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STEEL: PROVEN 100-YEARS STRONG

Polymer Coated CSP Trenchcoat®

- Lynn Riley — Valfilm
- Todd Gray — Advanced Coil Industries
- Bob Moore — Contech Engineered Solutions
- Scott Hensley — TrueNorth Steel

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Polymer Coated CSP

Not Your Grandfather's CSP

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Polymer Coated Presentation

- Polymer Coated Corrugated Steel Pipe – Introduction
- Performance / Durability
- Product Availability
- Trenchcoat
- Manufacturing/Coating Process
- Case Histories
- National Specification
- DOT Specifications

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- Here to learn
- Please ask questions as we go
- Your experiences, what you've heard
- Polymer coating is not the only solution available to corrosive conditions and extended service life

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Polymer Coated Corrugated Steel Pipe Introduction

- Why was TRENCHCOAT Developed/History?
- What is TRENCHCOAT Polymer Coated CSP?
- Why is this information important to you?
- Civil Engineering Applications.

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Why was Polymer Coated CSP Developed?

TRENCHCOAT Protective Film was developed by the Dow Chemical Company in 1974 to extend the service life of galvanized corrugated steel pipe (CSP).

With the development of TRENCHCOAT Polymer Coating, CSP could now be installed in corrosive environments outside the range of plain galvanized CSP.

Polymer Coated CSP combines the strength of steel with the corrosion protection of polymer.

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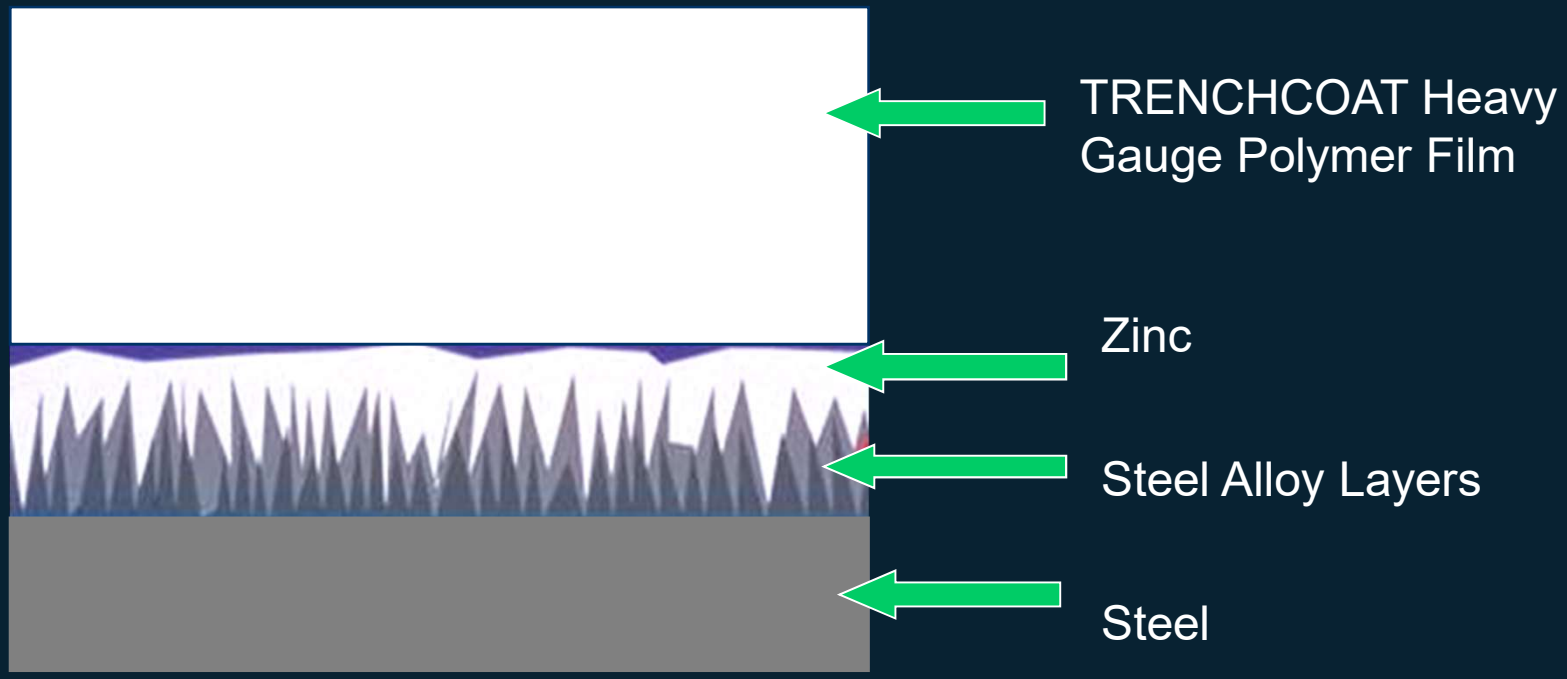
Polymer Coated Corrugated Steel Pipe

TRENCHCOAT® protective film bonds to galvanized steel both chemically and physically

Polymer consists of an ethylene acrylic protective film



TRENCHCOAT Polymer - Valfilm

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VALFILM
FINDLAY OPERATIONS

- Trenchcoat polymer coating is manufactured by Valfilm. Facility is ISO certified.
- Trenchcoat has been in widespread use on CSP since the mid 1980's. Based upon testing and field studies the NCSPA recommends a service life of 100 years.
- Trenchcoat exceeds specifications ASTM A742 and AASHTO M 246.
- There were some other companies briefly making a type of polymer film but installations are limited. "Blackclad". Other epoxy coating were made as well.

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Why is Polymer Coated CSP Important to You?
Added value compared to Rigid Pipe.

-Long term strength of steel

-Corrosion protection of polymer

-High pipe stiffness relative to plastic pipe

-Available in Round and Pipe Arch

-Long lengths available. High Beam Strength

-High % of Recycle Content up to 46%

-Wide range of diameters up to 144”

-Various End Treatments/End Sections

-Small OD/ID ratio vs RCP

-Installed cost savings

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Performance / Durability

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Polymer Coated CSP corrosion and abrasion resistant

- Excellent Adhesion
- Chemical resistance to
  - Acids
  - Alkalis
  - Salts
- High resistance to abrasion.

- All documented through extensive long term field and laboratory testing.

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- In highly corrosive environments beyond the recommended conditions for Aluminized Steel, Polymer coated galvanized steel CSP provides100-year service life.
- It combines the long term strength of steel and durability of an ethylene acrylic polymer “plastic”.

