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Standard Guide for Painting Inspectors (Metal Substrates)¹

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1. Scope

1.1 This guide is intended as an information aid to painting inspectors in carrying out their task efficiently. It includes the key elements of surface preparation, coatings application, and final approval for both field and shop work. The items should be selected that are pertinent to the specification of a particular job.

NOTE 1—For additional helpful information, refer to the following documents:

*Manual of Coating Work for Light-Water Nuclear Power Plant Primary Containment and Other Safety-Related Facilities*²

*New Concepts for Coating Protection of Steel Structures*³

D16 Terminology for Paint, Related Coatings, Materials, and Applications⁴

D4538 Terminology Relating to Protective Coatings and Lining Work for Power Generation Facilities⁴

Steel Structures Painting Manual Vol 1 Good Painting Practice⁵

Steel Structures Painting Manual Vol 2 Systems and Specifications⁵

Manufacturers Specifications and Instructions (made available to the inspector for reference to special requirements for proper application)

Safety Data Sheets (needed to ensure that personnel take necessary precautions in handling hazardous materials). Available from Materials manufacturer.

1.2 Certain industries or owners may require certified inspection personnel. See Guide D4537 for establishing procedures to certify inspectors for coatings work in nuclear facilities.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

¹ This guide is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.46 on Industrial Protective Coatings.

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² ASTM, 1979.

³ ASTM STP 841, ASTM, 1984.

⁴ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

⁵ Available from Association for Materials Protection and Performance (AMPP), 15835 Park Ten Place, Houston, TX 77084, https://www.ampp.org.

1.4 This guide is arranged in the following order:

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1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:⁴

- [D16 Terminology for Paint, Related Coatings, Materials, and Applications](#)
- [D1212 Test Methods for Measurement of Wet Film Thickness of Organic Coatings](#)
- [D1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting](#)
- [D2200 Practice for Use of Pictorial Surface Preparation Standards and Guides for Painting Steel Surfaces](#)
- [D3359 Test Methods for Rating Adhesion by Tape Test](#)
- [D3363 Test Method for Film Hardness by Pencil Test](#)
- [D4138 Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means](#)
- [D4212 Test Method for Viscosity by Dip-Type Viscosity Cups](#)
- [D4285 Test Method for Indicating Oil or Water in Compressed Air](#)
- [D4414 Practice for Measurement of Wet Film Thickness by Notch Gages](#)
- [D4417 Test Methods for Field Measurement of Surface](#)

- [Profile of Blast Cleaned Steel](#)
 - [D4537 Guide for Establishing Procedures to Qualify and Certify Personnel Performing Coating and Lining Work Inspection in Nuclear Facilities](#)
 - [D4538 Terminology Relating to Protective Coating and Lining Work for Power Generation Facilities](#)
 - [D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers](#)
 - [D4752 Practice for Measuring MEK Resistance of Ethyl Silicate \(Inorganic\) Zinc-Rich Primers by Solvent Rub](#)
 - [D4940 Test Method for Conductometric Analysis of Water Soluble Ionic Contamination of Blast Cleaning Abrasives](#)
 - [D5064 Practice for Conducting a Patch Test to Assess Coating Compatibility](#)
 - [D5162 Practice for Discontinuity \(Holiday\) Testing of Nonconductive Protective Coating on Metallic Substrates](#)
 - [D5402 Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs](#)
 - [D6386 Practice for Preparation of Zinc \(Hot-Dip Galvanized\) Coated Iron and Steel Product and Hardware Surfaces for Painting](#)
 - [D6677 Test Method for Evaluating Adhesion by Knife](#)
 - [D6913 Test Methods for Particle-Size Distribution \(Gradation\) of Soils Using Sieve Analysis](#)
 - [D7091 Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals](#)
 - [D7127 Test Method for Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces Using a Portable Stylus Instrument \(Withdrawn 2021\)⁶](#)
 - [D7393 Practice for Indicating Oil in Abrasives](#)
 - [E337 Test Method for Measuring Humidity with a Psychrometer \(the Measurement of Wet- and Dry-Bulb Temperatures\)](#)
- 2.2 *OSHA Standard:*⁵
- [29 CFR 1926.59 Hazard Communication](#)
- 2.3 *SSPC Standards:*⁵
- [SSPC-AB 1 Mineral and Slag Abrasives](#)
 - [SSPC-AB 2 Cleanliness of Recycled Ferrous Metallic Abrasives](#)
 - [SSPC-AB 3 Newly Manufactured or Re-Manufactured Steel Abrasives](#)
 - [SSPC-AB 4 Recyclable Encapsulated Abrasive Media](#)
 - [SSPC-SP 1 Solvent Cleaning](#)
 - [SSPC-SP 2 Hand Tool Cleaning](#)
 - [SSPC-SP 3 Power Tool Cleaning](#)
 - [SSPC-SP 5/NACE No. 1 White Metal Blast Cleaning](#)
 - [SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning](#)
 - [SSPC-SP 7/NACE No. 4 Brush-off Blast Cleaning](#)
 - [SSPC-SP 8 Pickling](#)
 - [SSPC-SP 10/NACE No. 2 Near-White Blast Cleaning](#)
 - [SSPC-SP 11 Power Tool Cleaning to Bare Metal](#)
 - [SSPC-SP 14/NACE No. 8 Industrial Blast Cleaning](#)
 - [SSPC-SP 15 Commercial Grade Power Tool Cleaning](#)

