

Background Information

In order to continue to satisfy the needs of customers, Flexpipe is expanding its popular Flexpipe High Temperature (FPHT) product line by manufacturing a 6", Flexpipe High Temperature, 600 ANSI (6" FP601 HT) and 300 ANSI (6" FP301 HT) product.

About this Bulletin

This document highlights the main characteristics of the 6" Flexpipe HT product line and serves as a supplement to the Flexpipe Technical Manual and the Flexpipe Pipe Installation Guide. To obtain a copy of Flexpipe documents, please visit www.flexpipesystems.com and search the technical library.

Technical Manual Additional Information

Product Lines

Flexpipe HT has been available in a nominal 6" internal diameter as FP601 HT since 2022. The addition of FP301 HT will expand the Flexpipe HT pressure offering of this versatile product line.

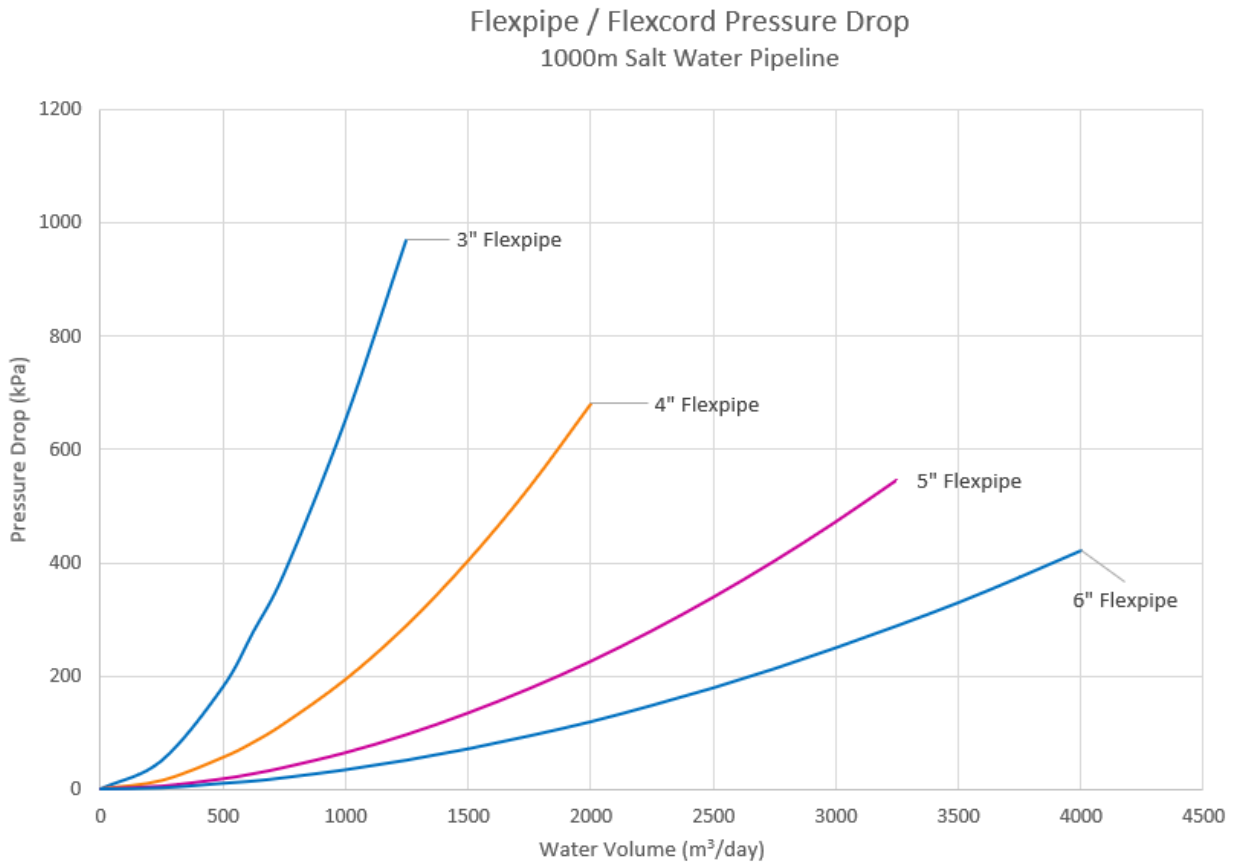


Figure 1: Estimated flow rates for 1km long Flexpipe pipelines of various sizes carrying water

Design

6" Flexpipe HT is the same multilayered construction, with a liner, reinforcement layers and jacket, as used in the 2" to 5" Flexpipe HT products. The design of Flexpipe HT is shown in Figure 2.

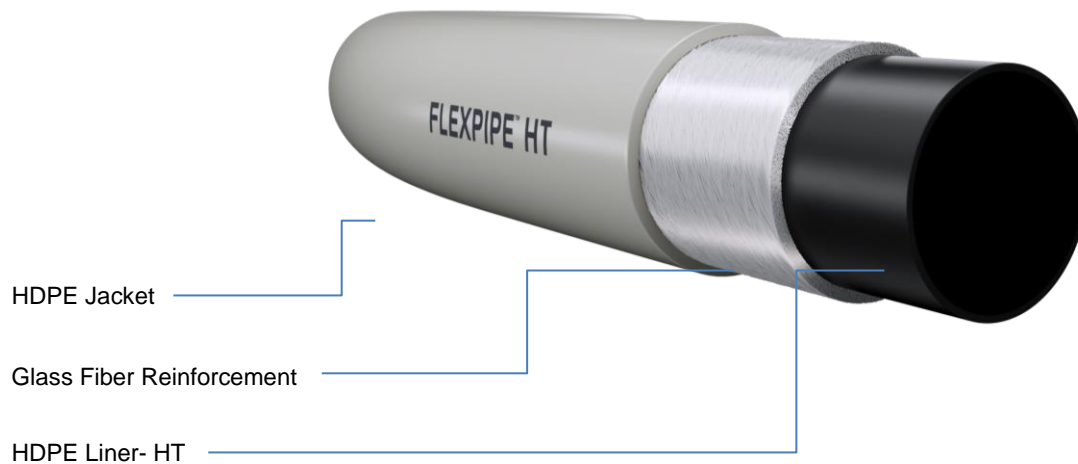


Figure 2: Flexpipe HT Design

Materials

6" Flexpipe HT uses the same HDPE-RT resin as used in the 2" to 5" Flexpipe HT products.