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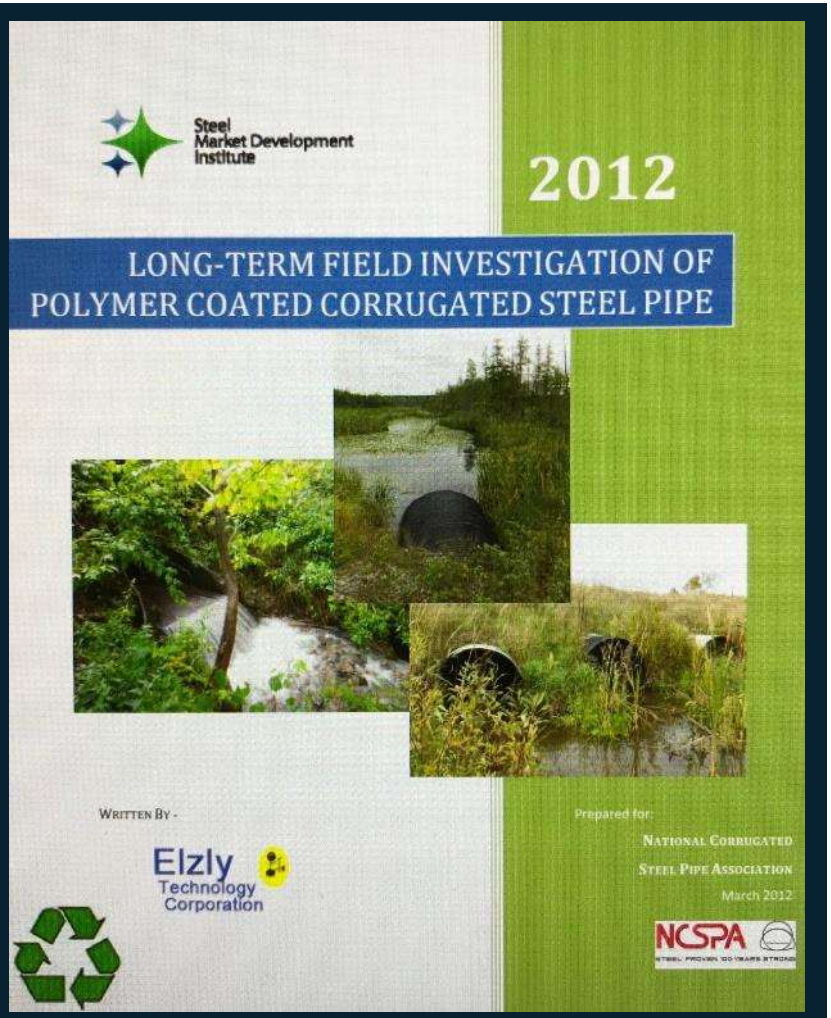
Polymer CSP Service Life
NCSPA Recommendations
Based on 2012 Field Studies

Data supports a add-on service life 80 years to plain galvanized pipe.

A 50-year add-on service life would Be a conservative approach.

CONCLUSIONS

1. The data continues to support guidance for a polymer coating "add-on" life of 80 years. Polymer coatings were observed to significantly extend the life of corrugated steel pipe.
2. The polymer coating continues to protect the galvanized steel pipe in severe environmental and abrasion conditions beyond the design conditions. This suggests a robust product design approach that is inherently conservative.
3. In all of the pipes, less than 5% of the polymer had coating delamination. This keeps the film intact and protecting the pipe from corrosion. Locations of polymer degradation which were observed are at locations of external damage such as cut edges or handling damage. None of these instances indicated a systemic breakdown of the coating on the entire length of the pipe.



Polymer Coated Steel Bridge Forms

Florida DOT – 124 year of service life

Florida Department of Transportation-Office of Materials
Service Life Estimation of Stay-in-Place Forms with Trenchcoat©

The service life was determined by examining the individual components of the stay-in-place form; polymer layer, galvanized layer and the steel substrate.

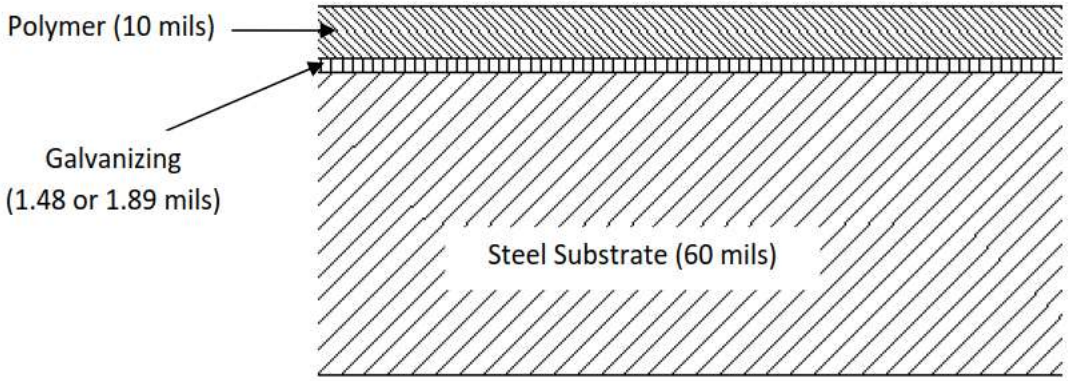


Figure 1. Representation of Stay-in-place form

Conclusion

Based on the evaluations of the different layers of protection provided by the Trenchcoat© coating system, the stay-in-place forms with Trenchcoat© polymer coating should provide at least 124 years of service before a failure of the forms is observed.

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Applications
Storm Sewer, Culvert, Reline
Irrigation & Stormwater Detention






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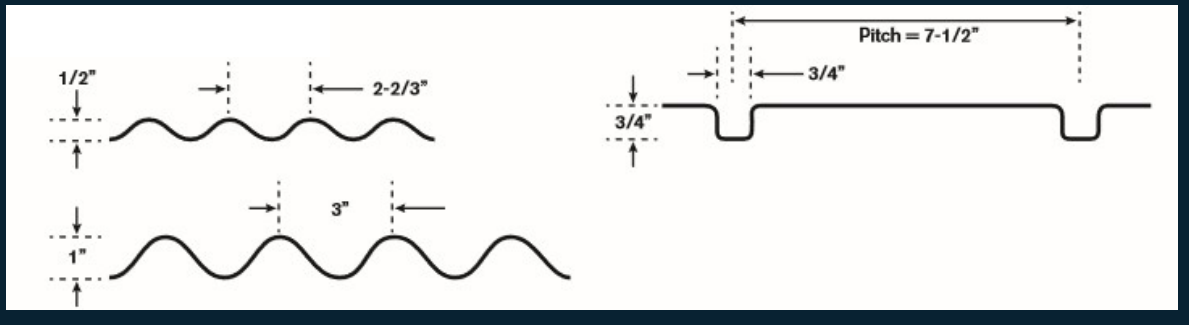
Product Availability

- Dia. 12” – 144”
- All corrugations
- 10 gage* – 16 gage



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Annular and Helical Smooth Spiral Rib

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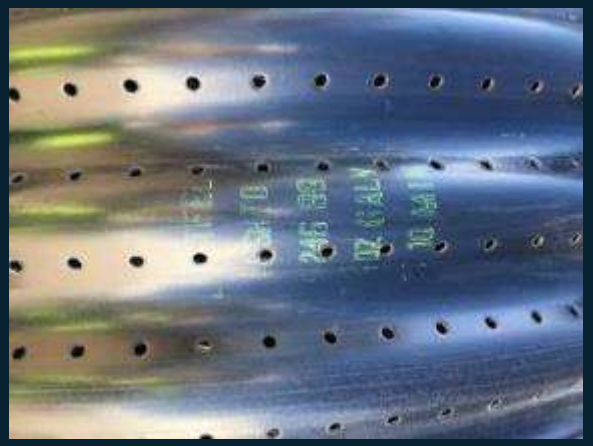
Round Pipe & Pipe Arch
Solid & Perforated Pipe



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Gage should be as per AASHTO LRFD

- Don't "over-gage" for added design life.
- Trenchcoat provides the added design life.
- 48" dia 16 gage

  "FS" is super high.

