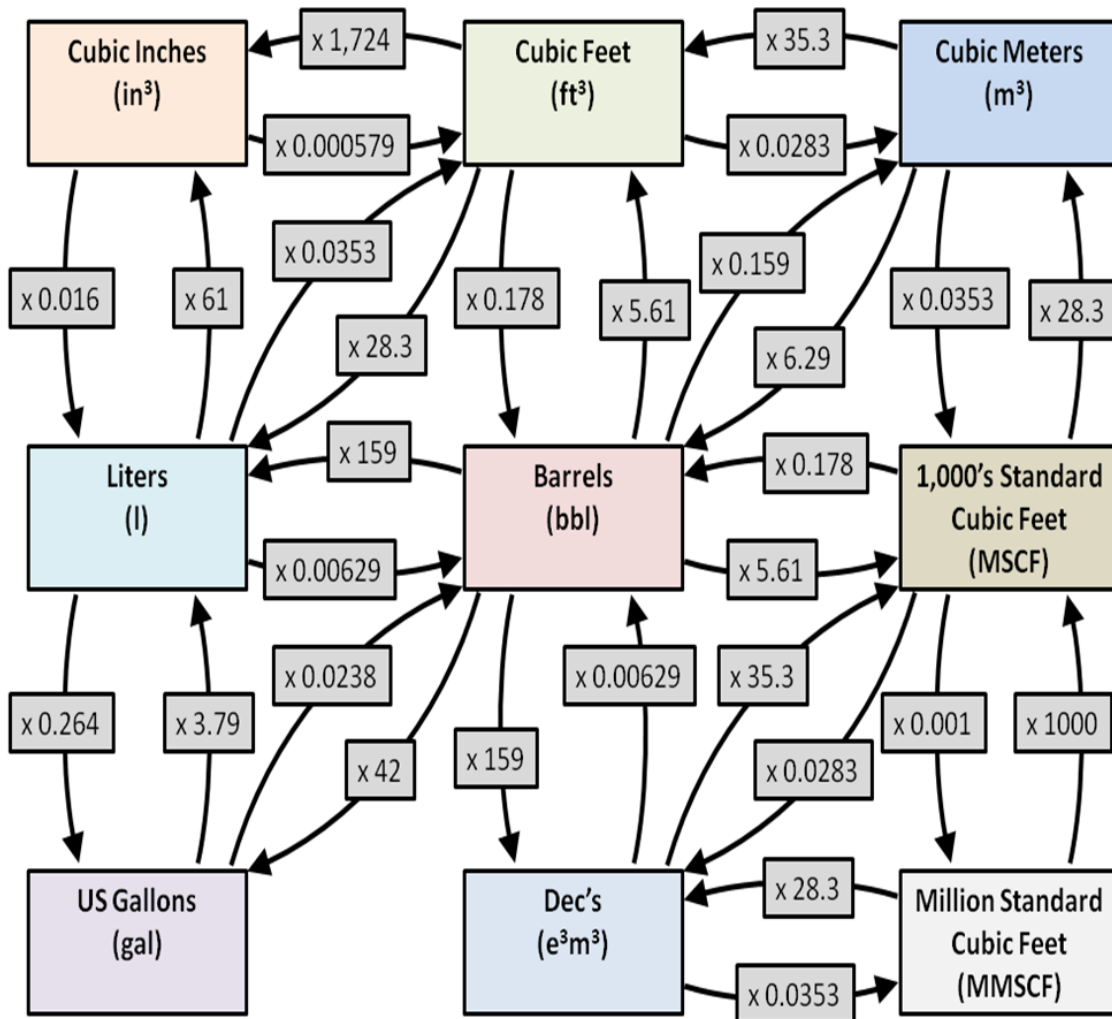
°F	°C
-40	-40
-25	-31.7
-13	-25
0	-17.7
15	-9.4
32	0
50	10
68	20
72	22.2
100	37.8
140	60
150	65.6
160	71.1
170	76.7
180	82

