SSPC: The Society for Protective Coatings

Surface Preparation Standard No. 11

Power-Tool Cleaning to Bare Metal

1. Scope

1.1 This standard contains the requirements for power-tool cleaning steel to produce a bare metal power tool cleaned surface having a minimum 25-micrometer (1.0-mil) surface profile.

1.2 This standard is suitable where a roughened, clean, bare metal surface as defined in Section 2.1 is required, but where abrasive blasting is not feasible or permissible (see Notes 8.1 and 8.2).

1.3 This standard differs from SSPC-SP 3, Power-Tool Cleaning, in that SSPC-SP 3 requires the removal of loosely adherent materials only, and contains no requirement to expose bare metal or to achieve a minimum surface profile.

1.4 This standard differs from SSPC-SP 15, Commercial Grade Power-Tool Cleaning, in that SSPC-SP 15 allows stains to remain on the surface.

2. Definition

2.1 A bare metal power tool cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, corrosion products, and other foreign matter, with the exception of trace amounts of coating and corrosion products in the lower portion of pits on pitted substrates (see Notes 8.1 and 8.3).

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, or the texture/features associated with the use of a particular power tool.

2.3 The surface profile shall be a minimum of 25 micrometers (1.0 mil). The peaks and valleys on the prepared surface shall form a continuous pattern with no smooth, unprofiled areas.

2.4 The profile shall be measured in accordance with ASTM D 4417 Method B unless otherwise specified (see Notes 8.4, 8.5, and 8.6).[1]

2.5 Reference photographs of power-tool cleaned surfaces found in SSPC-VIS 3 are often used to supplement the written definition. In any dispute, the written definition set forth in this standard shall take precedence over reference photographs. Additional information on reference photographs is in Note 8.3.

3. Referenced Standards

3.1 The latest issue, revision, or amendment of the referenced standards in effect on the date of invitation to bid shall govern unless otherwise specified. Standards marked with an asterisk (*) are referenced only in the Notes, which are not requirements of this standard.

3.2 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.

3.3 SSPC STANDARDS:

*	**PA 2**	Procedure for Determining Conformance to Dry Coating Thickness Requirements
	SP 1	Solvent Cleaning
	SP 3	Power-Tool Cleaning
*	**SP 5/NACE No. 1**	White Metal Blast Cleaning
	SP 15	Commercial Grade Power-Tool cleaning
	VIS 3	Guide and Reference Photographs for Steel Surfaces Prepared by Power- and Hand-Tool Cleaning

3.4 ASTM INTERNATIONAL STANDARDS[2]:

	D 4285	Method for Indicating the Presence of Oil or Water in Compressed Air
	D 4417	Standard Test Methods for Field Measurement of Surface Profile of Blast-Cleaned Steel
*	**D 7127**	Standard Test Method for Measurement of Surface Roughness of Abrasive Blast-Cleaned Metal Surfaces Using a Portable Stylus Instrument

[1] Although ASTM D 4417 and ASTM D 7127 indicate in their titles that they describe methods intended for use on blast-cleaned steel, there is currently no method specifically designed for measurement of profile on steel surfaces prepared using power-tools. Visual comparators used for ASTM D 4417 Method A represent surfaces prepared by abrasive blast cleaning and are inappropriate for comparison with power-tool cleaned surfaces. The replica tape used for ASTM D 4417 Method C cannot accurately measure the profile produced by some types of power-tool cleaning media. A test area prepared at the job site can be used to assess the suitability of media and profile measurement method for a project prior to full-scale production.

[2] ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. 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.

4. Tools and Methods for Power-Tool Cleaning to Bare Metal

4.1 POWER TOOLS: Any hand-held motorized tool on which the media described in Sections 4.1.1 and 4.1.2 are capable of being mounted in accordance with manufacturer's instructions and that will produce a steel surface meeting the requirements of Sections 2.1 and 2.3 is acceptable (see Notes 8.7.1, 8.7.2, 8.8, and 8.9). Sections 4.1.1 and 4.1.2 describe the two main categories of power tools. It is possible for power tools to alter an existing surface profile.