Corrugated Steel Pipe Backfill Heights

Round Pipe

Pipe Size (inches)	Minimum cover (inches)	2-2/3" x 1/2" Corrugations				
		Steel Thickness (Gage)				
		16	14	12	10	8
		Galvanized Thickness (inches)				
		0.064	0.079	0.109	0.138	0.168
		Corrugated Steel Pipe Backfill Heights (feet)				
12	12	219	273	–	–	–
15	12	183	228	255	–	–
18	12	146	182	191	–	–
24	12	109	137	191	–	–
30	12	87	108	153	–	–
36	12	73	91	127	164	–
42	12	62	78	109	141	172
48	12	55	68	96	123	150
54	12	–	61	85	109	134
60	12	–	–	76	98	120
66	12	–	–	–	89	109
72	12	–	–	–	82	100
78	12	–	–	–	–	89
84	12	–	–	–	–	77

The Table is based on the following criteria (ASTM/AASHTO embankment)

1. Pipe Type = Helical or Annular (riveted or spotweld)
2. Design Method = LRFD
3. Fill Density = 120pcf (prism above pipe)
4. Minimum Fill height taken as Span/8 but not less than 12"
5. Minimum cover for unpaved roadways is from the top of gravel surfacing.
6. Minimum cover for paved roadways is:
   a) To the top of the base for asphalt surfaces
   b) To the top of the pavement for concrete surfaces

Manufacturing/Coating Process

- **Next:**
- TRENCHCOAT Polymer Coating– Valfilm Lynn Riley
- Lamination to Galvanized Steel Coil Advanced Coil Industries Todd Gray
- Forming into Pipe – CSP Fabricators
- Handling
- Case Histories
- Existing Trenchcoat CSP DOT specifications.

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Poly video

TRENCHCOAT™
Protective Film

VALFILM
FINDLAY OPERATIONS

Valfilm is entering new markets for steel laminates that protect and perform better in chemical resistance and service life then competitive paint products. These films are manufactured in Findlay, OH and currently are sold under the trademarks of TRENCHCOAT and VALCOAT.

TRENCHCOAT laminated galvanized steel meets and exceeds all specifications of ASTM A742 and AASHTO M-246 and Federal Specification WWP-405-B.

The standard color is black, we can match custom colors or chose from one of our current colors.

The standard thickness is 12 mils, however the films can be ordered in a range of thicknesses from 6 mil to 18 mil.

The film can be embossed with a patterned finish or the standard gloss finish.

TRENCHCOAT™
Protective Film

VALFILM
FINDLAY OPERATIONS

Markets

1. Steel decking
2. Agriculture buildings
3. Bridge decking
4. Roofing
5. Steel tanks
6. Alternative to Stainless Steel and/or Aluminum

Valfilm Customers

VALFILM
FINDLAY OPERATIONS

Valfilm offers technical films for flexible packaging to various markets such as beverage, food, dairy, distribution centers, petrochemical, etc.. The quality of its products keeps on attracting customers in Europe, South America and across North America!

..

TRENCHCOAT™
Protective Film

VALFILM
FINDLAY OPERATIONS

Quality Control and Coating Validation

- ISO 9001:2015 Certified and In-process to GFSI Certification for Food Safety and Quality
- Traceability – Supplier to Customer
- Production Continuous and Lot inspections
- Additional Product Validation Testing – ASTM A742 + others
  - Chemical Resistance
  - UV Resistance
  - Abrasion Resistance
  - Adhesion Performance

TRENCHCOAT™
Protective Film

VALFILM
FINDLAY OPERATIONS

History of TRENCHCOAT

- Dow Chemical developed INTEGRAL™ 625 adhesive film for lamination to steel for corrugated steel pipe applications in 1974
- INTEGRAL 625 was available in thicknesses from 2 to 12 mils
- As the industry trialed different thicknesses, it was determined that a minimum thickness of 10 mils was preferred for corrugated steel pipe
- ASTM A742 was developed based on polymer coating thickness of a minimum of 10 mils on either side of the galvanized steel
- Dow registered the trademark for TRENCHCOAT Protective film in 1994
- TRENCHCOAT is the same formulation as INTEGRAL 625. except it is only available at a thickness of 12 mils, prior to lamination on steel.
- Valfilm purchased the TRENCHCOAT film business from Dow in 2015
- The formulation for INTEGRAL 625 and TRENCHCOAT have not changed since INTEGRAL 625 was first evaluated in this application in 1974

ADVANCED COIL INDUSTRIES

Advanced Coil Industries Inc.

Quality Control and Quality Assurance Program Review

TRENCHCOAT ™ Protective Film Coating

ADVANCED COIL INDUSTRIES

Quality Control Procedures

Data and Tracking Requirements

- Verification Process – ACI uses dual verification throughout the QC process. Information is recorded by one employee and a second employee verifies the recorded information with the first employee. This is done continually from receipt through shipment
- Receiving – Upon receipt of coil it is inspected and all weights, dimensions and Mill Coil Tag information is verified. An ACI coil identification number is assigned and both the Mill Coil ID and ACI ID are recorded on the coil and this information is entered into the inventory tracking system along with dimensions and weights.
- Laminating Line-Data Control Sheets – these production records serve as the coil data traveler through the production process. The information is dual verified at five stages of processing as additional information is recorded. Information such as ACI coil number, Lift number, Dimensions, Weight and Lineal Feet are recorded.
- Verification points
  - Forward Operation (Uncoiler)
  - Furnace Operation (Main Operations Control)
  - Laminating Operation (Polymer film tag information added)
  - Back End Operation (Recoiler)
  - Shipping

ADVANCED COIL INDUSTRIES

Quality Control Procedures

Quality Control Process - Production

Stages of Production - QC points of Control

- Straightening and Stitching – provides for flat / straight coil and continuous operation.
- Cleaning – two to three step process
  - Tank One – Mild detergent in heated water – QC Control: operator monitors detergent and temperature levels at two locations.
  - Tank Two – Water rinse only in heated water – QC Control: operator monitors levels of residual detergent.
  - Scotchbrite Operation – Rotary cleaning machine to remove stencil, white rust or Heavy Oil – QC Control: Only in use if needed on coil.
- Chemtreat - chemical treatment added to prevent corrosion and initiate chemical reaction with the polymer coating
  - Chemical treatment per ASTM specification – QC Control: Operator continuously checks electronic reading on measurement equipment and chemical monitoring testing is completed as needed throughout the production run (number of tests per day varies depending on length of each coil and atmosphere conditions)
- Drying – chemtreated coil travels down the line 80 feet in atmosphere to allow drying and setting of treatment

ADVANCED COIL INDUSTRIES

Quality Control Procedures

Quality Control Process - Production

Stages of Production - QC points of Control

- Furnace (Oven) Operation – steel is heated in a 400 (F) degree indirect heat natural gas fired oven to achieve optimal temperature to laminate the polymer coating.
  - Three zone oven is heated to approximately 600 degrees Fahrenheit (depending on atmospheric conditions).
  - Soak time for steel is achieved by passing the steel through the 35 foot long oven to achieve 380 to 400 degrees Fahrenheit surface temperature – QC Control: Oven temperature and Steel surface temperature are coordinated via a dual wave length industrial infrared pyrometer within the operations control of the oven. The operator records temperatures on the production records.
  - Surface temperature testing is done both electronically and manually. The manual testing is done with special markers designed to melt at 380 degrees – QC control: no marking should be visible from the marker and entrance temperatures to the laminator should not vary from furnace exit temperatures significantly.
- Lamination – the heated steel is immediately transferred from the oven to the laminator
  - The laminator consists of 4 feed rollers (two at a time are utilized top and bottom) where the polymer film is fed automatically to the steel and passed through compression rollers.
  - Excess polymer is trimmed from the edges of the steel for an edge to edge coating. This is an ACI specific production process as the ASHTO specification does not call for edge to edge coating specifically but allows a one-quarter inch coating gap.
  - Splices in material are marked with “flags” on the material and overlap is maintained per the ASHTO specification.

