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# **Heat-Shrinkable Sleeve Technology**

## **Bob Buchanan Seal For Life Ind.**

From corrosion coating basics to  
installed system inspection



Appalachian Underground Corrosion Short Course

# Pipelines

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**Oil & Gas Pipelines**



**High Temperature Pipelines**



**Water Pipelines**



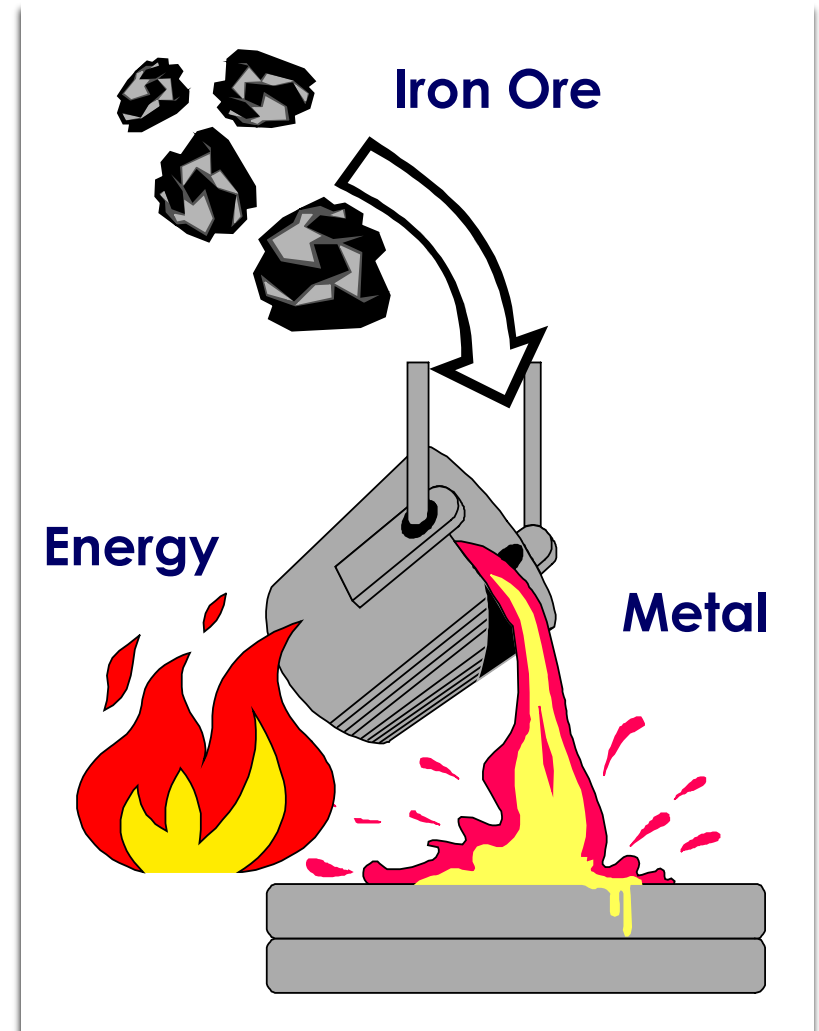
**Insulated Pipelines**



**Offshore Pipelines**

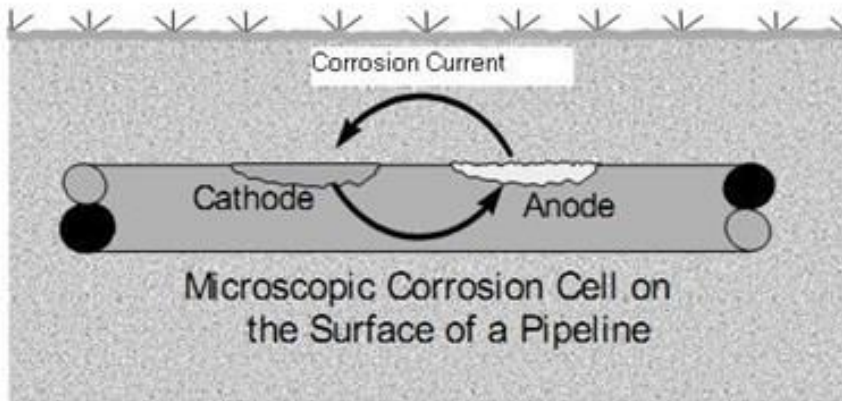
# Understanding Corrosion

- Steel is formed from Iron Ore and Energy
- With energy, steel may be returned to being iron ore - corrosion



