

# Common Coating Inspection Practices, Standards & Equipment

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# Presentation Summary:

- Basics of Coating Inspection.
- Coating Specification.
- Brief Introduction to Surface Preparation Standards.
- Commonly used Standards and Inspection Equipment.

# Types of Inspectors

- Third party inspector supplied by an independent consulting firm (full or part time).
- A corrosion engineer or someone assigned by the owner or architect.
- A retired painter or coating supervisor.
- The contractor.
- Should have some type of nationally recognized certification.

# Basic Inspection Practice

- Preliminary Inspection Responsibilities
- Inspection of Surface Preparation
- Inspection of Coating Application
- Post-Application Inspection

# Preliminary Inspection Responsibilities

1. Read and understand the job specification
2. Attend the pre-job conference
3. Become aware of safety hazards and responsibilities
4. Prepare inspection forms and inspection plan
5. Inspection of jobsite conditions
6. Inspection of materials
7. Inspection of equipment
8. Monitor ambient conditions

# What do you do when you don't have a 3<sup>rd</sup> Party Inspector?

Manufacturer' s can design very impressive technology but when it is improperly specified or installed incorrectly the technology is useless. –  
*Common Sense*

# Team Building Specification

# Elements of a Typical Coating Specification

- General
- Terms and definitions
- Reference standards and codes
- Scope
- Safety
- Prejob conference
- Surface preparation
- Coating materials
- Sampling coatings
- Workmanship
- Application
- Work schedule
- Repairs and remedial coating work
- Inspection
- Documentation

# Keys to Success...

- Put together a **team building** document for the specific project.
- Require a **qualified** and experienced industrial coatings & lining **installer**.
- Require a **knowledgeable** NACE Certified **Manufacturers Rep** to review existing coating conditions prior to beginning the project.

# Keys to Success...

- Require a **pre-paint meeting** where the owner, applicator and selected manufacturers NACE Certified Representative and inspector if employed all meet on site prior to coating application. This meeting will insure that everyone is clear on the schedule, surface preparation and application methods.
- Require **holdpoint-inspections**. The NACE Certified Manufacturer's Representative will visit the site weekly or as needed to support the application of the products and report any deficiencies to the team including the owner/engineer in writing.

# Keys to Success...

- Require the **performance** you believe in.
- Require **specific generic type** base on the performance of the manufacturer most involved with the project or most qualified for the application. Polyamidoamine Epoxy, Fluoropolymer, etc.
- Require necessary **performance characteristics**.  
i.e., adhesion, corrosion resistance, H<sub>2</sub>S Resistance, permeability, abrasion resistance, UV resistance, cyclic salt fog, immersion, etc.

## When in doubt...

- Contact your trusted knowledgeable coating **consultant/manufacturers representative**.
- If over-coating, require **test patch** to verify adhesion.
- Have the coating **consultant review** the project and put together a written coating recommendation.
- Utilize **qualified installers** for the recommended products.
- If you have a new project in design have your **manufacturer's** representative meet with the **design firm** to discuss the parameters of the application.

