NTPEP Committee Work Plan for

Evaluation of Structural Steel Coatings

NTPEP Designation: SSC-18-01
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INTRODUCTION

The National Transportation Product Evaluation Program (NTPEP) was established to minimize the amount of duplicative testing of transportation materials performed by AASHTO member states by providing a process where manufacturer/suppliers submit their products to NTPEP for laboratory and/or field testing. The results of the testing are then shared with member Departments for their use in product quality verification.

This work plan describes the NTPEP evaluation of structural steel coatings. Test results from this program are provided to NTPEP member departments. In keeping with the NTPEP philosophy of purely testing materials, no conclusions are provided with the test results. The evaluation of the test results is left up to each member department.

The National Transportation Product Evaluation Program (NTPEP) serves the member departments of the American Association of State Highway and Transportation Officials (AASHTO).

1. SCOPE

1.1.1 This work plan describes the requirements and testing criteria for the National Transportation Product Evaluation Program (NTPEP) evaluation of structural steel coatings (SSC). The National Transportation Product Evaluation Program (NTPEP) serves the member departments of the American Association of State Highway and Transportation Officials (AASHTO).

1.1.2 Results from this testing will be available through NTPEP DataMine at http://data.ntpep.org/.

1.1.3 This work plan 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. This work plan defines the evaluation procedures for protective coating systems for iron and steel surfaces which will serve as the standard testing protocol for AASHTO’s National Transportation Product Evaluation Program for these products. The protective coating systems are intended for use on bridges, similar structural steel, and other ferrous metal surfaces, both new and existing, prepared by abrasive blast cleaning, which is subject to corrosive atmospheric environments, such as marine, industrial, deicing chemicals, and high humidity. This work plan is furnished for the benefit of manufacturers/suppliers wishing to submit their products, which are classified as Structural Steel Coatings.

1.1.4 The testing format has been established to provide the end user with test results which can be used to make performance judgments on coating systems for long environmental exposures. The testing format for this standard has been developed around a three-coat system consisting of a zinc primer, epoxy or urethane intermediate, and an aliphatic urethane finish coat, however 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 bridge coating industry.

1.1.5 The Standard Recommended Practice for the evaluation shall be AASHTO Designation R 31. This Practice shall be followed as written except for modifications listed later in this work plan.

1.1.6 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. Details on the testing facility are found in Appendix A.

1.1.7 This work plan 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...
practice to establish the appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards:
- Standard Specifications for Highway Bridges
- AASHTO M 300, Inorganic Zinc-Rich Primer
- AASHTO R31, Standard Practice for Evaluation of Protective Coating Systems for Structural Steel
- AASHTO T 337, Non-Instrumental Determination of Metallic Zinc in Zinc-Rich Primers
- AASHTO T 338, Analysis of Structural Steel Coatings for Hindered Light Stabilizers
- AASHTO T 339, Analysis of Structural Steel Coatings for Isocyanate Content

2.2 ASTM Standards:
- ASTM A572 – Standard Specification for High-Strength, Low-Alloy Columbium-Vanadium Structural Steel
- ASTM D512 – Standard Test Methods for Chloride Ion in Water
- ASTM D520 – Standard Specification for Zinc Dust Pigment
- ASTM D523 - Standard Test Method for Specular Gloss
- ASTM D610 – Standard Test Method for Evaluating Degree of Rusting on a Painted Steel Surface
- ASTM D1640 – Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
- ASTM D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
- ASTM D2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
- ASTM D2371 Standard Test Method for Pigment Content of Solvent-Reducible Paints
- ASTM D2697 - Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
- ASTM D2698 -Test Method for the Determination of the Pigment Content of Solvent-Reducible Paints by High-Speed Centrifuging
- ASTM D3335 - Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
- ASTM D3723 – Standard Test Method for Pigment Content of Water-Emulsion Paints by Low Temperature Ashing
- ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
- ASTM D4285 - Standard Test Method for Indicating Oil or Water in Compressed Air
- ASTM D4417 – Standard Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel
- ASTM D4940 - Standard Test Method for Conductimetric Analysis of Water-Soluble Ionic Contamination of Blasting Abrasives
- ASTM D5894 – Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal
- ASTM D6133 - 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
- ASTM D6580 – Standard Test Method for the Determination of Metallic Zinc Content in Both Zinc Dust Pigment and in Cured Films of Zinc Dust Pigment and in Cured Films of Zinc-Rich Coatings
- ASTM E11 - Standard Specification for Wire-Cloth and Sieves for Testing Purposes