# Corrosion Basics

- Anode (pipe or other metallic structure)
- Cathode (pipe)
- Electrolyte (soil)
- External Circuit
- All 4 components creates a potential difference between the Anode and Cathode
- Removing any 1 of the components from the cell halts the corrosion process
- Break the circuit with a good coating as example



# Underground Pipeline Coatings

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- 1st line of defense against corrosion
- Must be properly specified based on constructability and pipeline operation
- Must be properly applied - big part of that is applicator training and final inspection



# What's Important

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- Specification / Product Selection
- Surface Preparation
- Proper Application
- Inspection & Testing



# Prevent corrosion

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## Coatings need to have

- high electrical resistance
- low permeability to hydrogen and oxygen
- mechanical strength
- chemical stability



# Heat-Shrinkable Sleeve System

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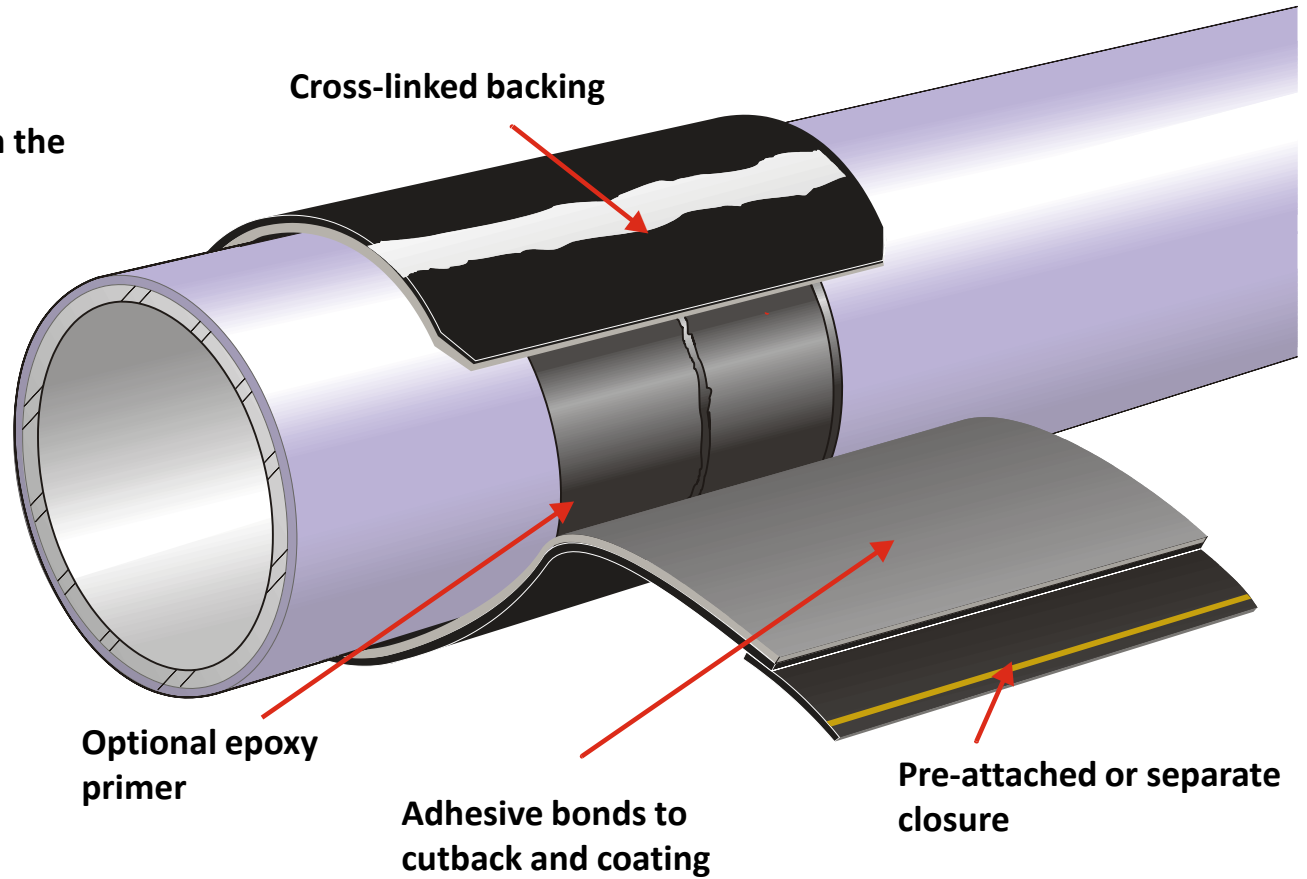
- Sleeves consist of a backing and adhesive
- The backing needs to be cross-linked in order to be heat shrinkable
- The adhesive has several functions:
  - corrosion protection, shear resistance, long term adhesion to the steel, bond to the coating...
- Design of the backing and adhesive dictates performance at operating temperature





