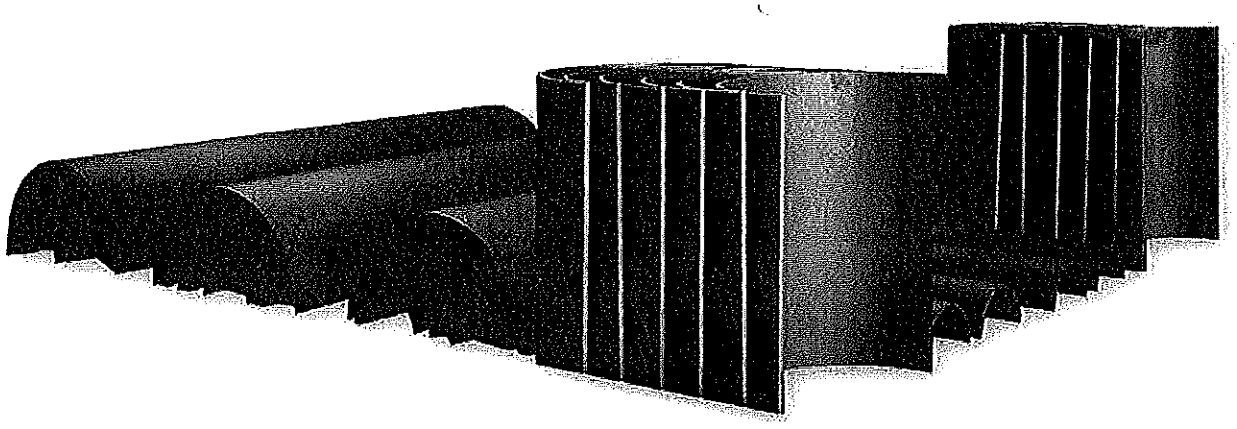
PLIDCO®

PLIDCO® SOLE+MATES™

Welded reinforcing and pressure containing sleeves

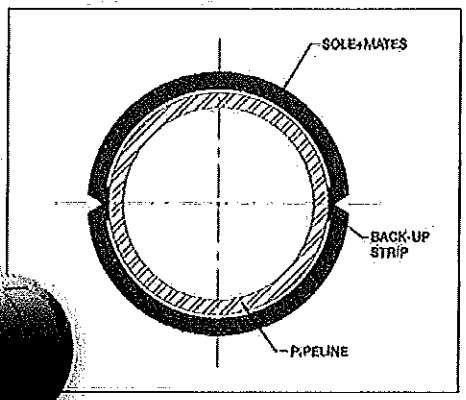


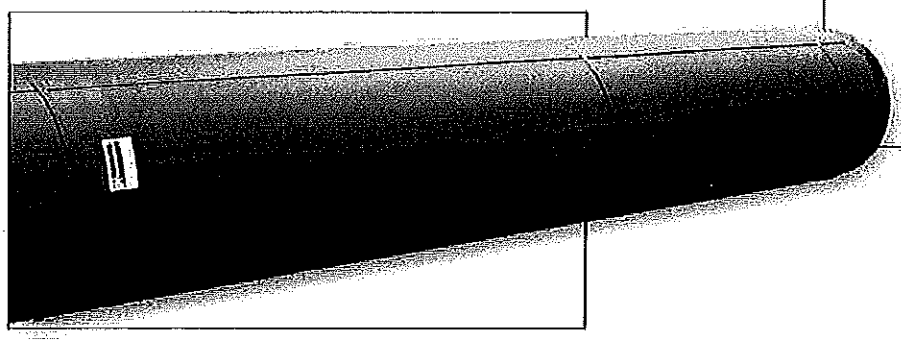
PLIDCO® Sole+Mates™ are designed to reinforce non-leaking, weakened, dented or damaged pipelines. The PLIDCO® Sole+Mates™ must fit snugly around the pipe when used for reinforcement applications. Gaps between the pipe and the sleeve, often caused by dents in the pipe, should be filled with a hard-setting grout. The sleeve must be butt-welded longitudinally but it is not necessary to seal-weld the circumferential ends. The line can remain on-stream. Moisture should be prevented from entering the ends of the sleeve. When used for pressure containment, the PLIDCO® Sole+Mates™ must be fully seal-welded to the pipeline in addition to the longitudinal weld. The line may also remain on-stream but the pressure must be a safe level according to DOT regulation 192.713.

PLIDCO® Sole+Mates™ are fabricated in lengths of 5 or 10 feet. Back-up strips for the longitudinal butt welds are furnished with all sleeves.

PLIDCO® Sole+Mates™ conform to ASME B31.4 and B31.8 as well as US Department of Transportation (US DOT) requirements. Individual company codes and safety practices should be observed. US DOT requires that population density be considered in the installation area for natural and other gas pipelines (DOT section 192.5). Tables showing maximum operating pressure for PLIDCO® Sole+Mates™ by size, materials of construction and class location are shown on the reverse side.

Standard body materials:
- ASTM A36
- ASTM A572 Gr. 50





PF029

THE PIPE LINE DEVELOPMENT COMPANY
870 Canterbury Road • Cleveland, Ohio 44145 • USA
+1 440-871-5700 • Fax +1 440-871-9577
pipeline@plidco.com • www.plidco.com

"Working together to make hazardous piping safer"

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Recommended Working Pressures (PSI)

Class I
Sparsely Populated Areas

API Nominal Pipe Size (In.)	A-36 Steel Plate				A-572-GR.50 Steel Plate			
	1/4" WALL	5/16" WALL	3/8" WALL	1/2" WALL	1/4" WALL	5/16" WALL	3/8" WALL	1/2" WALL
4	2529	3086	3617	4608	3512	4286	5023	6400
6	1788	2197	2592	3345	2483	3051	3600	4645
8	1401	1728	2046	2658	1946	2400	2842	3692
10	1139	1409	1672	2183	1582	1957	2323	3032
12	969	1200	1427	1868	1346	1667	1982	2595
14	888	1098	1307	1714	1231	1525	1815	2380
16	760	967	1152	1514	1083	1343	1600	2102
18	696	864	1030	1355	966	1200	1430	1882
20	628	781	931	1227	873	1084	1293	1704
22	573	712	850	1121	796	989	1180	1557
24	526	655	782	1032	731	909	1085	1433
26	487	606	723	956	676	841	1005	1327
28	453	563	673	890	629	783	935	1236
30	423	527	630	833	588	732	874	1157

Class II
Fringe Areas Around Urban Centers

API Nominal Pipe Size (In.)	A-36 Steel Plate				A-572-GR.50 Steel Plate			
	1/4" WALL	5/16" WALL	3/8" WALL	1/2" WALL	1/4" WALL	5/16" WALL	3/8" WALL	1/2" WALL
4	2107	2571	3014	3840	2927	3571	4186	5333
6	1490	1831	2160	2787	2068	2542	3000	3871
8	1168	1440	1705	2215	1622	2000	2368	3077
10	949	1174	1394	1819	1319	1630	1935	2526
12	807	1000	1189	1557	1121	1389	1651	2162
14	738	915	1089	1428	1026	1271	1513	1983
16	650	806	960	1261	902	1119	1333	1752
18	580	720	858	1129	805	1000	1192	1569
20	524	651	776	1022	727	904	1078	1420
22	477	593	708	934	663	824	984	1297
24	439	545	651	860	609	758	905	1194
26	406	505	603	796	563	701	837	1106
28	377	470	561	742	524	652	779	1030
30	353	439	525	694	490	610	729	964

