Pipeline Coatings

2023 AUCSC

Fundamentals Session

Jeff Didas – Kinder Morgan - Tucson, AZ

Remember This!

- Coatings are the #1 defense against corrosion.
- This is true for underground, transition and above ground service.

Coating Types

- Underground – buried or immersion service
- Transition area coatings
- Atmospheric coatings
- Internal coatings & linings

Underground Pipeline Coatings

- Mill or Plant Applied
- Field Applied
- Line Coatings
- Repair Coatings
- Coating Discussion
- Coating Cost
- Coating Quality

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Appalachian Underground Corrosion Short Course

Mill or Plant Applied

- Most economical method to apply coatings
- Highest level of quality and quality control
- Plant/Mill conditions allow use of higher performing coatings
- Normally, high quality storage, handling and shipping
- Normally allows for some coated pipe storage

Field Applied

- Costly method either over the ditch or in the ditch
- Hard to manage quality control due to environmental conditions
- Normally lower performing coatings
- Newer field coatings do allow higher productivity
- Keyhole applications can be a problem
- Includes Field Joint – FJC / Weld Joint – WJC Coatings

Line Coatings

- Coal Tar Enamel
- Asphalt Enamel
- Extruded Polyethylene
- Fusion Bonded Epoxy
- Somastic
- Pritec
- Liquid Epoxy
- 3 Layer – 3LPE & 3LPP
- ARO – Abrasion Resistant Overlay or Overcoat

Repair Coatings

- Tapes
- Wax
- Shrink Sleeves
- Two - Part Epoxy
- Mastic
- Epoxy Mastic
- Visco-Elastic
- Misc.

Coatings Discussion

- Most important component of a pipeline
- High quality holiday free coating requires almost no cathodic protection current
- Coatings need to be specified
- Coatings need to be tested
- Every coating has a use, but most coatings are used improperly – follow procedures

Coating Cost

- Cost of material
- Cost of application
- Cost to repair
- Handling
- Expected life
- Dielectric strength

Coating Quality

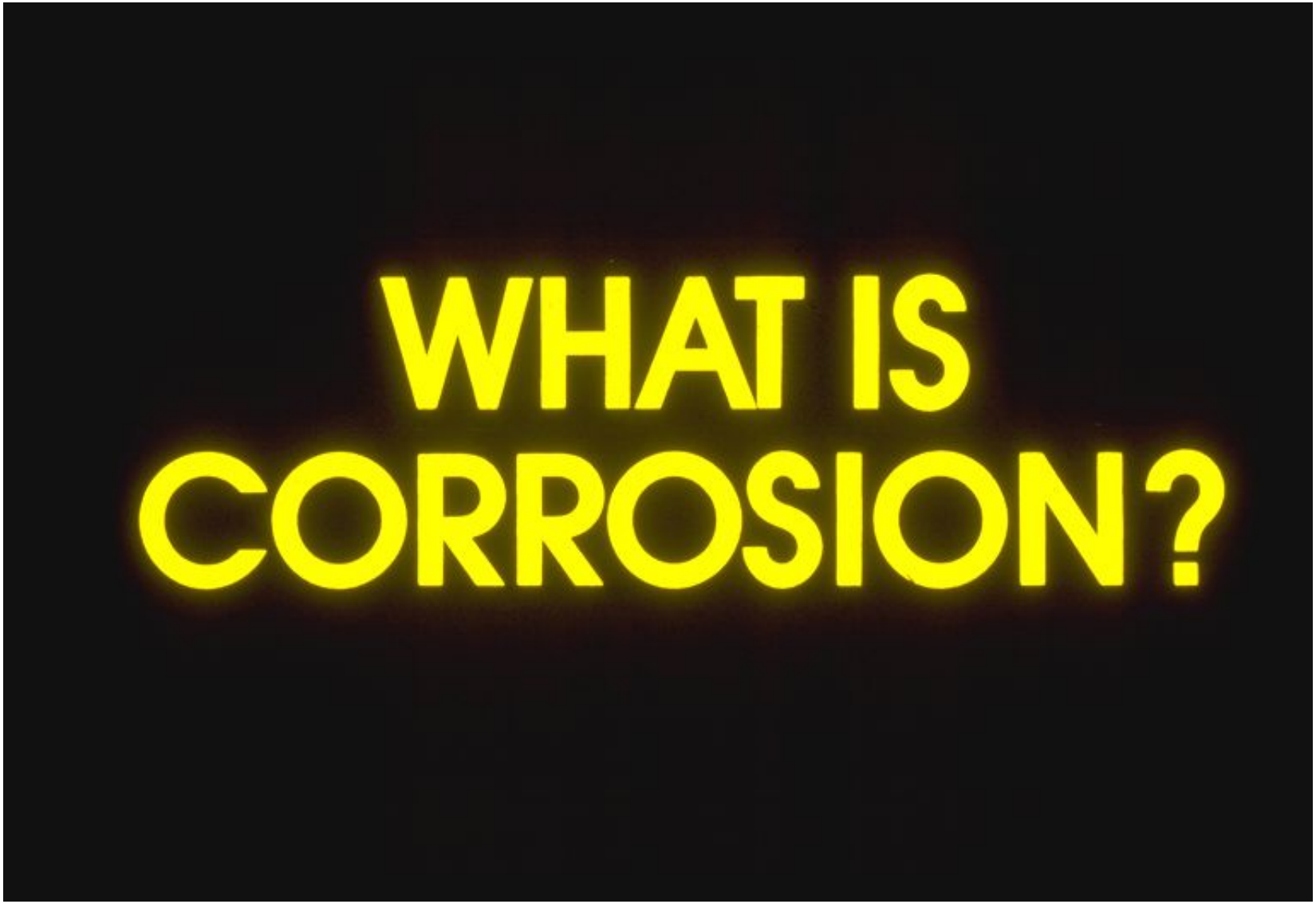
- Quality determines price
- Quality is normally dependent upon surface preparation & application methods
- Quality is assured with competent inspection
- Quality is determined by good procedures and good specifications

Transition Area Coatings

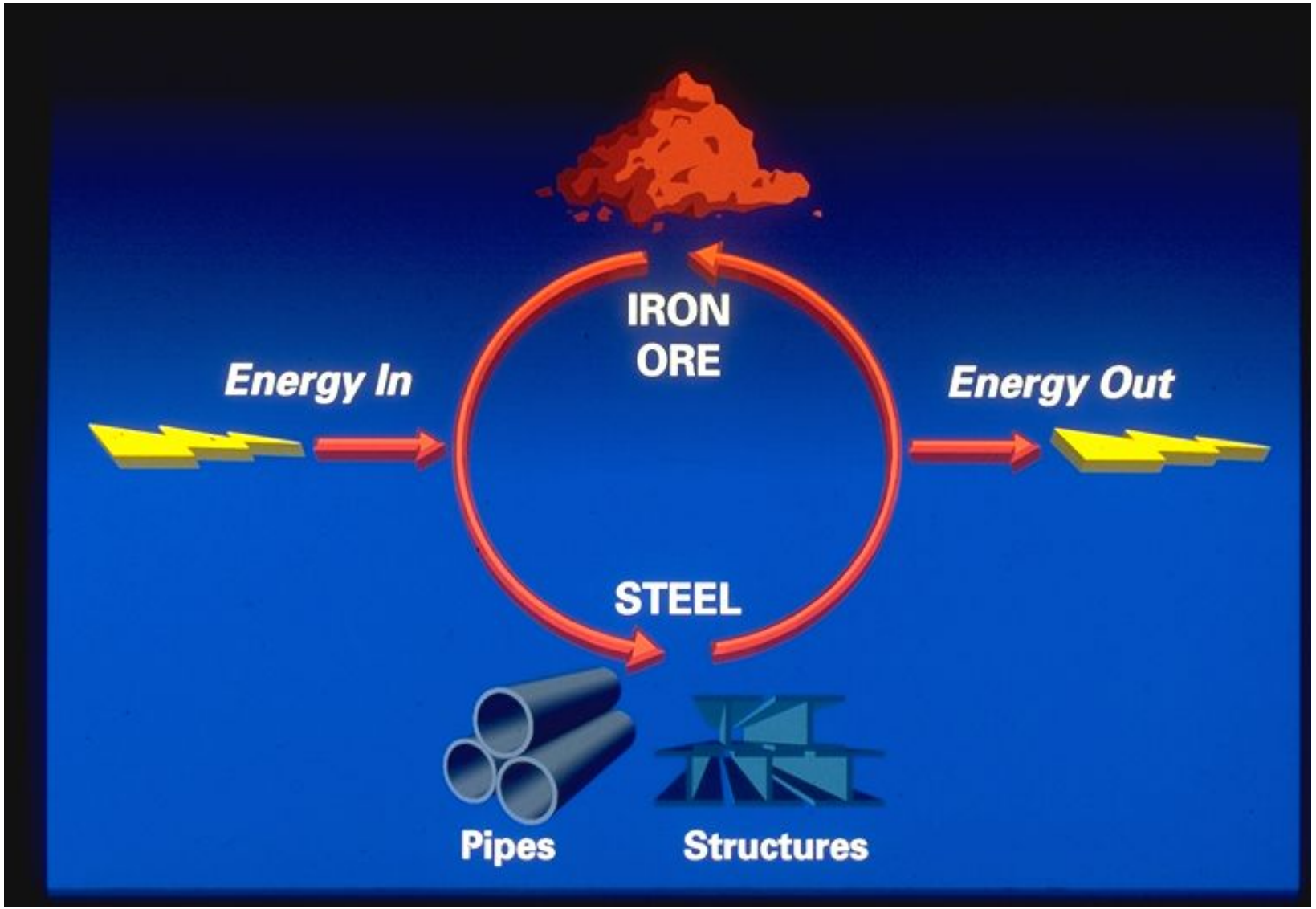
- Used where piping transitions from buried service to atmospheric service
- Used to protect from mechanical damage – freeze/thaw cycle, weed whackers, gravel, etc.
- Used to protect buried service coatings from Ultraviolet light when used above ground

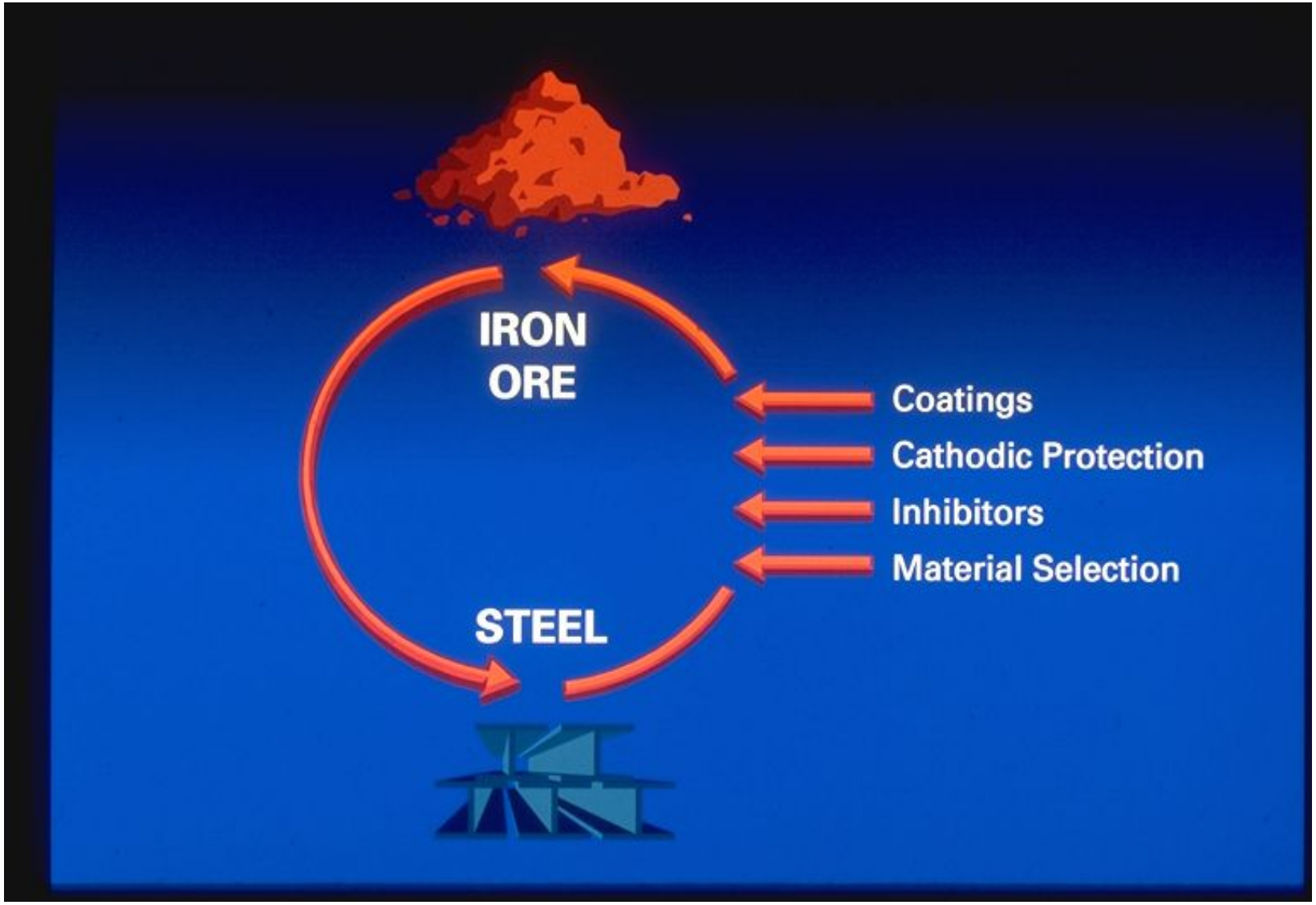
Atmospheric Coatings

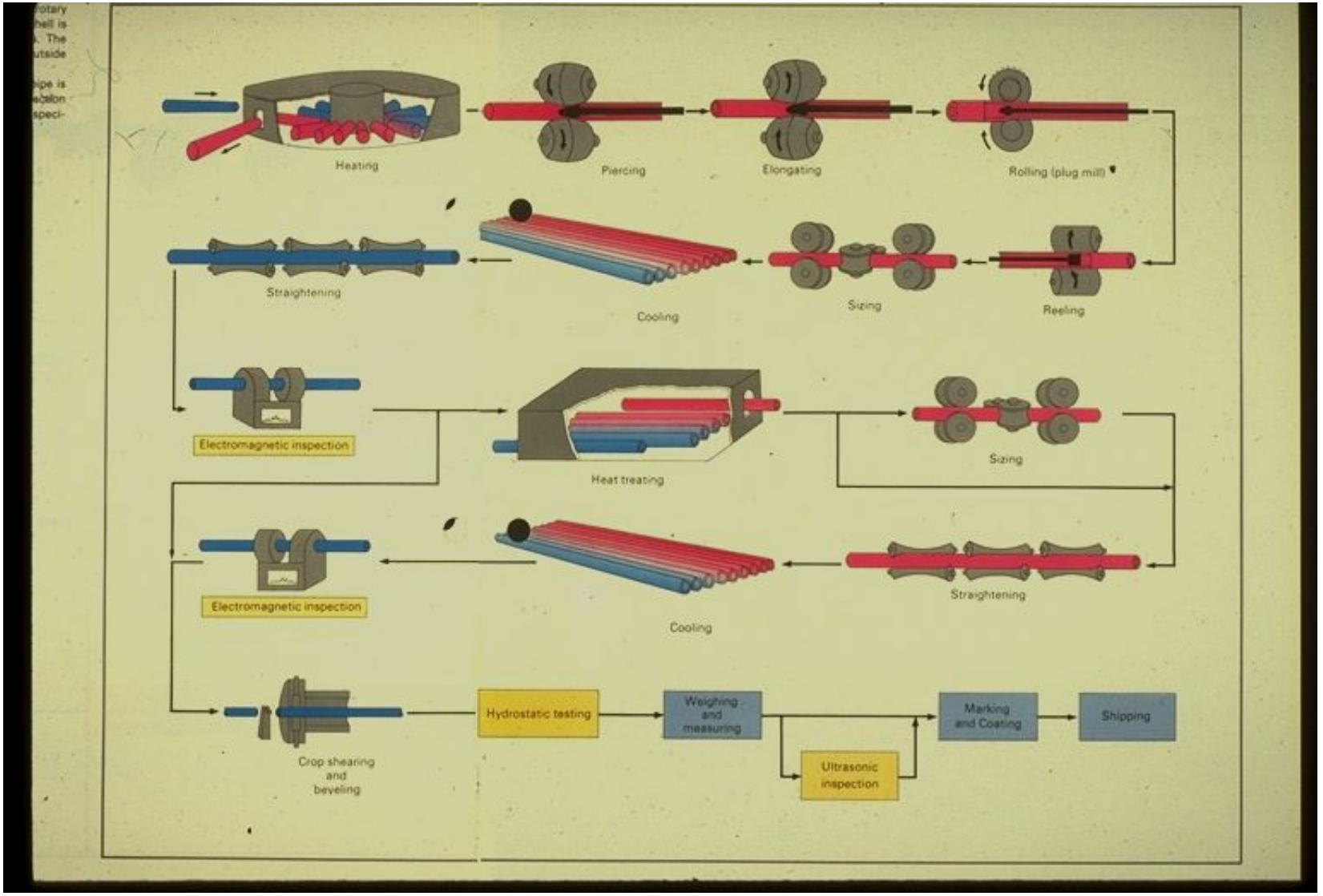
- Various types, quality and expected life
- Primary purpose is corrosion prevention, secondary purpose is appearance
- Problem areas, flanges, nuts, bolts, hold down clamps, high temperature service, beneath insulation, through walls/foundations, etc.

