Optimizing Protective Coatings Projects: From Specification to Completion

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IRWA
ILLINOIS RURAL WATER ASSOCIATION

Discussion Topics

- Coating System Development
- QA & QC
- Surface Preparation
- Team Selection and Competency
- Risk Mitigation
- Lifecycle Considerations

Coating System Development

Best Practices

- Clear and Transparent Communication
- Engaging a Multi-Disciplinary Knowledge Base
- Leveraging Tested and Emerging Technologies
- Managing Expectations
- Oversight & Accountability
- Long-Term Focus on Maintenance

Coating System Development

Collaborative Approach

- Design Professionals
- Coatings Manufacturers
- Experienced Contractors
- Equipment Manufacturers
- Coatings Inspectors
- Specialized Consultants
- Testing Agencies

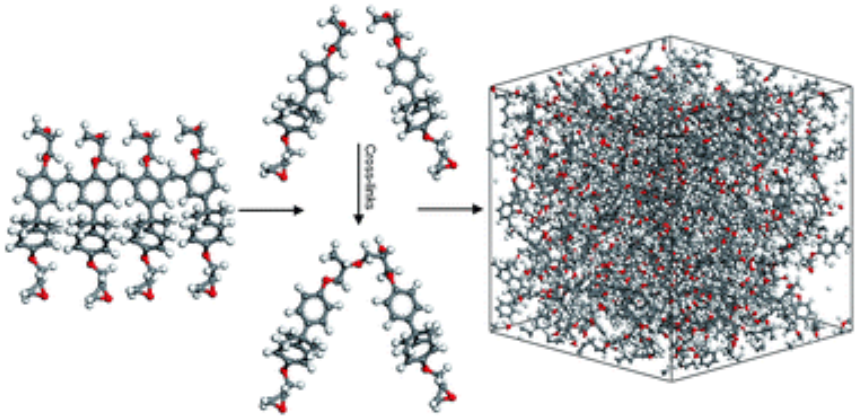
How Coatings Work – Protective Barriers

Coatings form a protective barrier between a substrate and the surrounding environment.

- Less permeable coatings provide better corrosion & chemical resistance.
- Advanced technologies provide additional performance benefits.
- More durable coatings also resist physical damage
- Color and sheen retentive topcoats provide aesthetic characteristics.

How Coatings Work – Functionality

- Chemical reactions during film formation result in cross-linking within the final film.
- More reactive sites = Tighter and more three-dimensional crosslinking density.
- Increased Functionality = Increased Cohesive Strength
  - Durability
  - Lower Permeability
  - Greater Chemical Resistance
  - Longer Corrosion Resistance



System Criteria – Service Environment

- Primary Considerations – System Viability
  - Intended Use / Facility Needs
  - Anticipated and Potential Exposures
  - Expected Service Life
- Secondary Considerations – Constructability
  - Potential Limitations
  - Repair and Recoating Requirements
  - Design Aesthetics

