

NACE No. 6/SSPC-SP 13, Surface Preparation of Concrete

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ABSTRACT

This NACE International/SSPC joint standard practice covers the preparation of concrete surfaces before the application of protective coating or lining systems. The standard includes two updated tables, Table 1 details classes of surface preparation, and Table 2 provides minimum acceptance criteria for concrete surfaces before coatings are applied and relevant test methods. The updated Appendix (nonmandatory) includes two additional tables, Table A1 provides typical surface properties of finished concrete, and Table A2 provides an extensive list of surface preparation methods for concrete surfaces. This standard should be used by specifiers, applicators, inspectors, and others who are responsible for defining a standard degree of cleanliness, strength, profile, and dryness of prepared concrete surfaces.

KEYWORDS

abrasive blasting, acid etching, cementitious repair, coating adhesion, coatings, concrete, lining systems, NACE No. 6, protective coating systems, surface preparation, spalling, surface profile, tensile strength, TG 417, vacuum cleaning, waterjetting

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Foreword

In NACE/SSPC standards, the terms “shall,” “must,” “should,” and “may” are used in accordance with Paragraph 2.2.1.8 of the Agreement between NACE International and SSPC: The Society for Protective Coatings. The terms “shall” and “must” are used to state mandatory requirements. The term “should” is used to state something considered good and is recommended but is not mandatory. The term “may” is used to state something considered optional.

This NACE International/SSPC Joint standard covers the preparation of concrete surfaces before the application of protective coating or lining systems. This standard should be used by specifiers, applicators, inspectors, and others who are responsible for defining a standard degree of cleanliness, strength, profile, and dryness of prepared concrete surfaces.

This standard was originally prepared in 1997 by NACE/SSPC Joint Task Group (TG) F, “Surface Preparation of Concrete.” It was reaffirmed in 2003 by NACE Specific Technology Group (STG) 04, “Coatings and Linings, Protective—Surface Preparation,” and SSPC Group Committee C.2, “Surface Preparation.” It was revised in 2018 by TG 417 (formerly Task Group F). This standard is issued by NACE under the auspices of STG 04, and by SSPC Group Committee C.7.7.



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Section 1: General

- 1.1** This NACE/SSPC standard details the requirements for surface preparation of concrete by mechanical and chemical methods before the application of bonded protective coating or lining systems.
- 1.2** The standard details specific methods of surface preparation as well as the amount of surface cleanliness and profile achievable by each method. The specifier is responsible for choosing the appropriate class of surface preparation from Table 1 for the intended protective coating and intended service conditions and these should be agreed upon by all parties involved (owner and/or specifier, manufacturer and contractor).

Table 1 Classes of Surface Preparation			
Class	Method	Profile Range (CSP) ^(A)	Section Referenced
D-VC	Vacuum Cleaning	NC ^(B)	4.2.2
W-LP	Low Pressure Water Rinse	NC ^(B)	4.2.2
W-DS	Detergent Scrubbing	NC ^(B)	4.2.3
W-SC	Steam Cleaning	NC ^(B)	4.2.3
W-AE	Acid Etching	1 – 3	4.4
W-WJ	Waterjetting (includes Hydrodemolition and Hydroblasting)	3 – 10	4.3.2
M-GRD	Grinding – Dry	1 – 2	4.3.4
M-GRW	Grinding – Wet	1 – 2	4.3.4
M-ABD	Abrasive Blasting – Dry	3 – 7 ^(A)	4.3.1
M-ABW	Abrasive Blasting – Wet	3 – 7 ^(A)	4.3.1
M-SB	Shot Blasting	3 – 9 ^(A)	4.3.1
M-SC	Scarifying	4 – 7	4.3.3
^(A) ICRI ⁽¹⁾ 310.2, ¹ Concrete Surface Profiles (CSP); see footnote in Appendix A, Table A2.			
^(B) No Change			

- 1.3** The requirements of this standard are applicable to all types of cementitious surfaces including, but not limited to, cast-in-place concrete floors and walls, precast slabs, masonry walls, shotcrete surfaces and cementitious grouts, overlayments and/or underlayments.
- 1.4** The composition and installation of new concrete and cementitious repair material may affect the selection and application of a coating system. It is the responsibility of the designer to specify the concrete composition, admixtures, finishing procedures, curing method or compound and form release agents; and cementitious repair materials that ensure the concrete is suitable for coating. The chemical, physical (abrasion), and environmental exposure conditions also must be defined for the appropriate coating system to be selected.
- 1.5** Existing concrete surfaces must be properly evaluated before the application of a coating system. It is the responsibility of the owner/specifier to assess the condition of the concrete to ensure the substrate is sound and suitable for coating.
- 1.6** An acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.

