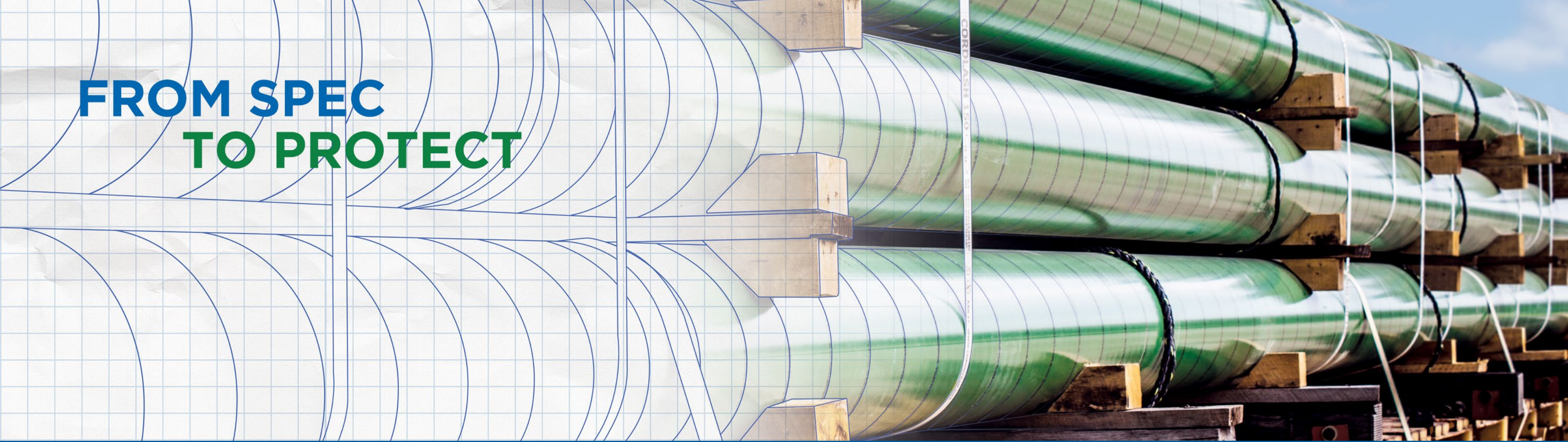



# MRO- Moisture Resistant Overcoat

## Advanced Moisture and Damage Resistance for Pipelines

### The Pipeliners Association of Houston
### Business Meeting

August 26, 2024

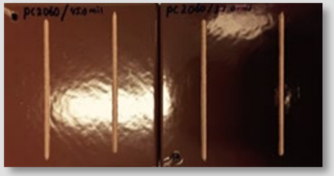
THE PIPELINERS ASSOCIATION OF HOUSTON
EST. 1953

# Moisture Resistant Overcoat (MRO)

**Strong** moisture-resistance + **Strong** damage tolerance + **High** flexibility

**Moisture Resistance**

**Damage Tolerance**

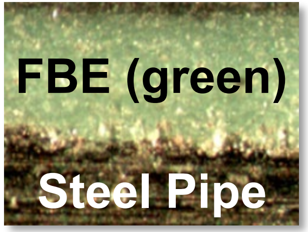


**Flexibility**

**Combines the barrier attributes of historic high operating temperature systems with advanced ARO (abrasion resistant overcoat) technology**

# Comparison of FBE Based Systems

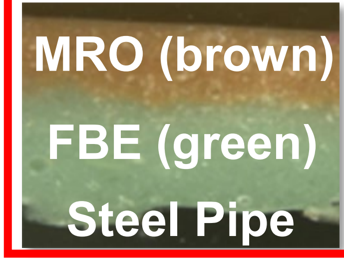
**Standard Single-Layer**
**16-20 mils**
**(400-500μ)**



