

**NATIONAL TRANSPORTATION  
PRODUCT EVALUATION PROGRAM  
(NTPEP)**

**PROJECT WORK PLAN FOR THE  
LABORATORY EVALUATION OF  
CONCRETE COATINGS**

**2012**

## **SUMMARY**

The American Association of State Highway and Transportation Officials (AASHTO) hosts a nationally recognized testing program called National Transportation Product Evaluation Program (NTPEP). NTPEP is a voluntary program whereby manufacturers may submit their products for a coordinated group evaluation. Individual manufacturers/suppliers are assessed a testing fee that covers costs for actual laboratory testing and/or field evaluation by either state highway agencies or an approved test facility. The Concrete Coatings program operates with capabilities of AASHTO member departments. A portion of the testing fee is used for maintaining the online data repository and reports that are accessible to all member departments and other end users.

This document is furnished for the benefit of manufacturers/suppliers interested in participating in the program by submitting their products. The testing format has been established to provide the end user with test results which can be used to assess the performance of coating systems for long environmental exposures. Coating systems are not required to meet any specific compositional requirements for submission and testing in this program. Manufacturers' are encouraged to submit products that they believe will perform well and meet the demands of the transportation industry.

This work plan defines the evaluation procedures for coating systems for concrete which will serve as the standard testing protocol for AASHTO's National Transportation Product Evaluation Program for these products.

The testing facility may be either a state highway laboratory, university laboratory or a private independent laboratory appropriately equipped and capable of performing the required evaluations. All laboratories performing these evaluations shall be contracted through AASHTO/NTPEP. AASHTO/NTPEP testing programs do not provide pass/fail acceptance criteria. Evaluation reports will provide performance data. The accepting agency will make the determination regarding specification compliance for the products selected.

## **TESTING FACILITY CRITERIA**

Candidate facilities to be considered for classification as an authorized test facility for AASHTO/NTPEP shall meet the following requirements:

### **Facilities Requirements:**

1. Provide verification that they have experience performing testing of “protective coating systems” on concrete.
2. Provide verification that they have the equipment, facilities and capability to perform the required testing procedures contained in this work plan. The laboratory shall provide a list of equipment that they use for testing protective coatings.
3. Identify their policies regarding qualifications and training of their staff to insure a high-quality level of performance. This shall include performance reviews of testing proficiencies and Standard Operating Procedures for each testing procedure as detailed in the Quality Control/Quality Assurance portion of this document.
4. Identify the administrative procedures that have been implemented to insure a high-quality level of comparative testing results.
5. Provide verification that it is in conformance with Federal and State regulations related to health and safety.
6. Provide verification that it has performed all testing procedures in conformance with requirements of the specified individual test methods. Accreditation by the National Voluntary Laboratory Accreditation Program or ISO 17025 shall be considered as verification. Other nationally recognized accreditation programs may be considered as verification.

### **Personnel Requirements:**

Provide an organizational chart that identifies the names and positions of management personnel and each person that will be involved in or associated with testing and the review of the AASHTO/NTPEP reports. A laboratory Quality Control Manager shall be designated for review of all Standard Operating Procedures and Proficiency evaluations of technicians as described.

Provide resumes or credentials for all persons identified in the organizational chart. It is recommended that the responsible person supervising the laboratory and the staff performing the testing have adequate levels of formal education.

### **Quality Control/Quality Assurance:**

The laboratory shall identify the procedures being used to insure a high quality level of testing. The process used for quality control should be based upon statistically evaluated conclusions. The conclusions should verify that the laboratory is capable of producing testing results that are accurate and reproducible. The preferred technique for comparative conclusions is to obtain

results based on tests performed on identical samples by other laboratories that are statistically evaluated for their comparative similarity. The comparative testing must be performed using the testing procedures required by AASHTO/NTPEP.

Testing proficiencies of all technicians shall be evaluated and documented by the laboratory Quality Control Manager. These evaluations shall be performed at six-month intervals unless the technician does not routinely perform the test. In this case, proficiency of the technician shall be evaluated and documented prior to testing of coatings for this program.

### **Testing Capability:**

The testing facility shall be comprised of a single entity or the combination of no more than three entities. When more than one facility is used, a single lead facility shall be responsible for the coordination and oversight of all testing and reporting and for the compilation of the final report.

The lead facility is responsible for identifying the tests that will be subcontracted and for providing the qualification, experience, standard operating procedures, and quality control programs of each of the facilities for review and approval of AASHTO/NTPEP. Subcontracted facilities cannot be changed without the approval of AASHTO/NTPEP.

The outdoor exposure testing shall be at an appropriate testing facility as designated by the AASHTO/NTPEP Concrete Coatings Technical Committee.

## **TESTS/TEST METHODS**

The standard tests and methods are detailed in this work plan. The Lead State and the NTPEP Concrete Coatings Technical Committee shall address any questions regarding the testing procedures or exceptions to any testing procedure.

The Test Facility shall prepare a testing and evaluation process timeline relative to the date samples are received for review and approval of AASHTO/NTPEP. The timeline shall indicate relative duration to complete analytical testing and data upload, coating system application and cure, each performance test (in the order to be performed), and each performance test evaluation and data upload.

The Test Facility shall complete all coating identification testing of the coating system prior to application to test panels. The facility shall have fifteen (15) working days, from the date samples are received, to complete all coating identification testing.

## **TEST REPORT**

Preparation of test reports shall consist of uploading required data, images and certificate of testing to the NTPEP Data Mine program. The lead testing facility is responsible for compiling and entering the required information for each coating system in accordance with the approved process timeline.

## **Inspection of Testing**

Specifying agency representatives, authorized through AASHTO/NTPEP, will be permitted (at any time) access to inspect testing procedures being performed and/or review test records of any coating systems being evaluated under this specification.

## **MANUFACTURERS PARTICIPATION**

Coating manufacturers participating in the AASHTO/NTPEP program must submit a completed NTPEP Product Evaluation Form (ePEF) to the attention of the AASHTO/NTPEP coordinator. This process is completed electronically through the NTPEP Data Mine program. It is highly recommended that actual Quality Control analysis data for submitted lots of coatings be supplied. Baseline compositional references will be established through these laboratory evaluations. Specifiers will utilize these values for compositional verification of field samples. All applicable compositional data contained in this work plan should be supplied for each component of each product in the coating system.

For the purposes of this testing program, a repair compound and single component systems, two component systems, or three component systems may be submitted for testing.