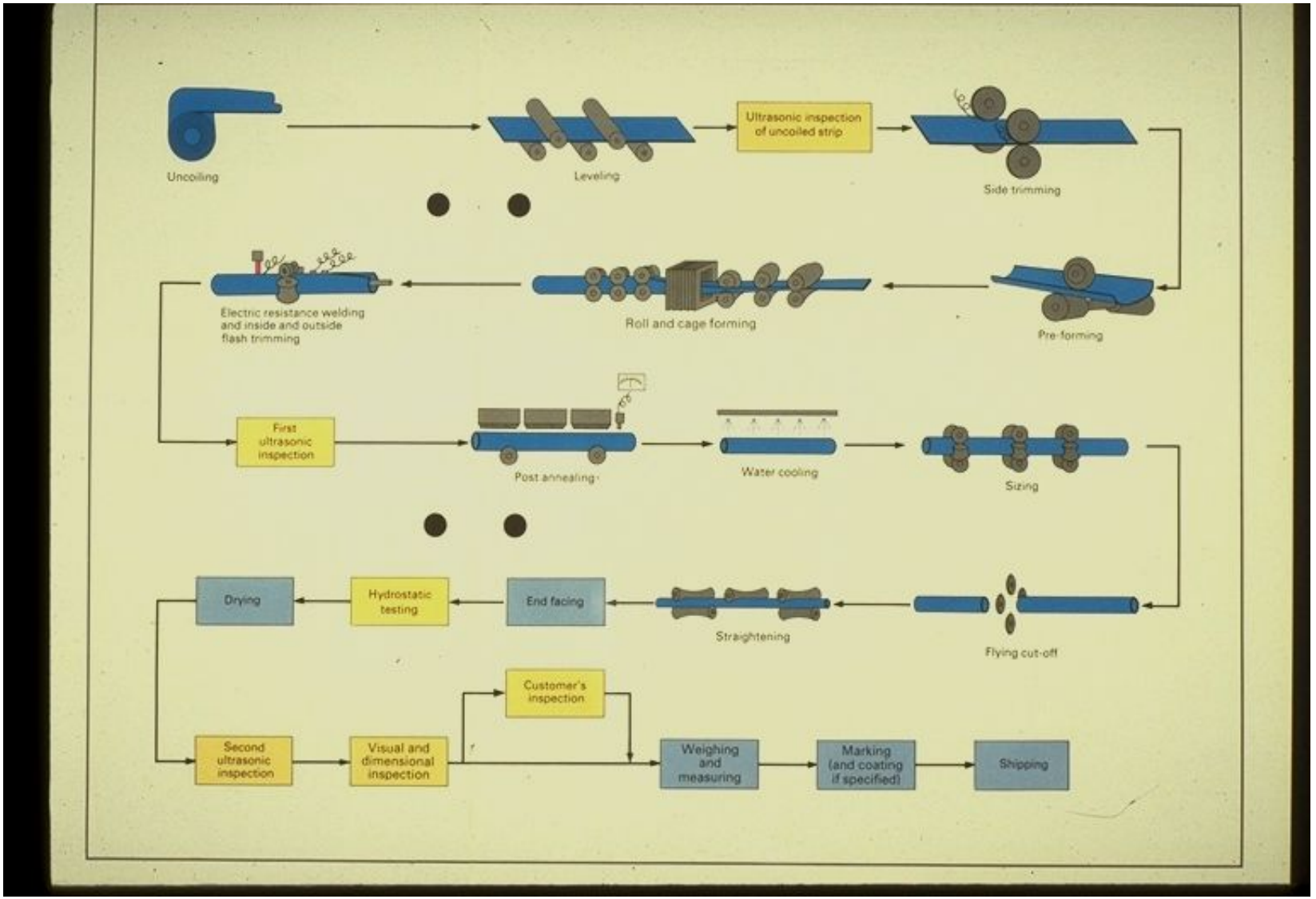

WHAT IS
CORROSION?

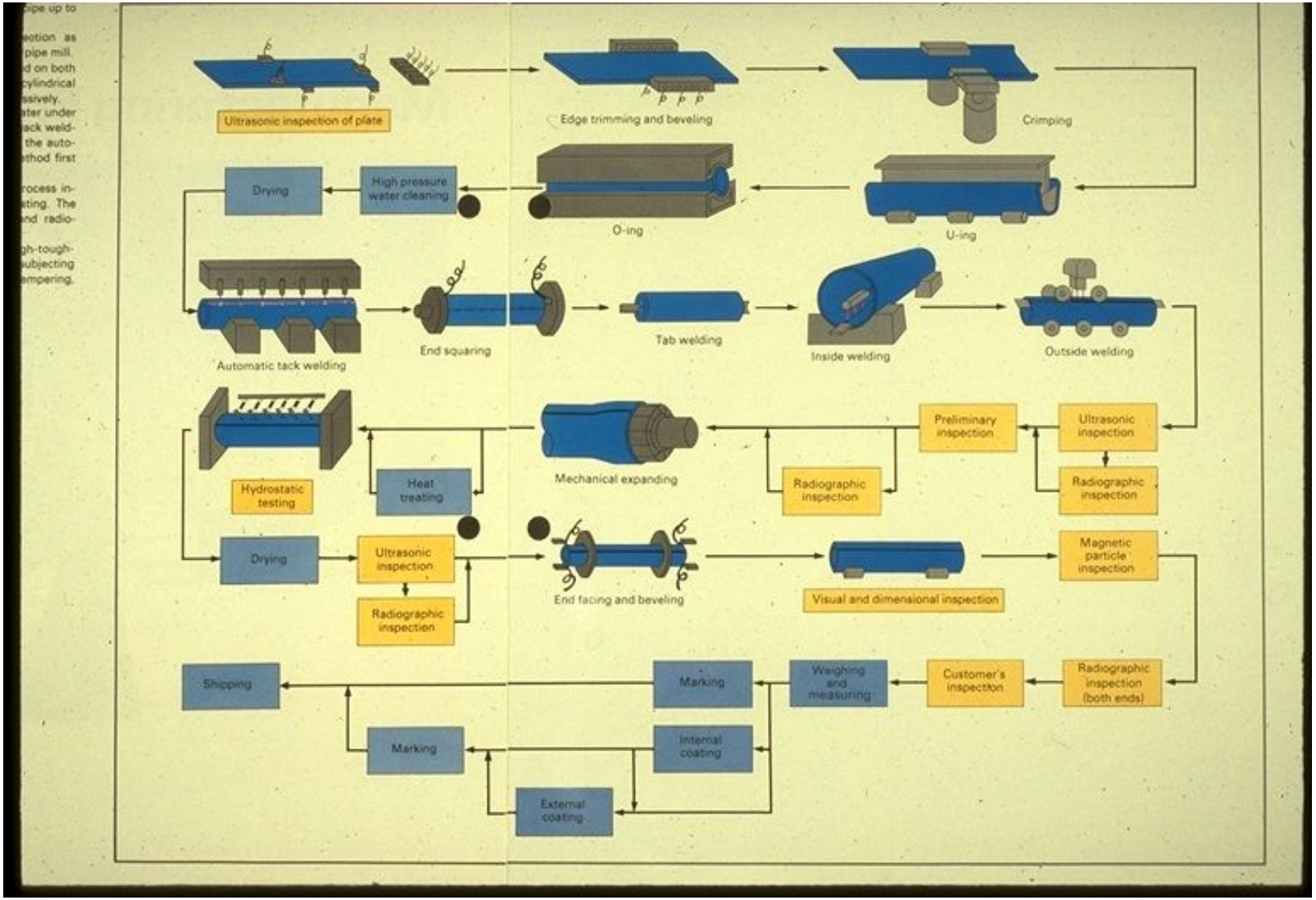

CORROSION IS THE DESTRUCTION
OF A SUBSTANCE, USUALLY A METAL,
OR ITS PROPERTIES BECAUSE OF
A REACTION WITH ITS ENVIRONMENT.

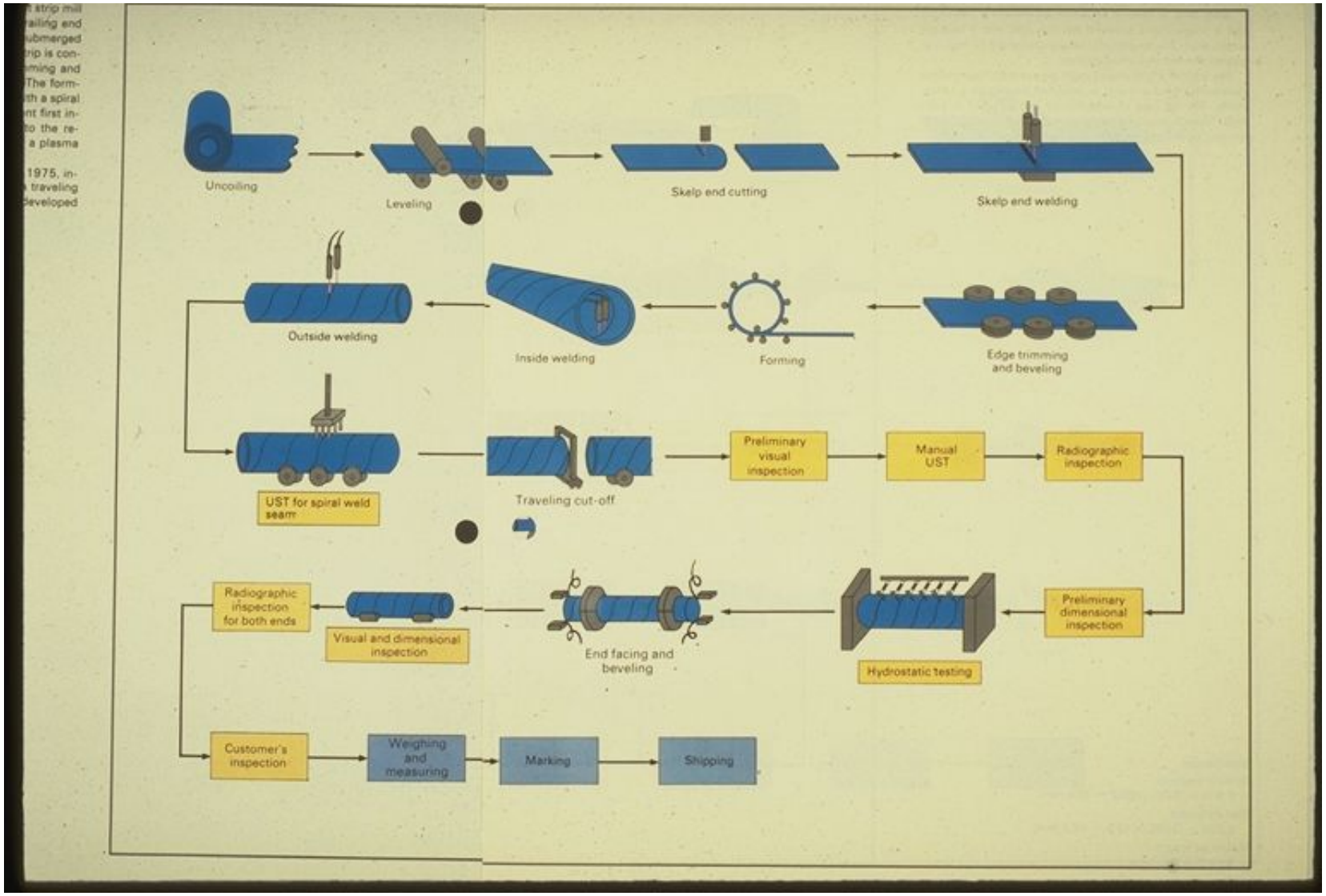

IRON
ORE
Energy In
Energy Out
STEEL
Pipes
Structures


IRON
ORE
STEEL
Coatings
Cathodic Protection
Inhibitors
Material Selection

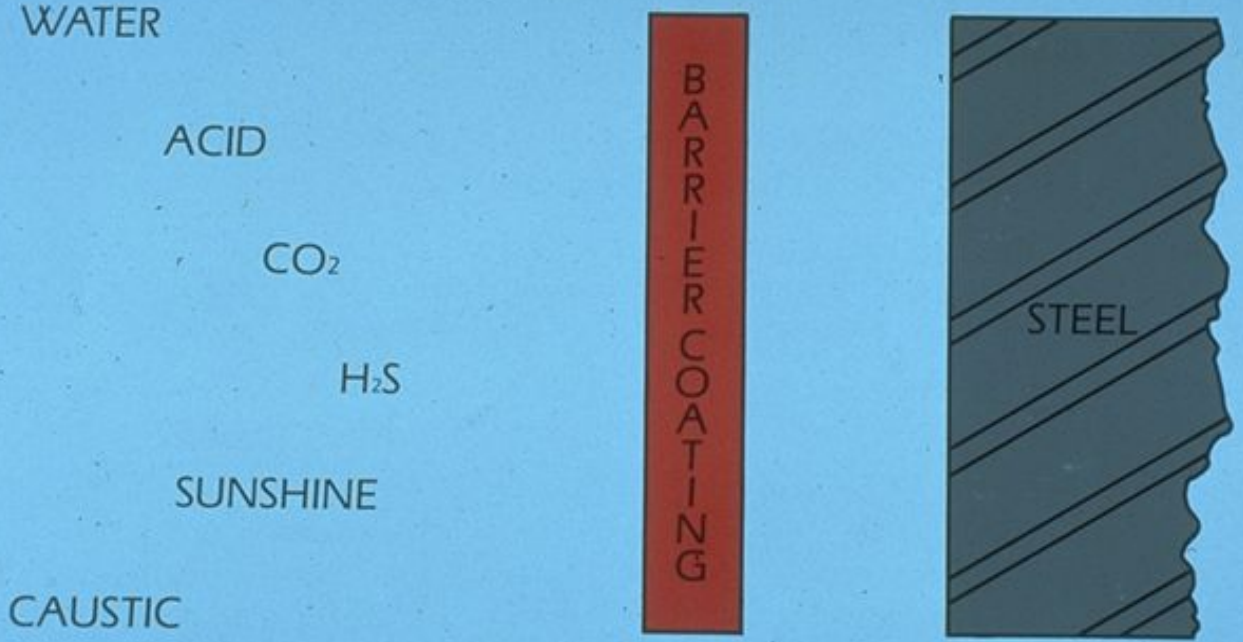

Heating
Piercing
Elongating
Rolling (plug mill)
Straightening
Cooling
Sizing
Reeling
Electromagnetic inspection
Heat treating
Sizing
Electromagnetic inspection
Cooling
Straightening
Crop shearing and beveling
Hydrostatic testing
Weighing and measuring
Ultrasonic inspection
Marking and Coating
Shipping


Uncoiling
Leveling
Ultrasonic inspection of uncoiled strip
Side trimming
Pre-forming
Roll and cage forming
Electric resistance welding and inside and outside flash trimming
First ultrasonic inspection
Post annealing
Water cooling
Sizing
Flying cut-off
Straightening
End facing
Hydrostatic testing
Drying
Customer's inspection
Second ultrasonic inspection
Visual and dimensional inspection
Weighing and measuring
Marking (and coating if specified)
Shipping


Ultrasonic inspection of plate
Edge trimming and beveling
Crimping
Drying
High pressure water cleaning
O-ing
U-ing
Automatic tack welding
End squaring
Tab welding
Inside welding
Outside welding
Hydrostatic testing
Heat treating
Mechanical expanding
Preliminary inspection
Ultrasonic inspection
Radiographic inspection
Radiographic inspection
Drying
Ultrasonic inspection
Radiographic inspection
End facing and beveling
Visual and dimensional inspection
Magnetic particle inspection
Shipping
Marking
Weighing and measuring
Customer's inspection
Radiographic inspection (both ends)
Marking
Internal coating
External coating


Uncoiling
Leveling
Skelp end cutting
Skelp end welding
Edge trimming and beveling
Forming
Inside welding
Outside welding
UST for spiral weld seam
Traveling cut-off
Preliminary visual inspection
Manual UST
Radiographic inspection
Preliminary dimensional inspection
Hydrostatic testing
End facing and beveling
Visual and dimensional inspection
Radiographic inspection for both ends
Customer's inspection
Weighing and measuring
Marking
Shipping

COATING DEFINITION



A coating is a barrier to protect steel from the environment.

Perfect Coating

- Ease of Application - It can be applied with a mop on any surface or from above ground.
- Cost Effective - Cost $1.00/Gallon or less!
- Environmentally Safe and Friendly – OK to Drink it.
- Performance - Lasts forever.