⁽¹⁾International Concrete Repair Institute (ICRI), 3166 S. River Road, Suite 132, Des Plaines, IL 60018

- 1.7 This standard provides minimum requirements for a concrete surface following surface preparation and specific test methods and acceptance criteria for surface tensile strength, profile, cleanliness, residual contaminants, pH, and moisture content.
- 1.8 The mandatory requirements of this standard are given in Sections 1 to 7 as follows:
- | | |
|------------|---|
| Section 1: | General |
| Section 2: | Definitions |
| Section 3: | Inspection Procedures Before Surface Preparation |
| Section 4: | Surface Preparation |
| Section 5: | Inspection and Classification of Prepared Concrete Surfaces |
| Section 6: | Acceptance Criteria |
| Section 7: | Safety and Environmental Requirements |
- 1.9 Appendix A (Nonmandatory) does not contain mandatory requirements.

Section 2: Definitions

Coating: See *Protective Coating or Lining System*.

Concrete: A material made from hydraulic cement and inert aggregates, such as sand and gravel that is mixed with water to a workable consistency and placed by various methods to harden and gain strength.

Curing (Concrete): Action taken to maintain moisture and temperature conditions in a freshly placed cementitious mixture to allow hydraulic cement hydration so that potential properties of the mixture may develop.

Curing Compound (Membrane Curing Compound): A liquid that can be applied to form a membrane on the surface of newly placed concrete to retard the loss of water.²

Efflorescence: A generally white deposit formed when water-soluble compounds emerge in solution from concrete, masonry, or plaster substrates and precipitate by reaction such as carbonation or crystallize by evaporation.²

Fins: A narrow linear projection on a formed concrete surface, resulting from mortar flowing into spaces in the form work.²

Finish: The texture of a concrete surface after consolidating and finishing operations have been performed.²

Finishing: Leveling, smoothing, consolidating, and otherwise treating surfaces of fresh or recently placed concrete or mortar to produce desired appearance and service.²

High-Pressure Water Cleaning (HP WC): Water cleaning performed at pressures from 34 to 70 MPa (5,000 to 10,000 psig).³

High-Pressure Waterjetting (HP WJ): Waterjetting performed at pressures from 70 to 210 MPa (10,000 to 30,000 psig).³

Honeycomb: Voids left in concrete due to failure of the mortar to effectively fill the spaces among coarse aggregate particles or other obstructions.²

Laitance: A thin, weak, brittle layer of cement and aggregate fines on a concrete surface. The amount of laitance is influenced by the types and amounts of admixtures, the degree of working, and the amount of water in the concrete.⁴

Lining: See *Protective Coating or Lining System*.

Porosity: Small voids that allow fluids to penetrate an otherwise impervious material.

Protective Coating or Lining System (Coating): For the purposes of this standard, protective coating or lining systems (also called protective barrier systems) are bonded thermoset, thermoplastic, inorganic, organic/inorganic hybrids, or metallic materials applied in one or more layers by various methods such as brush, roller, trowel, spray, and thermal spray. They are used to protect concrete from degradation by chemicals, abrasion, physical damage, and the subsequent loss of structural integrity. Other potential functions include containing chemicals, preventing staining of concrete, and preventing liquids from being contaminated by concrete.

Release Agents (Form-Release Agents): Materials used to prevent bonding of concrete to a surface.²

Scaling: Local flaking, or peeling away, of the near-surface portion of hardened concrete or mortar.

Sealer (Sealing Compound): A liquid that is applied to a concrete surface to prevent or decrease the penetration of liquid or gaseous media during exposure. Some curing compounds also function as sealers.

Soundness: A qualitative measure of the suitability of the concrete to perform as a solid substrate or base for a coating or patching material. Sound concrete substrates usually exhibit strength and cohesiveness without excessive voids or cracks.

Spalling (Concrete): The spontaneous chipping, fragmentation, or separation of a surface or surface coating. (For the purposes of this document, spalling includes a fragment, usually in the shape of a flake, detached from a larger mass by a blow, by the action of weather, by pressure, or by expansion within the larger mass; a small spall involves a roughly circular depression not greater than 120 mm (5 in) in depth and 150 mm (6 in) in any dimension; a large spall, may be roughly circular or oval or in some cases elongated, is more than 120 mm (5 in) in depth and 150 mm (6 in) in greatest dimension.)

Surface Porosity: Porosity or permeability at the concrete surface that may absorb vapors, moisture, chemicals, and coating liquids.

Surface Preparation: The method or combination of methods used to clean a concrete surface, remove loose and weak materials and contaminants from the surface, repair the surface, and roughen the surface to promote adhesion of a protective coating or lining system.

Surface Profile (Texture): Surface contour as viewed from the edge.

Surface Air Voids: Cavities visible on the surface of a solid.