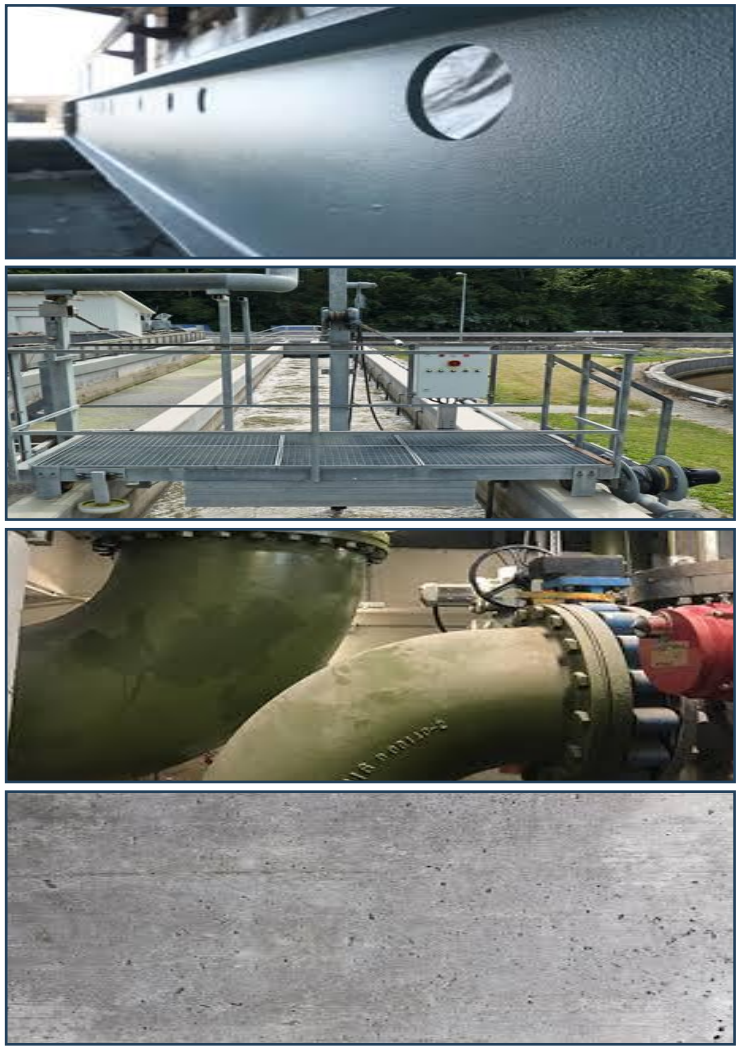
Coating System Considerations

Substrate Requirements

- Surface Preparation
- Primers / Sealers / Fillers

Environment / Intended Use

- Chemical Resistance / Corrosivity
- Heat Resistance / Thermal Shock
- Abrasion & Impact
- Finish Requirements
- Intermediate & Topcoats



System Selection Based on Service Life

NACE Paper No. 20960 Example

Coating System No.	Type	Coating Systems for Atmospheric Exposure (primer/midcoat/topcoat)	Surface Preparation[2]	Number of Coats	DFT Minimum (mils)	Practical Maintenance Time[1,3]		
						Mild (rural)/C2	Moderate (industrial)/C3	Severe (heavy industrial)/C5
1	Acrylic	Acrylic Waterborne/Acrylic WB/Acrylic WB	Hand/Power	3	6	12	8	5
2	Acrylic	Acrylic Waterborne/Acrylic WB/Acrylic WB	Blast	3	6	17	12	8
3	Alkyd	Alkyd/AlkydAlkyd	Hand/Power	3	6	12	8	5
4	Alkyd	Alkyd/Alkyd/Alkyd (AWWA OCS-1C)	Blast	3	6	17	12	8
5	Alkyd	Alkyd/Alkyd/Urethane Alkyd	Blast	3	6	18	13	9
6	Alkyd	Alkyd/Alkyd/Silicone Alkyd (AWWA OCS-1D)	Blast	3	6	18	13	9
7	Epoxy	Surface Tolerant Epoxy (STE)	Hand/Power	1	5	11	6	4
8	Epoxy	Surface Tolerant Epoxy/STE	Hand/Power	2	10	15	10	7
9	Epoxy	Surface Tolerant Epoxy/STE	Blast	2	10	21	15	12
10	Epoxy	Surface Tolerant Epoxy/Polyurethane	Hand/Power	2	7	15	10	7
11	Epoxy	Surface Tolerant Epoxy/Polyurethane	Blast	2	7	21	15	11
12	Epoxy	Surf-Tolerant Epoxy/STE/Polyurethane	Hand/Power	3	12	21	15	10

