

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 of hot-dip galvanized steel is considered to be the substrate, rather than the underlying steel. This standard is not to be used for cleaning coated or uncoated carbon steel substrates. Five different standards are available for cleaning carbon steel: White Metal Blast Cleaning¹, Near-White Metal Blast Cleaning², Commercial Blast Cleaning³, Industrial Blast Cleaning⁴, and Brush-Off Blast Cleaning⁵. This standard is intended for use by coating specifiers, applicators, inspectors, or others who may be responsible for defining a standard degree of surface cleanliness.

This standard represents a degree of cleaning that is similar to that defined for carbon steel substrates in SSPC-SP7/NACE No. 4 except that a minimum surface profile depth on the bare metal surface is required.

1. Scope

1.1 This standard covers the requirements for brush-off blast cleaning of uncoated or coated metal surfaces other than carbon steel by the use of abrasives. These requirements include visual verification of the end condition of the surface and materials and procedures necessary to achieve and verify the end condition.

1.2 Information about the function of brush-off blast cleaning as defined in SP 16 is in Paragraph A1 of Appendix A.

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).

2.1.1 The entire surface shall be subjected to the abrasive blast to achieve the specified degree of cleaning and to produce a dense and uniform surface profile on the bare metal substrate. The peaks and valleys on the surface shall form a continuous pattern, leaving no smooth, unprofiled areas. 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.

2.1.2 Intact coatings that are present shall be roughened and cleaned as specified in the procurement documents. If the surface profile is not specified in the procurement documents, the abrasive selected shall roughen the cleaned surface to the degree required by the product data sheet for the coating to be applied.

2.1.3 Immediately prior to coating application, the entire surface shall comply with the degree of cleaning as specified herein.

3. Associated Documents

3.1 Documents cited in the mandatory sections of this standard include:

Document	Title
SSPC-SP 1 ⁶	Solvent Cleaning
ASTM D 4285 ^{(1),7}	Standard Test Method for Indicating Oil or Water in Compressed Air

⁽¹⁾ ASTM International (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

- ASTM D 4417^{(2),8}** Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
- ASTM D 7127⁹** Standard Test Method for Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces Using a Portable Stylus Instrument
- ASTM D 7393¹⁰** Method for Indicating Oil in Abrasives

3.2 The latest issue, revision, or amendment of the documents listed in Paragraph 3.1 in effect on the date of invitation to bid shall govern unless otherwise specified.

3.3 If there is a conflict between the requirements of any of the documents listed in Paragraph 3.1 and this standard, the requirements of this standard shall prevail.

4. Procedures Before Brush-Off Blast Cleaning of Non-Ferrous Metal Surfaces

4.1 Before blast cleaning of non-ferrous metal surfaces, visible deposits of oil, grease, or other contaminants that would interfere with coating adhesion shall be removed in accordance with SSPC-SP 1 or other specified methods.

4.2 Surface imperfections shall be corrected to the extent specified in the procurement documents (project specifications). Additional information on surface imperfections is in Paragraph A2 of Appendix A.

4.3 Unique Requirements for Preparation of Galvanized Steel

4.3.1 Before blast cleaning, galvanized surfaces shall be checked for the presence of "wet storage stain." Blast cleaning shall not be used to remove wet storage stain. The "dwell time" necessary for the blast stream to remove wet storage stain can damage the galvanized surface. Additional information on the removal of wet storage stain is in Paragraph A3 of Appendix A. Additional information on blast cleaning galvanized steel is in Appendix A9.

4.3.2 Unless written documentation exists to confirm that a galvanized surface is known to be free of chromates or other passivating treatments, representative areas of galvanized surfaces that will be coated shall be tested as described in Section 4.3.3 for the presence of chromates or other passivating treatments before brush-off blast cleaning is performed. If chromates or other passivating treatments are detected, the surface shall be retested after blast cleaning to confirm complete removal. OSHA requirements for worker protection from toxic metals may apply. Additional information on heavy metal toxicity is in Paragraph A4 of Appendix A.

4.3.3 Test for Presence of Passivating Treatments on Galvanizing (e.g., Chromating): "Chromating" refers to the treatment of galvanized parts to prevent the occurrence of wet storage stain. Most sheet metal and coil stock used to fabricate decking and curtain wall receives chromating treatments. The presence of chromates or other passivating treatments is detected by using a solution of copper sulfate, with the following procedure:

1. Ensure that surfaces are free of any visible oxidation or oxidation by-products
2. Prepare the solution by dissolving 2 grams of copper sulfate crystals in 100 ml of deionized water.
3. Mark off three adjacent areas on the galvanized part, approximately 6.45 cm² (1 inch²)
4. Leave one area untouched, solvent wash the second and third areas, and also thoroughly sand the third area using emery paper.
5. Using an eyedropper or pipette, saturate a cotton swab with the copper sulfate solution and apply to all three areas, or apply the solution directly to the three areas.