Class III
Average Commercial and Residential Areas

API Nominal Pipe Size (In.)	A-36 Steel Plate				A-572-GR.50 Steel Plate			
	1/4" WALL	5/16" WALL	3/8" WALL	1/2" WALL	1/4" WALL	5/16" WALL	3/8" WALL	1/2" WALL
4	1756	2143	2512	3200	2439	2976	3488	4444
6	1241	1525	1800	2323	1724	2119	2500	3226
8	973	1200	1421	1846	1351	1667	1974	2564
10	791	978	1161	1516	1099	1359	1613	2105
12	673	833	991	1297	935	1157	1376	1802
14	615	763	908	1190	855	1059	1261	1653
16	541	672	800	1051	752	933	1111	1460
18	483	600	715	941	671	833	993	1307
20	436	542	647	852	606	753	898	1183
22	398	495	590	778	552	687	820	1081
24	365	455	543	716	508	631	754	995
26	338	421	502	664	469	584	698	922
28	314	391	468	618	437	543	649	858
30	294	366	437	578	408	508	607	803

Class IV
Densely Populated Areas

API Nominal Pipe Size (In.)	A-36 Steel Plate				A-572-GR.50 Steel Plate			
	1/4" WALL	5/16" WALL	3/8" WALL	1/2" WALL	1/4" WALL	5/16" WALL	3/8" WALL	1/2" WALL
4	1405	1714	2009	2560	1951	2381	2791	3556
6	993	1220	1440	1858	1379	1695	2000	2581
8	778	960	1137	1477	1081	1333	1579	2051
10	633	783	929	1213	879	1087	1290	1684
12	538	667	793	1038	748	926	1101	1441
14	492	610	726	952	684	847	1008	1322
16	433	537	640	841	602	748	889	1168
18	387	480	572	753	537	667	795	1046
20	349	434	517	682	485	602	719	947
22	318	396	472	623	442	549	656	865
24	292	364	434	573	406	505	603	796
26	270	336	402	531	376	467	558	737
28	252	313	374	494	349	435	519	687
30	235	293	350	463	327	407	486	643

$$P = \frac{2St}{D} \times E \times F \times T$$

(D.O.T. 192.105*)

P = Design Pressure
t = Sole+Mate Wall Thickness
S = Specified Min. Yield Strength
T = Temperature Derating Factor
E = Joint Efficiency Factor
F = Class Locations Factor: I = .72, II = .6, III = .5, IV = .4
D = Sole+Mate Outside Diameter = Pipe OD + 2t + 1/8 in. (for back-up strips)

Note: Formula applies to data in table for Class I through IV locations using a Joint Efficiency Factor of 1 and temperature less than 250°F.

REGISTERED FIRM REGISTERED FIRM

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pipeline@plidco.com • www.plidco.com

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The Pipe Line Development Company
870 Canterbury Road • Cleveland, Ohio 44145
Phone: (440) 871-5700 • Fax: (440) 871-9577
Toll Free: 1-800-848-3333
web: www.plidco.com • e-mail: pipeline@plidco.com

PLIDCO® SOLE+MATE™ INSTALLATION GUIDELINES

Plidco Sole+Mates, typically called full-encirclement welded split sleeves, are referenced in many pipeline codes. As such, most pipeline companies and contractors have already written their own installation procedures. The installation guidelines herein are not intended to override already established procedures, but are intended as a guide to those unfamiliar with Sole+Mates. Any helpful hints or recommendations are always appreciated from the end user so that we may incorporate them into these guidelines. If you have any questions, or encounter any difficulties using this product, please contact:

PLIDCO "DEPARTMENT 100" at 440-871-5700
toll free U.S. & Canada at 800-848-3333

Installation

Plidco Sole+Mates are typically used for two applications; pressure containing and non-pressure containing.

The application is pressure containing when the Sole+Mate is installed over a known leak. For a pressure containing application, the wall thickness of the Sole+Mate and all welds must be able to contain the full operating pressure of the pipeline. The longitudinal weld joint formed by the two halves of the Sole+Mate must be a full thickness butt weld. The circumferential joint formed by the Sole+Mate welded to the pipeline must be a full thickness fillet weld.

The application is non-pressure containing if the Sole+Mates is not installed over a known leak and the intended use is only to reinforce a damaged area of the pipe. The longitudinal weld joint formed by the two halves of the Sole+Mate may be a full thickness butt weld. The circumferential joint does not have to be welded, but should be sealed with a coating to prevent ground water from penetrating the crevice between the sleeve and the pipe. If the circumferential joint is welded, the application should be assumed to be pressure containing and all the requirements of a pressure containing application now apply.

To properly reinforce the pipe for a non-pressure containing application, the Sole+Mate halves should fit snugly around the pipeline. Consideration should be given to filling and re-contouring dents, flat spots, etc., with a hard setting grout. If injection of a grout is required, vents can be added to the Sole+Mate on request.

It is helpful to tack weld the backing strips into the bottom half of the sleeve before installing the top half as shown in Figure 1. Various chain clamps with jackscrew or hydraulic rams are available commercially and can provide assistance in achieving a tight, uniform fit. It may be helpful to use guide shims (not provided) or other tools such as screwdrivers, as shown in Figure 1, to guide the second half over the backing strips.

The temporary use of gap blocks, as shown in Figure 2, may be helpful in maintaining an equal gap on both sides of the sleeve while the sleeve halves are drawn together. The gap blocks may be tack welded in place, but must be removed before the sleeve halves are welded. Due to the diameter tolerance of the pipe, the exact size of the gap block is difficult to predict. A 0.25 inch (6 mm) block is a reasonable starting size.

Field Welding Instructions

Make certain there is not a combustible mixture inside the pipeline prior to welding. Completely welding the longitudinal joints first will assist in pulling the two halves of the sleeve tightly around the pipe. Mild steel backup strips are provided for the longitudinal welds. If the circumferential ends are to be welded, they should be welded last.

For the longitudinal welds, use weld material that meets or exceeds the tensile strength of the Sole+Mate. For the circumferential welds, use weld materials that meets or exceeds the tensile strength of the Sole+Mate or pipe, which ever is greater.

Carefully control the size and shape of the circumferential fillet welds. For a pressure containing application the circumferential fillet welds must be full thickness fillet welds. Strive for a concave faced fillet weld, with streamlined blending into both members; avoid notches and undercuts. The smoother and more streamlined the weld, the greater the resistance to fatigue failure. The worst possible shape would be a heavy reinforced convex weld with an undercut. Improper weld shape can lead to rapid fatigue failure, which can cause leakage, rupture or an explosion with attendant serious consequences.