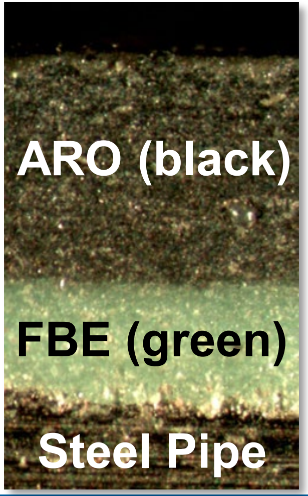

**12/12 Dual-Layer**
**20-28 mils**
**(500-700μ)**

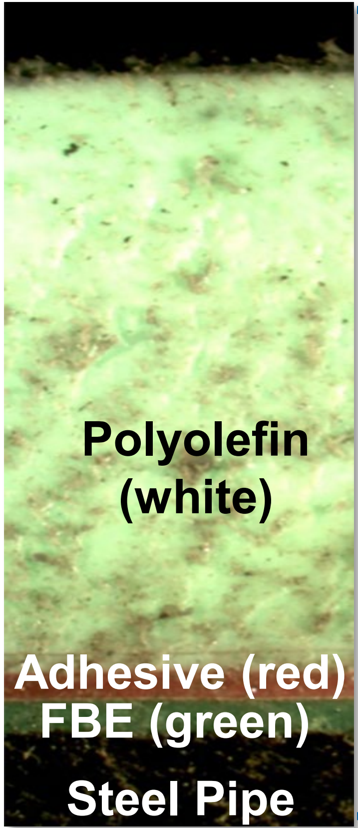
**Applied as a system**
FBE
12 ± 2 mils
(250-350μ)

MRO
12 ± 2 mils
(250-350μ)




**Standard Dual-Layer**
**40-60 mils**
**(1000-1500μ)**




**Standard 3-Layer**
**70-150 mils**
**(1750-3800μ)**

# Moisture Resistant Overcoat (MRO) Attributes

## MRO Abrasion-Resistant Overcoat (ARO)

### Dual Layer System

Applied as a dual layer powder system that provides an extremely robust protective coating to the outside of pipes.

### Application

Designed to be applied over fusion bonded epoxy (FBE) coatings on the exterior of pipes.

### Innovation

Features an innovation that provides superior protection against moisture and corrosive elements in the environment, while also providing abrasion resistance surpassing typical ARO coatings.

### Protection

Provides optimum protection for the corrosion protection layer against both moisture uptake, as well as damage throughout storage, transit, construction and service of the pipeline, including during horizontal directional drilling and backfilling.

### Temperatures

MRO is designed for service temperatures up to 150°C or higher dependent upon the base layer of corrosion protection which is applied.

# MROs – Benefits of 12/12 mils (250/250μ) System

| APPLICATION | PERFORMANCE |
|---|---|
| • **Faster throughput** (applies at single layer speeds)<br>• **Fewer holidays** “on the rack”<br>• **Superior damage resistance** for handling and storage | • **Improved moisture barrier** – less “steam jacking” in HOT systems |

## INSTALLATION

- **Improved damage tolerance** (gouge, impact, tabor abrasion), reduced DCVG detectable holidays after backfill
- **Reduces installation cost** (less field repairs because of reduced mechanical damage, reduce the amount of padding required during pipeline installation)
- **Higher intrinsic dielectric strength** – fewer “false positive holidays” on right of way
- **More cost-effective field joints** compared to three-layer systems
- Field joints coated with same dual powder system maintain **coating integrity of entire pipeline**

# Moisture Resistant Overcoat (MRO)

**Application Characteristics:**

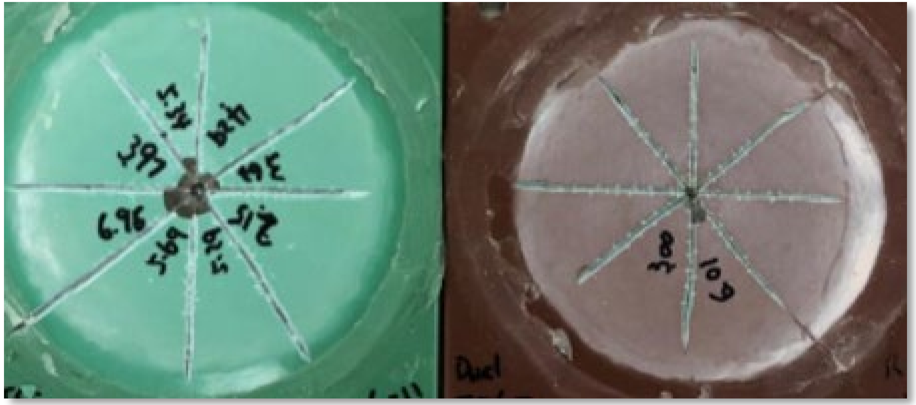
- At single layer speed
- Utilizes existing equipment
  - Same application booths as dual layer
  - Final DFT
    - ✓ 12 mils (300μ) FBE (green)
    - ✓ 12 mils (300μ) MRO (brown)

