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THE CORROSION SOCIETY

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Joint Standard

NACE No. 11/SSPC-PA 8
Thin-Film Organic Linings Applied in New Carbon Steel Process Vessels

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Foreword

This standard recommended practice specifies procedures to design, install, and inspect thin-film organic linings applied to new carbon steel process vessels to prevent corrosion and other forms of degradation, such as hydrogen-induced cracking, or to prevent product contamination. It is also useful for lining applications in existing process vessels and equipment. There is a recognized need for such a standard in order to achieve long-term durability in such applications. The standard is based on applications of organic linings 500 µm (20 mils) or less. Its concepts can be employed in the application of thicker linings but the specified procedures may be modified or not required. This recommended practice is useful for lining vessels in many industries including, but not limited to, refining, chemical, water-treating, and food. The intended users are owners, contractors, inspectors, applicators, vessel designers, protective coatings specialists, and others concerned with the lining of process vessels.

This joint standard was prepared by the NACE/SSPC Task Group 246 on Thin-Film Organic Linings Applied in Process Vessels and Tankage. This task group is administered by NACE Specific Technology Group (STG) 03 on Protective Coatings and Linings—Immersion/Buried. It is also sponsored by STG 02 on Protective Coatings and Linings—Atmospheric, STG 04 on Protective Coatings and Linings—Surface Preparation, STG 34 on Petroleum Refining and Gas Processing, and STG 43 on Land Transportation. This standard is published by NACE under the auspices of STG 03, and by SSPC.

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Contents

Section 1: General

1.1 Procedures detailed in this recommended practice shall be followed during the design, installation, and inspection of a thin-film (500 µm [20 mils] or less) organic lining in process vessels to maximize the service life of the process vessel.

1.2 A thin-film lining material must be carefully evaluated for use within a process vessel. The evaluation must be based upon consideration of the process stream constituents, temperature, pressure, and other factors. An important consideration is the end use for the process-vessel lining—a corrosive or noncorrosive service. Usually, a lining that has long-term service and experience in similar process conditions is selected.

1.3 Fabrication of the vessel must be suitable for lining application including surface preparation, application, and curing. Fabrication details are influenced by the service—corrosive or noncorrosive.

1.4 Dehumidification is desirable during the entire installation process because it achieves climate control during surface preparation and lining application. When dehumidification is employed, the lining application can be carried out without interruption, avoiding possible contamination by blasting debris.

1.5 The lining may be cured at ambient temperature or heat cured at an elevated temperature. It can be applied in the shop or at the work site. The lining must be applied according to the lining manufacturer's instructions, unless superseded by the direction of the owner.

1.6 When heat cured, instrumentation must be installed to determine the time and external metal temperature during the lining curing cycle. When applied and heat cured at the work site, the vessel shall be thermally insulated to provide uniform heat retention. Particular attention should be paid to heat sinks, such as vessel supports, ladders, and other attachments.

1.7 If piping, nozzles, or other appurtenances are to be abrasive blast cleaned and lined, proper equipment must be available.

1.8 All applicable safety regulations shall be followed during all phases of surface preparation, application, inspection, and curing.

1.9 Thin-film organic linings are not generally used when the process operating temperature exceeds 120°C (250°F). Also, if exposed in environments that cause excessive corrosion, the vessel's corrosion allowance, or internal inspection frequency, may require reevaluation. (See Paragraph 3.6.)

1.10 Appendix A contains a listing of all documents and standards used in conjunction with this recommended practice.

1.10.1 The lining manufacturer's technical data sheet, material safety data sheets (MSDS), and application and curing instructions shall be used in conjunction with the documents listed in Appendix A and the requirements contained within this recommended practice.

1.10.2 Any conflict between documents shall be resolved by the owner.

1.11 During all phases of the vessel lining installation, inspection shall be conducted by the lining applicator and, when appropriate, by the owner's inspector. (See Section 8.)