Appalachian Underground Corrosion Short Course

In Reality a Perfect Coating

- Requires a quality standard
- Requires a quality specification
- Requires a quality coating Mill/Plant
- Requires a quality material or materials
- Requires a quality inspector or inspectors

General Requirements of a Pipeline Coating

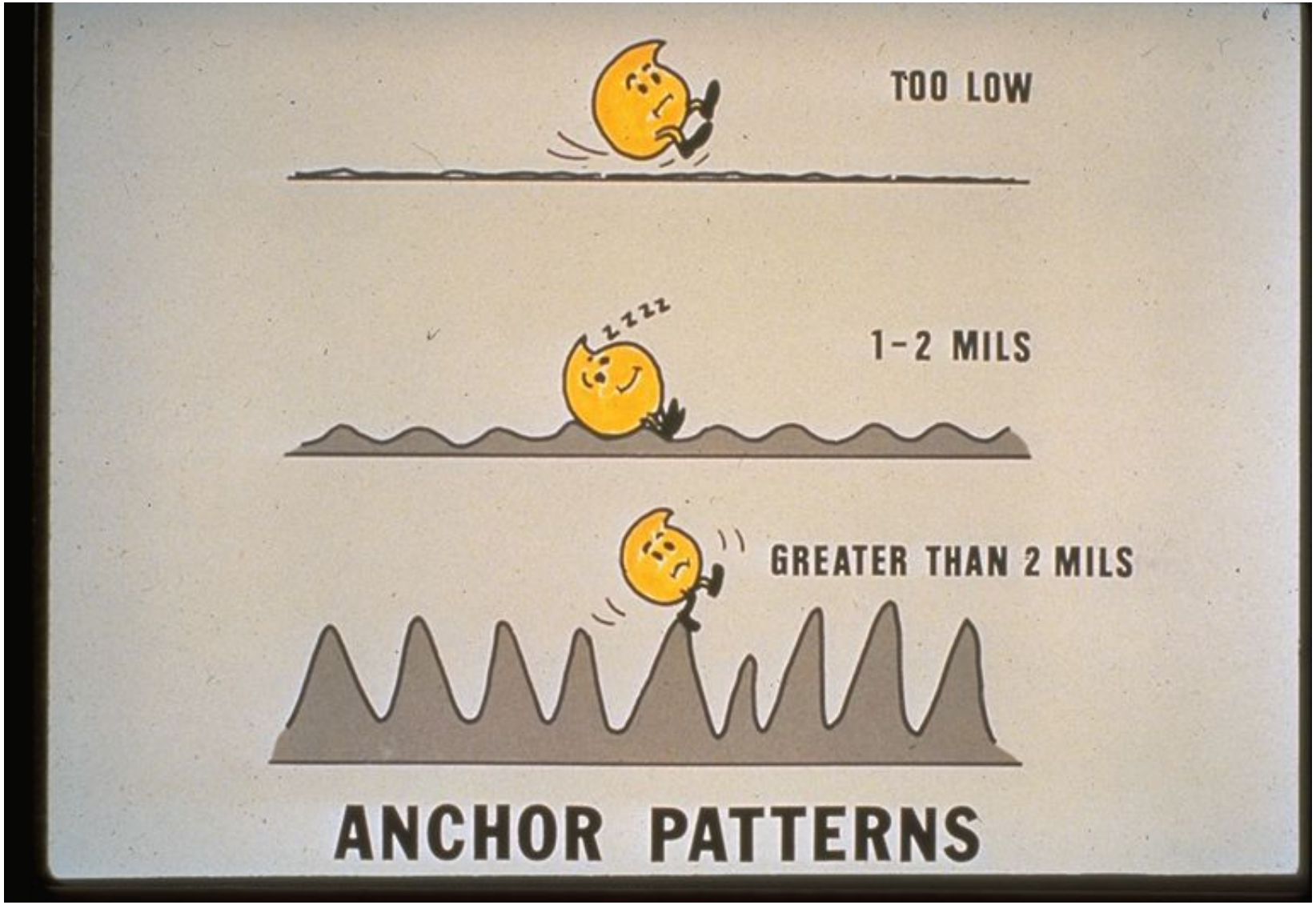
- Ease of Application
- Good Adhesion to Pipe
- Good Resistance to Impact
- Flexibility
- Resistance to Flow
- Water Resistance
- Electrical Resistance
- Chemical and Physical Stability
- Resistance to Soil Bacteria
- Resistance to Marine Organisms
- Resistance to Cathodic Disbondment
- Resistance to Soil Stress


SURFACE
PREPARATION

SURFACE PREPARATION

PURPOSE OF SURFACE PREPARATION

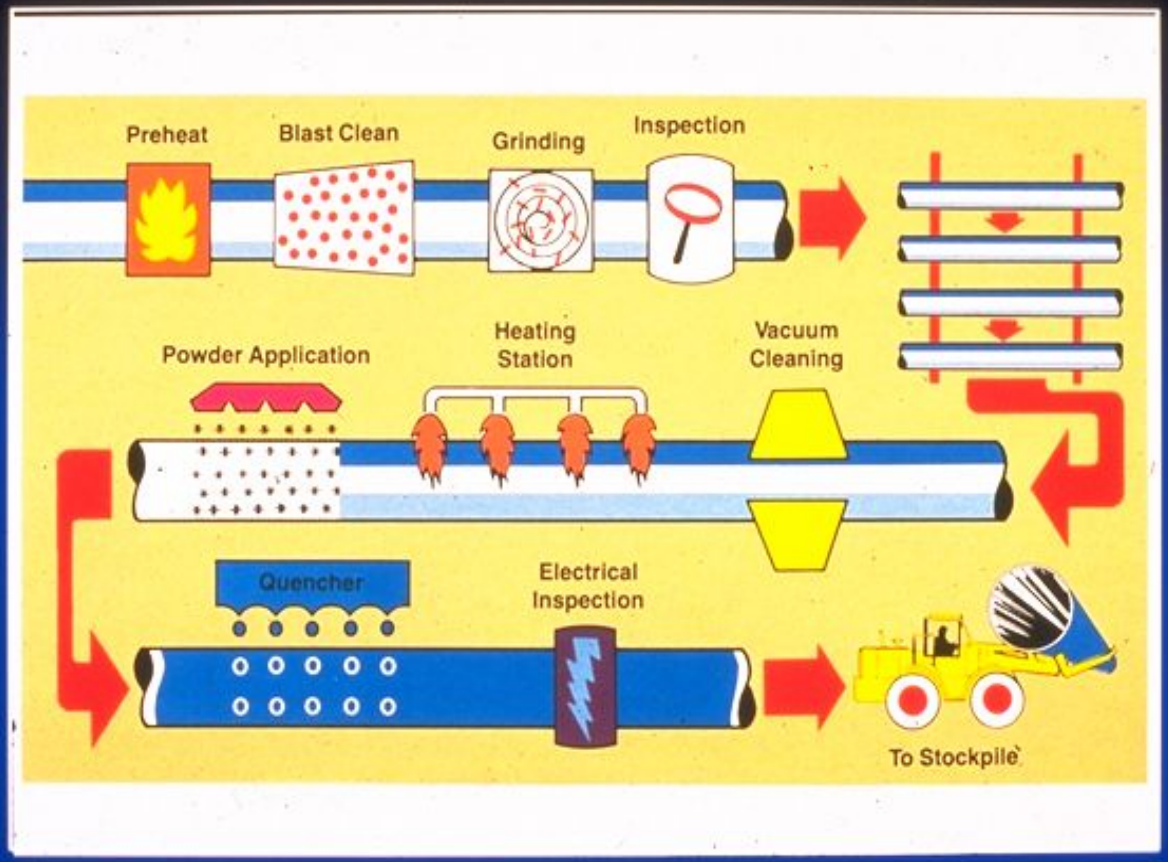
- To clean surface of materials which could cause the coating system to fail prematurely.
- To provide a surface that can be easily wetted for good coating adhesion.
- To provide an anchor profile.
- Paints adhere to the surface by mechanical bond.

