Pipe Repair Matrix

The Florida Department of Transportation (DOT) and the Contracting industry strive for problem-free installation of drainage systems on all DOT construction projects. This has been and always will be the goal of the Department. In some cases; however, deficiencies with the pipeline installation are discovered during the final pipe inspection. These deficiencies must be evaluated and resolved before the project is accepted. Since a properly installed, functioning, drainage system is critical to DOT's mission, the Department must have assurances that the installed pipe will meet the design service life and function as intended. Once the contractor has the opportunity to review any deficiencies associated with a pipeline installation, the contractor should submit their suggested repairs to the Department for review. The Construction Office has developed this Pipe Repair Matrix as a guidance document for selecting and approving repair methods submitted by contractors.

The Pipe Repair Matrix is a compilation of pipe repair methods submitted by pipe manufacturers and found in the Standard Specifications. This Matrix is a living document and will continue to evolve as the Department refines its pipeline inspection and repair processes and as repair technologies advance.

As a result, this Matrix is a guidance document ONLY and does not replace Engineering judgment.

It is incumbent upon the District to use that judgment when selecting and approving repairs for their projects. Finally, the Department encourages the review and use of emerging repair technologies provided they are based on sound scientific principles and defendable engineering analysis.

The Department does not accept Cured In Place Pipe (CIPP) point repairs. All Cured In Place Pipe repairs must be installed in accordance with Section 431.

Select a Type of Pipe



[Metal Pipe]



[HDPE / Polypropylene Pipe]



[PVC Pipe]



[Concrete Pipe]

The Pipe Matrix is a guidance document ONLY and does not replace Engineering judgment.

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Metal Pipe

**There are several types of metal pipe listed in the Drainage Manual. They Include:

1. Corrugated Aluminum Pipe (CAP)
2. Corrugated Steel Pipe (CSP)
3. Corrugated Aluminized Steel Pipe (CASP)
4. Spiral Rib Aluminum Pipe (SRAP)
5. Spiral Rib Steel Pipe
6. Spiral Rib Aluminized Steel Pipe (SRASP)

Problem Noted	**Acceptable Repair Methods**
1. Coating has been damaged by welding fabrication or from excessive rough handling.	Pipe should be repaired using special paints and procedures as outlined in ASTM A 780
2. Pipe damaged during normal handling which results in dents but no coating loss. The indentation cannot exceed the 5% deflection or can be no greater than 1 square foot or 10% of the diameter.	Saddle plates per the manufacturer's recommendation covering the area of damage can be provided to cover the indentation and should be field welded to the pipe. Any damaged metallic coating shall be repaired according to ASTM A 780
3. Joint gaps, leaks, or gasket intrusion	**1. Internal joint seals** **2. Concrete collars in accordance with Index 430-001 of the Department's Design Standards** **3. Pressure injection of an acceptable flexible chemical grout** **4. Pipe lining with materials and methods found in Section 431 of the Department's Standards Specifications**

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Corrugated HDPE / Polypropylene Pipe

Problem Noted	Acceptable Repair Methods
1. Excessive Joint gap, rolled gasket or damaged joint	External Repairs: 1. Mastic Banding 2. Concrete collars in accordance with Index 430-001 of the Department's Design Standards 3. Split Band Coupler Internal Repairs: 1. Internal joint seal 2. Welding 3. Pressure injection of an acceptable flexible chemical grout
2. Cracks	External Repairs: 1. Mastic Banding 2. Concrete collars in accordance with Index 430-001 of the Department's Design Standards 3. Split Band Coupler 4. Welding Internal Repairs: 1. Internal joint seal 2. Welding 3. Mechanical Repair Sleeve
3. Punctures or minor damage that does not exceed the width of a single corrugation.	External Repairs: 1. Mastic Banding 2. Concrete collars in accordance with Index 430-001 of the Department's Design Standards 3. Split Band Coupler 4. Slip Coupler Internal Repairs: 1. Internal joint seal 2. Welding 3. Pressure injection of an acceptable flexible chemical grout 4. Mechanical Repair Sleeve