1.12 The applicator shall record all pertinent information concerning the vessel lining installation within the *NACE Coating Inspector's Logbook*[1] or equivalent, as approved by the owner. This logbook shall be available to the owner's inspector at all times.

Section 2: Definitions(1)

Abrasive Blast Cleaning: Also called *abrasive blasting*; a surface preparation method that uses an abrasive propelled by air pressure, centrifugal force, or water pressure to clean and usually to add a profile to a surface.

Anchor Pattern: Contour of a blast-cleaned surface; it is classified by depth and texture (rounded, angular).

Coating: A liquid, liquefiable, or mastic composition that, after application to a surface, is converted into a solid, protective, decorative, or functional adherent film.

Corrosion Allowance: Additional metal thickness added to the vessel design thickness to offset the effect of corrosion metal loss during service.

(1) Some definitions are extracted from *Inspection of Coatings and Linings*,[2] SSPC, 1997, Appendix B—Glossary; *SSPC Protective Coatings Glossary* (SSPC-00-07);[3] and *NACE Glossary of Corrosion-Related Terms*,[4] NACE, 2002.

Curing: Chemical process of developing the intended properties of a coating or other material (e.g., resin) over a period of time.

Dry-Film Thickness (DFT): Thickness of cured film, usually expressed in micrometers (millionths of a meter) or mils (thousandths of an inch).

Holiday: A discontinuity in a protective coating that exposes an unprotected surface to the environment.

Holiday Detector, Low-Voltage Wet-Sponge Type: An instrument that uses 5 to 90 V DC for detecting holidays in a coating. It is typically used for coatings less than 500 µm (20 mils) thick.

Inspector: The individual responsible for implementing the inspection function specified in the contract documents in order to minimize or eliminate defects or failures.

Lining: A coating or layer of sheet material adhered to or in intimate contact with the interior surface of a container used to protect the container against corrosion by its contents and/or to protect the contents of the container from contamination by the container material.

Lower Explosive Limit (LEL): The concentration, at ordinary ambient temperatures, of a gas or vapor in air below which an explosion will not occur if the mixture is ignited. The concentration is expressed as a percent of the gas vapor in air by volume.

Manufacturer's Technical Data Sheet: Sheet printed by the supplier of a product to provide instructions and information on its use.

Materials Safety Data Sheet (MSDS): A printed source of information about the hazards of materials, including coatings. The MSDS contains the following information: (1) product identification; (2) hazardous ingredients, their permissible exposure limits (PEL), and threshold limit value (TLV); (3) physical properties; (4) fire and explosion hazard data; (5) health hazard data; (6) chemical reactivity/stability data; (7) spill and leak procedures; (8) special protection information; and (9) additional special precautions.

Mil: One thousandth (0.001) of an inch. 1 mil = 25 micrometers (µm). The thickness of a coating on a surface sometimes is expressed in mils and sometimes in micrometers.

Owner: The representative of the facility responsible for the work; others who are probably involved include safety personnel, tank engineers, storage tank inspectors, corrosion engineers, and coating and lining specialists.

Pitting: Localized corrosion of a metal surface that is confined to a small area and takes the form of cavities called pits. For the purpose of this standard there are two general types of pits, described by Uhlig[5] as "shallow" and "deep." Shallow pits have diameters greater than their depths. Deep pits have depths greater than their diameters.

Pencil Hardness: A method of testing coating hardness that uses a series of pencils of different hardness. The hardest pencil that leaves the coating film uncut defines the gouge hardness of the coating film.

Rust Bloom: Discoloration indicating the beginning of rusting.

Wet-Film Thickness (WFT): The thickness of a liquid coating film immediately after application.

Section 3: Lining Materials

3.1 There are many thin-film coating systems that are considered for the lining of carbon steel process vessels. These include, but are not limited to, the following generic groups:

- Epoxy or epoxy copolymers
- Phenolics
- Polyesters
- Polyurethanes
- Polyureas

The lining systems may be applied in multiple coats and can be ambient-temperature cured or heat cured. The heat-cured lining systems generally offer superior temperature, solvent, and chemical resistance in comparison with ambient-temperature-cured or forced-cured coatings.