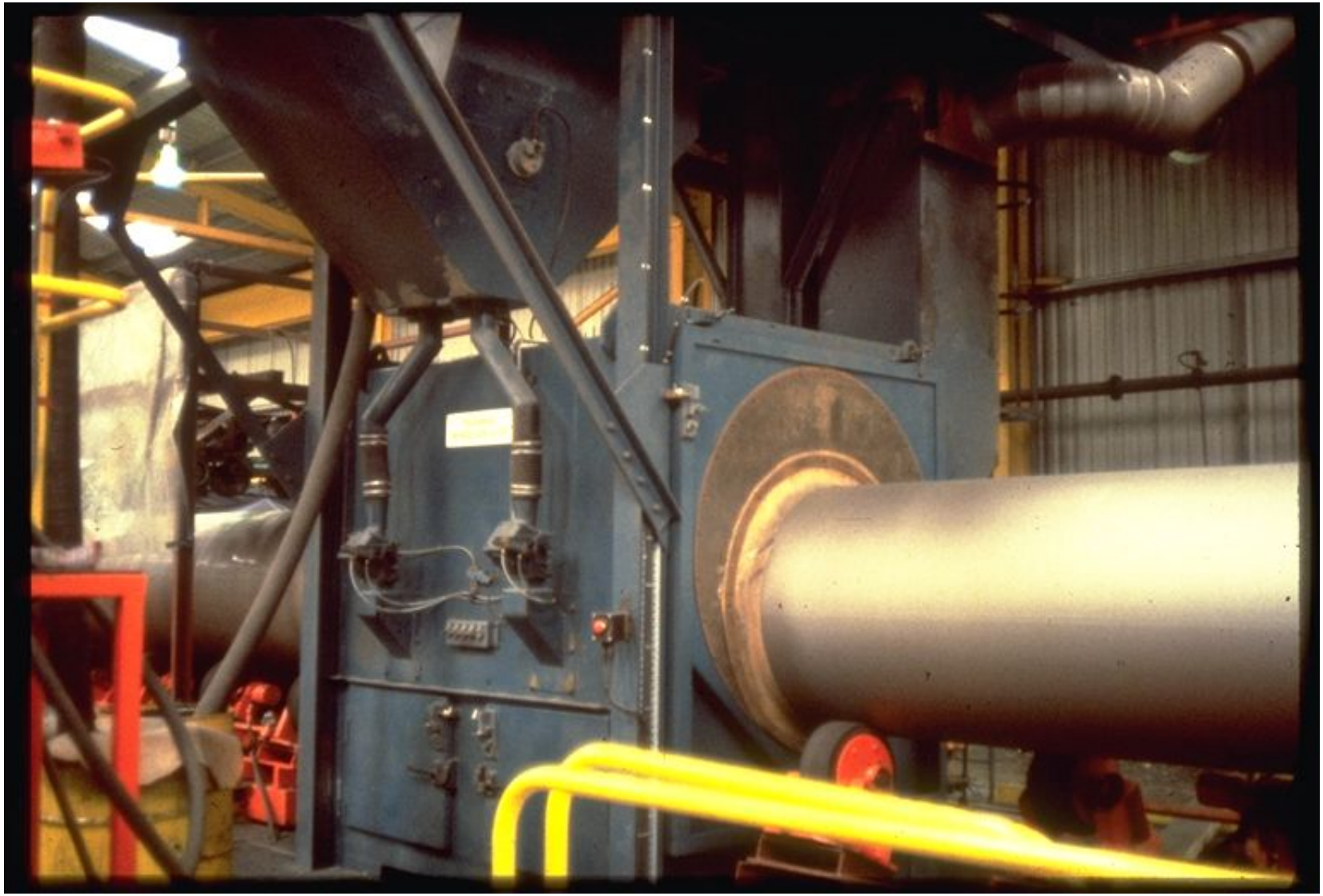

TOO LOW
ZZZZ
1-2 MILS
GREATER THAN 2 MILS
ANCHOR PATTERNS

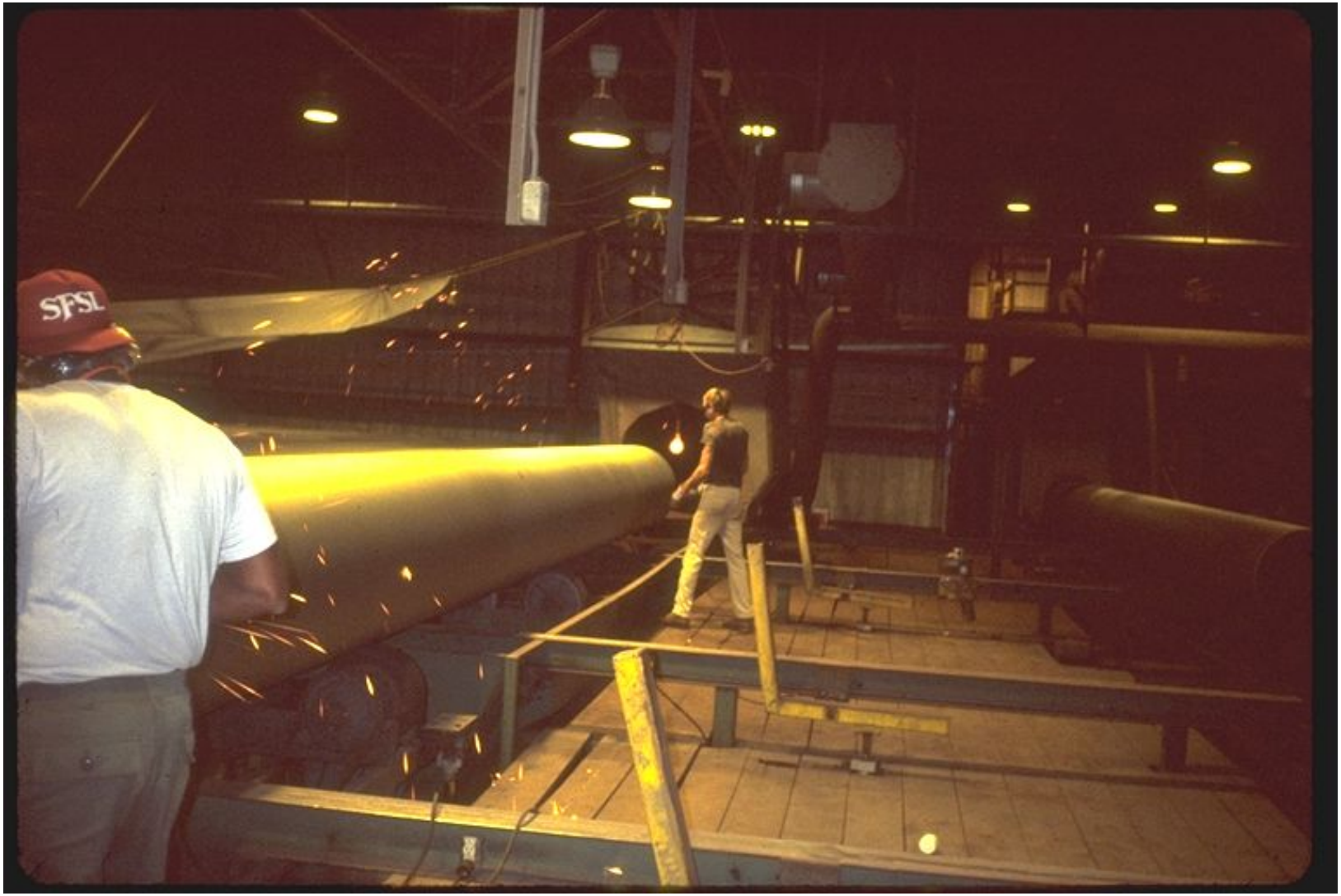

FUSION BONDED
COATINGS

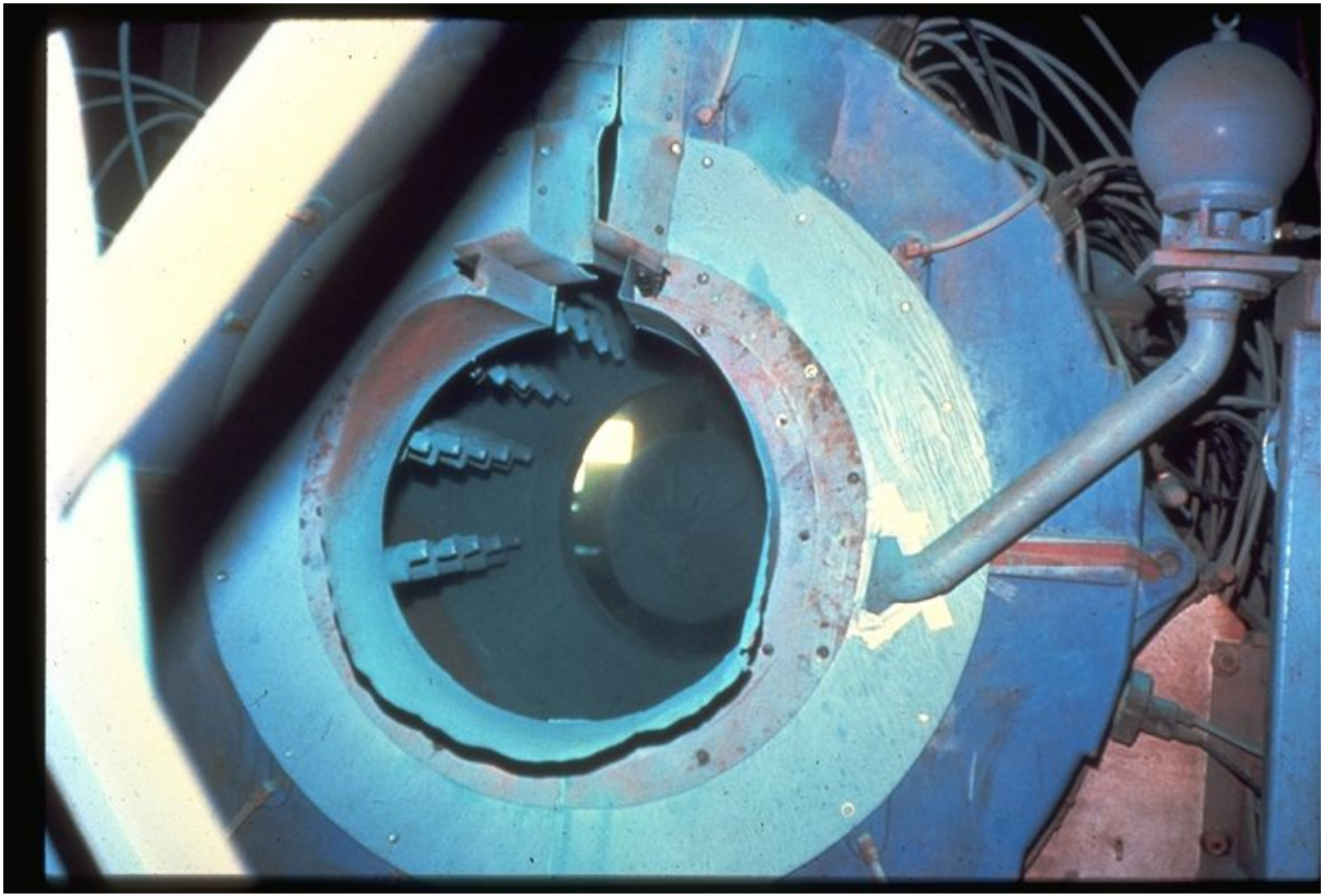

APPLICATION
PROCEDURE
1. CLEAN
2. HEAT
3. APPLY
4. CURE
5. INSPECT
6. REPAIR

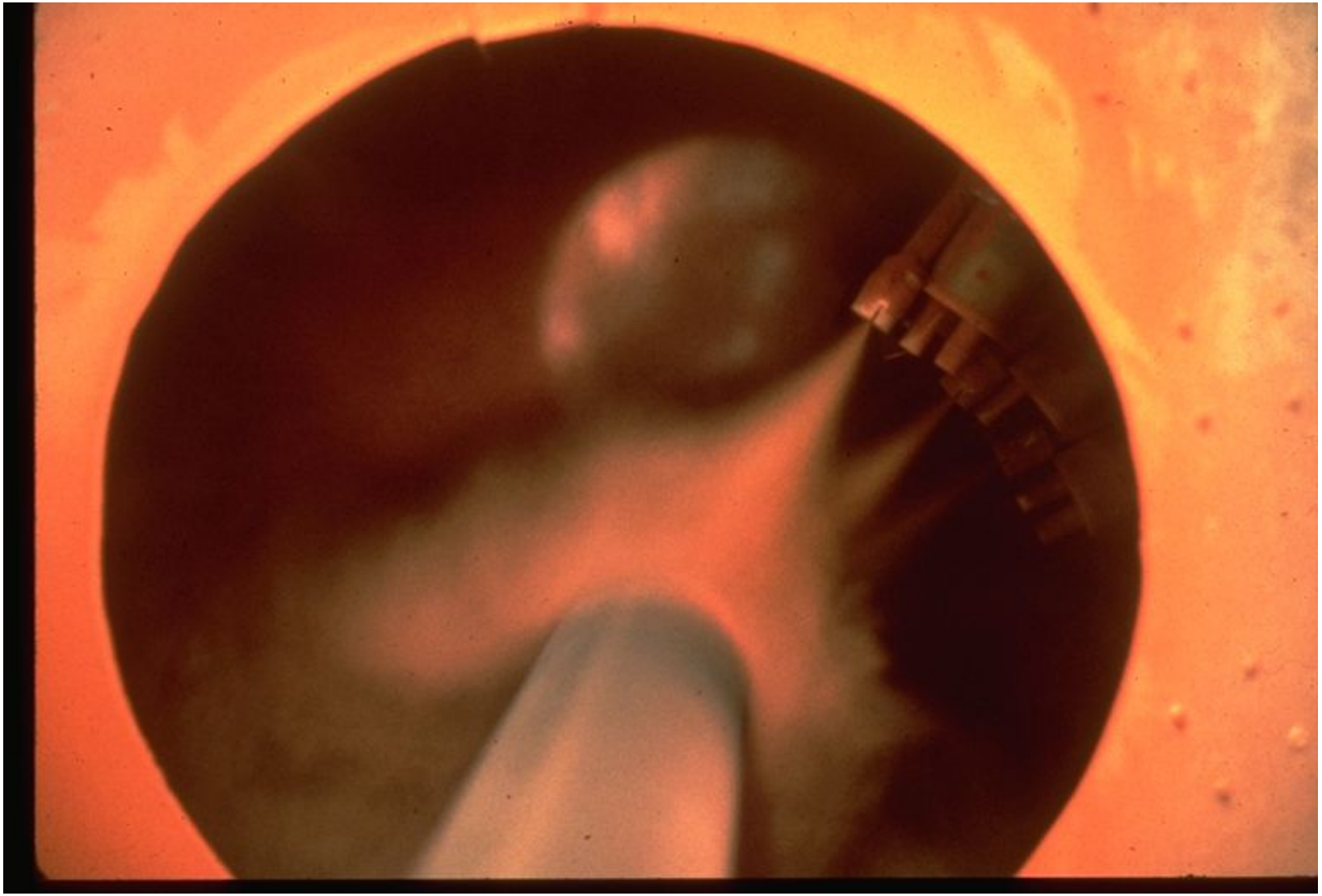
Fusion Bonded Epoxy

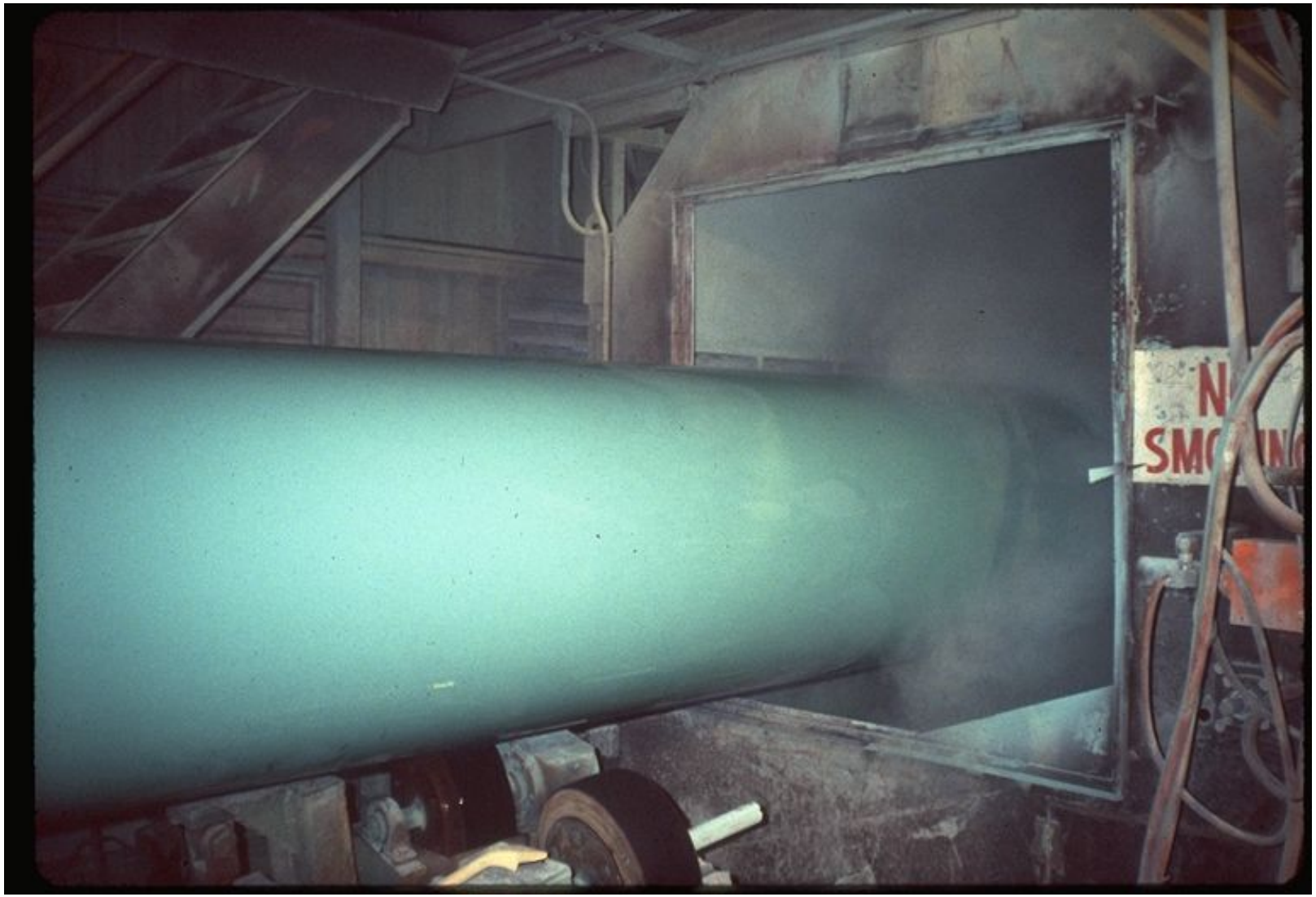


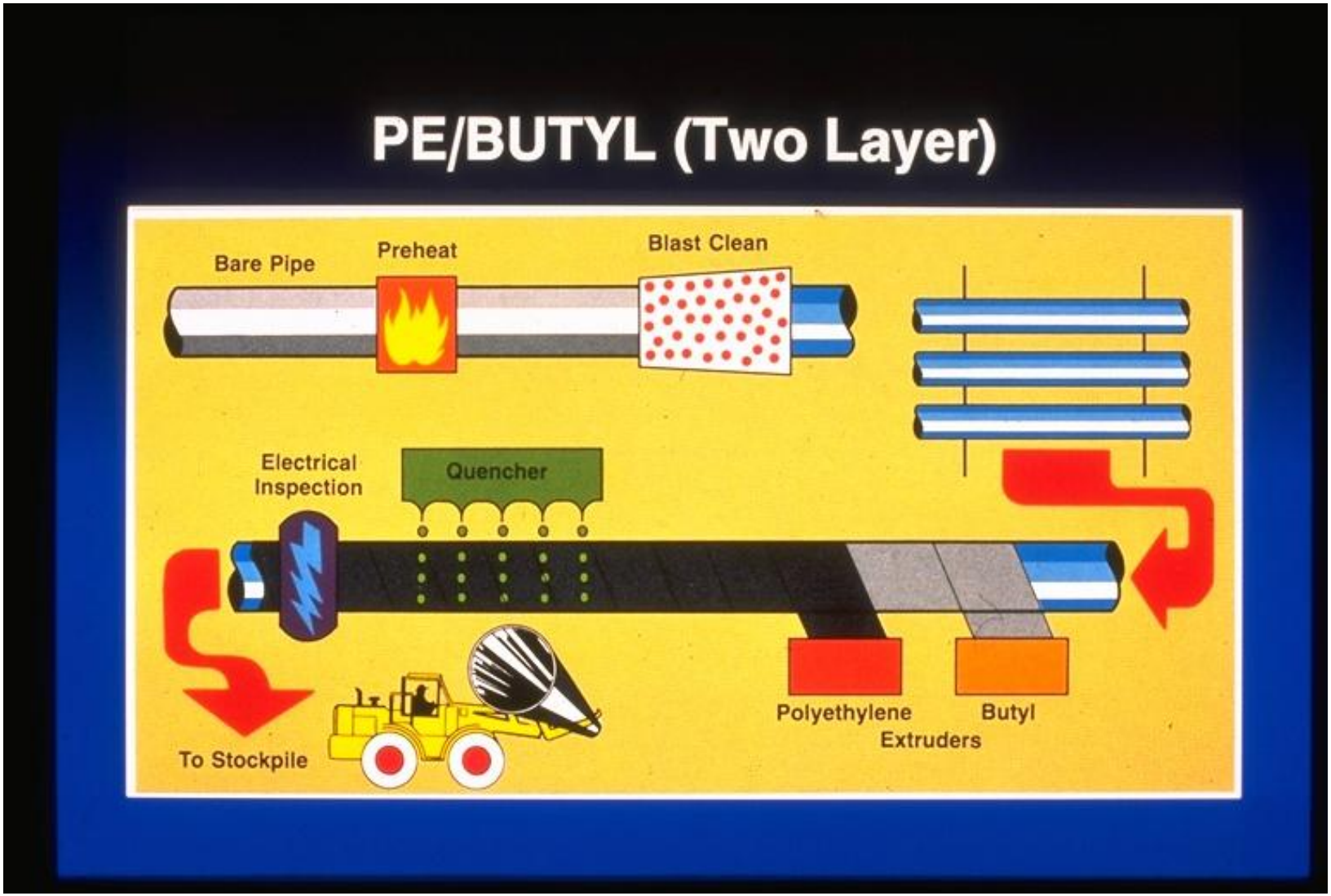


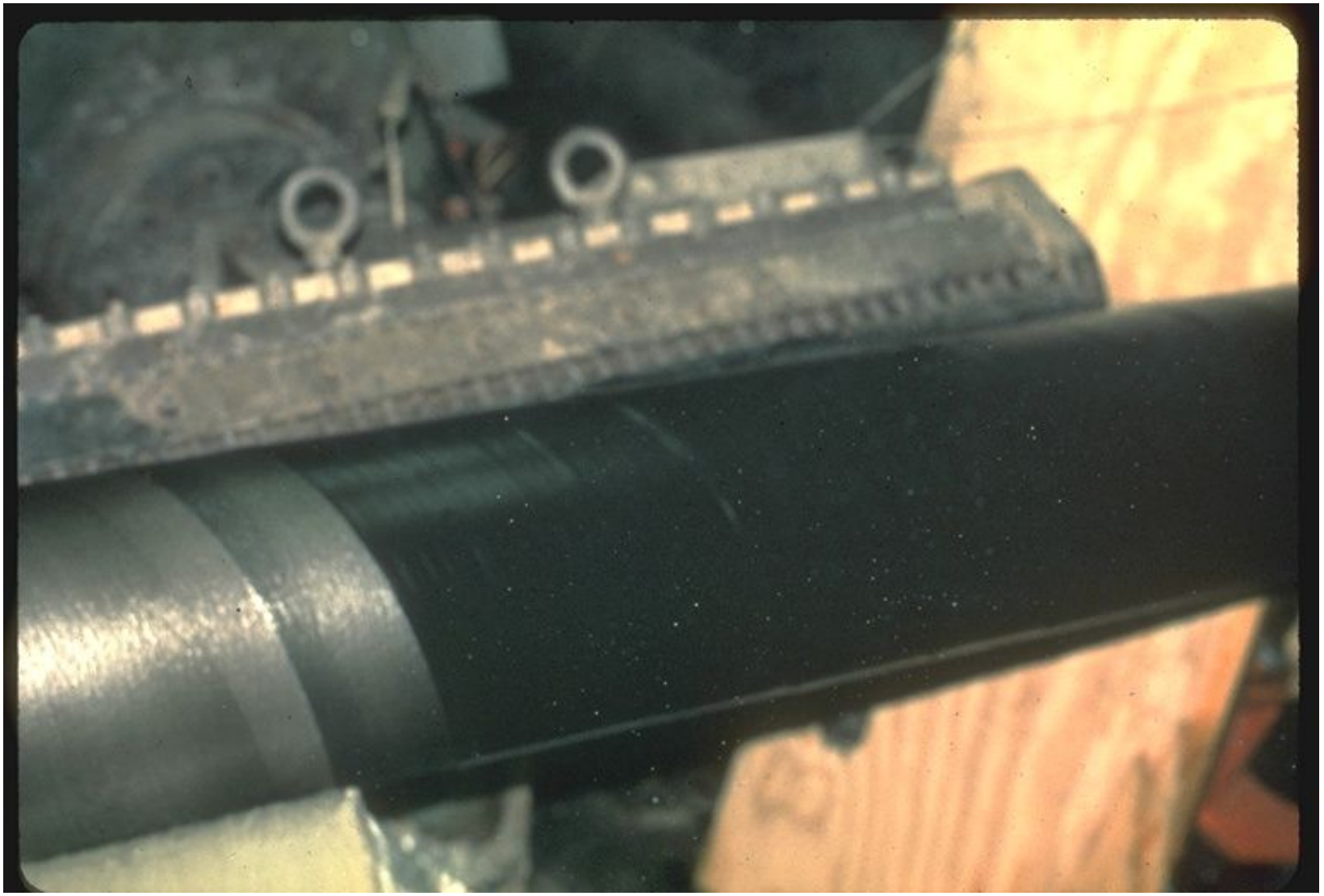

SFSL

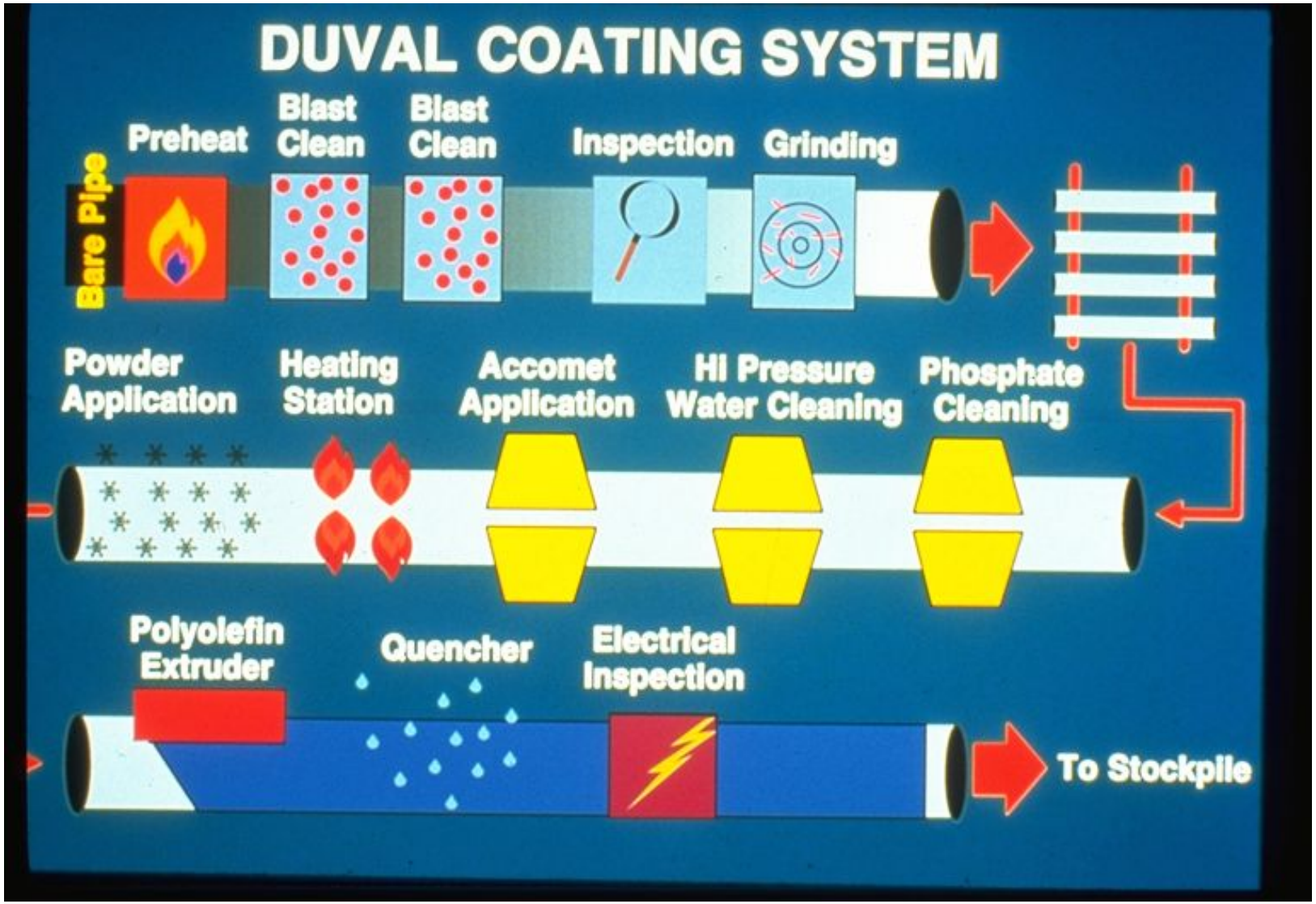