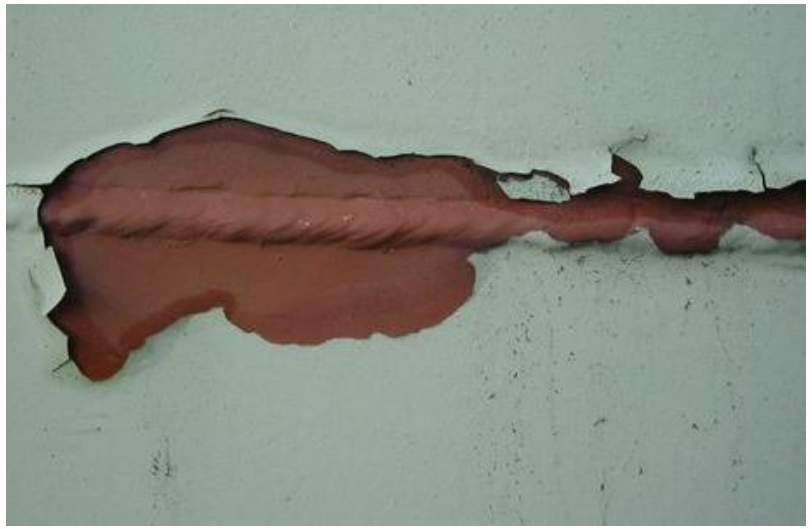
Quality Assurance & Quality Control

- **Surface Preparation Requirements**
  - Means & Methods
  - Minimum vs. Optimum
  - Impact on Performance & Service Life
- **Application & Inspection**
  - Material & Contractor Qualifications
  - Detailed Shop Drawings
  - Inspection & Oversight
  - Risk Mitigation

Surface Preparation

Surface Preparation

The most common contributor to coating system failure or shortened service life is poor or improper surface preparation.



General Criteria for Surface Preparatior

- **Soundness**
  - Remove loose substrate (rust, weak concrete, efflorescence)
  - Repair voids prior to coating application
- **Cleanliness**
  - Remove all loose materials and contaminants
  - Allow for unimpeded adhesion to the substrate
- **Surface Profile**
  - Provides anchor for mechanical adhesion of the coating
  - Must reflect requirements for specific coating thickness

Surface Preparation Considerations

- Determining / Specifying Surface Prep
  - Manufacturer's Recommendations
    - Provide Minimum Requirements
    - Better Prep = Longer Service Life
  - Reference Standards
    - Provide Means and Methods to Achieve Minimum Prep
    - Manufacturer's Formulate Coatings based on Standards
  - Focus on the Expected Results
    - Level of Cleanliness
    - Surface Profile

Surface Preparation Standards

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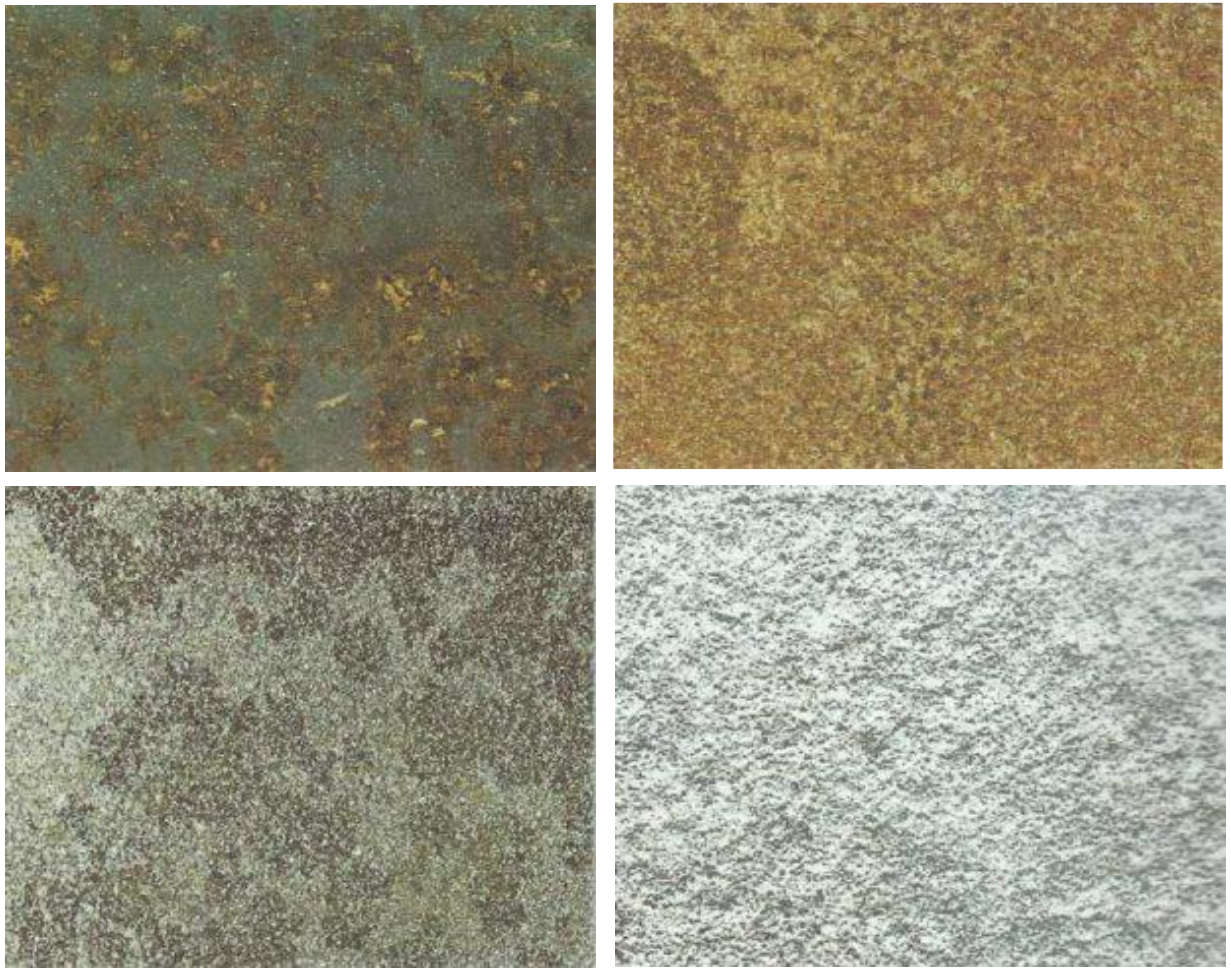
Surface Preparation - Steel