3.2 Linings are applied in the shop or field. Heat-cured linings are more likely to be applied in the shop under closely controlled temperature conditions. Linings may be heat-cured in the field, but additional precautions are required. See Paragraph 5.2.4.

3.3 The owner is responsible for selecting the lining system and the design to be used. However, alternatives can be considered and are subject to approval by the owner. Most frequently the owner specifies the complete lining system from one or several suppliers.

3.4 The selection of a lining shall be based on the following:

3.4.1 Analysis of process fluid including all major and minor constituents;

3.4.2 Temperature conditions and exposure intervals including the following:

3.4.2.1 Normal operating conditions,

3.4.2.2 Cyclic temperature conditions, and

3.4.2.3 Procedures for cleaning the vessel at turnaround times (e.g., steam cleaning, and exposure time) as well as cleaning agents to be used.

3.4.3 Pressure or vacuum operation:

3.4.3.1 Normal,

3.4.3.2 Cyclic, or

3.4.3.3 Rapid (explosive) decompression from operating pressure;

3.4.4 Abrasion or erosion conditions including amount, particle size, and rates of flow;

3.4.5 Possible damage caused by vibration, installation, and welding operations, etc.;

3.4.6 The intended internal inspection cycle (1, 5, 10 years, or other time period).

3.5 Unless there is previous long-term experience demonstrating that a lining is suitable for the specified process conditions, appropriate testing shall be conducted as directed by the owner.(2)

3.6 Thin-film organic linings are generally not applied to process vessels when the operating temperature is above 120°C (250°F). Also, exposure in environments causing excessive general and/or pitting corrosion may require an increase in the vessel's corrosion allowance and/or the frequency of internal inspections.

3.7 Ambient-temperature-cured coatings shall not be force cured unless the design and operation of such force-curing procedures are approved by the owner and the lining manufacturer.

Section 4: Vessel Fabrication and Preparation

4.1 For new vessels to be used in a corrosive service, it is recommended that the owner employ NACE Standard RP0178[7] and its requirements. This standard specifies key elements that are needed in the fabrication of a new vessel to facilitate lining application and to extend lining durability.

4.1.1 The owner should review NACE Standard RP0178 and specify design details which are discussed in nonspecific terms, including weld surface-preparation treatments.

4.1.2 This review by the owner should include the vessel design engineer, protective coating specialist, and owner's inspector. Input should also be obtained from potential fabricators and lining applicators.

4.1.3 The requirements of NACE Standard RP0178 and other owner design details must be furnished to the fabricator as part of the vessel design specification.

4.1.4 See Appendix B of NACE Standard RP0178 for a listing of suggested responsibilities.

4.2 For an existing process vessel, all the requirements of NACE Standard RP0178 may not be applicable. However, the owner shall select those requirements of the standard that can be applied beneficially to existing equipment and include those in the purchase order and/or the protective lining specification.

4.3 Whenever possible, any vessel internal members shall be removed to facilitate lining application. Carbon steel vessel internals shall be coated with the lining system to be applied in the vessel and subsequently reinstalled after completion of the vessel lining application. Bolted connections are acceptable when specified.

4.4 For new construction, all piping, nozzle, and instrument connections to the vessel shall be flanged. While flat-faced flanges are preferred,[8, 9] raised-face flanges are acceptable. The dry-film thickness of the lining applied to the flange face shall be limited to 375 µm (15.0 mils).

4.5 The fabricator shall be responsible for the preparation for shipment of the process vessel to the coating and lining shop or to the work site. All openings shall be sealed to prevent entrance of contaminants. If required by the owner, desiccants can be included within the vessel to ensure dryness.

4.6 For existing vessels, the owner shall clean and inspect the vessel to be lined with a thin-film coating and make any necessary mechanical repairs prior to the beginning of the lining installation. Any deep pits should be filled with weld metal and shallow pits repaired at the owner's discretion. The resulting surface condition shall be capable of attaining long-term performance of the coating system.