If all three areas turn black immediately, there is no passivation on the surface. If the first area does not turn black within 10 seconds and the second and third areas turn black immediately, there is no passivation on the surface with the possible exception of light oil. If the first and second areas do not turn black within 10 seconds and the third area turns immediately, a passivator of some type is present.

5. Blast Cleaning Methods and Operation

5.1 Clean, dry compressed air shall be used for nozzle blasting. Cleanliness of the compressed air shall be verified in accordance with the procedure described in ASTM D 4285. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve this requirement.

5.2 Any of the following methods of surface preparation may be used to brush-off blast clean a non-ferrous metal substrate, but the presence of toxic metals in the abrasives or coating being removed can place restrictions on the methods of cleaning permitted. The chosen method shall comply with all applicable regulations.

5.2.1 Dry abrasive blasting using compressed air, blast nozzles, and abrasive.

5.2.2 Dry abrasive blasting using a closed-cycle, recirculating abrasive system with compressed air, blast nozzle, and abrasive, with or without vacuum for dust and abrasive recovery.

5.2.3 Dry abrasive blasting using a closed-cycle, recirculating abrasive system with centrifugal wheels and abrasive.

⁽²⁾ Although ASTM D 4417 is written for blast-cleaned steel, the methods are suitable for use on non-ferrous metals.

5.2.4 When specified, other methods of surface preparation (such as wet abrasive blast cleaning) may be used to brush-off blast clean non-ferrous metal surfaces. Additional information on cleaning soft and thin substrates is in Paragraphs A5, A6, and A7 of Appendix A. Additional information on the use of wet abrasive blast cleaning to clean galvanized surfaces is in Paragraph A9.3 of Appendix A.

6. Abrasives for Brush-Off Blast Cleaning of Non-Ferrous Metal Substrates

6.1 The selection of abrasive size and type shall be based on the type, grade, and surface condition of the surface to be cleaned, the type of blast cleaning system used, the finished surface to be produced (cleanliness and surface profile [roughness]), and whether the abrasive will be recycled.

6.2 The cleanliness and size of recycled abrasives shall be maintained to ensure compliance with this standard.

6.3 The blast cleaning abrasive shall be dry and free of oil and grease, as determined by ASTM D 7393.

6.4 The abrasive shall comply with any limitations or special requirements stipulated by the procurement documents. Abrasive embedment and abrasives containing contaminants may not be acceptable for some service requirements. Additional information on abrasive selection is in Paragraphs A8 and A8.1 of Appendix A.

6.5 The abrasive material shall produce a dense and uniform profile acceptable for application of the intended coating. After cleaning, the cleaned metal surface shall have a minimum 19-micrometer (0.75 mil) profile, measured in accordance with ASTM D 4417 or ASTM D 7127. If present, intact tightly adherent coating shall be roughened as specified in the procurement documents (project specification). If the surface profile is not specified in the procurement documents, the abrasive selected shall roughen the cleaned surface to the degree required by the product data sheet for the coating to be applied.

7. Procedures Following Brush-Off Blast Cleaning and Immediately Prior to Coating

7.1 Visible deposits of oil, grease, or other contaminants shall be removed as required by SSPC-SP 1, or as specified.

7.2 Dust, dirt and loose residues shall be removed from prepared surfaces by brushing; blowing off with clean, dry air; vacuum cleaning; or other specified methods.

7.3 Removal of chromates or other passivating treatments detected on galvanized surfaces (see Section 4.3.2) shall be confirmed before coating application, using the procedure in Section 4.3.3.

7.4 Immediately prior to coating application, the entire surface shall comply with the degree of cleaning specified in this standard.

8. Disclaimer

8.1 While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

8.2 This specification does not attempt to address all problems concerning safety and health associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for ensuring compliance with all governmental regulations.