# Visual Standards & Observations

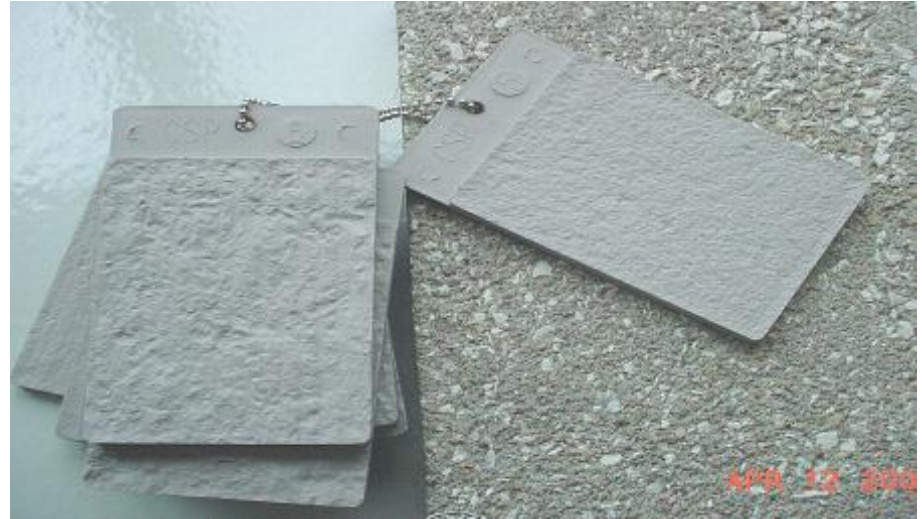
SSPC-Vis 1 Visual Standard



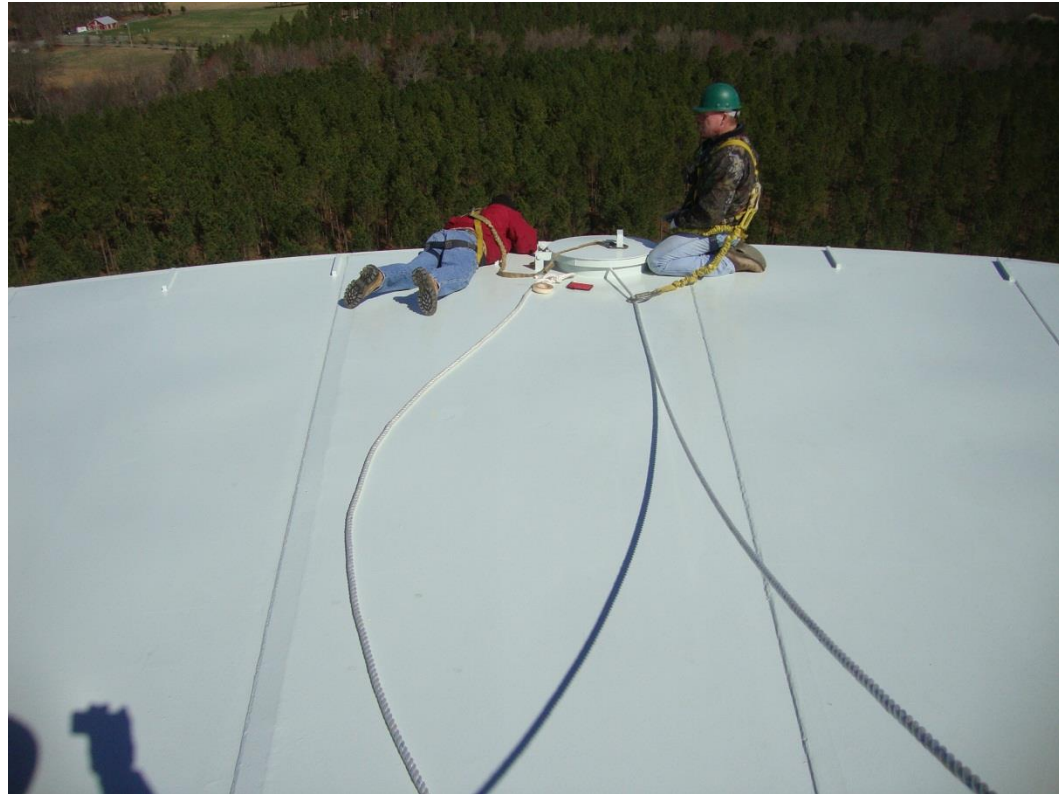
# SSPC-SP13/NACE 6

## *Surface Preparation of Concrete*

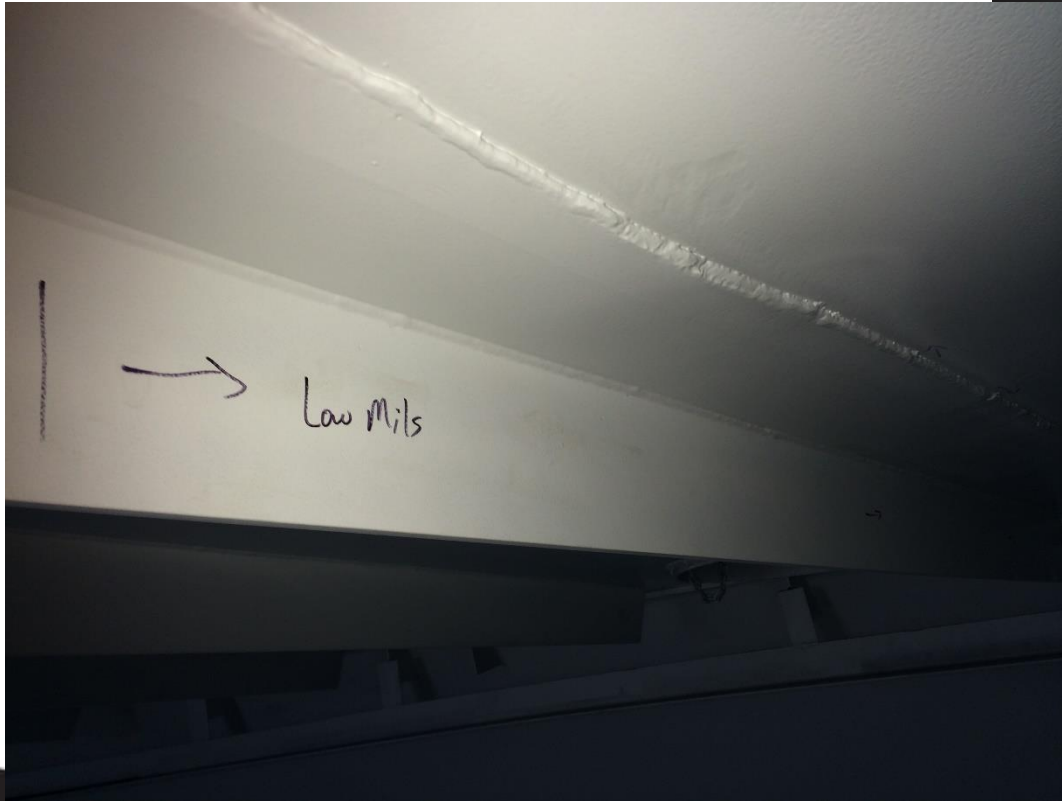
- Prep of concrete by mechanical, chemical, or thermal methods
- Applicable to CIP, Pre-Cast, CMU, & Shotcrete
- Free of laitance, loose adhering concrete & dust
- Use ICRI CSP visual standards Technical Guideline No. 03732



# Quality Control



# Visual & Dry Mils



# Quality Control

- How you ensure you are getting what you specify.
  - Verify adhesion & compatibility of coatings. *i.e., Evaluation/Report/Testing /Test Patch*
  - Verify Surface Preparation
  - Verify wet or dry film thickness
  - Verify surface and ambient conditions
  - Holiday Testing
  - Thorough visual inspection
  - All performed by the project team
  - Documented Findings (Daily Logs)



# Quality Control

When you fail to plan, you plan to fail!

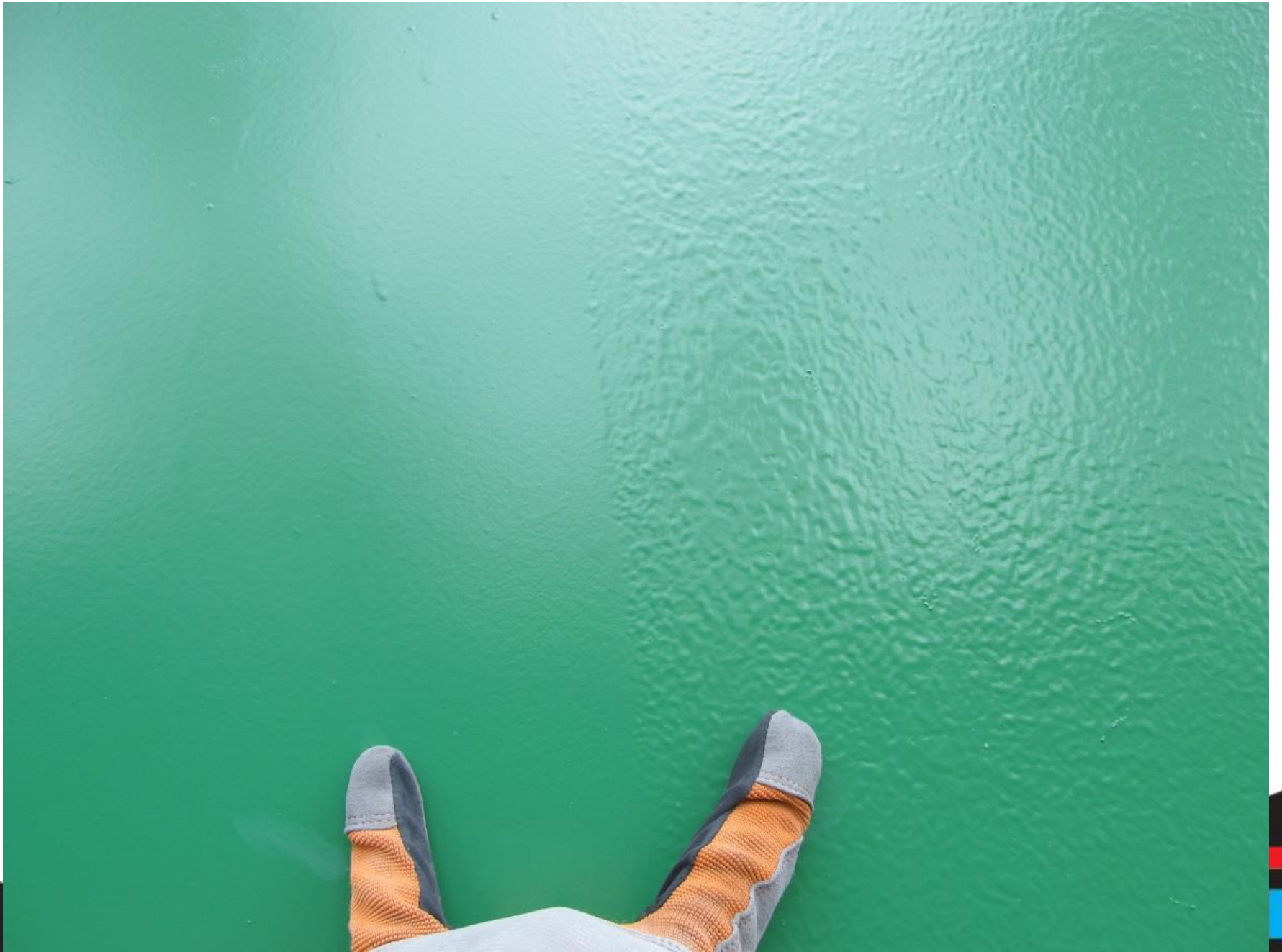


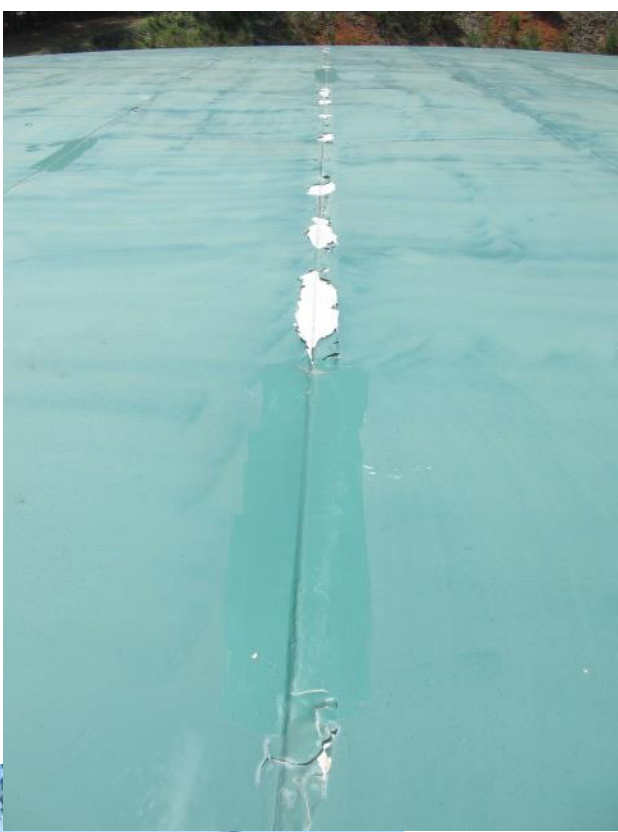
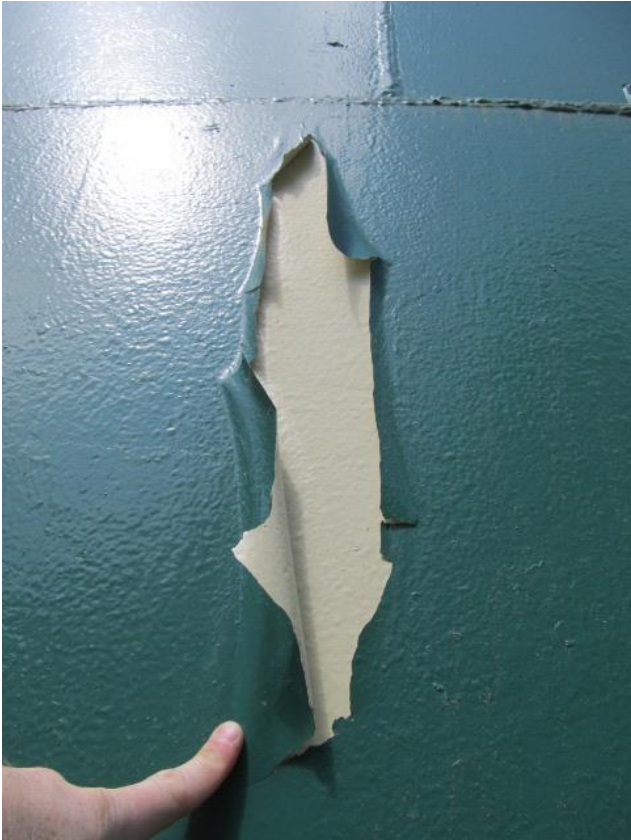