4.7 When required by the owner, dehumidification or temperature control equipment shall be used. Guidelines for the use of such equipment are contained in NACE Publication 6A192/SSPC-TR 3.[10]

(2) Testing and evaluation are frequently conducted using procedures described in NACE Standard TM0174.[6]

Section 5: Applicator Qualifications and Submissions

5.1 The applicators, including supervisors and workers, shall be qualified by commercial experience to install the type of lining system specified. To satisfy this experience requirement, the applicator shall be certified to SSPC-QP 1,[11] or SSPC-QP 3,[12] or equivalent, as approved by the owner. The applicator shall also submit to the owner a list of similar installations and a record of performance of such lining applications.

5.2 Prior to the start of the work, the following design information and data shall be submitted by the applicator for approval by the owner:

5.2.1 Vessel ventilation, dehumidification, or heating requirements.

5.2.2 Details concerning explosion-proof lighting installation.

5.2.3 Proposed lining application details including surface preparation, application, and plans for curing the lining, if required.

5.2.4 When the vessel is to be lined and heat cured in the field, details of the curing system to be used, such as heat source, hot-air circulation plans, and typical installation of external metal temperature and time recorders shall be furnished. Both direct- and indirect-fired heaters are permitted. The advantages and disadvantages of both should be evaluated.

5.2.5 Procedures for repairing damaged areas and detected holidays, and correcting excessive coating thickness in accordance with the lining manufacturer's instructtions and procedures.

5.2.6 Reference panels as described in Paragraph 8.2 and prepared by the lining manufacturer.

5.2.7 Plans for quality assurance and quality control, including names and qualifications of lining inspectors. Inspectors are required to be NACE-certified or equivalent, as approved by the owner.

Section 6: Surface Preparation

6.1 The vessel shall be properly lighted and properly ventilated. All parts of the work shall be clearly visible. For information regarding lighting see SSPC-Guide 12.[13] Any owner-related standards shall take precedence.

6.2 Oil, grease, and other hydrocarbon contaminants shall be removed using techniques described in SSPC-SP 1,[14] including the use of solvents, emulsions, or steam cleaning.

6.3 Any vessel appurtenances that are not to be lined, such as piping, instrument connections, or nozzles, shall be suitably sealed or shielded to prevent intrusion of blasting abrasive or debris and lining material.

6.4 The process vessel to be lined shall be abrasive blast cleaned to NACE No. 1/SSPC-SP 5[15] or NACE No. 2/SSPC-SP 10,[16] dependent upon the lining manufacturer's instructions. Unless otherwise specified by the lining manufacturer, the anchor pattern shall be 38 to 75 μm (1.5 to 3.0 mils) as measured by NACE Standard RP0287[17] or ASTM[(3)] D 4417[18] Method C.

6.5 The blasting abrasives shall conform to SSPC-AB 1[19] Class A, or to SSPC-AB 3.[20]

6.6 For existing equipment, the vessel or tank should be inspected for nonvisible contaminants such as chlorides, sulfates, or other contaminants that may affect the integrity or performance of the lining system. If such contaminants are detected, the owner shall determine if further additional cleaning such as high-pressure potable-water wash is required.

6.7 All blasting residue and waste shall be removed before lining application. Surfaces to be lined must be final cleaned by vacuuming. Accumulated dust and debris on the surrounding surfaces, including previously coated surfaces, shall be removed.

6.8 All workers entering the vessel, including safety personnel, supervisors, inspectors, and owner personnel, shall wear shoe covers. Contamination of the cleaned or coated surface is not permitted. A "clean" area immediately adjacent to the outside entrance of the vessel shall be available to satisfy this requirement. Access should be limited to essential personnel only.

6.9 Water shall be prevented from entering the vessel to be lined.

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

Section 7: Lining Application

7.1 If dehumidification is used, the entire vessel may be blast cleaned before beginning the lining application. If dehumidification is not used, the first coat of the lining system must be applied before any rust bloom occurs on the cleaned steel surface.