# Heat-Shrinkable Sleeve System

Must be compatible with the mainline coating



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# Backings



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# Irradiation Cross-linking

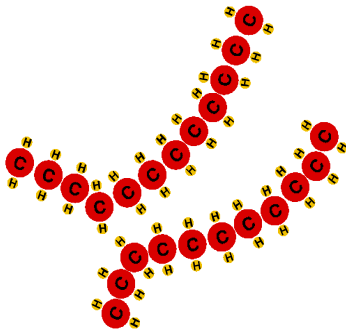
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- High energy electrons are used to strike the molecules at the C-H bond
- The hydrogen atom is set free leaving the parent carbon atom as a “free radical”
- At adjacent sites, the free radicals use their energy to form a chemical bond
- This bond is called a cross-link

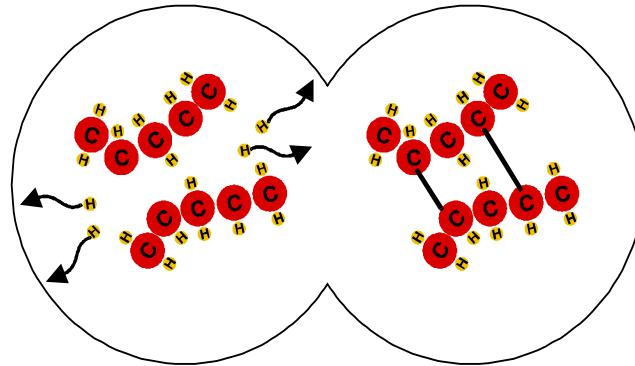


# Polyolefin Cross-linking

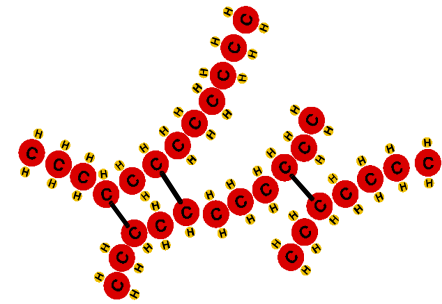
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**Polyolefin  
(before)**



