FROM SPEC TO PROTECT

Metals Surface Preparation Overview Steel • Ductile • Galvanized • Stainless • Aluminum

Presenter Name: Robert Spano

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Learning Objectives

1

Explain the importance of specifications for the surface preparation of steel including cleanliness standards and profile requirements.

2

Identify inaccessible areas and the need to address them in specifications.

3

Describe the SSPC cleaning standards including solvent cleaning, hand and power tool cleaning, abrasive blast cleaning, and waterjetting.

4

Explain the use of SSPC pictorial guides.



Describe the benefits of using of centrifugal blast cleaning to remove mill scale.

6

Explain the need to specify the removal of non-visible contaminants such as chlorides.

 $\overline{7}$

Explain the special requirements for preparing ductile iron, stainless steel, galvanizing, and aluminum.

Specifying Steel Preparation



ADDRESS THESE ISSUES:

- The specifier requires intimate knowledge of the structure.
- Determine surface profile required based on dry film thickness.
- Inaccessible areas, e.g. back to back, stitch-welds.
- Promote stripe coating of edges, welds, bolt-heads.
- Other metals treated differently:
 - Ductile Iron
 - o Galvanized
 - Stainless
 - Aluminum

Surface Profile

Does the surface profile match the dry film thickness of the coating?



Back to Back Steel



INACCESSIBLE AREAS:

Any area that cannot be prepared, coated, or inspected according to the specifications.

Back to Back Steel



Stripe Coat





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Standards Organizations

SSPC – SOCIETY FOR PROTECTIVE COATINGS

- Founded 1950 as the Steel Structures Painting Council
- www.sspc.org

NACE INTERNATIONAL

- Founded 1943 as the National Association of Corrosion Engineers
- www.nace.org





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 8	Pickling
SSPC-SP 10 / NACE 2	Near-White Blast Cleaning
SSPC-SP 11	Power Tool Cleaning to Bare Metal
SSPC-SP 12 / NACE 5	Surface Preparation and Cleaning of Steel and other Hard Materials by High and Ultra High Water Jetting
SSPC-SP 14 / NACE 8	Industrial Blast Cleaning
SSPC-SP 15	Commercial Power Tool Cleaning
SSPC-SP 16	Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

Water Jetting Standards

SPLIT FROM THE WITHDRAWN:

SSPC-SP 12 / NACE 5 SSPC-SP WJ-1/NACE WJ-1 SSPC-SP WJ-2/NACE WJ-2 SSPC-SP WJ-3/NACE WJ-3 SSPC-SP WJ-4/NACE WJ-4 Surface Preparation and Cleaning of Steel and other Hard Materials by High and Ultra High Water Jetting Clean To Bare Substrate Very Thorough Cleaning Thorough Cleaning Light Cleaning

SSPC-SP1 Solvent Cleaning

Solvent Cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces.

IT IS BY DEFINITION IN EVERY PREPARATION METHOD DISCUSSED

SSPC-SP2 Hand Tool Cleaning

Hand Tool Cleaning removes all loose mill scale, loose rust, loose paint and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust and paint be removed by this process. Mill scale, rust and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.



SSPC-SP3 Power Tool Cleaning

Power Tool Cleaning removes all loose mill scale, loose rust, loose paint and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust and paint be removed by this process. Mill scale, rust and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.



SSPC-SP 7 / NACE 4 Brush-Off Blast Cleaning

has the same definition. Appropriate for LARGE areas.

"The entire surface shall be subjected to the abrasive blast. . . . When a coating is specified, the surface shall be roughened to a degree suitable for the specified coating system."

SSPC-SP6 Commercial Blast

A Commercial Blast-cleaned surface, when viewed without magnification, shall be feel of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter, except for staining as noted:

Random staining shall be limited to no more than 33% of each unit area of surface (9 in²), and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.



A Near-White Blast-cleaned surface, when viewed without magnification, shall be feel of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter, except for staining as noted:

Random staining shall be limited to no more than 5% of each unit area of surface (9 in²), and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.



SSPC-SP5 White Metal Blast

A White Metal Blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter.