7.2 Lining application shall be conducted with equipment recommended by the manufacturer.

7.3 If small-diameter piping, nozzles, or instrument connections are to be internally lined, surface preparation and application shall be conducted with equipment designed for that purpose. The owner shall specify if small-diameter piping and nozzles are to be lined for noncorrosive service.

7.4 All application equipment, including material hoses, shall be thoroughly cleaned and free of all contaminants including previously applied coatings or solvents.

7.5 All internal angles, edges, welds, and other structural details required by the owner shall be stripe coated. The lining manufacturer shall be consulted to determine the suitability of the stripe-coat formulation. The stripe coat shall be applied after application of the first coat unless otherwise specified by the lining manufacturer and agreed to by the owner.

7.6 When several coats are necessary to achieve the design dry-film thickness, successive coatings shall be of a different color. Prior to application of the next coat, each coat shall be allowed to cure according to the lining manufacturer's instructions dependent on time and temperature.

7.7 During each phase of the coating application, and also during curing, the concentration of solvent vapor as measured within the vessel by portable LEL instruments shall not exceed 10% of LEL.[21]

7.8 Wet-film thickness measurements should be made to assure that the design dry-film thickness is achieved within the specified number of coats.

7.9 When the vessel is to be lined and heat cured in the shop, heat curing in ovens is preferred.

7.10 When an intermediate elevated-temperature cure is required between coats, it shall be carried out at a temperature that does not impair intercoat adhesion. The lining manufacturer's instructions shall be consulted.

7.11 There shall be no visible defects such as runs, orange peel, dimples, or other surface faults permitted in any of the successive coats. The reference panels described in Paragraph 8.2 may be used for a visual determination.

7.12 Dry-film thickness shall be measured after final-coat application and when the coating has cured sufficiently to support foot traffic. DFT shall be measured in accordance with SSPC-PA 2.[22] An additional coat shall be applied at any thin areas to attain the specified DFT. The dry-film thickness shall not exceed the maximum thickness recommended by the lining manufacturer. Areas where DFT exceeds the maximum allowable shall be repaired according to Paragraph 5.2.5.

7.13 At the owner's discretion, additional DFT measurements may be required in smaller areas than those specified in SSPC-PA 2.

7.14 Prior to final high-temperature curing of any heat-cured lining system, the coating shall be inspected for holidays using the procedure specified in Table 1 for wet-sponge testing, unless otherwise recommended by the lining manufacturer and agreed to by the owner. If the test of the lined equipment meets the quality standard agreed to by the owner, the final elevated-temperature cure can be undertaken.

7.15 Final curing of the lining system shall be undertaken as follows:

7.15.1 After the final coating application, ambient-temperature cured coatings shall be allowed to cure for the time required by the manufacturer. Ventilation shall continue until the specified time period has elapsed and/or measurements by portable gas analyzers indicate solvent concentration significantly below 10% of LEL.

7.15.2 For shop-applied heat-cured coatings, the vessel shall be placed in a facility capable of achieving the curing temperature for the time specified by the lining manufacturer. Suitable instrumentation and sensors shall be installed to record time and metal temperature. Metal temperatures at areas of greater thickness or at heat sinks should be closely monitored.

7.15.3 For field-applied heat-cured coatings, the applicator is responsible for the installation of thermal insulation on the process vessel. Particular care is required to insulate any potential cold spots such as ladders, supports, and other appurtenances. Curing shall be conducted as agreed to in Paragraph 5.2.4. Metal temperatures at areas of greater thickness or at heat sinks should be closely monitored.

7.16 After completion of the ambient-temperature or high-temperature curing cycle, the lining shall be examined to determine the state of cure. Evaluation shall be based upon pencil hardness and solvent resistance. These properties shall be determined at locations including the top, bottom, and intermediate shell locations. The results of these tests are compared to the results of identical procedures con-

ducted on the reference test panels described in Paragraph 8.2.

