



— BUREAU OF —
RECLAMATION

Coating Failures

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What is the Purpose of Coatings

- Coatings provide a barrier between the electrolyte (water or soil) and metal surface, providing corrosion protection
- Coatings are a primary corrosion protection method. Cathodic protection, another mitigation method, works best when paired with a bonded dielectric coating.
- Coatings must provide a defect free surface for the entire structure



Definitions

- Coating Failures – Premature coating failure due to errors during surface preparation, coating application, environmental conditions, or complex problems even specialist don't know about.
- Service Conditions – Premature failures due to short service life
- Coating Degradation – The natural process of coating aging



Types of Coating Failures

Inadequate Surface Preparation

- Surface cleanliness
- Surface profile
- Dust/ particulate contaminants
- Lead to adhesion failures

Environmental conditions

- Amine Blush
- Condensation/ precipitation
- Cold temperature application

Application

- Too thin
 - Pinpoint corrosion/ rust rashing
 - Edge corrosion
 - Bridging
- Too thick
 - Solvent entrapment
 - Crazing/ cracking/ mud cracking
 - Wrinkling
 - Internal Stress
 - Runs/ Sags/ Drips

- Recoat windows
- Contaminants air and surface
 - Bubbles/ air voids
 - Fish eyes/ Cratering
 - Blistering
 - Osmotic/ salt contamination
 - Solvent
 - CO₂ off-gassing
- Materials issue
 - Crawling
 - Bleeding
 - Cold wall effect/ heat sink phenomena
 - Off ratio/ iso spit



Flaking Paint Chips due to Painting over Particulate Contaminants

- Probable Cause
 - Application of coating to loose material/particulates
- Mitigation
 - Remove chalking/coating materials, sand and wipe clean
- Prevention
 - Sand and wipe clean



Amine Blush

- Probable Cause
 - Amines have a secondary reaction with CO₂ and moisture
 - exasperated at low temperature and high humidity
- Mitigation
 - Remove loose coating, clean with detergent to remove amine blush, and sand intact coating prior to receiving a new coat
- Prevention
 - Use dehumidification equipment and/or heat



Flash Rust due to Environmental Conditions

- Probable Cause
 - Flash rust due to increase in humidity levels (ex. one pipe had cold water flowing through the pipe)
- Mitigation
 - Abrasive blast clean once humidity is controlled
- Prevention
 - Use dehumidification equipment and/or heat
 - Dewater both pipes