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Corrugated PVC Pipe

1. Small breaks or punctures on the pipe wall	External Repairs:
	1. Cementing a patch or repair piece over small breaks or punctures in the pipe. Pieces are typically pipe saddles from the pipe manufacturer. The repairs are made by: (a) Cleaning the affected area with a suitable solvent. (b) Cementing the repair piece in place using a heavy bodied urethane adhesive. This requires a heavy, continuous bead of adhesive completely around the damaged area and through the full depth of the corrugations. (c) Cleaning away excessive adhesive. **2. Repair Couplings and Bands used in accordance with the pipe manufacturers specifications** **3. Concrete collars in accordance with Index 430-001 of the Department's Design Standards** 4. **Pressure injection of an acceptable flexible chemical grout**
	Internal Repairs:
	1. Mechanical Repair Sleeve
2. Leaking Joints	Internal Repairs:
	1. Pressure injection of an acceptable flexible chemical grout **2. Internal Joint seals**

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Steel Reinforced Concrete Pipe

Problem Noted	Acceptable Repair Methods
1. Cracks	1. Pressure injection of an acceptable flexible chemical grout 1. Pipe lining with materials and methods found in Section 431 of the Department's Standards Specifications 2. Mechanical Repair Sleeve
* Cracks that are 0.01 inches or greater in width and 12 inches or greater in length (ASTM C76) must be repaired or assessed by a Specialty engineer who can evaluate structural integrity, environmental conditions and the design service life of the culvert (AASHTO LRFD Chp. 27).	
2. Spalling	Spalling will be remediated by cleaning and removing any loose materials, if possible, and then applying a Portland cement grout or rapid setting mortar cement or grout or epoxy resin to the affected area. Do not fill the joint completely with these non-flexible grouts or epoxies.
3. Leaking Joints	2. Pipe lining with materials and methods found in Section 431 of the Department's Standards Specifications 3. Internal Joint seals 4. Pressure injection of an acceptable flexible chemical grout 5. Concrete collars in accordance with Index 430-001 of the Department's Design Standards 6. Mechanical Repair Sleeve

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Repair Types

Chemical Grout

Description: Chemically activated grout consisting of an acrylamide, acrylic, or urethane base that creates a collar around the pipe defects. Grouting chemicals are forced into the defect and the surrounding soil where they activate and seal the defect. Once cured, the grout remains flexible for the life of the repair.

Installation Instructions: Equipment containing the grout is inserted into the pipe and positioned over the defect. The grout is forced through the defect from the inside if the pipe and then gels or cures when it comes in contact with water to form a waterproof collar.

Mainline Sealing Animation





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Metal Pipe **HDPE Pipe** **PVC Pipe** **Concrete Pipe**

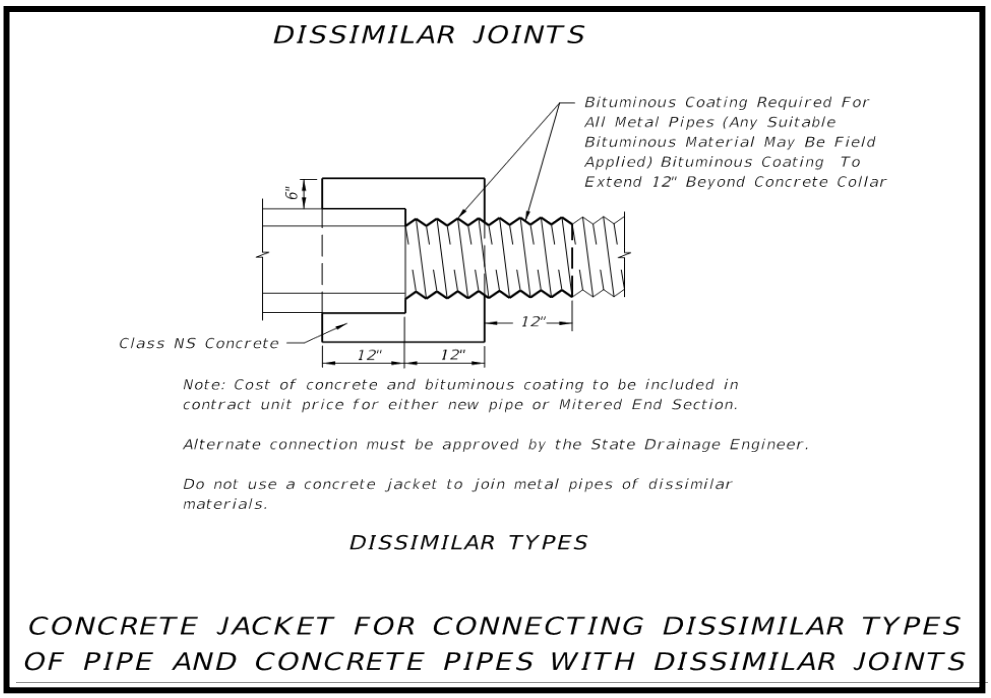
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Concrete Collar