7.17 Following the evaluation of cure, an ambient-temperature-cured lining shall be examined for holidays using procedures for wet-sponge testing, unless otherwise recommended by the lining manufacturer and agreed to by the owner.

7.18 Welding on an internally lined vessel is not permitted.

7.19 For corrosive service, no holidays are permitted. The owner shall determine if this same quality standard shall be used for linings applied to vessels in noncorrosive service.

Section 8: Inspection and Repair of Vessel Lining

8.1 The term "inspector" as used in Section 8 refers to the owner's representative. The inspector shall be NACE-certified or meet equivalent criteria, as approved by the owner.

8.2 Reference panels of the lining should be prepared and furnished to the owner prior to execution of any work. Four samples, approximately 15 cm x 15 cm (6.0 in. x 6.0 in.), are required as follows:

- Two panels shall be coated with lining applied in step-wise fashion showing the number of individual coats.
- Two panels shall be coated with the complete lining system.

8.3 Reference panels shall be used by the inspector as a standard for appearance, final hardness and cure, thickness, and holiday-verification evaluations.

8.4 Compliance with this standard shall be evaluated by the inspector. These evaluations may include but not be limited to examination of the items listed in Table 1. Reference documents and standards are also listed.

8.5 Evaluation by the inspector shall not relieve the lining applicator of making all necessary inspections and assuring that all work meets the required specifications.

8.6 Defects found by the inspector when comparing the applied lining to the reference panel, such as runs, orange peel, air bubbles, overspray, and others, shall be repaired by the agreed-on procedure of Paragraph 5.2.5. The repair shall then be re-inspected and approved by the inspector. A wet-sponge holiday test of the repaired area may be required by the inspector.

Table 1: Items Evaluated by Inspector

Evaluation Item	Reference Documents and Standards
Material Inspection and Storage	SSPC-PA 1[23]
Air Contamination	ASTM D 4285[24]
Vessel Fabrication	NACE Standard RP0178
Cure	ASTM D 5402[25] Pencil Hardness (ASTM D 3363[26])
Surface Cleaning	SSPC-SP 1, NACE No. 1/SSPC-SP 5, and NACE No. 2/SSPC-SP 10
Surface Profile	NACE Standard RP0287 or ASTM D 4417 Method C
Wet-Film Thickness	ASTM D 4414[27]
Dry-Film Thickness	SSPC-PA 2
Application Equipment	Lining manufacturer's specification
Application	Lining manufacturer's specification and SSPC-PA 1
Recoat Intervals	Lining manufacturer's specification
Visual Inspection	SSPC-VIS 1[28]
Holiday Test—Wet Sponge	NACE Standard RP0188[29]
Environment (relative humidity and temperature)	Lining manufacturer's specification and SSPC-PA 1

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1. NACE Coating Inspector's Logbook, 3rd ed. (Houston, TX: NACE, 1996).

2. Inspection of Coatings and Linings (Pittsburgh, PA: SSPC, 1997).

3. SSPC Protective Coatings Glossary (Pittsburgh, PA: SSPC, 2000).

4. NACE Glossary of Corrosion-Related Terms (Houston, TX: NACE, 2002).

5. H.H. Uhlig, Corrosion and Corrosion Control (New York, NY: John Wiley and Sons, 1963).

6. NACE Standard TM0174 (latest revision), "Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials in Immersion Service" (Houston, TX: NACE).

7. NACE Standard RP0178 (latest revision), "Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to Be Lined for Immersion Service" (Houston, TX: NACE).

8. BS 6374-3 (latest revision), "Lining of Equipment with Polymeric Materials for the Process Industries. Specification for Lining with Stoved Thermosetting Resins" (London, England: BSI[4]).

9. BS 6374-4 (latest revision), "Lining of Equipment with Polymeric Materials for the Process Industries. Specification for Lining with Cold Curing Thermosetting Resins" (London, England: BSI).