References

1. SSPC-SP 5/NACE No. 1 (latest revision), White Metal Blast Cleaning (Pittsburgh, PA: SSPC, and Houston, TX: NACE)
2. SSPC-SP 10/NACE No. 2 (latest revision), Near-White Metal Blast Cleaning (Pittsburgh, PA: SSPC, and Houston, TX: NACE)
3. SSPC-SP 6/NACE No. 3 (latest revision), Commercial Blast Cleaning (Pittsburgh, PA: SSPC, and Houston, TX: NACE)
4. SSPC-SP 14/NACE No. 8 (latest revision), Industrial Blast Cleaning (Pittsburgh, PA: SSPC, and Houston, TX: NACE)
5. SSPC-SP 7/NACE No. 4 (latest revision), Brush-Off Blast Cleaning (Pittsburgh, PA: SSPC, and Houston, TX: NACE)
6. SSPC-SP 1 (latest revision), Solvent Cleaning (Pittsburgh, PA: SSPC).
7. ASTM D 4285 (latest revision), Standard Test Method for Indicating Oil or Water in Compressed Air (West Conshohocken, PA: ASTM International).
8. ASTM D 4417 (latest revision), Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel (West Conshohocken, PA: ASTM International)
9. ASTM D 7127 (latest revision), Standard Test Method for Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces Using a Portable Stylus Instrument (West Conshohocken, PA: ASTM International)
10. ASTM D 7393 (latest revision) Method for Indicating Oil in Abrasive
11. Code of Federal Regulations, Title 29 Part 1926.1126 (Chromium VI)
12. ASTM B 6 (latest revision), Standard Specification for Zinc (West Conshohocken, PA: ASTM International)
13. Code of Federal Regulations, Title 29 Part 1926.62 (Lead)

14. ASTM D 1730 (latest revision), Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting (West Conshohocken, PA: ASTM International)
15. SSPC-SP COM (latest revision), Surface Preparation Commentary for Steel and Concrete Substrates (Pittsburgh, PA: SSPC)
16. SSPC-AB 1 (latest revision), Mineral and Slag Abrasives (Pittsburgh, PA: SSPC).
17. SSPC-AB 2 (latest revision), Cleanliness of Recycled Ferrous Metallic Abrasives (Pittsburgh, PA: SSPC).
18. SSPC-AB 3 (latest revision), Ferrous Metallic Abrasives (Pittsburgh, PA: SSPC).
19. SSPC-AB 4 (latest revision), Recyclable Encapsulated Abrasive Media (Pittsburgh PA: SSPC).
20. ASTM A 123 (latest revision), Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products (West Conshohocken, PA: ASTM International)
21. ASTM A 153 (latest revision), Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware (West Conshohocken, PA: ASTM International)
22. ASTM A 780 (latest revision), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings (West Conshohocken, PA: ASTM International)
23. ASTM D 6386 (latest revision), Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting (West Conshohocken, PA: ASTM International)

Nonmandatory Appendix A: Explanatory Notes

A1 FUNCTION: This standard provides a degree of cleaning for non-ferrous metal substrates comparable to or greater than brush-off blast cleaning (SSPC-SP 7/NACE No. 4) of carbon steel. It is used to clean and roughen coated and uncoated metal surfaces (other than carbon steel), typically associated with the application of a protective coating system. The primary functions of brush-off blast cleaning of non-ferrous metal substrates before coating are (a) to remove material from the surface that can cause early failure of the coating and (b) to obtain a suitable surface profile (roughness) to enhance the adhesion of the new coating system.

A2 SURFACE IMPERFECTIONS: Surface imperfections can cause premature failure when the service is severe. Coatings tend to pull away from sharp edges and projections, leaving little or no coating to protect the underlying surface. Other features that are difficult to properly cover and protect include crevices, weld porosities, laminations, etc. The high cost of the methods to remedy surface imperfections requires weighing the benefits of edge rounding, weld spatter removal, etc., versus a potential coating failure.

A3 WET STORAGE STAIN: Wet storage stain is the whitish zinc corrosion product that forms when galvanized

parts are exposed to moist air without sufficient air circulation between the parts. Wet storage stain will reduce the adhesion of subsequently applied coatings, possibly resulting in coating delamination. Using a nylon brush and rinsing with water may remove light cases of wet storage stain. More severe cases with thick deposits may be removed by brushing with a dilute solution of acetic or citric acid. Surface contact time should be less than four minutes. Lime juice and white vinegar have been found to be effective cleaners.⁽³⁾ Immediately after brushing, the cleaned areas should be rinsed with a large amount of water.

A4 TOXICITY: The presence of toxic substances in the abrasive or material being removed may place restrictions on the methods of cleaning permitted. If chromates are present, requirements of 29 CFR 1926.1126 (hexavalent chromium [chromium VI])¹¹ for worker protection may apply. ASTM B 6¹² lists five grades of zinc containing various levels of lead ranging from 0.003% to 1.4%. Depending on the grade of zinc used by the galvanizer, abrasive blast cleaning of the galvanized surface may also require compliance with Code of Federal Regulations,⁽⁴⁾ Title 29 part 1926.62 (Lead).¹³

A5 EROSION OF SOFT METAL SUBSTRATES: When performing brush-off blast cleaning of soft metals such as aluminum, copper, and brass, care should be taken to avoid erosion of the metal substrate. Examples of techniques that may reduce the risk of erosion include the use of softer abrasives, lower nozzle pressures, and increased stand-off distances.

