

## Joint Surface Preparation Standard

# SSPC-SP 5/NACE NO. 1

## White Metal Blast Cleaning

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### Foreword

This joint standard covers the use of blast cleaning abrasives to achieve a defined degree of cleaning of steel surfaces prior to the application of a protective coating or lining system. This standard is intended for use by coating or lining specifiers, applicators, inspectors, or others whose responsibility it may be to define a standard degree of surface cleanliness.

The focus of this standard is white metal blast cleaning. Near-white metal blast cleaning, commercial blast cleaning, industrial blast cleaning and brush-off blast cleaning are addressed in separate standards.

White metal blast cleaning provides a greater degree of cleaning than near-white blast cleaning (SSPC-SP 10/NACE No. 2).

The difference between a white metal blast and a near-white blast is that a white metal blast removes all of the coating, mill scale, rust, oxides, corrosion products, and other foreign matter from the surface. Near-white blasting allows light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coating to remain on no more than 5 percent of each unit area of surface.

This joint standard was prepared by the SSPC/NACE Task Group A on Surface Preparation by Abrasive Blast Cleaning. This joint Task Group includes members of both the SSPC Surface Preparation Committee and the NACE Unit Committee T-6G on Surface Preparation.

### 1. General

**1.1** This joint standard covers the requirements for white metal blast cleaning of unpainted or painted steel surfaces by the use of abrasives. These requirements include the end condition of the surface and materials and procedures necessary to achieve and verify the end condition.

**1.2** The mandatory requirements are described in Sections 1 to 9 as follows:

Section 1	General
Section 2	Definition
Section 3	References
Section 4	Procedures Before Blast Cleaning
Section 5	Blast Cleaning Methods and Operation
Section 6	Blast Cleaning Abrasives
Section 7	Procedures Following Blast Cleaning and Immediately Prior to Coating
Section 8	Inspection
Section 9	Safety and Environmental Requirements

NOTE: Section 10, "Comments" and Appendix A, "Explanatory Notes" are not mandatory requirements of this standard.

## 2. Definition

**2.1** 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.

**2.2** Acceptable variations in appearance that do not affect surface cleanliness as defined in Section 2.1 include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill or fabrication marks, heat treating, heat affected zones, blasting abrasives, and differences due to blasting technique.

**2.3** When a coating is specified, the surface shall be roughened to a degree suitable for the specified coating system.

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

**2.5** SSPC-VIS 1-89 may be specified to supplement the written definition. In any dispute, the written standards shall take precedence over visual standards and comparators. Additional information on visual standards and comparators is available in Section A.4 of Appendix A.

## 3. References

**3.1** The documents referenced in this standard are listed in Section 3.4.

**3.2** The latest issue, revision, or amendment of the referenced standards 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 cited reference standards and this standard, the requirements of this standard shall prevail.

## 3.4 SSPC: The Society For Protective Coatings Standards:

<b>AB 1</b>	Mineral and Slag Abrasives
<b>AB 2</b>	Cleanliness of Recycled Ferrous Metallic Abrasives
<b>AB 3</b>	Newly Manufactured or Re-Manufactured Steel Abrasives
<b>PA Guide 3</b>	A Guide to Safety in Paint Application
<b>SP 1</b>	Solvent Cleaning
<b>VIS 1</b>	Visual Standard for Abrasive Blast Cleaned Steel

## 4. Procedures Before Blast Cleaning

**4.1** Before blast cleaning, visible deposits of oil, grease, or other contaminants shall be removed in accordance with SSPC-SP 1 or other agreed upon methods.

**4.2** Before blast cleaning, surface imperfections such as sharp fins, sharp edges, weld spatter, or burning slag should be removed from the surface to the extent required by the procurement documents (project specification). Additional information on surface imperfections is available in Section A.5 of Appendix A.

**4.3** If a visual standard or comparator is specified to supplement the written standard, the condition of the steel prior to blast cleaning should be determined before the blasting commences. Additional information on visual standards and comparators is available in Section A.4 of Appendix A.

## 5. Blast Cleaning Methods and Operation

**5.1** Clean, dry compressed air shall be used for nozzle blasting. 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 achieve a white metal abrasive blast cleaned surface:

**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.

**5.3** Other methods of surface preparation (such as wet abrasive blasting) may be used to achieve a white metal blast cleaned surface by mutual agreement between those responsible for performing the work and those responsible for establishing the requirements. NOTE: Information on the use of inhibitors to prevent the formation of rust immediately after wet blast cleaning is contained in Section A.9 of Appendix A.

## **6. Blast Cleaning Abrasives**

**6.1** The selection of abrasive size and type shall be based on the type, grade, and surface condition of the steel to be cleaned, type of blast cleaning system employed, the finished surface to be produced (cleanliness and 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 specification.

**6.3** The blast cleaning abrasive shall be dry and free of oil, grease, and other contaminants as determined by the test methods found in SSPC-AB 1, AB 2 and AB 3.

**6.4** Any limitations on the use of specific abrasives, the quantity of contaminants, or the degree of allowable embedment shall be included in the procurement documents (project specification) covering the work, because abrasive embedment and abrasives containing contaminants may not be acceptable for some service requirements. NOTE: Additional information on abrasive selection is given in Section A.2 of Appendix A.