Ultra-High-Pressure Waterjetting (UHP WJ): Waterjetting performed at pressures greater than 210 MPa (30,000 psig).³

Section 3: Inspection Procedures Before Surface Preparation

- 3.1 Concrete shall be inspected before surface preparation to determine the condition of the concrete and to determine the appropriate method or combination of methods to be used for surface preparation to meet the requirements of the coat-

ing system to be applied. Inherent variations in surface conditions seen in walls and ceilings versus those in floors should be considered during the selection of surface preparation methods and techniques. For example, walls and ceilings are much more likely than floors to contain surface air voids, fins, form-release agents, and honeycombs. ACI⁽²⁾ 364.1R⁴ provides useful guidance for inspection and evaluation of structures.

3.2 Visual Inspection

All concrete surfaces to be prepared and coated shall be visually inspected for signs of concrete defects, physical damage, chemical damage, contamination, and excess moisture.

3.3 The Degree of Concrete Cure

All concrete should be cured using the procedures described in ACI 308.⁵ Curing requirements include maintaining sufficient moisture and temperatures for a minimum time period. Surface preparation performed on insufficiently cured or low-strength concrete may create an excessively coarse surface profile or remove an excessive amount of concrete.

3.4 Concrete Defects

Concrete defects such as honeycombs and spalling shall be repaired. The procedures described in ICRI 310.^{1,6} or ACI 301⁷ may be used to ensure the concrete surface is sound before surface preparation. Further information on investigation of defects may be found in ICRI 210.4⁸ and NACE SP0308.⁹

3.5 Physical Damage

3.5.1 Several common surface preparation methods are likely to reduce the tensile strength of the prepared substrate. Bond strengths achieved on surfaces prepared with high-impact mechanical cleaning methods are frequently shown to be lower than those achieved when nonimpact cleaning methods are used. This reduction in bond strength can be attributed to “bruising,” cracking of the cement paste, and loosening of the aggregate without fully separating from the underlying concrete. This layer of interconnecting microcracks typically extends to a depth of 3 to 10 mm (0.12 to 0.4 in) and it is generally accepted that damage increases with the increasing weight and power of the equipment used.

3.5.2 Concrete should be tested for soundness by the qualitative methods described in Appendix A, Paragraph A4.3.

3.5.3 When qualitative results are indeterminate, or when a quantitative result is specified, concrete shall be tested for surface tensile strength using the methods described in Appendix A, Paragraph A8.

3.5.4 Concrete that has been damaged because of physical forces such as impact, abrasion, or corrosion of reinforcement shall be repaired before surface preparation if the damage would affect coating performance. Repairs should be made in accordance with ACI 301, ACI 562,¹⁰ ACI 546,¹¹ NACE SP0390,¹² or Appendix A, Paragraph A4.

3.6 Chemical Damage

⁽²⁾American Concrete Institute International (ACI), 38800 International Way, Country Club Drive, Farmington Hills, MI 48331.

3.6.1 Concrete is attacked by a variety of chemicals, as detailed in ACI 515.2R¹³ and PCA⁽³⁾ IS001.¹⁴

3.6.2 All concrete surfaces that have been exposed to chemicals shall be tested and treated for contamination as described in Paragraph 3.7.

3.6.3 Concrete that has been exposed to chemicals shall be tested for soundness by the qualitative methods described in Appendix A, Paragraph A4.3.

3.7 Contamination

3.7.1 Contamination on concrete surfaces includes all materials that may affect the adhesion and performance of the coating to be applied. Examples include, but are not limited to, dirt, oil, grease, chemicals, and existing incompatible coatings.

3.7.2 Contamination may be detected by methods described in Appendix A, Paragraph A5. These methods include, but are not limited to, visual examination, water drop (contact angle) measurement, pH testing, petrographic examination, and various instrumental analytical methods. Core sampling may be required to determine the depth to which the contaminant has penetrated the concrete.

3.7.3 Concrete surfaces that are contaminated or that have existing coatings shall be tested by the method described in Appendix A, Paragraph A8 to determine whether the contamination or existing coating affects the adhesion and performance of the coating to be applied.

3.7.4 In extreme cases of concrete damage or degradation, or thorough penetration by contaminants, complete removal and replacement of the concrete may be required.

3.8 Moisture

Moisture levels in the concrete may be determined by the methods described in Paragraph 5.5.

Section 4: Surface Preparation

4.1 Objectives

4.1.1 The objective of surface preparation is to produce a concrete surface that is suitable for application and adhesion of the specified protective coating system.

4.1.2 Protrusions such as from sharp edges, fins, and concrete spatter shall be removed during surface preparation.

4.1.3 Voids and other defects that are at or near the surface shall be fully exposed during surface preparation.

4.1.4 All concrete that is not sound shall be removed so that only sound concrete remains.

4.1.5 Concrete damaged by exposure to chemicals shall be removed so that only sound concrete remains.

⁽³⁾ Portland Cement Association (PCA), 5420 Old Orchard Rd., Skokie, IL 60077.