ADVANCED COIL INDUSTRIES

Quality Control Procedures

Quality Control Process - Production

Stages of Production - QC points of Control

- Quench and Stenciling – the steel passes through a cold water quench tank to bring the surface temperature of the now coated steel down for recoiling
  - The temperature of the quench tank should not exceed 160 degrees Fahrenheit in order to properly bring the steel down to a temperature that allows recoiling of the steel. QC control: the main control operator monitors the temperature of the quench tank with a digital readout adding cold water as needed to maintain the proper temperature.
  - The polymer is fully adhered and does not require the quench for it's properties to be achieved. This process is mainly for handling purposes.
  - Stenciling is applied after quenching marking the date of production, customer name, company name, coil ID and the TRENCHCOAT ™ logo.
- Recoiling – the steel is recoiled under tension to ensure a straight and even recoiling without significant side to side travel.
  - At this point in the process the samples are taken from each coil.
  - All traveler information is written on the coil by the recoiler operator and this information is verified by the coil removal operator.
  - The coil is placed into inventory and it's location is noted on the traveler which is now complete and turned in for recording of final information.
  - QC control: end of QC control, start of Quality Assurance.

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Quality Control Procedures

Quality Assurance Process

Quality Assurance

- Recording of QC process Data – all data from the Laminating Line-Data Control Sheets is entered into the inventory and billing systems. Both systems are double checked for accuracy by two employees.
- Testing – six testing samples are sheared from the master sample removed from the coil. All samples from the previous days production are tested the following work day as to maintain control of each sample. Samples are logged by coil ID, date and run position as well as who tested them.
- Testing Procedure – testing is performed by a lab technician per ACI QA instructions. The following procedures are required of each test.
    - Three 4 inch by coil width test bars are sheared from the master sample. Each is labeled with the coil information from the master coil. Three additional 2 inch by 8 inch samples are sheared from the master sample and labeled just as the larger samples are.
    - The samples are numbered one through three for each group and logged in the Testing Log Form (Test Lab) per ACI QA instructions.
    - Two samples (one and two from each group) will be tested while the third will remain untested should an issue arise that may require independent verification.
    - Samples are retained for a period of seven years. The physical storage location of each sample is recorded in the Testing Log Form for access should it be required at a future date.
    - Any non-conformity with any test will be reviewed with the Operations Manager, The VP of Manufacturing or the President. Any material that is deemed to be non-conforming as confirmed by one aforementioned personnel is to be segregated and will not be allowed to leave the facility unless independent testing disproves the internal results.

ADVANCED COIL INDUSTRIES

Quality Control Procedures

Quality Assurance Process

Tests Performed per ASHTO, ASTM requirements or ACI requirements

- Thickness test – ASHTO requirement is 10-10 mil minimum
  - This test is carried out using an electronic thickness gauge. QA control: the thickness of the two samples is recorded at the top, middle and bottom on both sides of the larger test samples. This is a PASS / FAIL test. Reference ASTM D1005 or ASTM D7091.
- Impact test - one of three tests for adhesion
  - The large sample group is tested for adhesion by impact testing meeting a minimum impact of 34 in – lb. This impact is achieved with a horizontal impact testing device. Per the specification there will be no breaks in the polymer. The sample is run through the device and then tested for electric conductivity to determine if any penetration in the polymer coating has occurred (Holiday Test). This a PASS / FAIL test. Reference ASTM D2794.
- Mandrel Bend test (Ambient temperature) – test for adhesion
  - The small sample group is tested for adhesion by bending the samples over a mandrel with a hydraulic press. There should be spalling, cracking or disbonding of the coating on the outside of the bend after this test. This is a PASS / FAIL test. Reference ASTM 742
- Mandrel Bend test variant (Freeze/ Thaw) – not a requirement per ASTM unless for not approved material
  - At the request of the customer, ACI will perform the Mandrel Bend test on a sample chilled to 0 degrees Fahrenheit as well as heated to 122 degrees Fahrenheit. The test procedures and requirements are the same as above. This is a PASS / FAIL test. Reference ASTM 742.
- Holiday test - test for adhesion
  - The requirement is that an average of 2 or less holidays per square foot required. Per ASTM G62 Method A