The coating manufacturer shall supply sufficient quantities of each coating product and repair compound to perform the required testing. The testing facility determines sufficient quantities for testing, application, and compositional analysis. The coating manufacturer may supply single component products or multi-component products in pre-packaged kits. The coating manufacturer shall provide the mixing ratio (by mass) of multi-component systems in order for the testing laboratory to mix the test material in quantities sufficient for testing. In addition, the coating manufacturer shall indicate the minimum quantity of product to be mixed to assure proper reaction of the components. The test coatings shall be supplied from manufactured stock with traceable batch numbers. The test coating shall not be specifically manufactured for this test program.

The manufacturer shall supply certified Product Data Sheets, Materials Safety Data Sheets, and chemical test results that will define the character and nature of the coating system being submitted. Actual results shall be verified by the select laboratory, and shall be part of the select laboratory's report. Properties (determined on each mixed product, and on each liquid component as indicated) shall be stated on the ePEF as follows:

- Total solids, percent by mass in accordance with ASTM D 2369 of each liquid component.
- Volatile organic compound content in accordance with ASTM D 3960.
- EPA exempt solvents, identify compound and percent by volume per ASTM D 3960.

- Water, percent by mass, in accordance with ASTM D 4017.
- Pigment, percent by mass in accordance with ASTM D 2371 or ASTM D 3723.
- Total solids, percent by volume in accordance with ASTM D 2697 of each liquid component.
- Mass per volume (grams per liter) in accordance with ASTM D 1475 of each liquid component.
- Viscosity (Stormer at 25°C) KU in accordance with ASTM D 562 (Not suitable for measurement of viscosities below 50 KU or above 143 KU) of each liquid component.
- Viscosity (Brookfield at 25°C) cP in accordance with ASTM D 2196 of each liquid component. The instrument model (i.e. LV, DV, DVII+), spindle size, and revolutions per minute shall be reported.
- Pot life in hours, at specified temperature and specified humidity, shall be evaluated in the laboratory through viscosity measurements taken at regular intervals and reported in Krebs Units. Materials with manufacturer's stated pot life shall be evaluated at 25, 50, 75, and 100 percent of the stated pot life. Materials without manufacturer's stated pot life shall be evaluated at 2 hour increments for 8 hours.
- Sag resistance (Leneta) in micrometers wet film thickness in accordance with ASTM D 4400.
- Recommended film thickness in micrometers for each coat.
- Minimum and maximum wet film thickness.
- Minimum and maximum dry film thickness.
- Minimum (and maximum when applicable) drying time for each coat in accordance with ASTM D 1640 at 25°C and 50 percent relative humidity.
  - Dry to touch
  - Dry to handle
  - Dry to recoat
- Mixing ratio for multi-component coatings, by volume.
- Mixing ratio for multi-component coatings, by mass.
- Shelf life of each component stored at 25°C.

- Total heavy metals content for mixed coatings in accordance with ASTM D 3335 and D 3718. Heavy metals to be tested will include lead, chromium, and cadmium for each coating.
- Leachable heavy metals content for mixed coatings in accordance with Method 1311 of EPA SW-846. Analysis shall include Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver for each coating
- Epoxide values determined in accordance with ASTM D 1652, Method A.
- Amine values determined on the amine or amidoamine contained in the appropriate component of two component epoxy coatings, in accordance with ASTM D 2073.
- Isocyanate group content determined in accordance with AASHTO T 339.
- Hindered amine light stabilizers (HALS) AASHTO T 338.
- Ultraviolet (UV) Absorbers.
- The minimum and maximum surface CSP requirement in accordance with ICRI 03732.
- Application requirements for:
  - ambient temperature
  - surface temperatures
  - material temperature
  - humidity
  - tip size
  - application pressure

## **PRODUCT SUBMISSION GUIDELINES**

This testing program will accept submissions twice annually. Manufacturer's may submit samples during open submission cycles through the online submission process.

1. The AASHTO/NTPEP Coordinator and Lead State will verify receipt of testing fees and all appropriate documentation.
2. Once the manufacturer is notified that the system has been accepted for evaluation, the test facility will request that the manufacturer submit clearly marked samples of the coating with all required documentation (MSDS and complete Product data sheets) for mixing and application (directly to the test facility).
3. The test facility shall notify the Lead State and the AASHTO NTPEP Coordinator of

receipt of samples for evaluation.

The Coating Manufacturer may have a representative of the company present during the application process. AASHTO/NTPEP may also elect to have a representative present during the application process as part of the Quality Assurance function.

The Test Facility will notify the Coating Manufacturer and the Lead State, at least fifteen working days prior to the coating application date. The Test Facility will provide completed coatings identification test results to the Lead State and the coatings manufacturer for review prior to the application date. If the materials received by the facility do not produce compositional results as reported in the preliminary information submitted by the company, the Manufacturers representative will be expected to decide whether the system testing should proceed.

When present for the coatings application, the Manufacturers representative is required to sign a statement attesting to the appropriate application of the coatings system by the Test Facility. The Manufacturers representative will be expected to make decisions regarding any changes in the application process. If the Coating Manufacturer elects not to have a representative present during the application process, they shall provide an affidavit confirming notification of the application dates and agreement not to contest the validity of the application or compositional testing process.

When the application process is complete the Manufacturer is bound by the Non-Interference Policy as detailed in the General Terms and Conditions Section of submittal documents. All written or verbal correspondence between the Manufacturer and the Testing Laboratory after the application of the coating must be done through the Lead State. Any implication of interference from the Manufacturer during the testing and evaluation process will be cause for the evaluation to cease. Any written or verbal communication between the manufacturer and the Testing Facility that is not shared with the NTPEP Coordinator or the Lead State will be considered a violation of the non-interference policy.

## **NTPEP LEAD STATE**

The NTPEP Lead State will coordinate testing of accepted submittals with the testing facility and the manufacturer and designate the coating systems to be used as system monitors for testing.

## **TESTING FEES**

Testing fees are assessed to cover all costs associated with laboratory testing, field evaluation, administrative costs incurred by the NTPEP lead state, (electronic) report generation and distribution by AASHTO, document preparation and distribution to AASHTO member departments. Specific pricing for submission of products may be found at [www.ntpep.org](http://www.ntpep.org).

Laboratories will be reimbursed for testing performed if a system is withdrawn after testing has begun. If the manufacturer elects to withdraw initial samples after testing begins and resubmit products, the manufacturer will be charged additionally for all costs incurred by the laboratory

during the initial testing.