⁶ The last approved version of this historical standard is referenced on www.astm.org.

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

SSPC-SP WJ-1/NACE WJ-1 Clean to Bare Substrate

SSPC-SP WJ-2/NACE WJ-2 Very Thorough Cleaning

SSPC-SP WJ-3/NACE WJ-3 Thorough Cleaning

SSPC-SP WJ-4/NACE WJ-4 Light Cleaning

SSPC-PA 1 Shop, Field and Maintenance Painting of Steel

SSPC-PA 2 Procedure for Determining Conformance to Dry Coating Thickness Requirements

SSPC-PA Guide 11 Protecting Edges, Crevices, and Irregular Steel Surfaces by Stripe Coating

SSPC-PA 17 Procedure for Determining Conformance to Steel Profile/Surface Roughness/Peak Count Requirements

SSPC-VIS 1 Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blasting

SSPC-VIS 5/NACE VIS 9 Guide and Reference Photographs for Steel Surfaces Prepared by Wet Abrasive Blasting

SSPC-VIS 3 Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning

SSPC-VIS 4/NACE No. 7 Visual Standard for Steel Cleaned by Water Jetting

SSPC Paint 27 Basic Zinc Chromate-Vinyl Butyral Wash Primer

SSPC Guide 6 Guide for Containing Debris Generated During Paint Removal Operations

SSPC Guide 7 Guide for the Disposal of Lead Contaminated Surface Preparation Debris

SSPC Guide 15 Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Surfaces

2.4 *ISO Standards*.⁷

ISO 8501-4 Preparation Grades and Flash Rust Grades in Connection with High-Pressure Water Jetting

ISO 8502-3 Preparation of Steel Substrates before Application of Paints and Related Products – Tests for the assessment of surface cleanliness

2.5 *NACE International*.⁵

SP0178-2007 (formerly NACE RP0178) Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to be Lined for Immersion Service

2.6 *ASTM Adjuncts*:

Pictorial Surface Preparation Standards for Painting Steel Surfaces⁸

4. Preparation for Inspection

4.1 The guide describes the duties of the inspector and discusses inspection methods, both visual and instrumental, that can be used to determine that the specification requirements have been met by the painting contractor.

4.2 Before painting is started the project engineer should provide the inspector with information from the official plans and specifications as to coating type, thinner to be used, mixing ratios to be used, specified application thickness, primer, tie coat, topcoat, time between coats, surface preparation, method of application, and any special precautions to be followed such as limits on ambient conditions. These details should be recorded in an inspector's record book to eliminate any misunderstanding between the inspector and the contractor.

