Coating Inspection Techniques: Visual and Nondestructive Testing

Period 3

Pipeline Coatings Course
2017
Main Inspection Categories

• Visual
• Nondestructive Testing
• Destructive Testing
Main Inspection Categories

Subcategories

• Prior to start
• Substrate
• Mixing
• During/after application
VISUAL INSPECTION

• Prior to Start
• Substrate Reviews
• Mixing
• Application
Visual Inspection – Prior to Start

Review Specs and Data Pages (Inspection Scope)

- QC/QA Requirements
- Stop Work Authority
- Hold Points
- Documentation Requirements
Visual Inspection – Prior to Start

Review Specs and Data Pages (Coating Scope)

• What is included?
  – Transitions
  – Stripe coat
  – Mock-up or test plates? Why?
• Restrictions different from manufacturer
• Hold points
• Repair/touch up procedure
• Salt limits

Why is this conversation important?...
Visual Inspection – Prior to Start

Simple Coating Project – Why Talk through products, transition points, temperature restrictions...before starting? NBD!
Visual Inspection – Prior to Start
Regular Epoxy and Cold Temp... Still NBD
Visual Inspection – Prior to Start

Pits... getting a little more complicated, client/contractor decided on putty...
Visual Inspection – Prior to Start

But now Clock Spring or Contour Wrap???

And

Transitions....

And Top coat...
Visual Inspection – Prior to Start

Why yes, I am a bit stressed.

Why do you ask?
Visual Inspection – Prior to Start

Review Specs and Data Pages (Project Concerns)

• Temperature
• Narrow recoat window
• Short pot life
• Humidity
Visual Inspection – Prior to Start
Visual Inspection – Substrate Review

- Contaminants
- Pitting
- Difficult to detail areas
  - Bolts, brackets, rivets
  - Sharp edges
  - Gaps
    - Caulk/steel filler
    - Weld
    - Plates
  
(welds on next slide)
Visual Inspection – Substrate Review

Good

But...

...
Visual Inspection – Substrate Review
Visual Inspection – Substrate Review

• Welds (SPO 178)
    • *(Plastic Weld Replica)*
  – *API 652, Linings of Aboveground Petroleum Storage Tank Bottoms*

  – Porosity
  – Undercut
  – Skip welds
  – Spatter
  – Sharp edges from grinding
Visual Inspection – Substrate Review

Sample Mark-up
Visual Inspection – Prior to and During Mixing

Product Storage:
• Temperature
• Dates
• Correct thinner
• Components (ratios)

Mixing:
• Correct paddle
• Consistency
• Color
• Straining
• Sweat/induction time
Visual Inspection – Prior to and During Mixing
Visual Inspection – During/Following Application

- Consistency in coverage
- Finish
- Color
- Bubbles
- Contaminants
- Pinholes/misses
- Hard to access
  - Mirror/Lighting (NDT section)
Nondestructive Testing

- Visual
- Environmental Conditions
- Substrate Reviews

- Mixing/Spray Prep
- During/Following Application
Nondestructive Testing - Visual

- Mirrors
- Magnification
- Lighting (next slide)
Nondestructive Testing - Visual

100 lumens of clean white light
Nondestructive Testing — Environmental Conditions

- Surface and air temp
- Relative Humidity (hygrometers)
- Data loggers
Nondestructive Testing - Substrate

Poor surface prep is estimated to cause 75-90% of coating failures

Main surface prep factors: (overview)

- Free of contaminants
- Level of prep (cleanliness)
- Surface profile
Nondestructive Testing - Substrate

Visible Contaminants
- Solvent clean (SSPC SP 1)
  - Many “solvents”
  - Before prep

Soluble salt testing (Following solvent clean)
- Many types of tests and types of salts.
- Know what is specified and what potential contaminants there might be
Nondestructive Testing - Substrate

Surface Prep (overview)

Dry Methods
- Hand tool
- Power Tool
- Abrasive Blasting

Wet Methods
- Waterjetting
- Wet abrasive blasting
Nondestructive Testing - Substrate

Steel Condition:

A  intact mill scale
B  partially rusted mill scale
C  100% rusted, no pits
D  rusted and pitted
E  paint mostly intact
F  zinc-rich paint
G  deteriorated paint over mill scale
Nondestructive Testing - Substrate

Dry Prep:

Hand Tool (SSPC-SP 2) and Power Tool (SP 3)

- Use VIS-3
- No profile specified
- Solvent clean first (if visual contaminants)
- Remove everything “loose”
  - Hand – Chisel, wire brush, scraper
  - Power – Rotary, impact, power sander/abrader
- Dull putty knife
Nondestructive Testing - Substrate

Power Tool – 1 mil min profile

- No magnification
- SP 15 (Commercial Grade)
  - Staining limited to 33%
- SP 11 (Bare Metal)
  - Shadows and staining only in bottom of pits
Nondestructive Testing - Substrate

Abrasive Blasting

— Use VIS 1
  • Determine starting grade
— SP 7 (Brush off)
— SP 14 (Industrial)
— SP 6 (Commercial Grade)
— SP 10 (Near White)
— SP 5 (White Metal)
Nondestructive Testing - Substrate
Nondestructive Testing - Substrate

Profile (ASTM D4417)

- **Method A – Visual/Touch**
  - Up to 10x magnification
- **Method B – Probe**
  - Zero on glass
  - Average 10 readings at each location
- **Method C – Tape**
  - Coarse – 0-2 mils
  - X-coarse – 1.5-4 mils
  - HT
  - Measure and subtract for plastic (2 mils)
  - 3 readings at each location for mean
- **These methods are not interchangeable**
Nondestructive Testing – During/After Application

During Application
• Verify stripe on welds, rivets, sharp edges
• Watch for correct overlap
• Identify runs or sags
• Look for pinholes or bubbles
• Wet film (ASTM D4414)
  – A – Comb
  – B – Disc
• Stay out of the way
Nondestructive Testing – During/After Application

**Dry Film Thickness:**
SSPC-PA 2 – Procedure for Determining Conformance to Dry Coating Thickness Requirements

**Averaging**
- Gage reading (individual)
- Spot Measurement
  - Disregard non-repeatable highs and lows
- Area Measurement (recordable)
  - Must fall within the specified range for acceptance

![Diagram of coating inspection techniques](image)
Nondestructive Testing – During/After Application

Dry Film Thickness

• Conformance – If no range is given, then the range is +/-20% of the provided thickness

• Nonconforming readings – mark for correction
  – Within 5’ is non-compliant
  – Adjacent are suspect

• Appendix 7 – Pipe can be averaged per cart or rack, versus per section
Nondestructive Testing – During/After Application

Dry Film Thickness - Gages

• Type 1 – Magnetic Pull-off
  – Banana or pencil
• Type 2 – Electronic
  – Ferrous or non-ferrous probes
• **Calibrated by Manufacturer**, verified on-site
  – Type 1 – verify on smooth test blocks
  – Type 2 – follow manufacturer instructions
Nondestructive Testing – During/After Application

Holiday Testing (NACE SP0188)

Low Voltage – Max 20 mils
- 5v to 90v direct current
- Wet sponge – tap water
  - Wet enough to barely avoid dripping
  - Low sudsing surfactant may be used (dishwasher rinse aid)
  - Check frequently for grounding
  - Double pass per foot per second
Nondestructive Testing – During/After Application

High Voltage – 20 mils minimum without manufacturer approval

- V. per documents or table in SP0188
- Confirm proper cure to not have false positives
- No moisture on surface
- Check frequently for grounding
- Single pass per foot per second
PROJECT EXAMPLES

- Stadium
- Secondary Containment
- Bridge Warranty
Stadium Recoating – Importance of Warranty Walk Through
Stadium Recoating – Importance of Warranty Walk Through

Looking Great?
Stadium Recoating – Importance of Warranty Walk Through
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Stadium Recoating – Importance of Warranty Walk Through

Moral of the Story - You can’t catch it all
Reinforced Concrete Liner Examples
Reinforced Concrete Liner Examples
Bridge Examples
Holiday Testing on Concrete
Tank Containment
Questions?