**Irradiation  
processing**

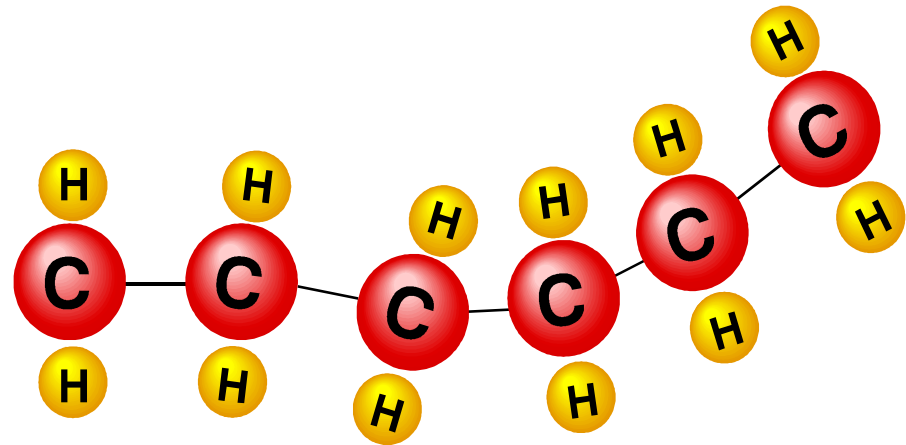


**Cross-linked Polyolefin  
(after)**

# Properties of Cross-linked Backings

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- Imparts Elastic Memory
- Increases Tensile Strength
- Increases Impact Resistance
- Increases Abrasion Resistance
- Increases Insulation Value



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# Adhesives



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# Adhesive Functions

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- Primary corrosion protection in 2-layer systems
- Develop a physical anchor to the substrate
- Provide shear force resistance
- Minimize cathodic disbondment
- Bond the sleeve to the mainline coating



# Adhesive Choice Considerations

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- Surface prep and pre-heat requirements
- Adhesion to cutback and adjacent coating
- Cathodic disbondment resistance requirements
- Soil stress resistance due to pipe movement and vertical soil shear
- Environmental conditions during construction
- Properties at operating temperature through service life





# Adhesive Technologies

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- Mastic Adhesives

- Low pre-heat requirements
- Forgiving on surface prep
- Excellent water resistance
- Excellent CD resistance

- Hot-Melt Adhesives

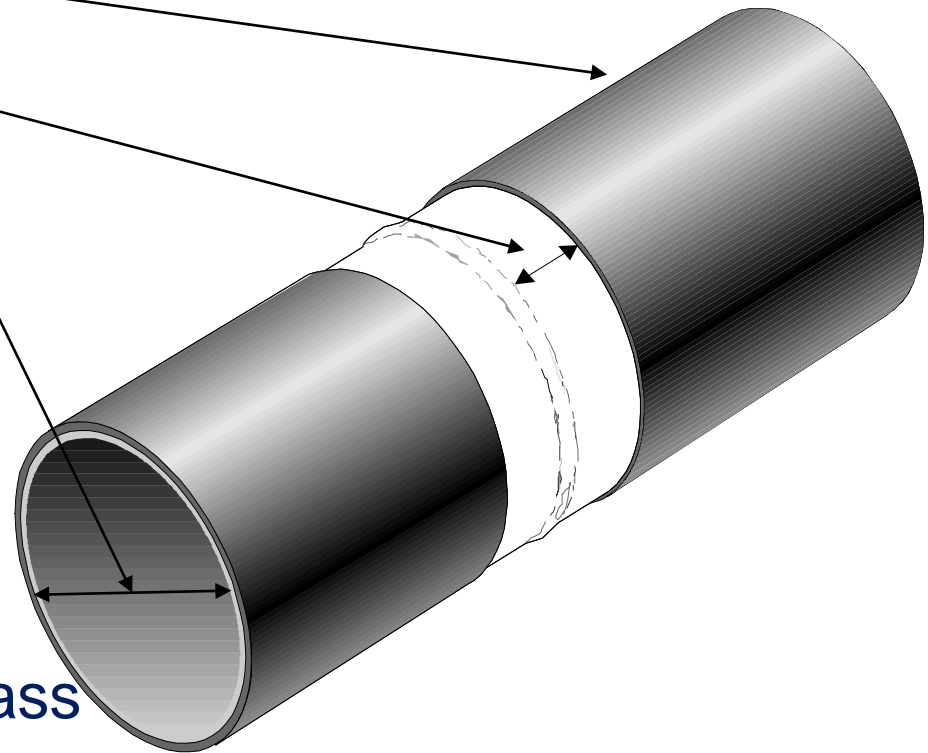
- High shear resistance
- Resistant to high ambient temperatures
- Higher pipeline operating temperature
- 3-Layer coating compatible