Description: Installing a concrete collar involves building a form around the area to be repaired and encasing it in concrete. Please reference Index 430-001 of the Design Standards.

Installation Instructions: Cut out the damaged area, make cuts in the center of the corrugation valley. Cut the replacement pipe section to the desired length. Trim any burrs from saw cut. Excavate bedding from under the existing cut ends of the pipe. Place gaskets in the pipe corrugation on each cut end. Build the collar form and strut or brace the pipe as necessary. Encase the damaged section of pipe with a concrete collar. Carefully replace and compact bedding and backfill to provide proper support for pipe and collar.

For cracks, joint defects and minor damage, excavate bedding from under the existing pipe to a width of 12" greater than the damaged portion. Encase the damaged section of pipe with a concrete collar. Carefully replace and compact bedding and backfill to provide proper support for pipe and collar.



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Hugger Bands

Repair Couplings and Bands

External repairs for larger damaged areas in PVC pipes are typically performed by cutting out the entire damaged section of pipe and splicing in a new pipe section. In doing this, the damaged section must be cut out squarely and a near identical length of new pipe put in its place.

To properly make an external repair, the bedding beneath the pipe needs to be removed approximately one foot on each side of the cut. This will aid in cutting the damaged section out and leaves working room to install a suitable joint between the old and new pipe sections. Once the entire repair to the pipe is made, this bedding material needs to be replaced and compacted to assure line and grade control.

FDOT requires watertight joints and any of the following repair couplings or bands involve using gaskets from the pipe supplier placed and lubricated (per the manufacturer's instructions) in the first and second corrugation valleys on both sides of each pipe cut prior to the final positioning of the coupling or band.

The pipe manufacturers and supporting industry offer several types of repair couplings including:

Sleeve couplings that can be worked over the connection by sliding them completely onto the repair section before it is placed and then slid back and centered over the joint after placement.

Rubber or flexible thermoplastic couplings (or boots) are offered by Fernco and others. These can be placed on the ends of the repair section, rolled back during placement and then rolled over the joint after the repair pipe is placed. They are tightened in place with the stainless steel bands and the included hardware at each end of the coupling.

Flat or partially corrugated (Hugger type) bands are available from corrugated metal pipe suppliers. These are centered under the cut pipe ends and tightened after the repair section is placed. They are used with an additional 12-inch wide flat gasket. Metal bands shall be made of Aluminized type 2 steel or aluminum, meeting any alternative metal pipe option on the project.