Fittings

6" Flexpipe HT uses a design similar to that of the Flanges, Couplings, and Weldnecks used in the 2" to 5" Flexpipe HT products. The configuration, design, materials, manufacturing, and corrosion protection as detailed in the Flexpipe Technical Manual are the same.

Standards

6" Flexpipe HT is designed in accordance with the Canadian Standards Association (CSA) Z662 Section 13.1, and the American Petroleum Institute (API) 15S "Spoolable Reinforced Plastic Line Pipe".

Testing

The 6” Flexpipe HT qualification program includes extensive testing following API 15S and Flexpipe internal test procedures, including but not limited to Table 1.

Table 1: Qualification Testing

Test Description	Applicable Standard(s)
Regression Pressure Testing	ASTM D1598 API 15S
Elevated Temperature Pressure Testing	API 15S
Minimum Bend Radius Pressure Testing	API 15S
Short Term Burst Pressure Testing	ASTM D1599 Procedure A API 15S
Cyclic Pressure Testing	ASTM D2992-12 Procedure A
Impact Resistance Testing	API 15S
Thermal Cycle Testing	API 15S

Performance

Flexpipe will conduct Application Engineering Reviews for all Flexpipe HT installations to verify fitness of the product for the intended service.

Gas

6” Flexpipe HT is compatible with systems gases including those containing H₂S and CO₂.

For gas applications in which condensates can form, a suitable pigging program should be implemented to prevent liquid buildup at low points along the pipeline.

Oil

6” Flexpipe HT is compatible with hydrocarbons including aromatic compounds.

Water

6” Flexpipe HT is compatible with produced water.

H₂S

6” Flexpipe HT is compatible with H₂S. Flexpipe chooses to limit H₂S content of up to 10% by mol in gas phase of liquids (oil and/or water) or multiphase. Applications above 10% are evaluated on a case by case basis.

CO₂

6” Flexpipe HT is suitable for gases or liquids containing up to 100% CO₂ by volume.

Aromatic and Cycloalkane Hydrocarbons

6” Flexpipe HT is compatible with aromatic and cycloalkane hydrocarbons (e.g. benzene, toluene, ethyl benzene, xylene, naphthalene and cyclohexane) in gas or liquids. Table 2 below lists the allowable aromatic and cycloalkane concentration for 6” Flexpipe HT at normal operating pressures, based on Flexpipe test data.

Table 2: Allowable Aromatic and Cycloalkane Hydrocarbon Content for FPHT

Operating Temperature	Maximum allowable aromatic and cycloalkane content (by volume)
Up to 82°C (180°F)	50%

Methanol and Ethanol

HDPE has good resistance to concentrated methanol and ethanol at temperatures up to 82°C (180°F). Alcohols may be used with 6" Flexpipe HT in continuous and batch programs, or during hydrotests to prevent freezing.

Maximum and Minimum Allowable Operating Temperature

6" Flexpipe HT is rated for a maximum allowable operating temperature of 82°C / 180°F, and a minimum allowable operating temperature of -29°C / -20°F for low temperature (LT) O-rings and -5°C / 23 °F for standard O-rings. It is recommended to limit the amplitude of the temperature differential between the maximum and minimum operating temperatures to 87°C / 156°F or lower. Contact your Flexpipe Account Manager to discuss applications with extreme temperature swings.

Maximum Allowable Operating Pressure

6" FP601 HT is rated for a maximum allowable operating pressure of 10,342 kPa (1500 psi). 6" FP301 HT is rated for a maximum allowable operating pressure of 5,171 kPa (750 psi).

Flexpipe HT Cyclic Capabilities

6" Flexpipe HT is primarily intended for use with pumps generating a steady (non-pulsating) pressure output, such as centrifugal pumps, progressive cavity pumps, gear pumps, etc. It is not recommended to utilize 6" Flexpipe HT with pumps generating a pulsating pressure output, such as Duplex, Triplex, Quintuplex, Diaphragm, Hydra-Cell, etc.

6" Flexpipe HT is not intended for severe cyclic applications. In order to eliminate or reduce the pressure fluctuations resulting from pump on/off cycles, Flexpipe recommends using a variable frequency drive (VFD) to regulate the flow rate while maintaining continuous and smooth operation of the pump.

Depending on their magnitude and frequency, pressure pulsations and fluctuations could be detrimental to the pipe performance. Please contact your Flexpipe representative for a project specific application evaluation, particularly in applications involving a pulsating or fluctuating pressure profile.

Pump Jacks

6" Flexpipe HT is a very good fit for applications with pump jacks. Recommendations for the maximum pressure differential between the routine upstroke and downstroke pressures are provided in Table 3. Infrequent pressure excursions beyond this limit are generally acceptable. Contact Flexpipe Engineering if the routine upstroke pressure is greater than 550 psi.

In order to ensure the long-term integrity of the piping system with pump jacks, Flexpipe recommends:

- Installing and maintaining a pressure switch (such as a Presco switch) set at a maximum of 100 psi above the upstroke pressure to limit the possibility of subjecting the pipeline to excessive pressure swings for extended time durations.
- Routinely monitoring the upstroke and down stroke pressure values using a calibrated pressure gauge mounted between the well head and the flow line.
- Implementing a suitable pigging program to ensure the upstroke pressure does not increase as a result of wax build up.

Table 3: Maximum recommended pressure differential between the routine upstroke and downstroke pressures.

Product	Routine Upstroke Pressure				
	<150 psi	151-250 psi	251-350 psi	351-450 psi	451-550 psi
	Recommended Maximum Pressure Differential				
FP301 HT	50	30	25	20	15
FP601 HT	75	50	45	40	35

Thermal Conductivity

The thermal conductivity properties of Flexpipe Spoolable Products result from the properties of the polyethylene and the reinforcement materials. Accordingly, Flexpipe is a good thermal insulator with higher resistivity than metallic pipes. Table 4 lists the approximate calculated thermal conductivity and resistivity values of the 6" Flexpipe HT products. Laboratory testing of these values has not been conducted or confirmed.

Table 4: 6" Flexpipe HT Thermal Conductivity and Resistivity

Item	Units	Value		Units	Value	
		FP301 HT	FP601 HT		FP301 HT	FP601 HT
Pipe Size						
Wall Thickness	mm	18.87	23.60	in	0.743	0.929
Resist_eff	1/K_eff	3.51	4.21	hr*ft*F/Btu	6.075	7.280
K_eff	W*m ⁻¹ *K ⁻¹	0.28	0.24	1/Resist_eff	0.165	0.137

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. Fittings within the elevated area should be directly 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 5.

Table 5: Recommended Pipe Support Spacing for the Flexpipe HT product

	Recommended Maximum Support Spacing			
	Liquid Service		Gas Service	
	(m)	(ft)	(m)	(ft)
6" Flexpipe HT	2.5	8.0	2.9	9.5

Buoyancy and Pipe Weights

Flexpipe Spoolable Products will float in water or muskeg if not weighted or buried in a clay base. If conditions are suitable, the pipeline may be plowed into muskeg without weighting. The suitability of the conditions may be evaluated based on existing pipelines in the area and consultation with Flexpipe Engineering.

If there is a concern that the pipe may float, the pipe can be weighted during installation. The weights should not have sharp edges that could point-load or cut the protective jacket of the product. Sand-filled saddlebag weights are recommended.

When weights are used it is preferable to place them while the pipe is in the ditch, if this is not possible, it is extremely important that the pipe is handled and lowered into the ditch by lifting as near as possible to the weights. Lifting on the pipe may cause the pipe to kink or be damaged by the weights.

The following formulas can be used to calculate the pipe buoyancy per unit length (note that some unit conversions may be required). To keep the pipe submerged, the sandbag weight per unit length must be slightly more than the buoyancy force per unit length. Note that there will also be a buoyancy force on the sandbags themselves, which is compensated for in the formulas below.

Pipe cross - sectional area = $OD^2 \times \frac{\pi}{4}$

Weight of fluid displaced per unit length of pipe = Pipe cross - sectional area \times Fluid density

Net buoyancy per unit length of pipe
= Weight of fluid displaced per unit length - Pipe weight per unit length
Note that the pipe will sink if the net buoyancy is less than 0.

Submerged sandbag weight required per unit length of pipe=Net buoyancy per unit length of pipe \times 1.1
Flexpipe recommends multiplying by 1.1 to ensure the pipeline is adequately weighted to remain submerged.

Weight of fluid displaced by sandbag = Volume of fluid displaced by sandbag \times Fluid density
Submerged weight of sandbag = Weight of sandbag in air - Weight of fluid displaced by sandbag

Sandbag spacing = $\frac{\text{Submerged weight of sandbag}}{\text{Submerged sandbag weight required per unit length of pipe}}$

Note: The sandbag spacing should be small enough to prevent the unrestrained pipe between sandbags from rising too far.

The recommended dry sandbag weight is shown in Table 6. These results are based on muskeg with a fluid density of 1,121 kg/m³ (70 lb/ft³).

Table 6: Recommended Sandbag Weighting

		Pipe Weight per Length		Pipe OD		Recommended Weights*		Recommended Maximum Spacing	
		(kg/m)	(lbs/ft)	(mm)	(in)	(kg)	(lb)	(m)	(ft)
FP601 HT	6"	15.6	10.5	191	7.5	100	220	2	6.5
		15.6	10.5	191	7.5	200	440	5	16
FP301 HT	6"	10.75	7.22	179.3	7.1	100	220	2	6.5
		10.75	7.22	179.3	7.1	200	440	5	16

*Dry sandbag weight. These weights already include the recommended safety factor of 1.1 to ensure the pipe remains submerged.

Installation Guide Additional Information

Shipping Reels

The reel for 6" Flexpipe HT products is different than those used for the 2" to 5" products. The height (diameter) of the reel for 6" Flexpipe Spoolable Products is 14 ft. compared to a height of 12 ft. for the 2" to 5" products. The width of the reel matches other large diameter products at 8 ft. The additional 2 ft. of height should be considered when booking shipping and unloading equipment.

Lifting Reels

Reference the Flexpipe Pipe Installation Guide for general guidance on lifting reels. Recommended lifting methods for 6" products are detailed below. 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. The full and empty weight of 6" reels is available in Table 17.

The designated lifting points (yellow or green lift plates) must be used for attaching slings and rated chains. The lift plate hole diameter is 38mm (1.5 inch). It is not recommended to attach slings or rated chains directly to the reel's outer steel hub.



Figure 3: Full reel of 6" Flexpipe HT

Use one of the below recommended methods for rigging and lifting a reel of 6" Flexpipe Spoolable Products.

Method 1:

This is the default method recommended to lift 6" Flexpipe reels. Use a 2.4 m (8 ft) wide spreader bar and slings or rated chains. The rated chain or sling should be attached to the yellow or green lifting plates with a clevis.

Method 2:

This method requires that the two rated slings or chains be long enough to prevent the load from crushing the reel, with a minimum length of 3.9 m (12.8 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 or green lifting plates with a clevis.

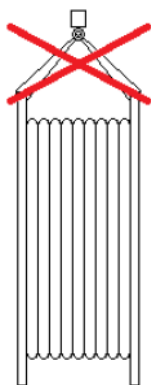
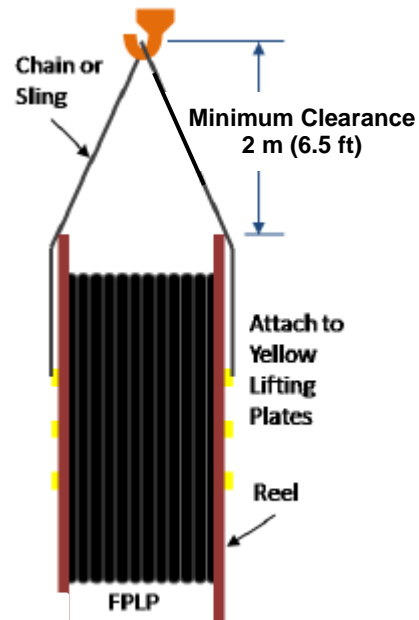


Figure 4: NOT ALLOWED. Lifting technique, lifting with rated chains attached to the reel hubs.



Figure 5: Proper lifting technique, lifting with rated chains or slings attached to the yellow lifting blocks.

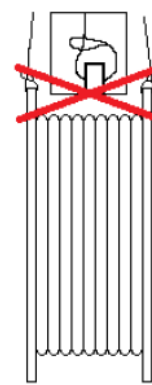


Figure 6: NOT ALLOWED. Lifting technique, lifting with rated slings attached to the reel hubs.

Pipe and Fitting Weight

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

Table 7: 6" Flexpipe HT pipe and fitting weights

6" FP601 HT				
Pipe	Flange	Coupling	SS Weldneck	Weldneck
15.6 kg/m	73.5 kg	72.6 kg	49.9 kg	47.6 kg
10.5 lb/ft	162 lb	160 lb	110 lb	105 lb
6" FP301 HT				
Pipe	Flange	Coupling	SS Weldneck	Weldneck
10.75 kg/m	56.7 kg	68 kg	44.4 kg	44.4 kg
7.22 lb/ft	125 lb	150 lb	98 lb	98 lb

Deploying Flexpipe Spoolable Products

Most of the standard Flexpipe HT deployment methods are acceptable for 6" Flexpipe HT products. Contact Flexpipe for approved installation methods. Slower deployment speeds may be required to reduce the amount of slack build-up on the reel.

Checking for Scratches

See table 8 for the maximum scratch depth used to determine whether a scratch in the outer jacket is acceptable. No matter the depth of the scratch, if the reinforcements are exposed, that section of pipe must be cut out.

Table 8: Maximum allowable scratch depth

Flexpipe NPS	Maximum Scratch Depth	
	mm	inch
6"	3.2	1/8

Minimum Operating and Handling Bend Radius

The minimum allowable bend radius of Flexpipe Spoolable Products differs in operation (pressurized) and transport/handling (un-pressurized) conditions, as shown in Table 9.

Table 9: Minimum Operation and Handling Bend Radius

Flexpipe Spoolable Products	Minimum Bend Radius OPERATION		Minimum Bend Radius TRANSPORT & HANDLING	
	(m)	(ft)	(m)	(ft)
6" Flexpipe HT	3.4	11	1.6	5.2

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. Typically, there should be no bends within 1 meter (3 feet) from a fitting.

Revision Date June 5, 2023

Document # 06-4098

Revision #2.1

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 inner liner, it is required that screws are used through the pipe wall to ensure the pull forces are evenly distributed through all layers of the pipe (inner liner, reinforcement, and outer jacket).

The Internal Pull Tools are compatible with all FP, FP HT and FC. The Internal Pull Tool for 6" Flexpipe Spoolable Products is similar to the 2" to 5" pull tool with some minor installation differences. The installation of the 6" Internal Pull Tool is outlined below.



COLD WEATHER INSTALLATION - 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 liner. Over-heating the liner would result in melting the HDPE which will also prevent proper grip on the liner.



Figure 7: 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 8: 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.

Revision Date June 5, 2023

Document # 06-4098

Revision #2.1



Figure 9: Securing Pipe with Screws

Once the pull tool has been inserted and tightened, install a minimum of 40, 1.5" long screws all the way around the pipe behind the paint mark. This will ensure all three layers (inner liner, reinforcement, and outer jacket) are pulled without separation.

The screws need to be 1.5" or longer to avoid creating shear lines, screws need to be staggered around the circumference of the pipe. See Figure 13 for an example of the screw locations.



Figure 10: Protective Paste on Pipe End

After the pull tool has been inserted, apply the protective paste (e.g. Denso Paste) to the pipe end to help prevent water ingress into the fiberglass reinforcement layer.



Figure 11: Petrolatum Tape Over Screws and Pipe End

Once the protective paste has been applied, use petrolatum tape (e.g. Denso Tape) to wrap over the screws, over the pipe end, over the pull tool nut, and onto the threads. It is required to rub-down the petrolatum tape to achieve tight continuous contact with the outer surfaces of both the pull tool and the pipe.



Figure 12: Wrap Pipe and Seal Pipe End

Starting 2" past the petrolatum tape, wrap over the petrolatum tape with corrosion protective pipeline tape up to the end of the pull tool sealing off the fiberglass reinforcement layer from water ingress. Not only will this protect the reinforcement layer, it keeps the pipe end clear of mud and will also make the clean-up and removal of the pull tool easier.

CAUTION!



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

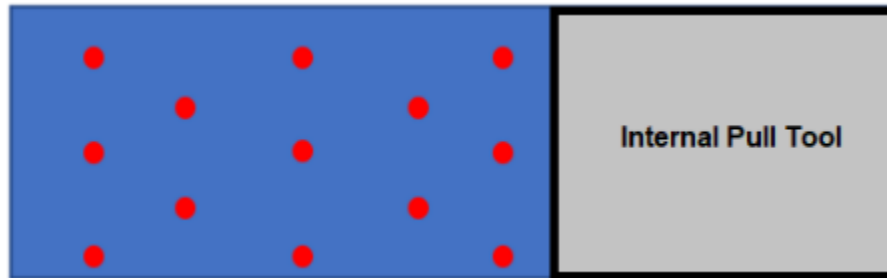


Figure 13: Screw Locations for the 6” Internal Pull Tools

Maximum Allowable Pull Force

Table 10 shows the maximum allowable pull force that can be exerted on 6” Flexpipe HT products without risk of damaging the pipe. It is Flexpipe’s recommendation to use an inline tensile load measuring device and a swivel 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.

Table 10: Maximum Allowable Pull Force

Flexpipe Spoolable Product	Kilogram-Force	Newtons	Pound-Force
6” Flexpipe HT	7,620	74,730	16,800

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 Flexpipe engineering to discuss maximum pull force loads for higher pipe temperature pulls.

Plowing

6” Flexpipe HT products are suitable to be plowed. Contact your Flexpipe representative for additional information regarding plowing 6” products and suitability of plow chute dimensions.

Pulling Through Conduit Pipe

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, it is recommended to work with an experienced contractor. 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 Product. Pigging is highly recommended to ensure the line is clear of wax, scale or debris.

See Table 11 below for guidance on compatibility of Flexpipe Spoolable Products with conduit pipe sizes. This guidance assumes round pipe and straight conduit.

Revision Date June 5, 2023

Document # 06-4098

Revision #2.1

Table 11: Steel Conduit Piping Compatibility Chart

Wall thickness	8" Steel		10" Steel			
	0.188" wall	Sch. 10	0.252"	0.220"	0.189"	0.157"
Conduit ID	8.249"	8.329"	10.246"	10.309"	10.372"	10.435"
Product						
6" Flexpipe HT	P	P	PF	PF	PF	PF

N = Not compatible

P = Compatible for pipe without fittings

PF = Compatible for pipe with coupling fittings

Many factors can affect actual pull forces and must be evaluated by the installation contractor during project planning stages.

- Pulling ovalized pipe off the reel
- Radius of bends
- Number of bends
- Friction forces acting on the pipe during the pull
- Length of pull
- Diameter of conduit or bore

Typically, digging a bell hole and removing the conduit is required at every bend for liner pulls. Contact Flexpipe engineering for guidance when pulling coupling fittings through bends.


Before installation of the Flexpipe Spoolable Products a sizing plate should be run through the conduit. Flexpipe recommends pulling the sizing plate in the direction of the original flow of the conduit pipe. Use an appropriately sized sizing plate based on the conduit ID with consideration for the Flexpipe pipe or fitting OD including protective wrapping. 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. The sizing guidance in this section is general in nature. The installation contractor should evaluate each installation and select the appropriate sizing plate dimensions based on all project variables.

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 the 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.

Crimp Kit

The standard crimp kit used to install 2” to 4” Flexpipe and Flexpipe HT is not used to install the 6” product. A specific large ID crimp kit with a 6” Mandrel Insertion Press is used to install 6” products.

NOTE!



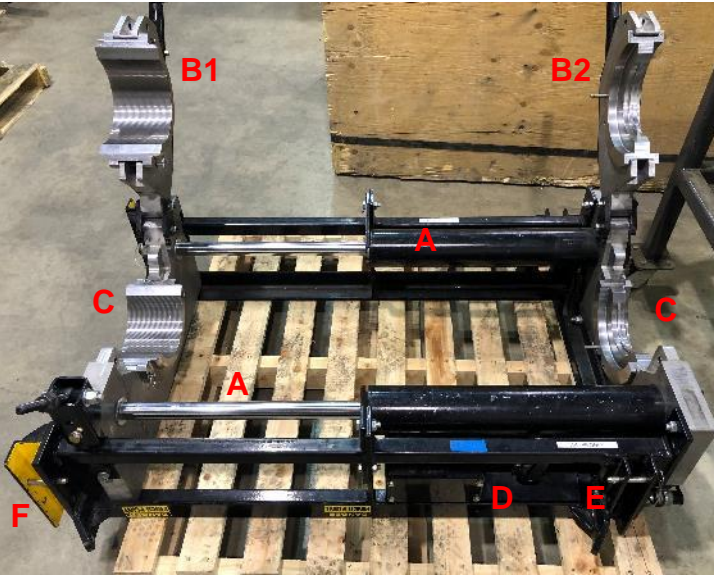
The large ID crimp kit is heavier than the standard crimp kit. Lifting equipment and proper lifting techniques should be used when handling the large ID crimp kit.

Table 12: Crimp kit equipment list and weight

Equipment	Weight	
	lbs	kg
4-Way Report Valve w/ Hoses	23	10.5
Press	754	342
Pump	134	61
Crimper	542	246

6” Mandrel Insertion Press

The 6” Mandrel Insertion Press is used to insert Flexpipe Spoolable Products into the fitting. The 6” Mandrel Insertion Press operated similar to the one for 2” to 4” pipe products.



- A.** Hydraulic cylinders
- B.** Press gates, with locking pins
- C.** Integrated clamps
- D.** Internal relief valve
- E.** Press Control Valve
- F.** Lifting Points

Figure 14: Mandrel Insertion Press

Custom 1-1/16" Socket

For the 6" Mandrel Insertion Press, a custom 1-1/16" socket with extended length must be used on the swing bolt which closes the press gates. The socket is provided in the crimp kit.



Figure 15: Custom 1-1/16" Socket

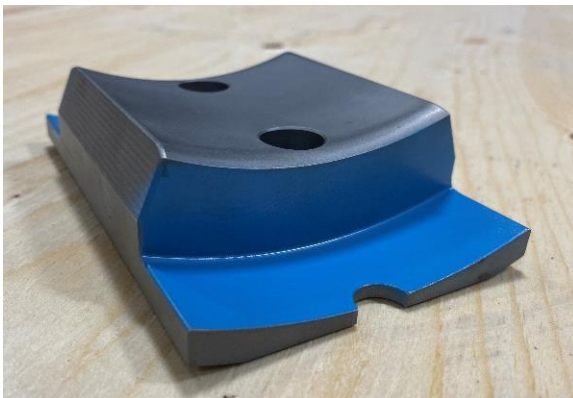
NOTE!



Press gates **B1** and **B2** from the figure above 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.

Crimper Die Sets

The 6" Flexpipe HT crimper die set comes with 8 individual dies that fit into the crimper. Each die has two bolt holes counter-sunk into the die. Unlike the 2" to 4" product lines, the 6" product line has a unique set of dies for each pressure class. In order to easily distinguish the die sizes from one another, the 6" FP601 HT crimper dies are Blue and the 6" FP301 HT crimper dies are yellow.



FP601 HT - Blue



FP301 HT - Yellow

Figure 16: 6" Flexpipe HT Crimper Dies

Reamer - Pipe Beveler

A cordless die grinder with a Reed's Power Pipe Beveler attachment as shown below is used for beveling the liner. This tool uses a Reed RBIT1 15° router bit to safely and consistently bevel the internal liner prior to fitting installation. Reference SOP 14-4194 – 5 Inch Pipe Beveler for additional information.