4.1.1 Grinding Tools: Grinding tools use media containing bonded abrasive grains to cut through corroded surfaces and include, but are not limited to, discs or wheels as described in Note 8.6.1.

4.1.2 Impact Tools: Impact tools use media that repeatedly collide with the target surface and include, but are not limited to, various rotary and reciprocating devices as described in Note 8.6.2.

4.2. The use of several different power tools meeting the requirements of Sections 4.1, 4.1.1 and 4.1.2 is sometimes necessary to achieve a bare metal power-tool cleaned surface meeting the requirements of Sections 2.1 and 2.3 (see Note 8.7 and subsections).

4.3 If the procurement documents require power-tool cleaning to prepare surfaces for subsequent coating, the edges of remaining intact coatings shall, unless otherwise specified, be feathered to improve the appearance of the repaired coating (see Note 8.2).

5. Procedures Prior to Power-Tool Cleaning

5.1 Prior to power-tool cleaning, visible deposits of oil, grease, or other materials that interfere with coating adhesion shall be removed in accordance with SSPC-SP 1 or other specified methods.

5.2 Surface imperfections such as slivers and laminations, sharp edges, weld spatter, or burning slag shall be removed from the surface to the extent specified by the procurement documents [project specifications] (see Note 8.10).

5.3 When air-driven tools are used, cleanliness of the compressed air shall be verified in accordance with the procedure described in ASTM D 4285.

6. Procedures Following Power-Tool Cleaning and Immediately Prior to Coating

6.1 Visible deposits of oil, grease, or other contaminants shall be removed in accordance with SSPC-SP 1 or as specified.

6.2 Dust and loose residues shall be removed from power-tool cleaned (SSPC-SP 11) surfaces by brushing; blowing off with clean, dry air per Section 5.3; vacuum cleaning; or other methods established in the procurement documents (project specification).

6.3 After power-tool cleaning, any remaining surface imperfections as described in Section 5.2 (e.g., laminations, sharp edges, weld spatter, burning slag, scabs, slivers) shall be removed to the extent required by 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 2.3 (see Note 8.10).

6.4 Immediately prior to coating application, the entire surface to be coated shall comply with the requirements of Sections 2.1 and 2.3 (see Notes 8.11 and 8.12).

7. Disclaimer

7.1 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.

7.2 This standard does not attempt to address problems concerning safety associated with its use. The user of this standard, 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 applicable governmental regulations.

8. Notes

Notes are not requirements of this standard.

8.1 FUNCTION: The type of power-tool surface preparation described in this standard removes tightly adherent material, producing a surface that is free from rust, mill scale, and old coatings. The surface must also have a minimum 25-micrometer (1.0 mil) surface profile. Power-Tool Cleaning to Bare Metal produces a greater degree of cleaning than SSPC-SP 3, which does not remove adherent material, and SSPC-SP 15, which allows visible stains on 33% of each unit area. Power-Tool Cleaning to Bare Metal may be considered for coatings that require a very clean surface.

This standard is suitable where a roughened, cleaned surface is required, but where abrasive blasting is not feasible or permissible. The surfaces prepared according to this standard should not be compared to surfaces cleaned by abrasive blast cleaning. Although this method produces surfaces that resemble SSPC-SP 5 (White Metal Blast Cleaning), with the exception of material allowed in pits, power-tool cleaned surfaces are not necessarily equivalent to surfaces produced by abrasive blast cleaning. The contracting parties should agree on the appropriateness of the finished surface to accept the specified coating system. Selection of power tools and

cleaning media should be based on (1) the condition of the surface prior to surface preparation; (2) the extent of cleaning that is required; and (3) the surface profile required.

The SSPC Surface Preparation Commentary (SSPC-SP COM) provides additional information on subjects related to power-tool cleaning. The recommendations contained in SSPC-SP COM are believed to represent good practice, but are not to be considered requirements of this standard.