Coated Galvanized
Steel Coil
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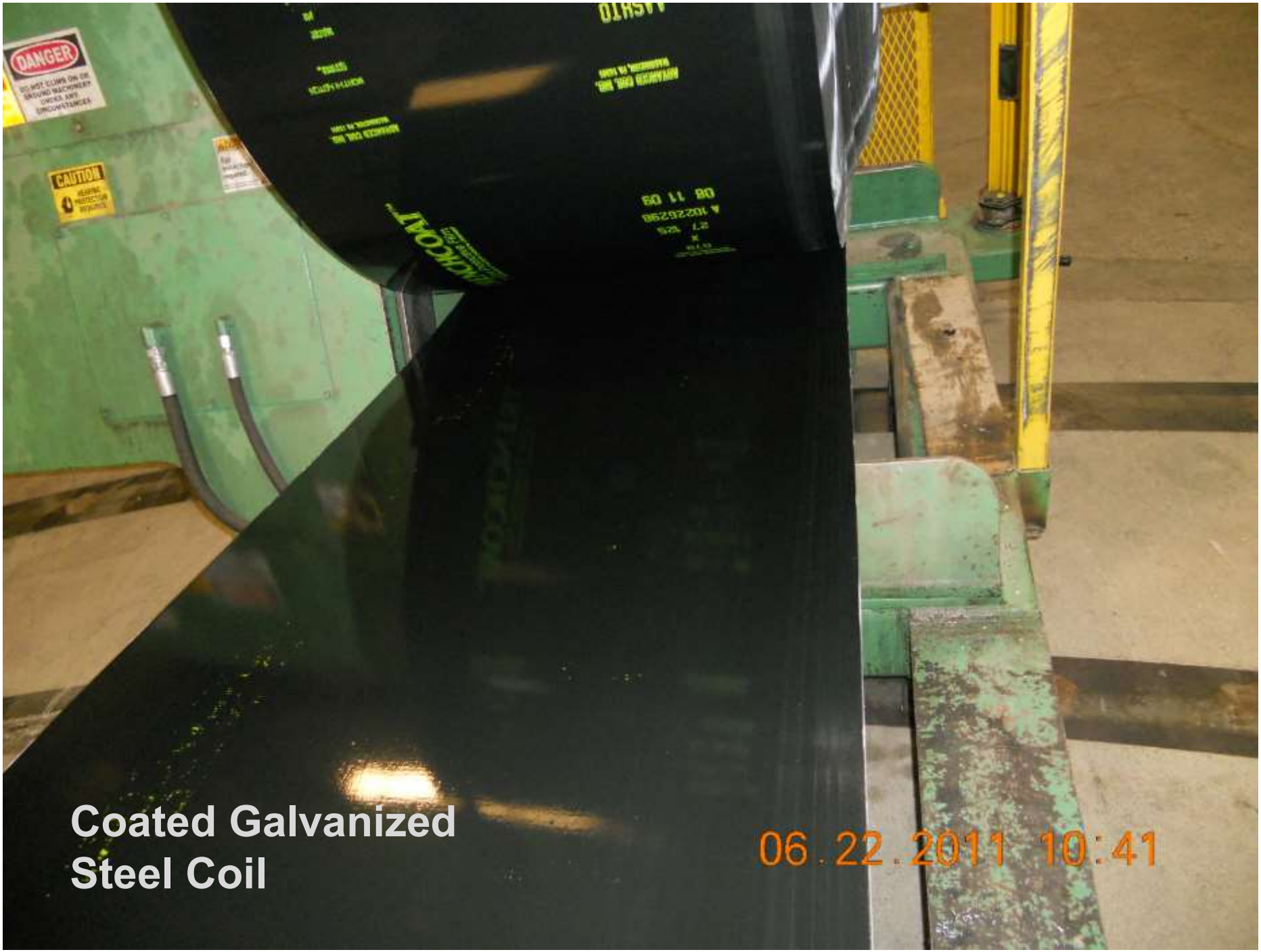
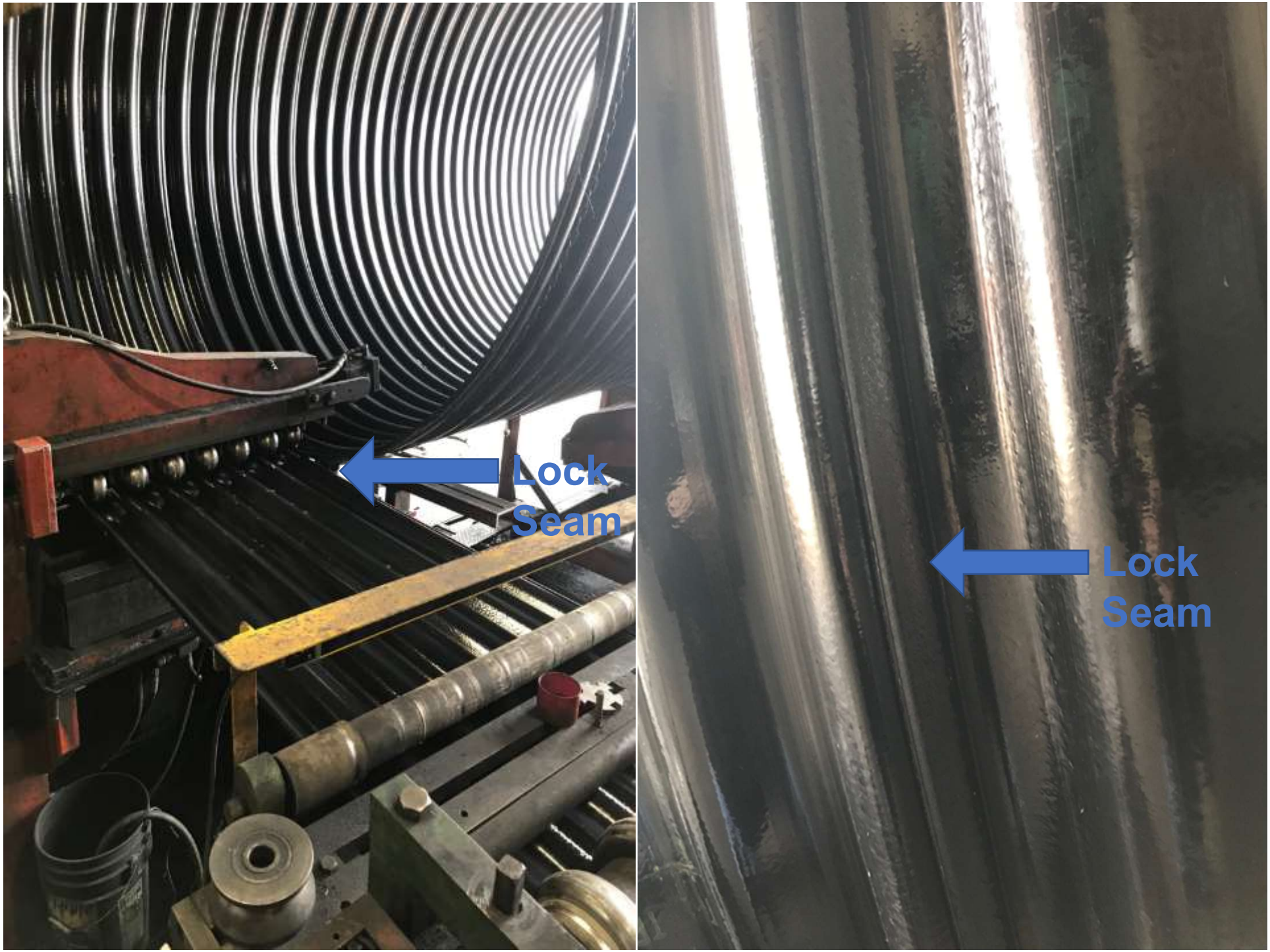


Coated Galvanized
Steel Coil

Corrugation Rollers


Lock
Seam
Lock
Seam


Lock
Seam

Tubosider Austria

Finished 48” diameter

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Manufacturing/Coating Process

Manufacturing Riveted (Annular) Pipe

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Manufacturing/Coating Process

Manufacturing Helical Pipe

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Manufacturing/Coating Process

Plant Handling

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Manufacturing/Coating Process

Plant Storage

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Manufacturing/Coating Process

Loading and Transportation
Use of timbers and nylon slings to protect coating

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Manufacturing/Coating Process

Field Handling – Nylon Slings or Lifting Lugs Recommended

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Manufacturing/Coating Process

Coating Repair

ASTM A762 is the standard which covers the fabrication of the pipe. Includes some language regarding the repair of the polymer coating. In section 10.1 it states the following:

Pipe which has been damaged, either during fabrication or in shipping, may be rejected unless repairs are made which are satisfactory to the purchaser.

New language for ASTM A 762 "Scratches > 0.125" wide. Total area > 1.0 sq. inches"

11.5 Areas of damaged polymer coating shall be repaired with a polymer coating similar and compatible with respect to durability, adhesion, and appearance of the original polymer coating.

11.5.1 Polymer coating damaged during shipping or installation may be repaired using materials as described in 11.5 or by the application of a coating material conforming to Specification A849.

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2012 Polymer Coated Performance Report

Long-Term Field Investigation of Polymer Coated Corrugated Steel Pipe - 2012

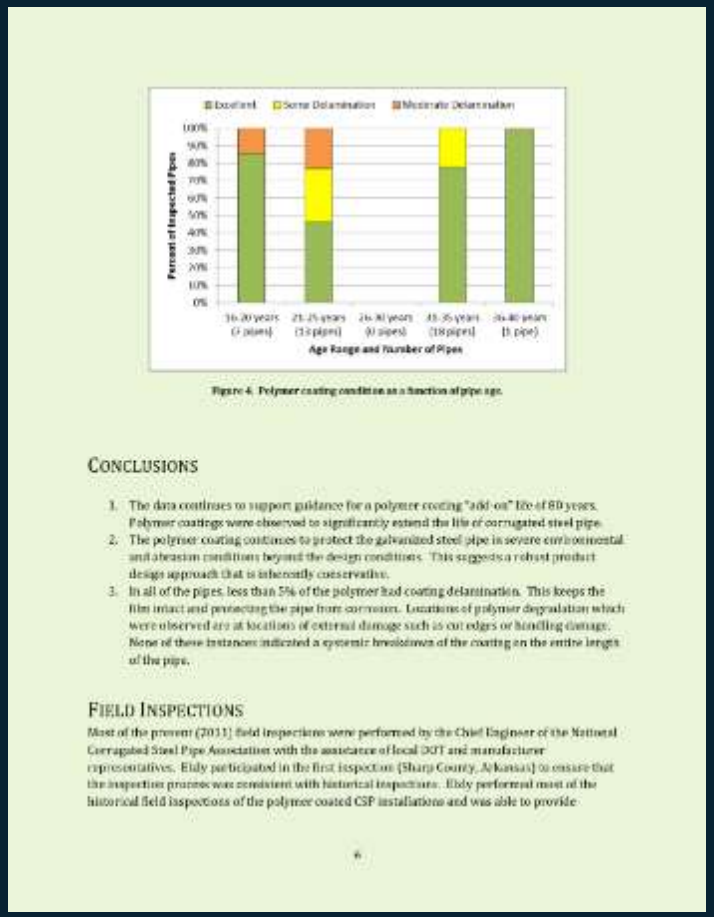

Figure 4. Polymer coating condition as a function of pipe age.