Basic Concerns

- Surface Cleanliness
  - Rust
  - Mill Scale
  - Salts / Other Chemicals
  - Dirt / Dust
  - Existing Coatings
- Surface Profile
  - Mechanical Adhesion
  - Right-sized for Film Thickness
  - Steel Shot vs. Steel Grit



Surface Preparation - Steel

Surface Preparation and Paint Application Standards

- SSPC-SP 1 — Solvent Cleaning
- SSPC-SP 2 — Hand Tool Cleaning
- SSPC-SP 3 — Power Tool Cleaning
- SSPC-SP 5 / NACE 1* — White Metal Blast Cleaning
- SSPC-SP 6 / NACE 3* — Commercial Blast Cleaning
- SSPC-SP 7 / NACE 4 — Brush Off Blast Cleaning
- SSPC-SP 10 / NACE 2* — Near White Metal Blast Cleaning
- SSPC-SP 11* — Power Tool Cleaning to Bare Metal
- SSPC-SP WJ 1-4 — Waterjet Cleaning of Metals 1- 4
- SSPC-SP 14 / NACE 8* — Industrial Blast Cleaning
- SSPC-SP 16* — Brush Off Blast Cleaning of Non-Ferrous

- SSPC-PA 1 — Shop, Field and Maintenance Painting of Steel
- SSPC-PA 2 — Procedure for Determining Conformance to Dry Coating Thickness Requirements

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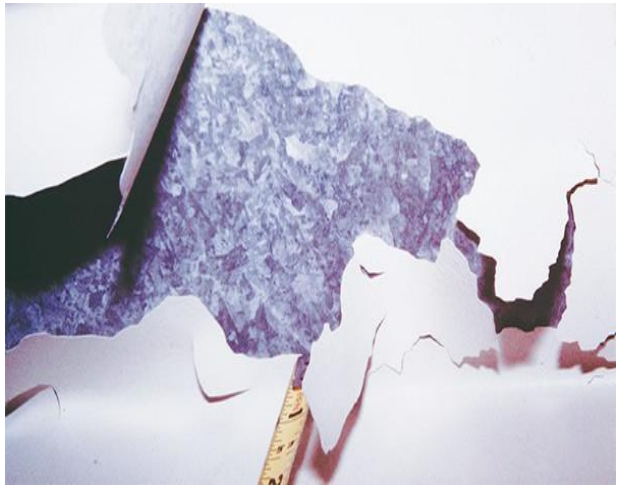
Surface Preparation – Galvanized Steel

Basic Concerns

- **Surface Cleanliness**
  - Zinc Oxide
  - White Rust (Storage Stain)
  - Oil / Grease
  - Existing Coatings
- **Surface Profile**
  - Mechanical Adhesion
  - Limited Profile
- **Timing**
  - Partially Weathered (48 hrs)
  - Fully Weathered (1 Year)