8.2 MAINTENANCE AND REPAIR PAINTING: When this standard is used in maintenance painting, specific instructions should be given on the extent of surface to be power-tool cleaned, including any additional requirements for retaining old paint, removing unsound paint, feathering and spot cleaning.

8.3 VISUAL GUIDES AND COMPARATORS: Note that the use of visual guides or comparators in conjunction with this standard is required only when they are specified in the procurement documents (project specification) covering the work. It is recommended, however, that the use of visual guides or comparators be made mandatory in the procurement documents.

SSPC-VIS 3 provides a suitable comparative visual guide for SSPC-SP 3, SSPC-SP 11, and SSPC-SP 15. However, visual comparators for blast-cleaned steel (e.g., SSPC-VIS 1) are not suitable for assessing power-tool cleaned surfaces. Because power-tool cleaning is time- and labor-intensive, it is advisable to prepare a test area of 1 x 1 sq meter (3 x 3 sq. ft.) for large areas or 30 x 30 cm (12 x 12 inch) for spot cleaning to an acceptable level agreed upon by the contracting parties, and cover it with a clear lacquer to save it as a standard during the power-tool cleaning operation. A 30 x 30 cm (12 x 12 inch) steel test plate can also be power-tool cleaned to an acceptable level and sealed to serve as a project standard. Alternatively, such a field standard could be protected with a volatile corrosion inhibitor, tablet, or impregnated paper, with or without a desiccant, and kept in a sealed plastic bag to permit examination of the surface profile.

8.4 PROFILE: The profile created by any cleaning media depends on many factors, including the composition and hardness of the steel, the presence and depth of any pre-existing profile, and the hardness and thickness of any existing coating materials.

The ability of various media to produce a profile or maintain an existing profile depends upon physical characteristics such as hardness, angularity or sharpness, size and mass; spacing; speed (velocity) of impact on the steel; and ability to fracture the coating material and alter the steel surface.

The media indicated in Section 4.1.1 are capable of producing a profile of 12.5 micrometers (0.5 mil) on mild (structural) steel, while the media in Section 4.1.2 are capable of producing a profile of 25 micrometers (1.0 mil) and greater on mild steel. The same media may not be capable of producing the same profile depth on other steels, e.g., weathering steel, stainless steel, welds, et al. These capabilities are possible when the tools are used by an experienced operator.

Power tools are also capable of reducing existing deeper profiles by partial removal of the tops of the existing profiles, especially by grinding, sanding, and the use of rotary flaps. In cases of excessive pressure or dwell period at a specific location, the power tools can cause sharp edges and cuts in the steel. Rotary power tools can cause a burnishing of profile previously imparted to steel or of the existing profile, thereby reducing that profile. Impact power tools can cause burrs and gouges.

It is important to determine prior to the start of production if the power tool[s] to be used can create a profile that meets the requirement of the project specification or the manufacturer's requirement for the specified coating. Concerns about the suitability of a tool to achieve these requirements should be discussed in advance with the tool manufacturer's technical representative.

8.5 FILM THICKNESS: It is essential that ample coating be applied after power-tool cleaning to adequately cover the peaks of the surface profile. The dry film thickness above the peaks of the profile should equal the thickness needed for the desired protection. If the dry film thickness over the peaks is inadequate according to contract documents or manufacturer's specifications, premature rust-through or failure will occur. The procedures in SSPC-PA 2 should be used to ensure that coating thickness is properly measured.

8.6 SUITABLE TOOLS AND MEDIA: The tools/media in the text of this standard are intended solely to guide the user to typical types of equipment and media that are available to meet the standard. The tools/media cited in this document do not include all of the tools, devices, or products available, nor does their mention constitute an endorsement by SSPC. The presence of hazardous material in the coatings, cleaning media, or in the work area itself, can place restrictions on the methods of cleaning permitted.