## **7. Procedures Following Blast Cleaning and Immediately Prior to Coating**

**7.1** Visible deposits of oil, grease, or other contaminants shall be removed according to SSPC-SP 1 or another method agreed upon by those parties responsible for establishing the requirements and those responsible for performing the work.

**7.2** Dust and loose residues shall be removed from prepared surfaces by brushing, blowing off with clean, dry air, vacuum cleaning, or other methods agreed upon by those responsible for establishing the requirements and those responsible for performing the work. NOTE: The presence of toxic metals in the abrasives or paint being removed may place restrictions on the methods of cleaning permitted. Comply with all applicable regulations. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve clean, dry air.

**7.3** After blast cleaning, surface imperfections that remain (e.g., sharp fins, sharp edges, weld spatter, burning slag, scabs, slivers, etc.) shall be removed to the extent required in the procurement documents (project specification). Any damage to the surface profile resulting from the removal of surface imperfections shall be corrected to meet the requirements of Section 2.4. NOTE: Additional information on surface imperfections is contained in Section A.5 of Appendix A.

**7.4** Any visible rust that forms on the surface of the steel after blast cleaning shall be removed by recleaning the rusted areas to meet the requirements of this standard before coating. NOTE: Information on rust-back (re-rusting) and surface condensation is contained in Sections A.6, A.7 and A.8 of Appendix A.

## **8. Inspection**

**8.1** Work and materials supplied under this standard are subject to inspection by a representative of those responsible for establishing the requirements. Materials and work areas shall be accessible to the inspector. The procedures and times of inspection shall be as agreed upon by those responsible for establishing the requirements and those responsible for performing the work.

**8.2** Conditions not complying with this standard shall be corrected. In the case of a dispute, an arbitration or settlement procedure established in the procurement documents (project specification) shall be followed. If no arbitration or settlement procedure is established, then a procedure mutually agreeable to purchaser and supplier shall be used.

**8.3** The procurement documents (project specification) should establish the responsibility for inspection and for any required affidavit certifying compliance with the specification.

## **9. Safety and Environmental Requirements**

**9.1** Because abrasive blast cleaning is a hazardous operation, all work shall be conducted in compliance with applicable occupational and environmental health and safety rules and regulations. NOTE: SSPC-PA Guide 3, "A Guide to Safety in Paint Application," addresses safety concerns for coating work.

## **10. Comments**

**10.1** Additional information and data relative to this standard are contained in Appendix A. Detailed information and data are presented in a separate document, SSPC-SP COM, "Surface Preparation Commentary." The recommendations contained in Appendix A and SSPC-SP COM are believed to represent good practice, but are not to be

considered requirements of the standard. The sections of SSPC-SP COM that discuss subjects related to industrial blast cleaning are listed below.

<u>Subject</u>	<u>Commentary Section</u>
Abrasive Selection .....	6
Film Thickness .....	10
Wet Abrasive Blast Cleaning .....	8.2
Maintenance Repainting .....	4.2
Rust-back (Re-rusting) .....	8.3
Surface Profile .....	6.2
Visual Standards .....	11
Weld Spatter .....	4.4.1

## Appendix A. Explanatory Notes

**A.1 FUNCTION:** White metal blast cleaning (SSPC-SP 5/NACE No. 1) provides the greatest degree of cleaning. It should be used when the highest degree of blast cleaning is required. The primary functions of blast cleaning before coating are: (a) to remove material from the surface that can cause early failure of the coating system and (b) to obtain a suitable surface roughness and to enhance the adhesion of the new coating system. The hierarchy of blasting standards is as follows: white metal blast cleaning, near-white blast cleaning, commercial blast cleaning, industrial blast cleaning, and brush-off blast cleaning.

**A.2 ABRASIVE SELECTION:** Types of metallic and non-metallic abrasives are discussed in the Surface Preparation Commentary (SSPC-SP COM). It is important to recognize that blasting abrasives may become embedded in or leave residues on the surface of the steel during preparation. While normally such embedment or residues are not detrimental, 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 steel is to be used in an immersion environment). Criteria for selecting and evaluating abrasives are given in SSPC-AB 1, "Mineral and Slag Abrasives," SSPC-AB 2, "Cleanliness of Recycled Ferrous Metallic Abrasives," and SSPC-AB 3, "Newly Manufactured or Re-Manufactured Steel Abrasives."

**A.3 SURFACE PROFILE:** Surface profile is the roughness of the surface which results from abrasive blast cleaning. The profile depth (or height) is dependent upon the size, shape, type, and hardness of the abrasive, particle velocity and angle of impact, hardness of the surface, amount of recycling, and the proper maintenance of working mixtures of grit and/or shot.