4.3 The inspector should obtain copies of the Safety Data Sheets (SDS) for all products that will be used on the project, review any hazard communications program in accordance with 29 CFR 1926.59 that will apply to the project, and review other safety information related to the work that will be performed by the contractor. The inspector should examine these materials and be supplied with appropriate protective equipment and devices.

4.4 The Product Data Sheets (PDS) for the coating products to be used, including thinners where applicable, shall be provided with the procured product. Note that the coating specification may allow only specific pre-qualified coatings to be used.

5. Surface Preparation Methods and Requirements

5.1 *Surface Preparation* is one of the most important factors affecting the performance of coatings. The specifier determines the proper level in accordance with the expected service life and type of coating specified.

5.1.1 *Pictorial Standard D2200 (SSPC-VIS 1)* should be provided to the inspector on a job involving blast cleaning of structural steel. The standard is used by the inspector to assist in determining whether the degree of surface preparation specified in a contract has been attained by the contractor. For large jobs it is recommended that before work starts, an actual steel sample of adequate size be blasted to the satisfaction of the project engineer. This blasted surface should be protected by a clear acrylic coating or encased in plastic and used for reference purposes as the work progresses.

5.2 *Factors Affecting Coating Performance*—There are a number of factors that should be considered to ensure a proper painting job.

5.2.1 *Cleanliness*—Many materials, if not removed from the surface, will affect the life of the coating. These include oil, grease, soil, weld spatter, and slag, that make it impossible to obtain proper adhesion to the metal surface. Surface soluble salts shall be removed to the degree specified or long term coating performance may be adversely affected. SSPC/NACE issues detailed surface preparation specifications that cover various methods for cleaning.

5.2.2 *Mill Scale*, The bluish-black oxide resulting from the hot-rolling process, is a constant source of trouble leading to coating failure. This scale is very brittle and can crack or

3. Significance and Use

3.1 This guide is intended as a reference for those concerned with the inspection of industrial coating work. The requirements for inspection should be addressed in all protective coating and lining work specifications. This guide may be used by specification writers when selecting and establishing the inspection requirements for coating and lining specifications. A checklist for use by inspectors in the field is included in **Appendix X1**.

⁷ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, <http://www.iso.org>.

⁸ The pictorial surface preparation standard Method A (ISO/Swedish Standard) is available from ASTM International Headquarters. Request Adjunct No. **ADJD2200**.

loosen due to temperature changes (both in fabricating and weathering in the field) leading to failure of the coating.

5.2.3 Surface Profile—The texture of the metal surface has a significant effect on the performance of coatings, since it increases the surface area to which the coating can develop adhesion. In fact, the term “anchor pattern” is sometimes used to describe the depth of profile. Profile varies both with the type and size of the abrasive used. Coarser abrasives generally produce a coarser and deeper profile. Deep profiles are advantageous for adhesion, but require more coating to fill in the valleys and cover the peaks of the profile; they cannot be used with low-build coatings that do not cover the peaks even when several coats are applied. The angularity (sharpness) and density of the profile may affect adhesion. Methods for measuring surface profile can be found in Test Methods **D4417** and **D7127**. Frequency of surface profile measurement and the acceptability of the measurements is described in SSPC-PA 17.

5.2.4 Sharp Edges—Sharp edges and rough welds can compromise coating performance, particularly in immersion service. Sharp edges and outside corners should be radiused, and rough welds should be smoothed or ground flat. NACE SP0178 and SSPC-PA Guide 11 may be used as guides. This operation should be specified during fabrication, but is frequently done by the coating contractor. The coating inspector should verify that such work has been done, if required by the coating job specification prior to other steps in surface preparation.

5.3 Cleaning Procedures—Safety precautions are not addressed separately for each of the following cleaning methods. Each has its own safety-related hazards, and U.S. Occupational Health and Safety Administration regulations should be followed. Safety Data Sheets (SDS) for the solvents and cleaning compounds provided by the manufacturer should also be consulted for proper worker protection.