Surface Preparation – Galvanized Steel

SSPC SP-16
Brush off Blast Cleaning of Non-Ferrous Metals

ASTM D6386-16
Standard Practice for Preparation of Zinc Coated Iron and Steel

- Hand / Power Tool Cleaning
- Chemical Cleaning
- Surface Treatments

Surface Preparation – Ductile Iron

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NAPF 500-03

- Reflective of SSPC Standards
- 500-03-01 (Solvent Cleaning)
- 500-03-02 (Hand Tool Cleaning)
- 500-03-03 (Power Tool Cleaning)
- 500-03-04 (Abrasive Blast Cleaning – Pipe)
- 500-03-05 (Abrasive Blast Cleaning – Fittings)

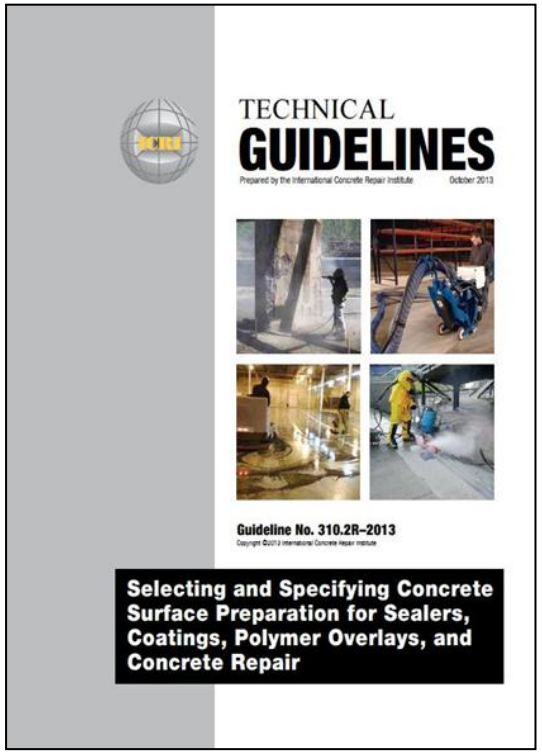
Basic Concerns

- Clean – Free of Rust, Dirt, Oil, Tar Coatings
- No Surface Profile Call-Out

Surface Preparation - Concrete

Basic Concerns

- Surface Cleanliness
  - Efflorescence
  - Laitance
  - Form-Release / Curing Agents
  - Dirt / Oil / Grease
- Surface Structure
  - Surface Profile
  - Surface Porosity
  - Voids – Bug holes / Honeycombs
  - Protrusions – Fins / Burs



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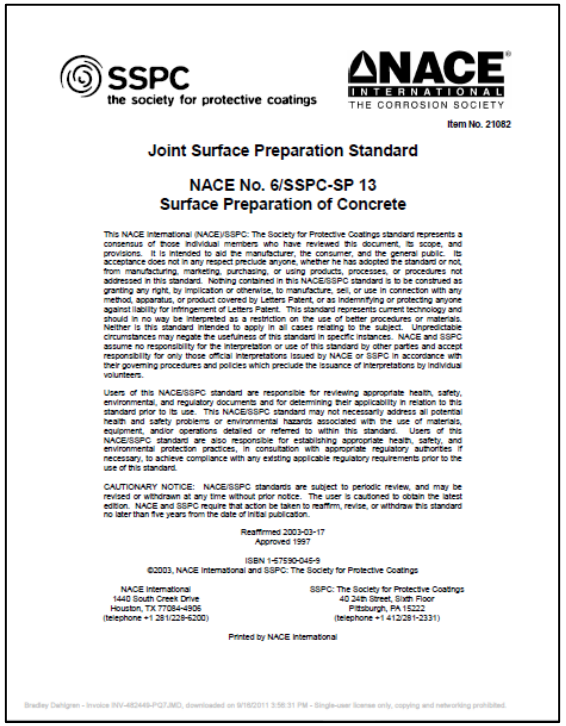

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Surface Preparation - Concrete

ICRI 310.2R-2013

Caution! The texture and appearance of the profile obtained will vary depending on the concrete strength, the size and type of aggregate, and the finish of the concrete surface. On sound substrates, the range of variation can be sufficiently controlled to resemble the referenced CSP standard. As the depth of removal increases, the profile of the prepared substrate will be increasingly dominated by the type and size of the coarse aggregate.