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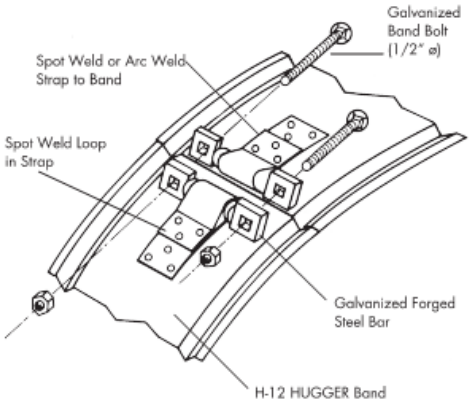
PVC Pipe

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CONTECH ENGINEERED SOLUTIONS

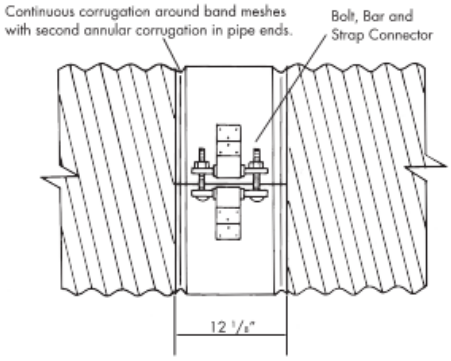
H-12 HUGGER Band

Physical Details

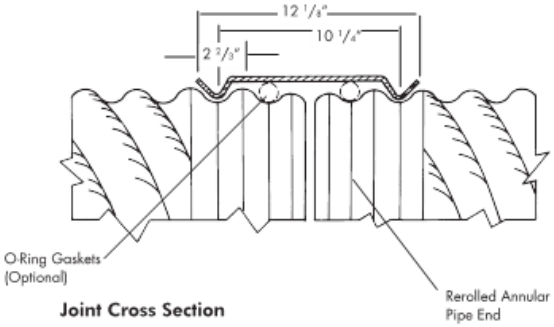


Bolt, Bar and Strap Connector*

*A single bolt, bar and strap connector is shown. The H-12 HUGGER Band is also available with Techno angles. Specifying a double bolt, bar and strap connector is recommended for some diameter and gauge combinations. When O-ring gaskets are to be used, the specifications should generally indicate the use of bolt, bar and strap connectors. Additional details and information are available from your local CONTECH Sales Engineer. For applications with ≥48" diameter pipe to meet infiltration/exfiltration requirements, double bolt, bar and strap connectors with a backing plate assembly should be specified.



Standard construction is one-piece for 12" through 48", two-piece for 54" through 96", and three-piece for 102" and above.



Joint Cross Section

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Internal Seal

Description: The internal seal is comprised of an EPDM rubber gasket and metal band which expands to conform to the inner wall of the pipe. Please refence Specification Section 948-9.6 of Standard Specifications for material requirements.

Installation Instructions: Ensure the area to be repaired is clean. Mark the pipe on either side of the joint or damaged section in several places to ensure proper alignment. The location of the marks will depend on the size of the seal. Move the seal into place over the center of the joint or damaged section. Tighten the internal expanding metal bands.

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Mastic Banding

Description: The band is self adhering rubberized mastic reinforced with geotextile fabric and a polyethylene outer cover. Securing bands wrap around the pipe to form a positive seal.

Installation Instructions: Cut out the damaged area, make cuts in the center of the corrugation valley. Cut the replacement pipe section to the desired length. Trim any burrs from saw cut. Excavate bedding from under the existing pipe cut ends. A protective peel away paper is removed from the back of the band to expose a tacky mastic surface. Ensure that the pipe is clean and free from debris. The band is then adhered to the entire circumference of the pipe. Straps on the band tighten to provide a positive seal. Carefully replace and compact bedding and backfill to provide proper support for pipe and coupler. In this application, the mastic bands may only be used outside of the control line.

For cracks, joint defects and minor damage excavate from under the existing pipe to a width greater than the bands. Center the coupler over the damaged area. A protective peel away paper is removed from the back of the band to expose a tacky mastic surface. Ensure that the pipe is clean and free from debris. The band is then adhered to the entire circumference of the pipe. Straps on the band tighten to provide a positive seal. Carefully replace and compact bedding and backfill to provide proper support for pipe and coupler.