Welders and weld procedures should be qualified in accordance with API Standard 1104, *Welding of Pipelines and Related Facilities*, Appendix B, *In-Service Welding*. We strongly recommend the use of a low hydrogen welding process such as GMAW or SMAW using low hydrogen electrodes (E-XX18) because of their high resistance to moisture pick-up and hydrogen cracking. SMAW electrodes must be absolutely dry.

It is very important that the field welding procedure closely follow the essential variables of the qualified procedure so that the quality of the field weld is represented by the mechanical tests performed for the procedure qualification.

To avoid severe thermal strains and produce a ductile circumferential weld, some companies use an overlapping back-stepping procedure. Even though the general weld progression may be from right to left, short bead segments, 4 to 8 inches long, are deposited left to right, overlapping half the previous welded bead. Another procedure used for the circumferential weld is buttering or surfacing of the pipe with weld metal prior to welding the fillet root pass.

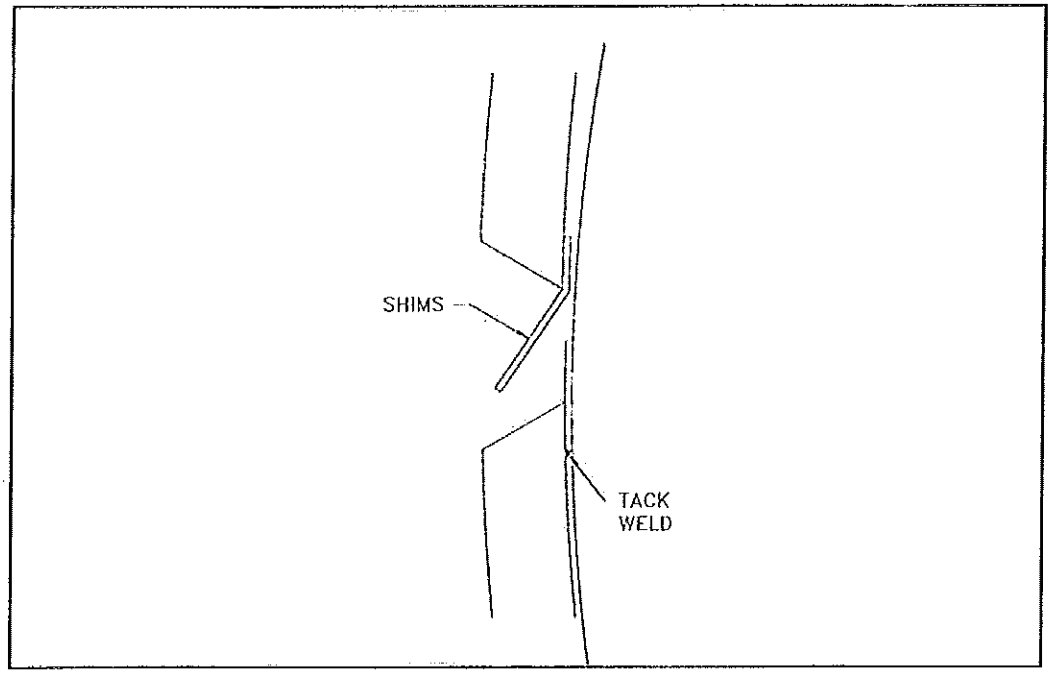

Figure 1

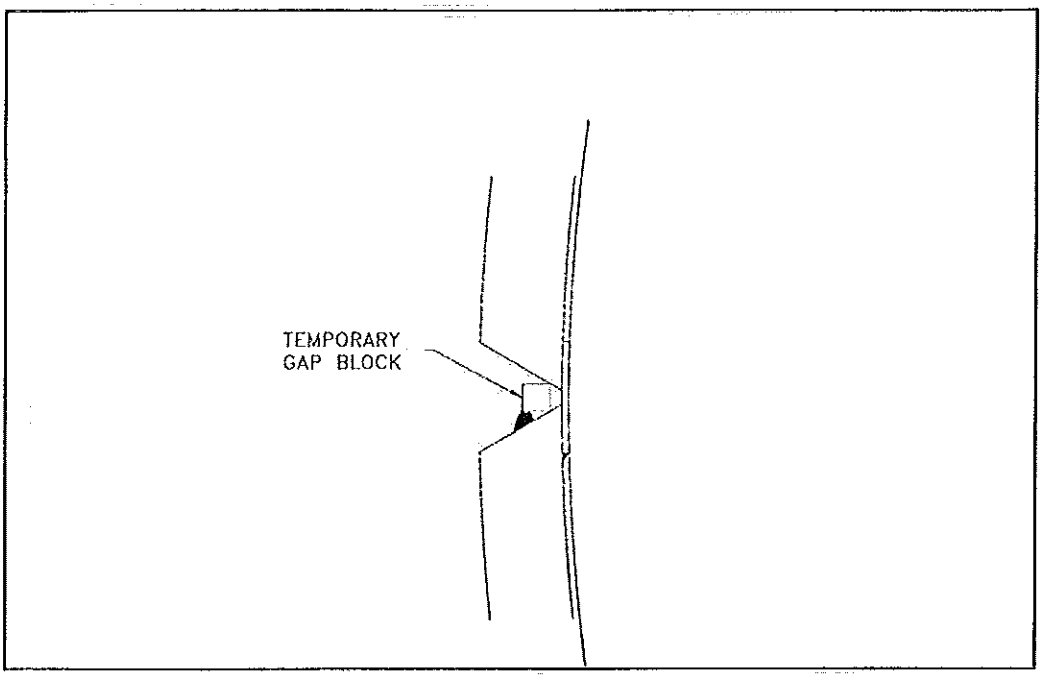

Figure 2

Notes

PLIDCO®
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Phone: (440) 871-5700 • Fax: (440) 871-9577
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PLIDCO® WELD+ENDS INSTALLATION INSTRUCTIONS

!! WARNING !!

IMPROPER SELECTION OR USE OF THIS PRODUCT CAN RESULT IN EXPLOSION, FIRE, DEATH, PERSONAL INJURY, PROPERTY DAMAGE AND/OR HARM TO THE ENVIRONMENT.

Do not use or select a Plidco Weld+Ends until all aspects of the application are thoroughly analyzed. Do not use the Plidco Weld+Ends until you read and understand these installation instructions.

Every effort has been made to securely package this product prior to shipment. Thoroughly inspect for any damage that may have occurred during shipment. If you have any questions or encounter any difficulties using this product please contact:

PLIDCO "DEPARTMENT 100" at 440-871-5700
toll free U.S. & Canada 800-848-3333

READ CAREFULLY

The person in charge of the installation must be familiar with these instructions and communicate them to all personnel involved.

SAFETY CHECK LIST

- ☐ Read and follow these instructions carefully. Follow your company's safety policy and applicable codes and standards.
- ☐ Be absolutely certain that the correct seal material has been selected for the intended use.
- ☐ Determine the type of joint that the Plidco Weld+Ends coupling is expected to connect. See (a) and (b) below and determine the appropriate rating from the ratings listed on the label of the Plidco Weld+Ends coupling.
- ☐ (a) Pipe Not Anchored

  A joint in which the pipe ends could move when subjected to internal or external forces, such as internal pressure, temperature expansion and contraction, underwater currents, ground movement or any

combination thereof. The assigned Plidco Weld+Ends Pipe Not Anchored rating considers only the end force created by the internal pressure. It does not consider any additional external forces such as temperature expansion and contraction, underwater currents, ground movement or any combination thereof. These additional external forces must be determined by the customer. If any of these forces cannot be restrained by customer proven techniques, a Plidco Clamp+Ring should be used.

- (b) Anchored Pipe

  A joint in which the pipe ends would not move when subjected to these same forces. The Plidco Weld+Ends Anchored Pipe rating is the maximum pressure at which the pipeline can be operated. It assumes that the pipeline is suitably anchored by welding, by the use of an appropriately rated Plidco Clamp+Ring or by other customer proven techniques.

- Observe the pressure and temperature ratings on the label of the Plidco Weld+Ends coupling. Do not exceed the maximum appropriate pressure indicated on the unit.

Minimum Pipe Wall Thickness for a Plidco Weld+Ends	
Nominal Pipe Size (inches)	Wall Thickness (inches)
1½	0.200
2	0.218
2½	0.276
3	0.237
4	0.237
6	0.280
8	0.322
10	0.365
12	0.409
14	0.438
16 & larger	0.500

- Pipe wall thickness less than those listed may be pushed inward by the force of the clamp screws. Contact Plidco for recommended maximum working pressure and revised clamp screw torque on thin wall pipe.

- A Plidco Clamp+Ring should be considered whenever the wall thickness is less than those listed. A Plidco Clamp+Ring should also be considered where high external forces (such as underwater currents or thermal contractions) are anticipated, even if the pipe has an adequate wall thickness.

- Pipelines should be carefully blocked at elbows and bends to prevent pullouts caused by internal and external forces; or a Plidco Clamp+Ring should be used. The pipeline should be evenly supported before repressuring. Follow applicable B31 codes during repressuring.

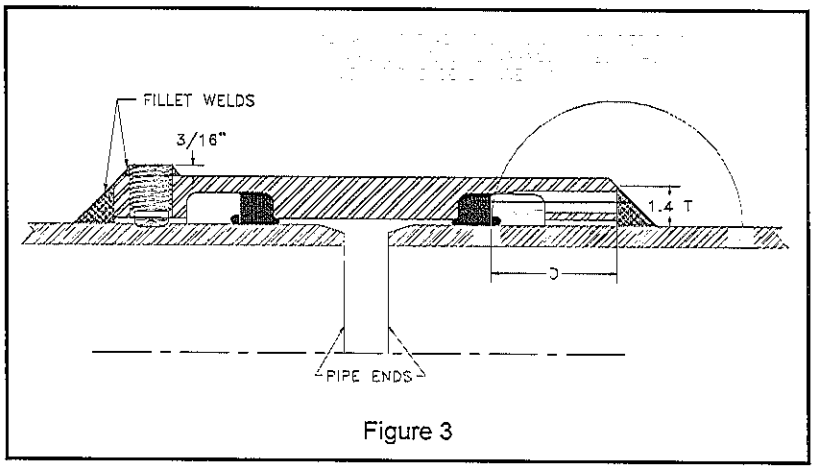


Figure 3

WELDING SEQUENCE

1. Caution should be observed so that welding or preheating does not overheat the seals. Sequence the welding so that the heat is not concentrated in one area.
2. Thrust screws should be cut or burned off flush. Start with the fillet weld to the pipe around circumference and include seal welding the thrust screws. (See Figure 3)
3. Cut or burn off clamp screws approximately 3/16" above the outside surface of the coupling and seal weld. One clamp screw near the top may be removed to serve as a vent while welding and also as a final test point for leakage. (See Figure 3)

FIELD TESTING

The Plidco Weld+Ends coupling can be field tested up to 1½ times the appropriate Pipe Anchored or Pipe Not Anchored Rating.

STORAGE INSTRUCTIONS

Plidco Weld+Ends couplings should be stored in a dry environment to prevent the unpainted surfaces from rusting. Storage temperatures should not exceed 120°F (49°C). Cover with a dark polyethylene to keep the direct sunlight from the seals. It is best to exclude contamination, light, ozone and radiation. Improperly stored Plidco Weld+Ends couplings can cause the gasket material to become cracked and brittle and lose its ability to seal.

The size of the fillet weld should be at least 1.4 times the wall thickness of the pipe. This assumes a 1.0 joint efficiency. You may need to select a different joint efficiency based on your level of inspection or your company's welding policy. Strive for a concave faced fillet weld with streamlined blending into both members; avoid notches and undercuts.

The smoother and more streamlined the weld, the greater the resistance to fatigue failure. The worst possible shape would be a heavy reinforced convex weld with an undercut. Improper weld shape can lead to rapid fatigue failure which can cause leakage, rupture or explosion with serious consequences.

Welders and weld procedures should be qualified in accordance with API Standard 1104, "*Welding of Pipelines and Related Facilities*", or RP 1107, "*Recommended Pipeline Maintenance Welding Practices*", latest edition. API 1104 and 1107 have easy to follow directions for procedure qualification.

We encourage the use of low hydrogen electrodes (E-XX18) because of their high resistance to moisture pick-up and hydrogen cracking. Shielded metal arc welding (SMAW) filler metals listed in API 1104 and 1107 include the cellulose coated electrodes (E-XX10 series) which are often preferred because of the excellent downhill welding characteristics. These are acceptable filler metals, provided they are proven by procedure qualification.

It is very important that the field welding procedure closely follow the essential variables of the qualified procedure so that the quality of the field weld is represented by the physical tests performed on the procedure qualification test specimen.

Dimension "D", as measured during the initial installation, may now be used to mark off locations "A" and "B", as shown in Figure 3. These locations are the same distance from the weld as the seal location "C". To prevent damage to the seals, monitor the heat generated by welding or preheating, particularly at location "A" and "B", by using temperature crayons or probe thermometers. If the heat generated approaches the temperature limit of the seal material which is indicated on the label and in the seal lubrication chart, welding should be discontinued or sequenced to another part of the fitting so that the affected area has a chance to cool.

- ☐ If the Plidco Weld+Ends coupling is welded according to our instructions, or a suitable Plidco Clamp+Ring is used, it can be considered an anchored joint.

PIPE PREPARATION

1. The pipe surface in the area of the repair should be clean, free of coating and burrs and lubricated to prevent abrasion to the seals.
2. For badly misaligned or out-of-round pipe, it is helpful to grind a pilot bevel with a generous taper on the pipe. This would eliminate the risk of damage to the seals while slipping the Plidco Weld+Ends coupling over the end of the pipe. (See Figure 1).

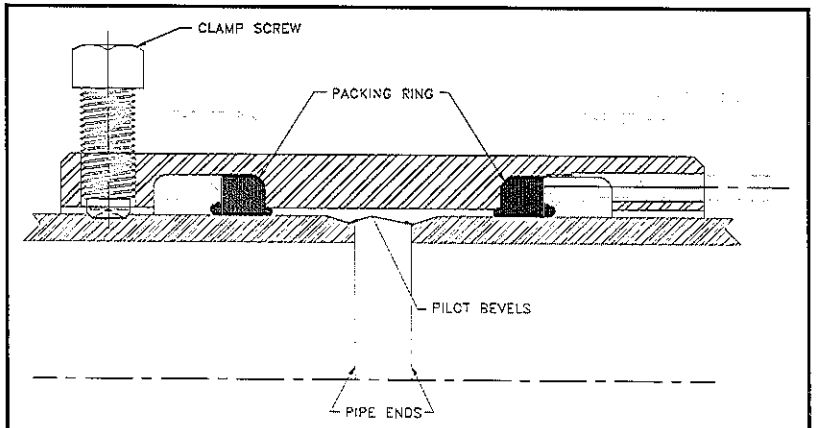


Figure 1

INSTALLATION

The seals can be damaged by careless handling. Lifting devices such as chains, cables or lift truck forks should not contact the seals. Failure to do so can result in the seals being damaged or pulled from their grooves.

1. Measure and record dimension "D", as shown in Figure 3. This will be needed later if the Plidco Weld+Ends is welded to the pipe.
2. Coat all exposed surfaces of the seal material with a lubricant. The following chart indicates the lubricants that are recommended for the various seal materials. The customer must determine if the lubricant is compatible with the product in the pipeline.

Buna-N	A, B, C	225°F
Viton	A, B, C	250°F
Silicone	C	450°F
Neoprene	B, C	250°F
Aflas	A, B, C	250°F
Teflon	A, B, C	500°F
Kevlar	A, B, C	750°F
Petroleum based lubricant	= A	
Silicone based lubricant	= B	
Glycerin based lubricant	= C	

3. Slide the Plidco Weld+Ends coupling completely over one end of the pipe. Mark on the pipe one-half the Plidco Weld+Ends coupling's length from the middle of gap (recommended gap not to exceed 3/4 inch). Slide the Weld+Ends coupling back to the mark to divide the coupling equally over the joint. (See Figure 2)

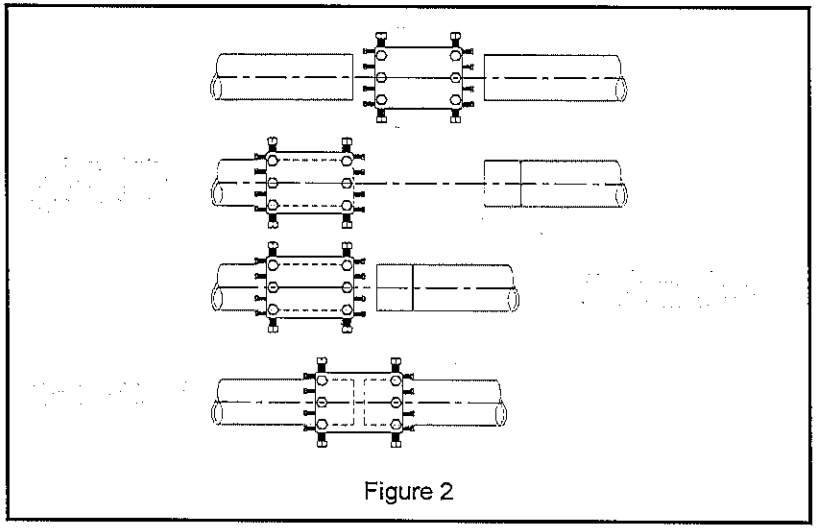


Figure 2

4. Clamp screws have case hardened cup points which are used to secure the coupling to the pipe. The shanks are mild steel and fully weldable. Clamp screws should be tightened evenly, maintaining an equal space between the pipe and the coupling using the recommended torque values. Clamp screws are designed for the assigned Plidco Weld+Ends Not Anchored rating which considers only the end force created by the internal pressure. Clamp screws do not consider any additional external forces or stresses imposed on the pipeline. (See Safety Check List, *(a) Pipe Not Anchored*)

5. Accurate clamp screw torque values are very important when the Plidco Weld+Ends coupling is used on a pipeline joint that is NOT ANCHORED. Do not exceed the Pipe Not Anchored Rating listed on the label of the Plidco Weld+Ends until subsequent welding has been completed. FAILURE TO DO SO CAN RESULT IN EXPLOSION, FIRE, DEATH, PERSONAL INJURY, PROPERTY DAMAGE AND/OR HARM TO THE ENVIRONMENT.

6. Check all clamp screws to make certain each has received at least the minimum torque specified in the chart below.

Cup Point Clamp Screws	Minimum Torque (ft-lbf)	(Nm)
5/8-11	100	136
3/4-10	150	240

7. Thrust screws activate the seals. They are made of mild carbon steel and are fully weldable. They should be tightened gradually and uniformly around the circumference. First, snug all the thrust screws firmly. Then advance each thrust screw about 1/8 of a turn before proceeding to an adjacent thrust screw. It will be necessary to make many circuits around the coupling before completing the thrust screw torque operation. Use recommended torque values in the chart below.

Thrust Screws	Torque Range (ft-lbf)	(Nm)
3/8-16	20 - 25	28 - 34
1/2-13	30 - 40	41 - 55
5/8-11	70 - 80	95 - 109

8. A final torque range, shown in the chart above, will be adequate to complete the assembly.

9. Repressuring after the repair should be done with extreme caution; slowly and steadily without surges which could vibrate the pipeline and fitting. Industry codes and standards are a good source of information on this subject. Operating pressure must not exceed the maximum appropriate Pipe Anchored or Pipe Not Anchored Rating. Personnel should not be allowed near the installation until the seal has been proven.

FIELD WELDING INSTRUCTIONS

PIPELINE SHOULD BE FULL AND UNDER FLOW

Use absolutely dry electrodes which are of equal or greater tensile strength than the pipe. Carefully control the size and shape of the circumferential fillet weld. The weld is required to anchor the joint and give longitudinal stability to the pipeline.

נספח ב' : הוראות תיקון קורוזיה חיצונית ע"י עטיפה תוצרת חברת CLOCK SPRING

4.0 INSTALLATION PROCEDURE FOR CLOCK SPRING® COIL PASS METHOD

This procedure is to be used as a guideline by certified Installers and Trainers for standard Clock Spring® installations. If questions or concerns arise, that are not clearly answered in this Manual or Appendices, contact Clock Spring Company, L.P. for detailed information and instruction.

4.1 Characterize the defect to determine if Clock Spring® is a suitable repair using GRIWrap™ or an equivalent method. See Appendix B for more information. The length of the defect will determine the number of Clock Spring® units needed for the repair. Clock Springs are nominally 11.5-inches (292 mm) wide and must overlap the defect by 2-inches (51 mm) on each side (Figure 1). Multiple units can be used side-by-side to repair longer defects (Appendix Q).

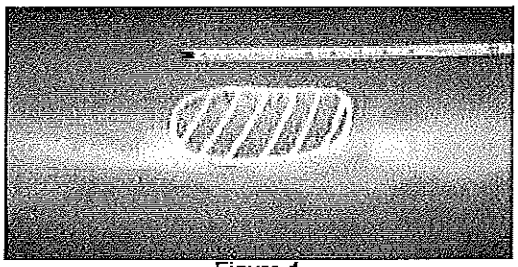


Figure 1

4.2 Table 1 outlines items provided in the Clock Spring® kit and items to be provided by the Installer. Verify that all necessary items are available.

Clock Spring® Kit	Installer Supplied Tools
Clock Spring® Sleeve	Safety Glasses
Starter Pad	Thermometer
Filler and Activator	Tarp or Covering (as necessary)
Adhesive and Activator	Thermal Pipe Wrap (as Necessary)
3-inch (76 mm) Putty Knife	Marker
Jiffy Mixer	Measuring Tape
Roller Handle and Sleeve	Electric Drill (Battery)
2-inch (51 mm) Brush (Qty. 2)	1-Pound (.45 kg) Rubber Mallet
Razor Knife	Shore A Hardness Tester
Adhesive Tray	MEK or Acetone Solvent
Wooden Alignment Blocks	Rags
Adhesive Spatula	3M Adhesive
Dual Lock Tight Pad	Cinch Bar and Strap
Trash Bag	Spool Feeder
1-inch (25 mm) Filament Tape	

Table 1.

4.3 Prepare pipe surface for repair by removing any pipe coating, corrosion residue, primer or adhesive, allowing 4 – 6 inches (102 – 152 mm) of prepared pipe on each side of the area to be sleeved (Figure 2). The pipe surface should conform to NACE # 3 standards or equivalent. Wipe the repair area with

MEK or Acetone. More surface preparation information is contained in Appendix D.

If condensation exists on the pipe surface, refer to Appendix E.

For severe weather conditions refer to Appendix F.

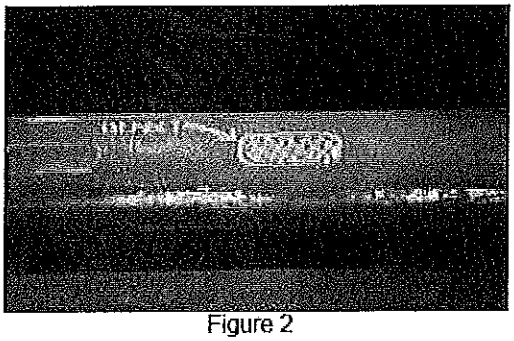


Figure 2

4.4 Dry apply 2 – 3 wraps of Clock Spring® sleeve around the defect area for "marking" purposes (Figure 3). (An alternative is to use any item (i.e. pipe wrap, plastic strip, etc.), which will conform to the pipe.) Center the Clock Spring® over the repair ensuring a 2-inch (51 mm) overlap on each side of the defect. Mark the edge of the Clock Spring®. This reference mark will be used later in the procedure.

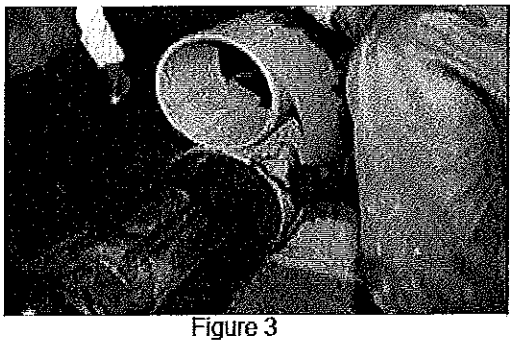


Figure 3

4.5 Remove the Clock Spring® dry wrap and attach the starter pad (Figure 4). Center the starter pad within the "marked" repair area about 4 – 6 inches (102 – 152 mm) from the primary defect area with the "easy peel" side towards the ground. If condensation exists on the pipe surface refer to Appendix E. For severe weather conditions refer to Appendix F. For deformation defects or extensive cluster corrosion, refer to Appendix G for single wrap mold instructions.

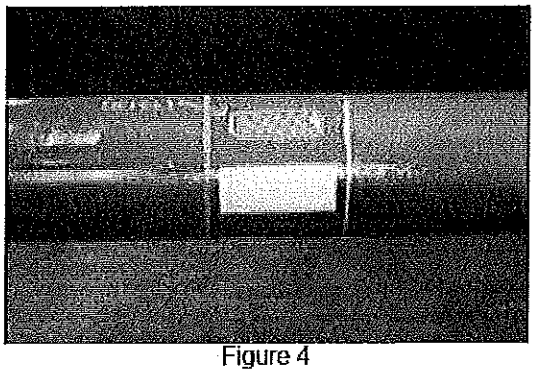


Figure 4

4.6 Obtain the ambient and pipe surface temperatures (Figure 5). If the pipe temperature is less than 32°F (0°C) or greater than 100°F (33°C), contact the Clock Spring Company, L.P. or their representative for special instructions. Use the highest temperature obtained to determine appropriate ratio of activator needed for filler and adhesive. Refer to the chart on the adhesive container or filler tube for the proper mix ratio. Thoroughly mix the adhesive with the blue colored activator and the filler with the orange colored activator until both mixtures are uniform in color and without streaks (Figures 6 and 7). Mix for approximately 2 – 3 minutes. Note that the working time has begun once the activator is mixed. Appendix H contains additional detailed mixing instructions.

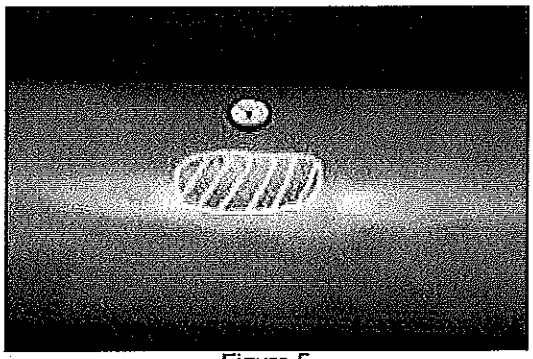


Figure 5

Appendix I contains additional information on the cleanup and disposal of Adhesive, Filler and Activators. Appendix C details the storage requirements for these materials.

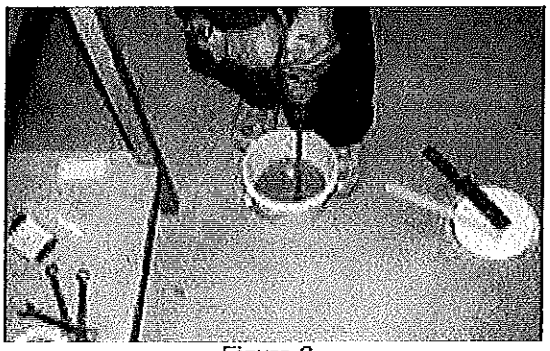


Figure 6

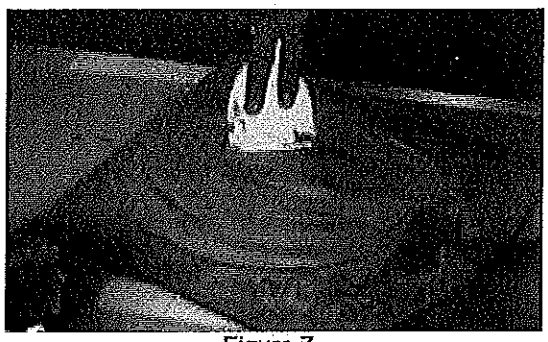


Figure 7

4.7 Using the 3-inch (76 mm) putty knife, apply filler to all voids, both edges of the longitudinal weld and on one edge of the starter pad (for the leading edge placement of the Clock Spring® (Figure 8). Ensure sufficient filler is applied to provide intimate contact between the prepared pipe surface and the Clock Spring® sleeve to be installed.

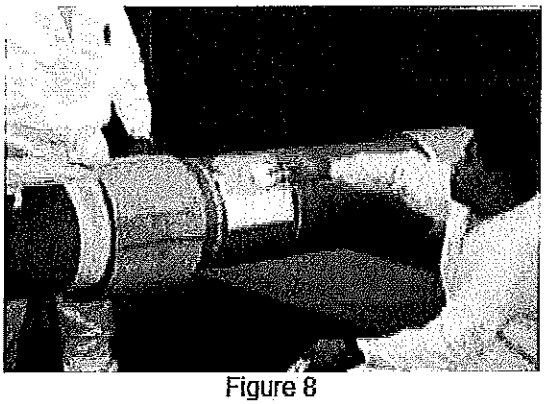


Figure 8

4.8 Pour mixed adhesive into the application tray and, using the roller handle and roller sleeve, apply the adhesive to the entire pipe surface to be repaired, including the starter pad and filler material (Figure 9).

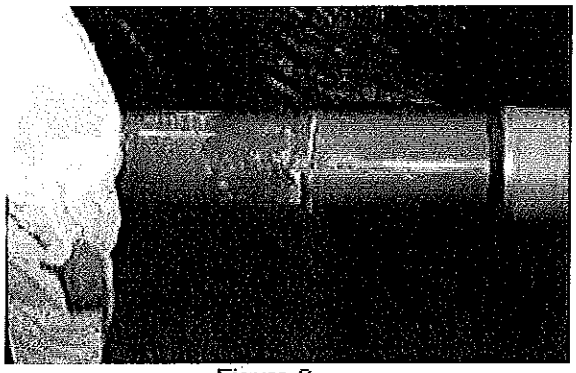


Figure 9

4.9 Remove the parting film (backing) from the starter pad and secure the leading edge of the Clock Spring® sleeve to the pad. Tap the composite sleeve onto the starter pad and ensure that it is anchored firmly to the pipe (Figure 10). Check that the sides of the Clock Spring® are 90° to the pipe axis and aligned with the reference mark created in Section 4.4.

Figure 10

4.10 Ensure sufficient filler material is applied to the area where the leading edge of the Clock Spring® will be positioned (Figure 11). Filler is required to ensure intimate contact at the point where the first layer of the Clock Spring® overlays the second layer.

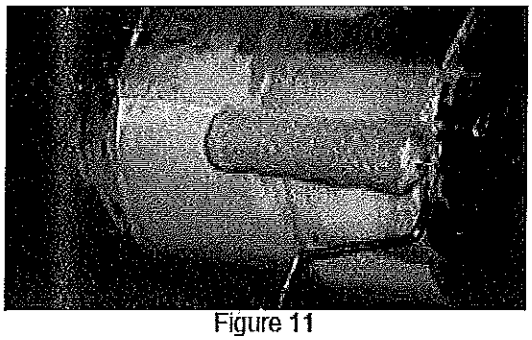


Figure 11

4.11 Apply adhesive to the Clock Spring® outer-surface while wrapping the unit around the pipe (Figure 12).

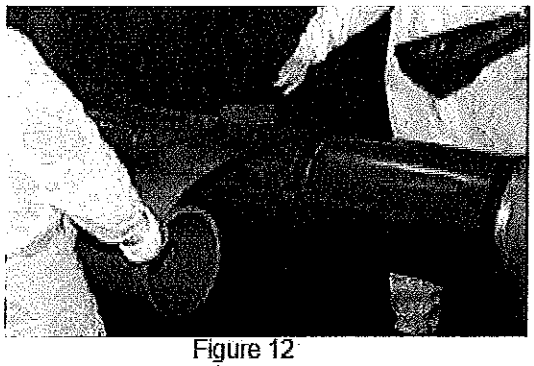


Figure 12

4.12 Continue applying adhesive and wrapping the Clock Spring® around the pipe until the "second black identifying line" appears. There are two identifying lines "marked" on the final wraps of the Clock Spring® sleeve. The first line is to alert the installer that the application of the adhesive is nearing completion. The second line indicates the stopping point of the adhesive application. Apply adhesive 1-inch (25 mm) beyond this point (Figure 13).

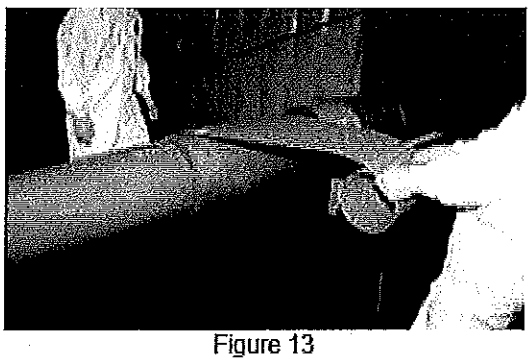


Figure 13

4.13 Carefully position the remaining portion of the Clock Spring® around the pipe and assist the "memory matrix" to tighten the sleeve onto the pipe. Align the edges of the installed sleeve using the wooden blocks and a hammer (Figure 14).

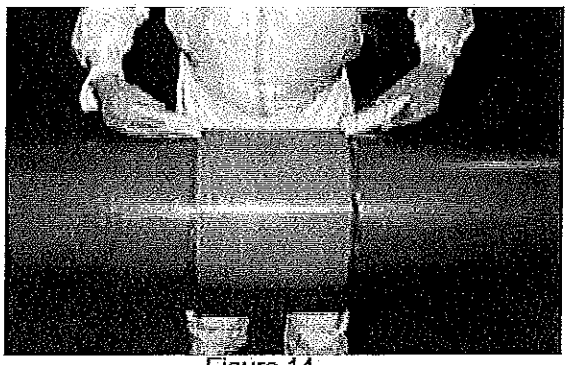


Figure 14

4.14 Prepare to tighten the Clock Spring® sleeve by centering the dual lock pad 6 – 12-inches (152 – 305 mm) from the trailing edge of the Clock Spring® (Figure 15).