## E.2: Pressure Conversions



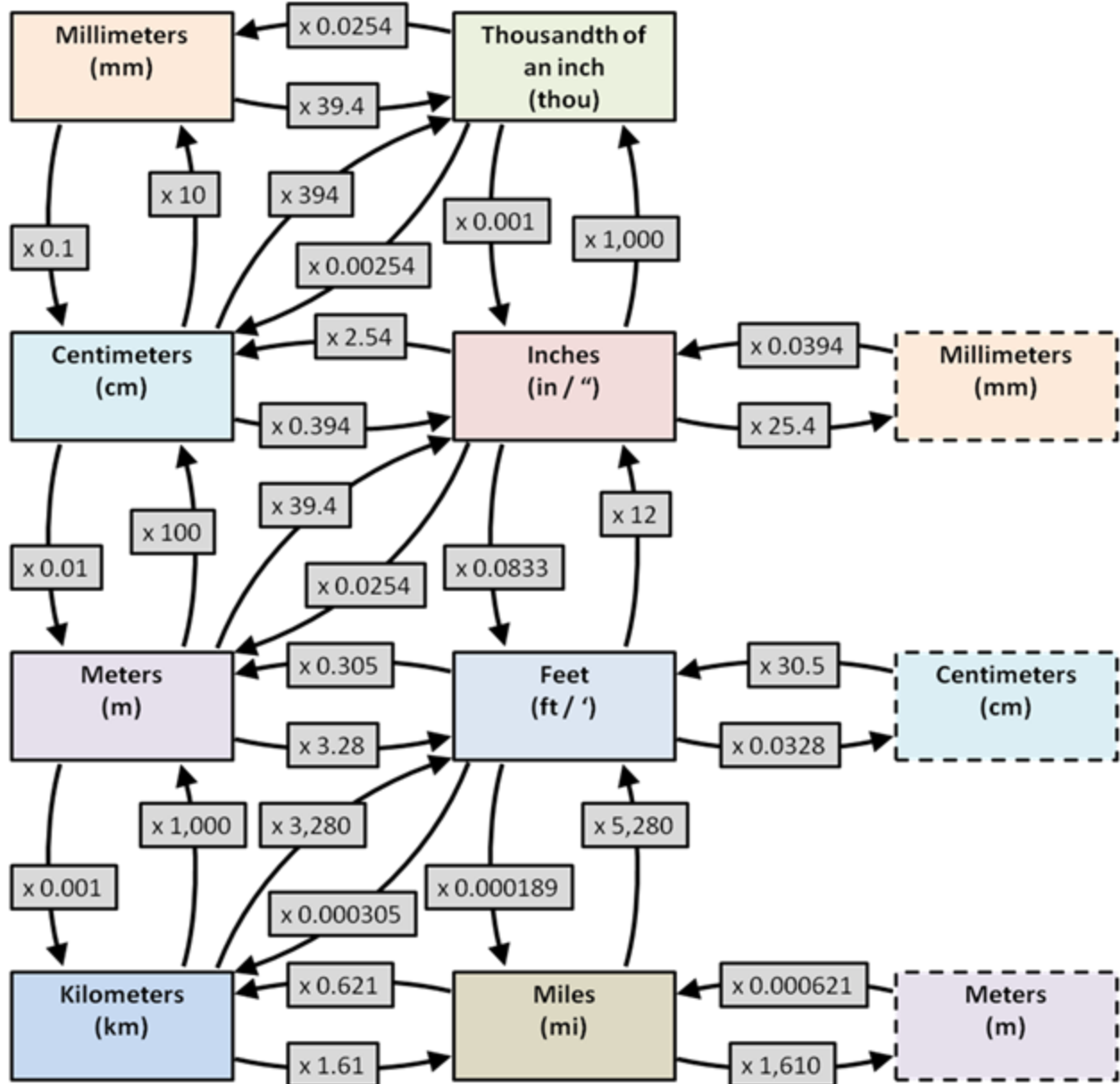
kPa	psi	bar	atm
34.5	5	0.345	0.34
68.9	10	0.689	0.68
100	14.5	1	0.987
101.3	14.7	1.01	1
200	29	2	1.97
345	50	3.45	3.4
500	73	5	4.9
689	100	6.89	6.8
1,000	145	10	9.9
1,379	200	13.8	13.6
1,965	285	19.7	19.4
2,068	300	20.7	20.4
3,447	500	34.5	34
4,960	719	49.6	49
5,000	725	50	49
5,171	750	51.7	51
6,895	1,000	68.9	68
9,930	1,440	99.3	98
10,000	1,450	100	99
10,342	1,500	103.4	102
13,790	2,000	137.9	136