Conclusions

1. The data continues to support guidance for a polymer coating "add-on" life of 60 years. Polymer coatings were observed to significantly extend the life of corrugated steel pipe.
2. The polymer coating continues to protect the galvanized steel pipe in severe environmental and abrasion conditions beyond the design conditions. This suggests a robust product design approach that is inherently conservative.
3. In all of the pipes, less than 5% of the polymer had coating delamination. This keeps the film intact and protecting the pipe from corrosion. Locations of polymer degradation which were observed are at locations of external damage such as cut edges or handling damage. None of these instances indicated a systemic breakdown of the coating on the entire length of the pipe.

Field Inspections

Most of the present (2011) field inspections were performed by the Chief Engineer of the National Corrugated Steel Pipe Association with the assistance of local DOT and manufacturer representatives. Elzly participated in the first inspection (Sharp County, Arkansas) to ensure that the inspection process was consistent with historical inspections. Elzly performed most of the historical field inspections of the polymer coated CSP installations and was able to provide

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Tax School Road, Marshall County IL – Installed 1975 13 Difference Culvert Pipes

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Highway 84 Cass County MN
Installed 1977
14 Different Culvert Pipes

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Montana DOT – Hwy 12 MP 13.7
Elliston, Montana
66″ X 51″ PA Installed in 1988 (30 years)
Heavy Bedload Present

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Medora, ND

- Installed in 1988.
- Zone 4 North Dakota DOT Corrosion Map. “RED Zone” <400 Ohms*cm the highest corrosion zone in ND.
- No signs of corrosion,
- Mud splatter on the side walls and mud layered on the inverts.

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Minneapolis, MN
Hiawatha Golf Course

Installed in 1988.
Steel Spiral Rib Storm Sewer
42” Pipe Arch

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MT Rail Link – Toston, Montana
Installed in 1990s - Abrasion Resistant

Montana Rail Link

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Polymer Coated CSP National Specifications

AASHTO

- Manufacturing – M 245
- Material – M 246
- Design – Section 12
- Installation – Section 26

ASTM

- Manufacturing – A-762
- Material – A 742
- Design – A-796
- Installation – A-798

AREMA

- Part 4 – Culverts

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NDDOT

North Dakota
Department of Transportation

- Added protection from abrasion, salts, alkalis and hot soils
- 100 Years Life, PH 5-9 and >1000 resistivity
- ND DOT Approval for Storm Sewer (shown), and Culvert

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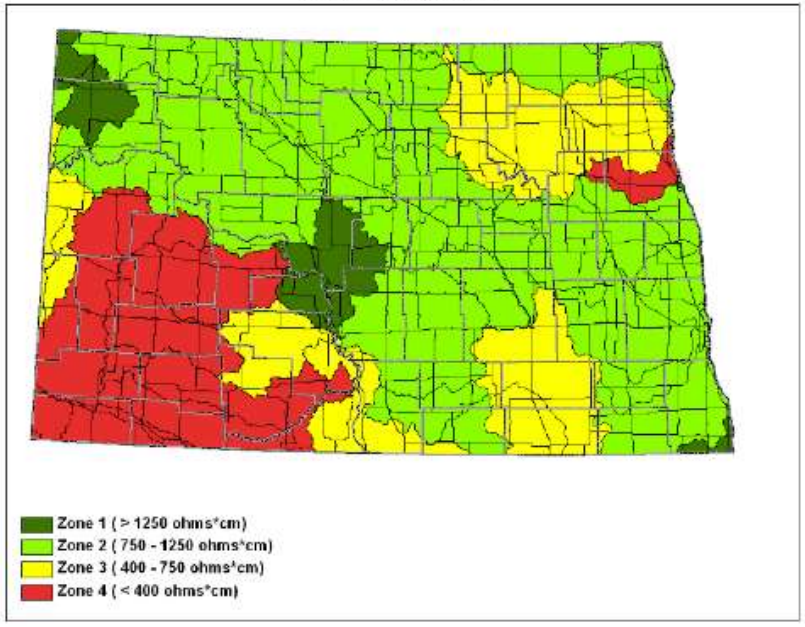
North Dakota Dept. of Transportation

SECTION V-05 Pipe Material Selection
Page 12 Revised 1/26/16

Corrosion Zone Map & Tables

North Dakota Corrosion Zones (Map 1)
(Based on Soil Resistivity)



Data Source: United States Environmental Protection Agency's (EPA) Environmental Monitoring Assessment Program.

Corrosion Table: 4a

- Mainline Drainage -
(Design Service Life - 75 Years)

Pipe Material		Corrosion Zone			
		Zone 1	Zone 2	Zone 3	Zone 4
Concrete Pipe (Section 830.01)		Y	Y	Y	Y
Metal Pipe (Section 830.02)	Gauge				
Zinc Coated Corrugated Steel	16 ga.				
	14 ga.				
	12 ga.				
	10 ga.	Y			
	8 ga.	Y	Y		
Aluminum Coated Corrugated Steel (Type 2)	16 ga.				
	14 ga.				
	12 ga.	Y			
	10 ga.	Y	Y		
	8 ga.	Y	Y	Y	
Polymeric Coated Steel (over Zinc or Aluminum Coated Steel)	16 ga.	Y	Y	Y	Y
	14 ga.	Y	Y	Y	Y
	12 ga.	Y	Y	Y	Y
	10 ga.	Y	Y	Y	Y
	8 ga.	Y	Y	Y	Y
Structural Steel Plate Pipe (Zinc Coated)	16 ga.				
	14 ga.				
	12 ga.				
	10 ga.	Y			
	8 ga.	Y	Y		
Aluminum Alloy Structural Plate Pipe	16 ga.	Y	Y		
	14 ga.	Y	Y		
	12 ga.	Y	Y		
	10 ga.	Y	Y		
	8 ga.	Y	Y		

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UDOT Keeping Utah Moving

- Added protection from abrasion, salts, alkalis and hot soils
- 100 Years Life, PH 5-9 and >1000 resistivity
- Utah DOT Approval for Storm Sewer, Culvert, Detention and reline applications

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Illinois Department of Transportation

Precoated Galvanized (Polymer Coated) meets minimum 75 year service life for culvert & storm sewer.

All small diameter CSP under 48" diameter should be Precoated or Aluminized Steel.