AASHTO/NTPEP will assess a fifteen percent (15%) handling fee to stalled submittals. A submittal will be deemed as stalled in the event the manufacturer fails to deliver appropriate quantities of materials to the testing facility within 30 days of notification of acceptance of the submission by AASHTO/NTPEP. Stalled submittals will be cancelled and the balance of the testing fee will be returned to the manufacturer. Future submission of stalled systems will be assessed the full testing fee.

**POLICIES FOR WITHDRAWING MATERIALS**  
**FROM NTPEP EVALUATION PROGRAMS**

**i) CONCRETE COATINGS**

A written request to withdraw the Product Evaluation Form must be received by the NTPEP Coordinator at least five business days before the application of the material to the test panels is to begin. Costs for completed or in-progress compositional testing and a handling fee of ten percent (10%) of the testing fee will be charged in this event. Testing fees will not be refunded after this deadline. Results obtained up until the time of withdrawal will not be reported. In this event, the material will be listed in the final report with a note that it was withdrawn from the evaluation program.

**ii) POLICY FOR REVIEW OF NTPEP REPORTS**

The coating manufacturer will be given access to the AASHTO/NTPEP Data Mine and asked to review the data from their products(s) for release. Upon receipt of results to be reviewed, the coating manufacturer will have thirty (30) days to complete their review. Any protest of the data from the coating manufacturer must be submitted in writing to the NTPEP Coordinator. Failure of the manufacturer to complete data review or protest data within the thirty day review period will result in automated release of data.

The NTPEP Coordinator, panel chairman and the testing facility generating the data in question, (Review Committee) will review data being protested to determine if an error was made. Typographical errors that are found will be corrected. Questions raised about the testing data, other than typographical errors, will be reported unless the investigation by the Review Committee verifies conclusively that the question(s) raised is legitimate.

A written notification will be sent by the NTPEP Coordinator to the coating manufacturer indicating the decision within five (5) working days after the decision has been made. The decision of the Review Committee will be considered final. The appeals procedure outlined here supercedes the NTPEP Operating Policy and Procedures on this topic and is project panel specific in nature.

## **POLICY ON MANUFACTURER PUBLICATION OF NTPEP TEST DATA**

Manufacturers may publish NTPEP data after formal release through the reporting process under the following conditions:

1. Only test data for the manufacturers own product may be reproduced.
2. Manufacturers may utilize the test data on their own products as a source of independent test data. However, the data may not be used for comparative marketing purposes with those of other manufacturers.
3. Whenever NTPEP test data are used or presented, the following statement must be used.

*“The preceding test data excerpts were reproduced with the permission of AASHTO, however, this does not constitute endorsement or approval of the product, material, or device”.*

Some areas where a manufacturer may use NTPEP data are as follows:

1. To indicate that the product was tested by NTPEP in their product bulletins and brochures.
2. Use as references on Product Evaluation Forms required by many government agencies.

# EVALUATION OF PROTECTIVE COATING SYSTEMS FOR CONCRETE

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## Scope

This specification covers testing criteria for evaluation of protective coating systems for use on concrete surfaces.

The protective coating systems are intended for use on bridges (except bridge decks), walls, barriers, similar structural concrete, and other masonry surfaces, both new and existing, prepared by abrasive blast cleaning or high pressure water cleaning. Tested coatings are intended to enhance durability, and/or aesthetics of concrete structures which are subject to degrading atmospheric exposure, such as marine, industrial, deicing chemicals, and high humidity.

Protective coating systems consist of a concrete repair compound and surface applied coatings, sealants, or stains.

The values stated in SI units are to be regarded as standard.

This standard may involve hazardous materials, operations, and equipment. It does not purport to address all safety problems associated with its use. It is the responsibility of the user of this standard to establish the appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

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## Referenced Documents

### **AASHTO Standards:**

T 338-09, Analysis of Structural Steel Coatings for Hindered Amine Light Stabilizers  
T 339-09, Analysis of Structural Steel Coatings for Isocyanate Content  
Standard Specifications for Highway Bridges  
T 161-08, Standard Method of Test for Resistance of Concrete to Rapid Freezing and Thawing  
T 259-02 (2006), Standard Method of Testing for Resistance of Concrete to Chloride Ion Penetration  
T 260-97 (2009), Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials

### **ASTM Standards:**

C 1305-08, Standard Test Method for Crack Bridging Ability of Waterproofing Membrane  
D 512-10, Test Methods for Chloride Ion in Water  
D 523-08, Test Method for Specular Gloss  
D 562-10, Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using the Stormer-Type Viscometer  
D 714-02 (2009), Test Method for Evaluating Degree of Blistering of Paints

D 1475-98 (2008), Test Method for Density of Liquid Coatings, Inks, and Related Products

D 1640-03 (2009), Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature

D 1652-04, Test Method for Epoxy Content of Epoxy Resins

D 1654-08, Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

D 1734-93 (2007), Standard Practice for Making Cementitious Panels for Testing Coatings

D 2073-92 (1998) Withdrawn, Test Methods for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines, Amidoamines, and Diamines by Referee Potentiometric Method

D 2196-10, Test Method for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield-Type) Viscometer

D 2240-05 (2010), Test Method for Rubber Property—Durometer Hardness

D 2244-11, Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates

D 2369-10, Test Methods for Volatile Content of Coatings

D 2371-85 (2010), Test Method for Pigment Content of Solvent-Reducible Paints

D 2697-03 (2008), Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings

D 2698-05 (2010), Test Method for the Determination of the Pigment Content of Solvent-Reducible Paints by High-Speed Centrifuging

D 2805-11, Standard Test Method for Hiding Power of Paints by Reflectometry

D 3273-00 (2005), Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Test Chamber

D 3335-85a (2009), Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy

D 3718-85a (2010), Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy

D 3719-00 Withdrawn, Standard Test Method for Quantifying Dirt Collection on Coated Exterior Panels

D 3723-05 (2011), Pigment Content of Water-Emulsion Paints by Low Temperature Ashing

D 3960-05, Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings

D 4017-02 (2008), Test Method for Water in Paints and Paint Materials by Karl Fischer Method

D 4285-83 (2006), Test Method for Indicating Oil or Water in Compressed Air

D 4400-99 (2007), Test Methods for Sag Resistance of Paints Using a Multinotch Applicator

D 4587-11, Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings

D 4940-10, Test Method for Conductimetric Analysis of Water-Soluble Ionic Contamination of Blasting Abrasives

D 6132-08, Standard Method for non-Destructive Measurement of Dry Film Thickness of Applied Organic Coatings Using Ultrasonic Gages