## E.3: Volume Conversion



in <sup>3</sup>	l	gal	ft <sup>3</sup>	Bbl	m <sup>3</sup>	MSCF	e <sup>3</sup> m <sup>3</sup>	MMSCF
1	0.016	0.0043	0.000579	---	---	---	---	---
61	1	0.264	0.0353	0.00629	---	---	---	---
231	3.79	1	0.134	0.0238	0.00379	---	---	---
1,724	28.3	7.48	1	0.178	0.00283	0.001	---	---
---	159	42	5.61	1	0.159	0.00561	0.000159	---
---	---	264	35.3	6.29	1	0.0353	0.001	0.0000353
---	---	---	1,000	178	28.3	1	0.0283	0.001
---	---	---	---	6,289	1,000	35.3	1	0.0353
---	---	---	---	---	28,300	1,000	28.3	1

## E.4: Distance Conversions

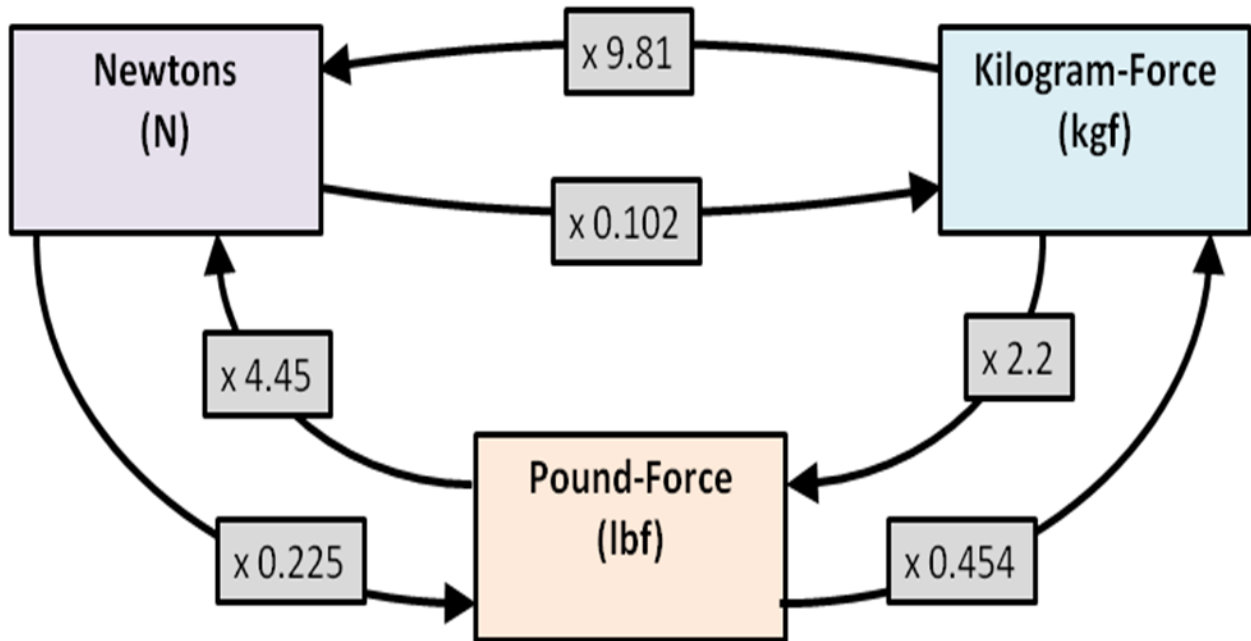


## Distance Conversions (continued)

thou	mm	Cm	in	ft	m	km	mi
1	0.0254	0.00254	0.001	---	---	---	---
39.4	1	0.1	0.0394	0.00328	0.001	---	---
394	10	1	0.394	0.0328	0.01	---	---
1,000	25.4	2.54	1	0.0833	0.0254	---	---
---	60.3	6.03	2.375	0.198	0.0603	---	---
---	88.9	8.89	3.5	0.292	0.0889	---	---
---	114.3	11.43	4.5	0.375	0.1143	---	---
---	168.3	16.83	6.625	0.552	0.1683	---	---
---	305	30.5	12	1	0.305	0.000305	0.000189
---	610	61	24	2	0.61	0.000610	0.000379
---	1,000	100	39.4	3.28	1	0.001	0.000621
---	---	152	60	5	1.52	0.00152	0.000947
---	---	200	78.7	6.56	2	0.002	0.00124
---	---	500	197	16.4	5	0.005	0.00311
---	---	---	---	3,280	1,000	1	0.621
---	---	---	---	5,280	1,610	1.61	1
---	---	---	---	6,560	2,000	2	1.24
---	---	---	---	10,560	3,220	3.22	2
---	---	---	---	16,400	5,000	5	3.11
---	---	---	---	26,400	8,050	8.05	5