TNEMEC





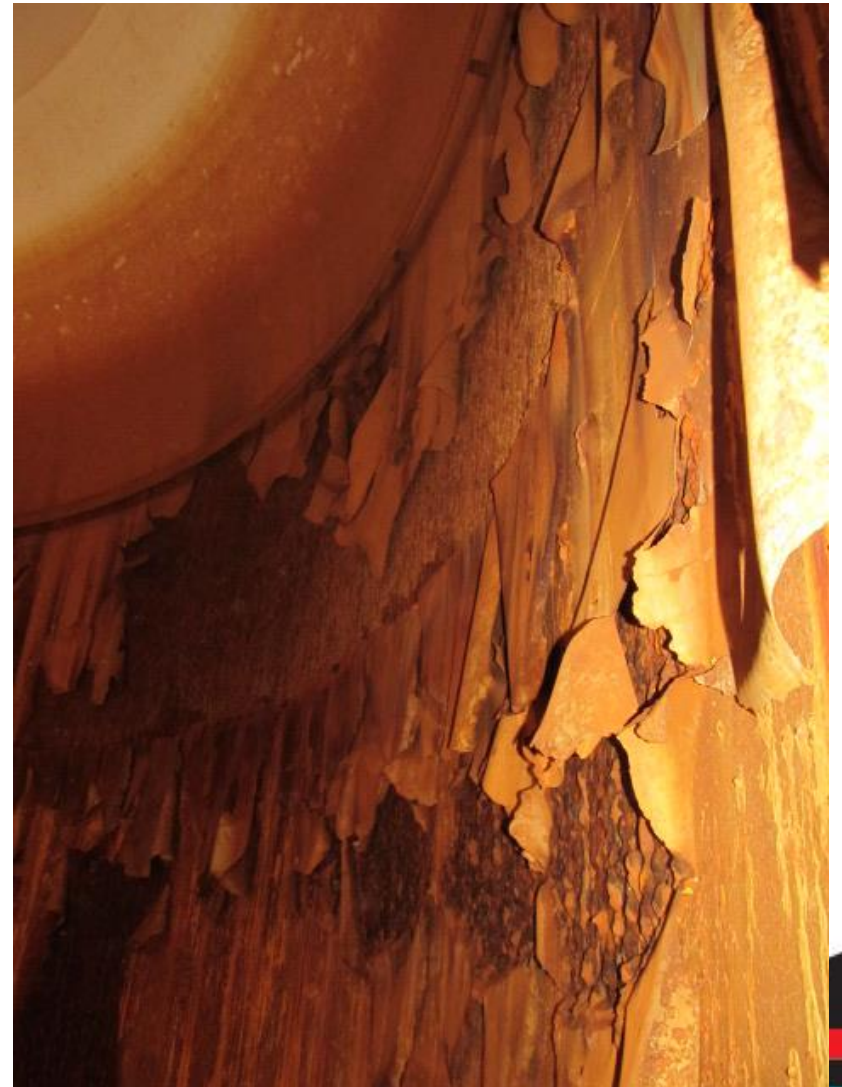












# Surface Preparation



# Contaminants

- Oil, grease, soil
- Dirt/dust
- Mildew
- Various chemical
- Soluble salts(non-visible)
- Rust
- Loose or broken mill scale
- Rust scale

# Loose Mill Scale



# Factors of Surface Preparation

- Anchor pattern
- Blast profile
- Prep cleanliness
- Sharp ridges, burs, edges or cuts
- Surface condensation
- Old coatings with poor adhesion

# Surface Preparation Standards

Industry accepted SP standards:

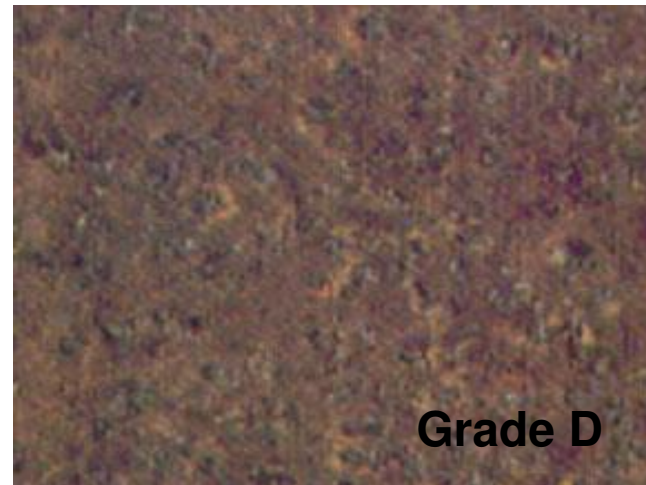
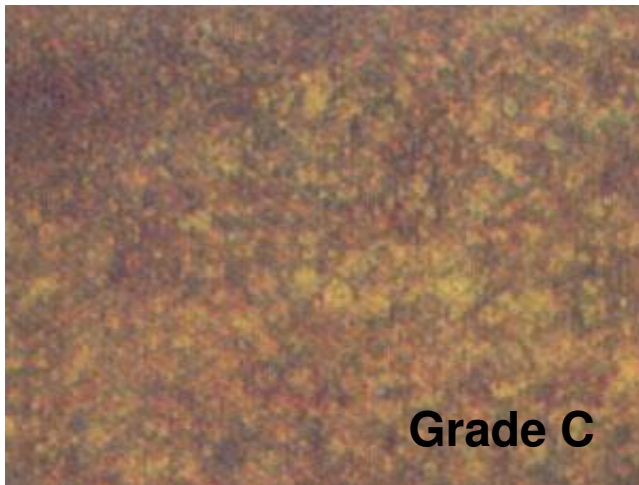
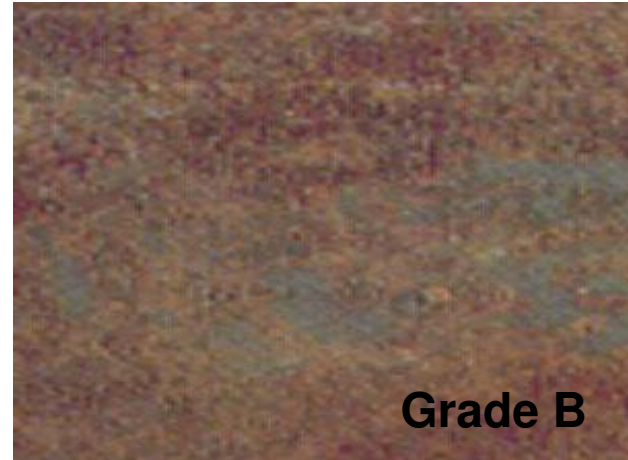
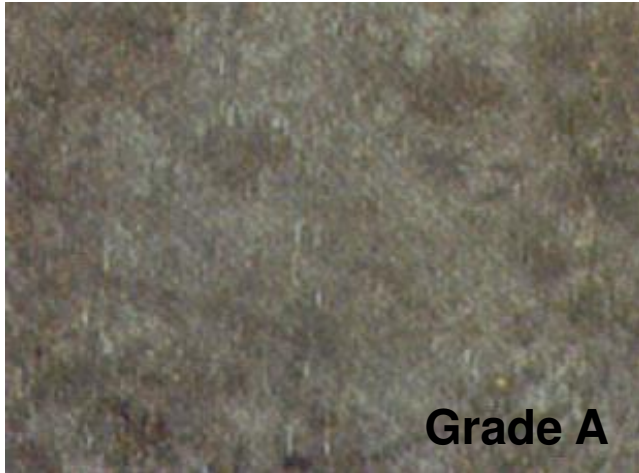
- SSPC: The Society for Protective Coatings (SSPC)
- NACE International (NACE)
- International Concrete Repair Institute (ICRI)