2.3 Federal Standards:

- Fed. Std. No. 40, CFR 51.100(s) Volatile Organic Compound Definition
- Fed. Std. No. 40, CFR 261.24, Table 1 Maximum Concentration of Contaminants for the Toxicity Characteristic
2.4 **The Society for Protective Coatings Standards (SSPC):**
- AB-2 Abrasive Specification No. 2, Cleanliness of Recycled Ferrous Metallic Abrasives
- AB-3, Abrasive Specification Number 3, Newly Manufactured or Re-Manufactured Steel Abrasive
- PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements
- Paint 20, Zinc-Rich Primers
- SP 5, White Metal Blast Cleaning
- SP 6, Commercial Blast Cleaning
- SP 10, Near-White Blast Cleaning

2.5 **Other documents:**
- Commercial Item Description (CID) A-A-1689B, Tape, Pressure Sensitive Adhesive, Plastic Film
- Commission Internationale de l'Eclairage (CIE) 1976 L*a*b*
- Appendix A, Testing Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints,” Specification for Structural Joints Using High Strength Bolts, as approved by the Research Council on Structural Connections

### 3. TERMINOLOGY AND CLASSIFICATION

#### 3.1 **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).

#### 3.2 **VOC Content**
- The weight of VOC per volume of coating, calculated according to the procedures in 40 CFR 59.406(a).

#### 3.3 **Dry Film Paint Thickness**
- The depth of coating to the top of the surface profile peaks, measured in accordance with SSPC PA 2.

#### 3.4 **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).

#### 3.5 **Primer**
- Primers act as the initial barrier over the prepared steel substrate. Single coat systems shall consist only of the primer. Primers recommended for use on structures with painted connections designed for Class
B allowable stress will be evaluated for Class B slip coefficient as detailed in Subsection 6.4 of this standard. Primers intended only for use on structures as maintenance applications (i.e., blast and recoat) may not be evaluated for Class B slip coefficient as detailed in Subsection 6.4 of this standard.

3.6 **Touch-Up Primer**

- The touch-up primer shall be as recommended by the manufacturer at the time of application. Touch-up procedures for the intermediate and finish coats shall be detailed in the product data sheets or by written submission.

3.7 **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 steel. The manufacturers for each (three-coat) coating system submitted for evaluation shall recommend the appropriate intermediate coat.

3.8 **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.
4. PROGRAM OVERVIEW

4.1 Overview of the Program

4.1.1 The NTPEP test facilities evaluate manufacturer’s product(s) according to the applicable testing standards that are listed in this document. The test facilities performing the evaluations are contracted to AASHTO.

4.1.2 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.

4.1.3 Test fees that are paid by the manufacturer for evaluation of their products will be paid to AASHTO. 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.

4.1.3.1 NTPEP Test Fee includes SLIP COEFFICIENT TEST (Section 8.1 of AASHTO Designation R 31). Systems not requiring slip and creep testing will be assessed a lower testing fee. Line item pricing for specific testing is included in the laboratory contract. 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 according to the line item bid for those tests.

4.1.3.2 Testing fees will not be prorated for multiple systems from a manufacturer submitted at the time. Further, if the manufacturer does not provide materials for test within 30 days of notification of acceptance for testing in the program, there will be a $500.00 handling fee assessed and the remainder of the testing fee will be returned. If this should occur and the manufacturer elects to submit the system, at a later date, the full submittal fee will be assessed.

4.1.4 The manufacturer shall submit completed Product Evaluation Forms, the informational spreadsheet (described under Coating Manufacturers Participation), SDS and Product Data Sheets to the Lead State.

4.1.5 The manufacturer shall submit the required testing fees to the AASHTO/NTPEP Coordinator with a copy of the Product Evaluation Form and a signed copy of the General Notes Page found in Appendix E.