Centrifugal Blasting Machine



Advantages of Centrifugal Blasting

- Savings of time, labor, energy and abrasive
- Superior, more uniform cleaning
- Best means to remove mill scale
- Reduction of blasting waste by recycling abrasive
- Protection of the environment



Mill Scale

ACTIVE

Magnesium Zinc Aluminum Cadmium Tin Lead Steel Iron Copper 410 Passive 304 Passive Silver Graphite Gold Platinum

PASSIVE / CATHODIC





Limitations of Centrifugal Blasting

- Limited portability
- High initial costs
- Difficult to use on irregular surfaces
- Primarily for new steel
- Expensive to maintain



Cleanliness and Profile Must be Specified

3 – 4-MIL PROFILE (75-100 μm)	1-MIL PROFILE (25 μm)	
8/20-mesh silica sand	30/60-mesh silica sand	
G-25 steel grit	G-80 steel grit	
S-330 or 390 steel shot	S-110 steel shot	
16-mesh garnet	80-mesh garnet	-
16-grit aluminum oxide	100-grit aluminum oxide	5-1

ABRASIVE IS NOT TYPICALLY SPECIFIED



SSPC-VIS 1



SSPC-VIS 1

Guide and Reference Photographs for Steel Surfaces Prepared by

Dry Abrasive Blast Cleaning



Rust Grades A–B

RUST GRADE A

Surface completely covered with mill scale; little or no rust visible



RUST GRADE B

Surface covered with both mill scale and rust



Rust Grades C–D

RUST GRADE C

Surface completely covered with rust; or no pitting



RUST GRADE D

Surface covered with rust; pitting visible



Rust Grade D



SP6 Commercial Blast

Start with Rust Grade B



Start with Rust Grade D



SSPC-VIS 3



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Surface Condition A–B

CONDITION A

100% adherent mill scale



CONDITION B

Mill scale rust



Surface Condition C–D

CONDITION C

100% rust



CONDITION D

100% rust with pits



Surface Condition E–F

CONDITION E

Light colored paint applied over blast cleaned steel



CONDITION F

Zinc-Rich paint applied over blast cleaned steel



Surface Condition G

CONDITION G

Paint system applied over mill scale



Soluble Salt Problems on Cleaned Surfaces

- Not removed by abrasive blasting
- Not removed by mechanical cleaning
- Will accelerate corrosion of cleaned steel
- Will cause osmotic blistering of coatings
 - Salts draw water through the coating through osmosis

Soluble Salt Problems on Cleaned Surfaces

SSPC: The Society for Protective Coatings

TECHNOLOGY GUIDE 15

Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates

1. Scope

1.1 This Guide describes the most commonly used field methods for the retrieval and analysis of soluble salts on steel and other nonporous substrates. Laboratory methods are only included for situations where laboratory control is desired. Much of this information was contained in SSPC-TU 4, Field Methods for the Retrieval and Analysis of Soluble Salts on Substrates, which will be withdrawn after publication of this Guide.¹

2. Description and Use

2.1 Coatings applied on surfaces contaminated with soluble salts exceeding a certain concentration exhibit diminished performance. This Guide is intended to assist the user in selecting specific procedures for retrieving and analyzing soluble salts. Section 4 of the Guide discusses the various methods for retrieving salts from a surface. Section 5 discusses the analytical methods used to determine the concentration of the soluble salts in the extracted solution. See Appendix E for links to information on sources for testing equipment and materials.

	5-1998)
Part 6	Extraction of soluble contaminants
	for analysis-The Bresle method
	(ISO 8502-6:1995)
Part 9	Field method for conductimetric
	determination of water-soluble
	salts (ISO 8502-9:1998)
Part 10:	Field method for the titrimetric
	determination of water-soluble
	chloride (ISO 8502-10:1999)
Part 12:	Field method for the titrimetric
	determination of water-soluble
	ferrous ions (ISO 8502-12:2003)

detection tube method (ISO 8502.

4. Retrieval Methods

4.1 CLASSES OF RETRIEVAL METHODS: Salt retrieval methods employed to help determine surface concentrations of salt on substrates fall into three general classes, which can be further subdivided. (See Appendix E for links to information on testing equipment and materials.)