# Standards in WTP & WWTP

## Steel Surfaces:

- SSPC-SP1 Solvent Cleaning
- SSPC-SP2 Hand Tool Cleaning
- SSPC-SP3 Power Tool Cleaning
- SSPC-SP11 Power Tool Cleaning to Bare Metal
- SSPC-SP5/NACE 1 White Metal Blast
- SSPC-SP10/NACE 2 Near White Metal Blast
- SSPC-SP6/NACE 3 Commercial Blast
- SSPC-SP7/NACE 4 Brush-Off Blast
- SSPC-SP12/NACE 5 Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
- SSPC-SP13/NACE No. 6 Surface Preparation of Concrete

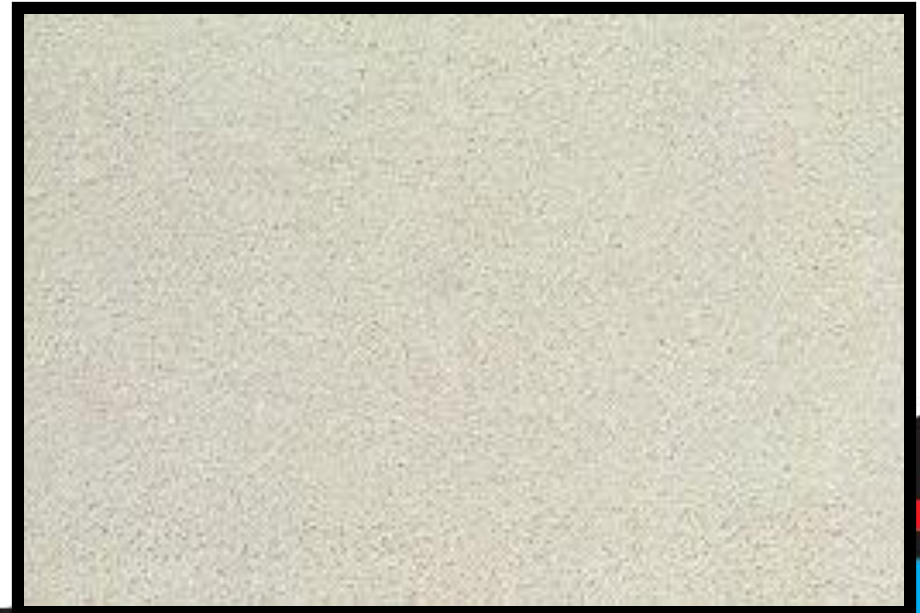
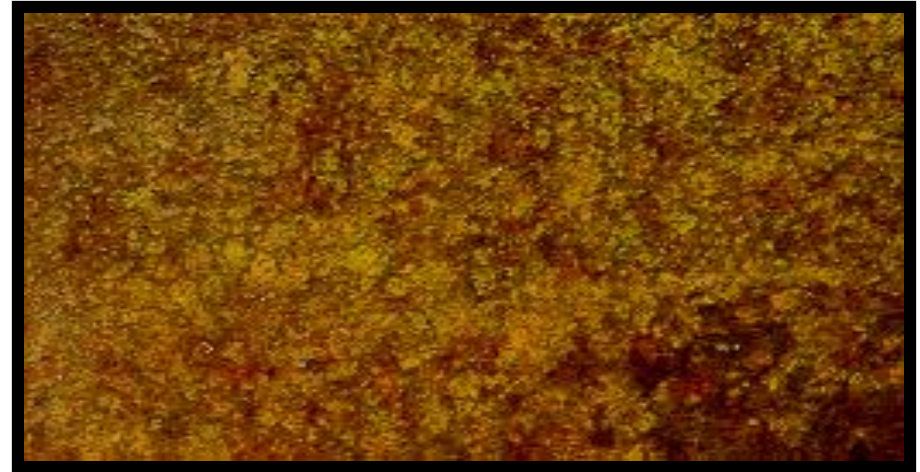
# Rust Grades of Steel



# SSPC-SP5/NACE 1

## *White Metal Blast Cleaning*

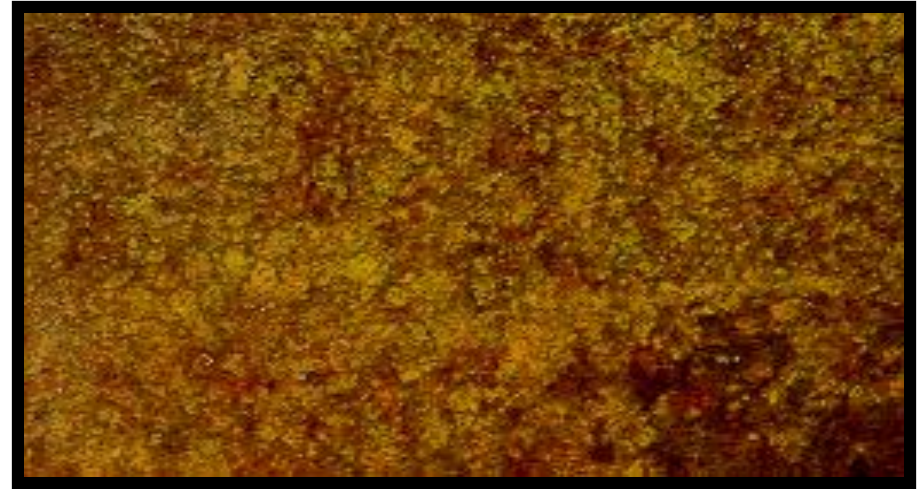
- Abrasive Blast cleaning of steel surfaces
- Free of all oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, foreign matter, & stains
- Removes all existing coating, mill scale, rust, oxides, corrosion products, stains, & other foreign matter



# SSPC-SP10/NACE 2

## *Near-White Metal Blast Cleaning*

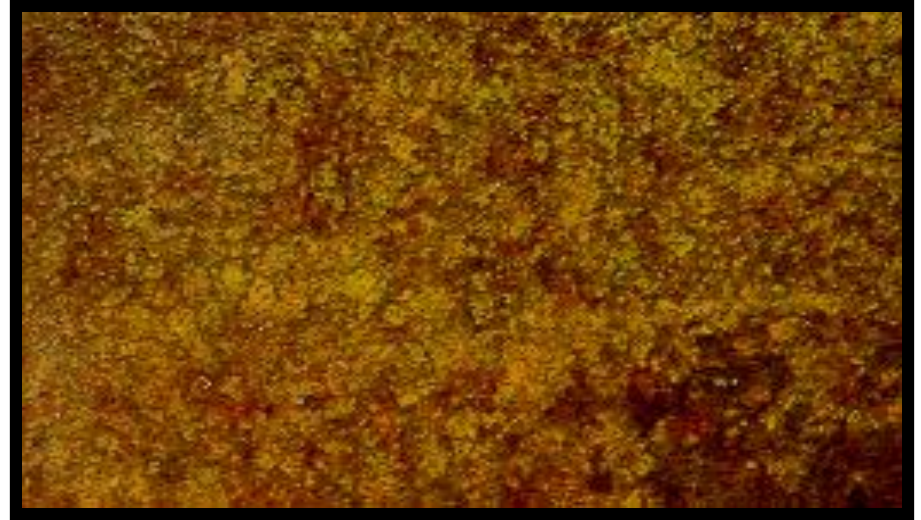
- Abrasive Blast cleaning of steel surfaces
- Free of all oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, foreign matter
- Random staining up to 5% from rust, mill scale or previously applied coatings