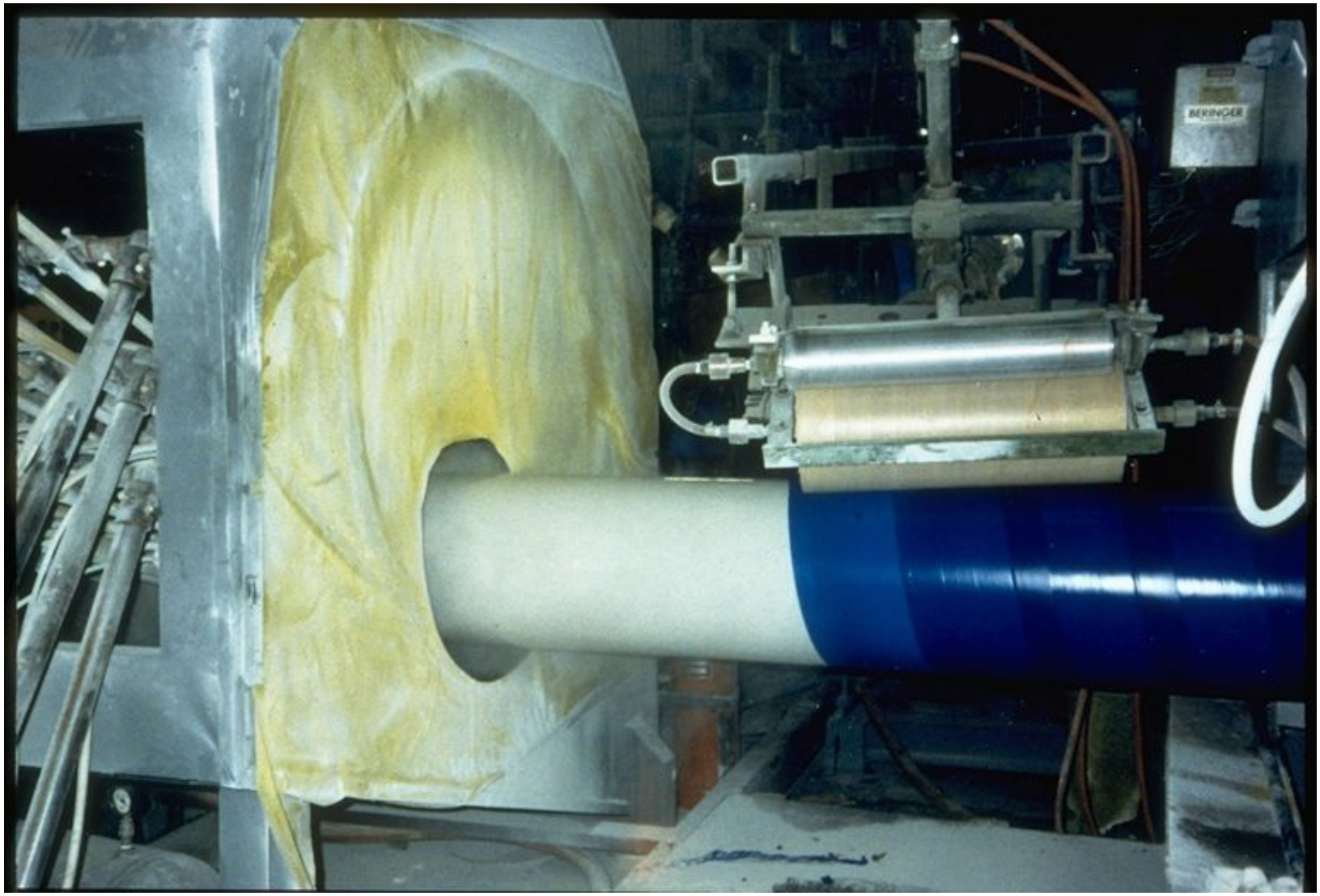




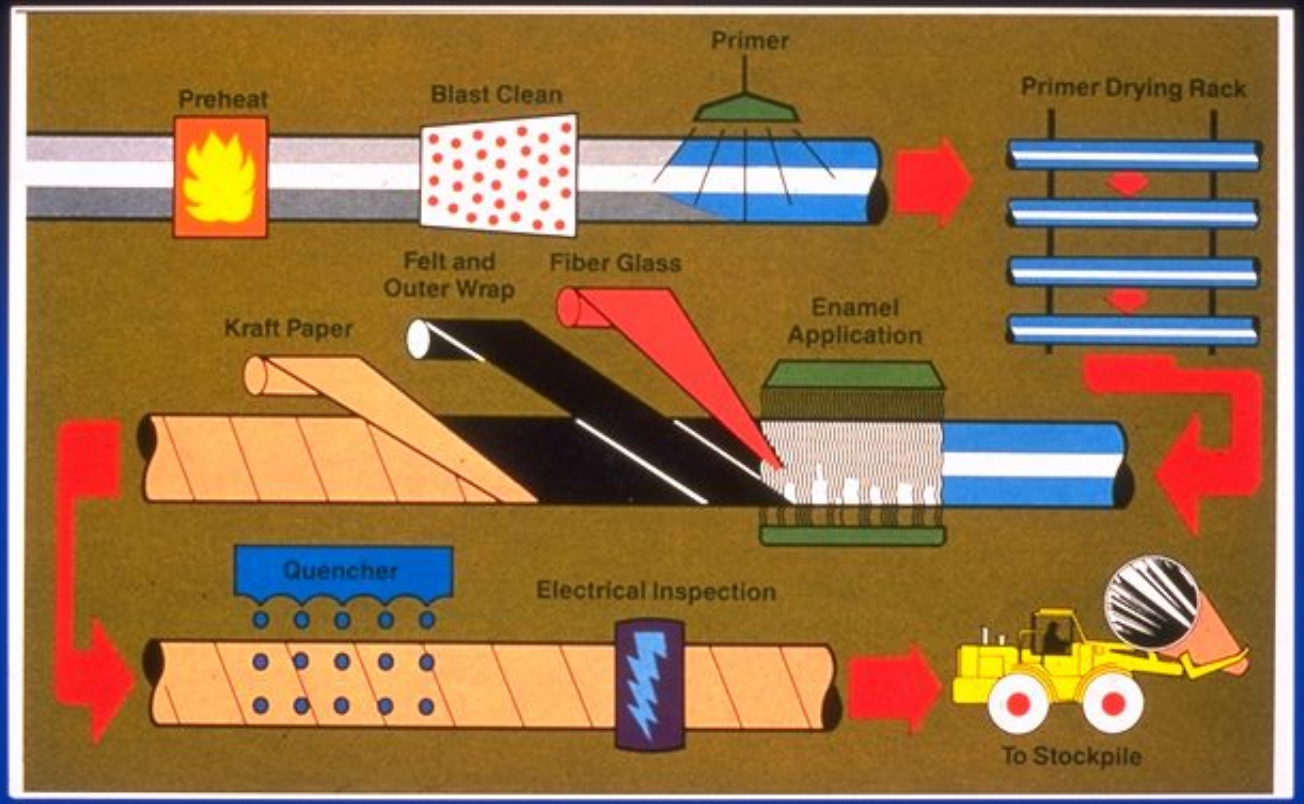

PE/BUTYL (Two Layer)
Bare Pipe
Preheat
Blast Clean
Electrical Inspection
Quencher
To Stockpile
Polyethylene Extruders
Butyl

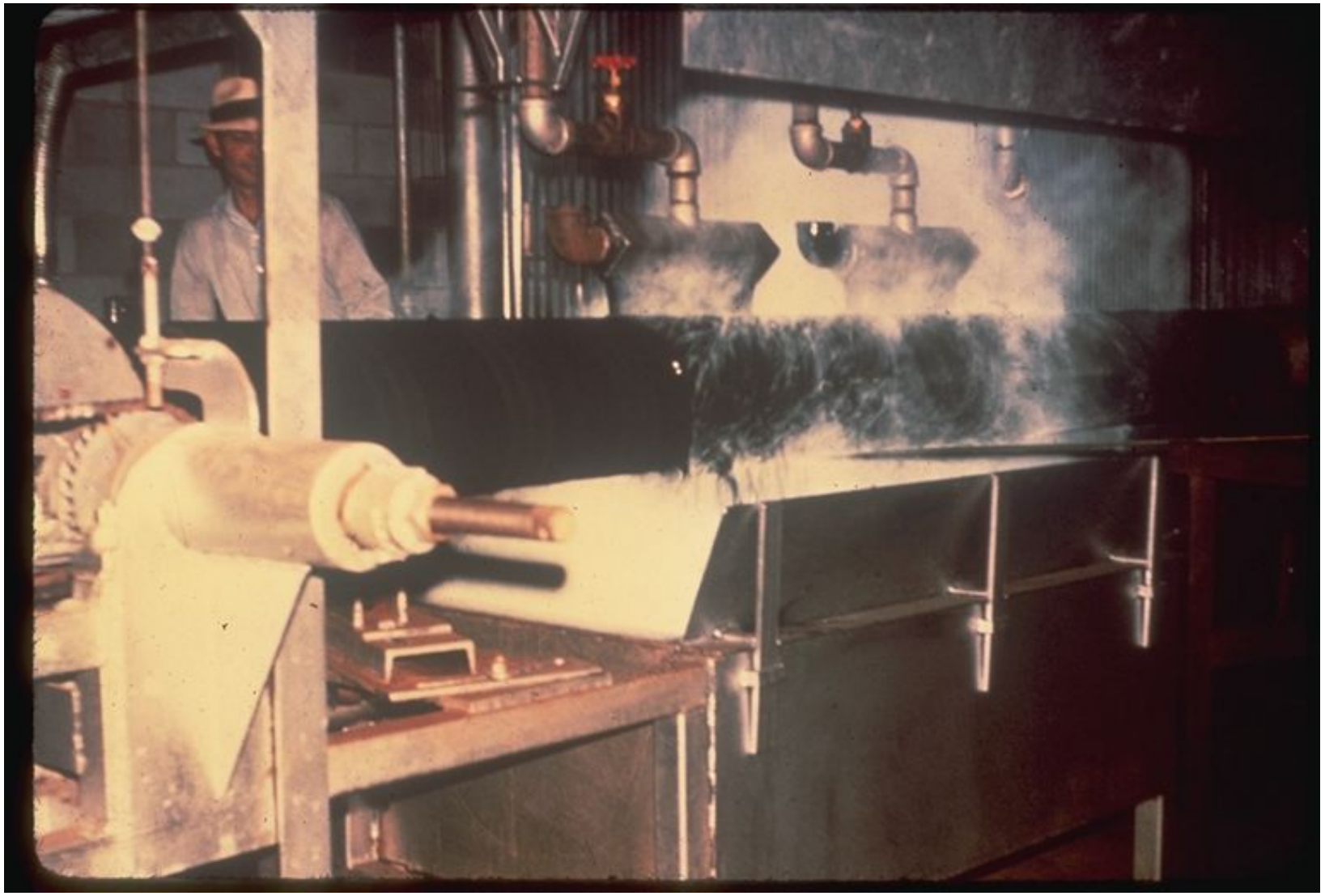


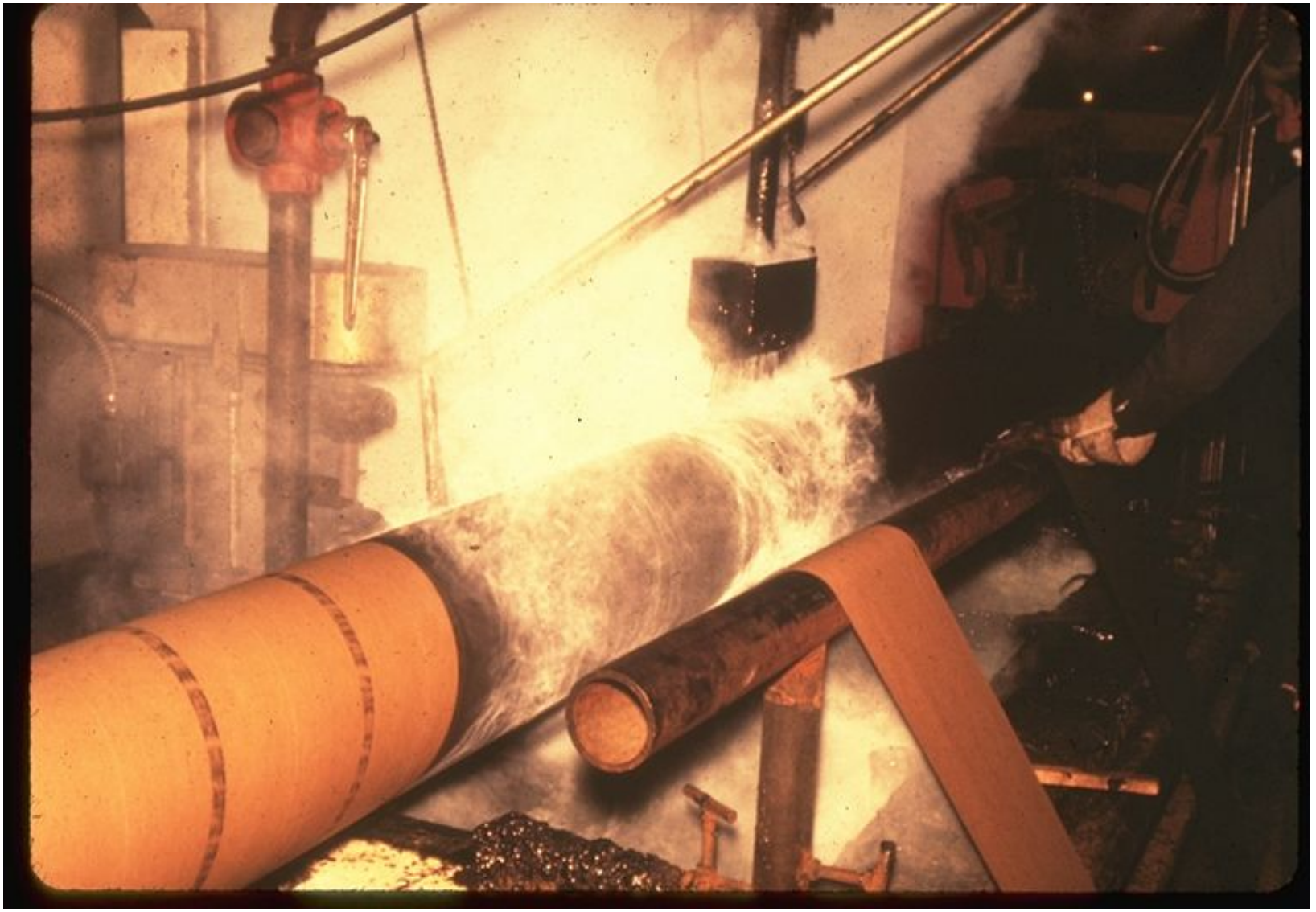

DUVAL COATING SYSTEM
Bare Pipe
Preheat
Blast Clean
Blast Clean
Inspection
Grinding
Powder Application
Heating Station
Accomet Application
HI Pressure Water Cleaning
Phosphate Cleaning
Polyolefin Extruder
Quencher
Electrical Inspection
To Stockpile


BERINGER

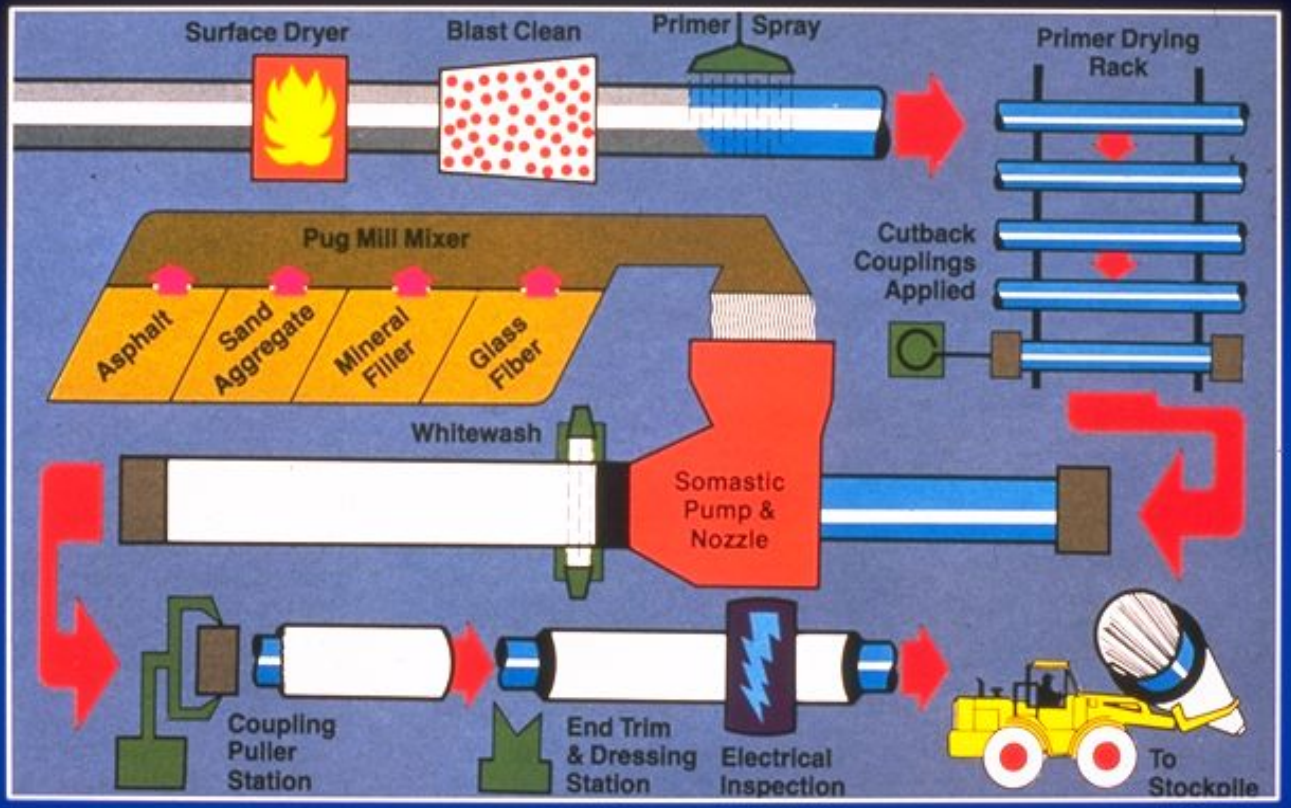
Coal Tar Enamels

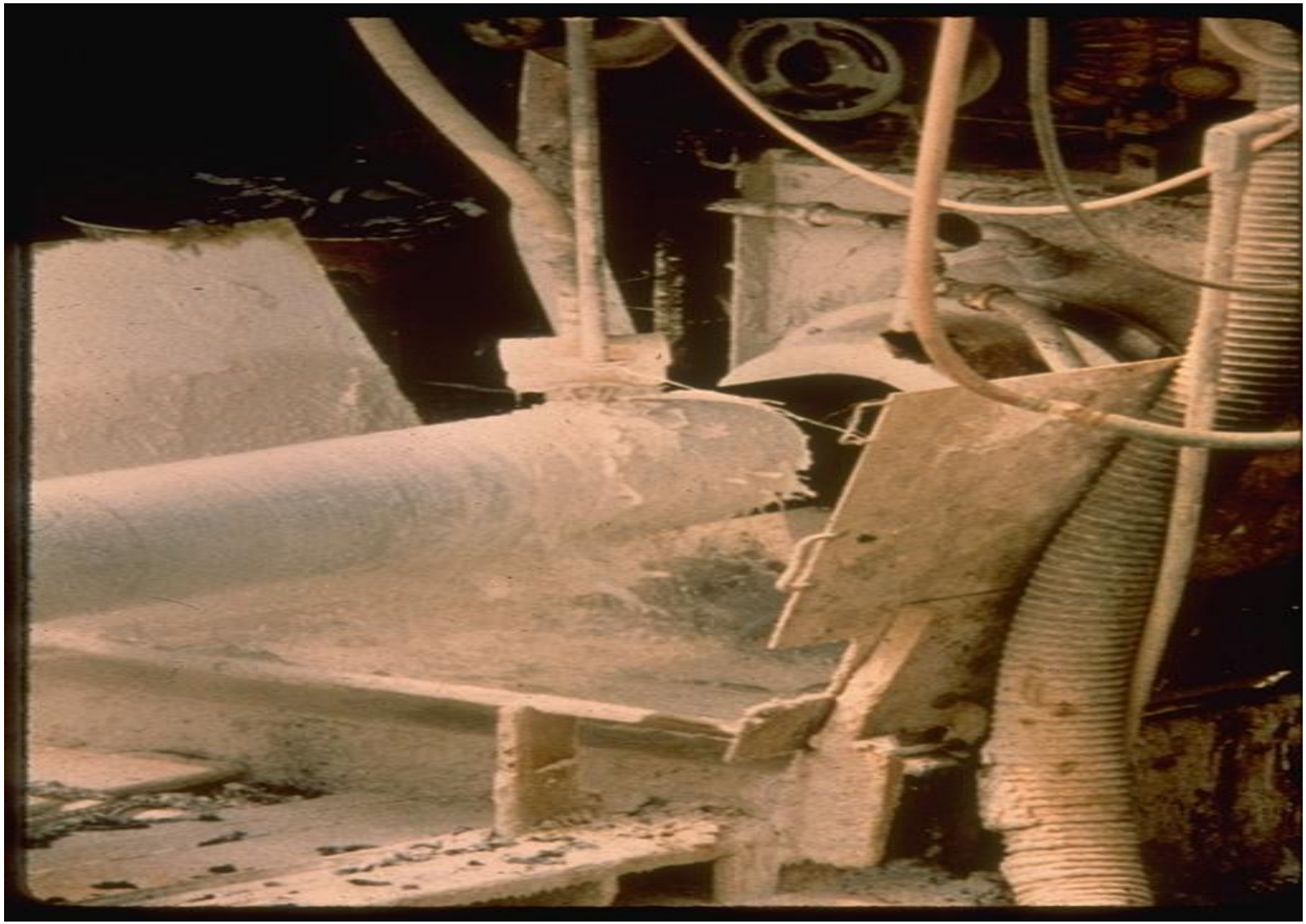






Asphalt Mastic





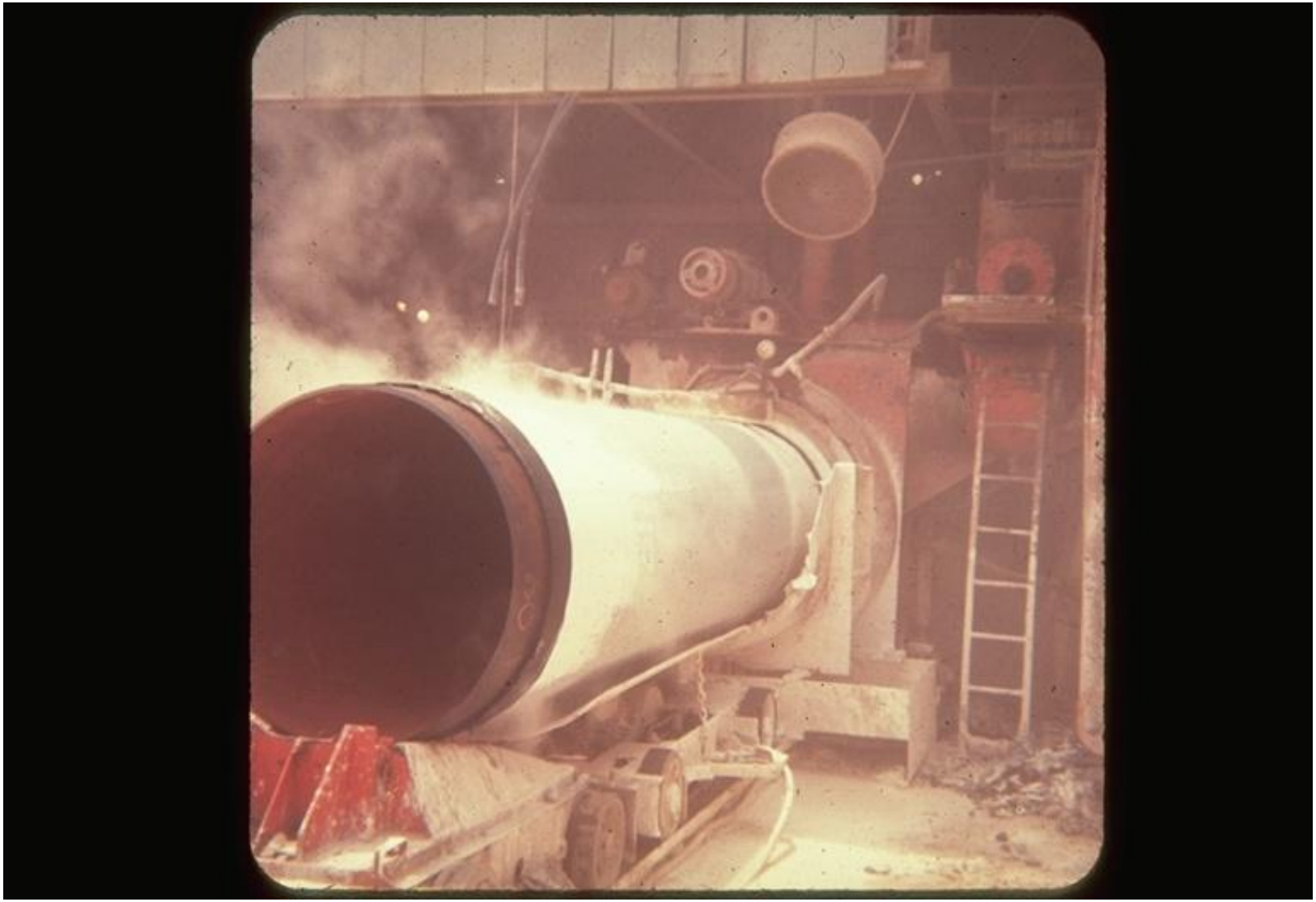
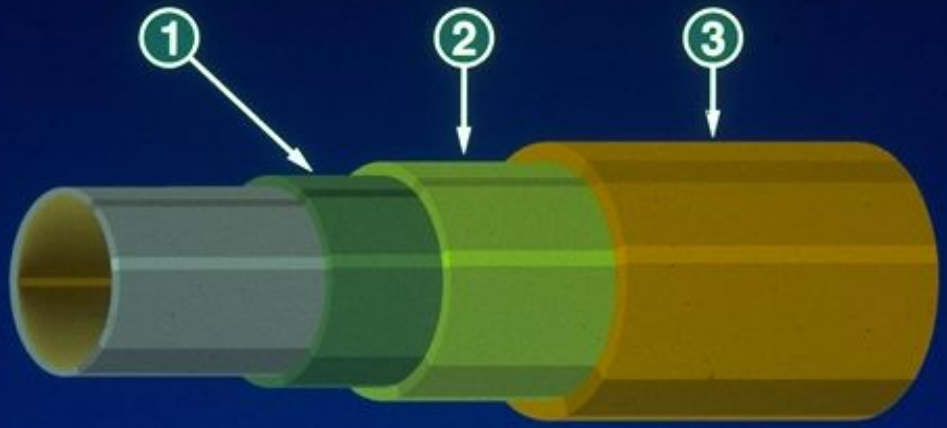
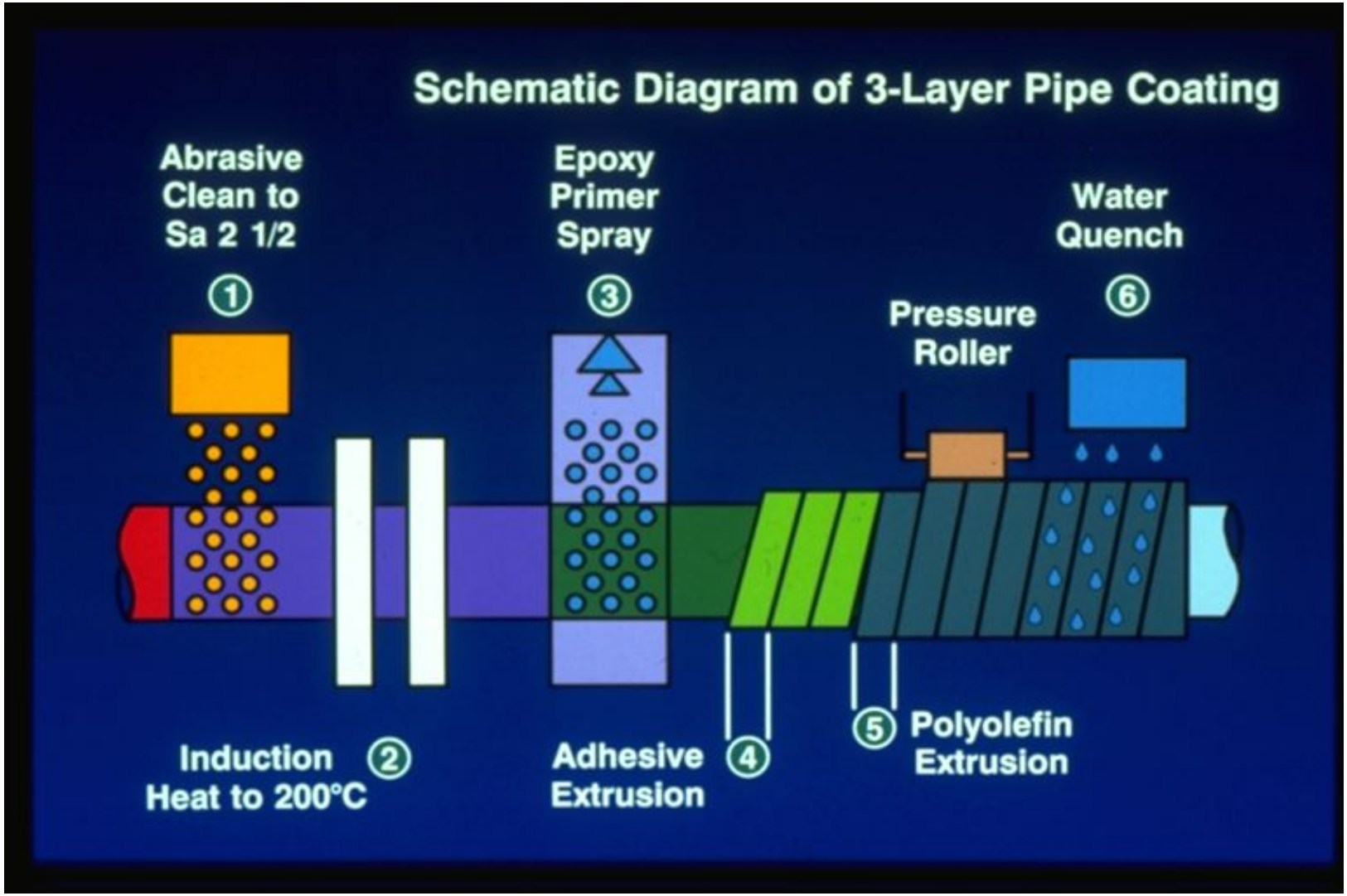
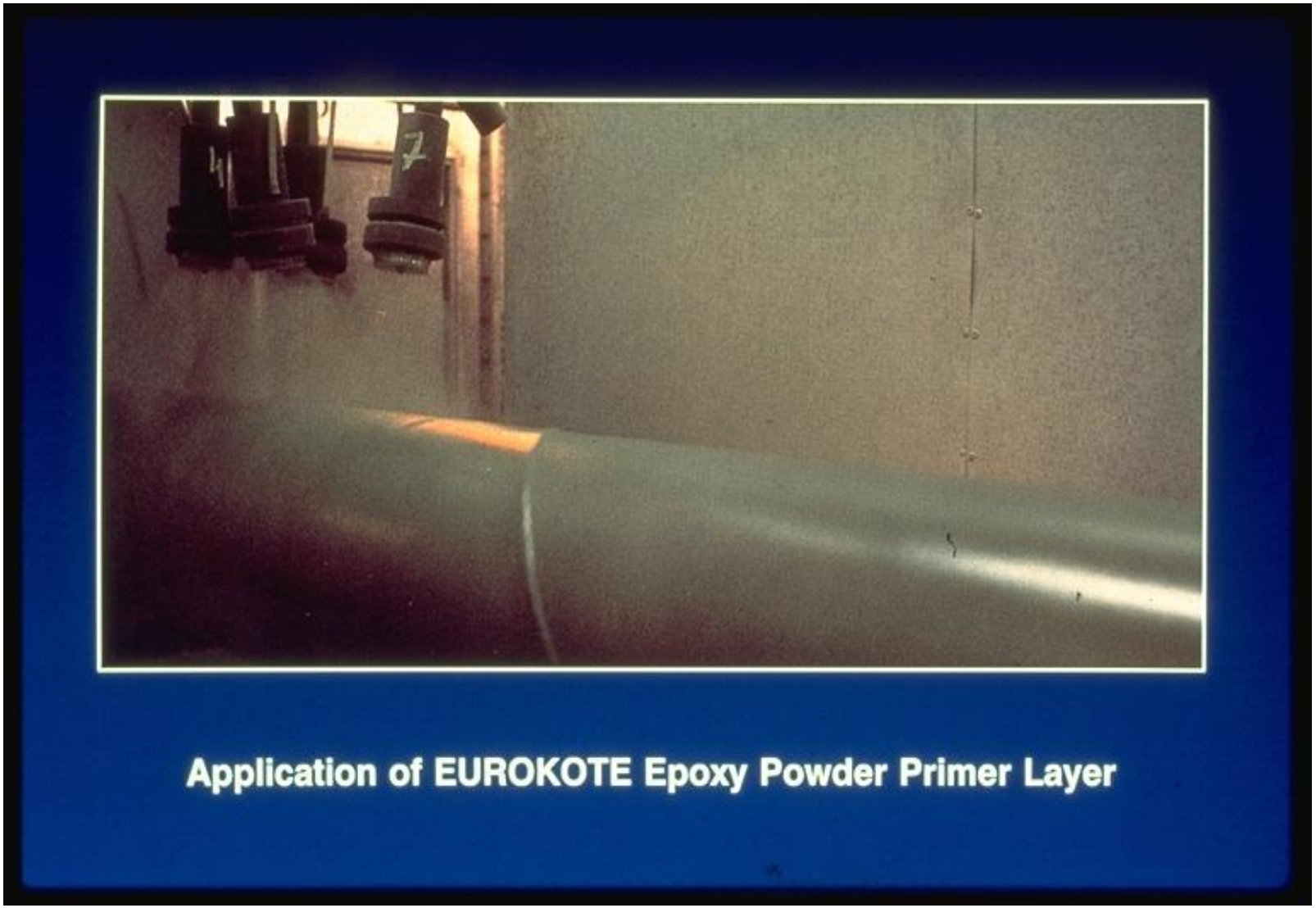


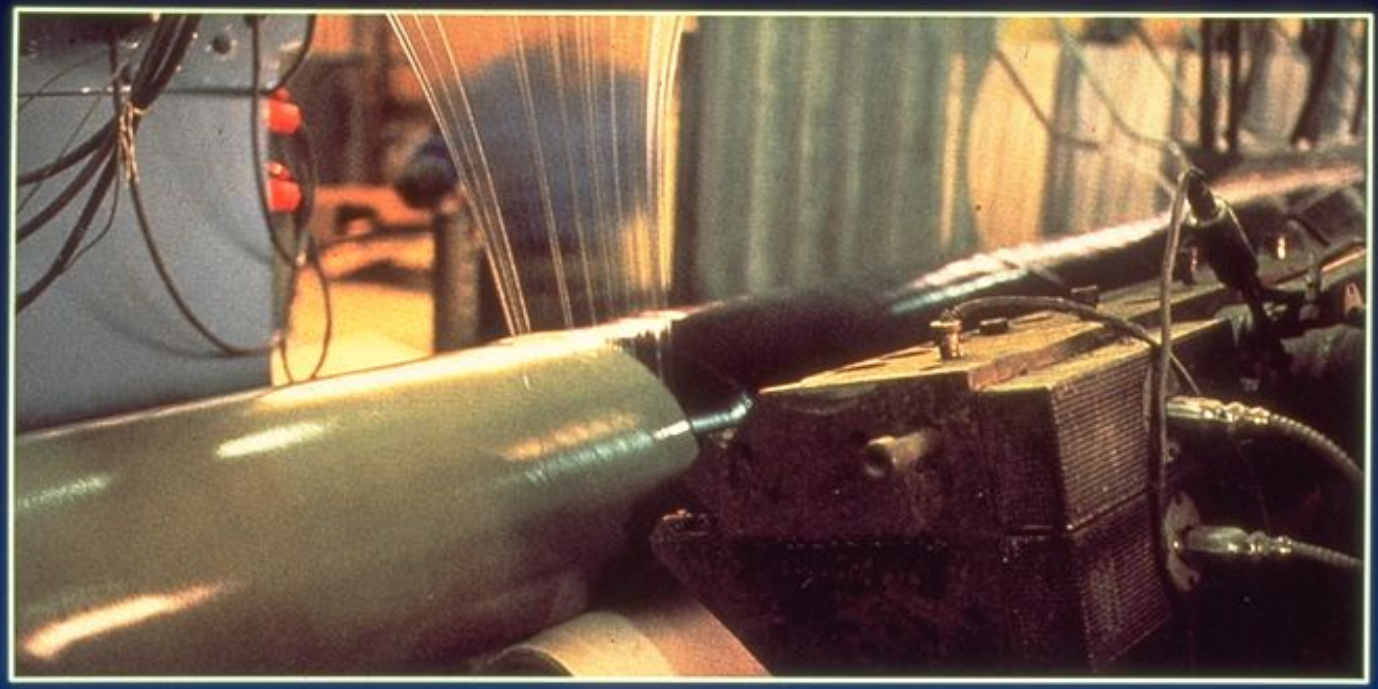
Figure 1 Shows a Schematic Diagram of a Typical 3-Layer Pipe Coating



1. EPOXY PRIMER
2. INTERMEDIATE ADHESIVE LAYER
3. POLYOLEFIN TOPCOAT

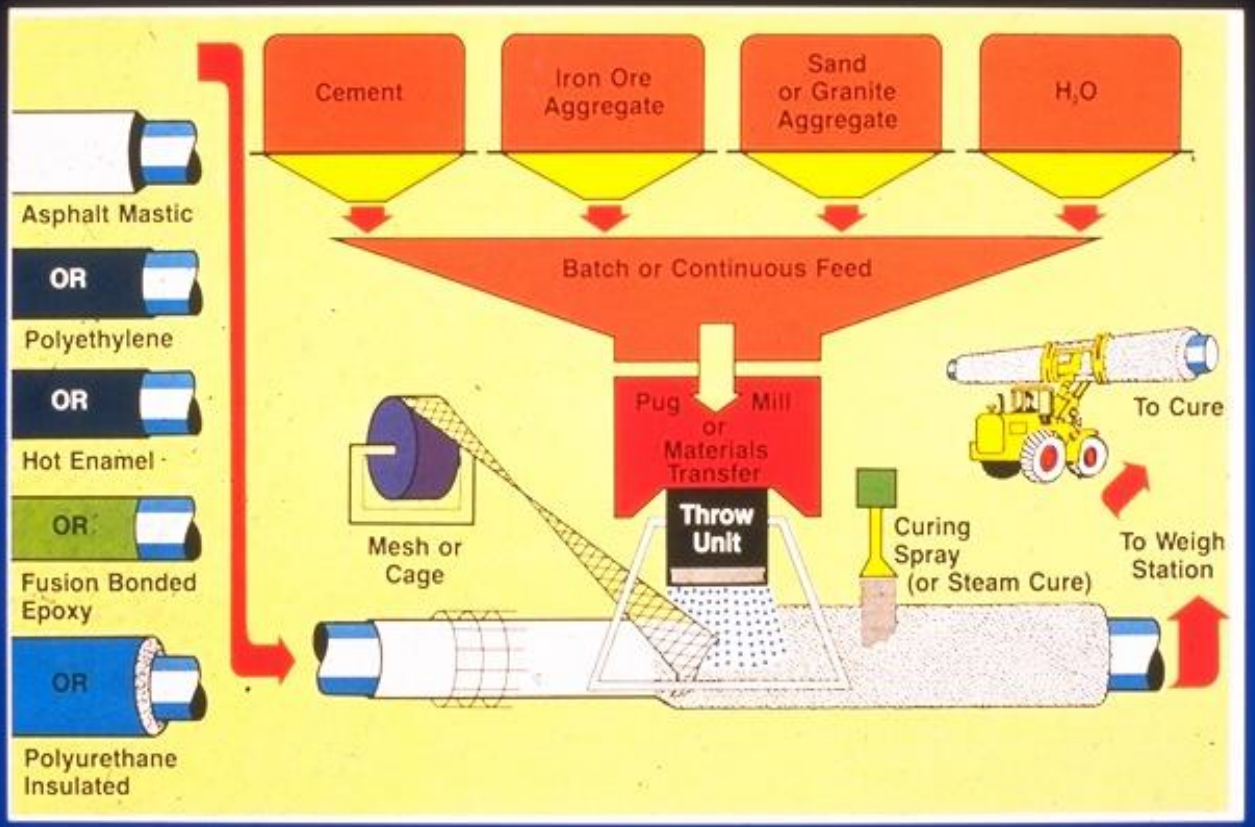

Schematic Diagram of 3-Layer Pipe Coating
Abrasive Clean to Sa 2 1/2
1
Epoxy Primer Spray
3
Water Quench
6
Pressure Roller
Induction Heat to 200°C
2
Adhesive Extrusion
4
5
Polyolefin Extrusion