Pressures for Cleaning with Water Jetting (WJ-1 to WJ-4)

LOW-PRESSURE WATER CLEANING (LP WC) Less than 5,000 psi (34 MPa)

HIGH-PRESSURE WATER CLEANING (HP WC) 5,000 to 10,000 psi (34 to 70 MPa)

HIGH-PRESSURE WATER JETTING (HP WJ) 10,000 to 30,000 psi (70 to 210 MPa)

ULTRAHIGH-PRESSURE WATER JETTING (UP WJ) above 30,000 psi (210 MPa)

Water Jetted Steel Cleanliness Levels

- WJ-1 bare metal with no visible contamination
- WJ-2 no more than 5% visible trace residues
- WJ-3 no more than 33% visible trace residues
- WJ-4 All loose residues (mill scale, rust and paint) removed





Flash Rusting Levels



- No flash rust (N)
- Light (L)
- Moderate (M)
- Heavy (H)

Specifying Levels of Soluble Salt Contaminants per the WJ Standards



IMMEDIATELY PRIOR TO THE APPLICATION OF THE COATING, THE SURFACE EXTRACT SHALL NOT CONTAIN MORE THAN...

xx µg/cm2 of the specific contaminant (e.g., chloride) when tested with a specified method

OR

xx μ S/cm when tested with a specified method.

Ductile Iron

Applying steel surface preparation specifications to ductile iron is inappropriate and may actually result in damage to the pipe surface with subsequent reduced coating effectiveness and life expectancy.





Surface Preparation Ductile Iron



STANDARD NAPF 500-03

Surface Preparation Standard for Ductile Iron Pipe & Fittings Receiving Special External Coatings And/Or Special Internal Coatings

National Association of Pipe Fabricators, Inc.

Surface Preparation Ductile Iron

NAPF 500-03 STANDARDS:

NAPF 500-03-01 NAPF 500-03-02 NAPF 500-03-03 NAPF 500-03-05 Solvent Cleaning Hand Tool Cleaning Power Tool Cleaning Abrasive Blast Cleaning for Ductile Iron Pipe Abrasive Blast Cleaning for Cast Ductile Iron Fittings

Excerpts from 500-03 Standard

"Narrative visual descriptions and/or visual standards prepared for steel surfaces are not applicable for ductile iron surfaces"

"After blasting, steel surfaces change from a dull black/gray (SP-7) to a gray (SP-6) to a near white (SP-10) to a bright white (SP-5). Ductile Iron changes from a medium gray to a bluish gray and eventually may produce an uneven black to a mottled gray/white"

"It is possible to over blast the external surface of ductile iron, causing 'blistering' or 'silvering'."

"The standard internal and external coating furnished by the manufacturer is an asphaltic cutback paint. The NAPF does not recommend the application of special coatings over asphaltic coatings. Therefore, uncoated pipe is recommended when special coatings are required." Solvent Cleaning is a method which shall result in the surface being clean of all oil, small deposits of asphalt, paint, grease, soil, drawing and cutting compounds and other soluble contaminants from iron surfaces.

IT IS THE FIRST STEP BY DEFINITION IN EVERY PREPARATION METHOD DISCUSSED

NAPF 500-03-02 Hand Tool Cleaning

Hand Tool Cleaning is a method of preparing iron surfaces by the use of non-power hand tools which shall result in the surface being free of all loose annealing oxide, loose rust, loose mold coating and other loose detrimental foreign matter.

Annealing oxide, mold coating, and rust are considered adherent if they cannot be removed by lifting with a dull putty knife.

All asphalt paint must be removed prior to hand tool cleaning.



Power Tool Cleaning is a method of preparing iron surfaces by the use of power assisted hand tools which shall result in the surface being free of all loose annealing oxide, loose rust, loose mold coating and other loose detrimental foreign matter.

Annealing oxide, mold coating, and rust are considered adherent if they cannot be removed by lifting with a dull putty knife.

All asphalt paint must be removed prior to power tool cleaning.

ABRASIVE BLAST CLEANING – External Pipe Surfaces:

A method of preparing the exterior of ductile iron pipe surfaces which, when viewed without magnification, shall result in the surface being free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter.