(h)	Precoated Galvanized Corrugated Steel Pipe	1006.01
(i)	Precoated Galvanized Corrugated Steel Pipe Arch	1006.01

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Polymer Coated CSP, Onawa, IA
US Army Corps of Engineers Levee

U.S. Army Corps of Engineers

Project required
10 psi factory joint test

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Polymer Coated Pipe Arch
MDT East Billings, MT

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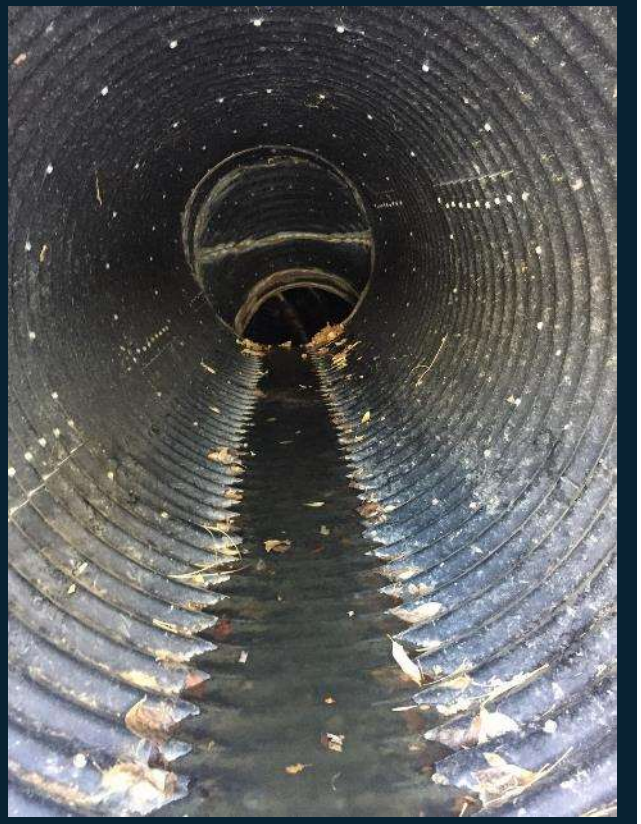
36” Polymer Coated Pipe Installed 1978
Yellowstone CC Billings, MT



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North Dakota DOT Highway 23 Improvements

- ND DOT – Hwy 23 Improvements – 18” – 60” Polymer Coated Spiral Rib Pipe
- Spiral Rib used for storm drain with a manning’s “n” of 0.012
- Polymer coating gives the pipe required service life in the site soil conditions

NDDOT
North Dakota
Department of Transportation

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Polymer Coated Double Wall
Indiana DOT – Indianapolis, IN

- 10,000 LF 96” Diameter Storm

  Fill heights 20’ – 45’

  Ground Water

INDIANA DEPARTMENT OF TRANSPORTATION

INDOT

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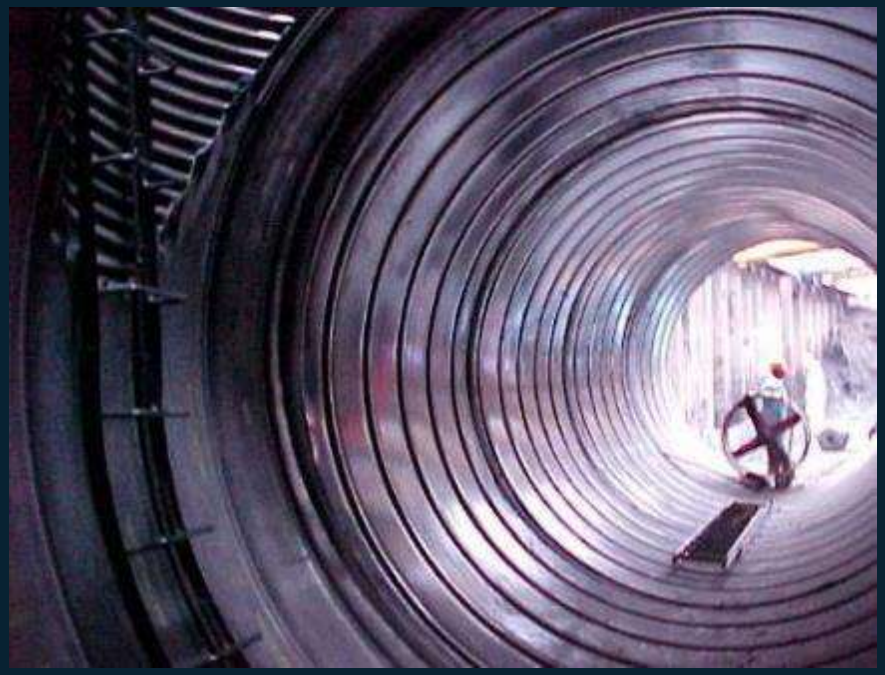
Polymer Coated Double Wall
New Jersey DOT – Lodi, NJ
Sewer Improvements

- 4,000 LF 132” Diameter
- 1,000 LF 120” Diameter
- Constrained Site
- Integrated Manholes



DEPARTMENT OF TRANSPORTATION
THE STATE OF NEW JERSEY

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144” Polymer Double Wall
Illinois DOT I-74, Moline, Illinois

Illinois Department of Transportation

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Polymer Coated Double Wall
CTH 16 Pewaukee, WI
Wisconsin DOT

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Underground Detention – Draper, Utah
96” Polymer CMP (in UDOT right of way)

Superior Storm Sewer, Superior, WI
114” Polymer Double Wall CMP

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SUPERIOR

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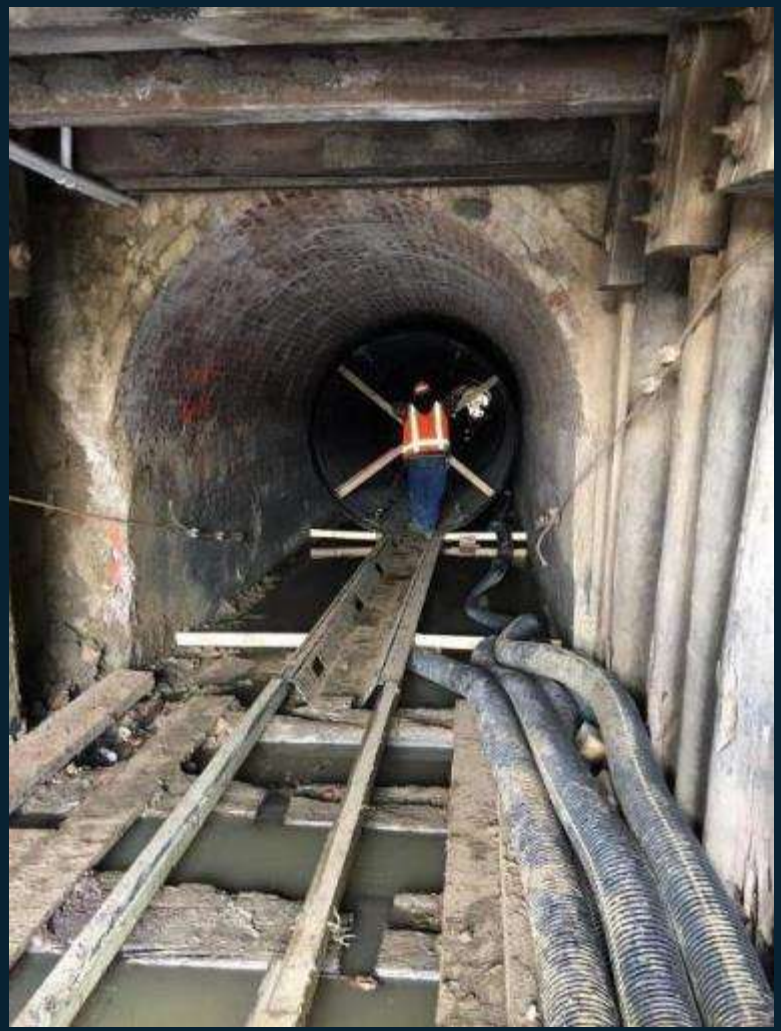
96” Polymer Coated Double Wall
BNSF Reline – Afton, Iowa