Fig. 6.1: CSP 1 (acid-etched)

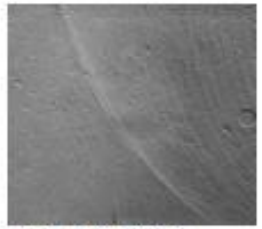

Fig. 6.2: CSP 2 (grinding)

Fig. 6.3: CSP 3 (light shotblast)

Fig. 6.4: CSP 4 (light scarification)

Fig. 6.5: CSP 5 (medium shotblast)

Fig. 6.6: CSP 6 (medium scarification)

Fig. 6.7: CSP 7 (heavy abrasive blast)

Fig. 6.8: CSP 8 (scabbled)

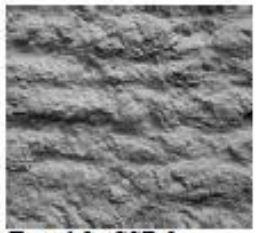

Fig. 6.9: CSP 9 (heavy scarification—rotomilled)

Fig. 6.10: CSP 10 (handheld concrete breaker followed by abrasive blasting)

Surface Preparation - Concrete

Table 7.1: Protective Systems

Material to be applied	Concrete Surface Profile									
	CSP 1	CSP 2	CSP 3	CSP 4	CSP 5	CSP 6	CSP 7	CSP 8	CSP 9	CSP 10
Sealers, 0 to 3 mils (0 to 0.075 mm)	■	■								
Thin films, 4 to 10 mils (0.01 to 0.025 mm)	■	■	■							
High-build coatings, 10 to 40 mils (0.025 to 1.0 mm)		■	■	■	■					
Self-leveling toppings, 50 mils to 1/8 in. (1.2 to 3 mm)			■	■	■	■				
Polymer overlays, 1/8 to 1/4 in. (3 to 6 mm)				■	■	■	■	■		
Concrete overlays and repair materials, >1/4 in. (>6 mm)				■	■	■	■	■	■	■

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Table 7.2: Preparation Methods

Surface preparation method	Concrete Surface Profile									
	CSP 1	CSP 2	CSP 3	CSP 4	CSP 5	CSP 6	CSP 7	CSP 8	CSP 9	CSP 10
Detergent scrubbing	■									
Low-pressure water cleaning	■									
Grinding	■	■								
Acid etching	■	■	■							
Needle scaling		■	■	■						
Abrasive blasting		■	■	■	■	■	■			
Shotblasting		■	■	■	■	■	■	■	■	
High- and ultra-high-pressure water jetting			■	■	■	■	■	■	■	■
Scarifying				■	■	■	■			
Surface retarder (1)					■	■	■	■	■	■
Rotomilling						■	■	■	■	
Scabbling							■	■	■	
Handheld concrete breaker							■	■	■	■

(1) Only suitable for freshly placed cementitious materials

Manufacturer's Recommendations

- Usually Provides Minimum Requirement
- Consider Atmospheric v. Immersion
- References Industry Standard Guidelines
- Lists Surface Profile

SURFACE PREPARATION

Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.

Minimum recommended surface preparation:

Iron & Steel:	Atmospheric: SSPC-SP2/3/ ISO8501-1:2007 St 2 or SSPC-SP WJ-3 / NACE WJ-3L Immersion: SSPC-SP10 / NACE 2/ ISO8501-1:2007 Sa 2.5, 2-3 mil (50-75 micron) profile or SSPC-SP WJ-2/NACE WJ-2L
Stainless Steel:	Atmospheric: SSPC-SP16, 1 mil (25 micron) profile
Aluminum & Galvanizing:	SSPC-SP1. If surface has not be weathered for more than 6 months, follow SSPC-SP1 then SSPC-SP16. For fire proofing projects, consult a Sherwin-Williams representative for surface preparation requirements.
Concrete & Masonry:	Atmospheric: SSPC-SP13/NACE 6, or ICRI No. 310.2R CSP 1-3 Immersion: SSPC-SP13/NACE 6-4.3.1
Ductile Iron Pipe:	Atmospheric: NAPF 500-03-03 Power Tool Cleaning Buried & Immersion: NAPF 500-03-04 Abrasive Blast Cleaning Cast Ductile Iron Fittings: NAPF 500-03-05 Abrasive Blast Cleaning