After the entire surface to be coated is struck by

the blast media, tightly adherent annealing oxide, mold coating, and rust staining may remain provided they cannot be removed by lifting with a dull putty knife.

ABRASIVE BLAST CLEANING – Internal Pipe Surfaces:

A method of preparing the interior of ductile iron pipe surfaces which, when viewed without magnification, shall result in the surface being free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter

The entire surface to be coated is struck by the blast media.

Depending on the type of service or lining specified, different degrees of tightly adherent annealing oxide and rust staining removal may be required.

A method of preparing the interior and exterior of ductile iron fittings which, when viewed without magnification, shall result in the surface being free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter.

NAPF 500-03-05 Abrasive Blast Cleaning of Ductile Iron Fittings

FOUR DEGREES OF ABRASIVE BLAST CLEANING ARE AVAILABLE:

Ductile Iron Fitting Blast Cleaning #1

No staining may remain on the surface after abrasive blasting. This is the only method recommended for fittings previously coated with asphaltic paint.

- Ductile Iron Fitting Blast Cleaning #2 No more than 5% staining may remain on the surface.
- Ductile Iron Fitting Blast Cleaning #3 No more than 33% staining may remain on the surface.
- **Ductile Iron Fitting Blast Cleaning #4** No limit is placed on the staining.

Galvanized Steel



Surface Preparation of Galvanized Steel after Fabrication

THREE STEPS TO PREPARE GALVANIZED STEEL:

- Inspection
- Cleaning
- Profiling

Note: The standard practice of weathering the galvanized steel for six months is many times impractical.

Surface Preparation of Galvanized Steel after Fabrication

INSPECTION:

- Chromate Testing per ASTM B201 (testing for passivators – see next slide)
- Surface Imperfections (bumpy spots, sharp icicles, rough edges...)





TESTING FOR PASSIVATORS:

- Prepare a solution of 20 grams copper sulfate in one liter of potable water (copper sulfate can be found at drug stores or hardware stores). You should have blue colored solution.
- Solvent wash a small area per SSPC-SP1.
- Sand $\frac{1}{2}$ of the area cleaned.
- Saturate a cotton swab with the copper sulfate solution and apply to the sanded and un-sanded areas.

(Continued)

TESTING FOR PASSIVATORS:

- If sanded and unsanded area turn black/dark brown, there are no passivators, and normal degreasing/cleaning is sufficient prior to coating. (Color change should happen in less than 10 seconds.)
- If unsanded area remains blue (and sanded turns black) then the galvanized steel has a passivator, and it must be removed mechanically (abrasive blast cleaning per SSPC-SP16 is the most efficient)

Recommended Surface Preparations for Galvanizing

- Water cleaning/jetting
- Solvent cleaning
- Light abrasive blasting
- Phosphoric acid and other chemical treatment



Recommended Surface Preparations for Galvanizing



SSPC-SP 16 April 1, 2010

SSPC: The Society for Protective Coatings

SURFACE PREPARATION SPECIFICATION SSPC-SP 16

Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

Foreword

This standard covers surface preparation of coated or uncoated metal surfaces other than carbon steel prior to the application of a protective coating system. Surface preparation using this standard is used to uniformly roughen and clean the bare substrate and to roughen the surface of intact coatings on these metals prior to coating application. Substrates that may be prepared by this method include, but are not limited to, galvanized surfaces, stainless steel, copper, aluminum, and brass. For the purpose of this standard, the zinc metal layer

2. Definitions

2.1 A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75 mil).

Stainless Steel





Summary

Explain the importance of specifications for the surface preparation of steel including cleanliness standards and profile requirements.

Identify inaccessible areas and the need to address them in specifications.

Describe the SSPC cleaning standards.

Explain the use of SSPC pictorial guides.

Describe the benefits of using of centrifugal blast cleaning to remove mill scale.

Explain the need to specify the removal of non-visible contaminants such as chlorides.

Explain the special requirements for preparing ductile iron, stainless steel, galvanizing, and aluminum.

Thank You





Bob Spano

Project Development Manager Sherwin-Williams Protective & Marine Robert.L.Spano@Sherwin.com

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Contact <u>swcoatingswebinars@sherwin.com</u> regarding webinar questions.