10. NACE Publication 6A192/SSPC-TR 3 (latest revision), "Dehumidification and Temperature Control During Surface Preparation, Application, and Curing for Coatings/Linings of Steel Tanks, Vessels, and Other Enclosed Spaces" (Houston, TX: NACE and Pittsburgh, PA: SSPC).

11. SSPC-QP 1 (latest revision), "Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)" (Pittsburgh, PA: SSPC).

12. SSPC-QP 3 (latest revision), "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators" (Pittsburgh. PA: SSPC).

13. SSPC-Guide 12 (latest revision), "Guide for Illumination of Industrial Painting Projects" (Pittsburgh, PA: SSPC).

14. SSPC-SP 1 (latest revision), "Solvent Cleaning" (Pittsburgh, PA: SSPC).

15. NACE No. 1/SSPC-SP 5 (latest revision), "White Metal Blast Cleaning" (Houston, TX: NACE and Pittsburgh, PA: SSPC).

16. NACE No. 2/SSPC-SP 10 (latest revision), "Near-White Metal Blast Cleaning" (Houston, TX: NACE and Pittsburgh, PA: SSPC).

17. NACE Standard RP0287 (latest revision), "Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape" (Houston, TX: NACE).

18. ASTM D 4417 (latest revision), "Field Measurement of Surface Profile of Blast-Cleaned Steel" (West Conshohocken, PA: ASTM).

19. SSPC-AB 1 (latest revision), "Mineral and Slag Abrasives" (Pittsburgh, PA: SSPC).

20. SSPC-AB 3 (latest revision), "Ferrous Metallic Abrasives" (Pittsburgh, PA: SSPC).

21. ANSI[5] Z117.1 (latest revision), "Safety Requirements for Confined Spaces" (Washington, DC: ANSI).

22. SSPC-PA 2 (latest revision), "Measurement of Dry Coating Thickness with Magnetic Gages" (Pittsburgh, PA: SSPC).

23. SSPC-PA 1 (latest revision), "Shop, Field, and Maintenance Painting of Steel" (Pittsburgh, PA: SSPC).

24. ASTM D 4285 (latest revision), "Standard Test Method for Indicating Oil or Water in Compressed Air" (West Conshohocken, PA: ASTM).

25. ASTM D 5402 (latest revision), "Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs" (West Conshohocken, PA: ASTM).

26. ASTM D 3363 (latest revision), "Test Method for Film Hardness By Pencil Test" (West Conshohocken, PA: ASTM).

27. ASTM D 4414 (latest revision), "Standard Practice for Measurement of Wet Film Thickness by Notch Gages" (West Conshohocken, PA: ASTM).

28. SSPC-VIS 1 (latest revision), "Visual Standard for Abrasive Blast Cleaned Steel" (Pittsburgh, PA: SSPC).

29. NACE Standard RP0188 (latest revision), "Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates" (Houston, TX: NACE).

[4] British Standards Institution (BSI), British Standards House, 389 Chiswick High Road, London W4 4AL, United Kingdom.
[5] American National Standards Institute (ANSI), 1819 L Street NW, 6th Floor, Washington, DC 20036.

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Appendix A:
Documents and Standards to be Used in Conjunction with this Standard

NACE International	
RP0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape
RP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
RP0178	Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to Be Lined for Immersion Service
TM0174	Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials in Immersion Service
SSPC	
SSPC-AB 1	Mineral and Slag Abrasives
SSPC-AB 3	Ferrous Metallic Abrasives
SSPC-PA 1	Shop, Field and Maintenance Painting
SSPC-PA 2	Measurement of Dry-Film Thickness With Magnetic Gages
SSPC-VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC-Guide 12	Guide for Illumination of Industrial Painting Projects
SSPC-SP 1	Solvent Cleaning
SSPC-QP 1	Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Structures)
NACE/SSPC Joint Documents	
NACE No. 1/SSPC-SP 5	White Metal Blast Cleaning
NACE No. 2/SSPC-SP 10	Near-White Metal Blast Cleaning
ASTM	
ASTM D 3363	Test Method for Film Hardness By Pencil Test
ASTM D 4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D 5402	Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs