RESISTOFLEX®

brands you trust

Field Fabrication Manual For Plastic Lined Piping

CRANE®

ChemPharma Flow Solutions

www.cranechempharma.com

CRANE® RESISTOFLEX®

Flanged Plastic-Lined Pipe

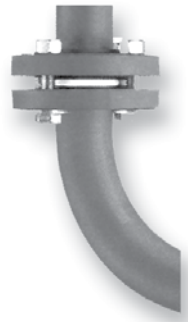
CRANE ChemPharma, Resistoflex plastic-lined pipe is made with a locked-in liner to minimize the adverse effects of differential thermal expansion between the liner and the steel. Available liners are: PP, Kynar® PVDF, PTFE and PFA

Plastic-Lined Fittings

Fittings are available in standard and custom shapes with multiple lining options including PTFE, PFA, PP, PVDF, and ETFE

Special Shapes

- Custom fittings, manifolds, and small vessels
- Lined with TEFZEL® ETFE
- Available through 24" diameter



Thermalok® Pipe

- Stress-relieved liner
- Carbon steel and stainless steel material options
- Sizes ranging from 1" - 24" diameter

Swaged Pipe

- Liner in compression for improved chemical resistance
- Sizes ranging from 1" - 8"
- Threaded flanges and threaded rotatable flange assemblies only
- Used for all Conquest and Multi-Axis piping

CONQUEST® Connections

- Patented flangeless joint design
- Performance of a welded system
- Available in 1" - 4" for all liner types
- Virtually zero maintenance

ResistoPure™

- High-Purity Silicone Hoses
- High-Purity Teflon® Hoses
- Clean-Room assembly packaging
- Virtually zero maintenance

Expansion Joints of TEFLON®

- 2, 3, or 5 Convolute construction
- Bolt or cable limited
- Teflon® T-62 for maximum flex life
- 1" - 24" Size range
- DI or SS Flanges available

CRANE RESISTOFLEX®

Table of Contents

The RESISTOFLEX® Difference

Corrosion resistance of plastic, field convenience

Resistoflex Plastic-Lined Pipe combine the best properties of two different materials of construction. On the outside, a metal housing provides strength, shock resistance, ease of installation, and a high pressure handling capability.

On the inside, a plastic lining offers corrosion resistance that even stainless steel and high alloy metals cannot match, at a cost that is generally lower. The thick plastic lining also prevents contamination of high purity fluids.

Resistoflex's field flare designs allow for custom pipes to be manufactured on the job site. Not sure of what pipe spool lengths you will need ahead of time? No problem. Both our Thermalok® and Swaged piping are available for field flaring. Field flare piping allows you to always have the correct length of pipe to finish the job.

Thermalok® Field Flare Pipe

Resistoflex supplies Thermalok Field Flare pipe with moveable liner for our distributors and end users who fabricate finished pipe spools in their shops. Moveable liner allows the fabricator a wide variety of flange options - rotating welded, or threaded. Thermalok Field Flare tooling is available - please see our Tooling and Fabrication section for more information. Available liners are PTFE, PFA, PP, and PVDF.

The Thermalok Field Flare product is made with the same process as our standard flanged Thermalok pipe spools, but the relaxing step is modified to result in a moveable liner. When fabricated by a distributor or end user with Resistoflex tooling and in accordance with our procedures, the finished piping has identical performance (pressure/temperature/vacuum) as our standard factory-made pipe spools. All field flare piping has been qualified to the rigorous testing requirements of ASTM F1545.

Swaged Field Flare Pipe

Swaged Piping is also available for field flaring and can be customized with two flange options - rotating or threaded. The process of swaging, as performed on the Abbey Etna Rotary Swager, consists of hammering a metal tube to reduce its diameter to a pipe diameter without grinding or cutting. The same piping used for field fabrication is also used for factory spools.

Product Identification Guide

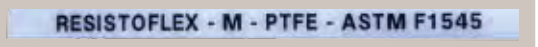
Thermalok® Pipe

Swaged Pipe

PTFE (Polytetrafluoroethylene)

- Pure White Color
- 1" - 8" Swaged (CS only)
- 1" - 12" Thermalok (CS and SS)

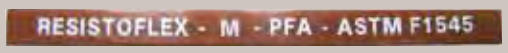
Cable Tie Information



PFA (Perfluoroalkoxy)

- Semi-Transparent Gray Color
- 1" - 8" Swaged (CS only)
- 1" - 8" Thermalok (CS and SS)

Cable Tie Information



PP (Polypropylene)

- Orange Color*
- 1" - 8" Swaged (CS only)
- 1" - 12" Thermalok (CS and SS)

Cable Tie Information

* Standard color. Unpigmented available

Kynar® PVDF (Polyvinylidene Fluoride)

- Black Color*
- 1" - 8" Swaged (CS only)
- 1" - 8" Thermalok (CS and SS)

Cable Tie Information

* Standard color. Unpigmented available

Field Fabrication Manual Guidelines

Resistoflex supplies steel pipe lined with four different liner materials: PTFE (Polytetrafluoroethylene), PFA (Perfluoroalkoxy), PVDF (Polyvinylidene Fluoride), and PP (Polypropylene). Resistoflex lined pipe can be supplied completely fabricated at the factory to the customer's specified length, ready for installation. However, if the customer is unable to determine in advance what specific lengths are required for various spool pieces, they may obtain Resistoflex field flare pipe and fabricate it to length at the job site. Resistoflex offers two types of field flare pipe: Thermalok® and Swaged. These field flare pipe spools can be used with the Resistoflex factory-made pipe spools and fittings described in the Resistoflex Design and Layout Manual.

This Field Fabrication Manual for Plastic Lined Piping contains instructions for field flaring liners in Resistoflex pipe spools made with threaded or lap joint flanges and containing PTFE, PFA, PVDF, or PP liners. Resistoflex field flare pipe can be fitted with lap joint flanges through the use of Conrac or T-Drill machines or fabricated using pre-flared stub ends.

Tooling

Before beginning the fabrication process, confirm that you have all of the required tooling. Resistoflex Universal Field Flaring Tool Kits (table right) streamline the fabrication methods described in this guide by including needed tools in one convenient package. For information on tooling and field flaring techniques for 10" and 12" size pipe, please contact the factory. All tools used in this manual are also available individually. For a listing of the tools used in the fabrication process, refer to the tooling section (p. 27-30) of this guide.

Resistoflex Field Flaring Tool Kit Part Numbers

Kits	Thermalok	Swaged		
		PTFE/PFA	PVDF	PP
1"-4"	R29650M	0660050 & 0660043	1"-2" 0754283 3"-4" 0742957	0660050 0785857
6"	R29650S-096*	6" - 8" 0660423	6"-8" 0742965	0660423
8"	R29650S-128*			

*Supplementary Kits

Warning

It is important that the procedures and techniques described herein be carefully adhered to, in order to achieve full performance capabilities of the finished assembly. Deviation from the prescribed procedures may result in unsatisfactory service life, failure or personnel and/or equipment hazard.

These warning signs are found throughout this guide. They are provided to ensure that proper safety measures are taken throughout the fabrication process.

For more information on safely using the materials described in this guide, please refer to the Society of the Plastics Industry (SPI) website at www.plasticsindustry.com.

The information contained herein is provided only as a guide for the fabrication of Resistoflex products. Because use, conditions, and applicable laws may differ from one location to another, and may change with time, the Customer is responsible for determining whether products and the information in this document are appropriate for the Customer's use, and for ensuring that the Customer's workplace and disposal practices are in compliance with applicable laws and other government enactments. Seller assumes no obligation or liability for the information in this document. NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY DISCLAIMED.

Fabrication should be performed only by trained personnel according to the instructions and procedures outlined herein.

Initial Procedures for all Swaged Piping Fabrication

1

To determine required finished length "X", select the proper cut-off length "D" from the cutting dimensions table for given liner material.

NOTE: If spool is being manufactured from a partially finished spool, with one end factory finished, use cut-off length "S".

Cutting Dimension Locations	
PTFE	Pg 9
PFA	Pg 11
PP	Pg 13
PVDF 1"-2"	Pg 15
PVDF 4"-8"	Pg 18

2

Cut pipe to proper cut-off length "D" using a sharp angled tip cutter to assure an accurate cut. DO NOT USE hacksaw or wheel-type cutters. A hacksaw tends to "lead," which produces non-right-angle cuts. A wheel-type cutter produces a slightly beveled cut that leaves burrs and can cause severe stress risers in the plastic liner.

3

Determine the cut-back dimension "E" from the cutting dimensions table. Use the same angled cutter to cut through the metal just to the surface of the plastic liner at the distance "E" from the end of the steel shell. Once the tool begins to "break through" the steel, stop cutting.

Standard Thread Length		
Pipe Size	(in.)	(mm)
1"	13/16"	21
1 1/2"	1"	26
2"	1 1/16"	27
3"	1 7/16"	37
4"	1 1/2"	39
6"	1 11/16"	43
8"	1 7/8"	48

4

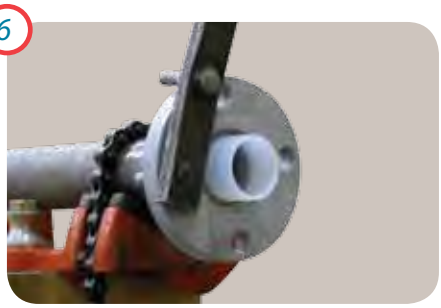
Remove the cut steel ring from the end of the pipe by inserting the proper size guide plug into the pipe and pulling with a modified gear puller.

NOTE: A guide plug has two diameters. Choose the end that fits snugly in the pipe bore.

5

Cut a standard tapered pipe thread on the end of the pipe with any conventional threader to accommodate a chamfered threaded flange. Use standard thread length and adjust thread depth to allow flange to be turned on hand tight until the last 1½ turns. See chart for standard thread length. Proper fit may be obtained by adjusting thread depth. To adjust thread depth, see threader manufacturer's manual.

6



Place flange on pipe with chamfer facing outward. Tighten flange with wrench until turn-up dimension "F" between end of plastic stub and face of flange matches requirement shown in the cutting dimensions table. Also be sure that the bolt holes on flanges at either end of pipe spool are aligned. Flanges must be tightened with a flange wrench and must be beyond hand tight. Proper turn up will locate pipe end at bottom of chamfer. Pipe end cannot be threaded more than 1/2 thread into the chamfer area. If flange turn up is more the thread has been cut too deep.

Rotatable Flange Option: Place flange and stub assembly on pipe with chamfer facing outward. Tighten to turn-up dimension "F" measured from end of plastic face of stub assembly.

NOTE: Stub assembly must be beyond hand tight like the chamfered flange.

Swaged Polytetrafluoroethylene (PTFE) Piping

Joint Fabrication of 1"-8" Swaged PTFE Piping

For steps 1-6, refer to "Initial Procedures for all Swaged Piping Fabrication" section

7

Clamp prepared pipe in horizontal or vertical position. Remove any notches on end of exposed plastic stub using a file or Vargus de-burring tool. Using a clean rag and a non-flammable degreaser that is compatible with the liner, wipe away cutting oil, shavings and dirt from exposed plastic stub.

Vargus De-Burring Tool

Warning

When field forming, use adequate ventilation (indoors, use exhaust fans). Avoid breathing of vapors resulting from overheating and possible degradation of the plastic. Do not consume food or beverages and do not smoke during fabrication process. Also, to prevent electrical shock, do not use heat gun near water.

8

Attach flaring die that matches pipe diameter. Fit the guide pins in the clamping block assembly to match the flange bolt holes. With the flaring die centered in the extended liner and the drive screw retracted, check to make sure the guide pins fit freely in the bolt holes with the clamping dogs behind the flange. If adjustment is needed, loosen the adjusting nuts, center the tool and retighten the nuts.

NOTE: See Page 31 for forming tool assembly details and parts list

9

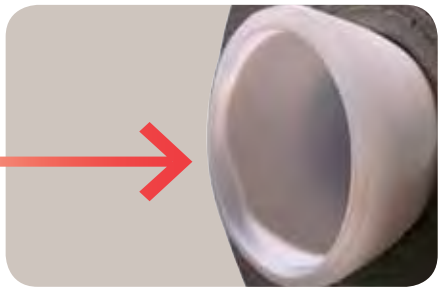
Position the proper patented venting collar over the plastic stub and place tight against the flange face, with curved crimped edge inward, fitting into flange chamfer. If flange is turned up too far onto pipe, the venting collar will stand away from the pipe flange.

NOTE: For PTFE, be sure to only use nickel-plated collar with small perforated holes. **DO NOT USE** stainless steel collar with large holes, which is designed for use with PVDF-lined pipe.

10

2-4 minutes

"Heat until 25-50% of the plastic stub becomes translucent."



The plastic stub can now be heated with a heat gun - attach proper size of heat cup to the hot air gun, set the heater dials as shown in chart, and allow the gun to preheat for 15-20 minutes. When gun is ready, place gun with heat cup against the flange and heat until 25-50% of the liner stubs leading edge becomes translucent. Heating time is 2-4 minutes. Frequently rotate heat gun to balance heat over plastic surface.

Pipe Size	Heat Settings	
	Leister 2200W 110V	Leister 4500W 220V
1"	10	5-6
1 1/2"	10	6-7
2"	---	7
3"	---	7-8
4"	---	8
6"	---	10
8"	---	10

The 110V gun is only recommended for heating 1" and 1 1/2" sizes.

Swaged Polytetrafluoroethylene (PTFE) Piping

11

Using gloves, gradually insert cone-shaped preformed tool into translucent plastic stub until it reaches the flange face. Allow plastic to cool until end lifts away from preformer before proceeding to next step (1" - 4" sizes only). On 6" - 8", use preformer to form plastic into trumpet shape. Allow PTFE to turn white before next step.

12

With the flaring die centered in the plastic stub, place the flaring tool guide pins into flange holes and lock clamping dogs in place. Crank the forming die snug to flange. Use cool air or water to speed cooling of plastic to room temperature. Remove tool once liner has cooled.

NOTE: To assure properly flared face, it is extremely important to cool plastic and flange to room temperature.

13

Visually inspect the finished sealing face for a flat, smooth surface and a smooth bend radius.

Ensure flare meets minimum flare diameter in chart below.

Minimum Flare Diameter		
Pipe Size	(in)	(mm)
1"	1 7/8	48
1 1/2"	2 11/16	69
2"	3 7/16	88
3"	4 5/8	118
4"	5 15/16	151
6"	8	204
8"	10 1/16	256

14

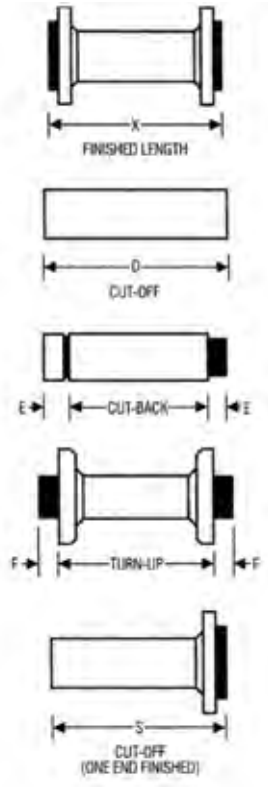
Spark test the finished face for defects that may not be readily visible. Adjust the sparker to arc about 1" to the flange. Insert probe into the pipe end and circle the inside near the liner. A defect is identified by apparent major arcing through the liner. DO NOT USE pipe with a defective liner.

15 To identify plastic liner, be sure to attach the correct color-coded (p. 5) plastic band to the spool.

16 A ½" thick plywood cover should be bolted to the flange to protect the plastic face and to prevent the face from "remembering" its preformed shape and pulling away from the flange.

17 Attach proper label to plywood cover.

For troubleshooting tips, please see page 35.



Cutting Dimensions for (PTFE) with Venting Collar[1]								
Pipe Diameter	D Cut-off		E Cut-back		F Turn-up[2]		S Cut-off	
	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)
1"	X + 1 3/8	X + 35	1 1/16	27	7/8	23	X + 11/16	X + 18
1 1/2"	X + 1 7/8	X + 48	1 5/16	34	1 1/8	29	X + 15/16	X + 24
2"	X + 2	X + 51	1 3/8	35	1 3/16	31	X + 1	X + 26
3"	X + 2 3/8	X + 61	1 9/16	40	1 3/8	35	X + 1 3/16	X + 31
4"	X + 2 1/2	X + 64	1 5/8	42	1 7/16	37	X + 1 1/4	X + 32
6"	X + 2 1/4	X + 58	1 5/8	42	1 7/16	37	X + 1 1/8	X + 29
8"	X + 2 3/8	X + 61	1 3/4	45	1 9/16	40	X + 1 3/16	X + 31

[1] PTFE venting collars are nickel-plated with small perforated holes.
[2] "F" dimension is to the flange face.

Swaged PFA Lined Piping (1“ - 4“)

Joint Fabrication of 1”-4” Swaged PFA Piping

For steps 1-6, refer to “Initial Procedures for all Swaged Piping Fabrication” section
For fabrication of 6” - 8” PFA piping consult factory

7

Clamp prepared pipe in horizontal or vertical position. Remove any notches on end of exposed plastic stub using a file or Vargus de-burring tool. Using a clean rag and a non-flammable degreaser that is compatible with the liner, wipe away cutting oil, shavings, and dirt from exposed plastic stub.

Vargus De-Burring Tool

8

Attach flaring die that matches pipe diameter. Fit the guide pins in the clamping block assembly to match the flange bolt holes. With the flaring die centered in the extended liner and the drive screw retracted, check to make sure the guide pins fit freely in the bolt holes with the clamping dogs behind the flange. If adjustment is needed, loosen the adjusting nuts, center the tool and retighten the nuts.

9

Position the proper patented venting collar over the PFA stub and place tight against the flange face, with curved crimped edge inward, fitting into flange chamfer.

NOTE: For PFA be sure to only use nickel-plated collar with small perforated holes. DO NOT USE stainless steel collar with large holes, which is designed for use with PVDF-lined pipe.

Warning

When field forming, use adequate ventilation (indoors, use exhaust fans). Avoid breathing of vapors resulting from overheating and possible degradation of the plastic. Do not consume food or beverages and do not smoke during fabrication process. Also, to prevent electrical shock, do not use heat gun near water.

10

Pipe Size	Heat Settings	
	Leister 4500W 220V	Heat Time (Minutes)
1”	5-6	1
1/2”	6-7	1.5
2”	7	1.5-2
3	7-8	1.5-2
4”	8	2

The plastic stub can now be heated with a heat gun; attach proper size of heat cup to the hot air gun, set the heater dials as shown in chart, and allow the gun to preheat for 15-20 minutes. For 3 and 4” sizes, preheat the flaring die to approximately 230°F-110°C during this time, using electric hot plate or additional hot air gun with an oversize heat cup. When gun is ready, place gun with heat cup against the flange and rotate heat gun to balance heat over plastic surface. Heat until liner looks glossy or wet, and no more than 1/16” (1.59mm) of liner at end turns clear. DO NOT let liner turn any more transparent – this is too hot. Squeeze the liner to check softness – it should be firm but flexible.

Swaged PFA Lined Piping (1"-4")

11

When the liner is properly heated, spray the preflare tool with mold release, then using gloved hand, gradually insert cone-shaped preformed tool into the PFA stub until it reaches the flange face.

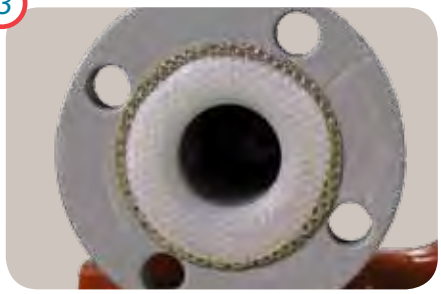
NOTE: For 4" size, the Enerpac hydraulic tool must be used in the preforming step for best results.

12

With the flaring die centered in plastic stub, place flaring tool guide pins into flange holes and lock clamping dogs in place. Crank the forming die snug to flange – excess force is not needed. When cooled, remove forming tool and check face for cracking or splitting. For 4" size, the Enerpac hydraulic tool must be used in the flaring step for best results.

NOTE: To assure properly flared face, it is extremely important to cool plastic and flange to room temperature. Air or water can be used as the cooling agent.

13



Visually inspect the finished sealing face for a flat, smooth surface and a smooth bend radius. For spool lengths less than 3 feet long, leave flaring tool in first end while flaring second end. This prevents the flare face of the first end from reheating and lifting from flange. It may take longer to heat the second end because of the reduced air flow.

14

Spark test the finished face for defects that may not be readily visible. Adjust the sparker to arc about 1" to the flange. Insert probe into the pipe end and circle the inside near the liner. A defect is identified by apparent major arcing through the liner. DO NOT USE pipe with a defective liner.

15 To identify plastic liner, be sure to attach the correct color-coded (p. 5) plastic band to the spool.

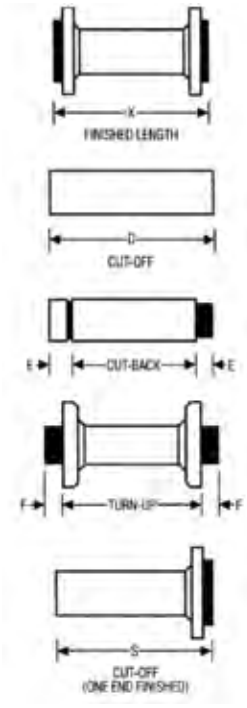
16 A ½" thick plywood cover should be bolted to the flange to protect the plastic face and to prevent the face from "remembering" its preformed shape and pulling away from the flange.

17 Attach proper label to plywood cover.

For troubleshooting tips, please see page 35.

Ensure flare meets minimum flare diameter in chart below.

Minimum Flare Diameter		
Pipe Size	**(in)**	**(mm)**
1"	1 7/8	48
1 1/2"	2 11/16	69
2"	3 7/16	88
3"	4 5/8	118
4"	5 15/16	151



Cutting Dimensions for PFA with Venting Collar[1]								
Pipe Diameter	**D Cut-off**		**E Cut-back**		**F Turn-up[1]**		**S Cut-off**	
	(in)	**(mm)**	**(in)**	**(mm)**	**(in)**	**(mm)**	**(in)**	**(mm)**
1"	X + 1 3/8	X + 35	1 1/16	27	7/8	22	X + 11/16	X + 18
1 1/2"	X + 1 7/8	X + 48	1 5/16	33	1 1/8	29	X + 15/16	X + 24
2"	X + 2	X + 51	1 3/8	35	1 3/16	30	X + 1	X + 26
3	X + 2 3/8	X + 60	1 9/16	40	1 5/8	41	X + 1 3/16	X + 31
4"	X + 2 1/2	X + 64	1 5/8	41	1 7/16	37	X + 1 1/4	X + 32

[1]PFA venting collar are nickel-plated with small perforated holes.

Swaged Polypropylene (PP) Piping

Joint Fabrication of 1"-8" Swaged PP Piping

For steps 1-6, refer to "Initial Procedures for all Swaged Piping Fabrication" section

7

Clamp prepared pipe in horizontal or vertical position. Remove any notches on end of exposed plastic stub using a file or Vargus de-burring tool. Ensure OD and ID of liner stub edge is free of burrs and nicks. Using a clean rag and a non-flammable degreaser that is compatible with the liner, wipe away cutting oil, shavings and dirt from exposed plastic stub.

8

With spring compressed on proper forming tool (1" - 4" or 6" - 8" tool) attach molding die that matches pipe diameter. Fit the guide pins in the clamping block assembly to match the flange bolt holes. With the molding die centered in the extended liner and the drive screw retracted, check to make sure the guide pins fit freely in the bolt holes with the clamping dogs behind the flange. If adjustment is needed, loosen the adjusting nuts, center the tool and retighten the nuts. Remove forming tool and set aside.

9

Attach proper size of heat cup to hot air gun, adjust guide pins to fit flange bolt hole spacing and set heater dials as shown in table. When forming 1" to 2" pipe, use standard heat cup. When forming larger pipe, use special baffle heat cup. The heat gun settings are approximate and may be adjusted to compensate for ambient temperature conditions and the length of electrical extension cord used.

NOTE: See page 31 for forming tool assembly details and parts list.

10

All hot air guns considered here use long-life, plug-in type elements, which will have extended life if the unit is allowed to cool for 5-10 minutes before shutoff. "Cool Air Only" position on Leister 110V and 220V hot air guns is at "0". Allow gun to preheat for 15-20 minutes. The hot air given off by gun during this time should be used to preheat the molding die to about 140°F-60°C, just above "too hot to touch."

Pipe Size	Heat Settings	
	Leister 2200W 110V	Leister 4500W 220V
1"	6	3
1/2"	6	4
2"	6-7	4-5
3	6-8	5
4"	8	6
6"	---	7
8"	---	7

Warning

When field forming, use adequate ventilation (indoors, use exhaust fans). Avoid breathing of vapors resulting from overheating and possible degradation of the plastic. Do not consume food or beverages and do not smoke during fabrication process. Also, to prevent electrical shock, do not use heat gun near water.

11

Place heat gun and cup against the flange and rotate cup position every 10 seconds to balance heat over surface of plastic stub. Heat for 2-4 minutes, until the plastic stub appears to be uniformly wet and glossy, checking softness with clean glove. If pipe is clamped in horizontal position and excessive plastic droop occurs, rotate pipe to control.

Swaged Polypropylene (PP) Piping

12

Plastic is ready when the PP liner feels like rubber and looks shiny. Heating time should be at least 2 minutes, to soften the liner on 1" - 4" size, and 4 minutes for 6" - 8" size. Remove hot air gun, then fold end of sagging plastic stub out toward the outside diameter of the flange and form plastic back to face of flange with a gloved hand. Quickly align molding tool and forming die assembly to the plastic and crank the molding die tight to the flange.

13

Allow plastic to cool at least 2 minutes before removing forming tool. When finished for the day, allow hot air gun to cool for 5-10 minutes with cool air blowing through the dial position 0, or lowest point on rheostat on Leister 110V and 220V hot air guns.

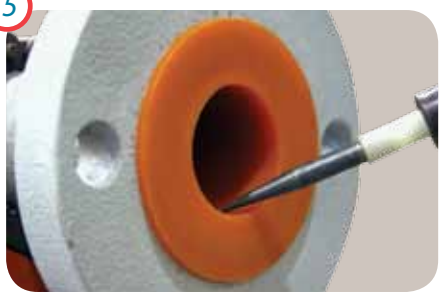
14

Visually inspect the molded face for a flat, smooth surface and a sharp transition between the ID and flare face. PP should not appear radiused like other liners.

Ensure molded face meets minimum flare diameter in chart below.

Minimum Flare Diameter		
Pipe Size	**(in)**	**(mm)**
1"	1 7/8	48
1 1/2"	2 11/16	69
2"	3 7/16	88
3"	4 5/8	118
4"	5 15/16	151
6"	8	204
8"	10 1/16	256

15



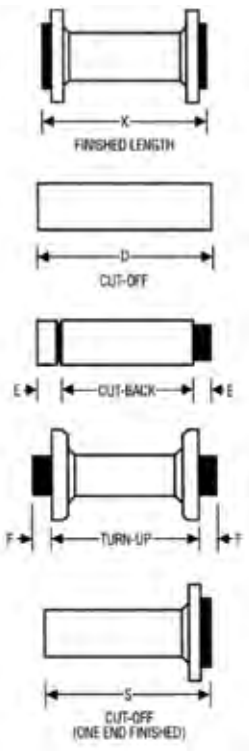
Spark test the finished face for defects that may not be readily visible. Adjust the sparker to arc about 1" to the flange. Insert probe into the pipe end and circle the inside near the liner. A defect is identified by apparent major arcing through the liner. DO NOT USE pipe with a defective liner.

16 To identify plastic liner, be sure to attach the correct color-coded (p. 5) plastic band to the spool.

17 A ½" thick plywood cover should be bolted to the flange to protect the plastic face and to prevent the face from "remembering" its preformed shape and pulling away from the flange.

18 Attach proper label to plywood cover.

For troubleshooting tips, please see page 35.



Cutting Dimensions for Polypropylene								
Pipe Diameter	**D Cut-off**		**E Cut-back**		**F Turn-up[1]**		**S Cut-off**	
	(in)	**(mm)**	**(in)**	**(mm)**	**(in)**	**(mm)**	**(in)**	**(mm)**
1"	X + 1 13/16	X + 47	1 1/8	29	1	26	X + 15/16	X + 24
1 1/2"	X + 1 3/4	X + 45	1 1/8	29	1	26	X + 7/8	X + 23
2"	X + 1 3/4	X + 45	1 1/8	29	1	26	X + 7/8	X + 23
3	X + 2 1/4	X + 58	1 7/16	37	1 5/16	34	X + 1 1/8	X + 29
4"	X + 2 1/2	X + 64	1 5/8	42	1 7/16	37	X + 1 1/4	X + 32
6"	X + 2 3/8	X + 61	1 1/2	39	1 3/8	35	X + 1 3/16	X + 31
8"	X + 3	X + 77	1 15/16	50	1 11/16	43	X + 1 1/2	X + 39

[1] "F" dimension is to the flange face.

Swaged Polyvinylidene Fluoride (PVDF) Piping

Joint Fabrication of 1"-2" Swaged PVDF Piping

For steps 1-6, refer to "Initial Procedures for all Swaged Piping Fabrication" section

7

Clamp prepared pipe in horizontal or vertical position. Remove any notches on end of exposed plastic stub using a file or Vargus de-burring tool. Ensure OD and ID of liner stub edge is free of burrs and nicks. Using a clean rag and a non-flammable degreaser that is compatible with the liner, wipe away cutting oil, shavings and dirt from stub.

Vargus De-Burring Tool

8

Set up hydraulic forming tool to proper size and "dry run" into flange bolt holes, checking alignment and centering. Check to make sure the guide pins fit freely in the bolt holes and the clamping dogs seat firmly behind the flange. If adjustment is needed, loosen the adjusting nuts, center the tool and retighten the nuts (see graphic next page). Remove tool, attach hydraulic hose and set aside.

Warning

When field forming, use adequate ventilation (indoors, use exhaust fans). Avoid breathing of vapors resulting from overheating and possible degradation of the plastic. Do not consume food or beverages and do not smoke during fabrication process. Also, to prevent electrical shock, do not use heat gun near water.

9

Lightly grease the proper size of aluminum flaring die and preformer with a high temperature grease.

Preheat die to temperature between 280°F-138°C (min.) and 300°F-149°C (max.) with hot plate, oven, propane gas stove or torch. Use a pyrometer to monitor while proceeding to next step.

NOTE: DO NOT HEAT PREFORMER "CONE" DIE. It is used at room temperature.

NOTE: See page 32 for forming tool assembly details and parts list.

10

Attach proper size of heat cup to hot air gun, set heater dials and allow gun to preheat for 15-20 minutes.

Pipe Size	Heat Settings	
	Leister 2200W 110V	Leister 4500W 220V
1"	5.0	2.0-3.0
1 1/2"	5.0-6.0	2.0-3.0
2"	5.0-6.0	3.0

11

Position the proper locking collar over the plastic stub and place tight against the flange face, with curved crimped edge inward, fitting into flange chamfer.

NOTE: For forming faces of PVDF, be sure to use only stainless steel locking collars with large holes. **DO NOT USE** nickel-plated collar with small perforated holes, which is designed for use with PTFE and PFA lined pipe.

12

Place heat gun and heat cup against flange, rotate heat cup frequently (10-20 seconds) to heat plastic stub to temperature. Heating time is 2-4 minutes. (See page 17 for graphic of proper air flow). When material is sufficiently heated the liner stub should be softened to allow it to yield to a gloved hand, yet still rigid enough to spring back to shape.

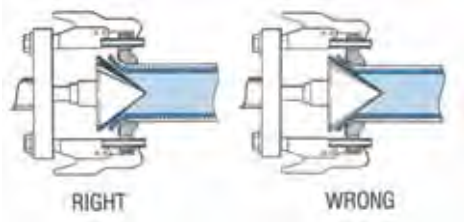
Swaged Polyvinylidene Fluoride (PVDF) Piping

13

Engage hydraulic forming tool to flange and securely lock flange dogs into position. Place preformer cone on cylinder pin of tool and advance forward into plastic stub. Hold in place for approximately 10 seconds at gauge pressure of 1000 psi (6900 kPa).

NOTE: Avoid excessive force on the preformer cone to prevent thinning of liner against end of steel shell. See graphic below.

Preformer Engagement



14

Release pressure and retract cylinder. Immediately replace preformer die with preheated aluminum flaring die: Again extend cylinder forward to complete forming of face flat to locking collar. Maintain pressure on flaring die (about 4000-6000 psig or 27,600-41,400 kPa) for 2 minutes. Then clamp flaring die to flange and retract and remove forming tool assembly. Leave die in place until plastic, steel pipe shell and flange have been properly cooled to room temperature by air cooling or water.

15

Visually inspect the finished flare for a flat, smooth surface and a smooth bend radius. Also, be sure the locking collar is firmly embedded in liner.

Ensure flare meets minimum flare diameter in chart below.

Minimum Flare Diameter		
Pipe Size	**(in)**	**(mm)**
1"	1 7/8	48
1 1/2"	2 11/16	69
2"	3 7/16	88

16

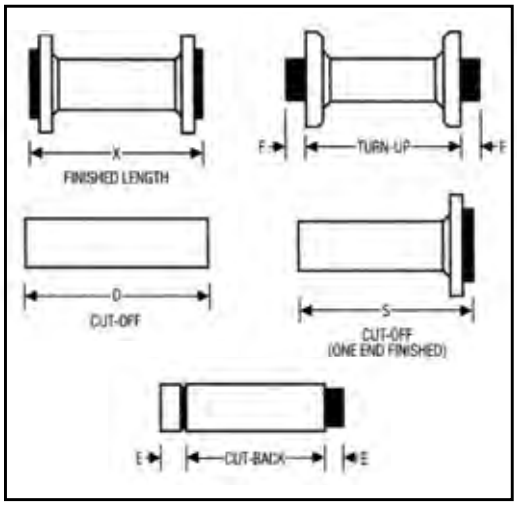
Spark test the finished face for defects that may not be readily visible. Adjust the sparker to arc about 1" to the flange. Insert probe into the pipe end and circle the inside near the liner. A defect is identified by apparent major arcing through the liner. DO NOT USE pipe with a defective liner.

17 To identify plastic liner, be sure to attach the correct color-coded (p. 5) plastic band to the spool.

18 A ½" thick plywood cover should be bolted to the flange to protect the plastic face and to prevent the face from "remembering" its preformed shape and pulling away from the flange.

19 Attach proper label to plywood cover.

For troubleshooting tips, please see page 35.



Cutting Dimensions for (PVDF) with Locking Collar[1]								
Pipe Dia.	**D Cut-off**		**E Cut-back**		**F Turn-up[2]**		**S Cut-off**	
	(in)	**(mm)**	**(in)**	**(mm)**	**(in)**	**(mm)**	**(in)**	**(mm)**
1"	X + 1 3/16	X + 31	15/16	24	3/4	20	X + 5/8	X + 16
1 1/2"	X + 1 11/16	X + 43	1 3/16	31	1	26	X + 7/8	X + 23
2"	X + 1 3/4	X + 45	1 1/4	32	1 1/16	27	X + 7/8	X + 23

[1] PVDF locking collars are stainless steel with large holes.
[2] "F" dimension is to the flange face.

Swaged Polyvinylidene Fluoride (PVDF) Piping

Joint Fabrication of 3"-8" Swaged PVDF Piping

For steps 1-6, refer to "Initial Procedures for all Swaged Piping Fabrication" section

7

Clamp prepared pipe in horizontal or vertical position. Remove any notches on end of exposed plastic stub using a file or Vargus de-burring tool. Ensure OD and ID of liner stub edge is free of burrs and nicks. Using a clean rag and a non-flammable degreaser that is compatible with the liner, wipe away cutting oil, shavings and dirt from stub.

Vargus De-Burring Tool

Warning

When field forming, use adequate ventilation (indoors, use exhaust fans). Avoid breathing of vapors resulting from overheating and possible degradation of the plastic. Do not consume food or beverages and do not smoke during fabrication process. Also, to prevent electrical shock, do not use heat gun near water.

8

Set up forming tool with proper guide pins for size of pipe being flared (3"-4" take 11.5" long pins, 6"-8" take 12" long pins) and by installing the proper size forming die (preformer is not used on 3"-8") and "dry run" into flange bolt holes, checking alignment and centering. Check to make sure the guide pins fit freely in the bolt holes with the locking pin slots behind the flange. See note below. If adjustment is needed, loosen the adjusting nuts, center the tool and retighten the nuts. Remove tool, attach hydraulic hose and set aside.

NOTE: See page 33 and 34 for setup, slotted rod adjustment, and forming tool assembly details/ parts list.

9

Lightly grease the proper size of aluminum flaring die and preformer with a high temperature grease.

Preheat die to temperature between 280°F-138°C (min.) and 300°F-149°C (max.) with hot plate, oven or torch. Use a pyrometer to monitor while proceeding to next step.

10

Attach proper size of heat cup to hot air gun, set heater dials and allow gun to preheat for 15-20 minutes.

Pipe Size	Heat Settings	
	Leister 2200W 110V	Leister 4500W 220V
3"	6-7	3-4
4"	7	4
6"	7	5-6
8"	7	6

11

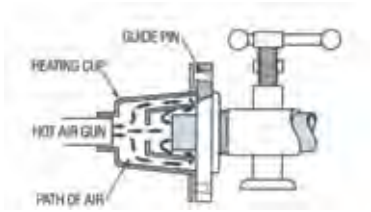
Position the proper locking collar over the plastic stub and place tight against the flange face, with curved crimped edge inward, fitting into flange chamfer.

NOTE: For forming faces of PVDF, be sure to use only stainless steel locking collars with large holes. **DO NOT USE** nickel-plated collar with small perforated holes, which is designed for use with PTFE and PFA-lined pipe.

Swaged Polyvinylidene Fluoride (PVDF) Piping

12

Place heat gun and heat cup to flange and heat plastic stub for 2-4 minutes. Frequently rotate gun for uniform heating When material is sufficiently heated the liner stub should be softened to allow it to yield to a gloved hand, yet still rigid enough to spring back to shape.



14

Visually inspect the finished flare for a flat, smooth surface, a smooth bend radius and a uniform circular OD. Also, be sure the locking collar is firmly embedded in liner.

Ensure flare meets minimum flare diameter in chart below.

Minimum Flare Diameter		
Pipe Size	(in)	(mm)
3"	4 5/8	118
4"	5 15/16	151
6"	8	204
8"	10 1/16	256

13

Attach the preheated forming die to the hydraulic cylinder on the forming tool. (CAUTION: Remember die is HOT.) With die centered in plastic stub, insert tool reaction arms through flange holes and insert locking pins in arms. Apply hydraulic pressure as seen in table below to eliminate the air gap between the heated die and the formed face. Note this pressure and maintain it for at least 2 minutes. Maintaining the pressure will require repeated pumping as the plastic slowly flows. TIP: Use the pressures listed in the table below as a guide for adjusting for heating for future preparation (e.g., if the pressure needed was higher than the value given in this table, plastic was too stiff and needed slightly more heating). Then clamp the flaring die to flange and retract and remove forming tool assembly. Leave die in place until plastic, steel pipe shell and flange have been properly cooled to room temperature by air cooling or with water.

NOTE: To assure properly flared face, it is extremely important to cool plastic and flange to room temperature.

Forming Die Pressure		
Pipe Size	Approx. Pressure (psi)	Approx. Pressure (kPa)
3"	2700 - 3000	18,600-20,700
4"	4000 - 4200	27,600-29,000
6"	5700 - 6000	39,300-41,400
8"	7500 - 7800	51,700-53,800

15

Spark test the finished face for defects that may not be readily visible. Adjust the sparker to arc about 1" to the flange. Insert probe into the pipe end and circle the inside near the liner. A defect is identified by apparent major arcing through the liner. DO NOT USE pipe with a defective liner.

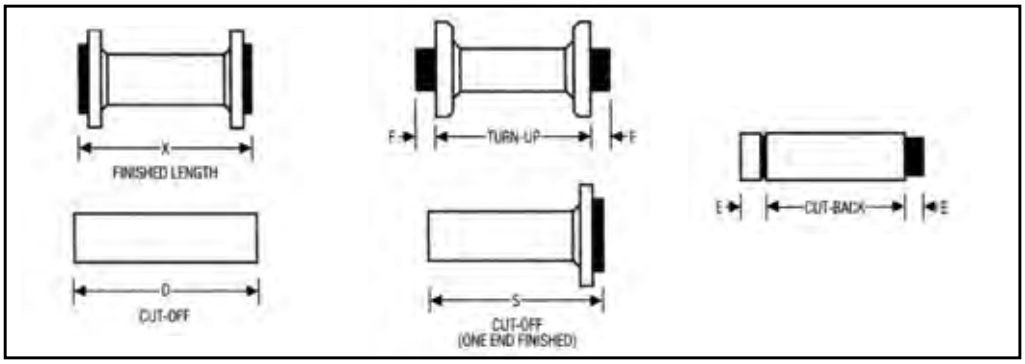
16 To identify plastic liner, be sure to attach the correct color-coded (page 5) plastic band to the spool.

17 A ½" thick plywood cover should be bolted to the flange to protect the plastic face and to prevent the face from "remembering" its preformed shape and pulling away from the flange. Attach proper label to plywood cover.

(Please see next page for cutting dimensions and page 35 for troubleshooting tips).

Swaged Polyvinylidene Fluoride (PVDF) Piping

Joint Fabrication of 3”-8” Swaged PVDF Piping (cont’d)



Cutting Dimensions for (PVDF) with Locking Collar[1]								
Pipe Dia.	D Cut-off		E Cut-back		F Turn-up[2]		S Cut-off	
	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)
3”	X + 2 1/8	X + 54	1 7/16	37	1 1/4	32	X + 1 1/16	X + 27
4”	X + 2 1/4	X + 58	1 1/2	39	1 5/16	34	X + 1 1/8	X + 29
6”	X + 2 3/8	X + 61	1 5/8	42	1 7/16	37	X + 1 3/16	X + 31
8”	X + 2 5/8	X + 67	1 3/4	45	1 9/16	40	X + 1 5/16	X + 34

[1] PVDF locking collars are stainless steel with large holes.

[2] “F” dimension is to the flange face.

Thermalok® PTFE, PFA, PP, and PVDF Lined Piping

Initial Procedures for all Thermalok Piping

Preparation of Lined Pipe

Note: Heating of the flaring heads can take place while the following preparatory operations are being performed.

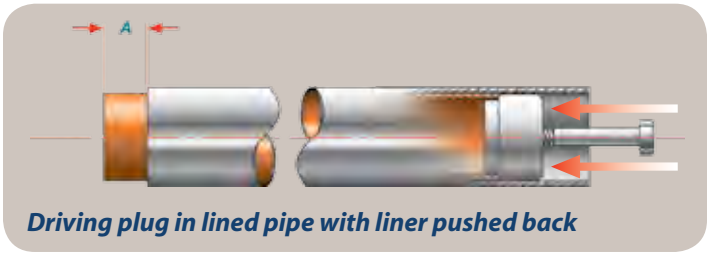
Warning

The Thermalok process custom fits each liner to its housing; therefore liners must not be removed from their original housings and indiscriminately used in other housings. If a liner must be removed from its housing, mark both the liner and the housing to assure the right liner goes back into the housing from which it came. Further, put the liner back in as soon as possible, otherwise it could relax slightly and make reinsertion difficult.

1

Driving Plug

Using the driving plug, push the liner along the steel pipe at one end, until it projects out the other end a distance equal to dimension "A" in the table below. (If the liner is difficult to move, use ice, dry ice or some other cooling medium to contract the liner to facilitate its movement.)



Driving plug in lined pipe with liner pushed back

Pipe Size	A (Push-out)	
	(in)	(mm)
1"	2 5/16	59
1 1/2"	2 7/16	62
2"	2 15/16	75
3"	2 15/16	75
4"	3 3/16	81
6"	3 11/16	94
8"	3 13/16	97

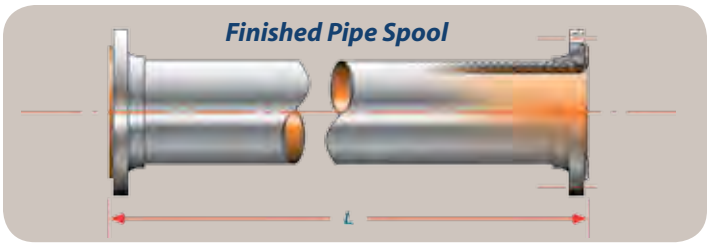
3

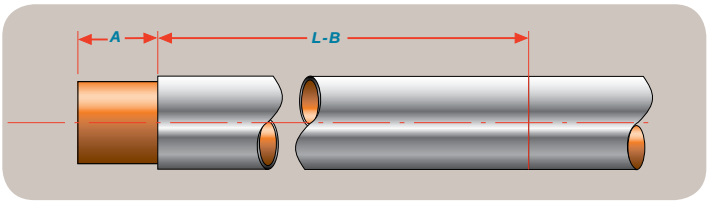
Using the driving plug at the newly cut end, push the liner approximately 2" (50mm) farther along the steel pipe. Then take a reamer or grinder and make a small radius on the inside edge of the steel pipe to eliminate any sharp corners or burrs at the newly cut end.

Each assembly must have at least two vent holes, one at each end approximately 3" to 4" from the end. This distance will allow flanging without obstructing the vent hole. To drill the holes, first push the liner far enough back inside the already cut-to-length housing to permit drilling the first hole safely. The hole diameter should be 3/32" (2.4mm) for pipe sizes through 4" and 5/32" (4mm) over 4". Be sure to deburr the hole inside the pipe and clean up any chips to prevent damage to the liner when repositioning it in the pipe. Repeat this operation at the opposite end.

2

With liner moved out of dimension "A", cut the lined steel pipe to length "L" minus dimension "B" (obtained from table below) using an abrasive cut-off wheel, lathe parting tool, or power hacksaw. Cut must be square with as little burr as possible. Do not use a pipe wheel or a tube cutter since these can deform the inside of the steel pipe.





Pipe Size	B (Cut-off)	
	(in)	(mm)
1"	13/16	21
1 1/2"		
2"		
3"		
4"	7/8	22
6"	15/16	24
8"	1 1/16	27

Warning

When field forming, use adequate ventilation (indoors, use exhaust fans). Avoid breathing of vapors resulting from overheating and possible degradation of the plastic. Do not consume food or beverages and do not smoke during fabrication process. Also, to prevent electrical shock, do not use heat gun near water.

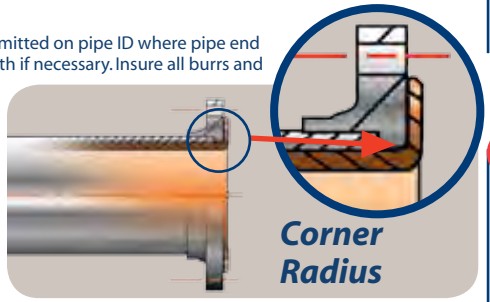
Thermalok® PTFE, PFA, PP, and PVDF Lined Piping

4

Thread the end of the pipe with either a straight pipe thread (NPSM) or a tapered pipe thread (NPT). Keep the interior of the lined pipe free of oil. If a straight pipe thread is used, to prevent the flanges from rotating out of position, apply Loctite® thread sealant or equivalent to the pipe threads before putting on the flange. Part # R60451DI-XXX can be screwed wrench tight to within 1/16" (1.5mm) of the internal flange shoulder.

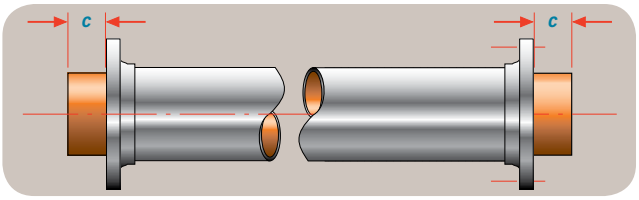
Note: No step or offset is permitted on pipe ID where pipe end and flange meet. Grind smooth if necessary. Insure all burrs and chips are removed. Corner radius should be ¼" in 1"-2", 5/16" in 3", 3/8" in larger sizes.

Note: Field fabrication pipe can also be fitted with lap joint flanges through the use of Conrac or T-Drill machines or fabricated by welding on pre-flared stub ends.



6

Using the driving plug, push the liner along the flanged pipe until it projects out Dimension "C" (found in chart below). Using a suitable saw (hacksaw, jigsaw, etc.) and the supplied cut-off rings to cut through the liner. Ensure that the the cut ends of the liner are square and even. Failure to make a clean, square cut could result in a split of the liner during flaring. If necessary, use a sharp knife to trim, any loose edges from the end of the liner, which may have resulted from the sawing or cutting operation.



Pipe Size	C (Turn-up)	
	(in)	(mm)
1"	13/16	21
1 1/2"	7/8	22
2"	1 1/8	29
3"		
4"	1 1/4	32
6"	1 1/2	38
8"	1 9/16	40

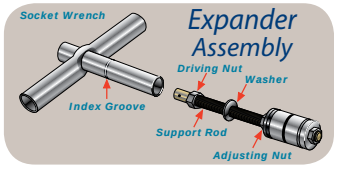
5

Using the driving plug at the unflanged end, push the liner back along the pipe until the end of the liner is at least two inches inside the steel housing. Repeat the reaming, threading and flange installation procedures in steps 3 and 4. Make certain flange bolt holes are properly aligned. Flanges may be backed-off as much as 1/4 turn from the fully bottomed position.

Note: Backing-off of flange must be done before thread sealant has had time to set up.

7

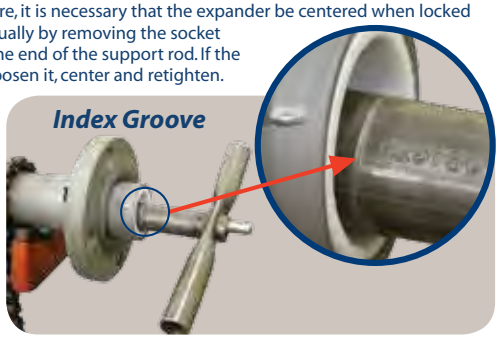
Note: If the liner was cooled to facilitate movement during previous steps, allow it to return to ambient temperature before proceeding with steps 7 and 8.



Remove the driving nut and washer from the expander assembly, then place the special socket wrench over the adjusting nut.

Insert this unit into the pipe so that the index groove on the wrench is even with the end of the liner or a little into the liner. Tighten the expander adjusting nut until the expander assembly is locked tightly in the pipe. Be careful not to misalign the expander or shift the liner.

Note: To insure a proper flare, it is necessary that the expander be centered when locked into the liner. Check this visually by removing the socket wrench and looking from the end of the support rod. If the expander is not centered, loosen it, center and retighten.



To prevent rotation of the rod while the expander adjusting nut is being tightened, hold it by means of the pin punch provided in the kit. The pin punch should be inserted into the small hole at the end of the rod. (There is no hole in the rod of the 1" expander. Instead, the end of the rod has parallel flat surfaces, which can be held with a wrench or pliers.)

Three extension pipes are supplied with the kit. One of the two smaller diameter pipes is supplied for placement over the handle of the pin punch to develop additional leverage, when needed. With PTFE liners, use of the pin punch extension is optional, but with PVDF & PP in 3" and larger sizes, use is desirable. (The second of the two smaller pipes is used in the handle of the socket wrench when flaring pipe liners 1 1/2" - 3" in size. The larger extension pipe is used in the handle of the socket wrench when flaring pipe liners over 3".)

Thermalok® PP and PVDF Lined Piping

Joint Fabrication of 1"-8" Thermalok PP and PVDF Piping

For steps 1-7, refer to "Initial Procedures for all Thermalok Piping" section

8

Clamp prepared pipe in horizontal or vertical position. Remove any notches on end of exposed plastic stub using a file or Vargus de-burring tool. Ensure OD and ID of liner stub edge is free of burrs and nicks. Using a clean rag and a non-flammable degreaser that is compatible with the liner, wipe away cutting oil, shavings and dirt from exposed plastic stub.

9

Note: Placing a metal cover over the flaring head opening reduces the heating time.

Heat the flaring head to the proper temperature as given in the table on page 24. (To save time, heating of the flaring head can take place while the previous seven steps are being performed.)

NOTE: If suggested methods of heating the flaring heads cannot be used, alternate heating methods can be used (conventional oven, gas torch with rosebud tip, etc.).

10

Switch on the 220 volt heat gun with the diffuser style tip (pictured above) to its maximum setting. Rotate the gun slowly around the plastic liner, making a full 360° sweep. Direct the hot air stream against the outer surface of the tubing, such that a minimum of air strikes the inner surface of the tubing. While the gun is being rotated around the liner, the operator should periodically press on the projecting liner with the thumb or fingers of his/her free hand which should be protected by heat resistant gloves. Initially the plastic will be stiff with no give. As the heating of the plastic continues, the material will begin to soften. When the operator feels the plastic just start to give, he should shut off the gun, lay it on a dry fireproof surface and then proceed with the flaring operation. This must coincide with the flaring head reaching the proper temperature.

11

Wearing the heat resistant gloves, place the heated flaring head onto the support rod. Then place the washer and driving nut onto the rod. (Do not bring the flaring head into contact with the liner extension until the washer and the driving nut are on the rod.) While using the supplied pin to keep the flaring head from rotating, take the special socket wrench and tighten the driving nut. This tightening will bring the hot flaring head into contact with the liner and the flaring process will have begun. A smoother operation and more uniform flare will result by using an extension pipe in the wrench handle as discussed in step 7 and with a cranking motion, advance the hot flaring head smoothly, steadily and without stopping, until the head bottoms. This is indicated by a sudden noticeable increase in resistance. Then tighten ¼ turn more. *Speed of flaring will be dictated by following the natural yield of the material as it softens against the flaring head. In some instances, after the flaring head has bottomed-out, the outer edge of the flare may not be flat against the flange face. There may be a slight gap. This is a perfectly normal condition and not a cause for rejection.

Note: When flaring polypropylene, caution should be taken to not force the head in too quickly by applying excessive torque to the flaring wrench.

Thermalok® PP, and PVDF Lined Piping

12

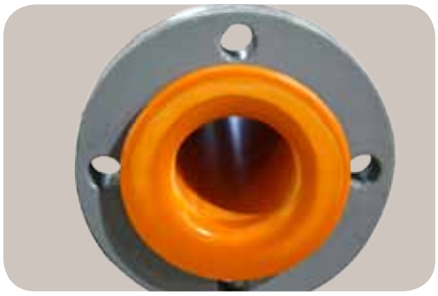
After flaring liner, immediately quench the flare with water. Leave the flaring head and the expander in place until the flare has cooled to 100°F-38°C or lower.
Then disassemble and remove the flaring head and the expander.

After the flaring head has been removed, the flared liner may taper away from the flange face at a slight angle, or may have a slightly convex surface. However, when the flange is bolted into position at installation, the flared liner will be pushed down snugly and provide a tight, leak-proof seal.

Ensure flare meets minimum flare diameter in chart below.

Minimum Flare Diameter		
Pipe Size	**(in)**	**(mm)**
1"	1 7/8	48
1 1/2"	2 11/16	69
2"	3 7/16	88
3"	4 5/8	118
4"	5 15/16	151
6"	8	204
8"	10 1/16	256

Finished Flare



13

Spark test the finished face for defects that may not be readily visible. Adjust the sparker to arc about 1" to the flange. Insert probe into the pipe end and circle the inside near the liner. A defect is identified by apparent major arcing through the liner. DO NOT USE pipe with a defective liner.

14

To identify plastic liner, be sure to attach the correct color-coded (p. 5) plastic band to the spool.

15

A 1/2" thick plywood cover should be bolted to the flange to protect the plastic face and to prevent the face from "remembering" its preformed shape and pulling away from the flange.

16

Attach proper label to plywood cover.

Thermalok® PTFE and PFA Lined Piping

Joint Fabrication of 1”-8” Thermalok® PTFE and 1”-4” PFA Piping

For steps 1-7, refer to “Initial Procedures for all Thermalok Piping” section

8

Clamp prepared pipe in horizontal or vertical position. Remove any notches on end of exposed plastic stub using a file or Vargus de-burring tool. Ensure OD and ID of liner stub edge is free of burrs and nicks. Using a clean rag and a non-flammable degreaser that is compatible with the liner, wipe away cutting oil, shavings and dirt from exposed plastic stub.

9

Note: Placing a metal cover over the flaring head opening reduces the heating time.

Heat the flaring head to the proper temperature as given in the table on page 24. (To save time, heating of the flaring head can take place while the previous seven steps are being performed.)

NOTE: If suggested methods of heating the flaring heads cannot be used, alternate heating methods can be used (conventional oven, gas torch with rosebud tip, etc.).

10

Wearing the heat resistant gloves, place the heated flaring head onto the support rod. Then place the washer and driving nut onto the rod. (Do not bring the flaring head into contact with the liner extension until the washer and the driving nut are on the rod.) While using the supplied pin to keep the flaring head from rotating, take the special socket wrench and tighten the driving nut. This tightening will bring the hot flaring head into contact with the liner and the flaring process will have begun. A smoother operation and more uniform flare will result by using an extension pipe in the wrench handle as discussed in step 7 and with a cranking motion, advance the hot flaring head smoothly, steadily and without stopping, until the head bottoms. This is indicated by a sudden noticeable increase in resistance. Then tighten ¼ turn more.

*Speed of flaring will be dictated by following the natural yield of the material as it softens against the flaring head. In some instances, after the flaring head has bottomed-out, the outer edge of the flare may not be flat against the flange face. There may be a slight gap. This is a perfectly normal condition and not a cause for rejection.

11

After flaring liner, immediately quench the flare with water. Leave the flaring head and the expander in place until the flare has cooled to 100°F-38°C or lower.
Then disassemble and remove the flaring head and the expander.

After the flaring head has been removed, the flared liner may taper away from the flange face at a slight angle, or may have a slightly convex surface. However, when the flange is bolted into position at installation, the flared liner will be pushed down snugly and provide a tight, leak-proof seal.

Ensure flare meets minimum flare diameter in chart below.

Minimum Flare Diameter		
Pipe Size	(in)	(mm)
1”	1 7/8	48
1 1/2”	2 11/16	69
2”	3 7/16	88
3”	4 5/8	118
4”	5 15/16	151
6”	8	204
8”	10 1/16	256

Finished Flare

Thermalok® PTFE, PFA, PP, and PVDF Lined Piping

12

Spark test the finished face for defects that may not be readily visible. Adjust the sparker to arc about 1" to the flange. Insert probe into the pipe end and circle the inside near the liner. A defect is identified by apparent major arcing through the liner. DO NOT USE pipe with a defective liner.

13

To identify plastic liner, be sure to attach the correct color-coded (p. 5) plastic band to the spool.

14

A 1/2" thick plywood cover should be bolted to the flange to protect the plastic face and to prevent the face from "remembering" its preformed shape and pulling away from the flange.

15

Attach proper label to plywood cover.

Prescribed Temperature, Equipment Settings and Approximate Flaring Head Heating Times

Pipe Liner Material & Type	Nominal Pipe Size (in.)	Prescribed Flaring Head Temp. ①②		Propane Gas Stove (R25750-GS)			Hot Plate w/ Fixed Settings (R25750-HDP)	Hot Plate w/variable settings (R25750-LHP) PVDF & PP		220 Volt Heat Gun (R29050-HG) for Liner Preheat PVDF & PP	
				Approx Heating Time (min.)	Regulator Setting		Approx. Heating Time (min.) Setting H ③	Approx. Heating Time (min.)③	Approx. Hot Plate Temp. Setting ④	Dial Setting	Approx. Time (min.) to Preheat Liner ⑤
		°F	°C		psi	kg cm2					
PP Thermalok	1	290	143	1.5	3	0.2	2	16	290°F-143°C	Maximum Setting	3/4
	1 1/2	290	143	2	3	0.2	2.5	18	290°F-143°C		1
	2	290	143	2	3	0.2	3	19	290°F-143°C		1 1/2
	3	290	143	2.5	3	0.2	4	38	290°F-143°C		2
	4	290	143	3	5	0.4	4.5	45	290°F-143°C		3
	6	290	143	4	15	1.0	13	70	290°F-143°C		4
	8	290	143	5	15	1.0	15	75	290°F-143°C		5
PVDF Thermalok	1	270	130	2	3	0.2	2	15	270°F-132°C	Maximum Setting	1
	1 1/2	270	130	2	3	0.2	2	17	270°F-132°C		1
	2	270	130	2	3	0.2	2	28	270°F-132°C		1
	3	270	130	2	3	0.2	2	33	270°F-132°C		1
	4	270	130	3	5	0.4	3	38	270°F-132°C		2
	6	270	130	4	15	1.0	7	87	270°F-132°C		3
	8	270	130	4	15	1.0	9	89	270°F-132°C		4
PTFE and PFA Thermalok	1	740	390	6	3	0.2	13	Not recommended Due to Extended Heating Times. Use R25750-GS or R25750-HDP			
	1 1/2	740	390	6	3	0.2	14				
	2	740	390	7	3	0.2	16				
	3	740	390	9	3	0.2	22				
	4	740	390	11	5	0.4	36				
	6	740	390	14	15	1.0	72				
	8	740	390	18	15	1.0	154				

① ALLOWABLE TEMPERATURE VARIATION: In order to achieve the full performance capabilities of the finished field flare piping assembly, it is essential to heat the flaring head to the temperature indicated in the table. A variation of no more than plus or minus 10°F (5°C) from the prescribed temperature is allowable.

② FLARING HEAD TEMPERATURE INDICATION: With smaller size flaring heads, the thermometer reading may lag behind the actual head temperature. Consequently, the thermometer reading may continue to rise even after the head has been removed from the electric hot plate or after the flame of the gas stove has been cut off. To determine whether this has occurred, the thermometer reading should be observed for several seconds. If the temperature continues to rise above the prescribed flaring temperature, the head should be allowed to cool to the prescribed temperature before flaring. (Temperature lag when the head is cooling can be ignored.)

③ HEATING TIMES WITH ELECTRIC HOT PLATES: For all liner materials and types, the heating times given in the table are based on the use of an insulating blanket on top of the flaring head and use of a hot plate which has been stabilized at the prescribed temperature for at least one-half hour.

④ CALIBRATION OF INFINITELY VARIABLE HOT PLATE: Dial readings on the infinitely variable hot plates are not necessarily accurate. When initially using the hot plate, it should be first preheated with the dial set at 270°F-132°C. A flaring head should then be placed on the hot plate with the stem of a thermometer placed into the hole in the head. After the temperature of the head has been allowed to stabilize, the thermometer reading should be observed. If it is not 270°F-132°C, the dial setting should be increased or decreased accordingly and the temperature again allowed to stabilize. The temperature reading of the thermometer should again be observed. If it is not 270°F-132°C, another adjustment of the dial should be made. This should be continued until the head attains a stabilized temperature of 270°F-132°C. A mark should then be made on the temperature dial under the temperature index. Thereafter the temperature index can be set at the mark and the head should stabilize at 270°F-132°C. This calibration should be checked periodically to verify its correctness.

⑤ APPROXIMATE PREHEATING TIMES WITH PVDF & PP: The times indicated are offered only as a guide for work scheduling. Actual heating times can vary considerably from those shown. Proper preheating should be determined by periodically pressing the end of the liner being heated until the required degree of "give" has been achieved.

Thermalok® PTFE Using/ Swaged Pipe Tooling

Joint Fabrication of 1"-8" Thermalok PTFE Piping Using Swaged Tooling

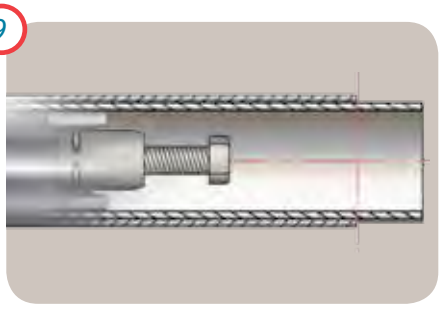
For steps 1-7, refer to "Initial Procedures for all Thermalok Piping" section

8

Clamp prepared pipe in horizontal or vertical position. Remove any notches on end of exposed plastic stub using a file or Vargus de-burring tool. Ensure OD and ID of liner stub edge is free of burrs and nicks. Using a clean rag and a non-flammable degreaser that is compatible with the liner, wipe away cutting oil, shavings and dirt from exposed plastic stub.

Vargus De-Burring Tool

9



Install the liner expander (see photo) far enough into liner to allow clearance for forming tools. Tighten capscrew on expander to prevent liner from slipping in the pipe during the forming operation.

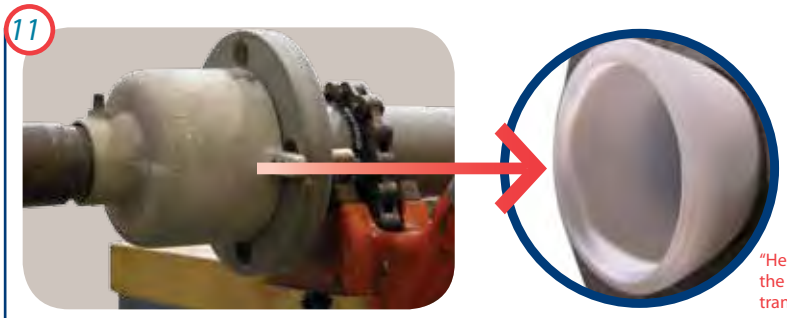
Warning

When field forming, use adequate ventilation (indoors, use exhaust fans). Avoid breathing of vapors resulting from overheating and possible degradation of the plastic. Do not consume food or beverages and do not smoke during fabrication process. Also, to prevent electrical shock, do not use heat gun near water.

10

Attach flaring die that matches pipe diameter. Fit the guide pins in the clamping block assembly to match the flange bolt holes. With the flaring die centered in the extended liner and the drive screw retracted, make sure the guide pins fit freely in the bolt holes with the clamping dogs behind the flange. If adjustment is needed, loosen the adjusting nuts, center the tool and retighten the nuts.

11



"Heat until 25-50% of the plastic stub becomes translucent".

The plastic stub can now be heated with a heat gun - attach proper size of heat cup to the hot air gun, set the heater dials as shown here, and allow the gun to preheat for 15-20 minutes. When gun is ready, place gun with heat cup against the flange and heat until most of the plastic stub becomes translucent. Let the last 1/4" at flange remain white. Heating time is displayed in chart below. Frequently rotate heat gun to balance heat over plastic surface.

Pipe Size	Heat Settings	
	Leister 2200W 110V	Leister 4500W 220V
1"	10	5-6
1 1/2"	10	6-7
2"	---	7
3"	---	7-8
4"	---	8
6"	---	10
8"	---	10

The 110V gun is only recommended for heating 1" and 1 1/2" sizes.

Thermalok® PTFE Using/ Swaged Pipe Tooling

12

Using gloved hand, gradually insert cone-shaped preformed tool into plastic stub until it reaches the flange face. Allow plastic to cool until end lifts away from preformer before proceeding to next step (1" - 4' sizes only). On 6" - 8", use preformer to form plastic into trumpet shape. Allow PTFE to turn white before next step.

13

With the forming die centered in the plastic stub, place forming tool guide pins into flange holes and lock clamping dogs in place. Crank the forming die snug to flange. Use cool air or water to speed cooling of plastic to room temperature. Then remove tool.

Note: To assure properly flared face, it is extremely important to cool plastic and flange to room temperature.

Finished Flare

14

Visually inspect the finished sealing face for a flat, smooth surface and a smooth bend radius.

Ensure flare meets minimum flare diameter in chart below.

Minimum Flare Diameter		
Pipe Size	**(in)**	**(mm)**
1"	1 7/8	48
1 1/2"	2 11/16	69
2"	3 7/16	88
3"	4 5/8	118
4"	5 15/16	151
6"	8	204
8"	10 1/16	256

15

Spark test the finished face for defects that may not be readily visible. Adjust the sparker to arc about 1" to the flange. Insert probe into the pipe end and circle the inside near the liner. A defect is identified by apparent major arcing through the liner. DO NOT USE pipe with a defective liner.

16

To identify plastic liner, be sure to attach the correct color-coded (p. 5) plastic band to the spool.

17

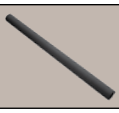
A 1/2" thick plywood cover should be bolted to the flange to protect the plastic face and to prevent the face from "remembering" its preformed shape and pulling away from the flange.

18

Attach proper label to plywood cover.

Fabrication Tooling For Thermalok® Piping

Equipment Type	Tooling Description	Resistoflex Part No.[1]	Liner Used to Fabricate			
Pipe Expander	Pipe expander is used to prevent liner from slipping during forming operation.					
	1" EXPANDER	R29620-016-1	PP	PVDF	PTFE	PFA
	1½" EXPANDER	R29620-024-1	PP	PVDF	PTFE	PFA
	2" EXPANDER	R29620-032-1	PP	PVDF	PTFE	PFA
	3" EXPANDER	R29620-048-1	PP	PVDF	PTFE	PFA
	4" EXPANDER	R29620-064-1	PP	PVDF	PTFE	PFA
	6" EXPANDER	R29620-096-1	PP	PVDF	PTFE	PFA
	8" EXPANDER	R29620-128-1	PP	PVDF	PTFE	PFA
	10" EXPANDER	R29620-160-1	PP	PVDF	PTFE	PFA
	12" EXPANDER	R29620-192-1	PP	PVDF	PTFE	PFA
Cut Off Ring	Cut off ring is used to measure cut length for pipe liner.					
	1" CUT-OFF RING	R29650-016-6	PP	PVDF	PTFE	PFA
	1½" CUT-OFF RING	R29650-024-6	PP	PVDF	PTFE	PFA
	2" CUT-OFF RING	R29650-032-6	PP	PVDF	PTFE	PFA
	3" CUT-OFF RING	R29650-048-6	PP	PVDF	PTFE	PFA
	4" CUT-OFF RING	R29650-064-6	PP	PVDF	PTFE	PFA
	6" CUT-OFF RING	R29650-096-6	PP	PVDF	PTFE	PFA
	8" CUT-OFF RING	R29650-128-6	PP	PVDF	PTFE	PFA
	10" CUT-OFF RING	R29650-160-6	PP	PVDF	PTFE	PFA
	12" CUT-OFF RING	R29650-192-6	PP	PVDF	PTFE	PFA
Flaring Head	Flaring Head used to shape the liner face flat to the flange.					
	1" FLARING HEAD	R29650-016-3	PP	PVDF	PTFE	PFA
	1½" FLARING HEAD	R29650-024-3	PP	PVDF	PTFE	PFA
	2" FLARING HEAD	R29650-032-3	PP	PVDF	PTFE	PFA
	3" FLARING HEAD	R29650-048-3	PP	PVDF	PTFE	PFA
	4" FLARING HEAD	R29650-064-3	PP	PVDF	PTFE	PFA
	6" FLARING HEAD	R29650-096-3	PP	PVDF	PTFE	PFA
	8" FLARING HEAD	R29650-128-3	PP	PVDF	PTFE	PFA
	10" FLARING HEAD	R29650-160-3	PP	PVDF	PTFE	PFA
	12" FLARING HEAD	R29650-192-3	PP	PVDF	PTFE	PFA
Drive Plug	Drive plug is used to push the liner along the inside of the pipe.					
	1" DRIVE PLUG	R28650-016-4	PP	PVDF	PTFE	PFA
	1½" DRIVE PLUG	R28650-024-4	PP	PVDF	PTFE	PFA
	2" DRIVE PLUG	R28650-032-4	PP	PVDF	PTFE	PFA
	3" DRIVE PLUG	R28650-048-4	PP	PVDF	PTFE	PFA
	4" DRIVE PLUG	R28650-064-4	PP	PVDF	PTFE	PFA
	8" DRIVE PLUG	R28650-096-4	PP	PVDF	PTFE	PFA
	8" DRIVE PLUG	R28650-128-4	PP	PVDF	PTFE	PFA
	10" DRIVE PLUG	R28650-160-4	PP	PVDF	PTFE	PFA
	12" DRIVE PLUG	R28650-192-4A	PP	PVDF	PTFE	PFA
T-Wrench	T-Wrench is used to tighten the expander assembly until it is locked into place.					
	1"T-WRENCH	R28650-016-2	PP	PVDF	PTFE	PFA
	1½"-3"T-WRENCH	R28650-032-2	PP	PVDF	PTFE	PFA
	4"-12"T-WRENCH	R28650-064-2	PP	PVDF	PTFE	PFA

Equipment Type	Tooling Description	Resistoflex Part No.[1]	Liner Used to Fabricate			
Drive Plug Handle	Drive Plug Handle					
	Drive Plug Handle	R25750-5	PP	PVDF	PTFE	PFA
Pin Punch	Pin Punch is used to prevent rotation of the rod while expander adjusting nut is being tightened.					
	PIN PUNCH ¼" (1½"-3")	R25750-PP-2	PP	PVDF	PTFE	PFA
	PIN PUNCH 3/8" (4" UP)	R25750-PP-3	PP	PVDF	PTFE	PFA
Extension Bar	Placed over handle of pin punch to develop additional leverage.					
	EXTENSION BAR (1½"-3")	R28650-29	PP	PVDF	PTFE	PFA
	EXTENSION BAR (4"-8")	R28650-30	PP	PVDF	PTFE	PFA
Thread Compound	Thread compound is used to prevent galling of the threads.					
	Thread Compound	R25750-L	PP	PVDF	PTFE	PFA
Storage Box	Storage box is used to store all tooling for field flaring Thermalok® piping.					
	Storage Box 1"-4"	R25750-B	PP	PVDF	PTFE	PFA
	Storage Box 6"-8"	7058480	PP	PVDF	PTFE	PFA
Heat Gun	Heat gun is used to preheat exposed liner prior to flaring					
	Thermalok style heat gun with tip diffuser (220V & 3060W)	R29050-HG	PP	PVDF		PFA
Propane Stove	Propane stove used to heat flaring dies					
	Propane Stove	R25750-GS	PP	PVDF	PTFE	PFA
Hot Plate	Hot plate used to heat flaring dies					
	Hot Plate w/ fixed settings	R25750-HDP	PP	PVDF	PTFE	PFA
	Hot Plate w/ variable settings	R25750-LHP	PP	PVDF		

General tooling for Thermalok® and Swaged piping see page 28

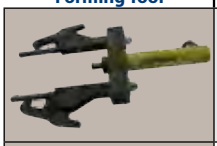
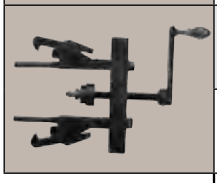
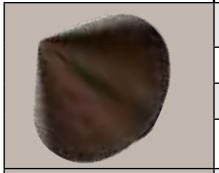
General Tooling For Thermalok® And Swaged Piping

Equipment Type	Tooling Description	Resistoflex Part No.[1]	Liner Used to Fabricate		
Thermometer	Thermometer is used to measure flaring head temperature.				
	Thermometer	R25750-T	PP	PVDF	PTFE
	Flat-tip probe for use with digital thermom-eter	3861K321	PP	PVDF	PTFE
	Thermometer (stem type)	FLATSURFTHER-MOM	PP	PVDF	
Spark Tester	Spark Tester is used to detect a hole or a crack in the liner				
	Model BD-10A (ETP Electronics) All Pipe sizes	214239	PP	PVDF	PTFE
	Model BD-10AV (ETP Electronics) (220V) Electrostatic tester	0214239-220	PP	PVDF	PTFE
High Temperature Gloves	HighTemperature Gloves are used to handling hot flaring head.				
	High Temperature Gloves	R28760-G	PP	PVDF	PTFE
Vargus De-Burring Tool	Vargus Deburring tool is used to remove notches and de-burr end of liner stub				
	Vargus De-Burring Tool	59321992	PP	PVDF	PTFE
Hacksaw	Hacksaw is used to cut liner to length				
	12" Hacksaw Frame	0122174	PP	PVDF	PTFE
	12" Hacksaw Blade	0122175	PP	PVDF	PTFE

Equipment Type	Tooling Description	Resistoflex Part No.[1]	Liner Used to Fabricate		
Hot Air Gun	Hot Air Gun is used to preheat the exposed liner prior to flaring or Morafing.				
	110V / 2200W Hot Air Gun	760611	PP	PVDF	
	Spare Heat Element for 110V Hot Air Gun	760637	PP	PVDF	
	Spare Carbon Brush Set	760652	PP	PVDF	PTFE
	220V / 4500W Hot Air Gun	785162	PP	PVDF	PTFE
	Spare Heat Element for 220V Hot Air Gun	785170	PP	PVDF	PTFE
Liner Expansion (Thermalok 1-10")	Liner Expansion for flaring Thermalok pipe with swaged tooling.				
	1" Expander	217398			PTFE
	1.5" Expander	214486			PTFE
	2" Expander	214494			PTFE
	3" Expander	214502			PTFE
	4" Expander	214510			PTFE
	6" Expander	214528			PTFE
	8" Expander	214536			PTFE
	10" Expander	E45809			PTFE
	12" Expander	E45810			PTFE
Liner Expander Wrench	1" Wrench	217406			PTFE

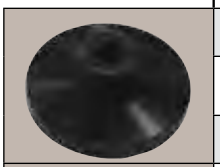
Fabrication Tooling For Swaged Piping

Equipment Type	Tooling Description	Resistoflex Part No.[1]	Liner Used to Fabricate		
Pipe Cutter	Wheeler Rex is used for doing cut-backs on the pipe ends and for threading the ends.				
(Use Angled Cutters Only) 	#6794 Threader w/ Angled Blade Cutter (1" - 4")	785824	PP	PVDF	PTFE
	#6590 Threaded w/ Angled Blade Cutter (2.5" - 6")	785832	PP	PVDF	PTFE
	Replacement Blade	785816	PP	PVDF	PTFE
	Operating Manual	R30745	PP	PVDF	PTFE
Gear Puller	Gear Puller is used in conjunction w/the guide plugs to remove steel rings.				
	1" - 4" Puller	660662	PP	PVDF	PTFE
	6" - 8" Puller	660670	PP	PVDF	PTFE
Guide Plug	Guide plug is used in conjunction w/ the gear puller to remove steel rings.				
	Pipe Size (in.)				
	1"	660266	PP	PVDF	PTFE
	2"	660704	PP	PVDF	PTFE
	2.5"	660712	PP	PVDF	PTFE
	3"	660720	PP	PVDF	PTFE
	4"	660738	PP	PVDF	PTFE
	6"	660746	PP	PVDF	PTFE
	8"	660753	PP	PVDF	PTFE
Heat Cup	Pins are used to line up the heat cups to the flanges. Heat Cups are attached to the hot air gun to heat the exposed liners prior to flaring or morafing.				
	NOTE: 3, 4, 6, and 8 have special baffles.	Part No.			
	Pipe Size (in.)				
	1" - 4" Heat Cup Guide Pin	7046311	PP	PVDF	PTFE
	6" - 8" Heat Cup Guide Pin	7046329	PP	PVDF	PTFE
	1"	660761	PP	PVDF	PTFE
	1.5"	660779	PP	PVDF	PTFE
	2"	660787	PP	PVDF	PTFE
	3"	660795	PP	PVDF	PTFE
	4"	784975	PP	PVDF	PTFE
	6"	660803	PP	PVDF	PTFE
	8"	660811	PP	PVDF	PTFE

Equipment Type	Tooling Description	Resistoflex Part No.[1]	Liner Used to Fabricate		
Molding Die	Molding dies are fastened to the forming tool which is fastened to the flange to form the liner face. (For use with PP only). Dies are available for individual pipe sizes or in 1" - 4" sets. Dies are clear anodized and identified by size and "WF".				
	Pipe Size (in.)				
	1"	760660	PP		
	1.5"	760678	PP		
	2"	760686	PP		
	3"	760702	PP		
	4"	760710	PP		
	6"	760728	PP		
	8"	760736	PP		
Forming Tool	Forming Tools hold the molding die in place. Then the die is attached to the flange to form the liner face.				
	Tool for 1" - 2" PVDF sizes (hydraulic)	753350		PVDF	
	3" - 4" (Reaction Arm Set - hydraulic)	742924		PVDF	
	6" - 8" (Reaction Arm Set - hydraulic)	742932		PVDF	
	Reaction Frame Assembly (3" - 8") (hydraulic)	742916		PVDF	
	1" - 4" Forming Tool Assembly	660241	PP		PTFE
	6" & 8" Forming Tool Assembly	660654	PP		PTFE
Preformer Cone	Preformer cone is used to begin the shaping of the liner prior to the flaring process				
	Pipe Size (in.)	Preformer Cone Part No			
	1"	753400		PVDF	
	1.5"	753418		PVDF	
	2"	743426		PVDF	
	Universal cone for all sizes with PTFE	661066		PVDF	PTFE
Head Grease	Head grease is used to lubricate surface of flaring head to aid in flaring process				
	Head Grease - Dow Corning 111 (5.3 oz.)	770297		PVDF	

General tooling for Thermalok® and Swaged piping see page 28

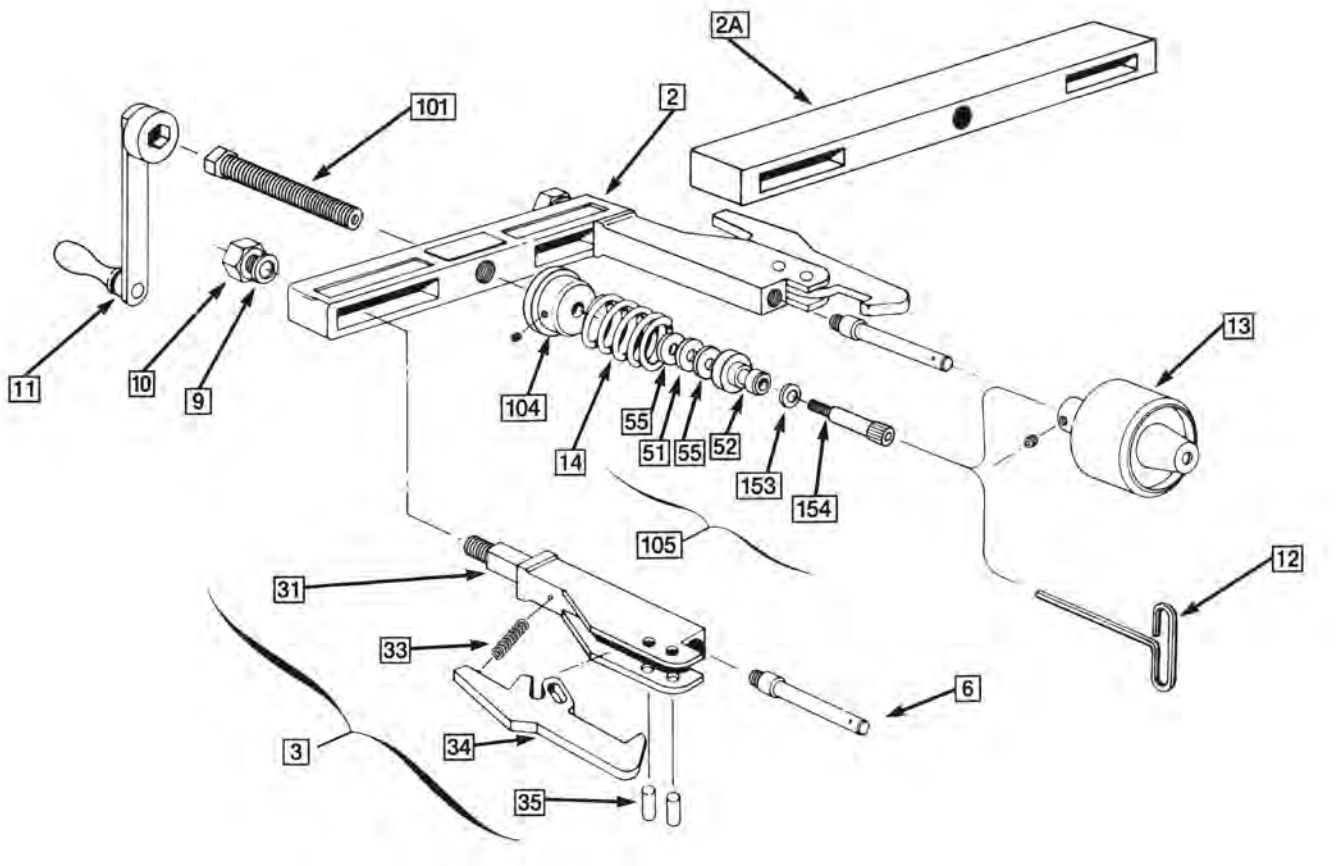
Fabrication Tooling For Swaged Piping

Equipment Type	Tooling Description	Resistoflex Part No.[1]		Liner Used to Fabricate	
Flaring Die	Flaring Die is pressed against the liner to complete the forming of the flare face flat to the locking collar.				
	Flaring Die Part No.				
	1″	753376		PVDF	
	1.5″	753384		PVDF	
	2″	753392		PVDF	
	3″	742874		PVDF	
	4″	742882		PVDF	
	6″	742880		PVDF	
	8″	742908		PVDF	
	1″	661074			PTFE
	1.5″	661017			PTFE
	2″	660969			PTFE
	3″	661033			PTFE
	4″	660985			PTFE
	6″	7058470			PTFE
	8″	7058480			PTFE
Hot Plate	Hot Plate is used to heat the PVDF dies.				
	Hot Plate needed to preheat forming die to: 280-300°F (138-149°C)	771923		PVDF	
Hydraulic Pump (10,000 psi)	Hydraulic Pump is attached to a forming tool hose and pushes the die in the form of a flared end.				
	Hydraulic Pump (10,000 psig)	776435		PVDF	
	Male hydraulic fitting w/ hose assembly	0776427		PVDF	
	Hydraulic gauge adapter fitting	0776419		PVDF	
	hydraulic gauge	0702740		PVDF	
	Male air fitting	255354000		PVDF	
	Female air fitting	255384000BB		PVDF	

General tooling for Thermalok® and Swaged piping see page 28

Swaged Tooling Details

Forming Tool Assembly for Swaged PP and PTFE Lined Pipe

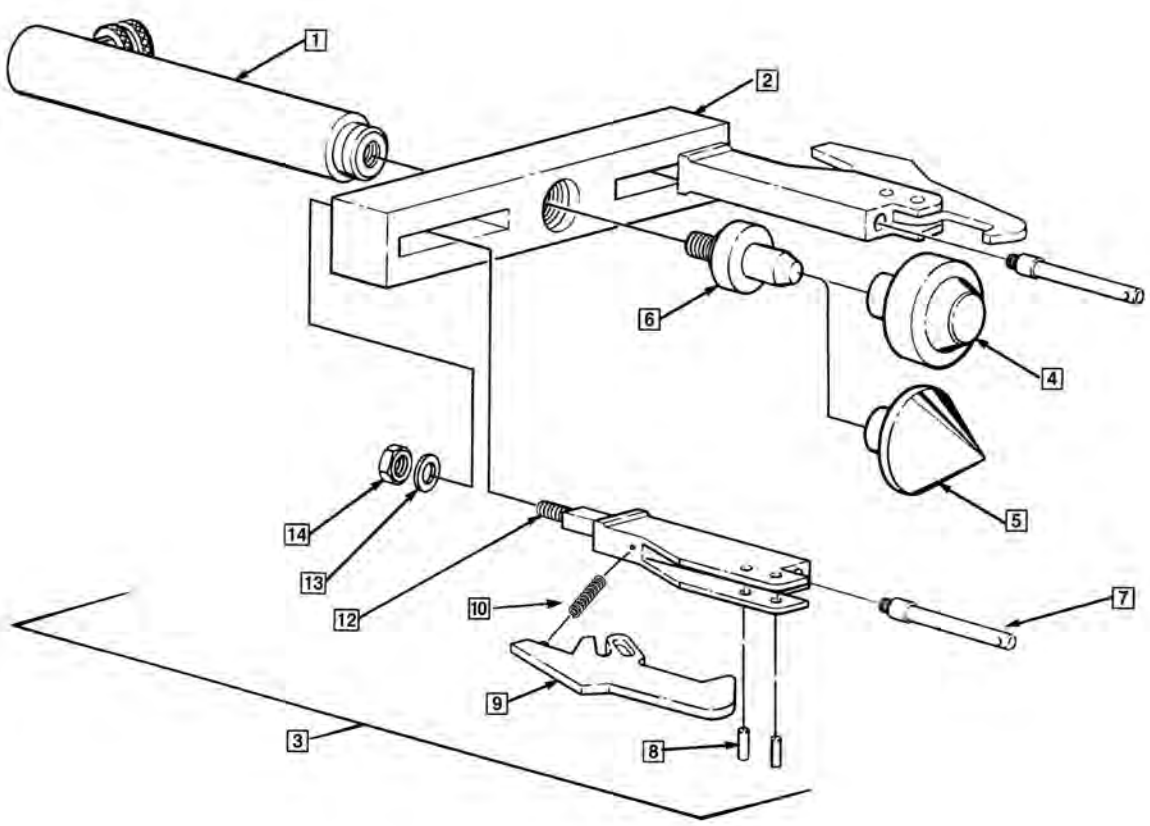


Item #	Decription	Part #
2	Frame, 1"-4" pipe size	0661660
2A	Frame, 6"-8" pipe size	0661694
3	Clamp block assembly (2 required) (consists of items 9,10, 31, 34 and 35)	0661728
6	Guide pin, 5/8" (2 required)	0661728
11	Handle (fitx hex head)	0660290
12	Hex key	0661793
13	Molding die (not part of assembly)	
14	Compression sping	0661710
101	Hex head drive screw	.7059020
104	Retainer and screw	7059030
105	Molding die insert assembly (consists of items 51, 52, 55, 153, 154)	7059040

Item #	Decription	Part #
Drive screw assembly:		
100	Drive screw assembly (consists of items 101,104 and 105)	7059010
Forming tool assembly:		
	1"-4" includes: All above except items 2A and 13	0660241
	6"-8" includes: All above except items 2 and 13	0660654

Swaged Tooling Details

Forming Tool Assembly for 1” - 2” Swaged PVDF Lined Pipe

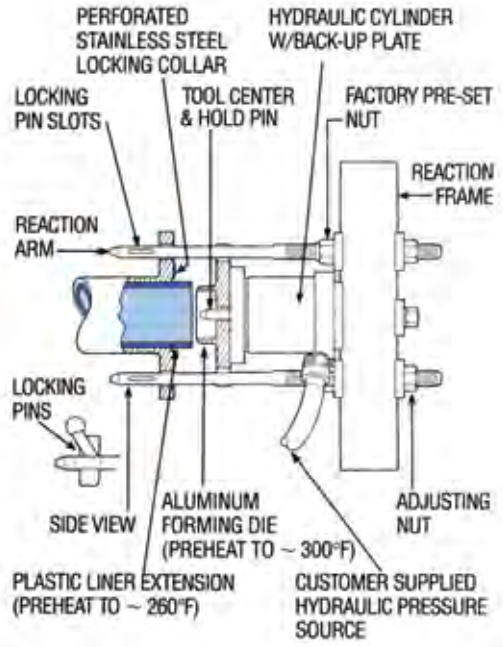


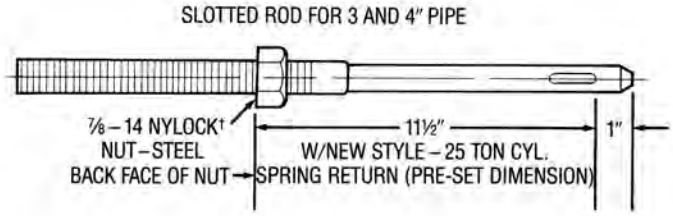
Item #	Decription	Part #
	Forming tool assembly	
	(with all flaring dies and preformers)	0754283
	Forming tool assmebly	
	(without flaring dies and preformers	0753350
Individual flaring dies/preofrmers:		
4	Flaring dies	
	1”	0753376
	1 1/2”	0753384
	2”	0753392
5	Preformers	
	1”	0753400
	1 1/2”	0753418
	2”	0753426

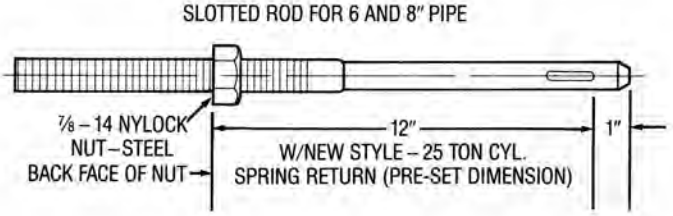
Item #	Decription	Part #
Forming tool parts:		
1	Hydraulic cylinder, 5-ton	
	Enerpac RC-55	7059010
2	Cross bar	0753368
3	Clamp block assembly (2 required)	
	(consists of items 6, 8, 9, 10, 12, 13, 14)	066173
	6 Adaptor, small PVDF dies	
	8 Pin clamp block (2 required)	
	9 Clamping dog	
	10 block spring	
	12 Clamping block	
	13 Washer	
	14 Adjusting nut	
7	Guide pin, 5/8” (2 required)	0661728

Swaged Tooling Details

Setup and Slotted Rod Adjustment for Swaged PVDF Lined Pipe







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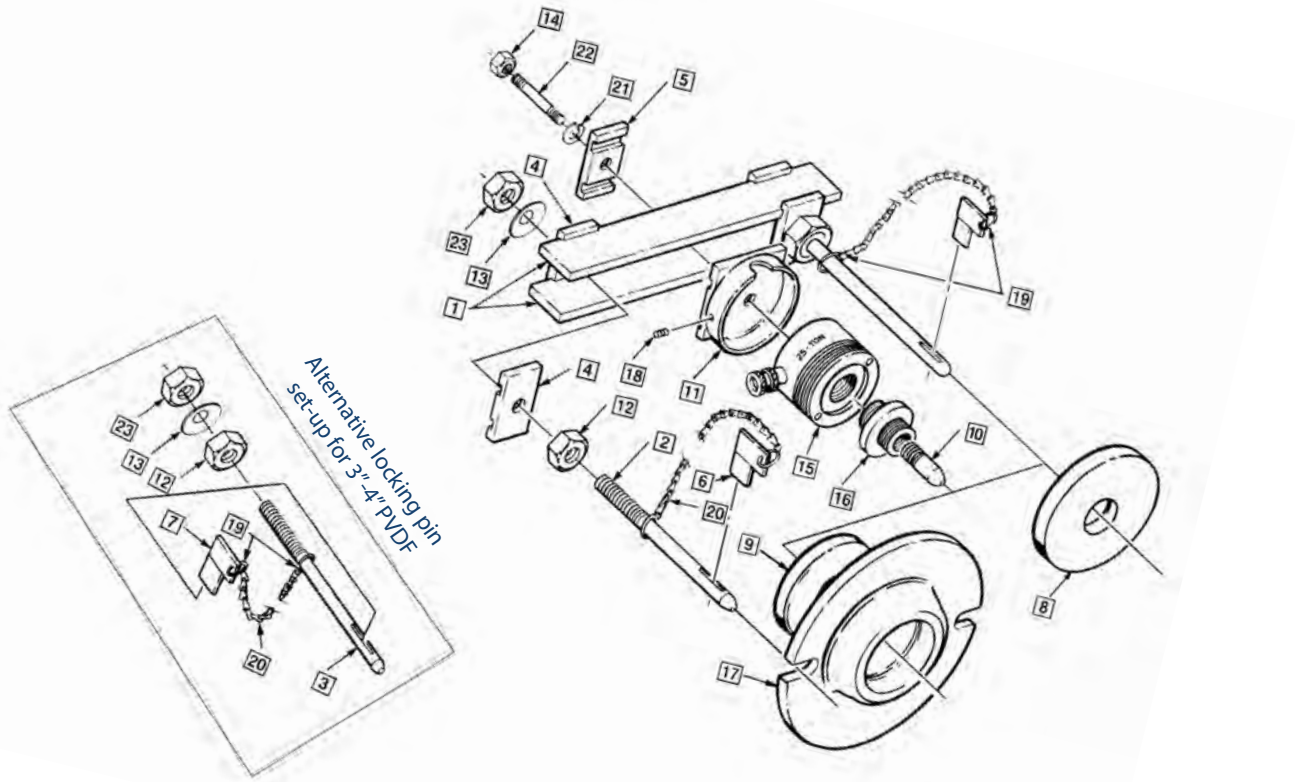
Swaged Tooling Details

Forming Tool Assembly for 3" - 8 Swaged PVDF Lined Pipe



Decription	Part #
A. Reaction from assembly	
(consists of items 1, 4,5, 10, 11, 14, 15, 16, 18, 21 and 22)	0742916
B. 3" and 4" additions	
Reaction arm assembly (consists of two each of items 3, 7,12,13, 19, 20 and 23)	0742924
Back-up plate	0785006
3" flaring die	0742874
4" flaring die	0742882
C. 6" and 8" additions	
Reaction arm assembly (Consists of two each of items 2, 6, 12, 13, 19, 20 and 23	0742932
Back-up plate	0785014
6" flaring die	0742890
8" flaring die	0742908

Item #	Decription ...	Part #
Forming tool parts:		
1	Reation frame member (two required)	0742767
2	Reaction arm 6" & 8"..Part of reaction arm assembly	
3	Reaction arm 3" & 4"..Part of reaction arm assembly	
4	End from block	0742734
5	Center frame block	0742726
6	Locking pin, 6" & 8"	0743187
7	Locking pin, 3" & 4"	0743195
8	Steel back-up plate, 6" & 8"	0785014
9	Steel back-up plate, 3" & 4"	0785006
10	Guide pin	0742809
11	Cylinder holding block	0785022
12	Force arm adjusting nut	0743229
13	7/8" flat washer	0742759
14	Standard 5/8"-11 hex nut	0742700
15	Hydraulic cylinder	0784983
16	Threaded saddle	0784991
17	Flaring die	Not part of toool
18	Set screw	Part of reaction frame assembly
19	Ring fastener	Part of reaction arm assembly
20	Chain fastening	Part of reaction arm assembly
21	Lock washer	Part of reaction frame assembly
22	5/8-11 tie stud	0742718
23	Rear alloy adjusting nut	0742742

Trouble Shooting Guide

For Flaring of PTFE and PFA

1. If small cracks or splits develop around the edge of a formed face
   a) Liner ends were not smoothed properly after the cut-off operation
2. If liner splits during the flaring operation
   a) Excessive force was used during the preforming step. While in the gel state PTFE is extremely shock sensitive. Extensive care must be taken so as not to unduly jar the PTFE in this state. Carefully insert the performer fully to the flange face to quench the inner side of the wall completely before continuing with the performing step.
3. If the flare face rises up from the flange
   a) The flaring tool was removed before cooling was complete. Or,
   b) The liner was not heated successfully in Step 10.
4. If there is a reduction in pipe diameter at the flare radius
   a) Liner was overheated to translucent in chamfer area. Or,
   b) Preforming before flaring was incomplete

For Flaring of PP

1. If plastic face appears distorted, one side normal and the other side erratic and not fully formed
   a) Hot air gun not properly rotated to ensure uniform heating. Or,
   b) Heat setting too high for conditions, thereby not allowing plastic liner to heat uniformly. Or,
   c) Not enough pressure on forming die to fill out mold cavity.
2. Plastic Face has rough laminar pattern molded into surface
   a) Soft plastic not properly rolled back and preformed with gloved hands before molding. Or,
   b) Too much time being taken to hand form soft plastic, thus allowing air hardened skin to form before molding tool is applied.
3. Plastic face is well molded but has flow lines in surface
   a) Molding die not preheated before forming operation. Or,
   b) Too much time being taken to hand form soft plastic, thus allowing air hardened skin to form before molding tool is applied.
4. Excessive flash at outer diameter and center of plastic face
   a) Allowed to heat to excess; lower heat setting, and/or shorten heating time. Or,
   b) Too much force on molding die, thus forcing hot plastic into tooling allowances.
5. Excessive flash inside diameter of plastic after molding tool is removed
   a) Heated plastic not properly hand-formed before molding, allowing forming die mandrel to push soft plastic inside pipe. Or,
   b) Excessive pressure on die causing very soft plastic to flow past die mandrel. Or,
   c) Molding tool not properly centered causing die mandrel to engage soft plastic and push it inside pipe. Or,
   d) ID undersized due to over-compression of pipe by flanging with too much force.

For Flaring of PVDF and PP

1. If the plastic face is smashed flat or thin on one side or distorted on one side while the other side ap pears normal
   a) The reaction frame may not be adjusted parallel to the flange face causing the forming die to bear more heavily on one side of the flare than on the other. Or,
   b) The plastic liner extension may not have been heated evenly. One side of the liner may have been hot, the other cold. Remember to rotate the hot air gun and cup while heating the liner.
2. If the flare face rises up from the flange
   a) The flaring tool was removed before cooling was complete. Or,
   b) The liner was not heated successfully in Step 12.
3. If the flare face is folded or wrinkled
   a) Plastic was overheated. Or,
   b) Molding die was incorrectly applied. Make sure liner end does not catch on locking collar, causing buckling instead of smooth outward flowing.

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