8.6.1 Grinding tools/media: Any rotary or reciprocating tool that uses bonded abrasives as the cutting media for generating surfaces meeting requirements of Sections 2.1, 2.2, and 2.3 These include, but are not limited to, reciprocating sanders, orbital sanders, or any grinding device, whether right angle or straight shaft, that utilizes abrasive cloths, discs, wheels, or flaps.

8.6.2 Impact tools/media: Any rotary or reciprocating tool that uses repetitious impact for generating surfaces meeting requirements of Sections 2.1, 2.2 and 2.3. This includes, but is not limited to: rotary flap, cutter bundle, needle gun, wire bristle impact, and hammer flail assemblies.

8.7 SELECTION OF TOOLS AND MEDIA

8.7.1 Selection of Tools: Power tools should be selected on the basis of the size and speed rating of the media. These requirements may differ from one type of medium to another and should be taken into consideration if more than one type of

medium will be used in the surface preparation process. Power tools should be selected that will produce enough power to perform the cleaning operation efficiently. Operator fatigue should be considered in the selection of power tools.

8.7.2 Selection of Media: When power-tool cleaning rusted surfaces, it is important to avoid embedding rust into the substrate. Use of more than one type of medium may be required in order to obtain the desired end result.

Power wire brushes or sanding discs when used alone may not produce the required surface profile and may remove or degrade an existing profile to an unacceptable level. Exceedingly heavy deposits of corrosion products should be removed using hand or power tools prior to using surface profiling media. After removal of excessive corrosion, a structural inspection may be warranted to ascertain if the metal thickness remains in compliance with the governing requirements, including applicable codes (e.g. ASME codes for pressure vessels).

8.8 CAUTION: Improper use of power tools can result in damage to the surface being cleaned. Excessive pressure or an overly long dwell time on a surface being cleaned using impact tools can result in formation of burrs and gouges. Rotary or grinding tools that remain over a specific location too long can bend the peaks of an existing profile and damage the anchor pattern. In extreme cases, burnishing of the surface may result. Improper use of tools with embedded abrasive media, including, but not limited to discs, wheels, pads, and flappers, may result in partial melting and smearing of the matrix on the surface. A review of the manufacturer's literature or a discussion with the technical representative about the tool and its use on the intended substrate should be undertaken if the operator has little or no experience with the tool.

8.9 CLEANING LIMITED ACCESS AREAS: SSPC defines a "limited access area" as a location in which the configuration of a structure or surface or the characteristics of a tool restrict the use or performance of that tool at that location. Alternative methods should be considered for limited access areas.

8.10 SURFACE IMPERFECTIONS: Surface imperfections can cause premature failure when the environment is severe. Generally, 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 for a coating to properly cover and protect include crevices, weld porosity, laminations, etc. Poorly adherent contaminants, such as weld slag residues, loose weld spatter, and some minor surface laminations, should be removed during power-tool cleaning. Other surface defects may not be evident until the surface preparation has been completed. Therefore, proper planning for such repair work is essential, since the timing of the repairs may occur before, during, or after power-tool cleaning operations.

8.11 RUST-BACK: Rust-back (re-rusting) occurs when freshly cleaned steel is exposed to conditions of high humidity, moisture, contamination, or a corrosive atmosphere. The time interval between power-tool cleaning and rust-back will vary greatly from one environment to another. Under mild ambient conditions, it is best to clean and coat a surface the same day. Severe conditions may require coating more quickly to avoid contamination. For exposure under controlled conditions, the coating time may be extended. Under no circumstances should the steel be permitted to rust-back before painting, regardless of time elapsed.

8.12 DEW POINT: Moisture condenses on any surface that is colder than the dew point of the surrounding air. It is recommended that the temperature of the steel surface be at least 3 °C (5 °F) above the dew point during power-tool cleaning operations. It is advisable to visually inspect for moisture and periodically check the surface temperature and dew point during cleaning. It is equally important to continue to monitor the surface temperature/dew-point relationship until the coating is applied in order to avoid painting over a damp surface, unless the selected coating is specifically intended for application on damp substrates.