# SSPC-SP6/NACE 3

## *Commercial Blast Cleaning*

- Abrasive Blast cleaning of steel surfaces
- Free of all oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, foreign matter
- Random staining up to 33% from rust, mill scale or previously applied coatings

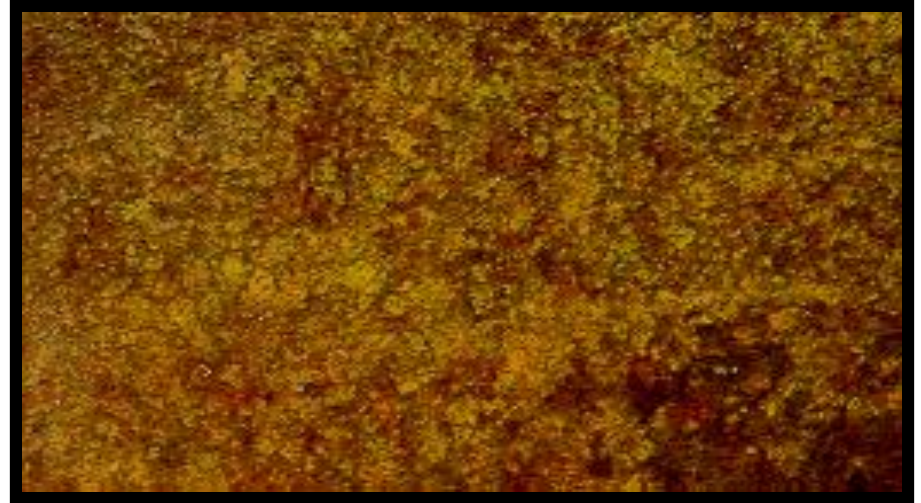




# SSPC-SP7/NACE 4

## *Brush-Off Blast Cleaning*

- Abrasive Blast cleaning of steel surfaces
- Free of all oil, grease, dust, dirt, & *loose* mill scale, *loose* rust, & *loose* coating
- Mill scale, rust, and coating considered adherent if cannot be lifted by putty knife



# SSPC-SP12/NACE 5

## *High- & Ultrahigh Pressure Water Jetting*

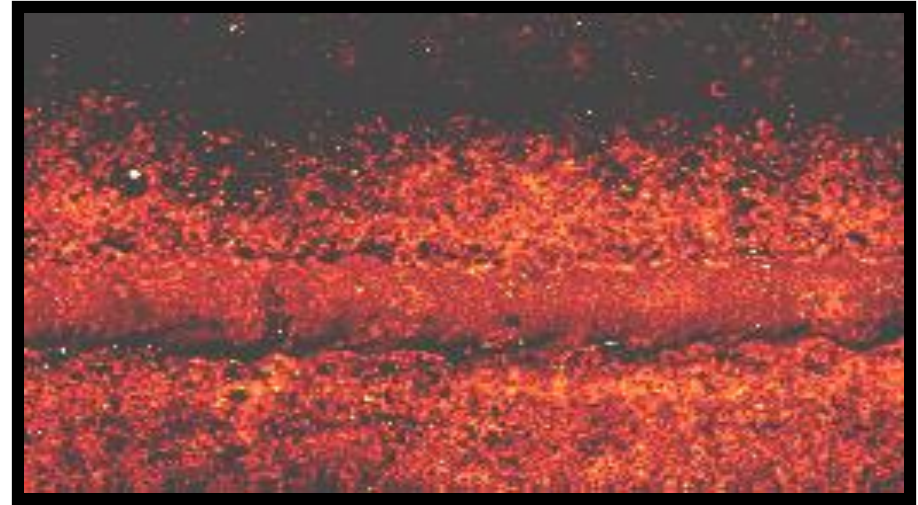
- The use of water without addition of solid particles in the stream
- Recently updated to simplify



# SSPC-SP11

## *Power Tool Cleaning to Bare Metal*

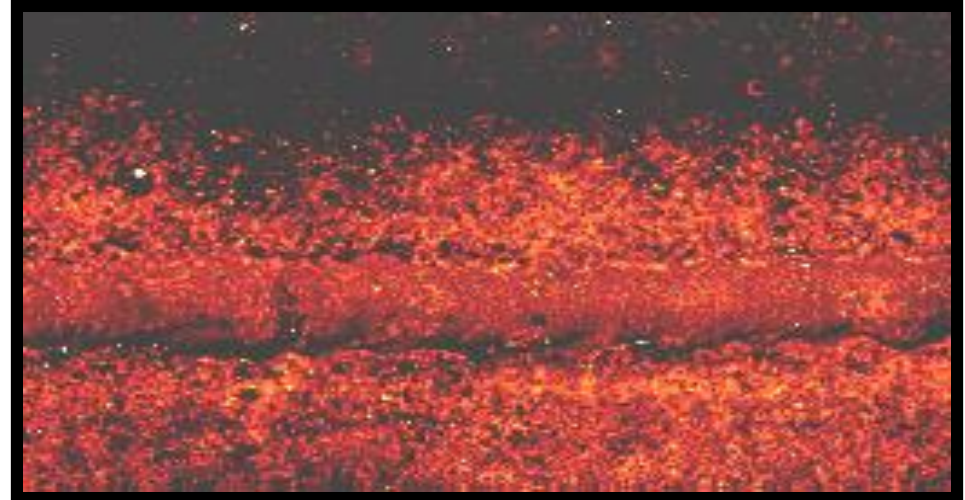
- Use of power tools to produce or retain surface profile
- Suitable when abrasive blasting is not feasible
- Free of all oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, foreign matter
- Min 1 mil profile required



# SSPC-SP3

## *Power Tool Cleaning*

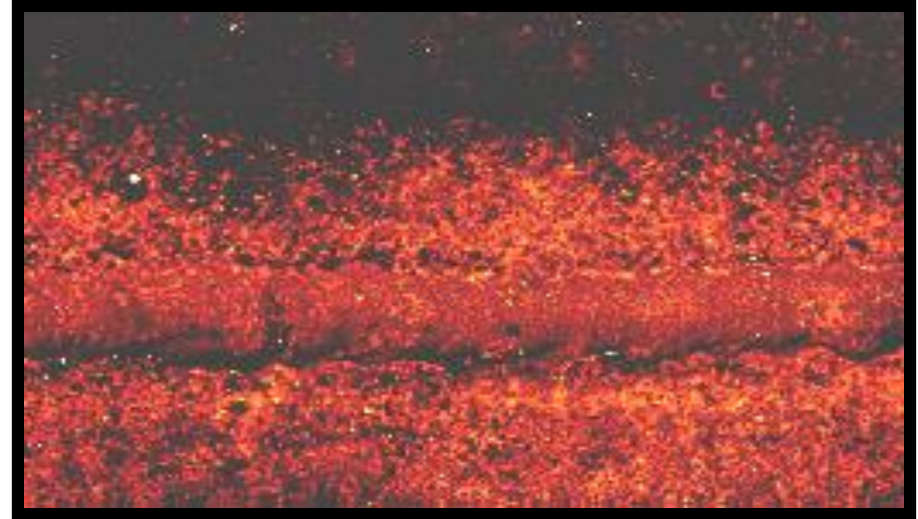
- Method of preparing steel surfaces with power tools
- Removes all loose mill scale, loose rust, loose coating, and other loose foreign matter
- Mill scale, rust, and coating considered adherent if cannot be lifted by a dull putty knife



# SSPC-SP2

## *Hand Tool Cleaning*

- Method of preparing steel surfaces with hand tools
- Removes all loose mill scale, loose rust, loose coating, and other loose foreign matter
- Mill scale, rust, and coating considered adherent if cannot be lifted by a dull putty knife