D 6133-02 (2008), Standard Test Method for Acetone, p-Chlorobenzotrifluoride, Methyl Acetate, or t-Butyl Acetate Content of Solventborne and Waterborne Paints, Coatings, Resins, and Raw Materials by Direct Injection into a Gas Chromatograph  
D 7072-04 (2009), Standard Practice for Evaluating Accelerated Efflorescence of Latex Coatings  
D 7234-05, Standard Test Method for Pull-Off Adhesion Strength of Coatings in Concrete Using Portable Pull-Off Adhesion Testers  
E 11-09, Specification for Wire-Cloth and Sieves for Testing Purposes  
E 96/E96M-10, Test Methods for Water Vapor Transmission of Materials  
E 1349-06, Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional Geometry  
E 1613-04, Test Method for Determination of Lead by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES), Flame Atomic Absorption Spectroscopy (FAAS), or Graphite Furnace Atomic Absorption Spectroscopy (GFAAS) Techniques  
F 1869-11, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride  
G 92-86 (2010), Practice for Characterization of Atmospheric Test Sites  
G 140-02 (2008), Standard Method for Determining Atmospheric Chloride Deposition Rate by Wet Candle Method

**Federal Standards:<sup>1</sup>**

Fed. Std. No. 40, CFR 51.100(s) Volatile Organic Compound Definition  
Fed. Std. No. 40, CFR 59.406(a) Volatile Organic Compound Compliance Provision  
Fed. Std. No. 40, CFR Part 59, Subpart D, Section 59.400 Through 59.413 National Volatile Organic Compound Emission Standards for Architectural Coatings  
Fed. Std. No. 40, CFR 261.24, Table 1 Maximum Concentration of Contaminants for the Toxicity Characteristic  
Fed. Std. No. 595, Colors Used in Government Procurement  
EPA-SW846, Method 1311 Toxicity Characteristic Leaching Procedure (TCLP)

**International Concrete Repair Institute (ICRI)**

Guide No. 03732, Guide for Selecting and Specifying Surface Preparation for Sealers, Coatings and Membranes

**The Society for Protective Coatings (SSPC) Standards:<sup>2</sup>**

AB-1, Mineral and Slag Abrasives  
Guide 9, Guide for Atmospheric Testing of Coatings in the Field  
PA 9, Measurement of Dry Organic Coating Thickness on Cementitious Substrates Using Ultrasonic Gages  
Technology Update #2, Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment

**Other Documents:**

Commercial Item Description (CID) A-A-1689B; Tape, Pressure Sensitive Adhesive, Plastic Film<sup>3</sup>

Commission Internationale de l'Eclairage (CIE) 1976 L\*a\*b\*

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## **Terminology**

### **Definitions:**

Coating – A liquid, liquefiable, or mastic composition that is converted by evaporation, cross-linking, or cooling to a solid or semisolid protective, decorative, or functional adherent layer after application.

Dry Film Paint Thickness—the depth of coating to the top of the surface profile peaks, measured in accordance with SSPC PA 9.

Minimum (Laboratory) Recoat Time – the period of time required to sufficiently cure the applied coating when applied within the manufacturers' recommended wet film thickness range and obtain dry film thickness readings of the coating (without causing physical damage to the applied film).

Sealer – A liquid composition to prevent excessive absorption of finish coats into porous surfaces.

Stain – A penetrating composition that changes the color of a surface, usually transparent and leaving practically no surface film.

Volatile Organic Compound (VOC)—any organic compound that participates in atmospheric photochemical reactions, that is, any organic compound other than those which the U.S. EPA Administrator designates as having negligible photochemical reactivity. For a list of compounds that the U.S. EPA Administrator has designated as having negligible photochemical reactivity, also referred to as exempt compounds, refer to 40 CFR 51.100(s).

VOC content—the weight of VOC per volume of coating, calculated according to the procedures in 40 CFR 59.406(a).

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## **Classification**

Repair Compound—The repair compound shall be as recommended by the manufacturer at the time of application. Repair compounds are materials intended for hand application to repair and

smooth surface defects (e.g., bugholes) prior to application of the primer coat. Each manufacturer shall supply an appropriate repair compound compatible with their coating system.

Primer—Primers act as the initial barrier over the prepared concrete substrate. Single coat systems shall consist only of the primer.

Intermediate Coat—The intermediate coat for a three-coat system serves as a tie coat between primer and finish coat as well as a protective barrier for the concrete. The manufacturers for each (three-coat) coating system submitted for evaluation shall recommend the appropriate intermediate coat.

Finish Coat—The finish coat for each system evaluated serves as the final barrier coating and provides the desired aesthetic finish for the surface of the structure. The manufacturers for each coating system submitted for evaluation shall recommend the appropriate finish coat.

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## **Materials**

The materials used in the manufacture of the system shall conform to the requirements of the following specifications:

Each coating (primer, repair compound, intermediate, and finish coat) shall be tested by an NLLAP (National Lead Laboratory Accreditation Program) accredited laboratory to determine its total lead content. The total lead content shall be determined using a dry film sample in accordance with ASTM D 3335. The percentage of total lead in each coating shall not exceed 0.01 percent (100 ppm).

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## **GENERAL Requirements**

Color—For production, the color of the coatings shall be as mutually agreed, except that the successively applied coatings shall contrast in color a minimum of  $10.0\Delta E^*$ . For testing purposes, the finish coat color shall conform to Federal Standard No. 595, Color Chip No. X6622 (light grey) (“X” signifies that the gloss is undesignated). Acceptable finish coat color shall be within  $3.0\Delta^*$  of the required standard

Pigment—Prime pigments shall be used except for shaders. Leachable, heavy-metal compounds shall not exceed the regulatory limits of 40 CFR, 261.24, Table 1, when tested in accordance with Section 6.4.3.18. Total levels of lead, cadmium, and chromium shall not exceed 20 times the specified limits for these elements.

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## **Coating Identification Tests**

Perform the following referenced tests, as applicable, to define the character and nature of each coating product, and when indicated, each liquid component of a coating product.

Perform each test in duplicate or the number of replicates as stated in the appropriate test method, whichever yields the greatest number of replicate tests. Reportable data shall comply to stated precision and bias statements.

- Total solids, percent by mass in accordance with ASTM D 2369 of each liquid component.
- Volatile organic compound content in accordance with ASTM D 3960.
- EPA exempt solvents, identify compound and percent by volume per ASTM D 3960.
- Water, percent by mass, in accordance with ASTM D 4017.
- Pigment, percent by mass in accordance with ASTM D 2371 or ASTM D 3723.
- Total solids, percent by volume in accordance with ASTM D 2697 of each liquid component.
- Mass per volume (grams per liter) in accordance with ASTM D 1475 of each liquid component.
- Viscosity (Stormer at 25°C) KU in accordance with ASTM D 562 (Not suitable for measurement of viscosities below 50 KU or above 143 KU) of each liquid component.
- Viscosity (Brookfield at 25°C) cP in accordance with ASTM D 2196 of each liquid component. The instrument model (i.e. LV, DV, DVII+), spindle size, and revolutions per minute shall be reported.
- Pot life in hours, at specified temperature and specified humidity, shall be evaluated in the laboratory through viscosity measurements taken in accordance with Astm d 562 at regular intervals and reported in Krebs Units. Materials with manufacturer's stated pot life shall be evaluated at 25, 50, 75, and 100 percent of the stated pot life. Materials without manufacturer's stated pot life shall be evaluated at 2 hour increments for 8 hours.
- Sag resistance (Leneta) in micrometers wet film thickness in accordance with ASTM D 4400.
- Minimum (and maximum when applicable) drying time for each coat in accordance with ASTM D 1640 at 25°C and 50 percent relative humidity.
  - Dry to touch

- Dry to handle
- Total heavy metals content for mixed coatings in accordance with ASTM D 3335 and D 3718. Heavy metals to be tested will include lead, chromium, and cadmium for each coating.
- Leachable heavy metals content for mixed coatings in accordance with Method 1311 of EPA SW-846. Analysis shall include Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver for each coating
- Epoxide values determined in accordance with ASTM D 1652, Method A.
  - For clear components, the method can be used as written. For pigmented components, the sample must first be weighed into a centrifuge tube, then thinned 50 to 100 percent with xylene or toluene. If a glass stirring rod is used to aid in dispersing the sample in a thinner, it may be necessary to use an additional small amount of thinner to rinse residues off of the rod and back into the centrifuge tube.
  - The sample is then centrifuged to remove the pigment, and the supernatant should then be transferred to the container in which the D 1652 procedure will be done. The pigment in the bottom of the centrifuge tube should then be redispersed in 2 or 3 mL of solvent, recentrifuged, and the supernatant combined with the original supernatant for analysis.
- Amine values determined on the amine or amidoamine contained in the appropriate component of two component epoxy coatings, in accordance with ASTM D 2073.
  - For pigmented components containing amine, weigh 1.0 grams of the pigmented component to the nearest 0.1 mg into a glass centrifuge tube and thin with approximately one milliliter of methylene chloride. If a glass stirring rod is required to disperse the pigmented component with the methylene chloride, it may be necessary to use a small additional amount of methylene chloride to rinse any material off of the glass stirring rod before removing it from the centrifuge tube.
  - Separate the pigment by high-speed centrifugation, and transfer the supernatant into a 25-mL low-form beaker. The pigment in the bottom of the centrifuge tube should be redispersed in an additional 2 to 3 mL of methylene chloride, recentrifuged, and the supernatant combined with the original supernatant for analysis. At this point, follow the titration procedure described in ASTM D 2073.
- Isocyanate group content determined in accordance with AASHTO T 339.
- Hindered amine light stabilizers (HALS) AASHTO T 338.

- Fourier Transform Infrared Spectroscopy (FTIR).
  - Perform a minimum of 32 scans per sample.
  - For single component products obtain an infrared spectrum (2.5 to 15  $\mu\text{m}$ ) of the dried film via the potassium bromide single-pellet technique.
  - For multi-component, solvent-based products obtain an infrared spectrum (2.5 to 15  $\mu\text{m}$ ) of each single component via the potassium bromide sandwich technique, and of the mixed and dried components in appropriate mixing ratios (dried film) via the potassium bromide single-pellet technique.
  - For multi-component water-based products obtain an infrared spectrum (2.5 to 15  $\mu\text{m}$ ) of each single component after drying and applying the potassium bromide single-pellet technique and of the mixed and dried components in appropriate mixing ratios (dried film) via the potassium bromide single-pellet technique.
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## **Performance Tests**

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### **Test Panel Requirements for Test**

Test panels shall be manufactured from a single batch of concrete and cured for a minimum of 28 days. . Environmental conditions during manufacture and cure of test panels will be documented and nominally maintained at  $25 \pm 5^\circ\text{C}$  and  $60 \pm 20$  percent relative humidity Cured test panels shall be conditioned at  $25 \pm 2^\circ\text{C}$  and  $50 \pm 5\%$  relative humidity for a minimum of 10 days immediately prior to coating application.

1. Flat Mortar Test Panel: Mortar panels in accordance with ASTM D 1734 with modified dimensions of 6"x12 1/4"x3/4" shall be used for the Weatherability Test, the Resistance to Freeze/Thaw Testing and the Two-year Atmospheric Exposure Test. Certification of all materials used will be documented for each batch of material.
2. Mortar Test Panels with Defects: Mortar panels in accordance with ASTM D 1734 with dimensions of 6"x12 1/4"x3/4" shall be used for testing coatings over defects test and the

two-year atmospheric exposure test. These panels will be cast with 6 intentional defects cast into one of the large faces. These defects shall be round, ¼” deep mock bugholes. Three defects shall be ½” in diameter, the other three shall be ¼” in diameter. The opposite side of the panels shall receive a broom finish to provide a typical “roughened” surface for application of test coatings. Certification of all materials used will be documented for each batch of material.

Large Ponding Cubes: 12”x12”x6” cubes shall be cast with a 2”x1” rim on the top surface.. These samples will be used for the Chloride Ion Penetration Test and the Adhesion Test, with adhesion testing performed on the side surfaces of the block. Cubes shall be cast using the following concrete mix design:

Portland cement: AASHTO M 150, Type I, 611 lbs/yd<sup>3</sup>  
Water Cement Ratio: 0.45  
Aggregate: Saturate Surface Dry (SSD), maximum size of 1/8. in.  
Entrained air: 6.5% to 7.0%

Certification of all materials used will be documented for each batch of material.

3. Crack Bridging Test Panel: Concrete blocks will be cast in accordance with ASTM C 1305 to perform crack bridging testing on each coating in the Crack Bridging. These panels will be 1”x2”x1” thick. In addition, grip tabs will be either cast into the blocks or adhered to the blocks to apply load.

Three replicate test panels shall be prepared for each complete system for each test. The Coatings Over Typical Defects Test requires three test panels with test coatings applied to the defect side, plus three with the coating applied to the broom finish side.

The panels shall be cleaned in accordance with ICRI 03732, CSP3, using abrasives qualified to SSPC AB-1. The abrasives shall have a maximum chloride content of 15 ppm determined in accordance with ASTM D 512 and a maximum conductivity of 150 microhms per cm determined in accordance with ASTM D 4940. The surface shall be as described by CSP 3 in ICRI 03732 and shall be clean, sharp and free of embedded friable material, with adequate roughness to insure effective adhesion of the applied primer. Morphology of the prepared surface shall be documented in accordance with ASTM D 7127.

Each coating shall be applied within the dry film thickness (DFT) range recommended by the manufacturer. If no DFT range is recommended, apply the coating at the recommended DFT  $\pm 13 \mu\text{m}$ .

Apply monitor coating systems, as designated by the NTPEP Lead State, to test panels for Weatherability testing, Two-year Atmospheric testing, and to cubes for Chloride Ion Penetration Resistance Testing.

Dry Film Paint Thickness—The dry film paint thickness shall be taken in accordance with ASTM D 6132, with the following exception:

Measure the dry film coating thickness on each test panel utilizing a dry film thickness gage calibrated according to SSPC PA9 as follows: Take two gage readings from the top third, the middle third, and the bottom third of the test panel. Readings should be taken at least 25 mm from any edge. To facilitate consistent measurements at fixed positions on the panel, the laboratory shall use a template, providing six fixed locations on the panels. Discard any gage reading that cannot be repeated consistently. The average of the acceptable gage readings shall be no less than the manufacturer's recommended minimum thickness. No single gage reading shall be less than 80 percent of the manufacturer's recommended minimum. The average of the acceptable gage readings shall be no more than the manufacturer's recommended maximum thickness. No single gage reading shall be more than 120 percent of the manufacturer's recommended maximum. Recommended maximum dry film thickness must be detailed on the product submission.

All products shall be applied using proper airless equipment except when this method is specifically not allowed by the coating manufacturer. All coatings shall be applied to panels mounted vertically at a distance described in the standard operating procedure for applications (nominally 18-21 inches) from the tip of the spray gun. The equipment shall be capable of developing sufficient pressure to properly atomize the coating. Orifice size, application pressure, pump type and ratio, hose size and length, and any atypical application requirements shall be recorded. If the pressure used varies by more than 10 percent from the suggested pressure listed in the manufacturer's application data information, the actual pressure used and a statement explaining the deviation shall be provided in the final report. All coatings will also be rolled onto a minimum of two additional flat test panels to assess application properties. These roll-applied panels will not be subjected to performance testing.

Each sample or panel shall be marked and identified by a NTPEP-assigned system code number. The identification code number shall be placed on the back of each panel with permanent yellow paint stick. It will also be typed and placed in front of the corresponding panel when photographs are taken. The number will have a minimum height of 10 mm and will identify the following information, which will be part of the final report:

1. Test being performed.
2. Replica test being performed (i.e., System xxx, Panel No. 3).
3. Date of panel/sample preparation.
4. Date that the test evaluation was performed.

Coatings shall be applied to test panels at the minimum (laboratory) recoat time as defined in the Terminology Section of this specification. Curing of the coated test panels, for the complete system, shall be a minimum of 30 days and no more than 45 days. The curing climate shall be at  $25 \pm 2^{\circ}\text{C}$  and  $55 \pm 5$  percent relative humidity.

Edges of panels shall be spray stripe coated to ensure proper build on test sample edges.

## Photographic Requirements

Color photographs of each sample or panel shall be taken as follows:

1. All photographs shall include the code identification number for each sample or panel and the number of hours.
2. A photograph of the coated surface of each sample or panel shall be taken after the application of the entire system to be evaluated.
3. All photographs shall have resolution of 6 megapixels or better. Photos shall be taken with appropriate illumination and focus to clearly show the critical performance features on each panel. This may require adjustments between separate samples to achieve appropriate contrast between defects and good performing areas and subtle but visible changes in color or other surface characteristics.
4. Chloride Ion Penetration Test—Surface of each sample prior to and after each test.
5. Weatherability Test – Before testing and following testing.
6. Two-year Atmospheric Exposure Tests – Before testing and at the one-year interim inspection point.

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## **Tests to be Performed by Selected Test Facility**

### Chloride Ion Penetration Test

Protective coatings enhance the durability of concrete structures primarily by adding resistance to penetration of chloride ions into the concrete matrix. This property can be tested using standardized tests:

AASHTO T259 – Standard Method of Testing for Resistance of Concrete to Chloride Ion Penetration

This method involves saline ponding (3% Chloride solution) of concrete blocks for 90 days.

Following the 90-day test period, chloride ingress will be evaluated using the procedures described in AASHTO T 260, Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials. Chloride sampling will be at depths of 0.5 and 1.0 inches.

### Breathability (Water Vapour Transmission)

ASTM E 96, Standard Test Methods for Water Vapor Transmission of Materials

This test evaluates the relative ability of free films of the coatings to pass moisture from within the concrete to the outside.

### Weatherability

ASTM D 4587, Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings

Tests are performed on mortar test panels prepared in accordance with ASTM D 1734. These panels will be 6"x12.25"x3/4" for an optimum fit in a standard test chamber. Testing is conducted in a QUV cabinet (UV light/condensing humidity cycle) for 2500 hours total test time.

Evaluate coating durability through blistering, dry film thickness, loss of adhesion and gloss and color retention.

Evaluate coatings for resistance to transmission of effluorescence in accordance with ASTM D 7072. Evaluate coatings for dirt pickup in accordance with ASTM D 3719, and fungal resistance in accordance with ASTM D 3273.

### Adhesion

ASTM D 7234, Standard Test Method for Pull-Off Strength of Coatings on Concrete Using Portable Pull-off Adhesion Testers

Note: Premature loss of adhesion is a typical failure mode of concrete coatings in real world applications. Many times, this can be attributed to poor or improper surface preparation and/or application. Basic compatibility can be assessed in this program by evaluating:

Adhesion Strength to Concrete – Adhesion testing will be conducted on the side surfaces of the larger concrete blocks used for the Chloride Ion Penetration Test. This testing will be performed following 7 days of curing after application of the system.