# Selecting the sleeve

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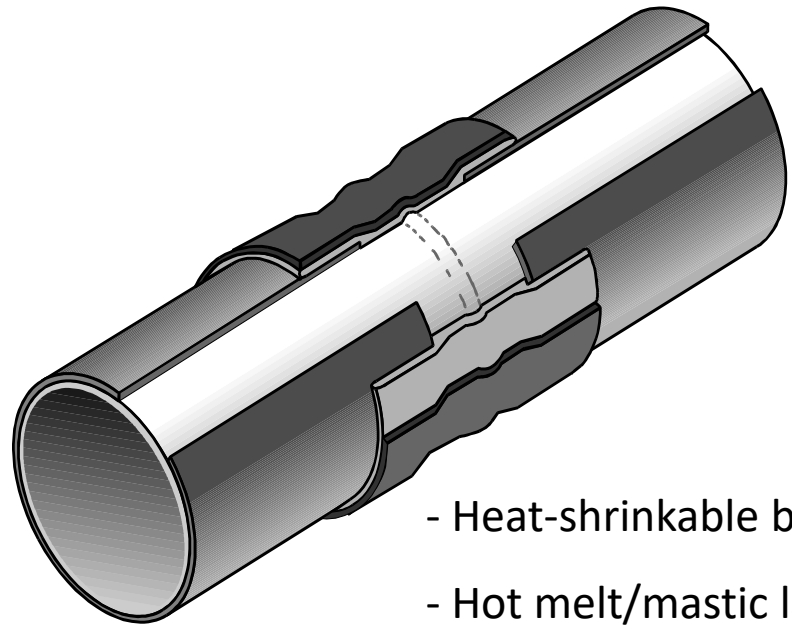
- Pipe operating temperature
- Pipe coating type
- Cutback distance
- Outside pipe diameter
- Adverse soil conditions
- Pipe laying method
- Climate conditions
- Recommended pipe preparation
- Mechanical resistance class



# Wraparound 2- or 3-Layer Sleeve

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- Installation directly on cleaned and dried pipe surface
- Compatible with standard mill-applied coatings
- Epoxy primer for 3-layer only



- Heat-shrinkable backing
- Hot melt/mastic layer
- Primer if used

# Coating of Fittings & Bends

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## Heat Shrink Tape

- Highly flexible, hand installed tape
- Minimal inventory



# Tubular Heat Shrink Sleeves

Two-layer coating for pipes with ambient operating temperature up to 30°C (86°F)

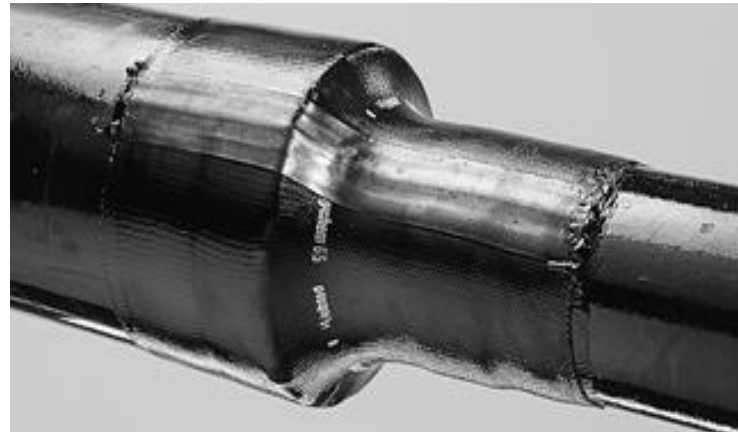
- Only handbrush or wirebrush required
- No closure patch, easy to install
- High impact strength and penetration resistance
- Thermal indicator (TPS)



# Shrink Sleeves for Casing Ends and Flanges

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- Fiberglass reinforced: mechanical strength, high impact strength, high penetration resistance
- Convenient wraparound design
- High shrink ratio (65%)



# Special Applications

Three-layer coating for horizontal or directional drilling

- Extremely high shear and peel strength
- Fiber-reinforced sleeve, excellent abrasion resistance
- No 'curing time' - just cool and use immediately
- Superior cathodic disbondment
- Simple installation without special tools



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# **Sleeve System**



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# Required Properties & Characteristics

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- Resistance to impact, abrasion, penetration
- Must be flexible
- Good adhesion to the substrate
- Resistance to environmental conditions
- Resistance to cathodic disbondment
- Remain functional under operating conditions