BNSF RAILWAY



Polymer Coated CMP 48” & 42” Detention
Marshfield, WI Library

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City Of Marshfield Wisconsin

11th and Walnut St. Denver, Colorado
Polymer Coated CMP 42” Detention/Retention

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STEEL: PROVEN 100-YEARS STRONG

DENVER
THE MILE HIGH CITY

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STEEL: PROVEN 100-YEARS STRONG

Steel End Sections Improve Hydraulic Capacity Available in Polymer Coated

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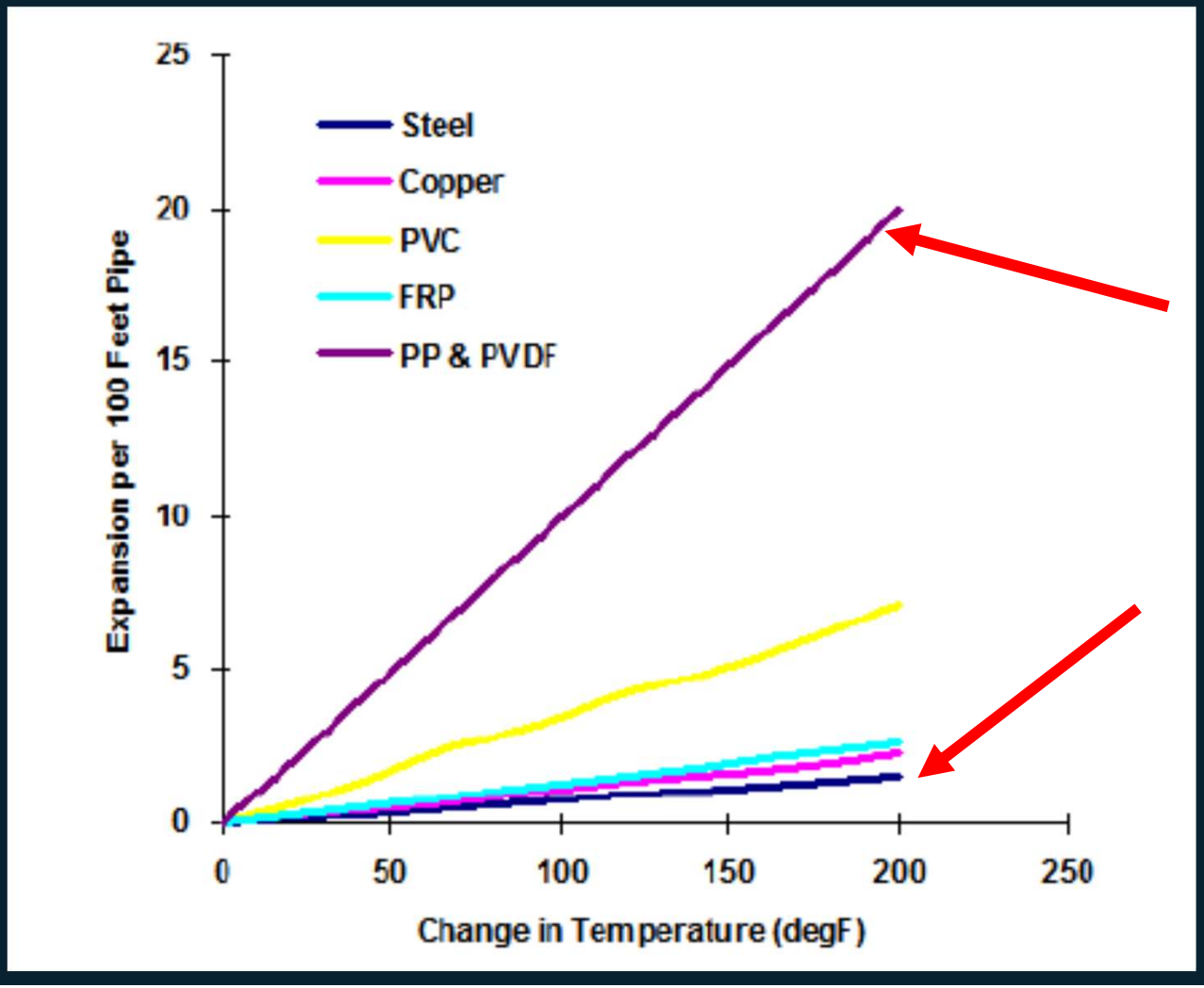
STEEL: PROVEN 100-YEARS STRONG

Why is Polymer Coated CSP Important to You?
Added value compared to Rigid Pipe.

-Strength of steel
-High pipe stiffness
-High Beam Strength
-Long Lengths available
-Flexibility in diameters
-Small OD/ID ratio
-Cost Savings

-Corrosion Protection of Polymer
-Available in Round and Pipe Arch
-High % of Recycle Content up to 46%
-(BOF = 22.3% & EAF = 46.2%)
-Various End Treatments/End Sections
-Multiple Fabrication Options
-Best Overall Value!

Why is Polymer Coated CSP Important to You?
Physical Properties Compared to HDPE.



PP Plastic has 10 X the thermal expansion as Steel.

Steel performs better in cold weather climates than HDPE & PP plastic pipe

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Why is Polymer Coated CSP Important to You?
Physical Properties Compared to HDPE.

Table 12.6.6.3-1—Minimum Cover

Type	Condition	Minimum Cover*
Corrugated Metal Pipe		$S/8 \geq 12.0$ in.
Spiral Rib Metal Pipe	Steel Conduit	$S/4 \geq 12.0$ in.
	Aluminum Conduit where $S \leq 48.0$ in.	$S/2 \geq 12.0$ in.
	Aluminum Conduit where $S > 48.0$ in.	$S/2.75 \geq 24.0$ in.
Structural Plate Pipe Structures	—	$S/8 \geq 12.0$ in.
Long-Span Structural Plate Pipe Structures	—	Refer to Table 12.8.3.1.1-1
Structural Plate Box Structures	—	1.4 ft. as specified in Article 12.9.1
Deep Corrugated Structural Plate Structures	—	See Article 12.8.9.4
Thermoplastic Pipe	Under unpaved areas	$ID/8 \geq 12.0$ in.
	Under paved roads	$ID/2 \geq 24.0$ in.
* Minimum cover taken from top of rigid pavement or bottom of flexible pavement		
Type	Condition	Minimum Cover
Reinforced Concrete Pipe	Under unpaved areas or top of flexible pavement	$B_c/8$ or $B'_c/8$, whichever is greater, $\geq$ 12.0 in.
Type	Condition	Minimum Cover
Reinforced Concrete Pipe	Under bottom of rigid pavement	9.0 in.

Steel Pipe requires only 12” minimum cover under pavement.

Thermoplastic pipe requires 24” minimum cover under pavement

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Why is Polymer Coated CSP Important to You?
Physical Properties Compared to HDPE.

Spiral Rib Steel Pipe does not "creep" under load and re corrugate inside after installation

HDPE AASHTO M293 & PP AASHTO 330 Plastic Pipe will re corrugate under soil loading after installation.

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Corrugated Steel Pipe - 122 years of innovation and expertise.

Solution Development → Design Assistance → Installation

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https://ncspa.org/