Resistance to Freeze/Thaw Cycling – Mortar panels similar to those used in the weatherability test will be exposed to freeze/thaw cycling. Adhesion testing will be performed prior to and following the testing to determine any loss of property. Prepared panels shall be exposed to freeze/thaw testing in accordance with AASHTO T 161 for 30 days.

Post Weathering Adhesion – Adhesion testing will be performed on selected panels for each test system following the weatherability test.

### Crack Bridging

ASTM C 1305 – Standard Test Method for Crack Bridging Ability of Liquid-applied Waterproofing Membranes

### Performance over typical Defects in Concrete

Candidate Coatings will be applied over mortar test panels with embedded intentional defects of two different sizes (1/4" and 1/2" diameter circular "bugholes" 1/4" deep). These defects will be cast into the panels. These defects will be filled with the coating manufacturer's recommended repair compound and properly cured prior to application of the coating. These panels will be exposed to testing under the conditions described in the Weatherability Test. Adhesion testing will be conducted post test exposure to ensure compatibility of the coating with the repair material and concrete.

The opposite sides of the defect panels will be broom finished to produce a roughened surface. These surfaces will also be exposed to the conditions of the Weatherability Test.

### Ease of Application

Coatings will be sprayed onto all test panels and samples; however, each coating will also be rolled and brushed onto mortar panels to assess application characteristics. Checklists for application property documentation appear in Appendix C.

### Overcoatability/Graffiti Resistance

Panels tested in the weatherability test will be subjected to aerosol spray paint and permanent marker following the completion of the weatherability test. After 7 days of curing of the spray paint and marker, a topcoat of the test system will be applied to hide the spray paint. After a 30 day curing period, adhesion testing will be conducted on the overcoated area per ASTM D 7234. Hiding power of the coating over the tagging material will be evaluated per ASTM D 2805.

### Two-Year Atmospheric Testing

Each complete system shall be subjected to a two-year atmospheric test at a location designated by the NTPEP Concrete Coatings Technical Committee. The distance from high tide to the ocean side test fence shall be monitored periodically throughout the test period. This data shall be included in the final report from the test facility. The test panels shall be exposed at a site adjacent to the ocean at a 30 degree angle, facing South. Periodic characterization of the test site shall be documented through use of atmospheric chloride testing per ASTM G 140.

Five mortar test panels prepared in a manner similar to those used for the weatherability testing in the laboratory, will be exposed. The panels shall be exposed for two years and inspected and photographed at the one year and two year point in accordance with ASTM , and D 714.

Evaluate coating durability through coating thickness, blistering, loss of adhesion (only at two year conclusion of testing) and gloss and color retention. Evaluate coatings for resistance to transmission of effluorescence in accordance with ASTM D 7072. Evaluate coatings for dirt pickup in accordance with ASTM D 3719, and fungal resistance in accordance with ASTM D 3273.

Total UV, total solar energy, temperature (minimum, maximum, average), relative humidity (minimum, maximum, average), average dew point, time of wetness and rain fall will be monitored and documented in a monthly summary. These values will be made part of the final report.

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### **Test Report and Protective Coating Information**

The principal testing firm will be responsible for compiling and entering all required data into the Concrete Coatings Module for DataMine.

The required data shall, at a minimum, consist of the following:

*Certificate of Testing (see Figure 1). Uploaded to DataMine in portable document file (PDF) format.*

ORGANIZATION LETTERHEAD  
(Testing Firm)

“AASHTO” CERTIFICATE OF TESTING

We hereby certify that this coating system manufactured by

\_\_\_\_\_ (coating manufacturer)  
\_\_\_\_\_  
(prime coat)                      (intermediate coat)                      (finish coat)

was tested in accordance with the requirements for each applicable test as defined by Concrete Coating Work Plan, its support specifications, and that all information presented is truthful and without bias.

All record and documents pertaining to this certificate and not submitted herewith will be maintained available by the undersigned for a period of not less than seven years.

(OPTIONAL)

(1) \_\_\_\_\_  
(Signature of Manufacturer’s Representative)

\_\_\_\_\_  
(Name–Type or Print)

(2) \_\_\_\_\_  
(Signature of Testing Supervisor)

\_\_\_\_\_  
(Name–Type or Print)

(3) \_\_\_\_\_  
(Signature of Principal–Testing Firm)

\_\_\_\_\_  
(Name–Type or Print)

Title: \_\_\_\_\_  
(Title of Testing Firm Principal)

Subscribed and sworn before me this

\_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_

\_\_\_\_\_  
(Notary Public)

with commission expiring on \_\_\_\_\_  
(date)

**Figure 1**—Certificate of Testing

Digital Color photographs

Individual test results for each test performed.

Specification information for the specific coating system contained in the report as follows:

Name, address, telephone number and fax number of the manufacturer and the manufacturer's technical representative.

Product name and/or identification number for each coating tested (primer, intermediate, and finish coat).

The manufacturers recommended minimum and maximum dry film thickness (in micrometers) for each coating (primer, intermediate, and finish coat).

The manufacturers recommended minimum (recoat) time, (hours), with specified temperature (°C), and relative humidity (%) for each coating.

The manufacturers recommended minimum and maximum application temperature (°C) and relative humidity (%), for each coating. All results of 'Tests to be Performed by Selected Test Facility'

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## **Requalification**

Requalification with NTPEP shall occur every seven years from the date of system acceptance. If changes in formulation occur at any time, complete retesting will be required. Any change in an ingredient amount, quality, or type will constitute a formulation change. Any change in manufacturing location shall constitute a formulation change. Tolerances for sameness will be based on the precision tolerances for each test within the ASTM standard.

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## APPENDICES

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### APPENDIX A

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(Nonmandatory Information)

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#### CHARACTERIZATION TESTS FOR PRODUCT VERIFICATION

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The following tests are recommended for determining if the coatings supplied are the same quality as the manufacturer's materials originally tested and certified for acceptance. The most pertinent and feasible ones may be selected to verify compliance.

*Group I Tests*—Most commonly used tests.

- Infrared analysis: see requirements of Section 8.7.1.
- For two-component finish coats infrared spectrum (2.5 to 15  $\mu\text{m}$ ) of each single component and also of the mixed components (when applicable) in appropriate mixing ratios.
- Viscosity of individual liquid components and the mixed coating determined in accordance with ASTM D 562.
- Mass per volume (grams per liter) of individual liquid components and the mixed coating in accordance with ASTM D 1475.
- Total solids, percent by mass of individual liquid components and the mixed coating in accordance with ASTM D 2369.
- Dry time of mixed coating in accordance with ASTM D 1640.
- Pigment, percent by mass of total solids of individual liquid components and the mixed coating in accordance with ASTM D 2371.
- Lead and cadmium content of the mixed coating in accordance with ASTM D 3335.