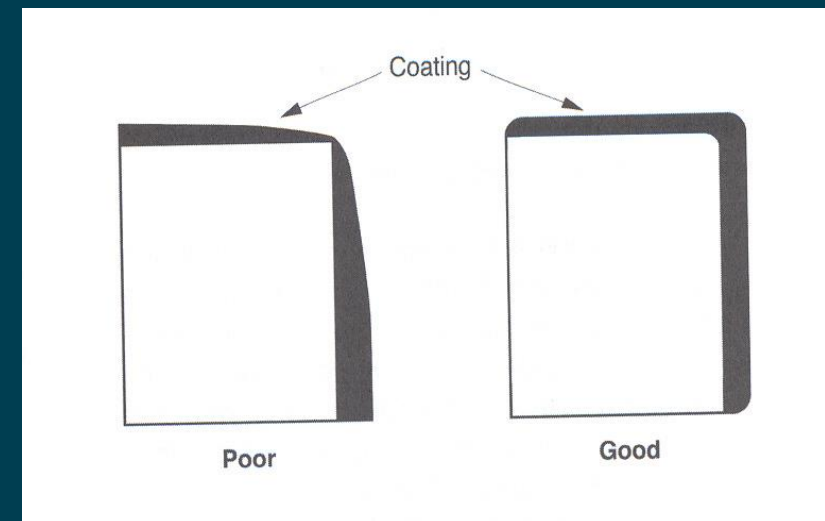
Edge Corrosion

- Probable Cause

- Sharp edges: coatings have a natural tendency to pull away from sharp edges

- Prevention

- Grind or chamfer the edges
- Stripe coat to add more coating on edges



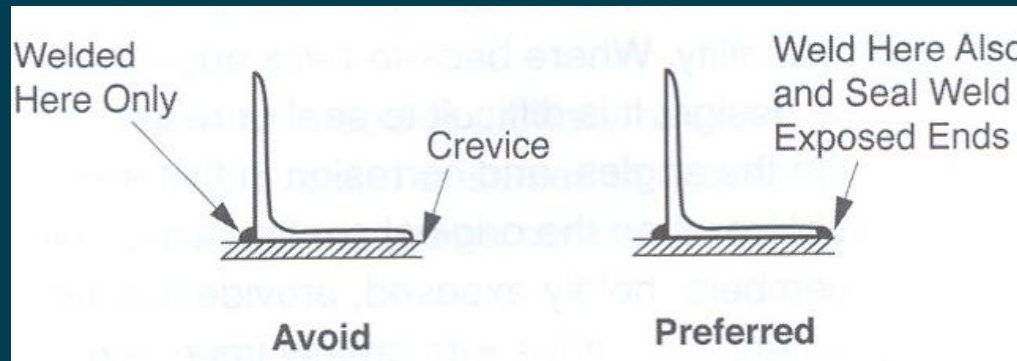
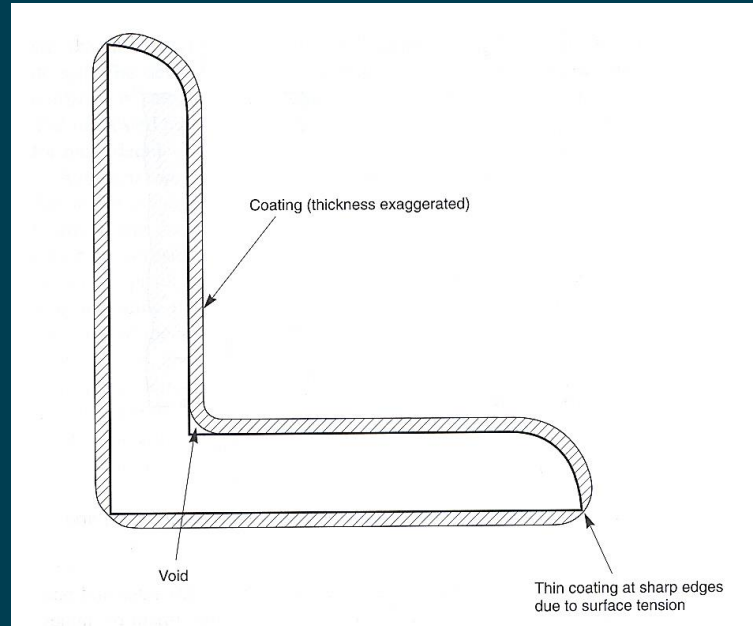
Bridging in Corners