---	---	---	---	32,800	10,000	10	6.21
---	---	---	---	52,800	16,100	16.1	10
---	---	---	---	82,000	25,000	25	15.5
---	---	---	---	132,000	40,200	40.2	25

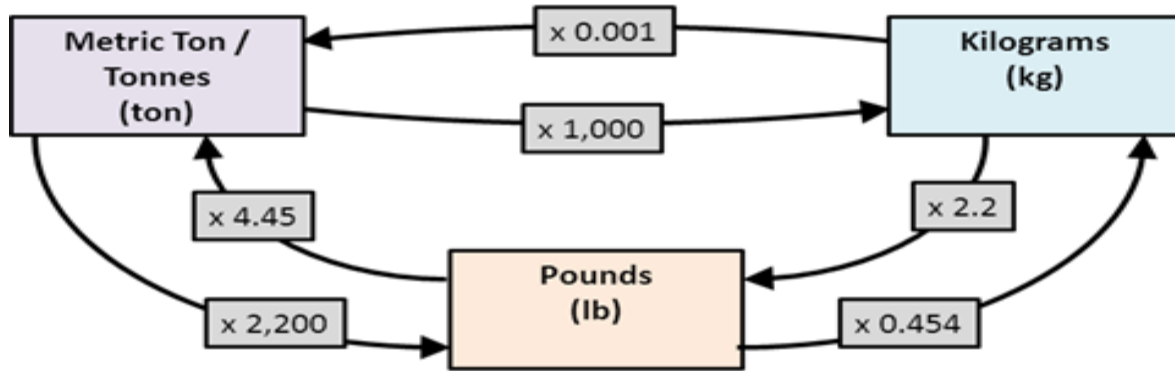


**E.5: Force Conversions**



<b>N</b>	<b>lbf</b>	<b>kgf</b>
1	0.225	0.102
4.45	1	0.454
9.81	2.2	1
500	112	51
1,000	225	102
2,000	450	204
2,220	500	227
3,000	674	306
4,450	1,000	454
4,900	1,100	500
8,900	2,000	907
9,810	2,200	1,000
13,300	3,000	1,360
20,000	4,500	2,040
22,200	5,000	2,270
25,000	5,620	2,550
26,700	6,000	2,720

## E.6: Weight Conversions



lb	kg	ton
1	0.454	0.000454
2.2	1	0.001
551	250	$\frac{1}{4}$
1,102	500	$\frac{1}{2}$
1,444	655	0.66
2,050	930	0.93
2,205	1000	1
5,200	2359	2.36
5,800	2631	2.63
6,500	2948	2.95
7,000	3175	3.18
8,200	3719	3.72
9,100	4128	4.13
10,600	4808	4.81
11,600	5262	5.26

## E.7: Pipe Fill Volume per Unit Distance

FlexPipe, FlexPipe HT, FlexCord

Nominal Size (in)	bbf/ft	gal/ft	m <sup>3</sup> /m
2	0.0044	0.1834	0.0023
3	0.0089	0.3721	0.0046
4	0.0148	0.6206	0.0077
5	0.0233	0.9794	0.0122

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<b>Manufacturing Facility</b>	1820 100th Ave NE, Suite 195 Calgary, Alberta T3J 0P7 Canada	Tel: 403-503-0548 Fax: 403-567-5452
<b>Canada Solution Centers</b>	<input type="checkbox"/> Grande Prairie, AB – Tel: 780-402-4765 <input type="checkbox"/> Estevan, SK – Tel: 306-861-0509	
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