# SSPC-SP1

## *Solvent Cleaning*

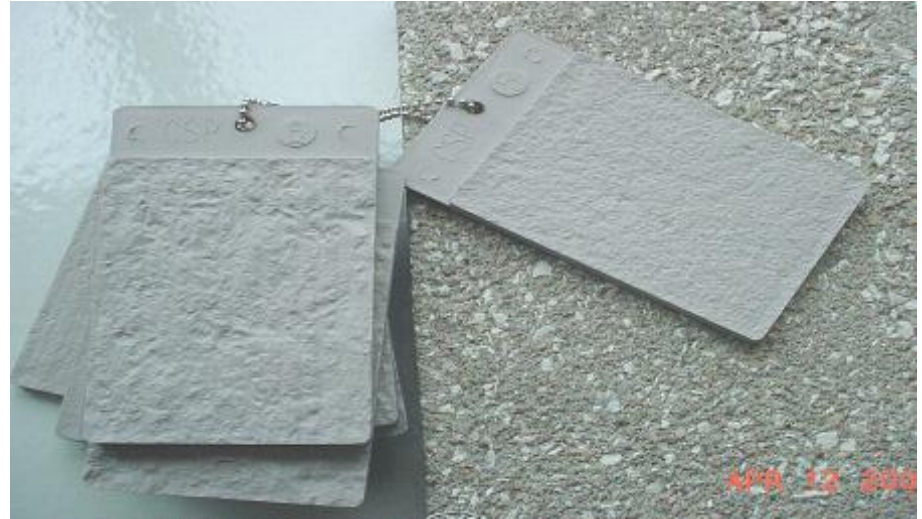
- Method of removing all visible oil, grease, soil, drawing & cutting compounds, and other soluble contaminants from steel surfaces
- Hydrocarbon solvents, Emulsion or Alkaline cleaners, or Steam cleaning with detergents
- A prerequisite requirement for all steel surface preparation methods



# SSPC-SP13/NACE 6

## *Surface Preparation of Concrete*

- Prep of concrete by mechanical, chemical, or thermal methods
- Applicable to CIP, Pre-Cast, CMU, & Shotcrete
- Free of laitance, loose adhering concrete & dust
- Use ICRI CSP visual standards



# QUESTIONS?



# ASTM Standards Used In Field Inspections

# ASTM Standards

- **D 523 Test Method for Specular Gloss**
- **D 610 Degree of Rusting on Painted Steel Surfaces**
- **D 660 Degree of Checking of Exterior Paints**
- **D 661 Degree of Cracking of Exterior Paints**
- **D 662 Degree of Erosion of Exterior Paints**
- **D 714 Degree of Blistering of Paints**
- **D 1186 Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base**
- **D 3274 Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation**
- **D 3359 Measuring Adhesion by Tape Test**

# ASTM Standards

- **D 4138 Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means**
- **D 4214 Degree of Chalking of Exterior Paint Films**
- **D 4263 Indicating Moisture in Concrete by the Plastic Sheet Method**
- **D 4417 Field Measurement of Surface Profile of Blast Cleaned Steel**
- **D 4414 Measurement of Wet Film Thickness of Organic Coatings by Notch Gauges**
- **D 4541 Pull-Off Strength of Coatings Using Portable Adhesion Testers**
- **D 4610 Determining the Presence of and Removing Microbial (Fungal or Algal) Growth on Paint and Related Coatings**
- **D 4752 Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub**

# ASTM Standards

- **D 5162 Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates**
- **D 5402 Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs**
- **D 6677 Evaluating Adhesion by Knife**
- **D7091 Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals**
- **D 7234 Pull-Off Adhesion Strength of Coating on Concrete Using Pull-Off Adhesion Testers**
- **E 337 Measuring Humidity with a Psychrometer (The measurement of Wet-Bulb and Dry-Bulb Temperatures)**
- **F 1869 Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride**

# ASTM D 523

## Test Method for Specular Gloss

- Gloss reading should be an average of 3 readings per area.
- Gloss is measured at angles of 20°, 60° and 85°. 85° is used for low gloss coatings, 20° for high gloss coatings and 60° at all gloss levels.
- Tnemec used 60° gloss readings at the following levels across our product line.
  - 0-10 flat
  - 10-25 eggshell
  - 25-40 low semigloss
  - 40-55 semigloss
  - 55-70 high semigloss
  - 70-85 gloss
  - 85+ high gloss



# ASTM D 610

## Degree of Rusting on Painted Steel Surfaces

- Method to evaluate the degree and type/s of rusting present in an area.
- Degree of rusting is rated on a scale of 0 to 10. Rating of 0 being greater than 50% rusting, 10 being less than or equal to 0.01%.
- Tnemec typically does not want to overcoat structures with ratings greater than 4-S, 5-G or 6-P. (Reference Technical Bulletin 98-10 R2)
- Corresponds to SSPC-VIS 2 (Scale on next slide)



## ASTM D 610 / SSPC-VIS 2

		Photographic Standard		
Rust Grade	Percent of Surface Rusted	Spot	General	Pinpoint
10	Less than or equal to 0.01%	None	None	None
9	Greater than 0.01% to 0.03%	9-S	9-G	9-P
8	Greater than 0.03% to 0.1%	8-S	8-G	8-P
7	Greater than 0.1% to 0.3%	7-S	7-G	7-P
6	Greater than 0.3% to 1%	6-S	6-G	<u>6-P</u>
5	Greater than 1% to 3%	5-S	<u>5-G</u>	5-P
4	Greater than 3% to 10%	<u>4-S</u>	4-G	4-P
3	Greater than 10% to 16%	3-S	3-G	3-P
2	Greater than 16% to 33%	2-S	2-G	2-P
1	Greater than 33% to 50%	1-S	1-G	1-P
0	Greater than 50%	None	None	None

# ASTM D 660

## Degree of Checking of Exterior Paints

- Defined as a break in the film that does not go all the way to the substrate.
- Visual examples are given for identification purposes.
- May be visible or microscopic
- Many types of checking are recognized.
- More than 1 type of checking may be present at a time.

Checking can cause dirt, mold, or mildew collection. It can be a sign of limited coating flexibility, or a coating applied too thick or at too high a substrate temperature.



# ASTM D 661

## Degree of Cracking of Exterior Paints

- Defined as a break in the film that goes to the substrate.
- Visual examples are given for identification purposes.
- Three types of cracking are recognized.

Some Causes of Cracking Include:  
Paint shrinkage; limited flexibility of the film; excessive thickness (especially in zinc rich materials); an applied or cured coating at too high a temperature.



# ASTM D 714

## Degree of Blistering of Paints

- Photographic reference standard to evaluate size & frequency of blistering present.
- The size & density of the blisters are rated on a scale of 10 to 0. A rating of 10 being no blistering. A rating of 8 represents the smallest size easily seen by the unaided eye. Ratings of 6, 4, and 2 represent progressively larger sizes.
- Level of frequency is rated as Dense, Medium Dense, Medium, & Few.

Example causes of blistering:  
Solvent entrapment, oils, chlorides, sulfates, cathodic disbondment



# **ASTM D 1186 Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings applied to a ferrous base & ASTM D 7091 Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals**

- Two basic types of DFT gages cover in this standard.
  - Magnetic Pull-Off Gages (also known as Type I Gages)
  - Electronic Gages (also known as Type II Gages)
- Complimenting Standard is SSPC PA2



# ASTM D 3274 & D 4610 Microbial Growth or Soil and Dirt Evaluation Methods

- D 3274 – Provides a numerically graded photographic reference standard (0 to 8) for the degree of fungal and algal growth, or soil and dirt accumulation on coatings. A rating of 10 indicates a film absent of disfigurement by particulate matter.
- D4610 – Guide used for determining the presence of fungal or algal growth on coatings and methods for removal of such growth prior to recoating.

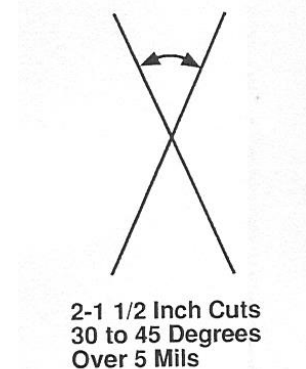
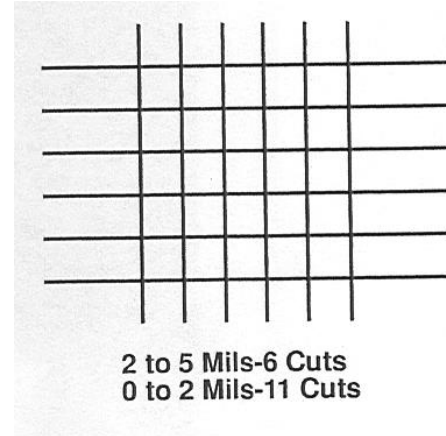
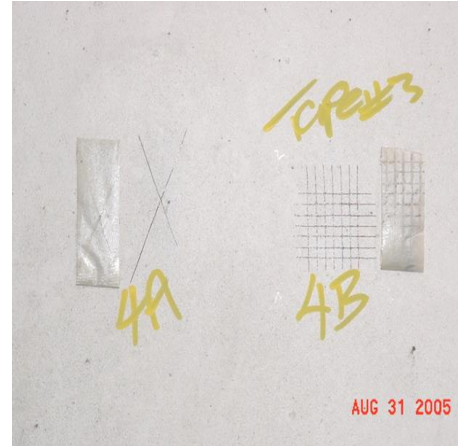


# ASTM D 3359

## Measuring Adhesion by Tape Test

This Standard cover two Test Methods.