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HDPE Pipe

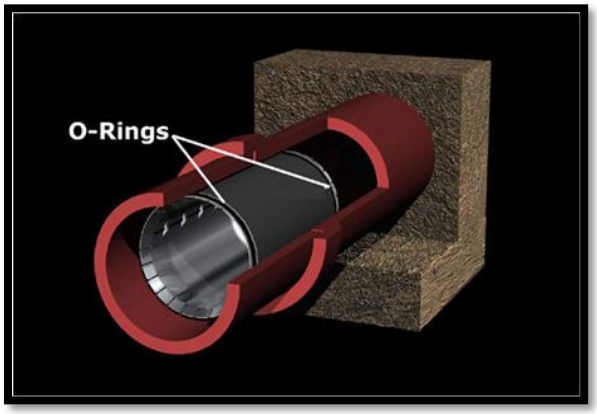
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Mechanical Repair Sleeves

Description: The system is comprised of a stainless steel structural core, which uses a mechanical lock to hold it against the host pipe, the core is either surrounded by a gasket or uses two o-ring type gaskets on each end, depending on the application. Limit straps prevent the sleeve from expanding beyond a preset diameter, preventing it from harming the host pipe. Please refence Specification Section 948-9.6 of the Standard Specifications for material requirements.

Installation Instructions: Gaskets are placed on the sleeve on site before the sleeve is installed. Being monitored by a CCTV camera, the sleeve is positioned over the defect and the air plug is then inflated to expand the sleeve until the locks engage. The air plug is then deflated and withdrawn. **Ensure that the locking mechanisms are placed at the crown of the pipe to minimize trapping debris.**







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Pipe Coatings

Description: Centrifugally Cast Concrete Pipe is the process whereby a high-strength fiber reinforced mortar is centrifugally cast inside the pipe wall to form a fully structural pipe within a pipe.

Instructions: Before any work commences the pipe must first be inspected and material and thickness specified by the design engineer. The interior surface shall be cleaned with a high-pressure water-blast sufficient to remove all laitance and loose material and flush debris from the pipe. If necessary, any voids, separated joints or missing invert sections must be filled with a high-strength grout and allowed to set. All active infiltration must be stopped. Position the rotating casting applicator within the center of the host pipe and commence pumping the mixed mortar. As the mortar begins to be centrifugally cast evenly around the interior, retrieve the applicator head at the best speed for applying the engineered design thickness that has been selected. To achieve the required thickness several passes may be necessary. Allow proper curing before releasing bypass.





Centrifugally Cast Concrete Pipe Liner

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Pipe Lining

There are several different materials and methods available for lining pipe. Please reference Section 431 of the Standard Specifications.

Fold and Form Liner



Slip Liner



[Pipe Coatings]

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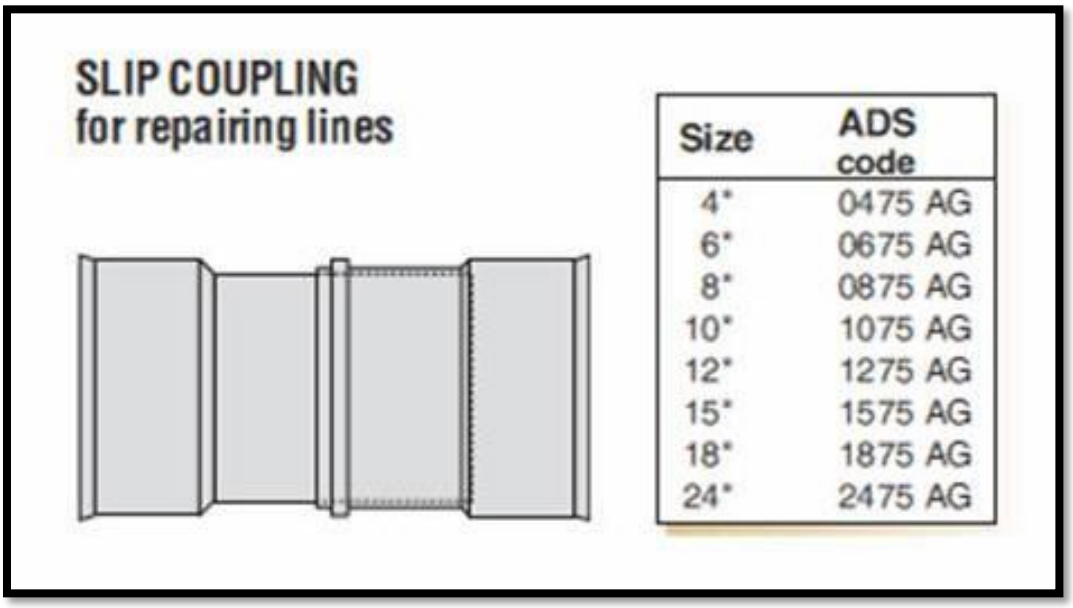
[Metal Pipe] [HDPE Pipe] [PVC Pipe] [Concrete Pipe]