- Probable Cause

- Coating was bridged during application, crack in coating developed over a weld

- Prevention

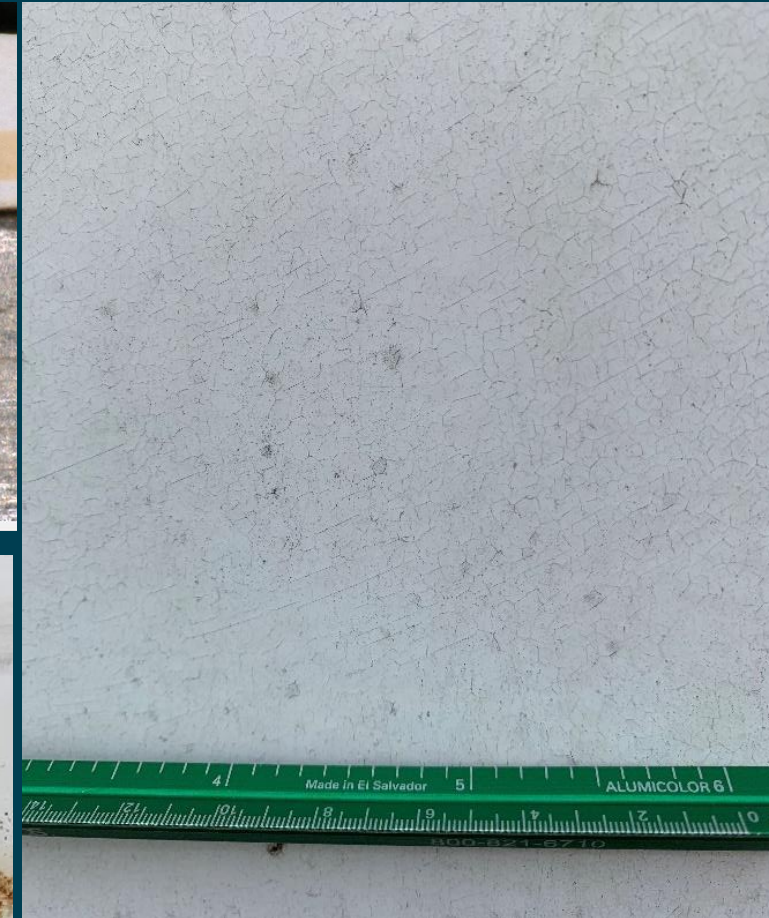
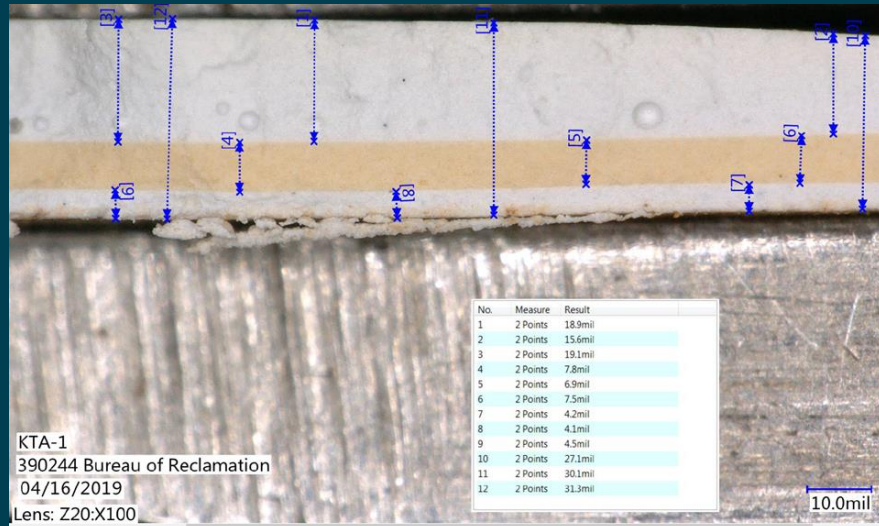
- Stripe coat using a brush to work the coating into the irregular shape



Solvent Entrapment/ Cracking/ Corrosion Rash

- Probable Cause

- Excessively thick coating applied, resulting in solvent entrapment
- Increased internal stress, resulting in cracked coating



- Prevention

- Good quality control
- Applicators should apply coatings within the manufacturers dry film thickness guidelines



Wrinkling, Waves, Drips, Sags, Runs

- Probable Cause

- Excessively thick coating applied, resulting in runs, sags, waves, and drips

- Prevention

- Coating applicator needs more practice in applying coatings, or
- Lower the volume of coating coming out of the spray gun



Heat Sink Phenomena

- Probable Cause

- Observed with fast cured Polyurethane's or Polyurea's
- Coating is applied on cold pipe, but contractor is using heat and DH to control the environment
- Initial layer of paint on the steel reaction is slower than the coating in contact with the air, resulting in blistering

- Prevention

- Reduce the temperature so that there is not a large temperature differential, or switch coatings for a slower reaction rate material



Disbondment due to Off-Ratio Mixing

- Probable Cause

- Plural component coatings are applied at the gun tip, if equipment has issues, the coating ratio is not correct and will form blisters

- Prevention

- Applicators must purge material to make sure materials are on ratio prior to application on structure



Service Conditions Causing Premature Failures

- Up lift forces- cause delamination
- Erosion
- Impact
- Cavitation
- UV degradation- causes chalking/ loss in gloss/ yellowing
- Slight movement/ vibrations- cause cracking
- Rivets and fasteners- can be a source of cracking
- Cyclic wetting/drying



Disbondment due to Uplift Forces



Uplift Forces (cont.)



Erosion of Linings



Cavitation Damage to Linings



Cracking due to Vibration



Natural Coating Degradation

- UV degradation/ chalking/ loss in gloss/ yellowing
- Blistering
- Cracking/ due to volume loss/ internal stress
- Barrier breakdown



UV Degradation



Blistering due to Degradation



Cracking of Coal Tar Enamel



Barrier Properties Degradation



QUESTIONS?

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Cathodic Protection



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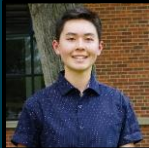
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Hazardous Materials

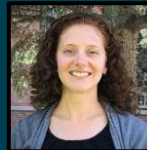


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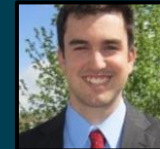
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