Figure 17: Pipe Beveler

Checking Flattened Pipe

Minor indentations and ovalization of the pipe from spooling the pipe onto the reel during manufacturing 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 a round shape. Pipe that has been flattened beyond 50% of the original outside diameter must be cut out. Please refer to Figure 18 and Figure 19 as well as the ovality % calculation below.

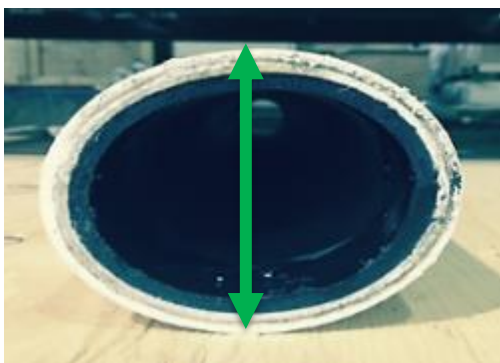


Figure 18: Acceptable Ovalization



Figure 19: 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 20 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 it circumferentially), must be measured. If the width exceeds that found in the Table 13, the pipe section containing the indentation must be cut out.

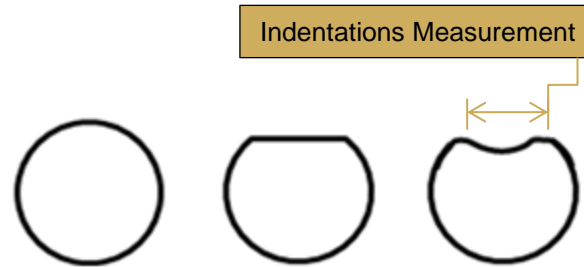


Figure 20: Indentations Diagram

Table 13: Maximum Acceptable Width of Indentation

Flexpipe NPS	Concave Indentation Width	
	mm	inch
6"	76.2	3.0


If the pipe end is severely ovalized where it may interfere with insertion, the pipe must be re-rounded. Squeeze the end of the pipe back into round by positioning using the external re-rounding pipe clamp shown below 2-3 inches from the end of the pipe. Align the external pipe 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. A section of pipe approximately 1 m (3 ft.) long should be heated. 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.




Figure 21: 6" External Re-Rounding Pipe Clamp

CAUTION!



Tripping Hazard - The size and amount of equipment used to install 6” pipe is greater than with smaller diameters. Pipe cones, dunnage, and larger installation equipment increase the risk of slips, trips, and falls.

WARNING!



There is significantly more stored energy with 6” pipe when compared to smaller diameters. Plan ahead and use caution when moving, lifting, or cutting 6” pipe.

Marking the Pipe End

Trace the insertion mark **A** and the clamp mark **B** on the pipe end as per the table 14 below. Insertion mark **A** indicates how far the pipe should be pushed into the fitting. Clamp mark **B** shows where to place the pipe clamp.

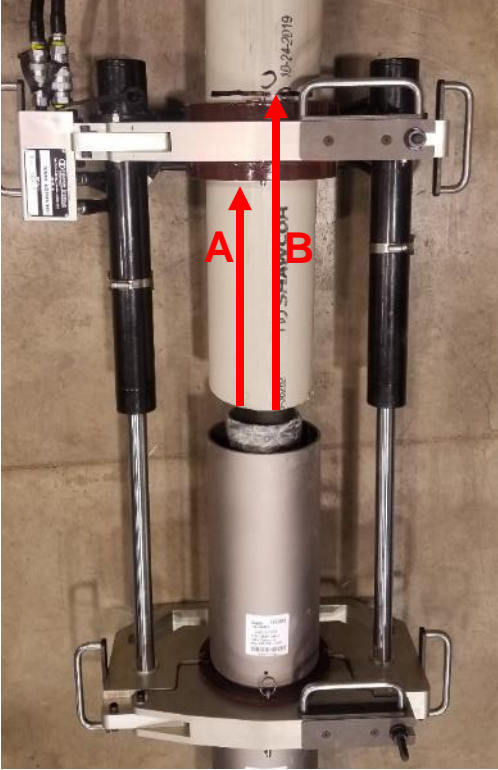


Figure 22: Insertion mark (A) and clamp mark (B)

Table 14: Marking Distances

Flexpipe NPS	Insertion Mark (A)		Clamp Mark (B)	
	(mm)	(inches)	(mm)	(inches)
6” (All fittings)	410	16 1/8	152	6

Joining Pipes and Fittings

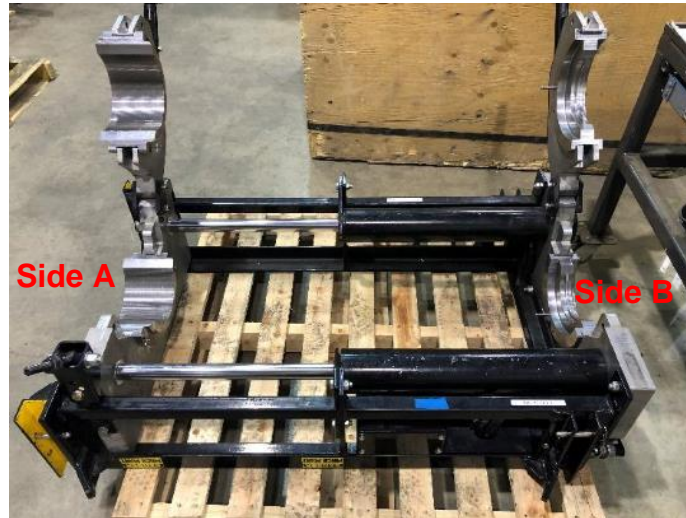


Figure 23: Mandrel Insertion Press with the integrated fitting adapter clamp and the integrated pipe clamp.