Surface Preparation Based on Service Life

NACE Paper No. 20960 Example

- Same Coating System
- Same Dry Film Thickness (DFT)
- Note Service Life Change
- Note Service Life in Each Environment

Coating System No.	Type	Coating Systems for Atmospheric Exposure (primer/midcoat/topcoat)	Surface Preparation[2]	Number of Coats	DFT Minimum (mils)	Practical Maintenance Time[1,3]			
						Mild (rural)/C2	Moderate (industrial)/C3	Severe (heavy industrial)/C5-I	Seacoast Heavy Industrial/C5-M
10	Epoxy	Surface Tolerant Epoxy/Polyurethane	Hand/Power	2	7	17	12	9	9
11	Epoxy	Surface Tolerant Epoxy/Polyurethane	Blast	2	7	21	15	12	12

Materials, Application & Oversight

Best Practices for Quality Control

- Pre-Bid Meetings
  - Prime Contractors (Mandatory)
  - Subcontractors
  - Coatings Manufacturers
  - Coatings Inspection Firms
- RFI / Substitution Requests / Shop Drawings
  - Collaboration with Contractors / Manufacturers
- Mandatory Pre-Construction Meetings
  - General Contractor
  - Installing Contractors
  - Manufacturer Representatives
  - Coatings Inspection Firms

Qualified Manufacturer Requirements

1.4 SUBMITTALS

A. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

A. Manufacturer's Project References: Submit manufacturer's list of successfully completed resinous flooring system projects, including project name and location, name of architect, and type and quantity of flooring systems furnished.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in the manufacturing of products specified in this section with a minimum five years documented experience.

1.6 PRE-INSTALLATION CONFERENCE

A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

Qualified Applicator Requirements

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

A. Applicator Qualifications:
   1. Applicator shall be trained in application techniques and procedures of coating materials and shall demonstrate a minimum of 5 years successful experience in such application.
   2. Provide a letter from coating manufacturer's representative attesting to the qualifications of the applicator firm relevant to this project.
   3. Maintain, throughout duration of application, a crew of painters who are fully qualified.

A. Qualifications:
   1. Applicator firm shall have SSPC QP 1 Certification for complex industrial and marine structures.
   2. Applicator firm shall provide project references of similar size and scope prior to contract award.
   3. Maintain, throughout duration of application, a crew of painters who are fully qualified.

Benefits of Coatings Inspection

- Comprehensive Documentation
  - Materials Used / Batch Identification
  - Environmental Conditions
  - Surface Preparation Methods & Results
  - Coating Application Methods & Results
- Specialized Knowledge
  - Regular Usage of Inspection Tools & Methods
  - Advanced Methods & Equipment to Reflect Project Needs
  - Secondary Resource for Regulatory Compliance
- Additional Oversight
  - 3rd Party with Responsibility to Project

Qualified Inspector Requirements

1.5 QUALITY ASSURANCE (General Painting Clause)

A. Inspector Qualifications: All coating inspection work shall be performed by an inspector certified at a minimum of **AMPP (formerly NACE) CIP Level 1** (or 2/3, depending on complexity). The inspector must be on-site during all surface preparation and coating application activities.

1.5 QUALITY ASSURANCE (Specific Requirements Clause)

A. Inspector Qualifications: The Contractor shall employ an independent third-party **AMPP/NACE Certified Coating Inspector (Level 2 or higher)** to verify that all work complies with the project specifications and manufacturer requirements. The inspector shall provide daily written reports, signed and dated, documenting ambient conditions, surface cleanliness, profile, DFT, and application techniques

1.5 QUALITY ASSURANCE (Complex/Critical Projects)

A. Inspector Qualifications: Inspection shall be performed by a **Senior Certified Coating Inspector (AMPP/NACE CIP Level 3)**, or a Level 2 reporting to a Level 3, to oversee specialized coating systems.

Highlights for Project Success

- Project Design Collaboration
- Qualified Applicators
- Clear Shop Drawings
- Quality Controls & Oversight
- Consistent Communication

Thank You!

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