# High Performance

## Exceptional Cathodic Disbondment Resistance: 56 days @ 65°C

**Long-term Performance:**

- Elevated temperature, long duration CDT testing
- Illustrates demonstrable improvement versus similar thickness FBE without the MRO
- Lower water vapor transmission rates



**FBE alone 20 mils (500µ)** | **FBE/MRO @ 10/10 mils (250/250µ)**

# Moisture Resistant Overcoat (MRO)

## 95°C Hot Water Soak, 90 Days

**Long-term Performance:**

- Superior performance in long term wet conditions


**Existing Technology Delaminates**

**New "MRO" No Change**

# Moisture Resistant Overcoat (MRO)

**Improved Dielectric Properties:**

- Less moisture uptake
- Fewer issues with wet/dry sponge holiday detection (fewer “false positives”)

# Moisture Resistant Overcoat (MRO)

## Damage Tolerance:

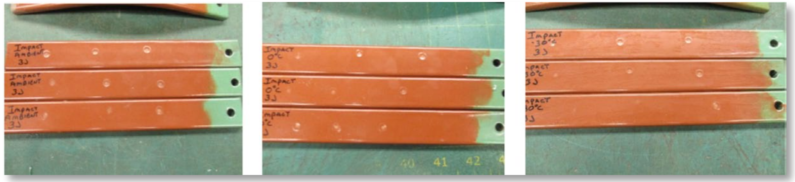
- 20-24mils (500-600µ)
- Flexibility over 3°/pd at -30°C
- Impact at over 3J at -30°C

### 3°/pd @ -30°C

| Sample | Mandrel | Coating Thickness | Result (Pass/Fail) |
|---|---|---|---|
| 1 | 5.75 | 20-22 mils | No cracking: Pass |
| 2 | 5.75 | 21-24 mils | No cracking: Pass |
| 3 | 5.75 | 22-23 mils | No cracking: Pass |

### Impact Testing

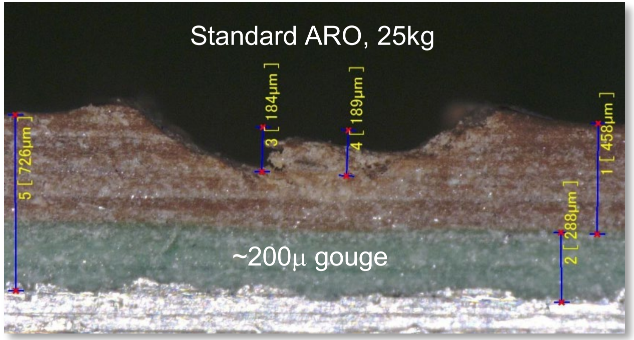
| Temperature | Impact Joules | # of Specimens | Holiday Detection | Result (Pass/Fail) |
|---|---|---|---|---|
| Ambient (25°C) | 3.0 Joules | 3 | No holidays | Pass |
| 0°C | 3.0 Joules | 3 | No holidays | Pass |
| -30°C | 3.0 Joules | 3 | No holidays | Pass |

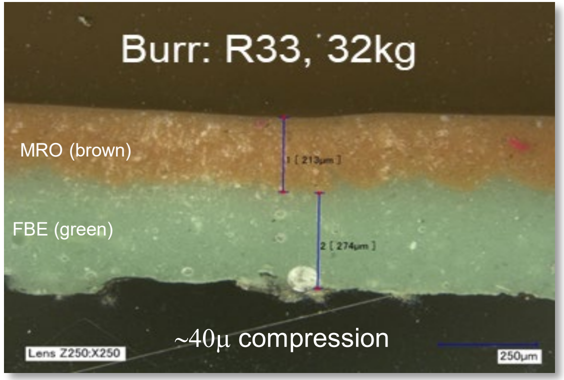


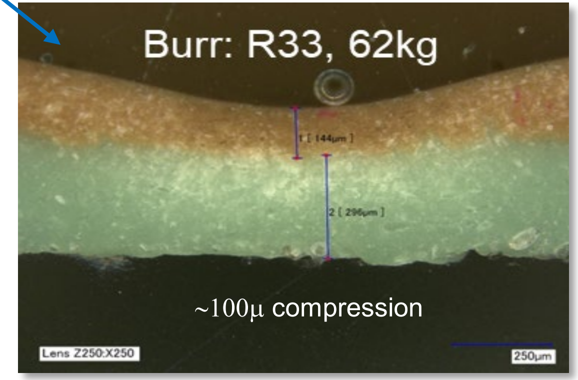
# Moisture Resistant Overcoat (MRO)