5.3.1 Chemical Cleaning—Solvents are used to remove oil, grease, and related materials. The solvent is applied to the surface by wiping or scrubbing with rags or brushes. The contaminants should be removed (not simply spread out) by a thorough wiping of the affected areas with cloths saturated with clean solvent. Contaminated cloths should not be dipped into clean solvent. The cleaning should be repeated with clean rags and fresh clean solvent. Emulsions, cleaning compounds, steam cleaning, or similar methods and materials may also be used. Where emulsion cleaners, soaps, or detergents are used, they should be removed completely by washing with clean hot water. SSPC-SP 1 covers cleaning procedures using these materials.

5.3.1.1 Solvent Vapor Cleaning is a procedure that can be adapted to a production line or piecework operation. Vapor cleaning removes all soluble contaminants but does not disturb the natural oxide film. If this film should be removed, mechanical cleaning will be necessary as well. The part to be cleaned is placed in the saturated vapor above the heated solvent so that the solvent vapor condenses on the metal surface. Vapor degreasing does not remove particulate matter, so parts should be wiped to remove any insoluble soils. Vapor degreasing has

the advantages over solvent wiping in that hot solvents are used and the solvent condensation removes oils without recontamination.

5.3.2 Hand Tool Cleaning is the method used for the removal of loose mill scale, loose rust, loose or otherwise defective coating, weld flux, slag and spatter from metal surfaces by hand brushing, hand sanding, hand chipping or scraping using wire, fiber or bristle brushes, sandpaper, steel wool, hand scrapers or chisels, and chipping hammers. Material is considered tightly adherent if it cannot be lifted with a dull putty knife. SSPC provides a detailed specification, SSPC-SP 2. A visual standard, SSPC-VIS 3, may be used to assist in determining compliance.

5.3.2.1 Hand tool cleaning requires that all weld flux, tar, oil and grease, and other greasy contaminants be removed first by solvent cleaning (**5.3.1**).

5.3.2.2 Wire brushes should be rigid enough to clean the surface thoroughly, and shaped to penetrate into all corners and joints. Brushes should be kept free of all materials that may clog the wires of the brush.

5.3.2.3 Hand scrapers should be made of tool steel, tempered and ground to a sharp edge, and should be of the proper size and shape to enable cleaning to be done as specified. Scrapers should be kept sharp at all times.

5.3.3 Power Tool Cleaning is a method used for the removal of loose mill scale, loose rust, loose or otherwise defective coating, and weld flux from metal surfaces by power wire brushes, power impact tools, power grinders, power sanders, or by a combination of these methods. Material is considered tightly adherent if it cannot be lifted with a dull putty knife. SSPC-SP 3 is the detailed specification for power tool cleaning. A visual standard, SSPC-VIS 3, may be used to assist in determining compliance.

5.3.3.1 Power tool cleaning requires that all oil, grease, weld flux, and other contaminants be removed first by solvent cleaning (**5.3.1**). Hand tool cleaning in accordance with **5.3.2** may be used prior to power tool cleaning.

5.3.3.2 All equipment should be suitable for the configuration of the work to be cleaned and maintained free of material that clogs the wire or disks making them ineffective. All impact tools should be kept sharp.

5.3.4 Power Tool Cleaning to Bare Metal is a method used for the total removal of coating, rust, and mill scale. It also requires a minimum of 1-mil anchor profile. Surface cleaning, power tools, and surface profile producing media are used to

TABLE 1 Comparison of Surface Preparation Standards

Preparation Guide	SSPC	ASTM D2200		NACE
		Method A ^A	Method B ^B	
Blast clean to white metal	SSPC-SP 5	Sa 3	SP 5	1
Blast clean to near-white metal	SSPC-SP 10	Sa 2½	SP 10	2
Commercial blast cleaning	SSPC-SP 6	Sa 2 ^C	SP 6	3
Brush-off blast cleaning	SSPC-SP 7	Sa 1	SP 7	4
Industrial blast cleaning	SSPC-SP14	8

^A Method A is ISO/Swedish Standard.

^B Method B is SSPC- VIS-1.

^C Pictorial Standard Sa 2 shows mill scale and conflicts with SSPC definition of commercial blast (SP 6), which does not allow mill scale.