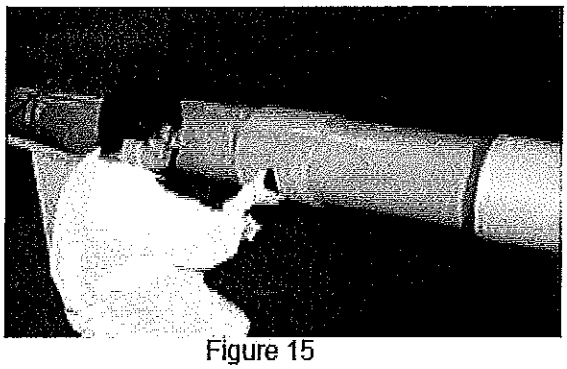


Figure 15

4.15 Secure the cinch bar strap to the dual lock (Figure 16). Position the cinch bar and apply steady pressure (approximately 80 – 100 ft. lbs.(11 – 14 Kg m). Hold for about one minute until excess material extrudes from the edges of the Clock Spring® (Figure 17).

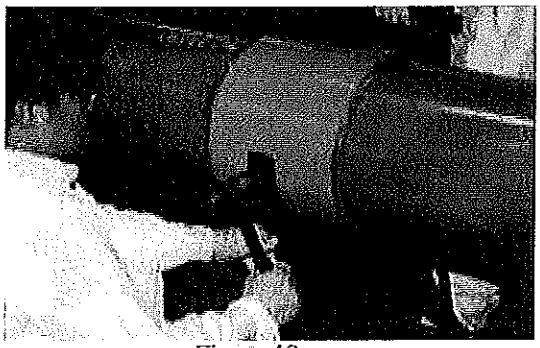


Figure 16

Figure 17

4.16 While maintaining steady pressure, secure the Clock Spring® in position by wrapping filament tape around the sleeve at least three times, approximately 1-inch (25 mm) from each edge (Figure 18).

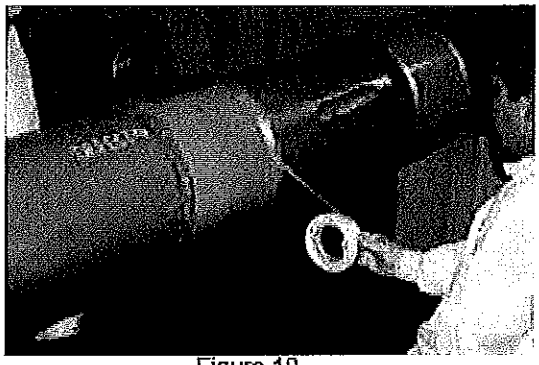


Figure 18

4.17 Perform final alignment of the Clock Spring® sleeve with the wooden blocks (Figure 19).

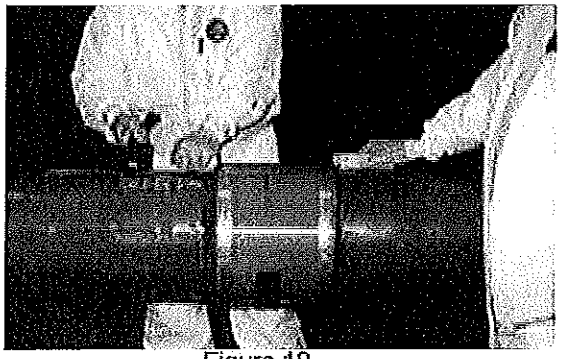


Figure 19

4.18 Remove the extruded filler material from both edges of the sleeve using the 3-inch (76 mm) putty knife (Figure 20).

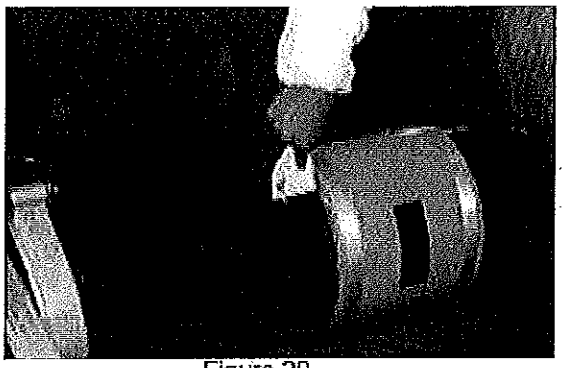
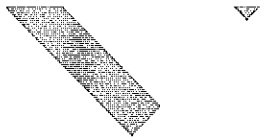


Figure 20

4.19 Seal both edges and trailing edge of the sleeve with the remaining adhesive using the paintbrushes (Figure 21).



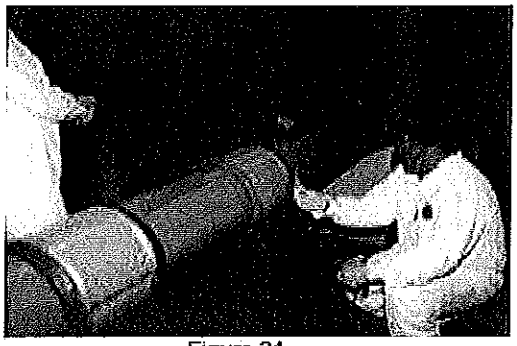


Figure 21

4.20 Ensure that all edges and seams have been sufficiently coated with adhesive (Figure 22). Full cure should occur in approximately 2 hours. To verify that the adhesive is cured, check for a minimum hardness of 40 on the Shore A scale. The completed Clock Spring® assembly is to be treated as a standard pipe repair requiring an external coating. The Clock Spring® is U-V sensitive. Pipe coatings for aboveground pipe must be opaque.

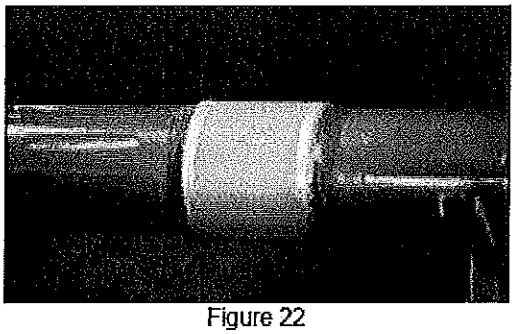


Figure 22

4.21 It is valuable for a pipeline operator to be able to detect prior repairs on subsequent in-line inspections so that time is not spent determining the disposition of a defect detected and repaired during a previous program. The older more traditional repairs are identifiable in the magnetic flux leakage inspection tool data but the Clock Spring® composite repairs are invisible to this technology. The Clock Spring® repair can be fitted with a metallic band to allow detection by Magnetic Flux Leakage inspection tools. This procedure is outlined in Appendix P.

Simply the smartest pipeline repair decision you can make!