**Damage Tolerance:**

- Better gouge resistance than standard ARO
- Illustrates “compressive” behavior for HDD applications
- Better tabor abrasion than standard ARO



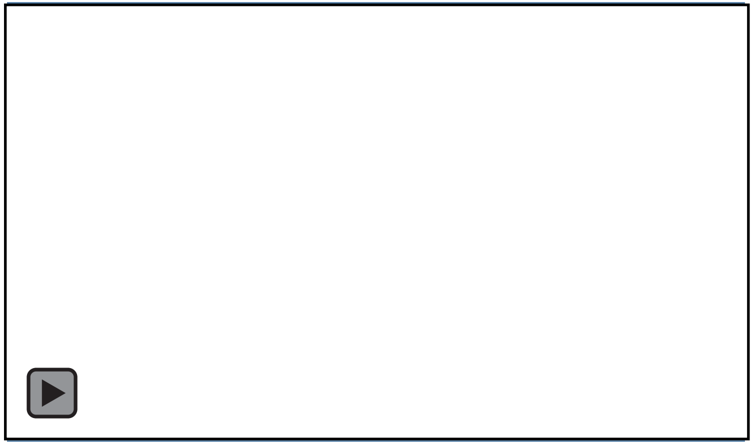



# Moisture Resistant Overcoat (MRO)

**Backfill Drop Test:**

- Raised rocks 10ft (3m) above pipe
- ~3in (~7.6cm) aperture
- Let them drop

## Field Testing: Del Rio, Texas



# Moisture Resistant Overcoat (MRO)

**Backfill Drop Test:**

- Appeared as if there were holidays, however…

## Field Testing: Del Rio, Texas

# Moisture Resistant Overcoat (MRO)

**Backfill Drop Test:**

- Hand wiped away "pulverized" rock dust
- No holidays (NACE SP01888 @ 3000V)
  - 12 mils (300$\mu$) FBE
  - 12 mils (300$\mu$) MRO

## Field Testing: Del Rio, Texas

# Moisture Resistant Overcoat (MRO)

**Field Flexibility Test:**

- “Wrinkled” the pipe
- No cracks or holidays (NACE SP01888 @ 3000V)
  - 12 mils (300μ) FBE
  - 12 mils (300μ) MRO

## Field Testing: Del Rio, Texas

# Moisture Resistant Overcoat (MRO)

## Whistler Project, Southwest Texas, USA

# Moisture Resistant Overcoat (MRO)

**Recent Update to Federal Regulations**

49 CFR 192.461 (up to date as of 5/26/2023)
External corrosion control: Protective coating.

49 CFR 192.461 (2023-05-26)

This content is from the eCFR and is authoritative but unofficial.

**Title 49 —Transportation**
**Subtitle B —Other Regulations Relating to Transportation**
**Chapter I —Pipeline and Hazardous Materials Safety Administration, Department of Transportation**
**Subchapter D —Pipeline Safety**
**Part 192 —Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards**
**Subpart I —Requirements for Corrosion Control**

**Source:** Amdt. 192–4, 36 FR 12302, June 30, 1971, unless otherwise noted.
**Authority:** 30 U.S.C. 185(w)(3), 49 U.S.C. 5103, 60101 *et. seq.*, and 49 CFR 1.97.
**Source:** 35 FR 13257, Aug. 19, 1970, unless otherwise noted.

**Editorial Note:** Nomenclature changes to part 192 appear at 71 FR 33406, June 9, 2006.

# Moisture Resistant Overcoat (MRO)

**§ 192.461 External corrosion control: Protective coating.**

(a) Each external protective coating, whether conductive or insulating, applied for the purpose of external corrosion control must—

(1) Be applied on a properly prepared surface;

(2) Have sufficient adhesion to the metal surface to effectively resist underfilm migration of moisture;

(3) Be sufficiently ductile to resist cracking;

(4) Have sufficient strength to resist damage due to handling (including, but not limited to, transportation, installation, boring, and backfilling) and soil stress; and

(5) Have properties compatible with any supplemental cathodic protection.

(b) Each external protective coating which is an electrically insulating type must also have low moisture absorption and high electrical resistance.

(c) Each external protective coating must be inspected just prior to lowering the pipe into the ditch and backfilling, and any damage detrimental to effective corrosion control must be repaired.

(d) Each external protective coating must be protected from damage resulting from adverse ditch conditions or damage from supporting blocks.

(e) If coated pipe is installed by boring, driving, or other similar method, precautions must be taken to minimize damage to the coating during installation.

(f) Promptly after the backfill of an onshore steel transmission pipeline ditch following repair or replacement (if the repair or replacement results in 1,000 feet or more of backfill length along the pipeline), but no later than 6 months after the backfill, the operator must perform an assessment to assess any coating damage and ensure integrity of the coating using direct current voltage gradient (DCVG), alternating current voltage gradient (ACVG), or other technology that provides comparable information about the integrity of the coating. Coating surveys must be conducted, except in locations where effective coating surveys are precluded by geographical, technical, or safety reasons.

**49 CFR 192.461(f) (enhanced display)** **page 1 of 2**

**49 CFR 192.461 (up to date as of 5/26/2023)**
**External corrosion control: Protective coating.** **49 CFR 192.461(g)**

(g) An operator must notify PHMSA in accordance with § 192.18 at least 90 days in advance of using other technology to assess integrity of the coating under paragraph (f) of this section.

(h) An operator of an onshore steel transmission pipeline must develop a remedial action plan and apply for any necessary permits within 6 months of completing the assessment that identified the deficiency. The operator must repair any coating damage classified as severe (voltage drop greater than 60 percent for DCVG or 70 dBμV for ACVG) in accordance with section 4 of NACE SP0502 (incorporated by reference, *see* § 192.7) within 6 months of the assessment, or as soon as practicable after obtaining necessary permits, not to exceed 6 months after the receipt of permits.

(i) An operator of an onshore steel transmission pipeline must make and retain for the life of the pipeline records documenting the coating assessment findings and remedial actions performed under paragraphs (f) through (h) of this section.

*[Amdt. 192–4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192–132, 87 FR 52268, Aug. 24, 2022]*

## MRO system meets key attributes

- Moisture Resistance
- Flexibility
- Impact and Gouge resistance
- Synergistic with cathodic protection
- Low Moisture Uptake and High Dielectric Strength
- HDD Suitability
- DCVG/ACVG validation

# Moisture Resistant Overcoat (MRO)

## Award Winning

**Pipeline & Gas Journal Awards**

*Best Coating/Corrosion Advancement Technology*


TOP PROJECTS

**Journal of Protective Coating and Linings** (**JPCL**)
Top Projects for Steel Coatings

**WHISTLER PIPELINE PROJECT**

**PROJECT LOCATION**: PERMIAN BASIN, TEXAS

**CLIENT/OWNER:** WHITEWATER MIDSTREAM, LLC (AUSTIN, TEXAS)

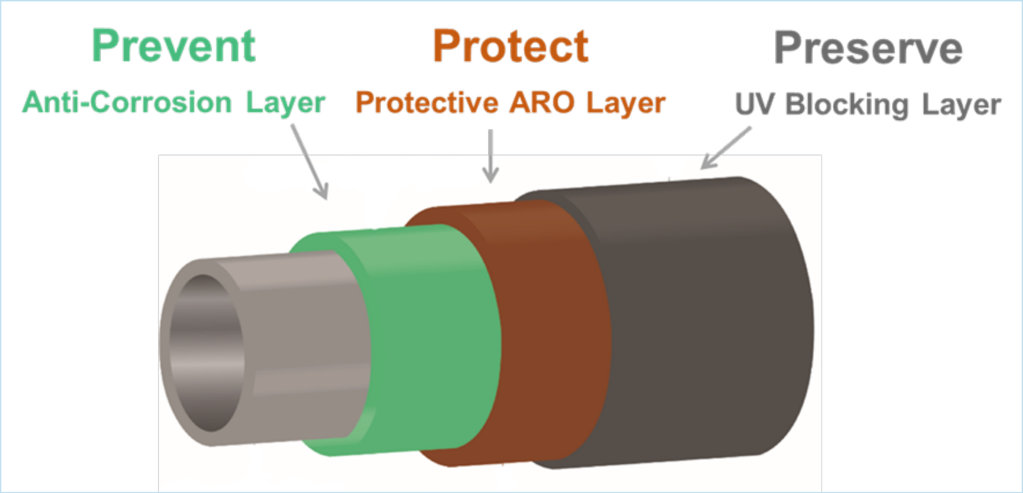
**CONTRACTOR:** STUPP COATINGS (BATON ROUGE, LOUISIANA)