**Note**—The coating evaluation tests use standard colors for uniform analysis of results. Use of different colors than those tested may change some of the baseline parameters.

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### APPENDIX B

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(Nonmandatory Information)

## GUIDE FOR PROJECT VERIFICATION TESTING

- B1.1. The extracted pigment upon analysis shall conform to the originally approved batch and the pigment content, percent by mass, shall not vary more than –2 percent or +3 percent. Allowances for the finish coats will be permitted in order to produce the desired color.
- B1.2. Vehicle
- B1.2.1. The vehicle solids shall not be more than  $\pm 2$  percent from the initially approved batch.
- B1.2.2. The infrared spectra of the vehicle/resin shall match that of the initially approved batch.

## APPENDIX C: RATING OF APPLICATION PROPERTIES:

(Mandatory Information)

### RATING OF APPLICATION PROPERTIES

*Scope:* The Testing Laboratory shall include ratings for each of the following parameters. Products requiring special application procedures or equipment by manufacturers' recommendation shall also be detailed in the report.

**C1 Mixing:** During mixing of the products, evaluate each product on a 10 to 1 scale. Place a checkmark across from the mixing characteristic exhibited by the product.

Characteristic	Rating	√
<b>One component</b> – Little or no settling – easily mixed by hand	10	
<b>One component</b> – Some settling, but easily mixed by hand.	9	
<b>One component</b> – Blends easily when mixed with mechanical agitation, typically in less than thirty seconds with 3/8" drill motor and a jiffy mixer for a gallon sample.	8	
<b>One component</b> – Mixes with some difficulty, typically requiring more than three minutes with 3/8" drill motor and a jiffy mixer for a gallon sample. <b>Two components</b> – Both components and their blend mix easily as defined in Rating 8.	7	
<b>One component</b> – Mixes with difficulty, typically requiring more than three minutes with 3/8" drill motor and a jiffy mixer for a gallon sample – Settled layer about one inch thick or very hard to agitate – Thin material on top requires effort to prevent splash out of can. <b>Two components</b> – Both components settled and mixed as defined in Rating 7, blend mixes easily or one of the components is a powder.	6	
<b>One component</b> – Same as Rating 6, but had to scrape bottom of can. <b>Two components</b> – One of the components mixes with difficulty as in Rating 6 – Blend settles ten to thirty minutes after mixing, continuous agitation required. <b>Multi component systems</b> – One of the components is a powder – All components and their blend mix easily.	5	
<b>One component</b> – Extremely thick – Must first break up settled material by hand, then mix with power equipment. <b>Two components</b> – Both components mix with difficulty as in Rating 6.	4	

<b>Multi component systems</b> – One of the components is a powder and one of the liquid components is difficult to mix as in Rating 6.		
<b>Two components</b> – One of the components extremely thick – Must first break up settled materials by hand then mix with power equipment.	3	
<b>Multi component systems</b> – One of the components is a powder and both the liquid components are difficult to mix as in Rating 6.		
Considerable effort is needed to mix products with normal job site mixing equipment.	2	
Heavily settled, cannot re-disperse products with normal job site mixing equipment.	1	

**C2 Spray-ability:** During the spraying of the products, evaluate their respective atomization characteristics on a 10 to 1 scale. Place a checkmark across from the atomization characteristic(s) exhibited by the product.

Characteristic	Rating	√
Excellent Atomization – Excellent definition to spray pattern – No runs or sags if sprayed in one pass – Easy to control film build – No tip plugging – Positive shut off of coating material at tip – No dripping from spray tip – No mist coat required.	10	
Good Atomization – Good definition to spray pattern – No runs or sags if sprayed in one pass – Easy to control film build – No tip plugging, but some build-up on spray tip – Mist coat required to prevent out-gassing – Less than two minutes wait necessary between mist and full coats.	9	
Atomizes satisfactorily, but lacks some definition of spray pattern – Less than two tip plugs per gallon – Some build-up on spray tip – Mist coat required to prevent out-gassing. Two-five minutes wait necessary between mist and full coats.	8	
Atomizes satisfactorily, but lacks definition of spray pattern – Two to four tip plugs per gallon – Spray tip requires occasional wiping – Mist coat somewhat difficult to apply consistently over the surfaces.	7	
Atomizes, but poor definition of spray pattern – Four to six tip plugs per gallon – Frequent drips from spray tip. Mist coat difficult to apply consistently over the surfaces.	6	
Poor atomization with airless, but coating levels satisfactory – Seven or more tip plugs per gallon – Consistent mist coat cannot be applied without multiple passes – Some out-gassing evident.	5	
Poor Atomization with airless, and coating levels poorly – Consistent mist coat impossible to apply – Out-gassing impossible to eliminate.	4	
Cannot be applied using airless equipment, but can be applied satisfactory with conventional equipment.	3	
Can be sprayed with conventional equipment with special effort.	2	
Cannot be sprayed with conventional or airless equipment.	1	

**C3 Settling:** During the application of the products, evaluate the settling characteristics of the mixed coating on a 10 to 1 scale. Place a checkmark across from the settling characteristic(s) exhibited by the product.

Characteristic	Rating	√
No agitation required after mixing.	10	
No agitation required after mixing, but settles over night (16 hours).	9	
No agitation required after mixing, but settles in 8 hours.	8	
Agitation required, some settling after 4 hours.	7	

Agitation required, some settling after 2 hours but not noticeable settling in 30 minutes.	6	
Agitation required, some settling after 1 hour but not noticeable settling in 30 minutes.	5	
Settles in 10 to 30 minutes, material easily re-dispersed with stirring stick	4	
Settles in 10 to 30 minutes, mechanical agitation required to re-disperse material.	3	
Settles in less than 10 minutes.	2	
Falls out of suspension immediately. Cannot maintain suspension.	1	

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<sup>1</sup>Available from GSA Specification Department, Federal Supply Services, Specification Section, 470 East L'Enfant Plaza, S.W., Suite 8100, Washington, DC 20407.

<sup>2</sup>Available from The Society for Protective Coatings, Bldg. 40, 24<sup>th</sup> Street, Pittsburgh, PA 15222-4645.

<sup>3</sup> Available from GSA Specification Department, Federal Supply Services, Specification Section, 470 East L'Enfant Plaza, S.W., Suite 8100, Washington, DC 20407.