Integrated Pipe Clamp

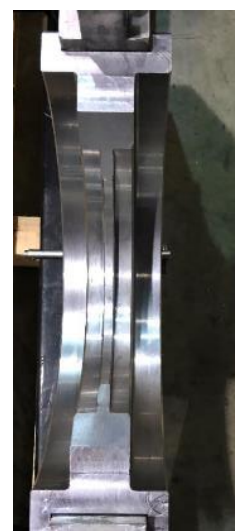
In Figure 23, the integrated pipe clamp is shown in **Side A** of the Mandrel Insertion Press. The integrated pipe clamp functions the same as the standard 2" to 4" pipe clamps with the exception that it fits within the Mandrel Insertion Press gate.

Integrated Fitting Adapter Clamp

In Figure 23, the integrated fitting adapter clamp is shown in **Side B** of the Mandrel Insertion Press. The integrated fitting adapter clamp is used on couplings, weldnecks, and flanged fittings.



**Figure 24: Integrated Pipe Clamp
Side A**



**Figure 25: Integrated Fitting Adapter
Clamp - Side B**

The Mandrel Insertion Press can be operated on the ground or suspended by chain-slings. The chain-slings are adjustable and can aid with the alignment of pipe and fittings for insertion.



Figure 26: Mandrel Insertion Press on the ground



Figure 27: Mandrel Insertion Press suspended by chain-slings.

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 or contraction limit.

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 be pulled out of the fitting.



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

Flexpipe 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.

Clamp Installation

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 contact 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 5000 psi for the 6" Mandrel Insertion Press.
4. Fully extend the cylinders of the Mandrel Insertion Press.
5. Select the integrated pipe clamp that matches the product size and series you are installing.
6. Put the integrated pipe clamp into the Mandrel Insertion Press. Orient the pipe clamp so that the one-way teeth grip the pipe for inserting the pipe into the fitting by ensuring that the point on the 'V' marking on the integrated pipe clamp points towards the pipe (away from the fitting).



Figure 28: Lining Up the 'V'



Figure 29: One-Way Teeth on the Pipe Clamp

7. Position the fitting and pipe in the press. Ensure that the fitting is centered and aligned with the pipe.
8. Close both press gates (**Side A** & **Side B**) of the Mandrel Insertion Press and pin them into position.

NOTE!



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

CAUTION!



Ensure that the correct pipe clamp is used for the appropriate pipe size and series. Using the wrong pipe clamp on the pipe could damage the Flexpipe Spoolable Product and require replacement of the damaged pipe.

9. 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 shown in Figure 30. It is important to ensure 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, and proceed with the following steps to insert the pipe 2" onto the mandrel, then repeat the steps to insert the pipe with the clamp set back at mark **B**.
10. 6" 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**. Ensure the pipe clamp stays a minimum of 6" from the fitting crimp sleeve at all times.



Figure 30: Misaligned pipe and fitting



Figure 31: Pipe Clamp set closer for curved pipe insertion

Inserting Pipe

11. Engage Selector Valve on the HPU.
12. Turn the 3-Position Remote Valve to the 'close' position to close the press and begin inserting the pipe.
13. Ensure the pipe clamp does not slide past the insertion mark **B**.
14. 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 onto the fitting.
15. Set the 3-Position Remote Valve to neutral.

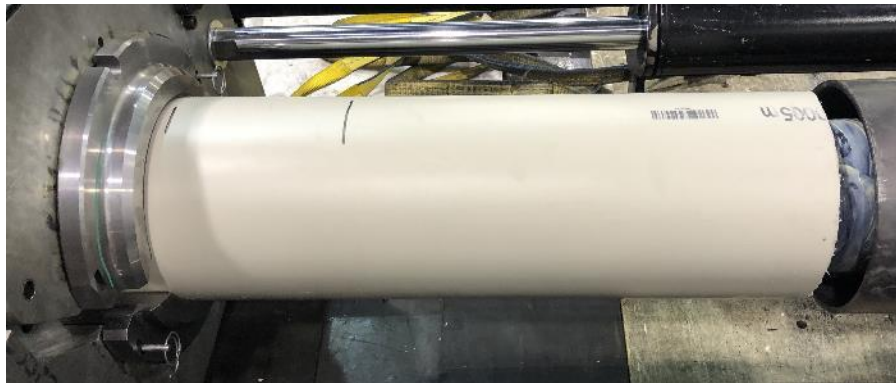


Figure 32: Integrated pipe clamp set past mark B, aligned with mandrel and ready for insertion.

16. If the clamp slips past mark **B** or closer than 6” to the fitting sleeve, the clamp must be repositioned.
17. Use the custom 1-1/16” 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 pipe. Optionally, a torque wrench may be used to ensure proper clamp tightness. Refer to Table 15 below for recommended torque values, which are based on the pipe being clean, round, dry, and at a temperature from -25°C (-13°F) to 45°C (113°F). If a clamp continues to slip after reaching the maximum torque allowed, clean the clamp and try again.

Table 15: Recommended Torque Values

Flexpipe NPS	Maximum Torque	
	kg-m	ft-lb
6”	5.5	40

Revision Date June 5, 2023

Document # 06-4098

Revision #2.1

Press Shut Down

When you finish with the Mandrel Insertion 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.

CAUTION!

For 6" pipe, the press gates must be opened prior to opening the press.

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

Marking the Fitting

Based on the fitting size and grade, mark the applicable crimp locations on the fitting as shown below in Table 16. All distances are from the sleeve end on the pipe side.