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Slip Coupler

Description: The slip coupler uses PVC bells and polyisoprene gaskets. The gaskets are placed in the corrugation valley on either side of the section to be repaired and the slip couplings are the slid over the gasket. Slip couplers should be supplied by the same manufacturer as the pipe.

Installation Instructions: Cut out the damaged area, make cuts in the center of the corrugation valley. Cut the replacement pipe section to the desired length. Trim any burrs from saw cut. Excavate bedding from under the existing cut ends of the pipe. Lubricate the slip coupler bell ends then slide the slip coupler over the cut end of the pipe. Install a gasket on each cut end (4 per repair) in a valley corrugation. Lubricate the gasket. Do not allow the lubricated section to touch dirt or backfill. Slide the slip coupler over the gasket making sure to center the coupler. Carefully replace and compact bedding and backfill to provide proper support for pipe and coupler.



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Split Band Couplers

Description: The split band couplers are corrugated to match the pipe's corrugations and engage at least two full corrugations on each pipe end. The split band couplers must be supplied by the same manufacturer as the pipe.

Installation Instructions: Cut out the damaged area, make cuts in the center of the corrugation valley. Cut the replacement pipe section to the desired length. Trim any burrs from saw cut. Excavate bedding from under the existing cut ends of the pipe. The split band couplers are installed by laying the adjoining sections of pipe in the open split band coupler and wrapping the coupler around the pipe. Nylon ties are fed through the holes in the ends of the coupler and pulled tight. The pipe and inside of the coupler should be free of debris. Carefully replace and compact bedding and backfill to provide proper support for pipe and coupler.

For cracks, joint defects and minor damage excavate from under the existing pipe to a width greater than the bands. Center the coupler over the damaged area and wrap the coupler around the pipe. Nylon ties are fed through the holes in the ends of the coupler and pulled tight. The pipe and inside of the coupler should be free of debris. Carefully replace and compact bedding and backfill to provide proper support for pipe and coupler.

This repair method should only be considered in perforated systems since it will not meet soil tight/watertight requirements as defined in Florida DOT Standard Specification Section 430.





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HDPE Pipe

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Welding

Description: Cracks with a gap less than 1/8" can be repaired using a single bead extrusion weld. Joints, punctures, cracks, or minor damaged sections larger than 1/8” in thickness should utilize HDPE sheet reinforcement, and sheet thickness should be at a minimum the same thickness as pipe wall.

Installation Instructions: Only an experienced welder knowledgeable in corrugated HDPE Pipe repair shall be allowed to repair the pipe. Evaluate the extent of the repair required. Thoroughly clean the area to be repaired, ensuring all oxidation is removed. The welding rod and sheet material used to make repairs should be the same cell classification as the pipe or meet the cell classification of 345464C as defined by ASTM D3350. Single cracks with a gap less than 1/8" can be repaired using a single bead extrusion weld. For larger cracks, joints, punctures, or minor damage sections should utilize HDPE sheet reinforcement with a thickness at least the same as the pipe wall.

Extrusion Welding Animation
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Electrofusion Welding Animation
(Opens New Browser Window)

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