- Method A: An X-cut is made through the film to the substrate, pressure-sensitive tape is applied and removed, and adhesion is assessed qualitatively on a 0 to 5 scale.
- Method B: A lattice pattern with either six or eleven cuts in each direction is made in the film to the substrate, pressure-sensitive tape is applied and removed, and adhesion is evaluated by comparison with descriptions and illustrations.



# ASTM D 3359, Method A

5A: No peeling or removal

4A: Trace peeling or removal along incisions or at their intersection.

3A: Jagged removal along incisions up to 1.6 mm (1/16 in.) on either side.

2A: Jagged removal along most of incisions up to 3.2 mm (1/8 in.) on either side.

1A: Removal from most of the area of the X under the tape.

0A: Removal beyond the area of the X.



2-1 1/2 Inch Cuts  
30 to 45 Degrees  
Over 5 Mils

# ASTM D 3359, Method B

5B: The edges of the cuts are completely smooth; none of the squares of the lattice is detached.

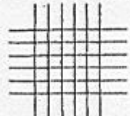
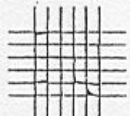

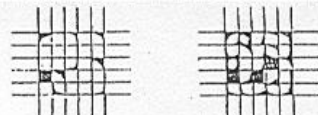
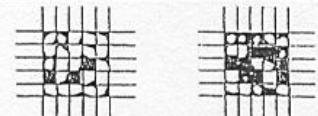
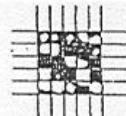
4B: Small flakes of the coating are detached at intersections; less than 5% of the area is affected.

3B: Small flakes of the coating are detached along edges and at intersections of cuts. The area affected is 5 to 15% of the lattice.

2B: The coating has flaked along the edges and on parts of the squares. The area affected is 15 to 35% of the lattice.

1B: the coating has flaked along the edges of cuts in large ribbons and whole squares have detached. The area affected is 35 to 65% of the lattice.

0B: Flaking and detachment worse than Grade 1.

CLASSIFICATION OF ADHESION TEST RESULTS		
CLASSIFICATION	PERCENT AREA REMOVED	SURFACE OF CROSS-CUT AREA FROM WHICH FLAKING HAS OCCURRED FOR SIX PARALLEL CUTS AND ADHESION RANGE BY PERCENT
5B	0% None	
4B	Less than 5%	
3B	5 - 15%	
2B	15 - 35%	
1B	35 - 65%	
0B	Greater than 65%	

# ASTM D 4138 Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means

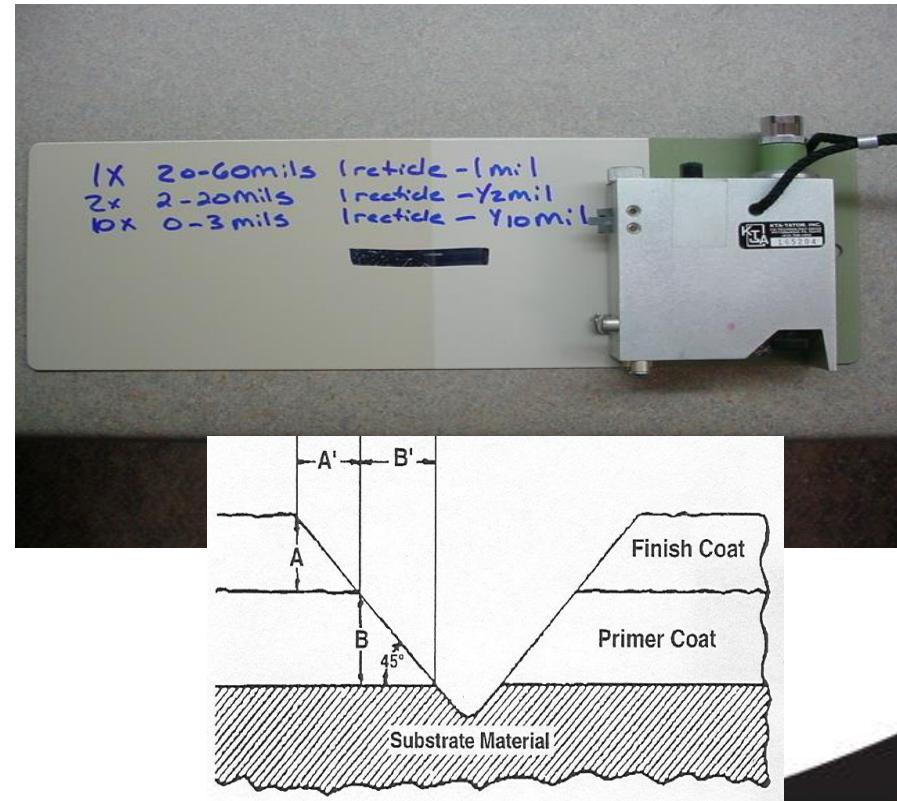
- Three test methods are discussed.
- Test Method A (illustrated) is the most common method used.

Main use –

- Investigative method/s to evaluate layers & DFT of a coating system.

Some limitations of use –

- Max DFT of 50 mils
- Ctg./surf. needs to be rigid enough to prevent deformation
- Complex shapes



# ASTM D 662 & D 4214 Degree of Erosion & Chalking of Exterior Paint Films

- Methods are used to define the amount of degradation and/or erosion of a coating film.
- Photographic references are used with both of these methods.
- Erosion is typically more visible on wet surfaces, chalking is more visible on surfaces dry for an extended period of time.
- Examples where this may be helpful – evaluating a coating system's remaining useable life, overcoating potential, aesthetic evaluation, & possible warranty compliance.



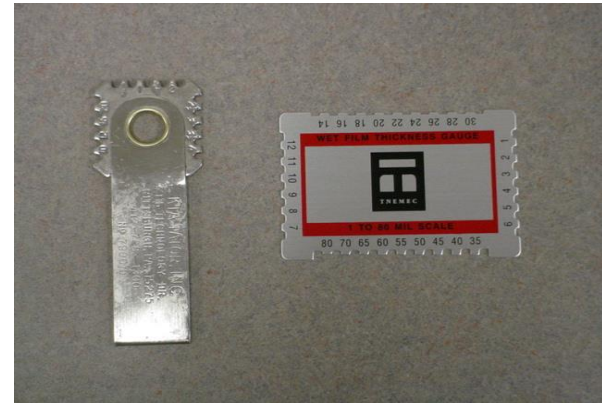
# ASTM D 4263 & F 1869 – Qualitative & Quantitative Moisture Detection Methods

- D 4263: A Qualitative Test used to indicate the presence of moisture in concrete
- F 1869: A Quantitative Test used to determine the rate of moisture vapor emitted from below-grade, on-grade, and above-grade (suspended) concrete floors.



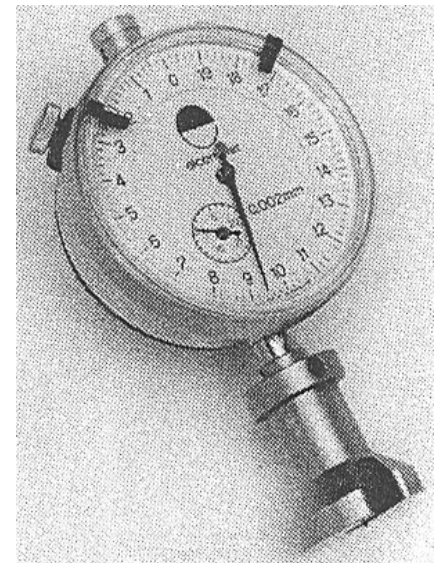
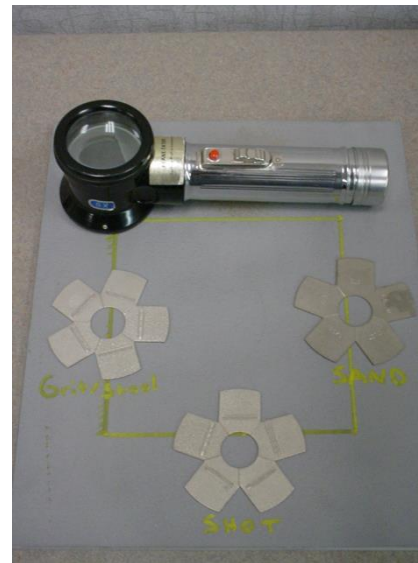
# ASTM D 4414 Measurement of Wet Film Thickness of Organic Coatings by Notch Gauges

- Two procedures in the Standard
  - Procedure A: A square or rectangular rigid metal gage with notched sides is used to measure WFT ranging from 0.5 to 80 mils.
  - Procedure B: A circular thin rigid metal notched gage is used to measure WFT ranging from 1 to 100 mils.



# ASTM D 4417 Field Measurement of Surface Profile of Blast Cleaned Steel

- Three test methods are discussed.
- Method A: Profile comparator is used.
- Method B: Dial gage depth micrometer is used.
- Method C: Special tape containing a compressible foam attached to a noncompressible uniform plastic film is used.



# ASTM D 4541 & D 7234

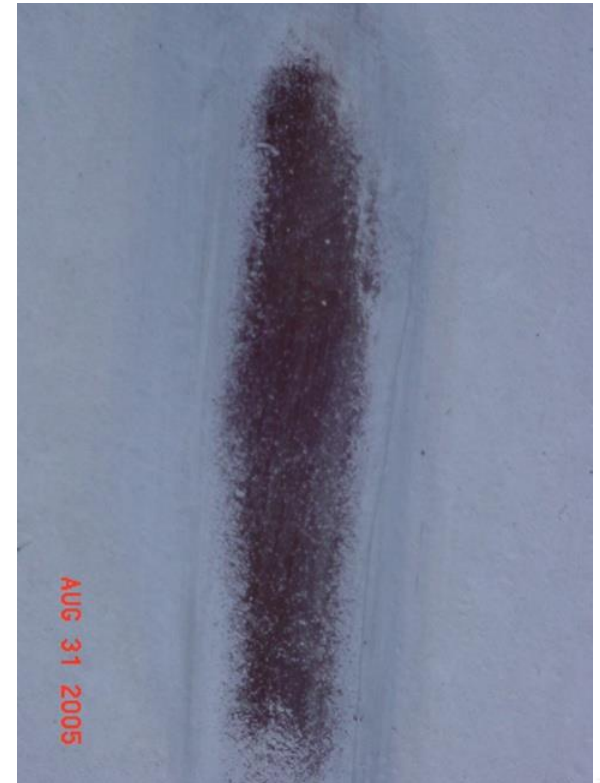
## Pull-Off Strength of Coatings Using Portable Adhesion Testers

- Determines the tensile adhesion strength of a coating system by the application of axially directed pulling forces.
- Substrates tested must be rigid.
- Failure during testing will occur at the weakest plane.



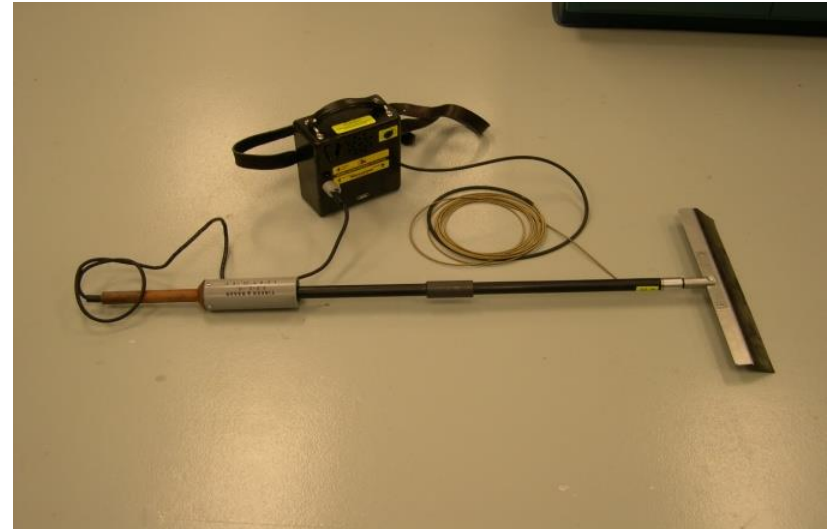
# ASTM D 4752 & D 5402 Solvent Resistance of Inorganic & Organic Coatings by Solvent Rubs

- Both methods help indicate cure – D4752 for IOZ & D5402 for organic coatings.
- Example –Tnemec states that 100 D.R.s of MEK with no effect to Series 20 indicates that most likely that lining system is ready to be put into immersion service.
- Certain solvents can help indicate what a coating may be generically.
- Can help evaluate the integrity of an old coating.
- Contact Tnemec for solvent to use & amount of D.R.s for each one of our products.



# ASTM D 5162 Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates

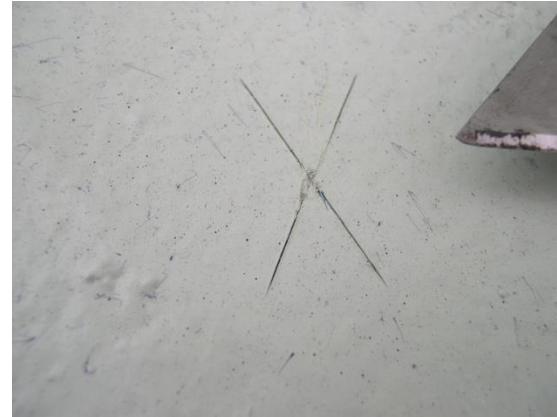
- Also covered under NACE SPO 188-06.
- Two methods are covered – low voltage (up to 20 mils DFT) & high voltage (greater than 20 mils DFT).
- Used to help indicate discontinuities in a newly applied coating film..



# ASTM D 6677

## Evaluating Adhesion by Knife

- Commonly used method to evaluate shear adhesion of a coating.
- “X” cut is made at a 30-45° opposing angles & then probed using a sharp utility knife.
- Adhesion is evaluated qualitatively on a 0 to 10 scale.  
(next slide)
- This is a highly subjective test & its value depends largely upon the inspector’s experience.



# ASTM D 6677

- 10: Coating is extremely difficult to remove; fragments no larger than approximately 0.8 by 0.8 mm (1/32 by 1/32 in.) removed with great difficulty.
- 8: Coating is difficult to remove; chips ranging from approximately 1.6 by 1.6 mm (1/16 in. by 1/16 in.) to 3.2 by 3.2 mm (1/8 by 1/8 in.) can be removed with difficulty.
- 6: Coating is somewhat difficult to remove; chips ranging from approximately 3.2 by 3.2 mm (1/8 by 1/8 in.) to 6.3 by 6.3 mm (1/4 by 1/4 in.) can be removed with slight difficulty.
- 4: Coating is somewhat difficult to remove; chips in excess of 6.3 by 6.3 mm (1/4 by 1/4 in.) can be removed by exerting light pressure with the knife blade.
- 2: Coating is easily removed; once started with the knife blade, the coating can be grasped with ones fingers and easily peeled to a length of at least 6.3 mm (1/4 in.)
- 0: Coating can be easily peeled from the substrate to a length greater than 6.3 mm (1/4 in.).

# ASTM E 337 Measuring Humidity with a Psychrometer (The measurement of Wet-Bulb and Dry-Bulb Temperatures)

An instrument for determining atmospheric humidity consisting of dry bulb and wet bulb thermometers. The dry bulb thermometer indicates the temperature of the air, and the wet bulb thermometer the lowest temperature to which air can be cooled by evaporating water into it at constant pressure. With the information obtained from a psychrometer, the humidity, dew point, and vapor pressure for any atmospheric pressure can be obtained by means of psychrometric tables.



# Questions

Thank you for your time.