**COATINGS SUPPLIER:** SHERWIN-WILLIAMS PROTECTIVE & MARINE (CLEVELAND)

# Moisture Resistant Overcoat (MRO)

**The Three Ps:**
**Prevent – Protect – Preserve**

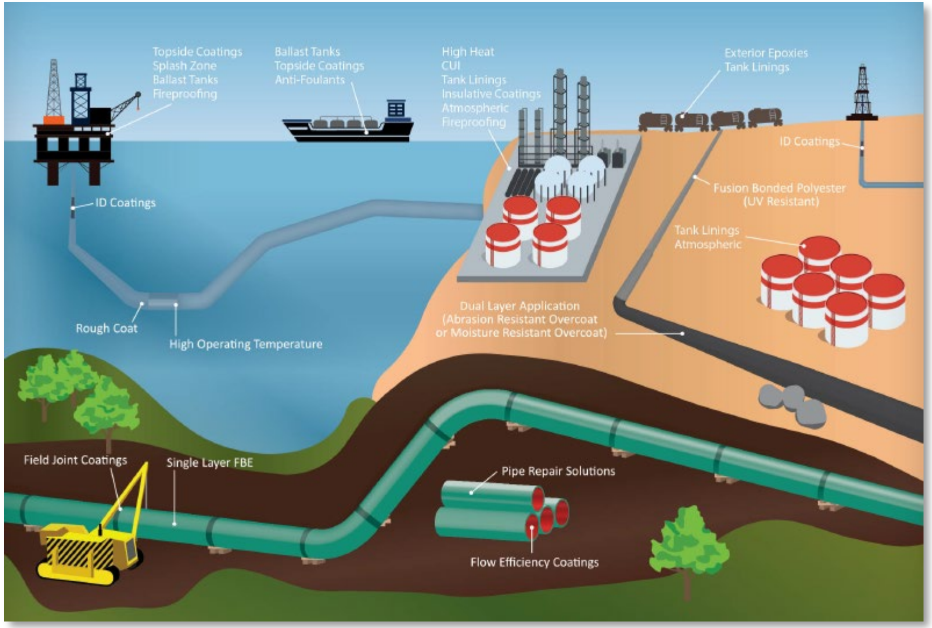
- Building pipeline performance, one layer at a time
- Families of products to suit end user requirements

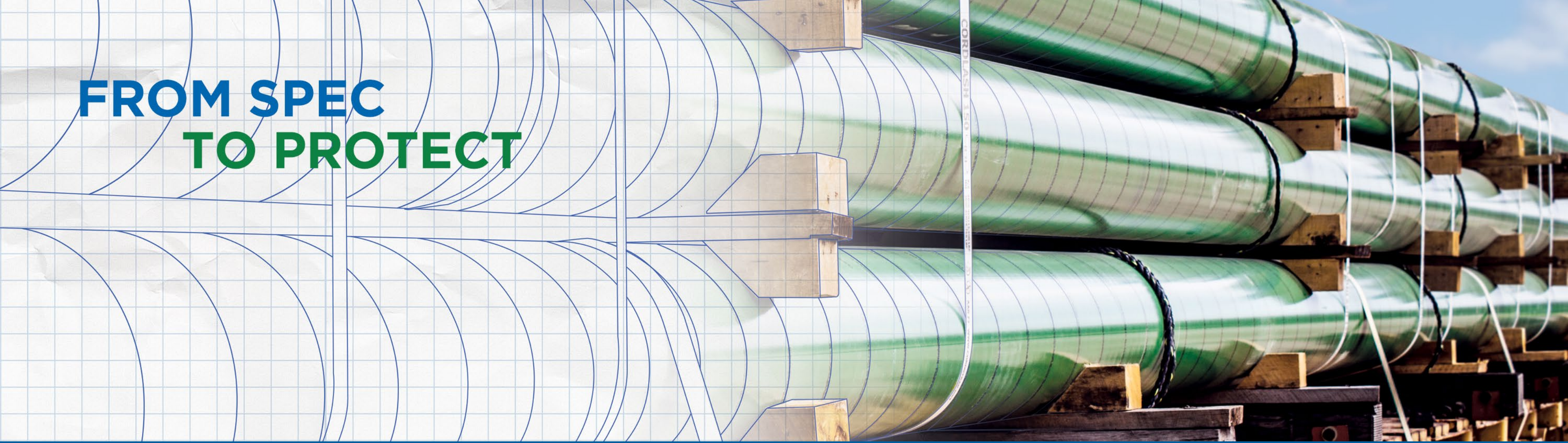


# Fitting It All Together

## From Exploration to Transportation:

A full portfolio of coatings for the oil & gas market






# THANK YOU

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