The allowable minimum/maximum height of profile is usually dependent upon the thickness of the coating to be applied. Large particle sized abrasives (particularly metal-

lic) can produce a profile that may be too deep to be adequately covered by a single thin film coat. Accordingly, it is recommended that the use of larger abrasives be avoided in these cases. However, larger abrasives may be needed for thick film coatings or to facilitate removal of thick coatings, heavy mill scale, or rust. If control of profile (minimum/maximum) is deemed to be significant to coating performance, it should be addressed in the procurement documents (project specification). Typical profile heights achieved with commercial abrasive media are shown in Table 5 of the Surface Preparation Commentary (SSPC-SP COM). Surface profile should be measured in accordance with NACE Standard RP0287 (latest edition), "Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using Replica Tape," or ASTM<sup>(1)</sup> D 4417 (latest edition), "Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel."

**A.4 VISUAL STANDARDS:** Note that the use of visual standards or comparators in conjunction with this standard is required only when specified in the procurement document (project specification) covering the work. However, it is strongly recommended that the procurement document require the use of visual standards or comparators. SSPC-VIS 1-89 (Visual Standard for Abrasive Blast Cleaned Steel) provides color photographs for the various grades of surface preparation as a function of the initial condition of the steel. The series A-SP 5, B-SP 5, C-SP 5 and D-SP 5 depict surfaces cleaned to white metal grade. In addition, the series A-SP 5 M and N depict surfaces cleaned by various metallic and non-metallic abrasives to SP 5 condition. The NACE Visual Comparator for Surface Finishing of Welds Prior to Coating is a plastic weld replica that complements NACE Standard RP 0178. Other available visual standards are described in Section 11 of SSPC-SP COM.

**A.5 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 steel. 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.

Poorly adhering contaminants, such as weld slag residues, loose weld spatter, and some minor surface laminations may be removed during the blast cleaning operation. Other surface defects (steel laminations, weld porosities, or deep corrosion pits) may not be evident until the surface preparation has been completed. Therefore, proper plan-

<sup>(1)</sup> ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ning for such surface repair work is essential because the timing of the repairs may occur before, during, or after the blast cleaning operation. Section 4.4 of SSPC-SP COM and NACE Standard RP0178 (latest edition), "Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service" contain additional information on surface imperfections.

**A.6 CHEMICAL CONTAMINATION:** Steel contaminated with soluble salts (e.g., chlorides and sulfates) develops rust-back rapidly at intermediate and high humidities. These soluble salts can be present on the steel surface prior to blast cleaning as a result of atmospheric contamination. In addition, contaminants can be deposited on the steel surface during blast cleaning if the abrasive is contaminated. Therefore, rust-back can be minimized by removing these salts from the steel surface and eliminating sources of recontamination during and after blast cleaning. Wet methods of removal are described in SSPC-SP 12/NACE No. 5. Identification of the contaminants along with their concentrations may be obtained from laboratory and field tests as described in SSPC-TU 4, "Technology Update on Field Methods for Retrieval and Analysis of Soluble Salts on Substrates."

**A.7 RUST-BACK:** Rust-back (re-rusting) occurs when freshly cleaned steel is exposed to moisture, contamination, or a corrosive atmosphere. The time interval between blast cleaning and rust-back will vary greatly from one environment to another. Under mild ambient conditions, if chemical contamination is not present (see Section A.6), it is best to blast clean and coat a surface the same day. Severe conditions may require more expedient coating application to avoid contamination from fallout. Chemical contamination should be removed prior to coating (see Section A.6).

**A.8 DEW POINT:** Moisture condenses on any surface that is colder than the dew point of the surrounding air. It is, therefore, recommended that the temperature of the steel surface be at least 3 °C (5 °F) above the dew point during dry

blast cleaning operations. It is advisable to visually inspect for moisture and periodically check the surface temperature and dew point during blast cleaning operations and to avoid the application of coating over a damp surface.

**A.9 WET ABRASIVE BLAST CLEANING:** Steel that is wet abrasive blast cleaned may rust rapidly. Clean water should be used for rinsing. It may be necessary that inhibitors be added to the water or applied to the surface immediately after blast cleaning to temporarily prevent rust formation. The use of inhibitors or the application of coating over slight discoloration should be in accordance with the requirements of the coating manufacturer. CAUTION: Some inhibitive treatments may interfere with the performance of certain coating systems.

**A.10 FILM THICKNESS:** It is essential that ample coating be applied after blast cleaning to adequately cover the peaks of the surface profile. The dry film thickness of the coating above the peaks of the profile should equal the thickness known to be needed for the desired protection. If the dry film thickness over the peaks is inadequate, premature rust-through or failure will occur. To assure that coating thicknesses are properly measured the procedures in SSPC-PA 2 (latest edition), "Measurement of Dry Coating Thickness with Magnetic Gauges" should be used.

**A.11 MAINTENANCE AND REPAIR PAINTING:** When this standard is used in maintenance painting, specific instructions should be given on the extent of surface to be blast cleaned or spot blast cleaned to this degree of cleanliness. In these cases, the cleaning shall be performed across the entire area specified. For example, if all weld seams are to be cleaned in a maintenance operation, this degree of cleaning shall be applied 100% to all weld seams. If the entire structure is to be prepared, this degree of cleaning shall be applied to 100% of the entire structure. SSPC-PA Guide 4 (latest edition), "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," provides a description of accepted practices for retaining old sound coating, removing unsound coating, feathering, and spot cleaning.