# What is important to install?

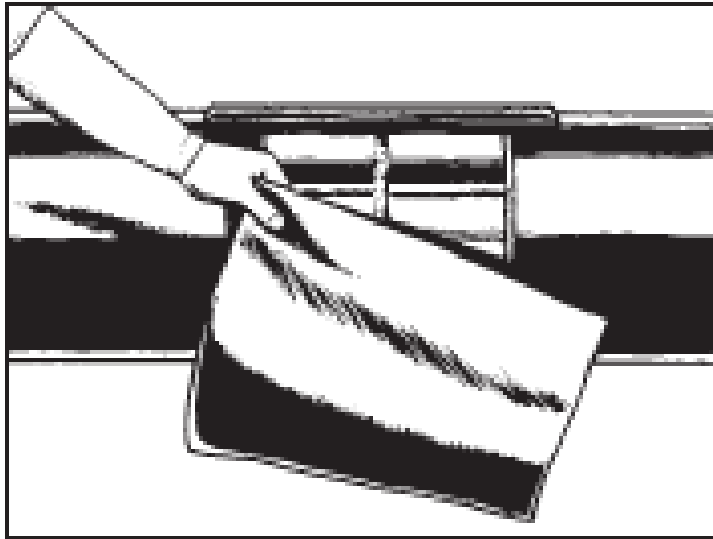
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- Suitable surface preparation
- Use of the proper tools
- Primer application (if used)
- Achieve the correct pre-heat
- Sleeve centered on the cutback
- Correct overlap to the coating
- Closure properly installed
- Correct procedure for shrinking
- Visual Inspection
- Field Peel Test
- Holiday Detection



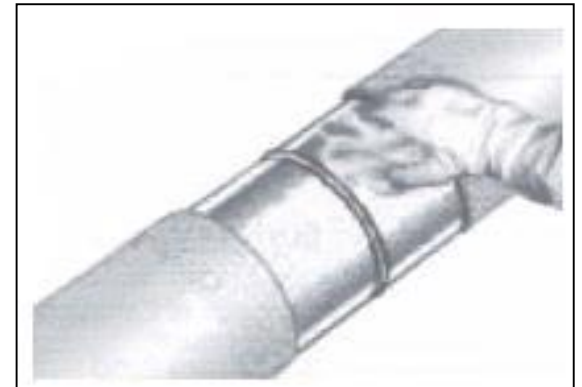
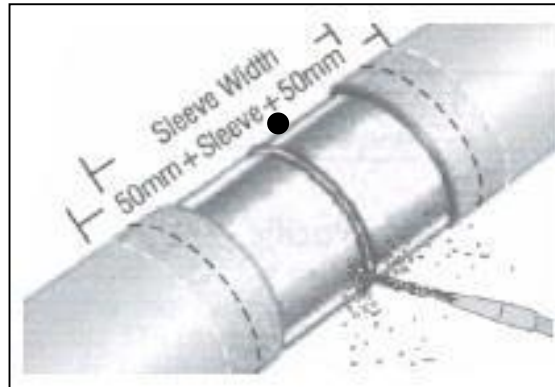
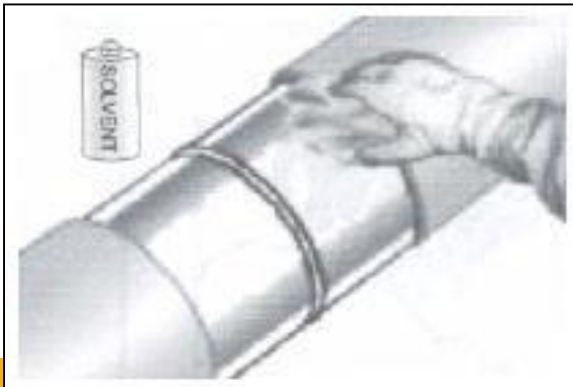
# Material and Tools for Proper Installation

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# Surface Preparation

- Chamfer 3LPE edges to minimum 45 degrees.
- No Chamfer required for FBE
- Clean and dry surface prepared to minimum St3 – ISO 8501:1
- Sand or Grit blasting possible
- Coating abraded at the sleeve overlap area with sand paper or grinder to achieve proper bonding of the sleeve