A6 DEFORMATION OF THIN METAL SUBSTRATES: Metal parts less than about 20 gauge in thickness may deform during brush-off blast cleaning. Deformation of thin metal substrates may be prevented by reducing the blast pressure and moving the blast nozzle rapidly across the surface being roughened and cleaned.

A7 BRUSH-OFF BLAST CLEANING ALUMINUM, COPPER, BRASS AND STAINLESS STEEL: Brush-off blast cleaning may not remove stains that could be detrimental to a paint system. If stains are still present after brush-off blast cleaning, they should be removed by spot cleaning, power brushing, or orbital sanding using stainless steel wire brushes, or stainless steel abrasive pads, followed by repeat brush-off blast cleaning if necessary to provide the desired profile.

When brush-off blast cleaning aluminum, the protective oxide layer is removed. A high performance coating system will improve the corrosion protection of the metal.

Additional information on the preparation of aluminum and aluminum alloys for painting can be found in ASTM D 1730.¹⁴

⁽³⁾ B. Duran and T. Langill, "Cleaning Wet Storage Stain from Galvanized Surfaces," in Galvanizing Notes, October 22, 2007. (Centennial, CO: American Galvanizers Association).

⁽⁴⁾ The U.S. Code of Federal Regulations may be accessed online at <<http://www.access.gpo.gov/nara/cfr/cfr-table-search.html>>.

A8 ABRASIVE SELECTION AND USE: Types of metallic and non-metallic abrasives are discussed in the Surface Preparation Commentary (SSPC-SP COM).¹⁵ It is important to recognize that blasting abrasives may become embedded in or leave residues on the surface during preparation. Embedment can be detrimental (for example, ferrous metallic abrasives on stainless steel or aluminum). Carbon steel and chilled iron abrasives should not be used on stainless steel substrates, or when chemistry of the embedded abrasive could cause halogen-induced stress corrosion cracking or liquid metal embrittlement. Care should be taken to ensure that the abrasive is free from detrimental amounts of water-soluble, solvent-soluble, acid-soluble, or other soluble contaminants (particularly if the prepared surface is to be used in an immersion environment). Criteria for selecting and evaluating some types of abrasive media are given in SSPC-AB 1, AB 2, AB 3 and AB 4.^{16, 17, 18, 19} Other media may also be suitable (see A8.1.1).

A8.1 Abrasive Size and Hardness: The size and hardness of abrasive media selected for brush-off blasting of non-ferrous metal substrates should be based on surface profile requirements. Abrasives in the size range 35 to 70 mesh having a Mohs hardness of 5 or less will generally perform well for cleaning substrates such as galvanized steel, aluminum, brass, and copper. Harder abrasives are typically required for stainless steel.

A8.1.1 Softer abrasives are frequently used to prevent deformation of thin sheets of metal during blast cleaning. Some materials that have been found to be suitable include, but are not limited to aluminum/magnesium silicate, soft mineral sands, soft crushed glass and glass bead media, and organic media such as corncobs or walnut shells.

A8.2 Air Pressure: Relatively low nozzle pressures should be used for aluminum, copper, and galvanized steel to reduce the risk of damage to the substrate. Higher pressures are more suitable for stainless steel.

A9 BRUSH-OFF BLAST CLEANING GALVANIZED STEEL

A9.1 Thickness of Zinc on Galvanized Steel: The zinc layers should remain intact during brush-off blast cleaning. The rate of cleaning is typically 110 m² per hour (1200 ft² per hour) or greater. It is recommended that the thickness of new galvanizing be measured before and after brush-off blast cleaning using measurement techniques described in SSPC-PA 2 to confirm that it still conforms to ASTM A123 or ASTM A153A/153M, as applicable. Any areas with insufficient thickness should be repaired in accordance with ASTM A 780.^{20,21,22}

A9.1.1 For some complicated shapes, a reduction in galvanizing thickness may be difficult to avoid. A mock-up or test area should be abrasive blasted to determine if excessive zinc is removed. If this is the case, consideration should be given to replacing the zinc (e.g. spot applications of an organic zinc-rich primer) or alternative measures of surface preparation such as zinc phosphate treatment may be used. These methods are beyond the scope of this standard.

A9.2 Zinc Oxides: Newly exposed zinc surfaces will oxidize rapidly, especially in the presence of moisture. During brush-off blast cleaning and subsequent painting of galvanized steel, the surface temperature should be a minimum of 3 °C (5 °F) above the dew point, in order to retard the formation of zinc oxides. To limit the amount of zinc oxide on the cleaned surface, galvanizing should not be permitted to get damp after cleaning, and should be painted as soon as possible within the same work shift that the surfaces were cleaned.

A9.3 On galvanized steel surfaces, the use of wet abrasive blast cleaning can result in formation of oxides and hydroxides. Additional information on the preparation of galvanized steel for painting can be found in ASTM D 6386.²³