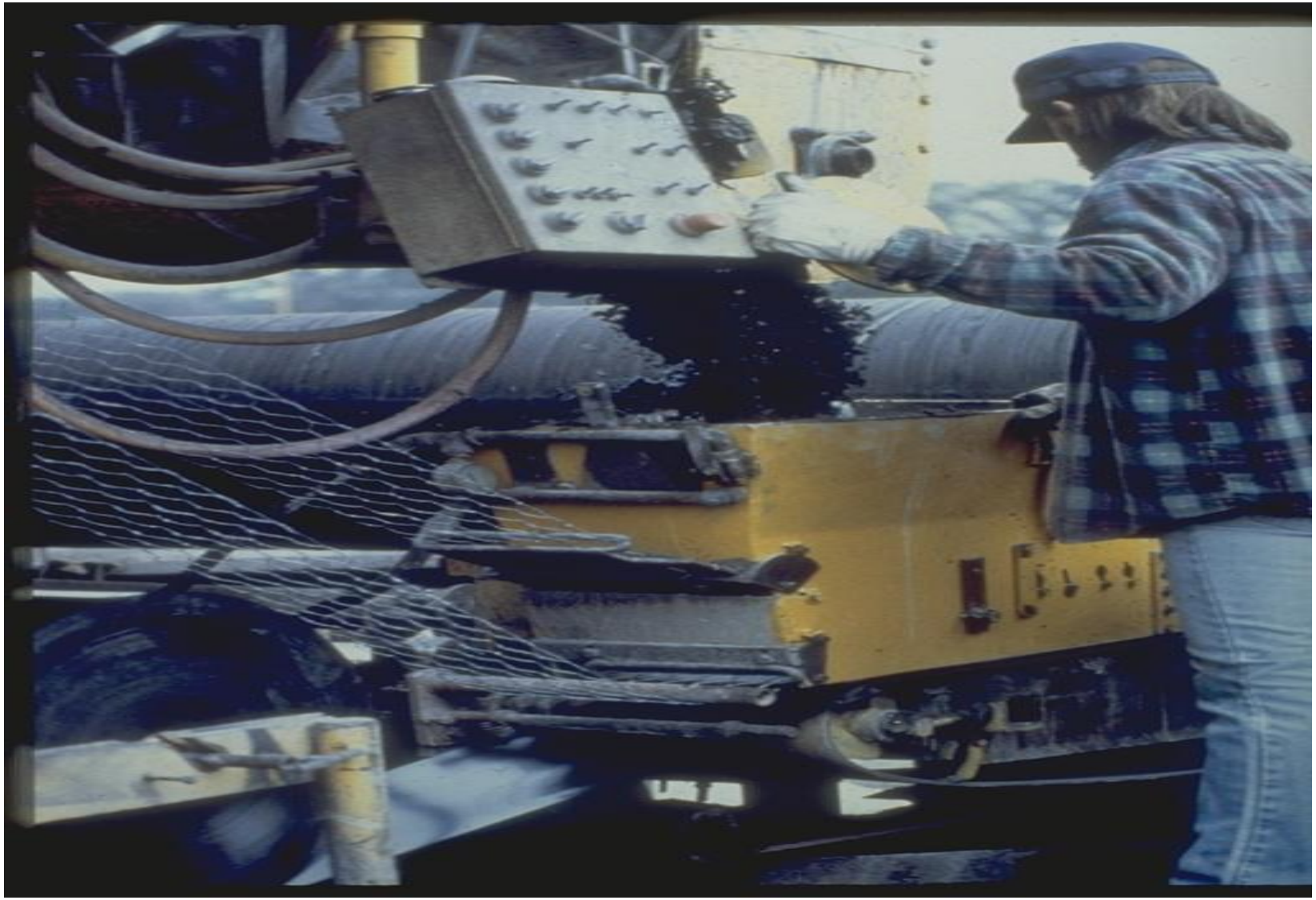

Application of EUROKOTE Epoxy Powder Primer Layer



Extrusion of Adhesive and Low Density
Polyethylene Over the Epoxy Primer Layer

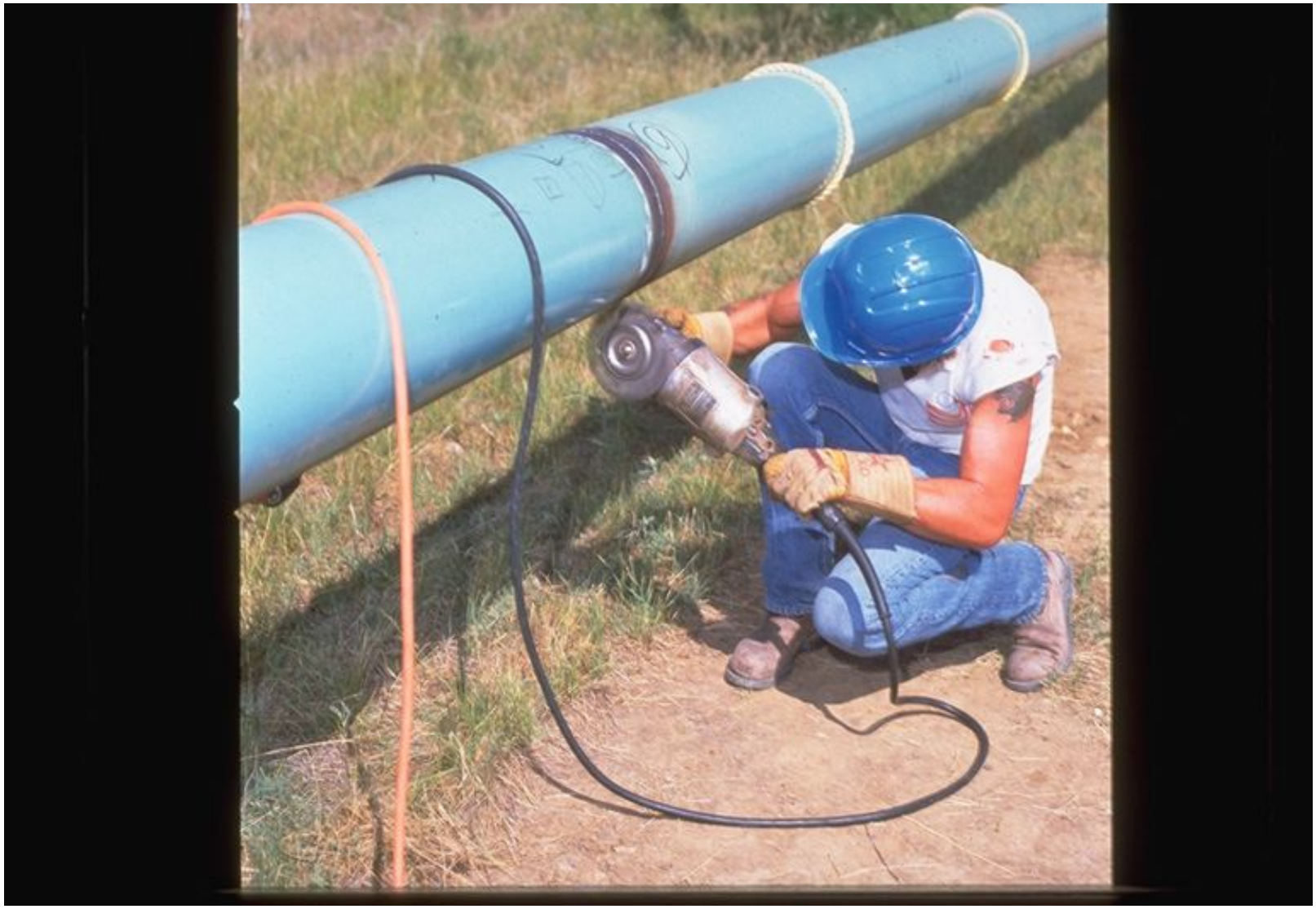
Impingement Concrete Coating

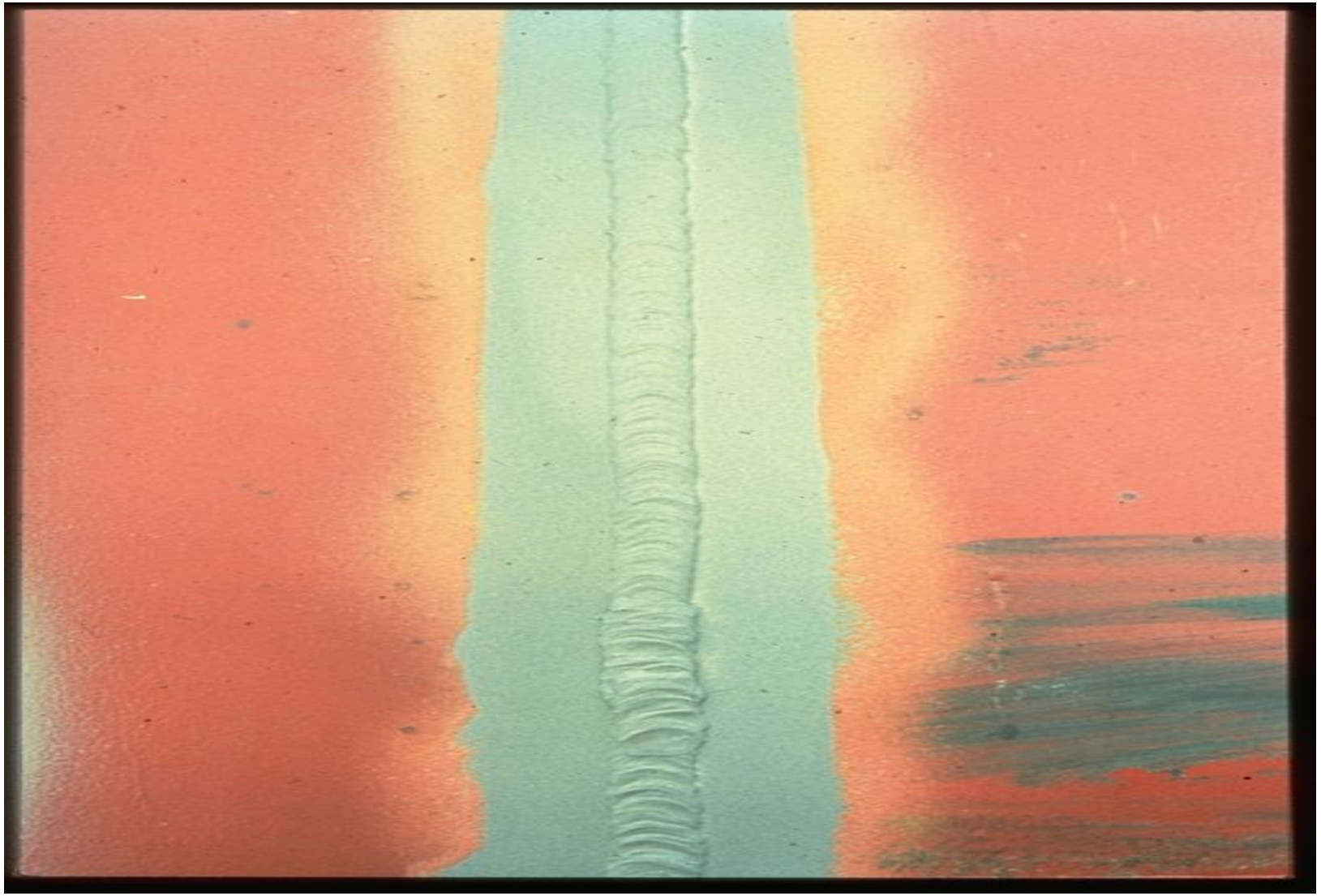


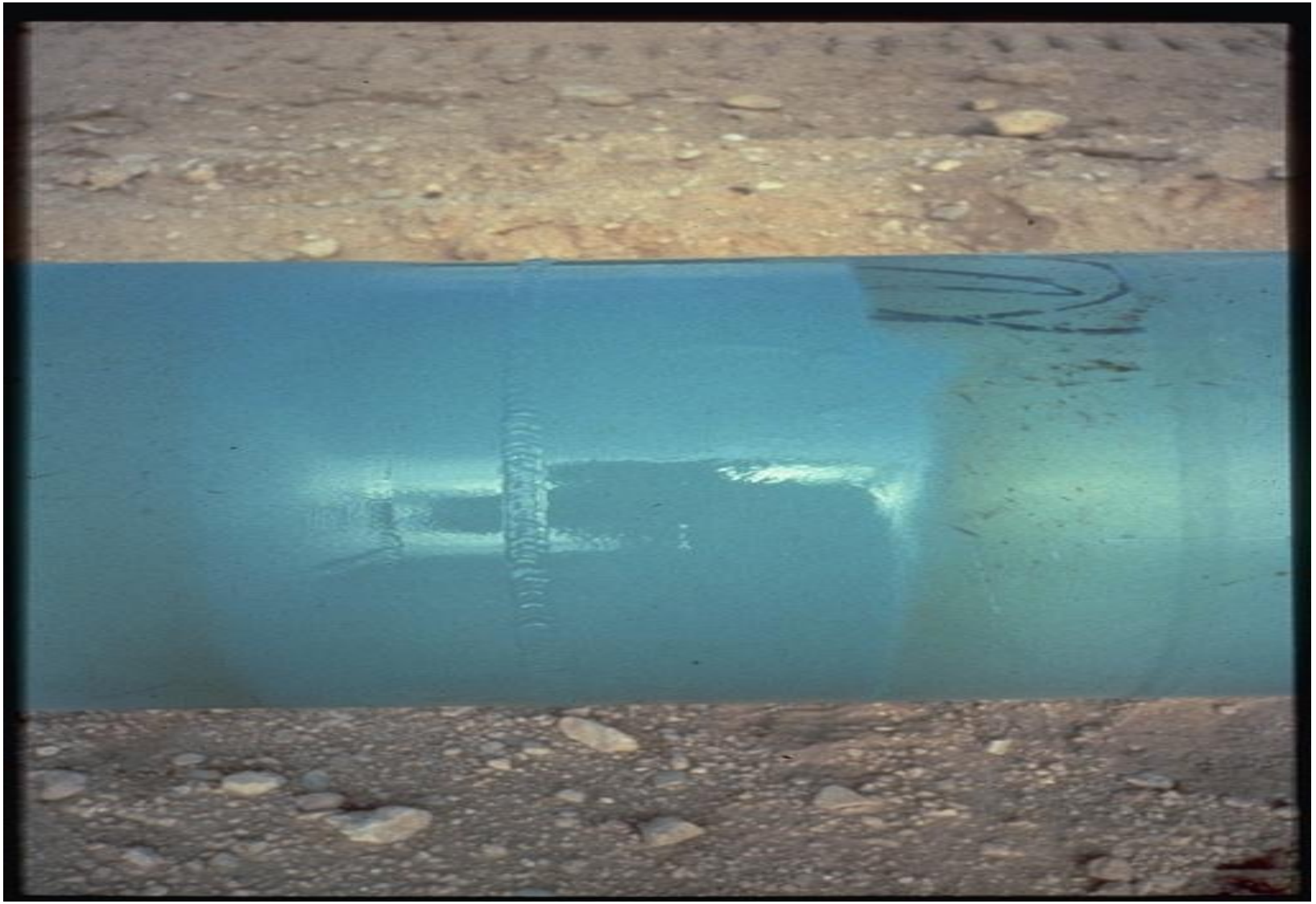


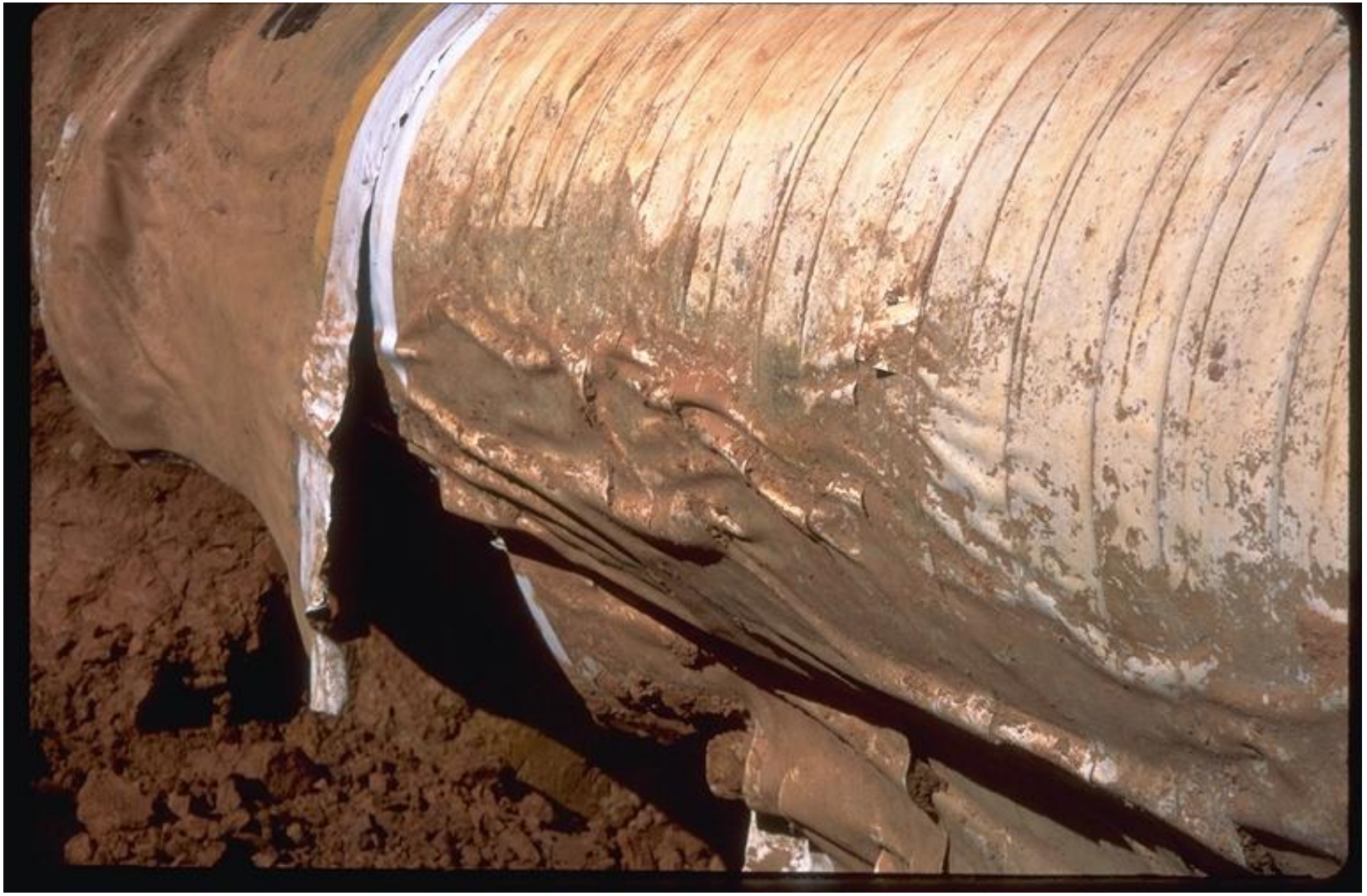

MARTIN
DECKER


2









Line Pipe Coating Process

Appalachian Underground Corrosion Short Course

INTRODUCTION

This slideshow steps you through the process of Plant/Mill-Applied external thin film – Fusion Bonded Epoxy (FBE) coating. The guideline for this process is set forth in NACE Specification SP0394 – latest revision.

The pipe enters the mill and is ready for the abrasive blasting procedure.

The pipe enters the pre-heat oven where its temperature is raised to approximately 130 degrees. It then enters the abrasive blasting booth.

The pipe exits the blasting booth with a near-white surface finish and the required anchor profile.

At this stage, the blasted pipe surface is checked for raised slivers, scabs, laminations, or bristles which are removed by file or abrasive sanders. A coupler is then inserted into the end of each joint of pipe.

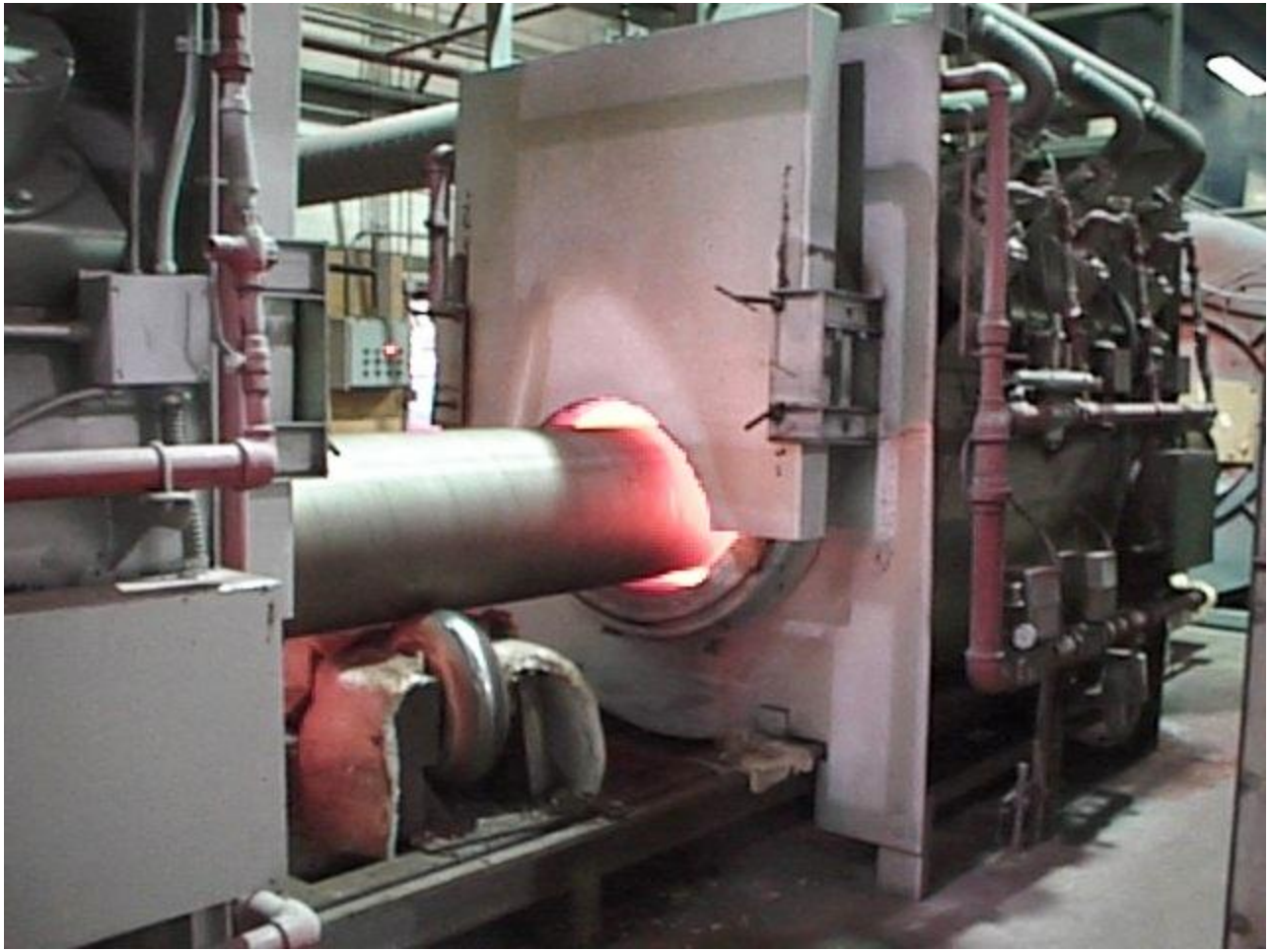
The coupler is used to connect and seal two joints of pipe together, so one pushes the other through the rest of the process.

Two pipe joints joined with coupler.

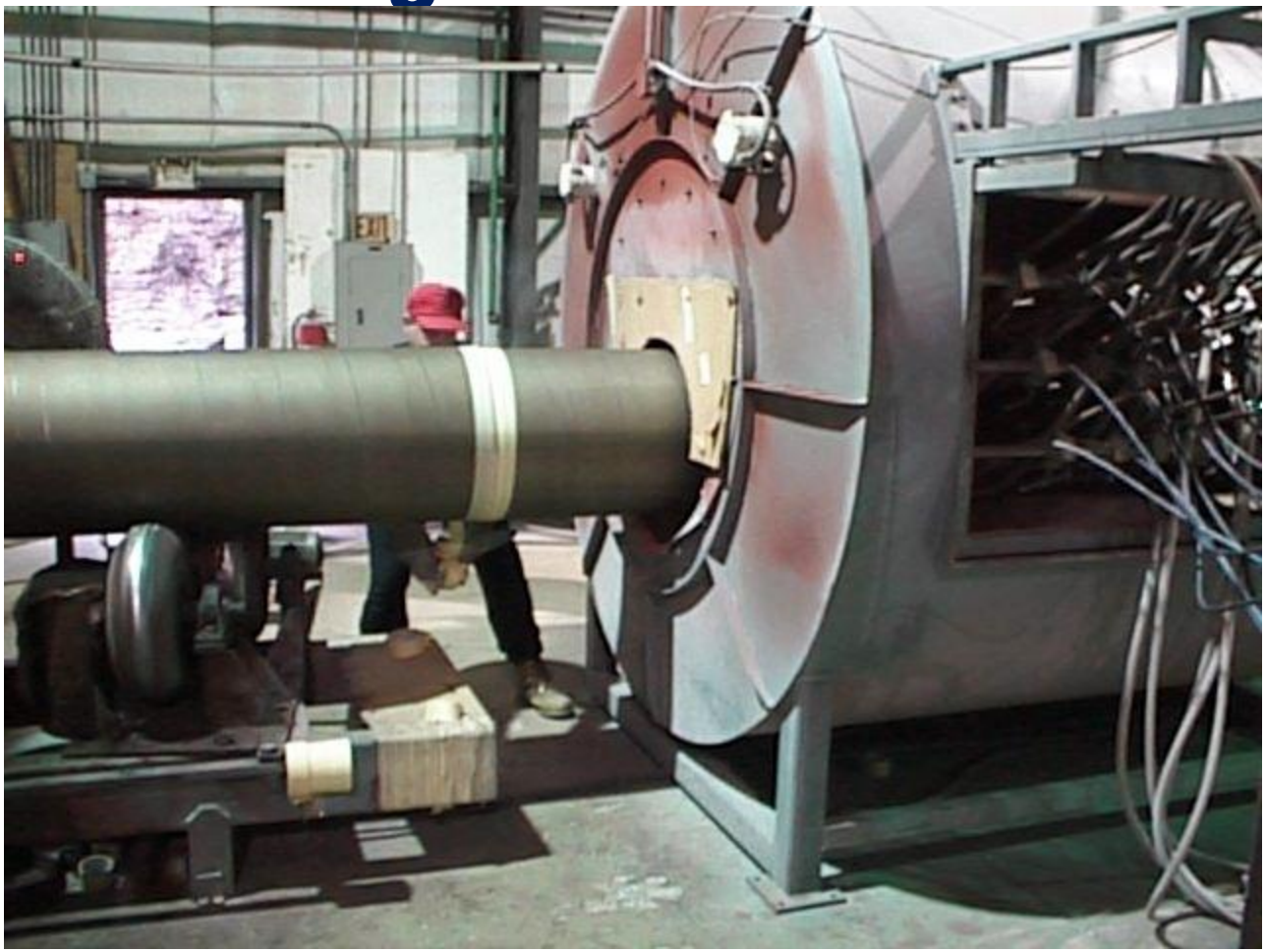
The pipe then enters an acid bath to remove surface contaminants.

After the acid bath and rinse, the pipe enters a series of ovens that raise the temperature of the pipe to approximately 475 degrees before application of the coating.

Pipe entering last oven before coating.



The joint between pipes is covered, so that the ends of each joint are left free of coating. This is done to allow welding in the field.



The pipe exits the coating booth where jets have applied a coating to the hot pipe with an average coating thickness of 15 mils.

The tape around the joint is now removed and pipe continues to the quenching chamber.

In the next step of this process, the pipe enters a quenching chamber and is water cooled to around 250 degrees.

Pipe coming out of quenching chamber.

Stencil being added to pipe stating the company name, API information and size and wall thickness of pipe.

Company Inspector verifying that the coating thickness is acceptable.

Ropes are put around pipe to keep joints of pipe separated and to prevent coating damage.

A 2,000 volt , nonpulsating, low ripple DC dry-type holiday detector is then used to detect any holidays that may exist in the coating.

Repair of a pinhole size holiday in the coating. Patching with these touch up sticks is only allowed in the mill while the pipe is still hot. Preheating the pipe properly is the limiting factor for field application.

Holiday repair using touch-up sticks.

Each pipe is measured and given a number.

The pipe is then carried into the yard. The forklift has protective padding on the jaws.

The pipe is stacked with padded boards between them to prevent damage to the coating.

The joints of pipe are unloaded on to the padded boards and the ropes separate the joints and protect them from damage when striking other pipes.

The End!

- Questions
- Comments
- Concerns
- Thank you for attending!

AUCSC

Appalachian Underground Corrosion Short Course