# Surface Preparation

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- The primary objective of surface preparation is to provide maximum coating adhesion
- The actual mechanism of surface preparation is threefold:
  - Remove any loose material from the surface
  - Increase the surface area
  - Impart an anchor pattern



# Surface Preparation Standards

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Description	SIS	SSPC	NACE
White Metal	Sa3	SP5	1
Near White Metal	Sa2.5	SP10	2
Medium Blast	Sa2	SP6	3
Light Blast	Sa1	SP7	4
Power Wire Brush	ST3	SP3	-
Hand Wire Brush	ST2	SP2	-



# Abrasive Blast Cleaning

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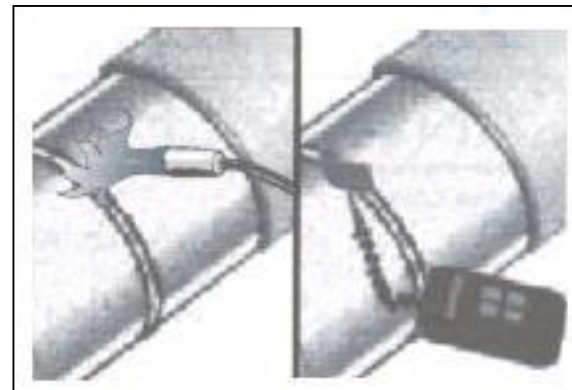
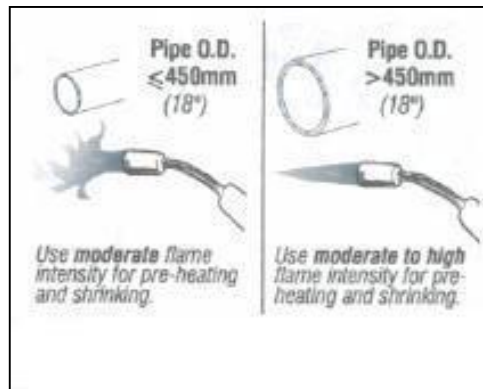
# Cleaning Blasting & Abrasion





# Pre-heating

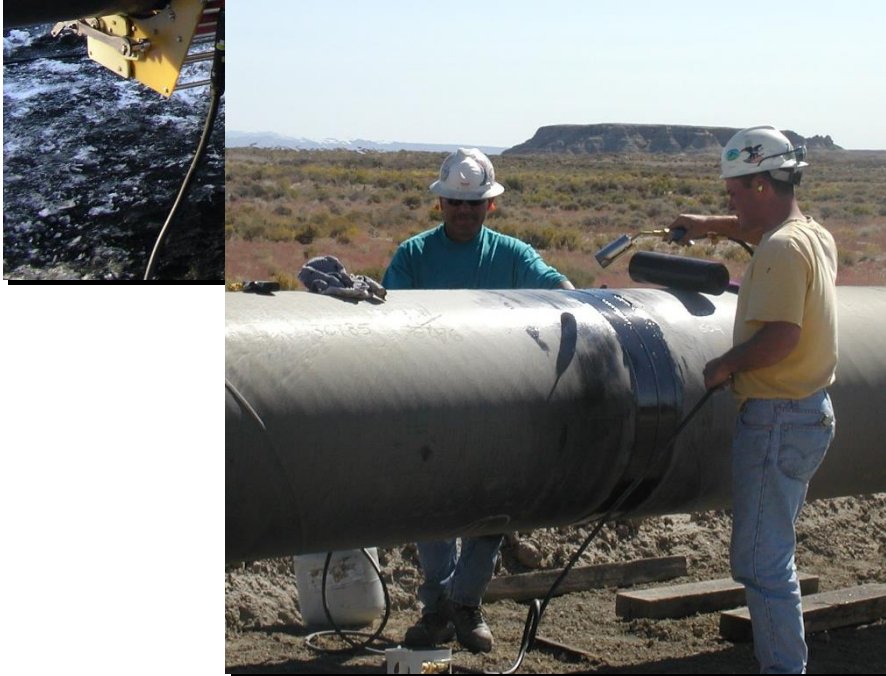
- Mastics – 150°F (65°C)
- Hot Melts – 200°F (90°C)
- OD pipe < 12", one torch required
- OD >12", two torches recommended
- Verify temperature with contact probe thermometer