Table 16: Crimp Location Dimensions – Fittings

Crimp Number	6" (7 Crimps)	
	(mm)	(inches)
1 st Crimp	327	12 - 7/8
2 nd Crimp	273	10 - 3/4
3 rd Crimp	217	8 - 9/16
4 th Crimp	164	6 - 7/16
5 th Crimp	110	4 - 5/16
6 th Crimp	54	2 - 1/8
7 th Crimp	Flush with Sleeve End	Flush with Sleeve End

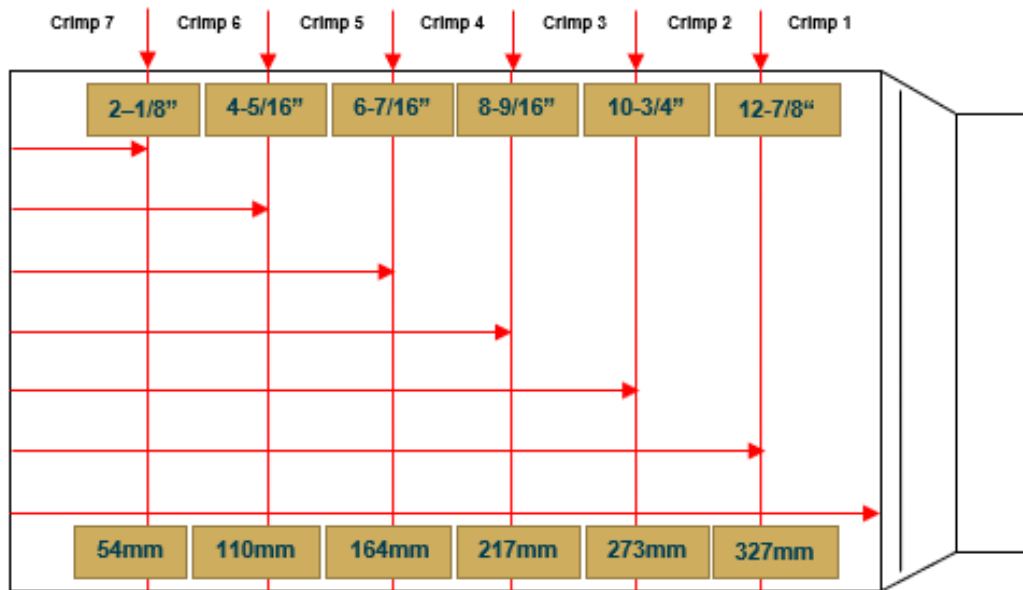


Figure 33: 6" Fitting Crimp Locations

Note: The flare on 6" is smaller than 2" to 4" Flexpipe Spoolable Products.

Anode Kit

In jurisdictions requiring, or in applications deemed advantageous, an optional sacrificial anode can also be applied to the crimp fitting. Shawcor has developed a sacrificial ribbon anode kit for buried steel fittings that provides external corrosion protection for a 20 year life in soil resistivities ranging between 1500 to 3000 ohm/cm. This is based on a fitting external wrapping efficiency of 95%. Please refer to the Shawcor Pipe Installation Guide for more information.

The anodes for 6" Flexpipe HT have three anode strips. The anodes are installed similar to other Flexpipe Spoolable Products. The anode is secured to the fitting using the attached clamp. The three anode strips are secured to the pipe on the same side of the coupling. The anodes should be arranged at uniform intervals around the pipe using the provided cloth tape. The fitting is wrapped with protective wrapping as outlined in the Pipe Installation Guide.



Figure 34: 6" Anode Kit

Risers

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 Spoolable Products from buried to an above ground connection. Riser chutes are available from Flexpipe. Check with Flexpipe for the latest versions of the riser drawings.

For 6" products, Flexpipe currently only offers a 45° riser chute due to the bend radius of the 6" pipe. Contact Flexpipe if a 90° riser is required.

The installation of the 6" riser chute is similar to those for 2" to 5". The 6" riser chute will have a small gap between the pipe and the C-channel. It is also required to use the supplied square backing tube between the bottom of the riser chute and the U-bolt nuts. U-bolts must only be hand tight. Do not over tighten the U-bolts. There will be a gap between the edge of the plastic half-moon and the pipe. Additional riser installation guidance is available in the Flexpipe Pipe Installation Guide.



Figure 35: 6" FP601 HT installed into a 45° riser chute



Figure 36: Square backing tubing and gap between the plastic half-moon and the pipe (left). Gap between the pipe and C-channel (right).

Table 17: 6” Flexpipe HT Product Datasheet

Flexpipe HT (FPHT)		FP601 HT	FP301 HT
Maximum Operating Pressure @ 82°C or 180°F		10,342 kPa / 1,500 psi	5,171 kPa / 750 psi
Nominal Size		6"	6"
Outside Diameter	Metric (mm)	191	179
	Imperial (inches)	7.5	7.1
Inside Diameter	Metric (mm)	142	142
	Imperial (inches)	5.6	5.6
Weight	Metric (kg/m)	15.6	10.8
	Imperial (lbs/ft)	10.5	7
Weight – Full of Water	Metric (kg/m)	31.4	26.3
	Imperial (lbs/ft)	21.1	17.7
Minimum Bend Radius (Operational)	Metric (m)	3.4	3.4
	Imperial (ft)	11	11
Length/Reel*	Metric (m)	350	350
	Imperial (ft)	1,148	1,148
Reel Diameter	Metric (m)	4.3	4.3
	Imperial (ft)	14	14
Reel Width	Metric (m)	2.4	2.4
	Imperial (ft)	8	8
Reel Weight - Full*	Metric (kg)	6,920	5,590
	Imperial (lbs)	15,255	12,323
Reel Weight - Empty	Metric (kg)	1,500	1,500
	Imperial (lbs)	3,300	3,300
Fitting Outside Diameter**	Metric (mm)	213	203
	Imperial (inches)	8.4	8
Fitting Inside Diameter**	Metric (mm)	124	124
	Imperial (inches)	4.9	4.9

*Lengths and reel weights are approximate as they may vary depending on the manufacturing run.

**Fitting dimensions do not include O.D. of flange provided for flanged end fittings. Fitting O.D. and I.D apply to flanged end, weld-neck and pipe-to-pipe coupling fittings.

Product data is subject to change without notice. Flexpipe’s products are patented by US Patents 6,889,716, 6,902,205, 7,946,629 B2 and 8,042,252 B2 by Canada Patents 2,513,506, 2,513,468 and 2,562,823 and by European Patent 1592908. Additional patents are pending. Flexpipe Spoolable Products comply with API 15S, API 17J, CSA Z662-15, ASTM F2686 and ASTM D2992. ©Shawcor Ltd., 2015

Table E.7 Pipe Fill Volume per Unit Distance

Flexpipe, Flexpipe HT, FlexCord			
Nominal Size (in)	bb/ft	gal/ft	m ³ /m
6	0.03	1.279	0.016