# Surface Pre-Heating

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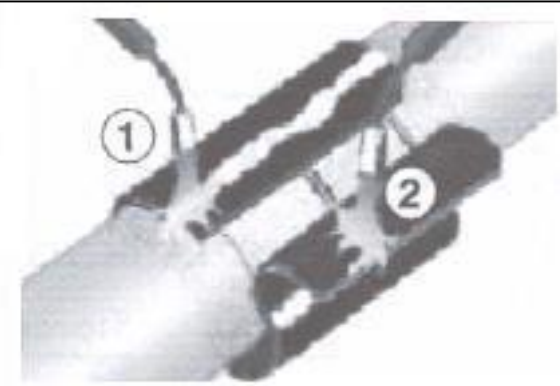
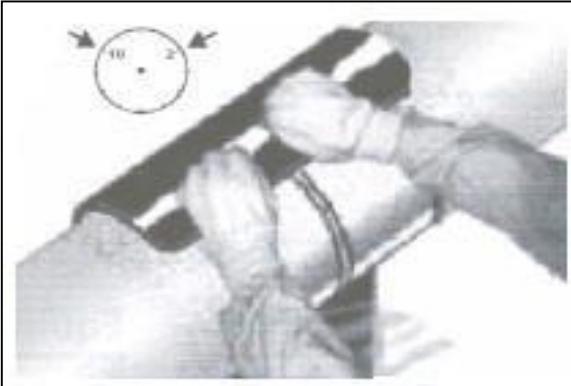
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- Pre-heating with induction coils or propane torches
- Removes moisture from steel substrate (prior to surface prep)
- Pre-heats substrate to a specified temperature to melt and “Wet-Out” adhesives
- Oxidizes coating surface to aid bonding

# Centralize the Sleeve and Install the Closure

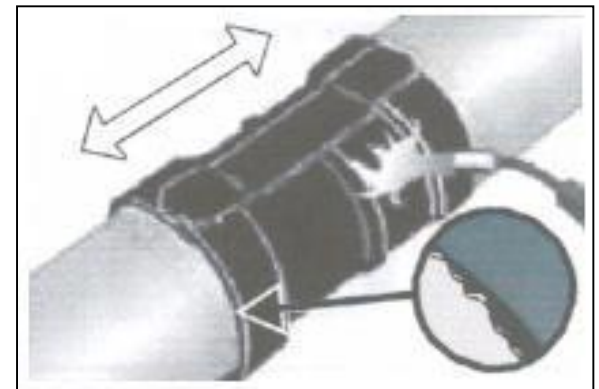
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# Shrink the Sleeve / Visual Inspection

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- Start shrinking at the center and complete to the edges
- Both installers shall shrink to the same side, then to the other side
- Check if the adhesive oozed to both edges on the entire circumference



# Heat-Shrinkable Sleeve Installation



# Heat-Shrink Sleeve Field Installation

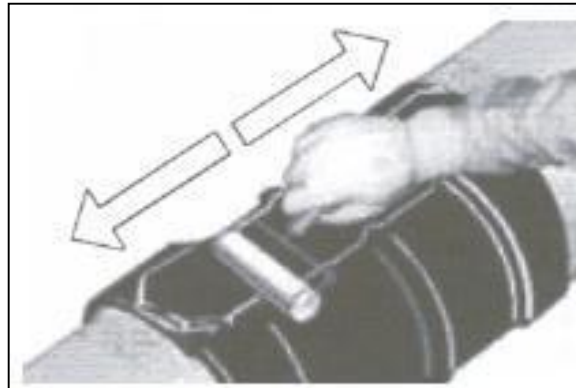
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# Finishing the Installation

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- Roll sleeve surface and the overlapping sleeve/sleeve region where a air channel can be formed in order to remove entrapped air



# Rolling the sleeve

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# Post installation inspection Holiday Detection & Adhesion Testing



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# Contact

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