4.1.6 The AASHTO/NTPEP Coordinator and Lead State will verify receipt of testing fees and all appropriate documentation. For information regarding costs, and their associated due dates, please refer to the Terms and Conditions located under DataMine’s (http://data.ntpep.org) Legal Information section.

4.1.7 The manufacturer shall submit clearly marked samples of the coating with all required documentation (SDS and complete Product data sheets) for mixing and application directly to the testing laboratory.

4.1.8 The testing laboratory shall notify the Lead State and the AASHTO NTPEP Coordinator of receipt of samples for evaluation.

4.1.9 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.

4.1.10 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 Manufacturer’s representative will be expected to decide whether the system testing should proceed.
4.1.11 When present for the coatings application, the Manufacturer’s representative is required to sign a statement attesting to the appropriate application of the coatings system by the Test Facility. The Manufacturer’s 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.

4.1.12 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.

4.1.13 All information generated through this testing program is considered property of AASHTO. Test results will be posted either as a static file online for download or the data will be reported through our online data base and viewable by our Member Departments.

4.2 Participation and Administration of the Program:

4.2.1 Manufacturer participation and AASHTO administration of the program will be governed by the NTPEP Information and Operations Guide. This Guide provides the general requirements for submittal of products and review of data that is generated through testing prior to posting for review by Member Departments. A copy of the Guide is available online at www.NTPEP.org.

4.2.2 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.

4.2.3 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. All information noted in the Test Report Section of AASHTO Designation R 31 shall be included in the test report.

4.2.4 The structural steel coating manufacturer will be responsible for reviewing the submittal timelines as posted online at www.NTPEP.org. All testing will be performed by contracted laboratories as described in this work plan.

4.2.5 This testing program is continuous; a manufacturer may submit a sample at any time through the NTPEP Coordinator and the Lead State.

4.2.6 Coating manufacturers wishing to participate in the AASHTO/NTPEP program must submit a completed NTPEP Product Evaluation Form (ePEF) to the attention of the AASHTO/NTPEP coordinator. The completed ePEF must be accompanied by an informational spreadsheet (supplied to the manufacturer by the Lead State), the Product Data Sheets, any application literature for the products and all SDS. The informational spreadsheet is to be completed by the Manufacturer. 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 R 31 should be supplied for each product in the coating system. Samples must be submitted to the designated testing facility in sufficient quantity to conduct all testing, as instructed by the NTPEP representative.

4.2.7 For the purposes of this testing program, single component systems, two component systems, or three component systems may be submitted for testing. Systems not utilizing a zinc rich primer will be tested according to the complete testing criteria of the program except for those tests that are specific to zinc primers (i.e. slip and creep testing). Primers utilized only for blast and recoat of existing structures are not
required to have the slip and creep testing performed. The manufacturer is required to specifically state this application limitation in submission documents.

4.2.8

The coating manufacturer shall supply sufficient quantities of each product to perform the required testing. The testing laboratory 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.

4.2.9

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

4.2.9.1 Zinc Dust - ASTM D 520, Type II. Manufacturers shall submit a certificate of analysis from the zinc suppliers showing conformance with the requirements.

4.2.9.2 Lead Content - ASTM D 3335. Each coating (primer, 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).

4.2.9.3 Color— For production, the color of the coatings shall be as mutually agreed, except that the intermediate coat shall contrast in color a minimum of 10.0ΔE* from the primer and the finish coat. For testing purposes the color of the finish coat shall conform to Federal Standard No. 595, Color Chip No. X6134 (grey) (“X” signifies that the gloss is undesignated). Acceptable finish coat color shall be within 3.0Δ* of the required standard.

4.2.9.4 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. If titanium dioxide is used in the finish coat, it shall meet the requirements of ASTM D 476, Type IV.

4.2.9.5 Slip Coefficient for Primer - Primer coatings for use on new and rehabilitated structures with painted connections designed for Class B allowable stress shall meet the Class B slip coefficient requirements specified in the AASHTO Standard Specifications for Highway Bridges. The test data indicating compliance shall also state the type and quantity of reducer, cure time, and maximum coating thickness for that coating as tested.

4.2.10 The manufacturer shall supply certified Product Data Sheets, 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. This information will be kept in confidence by NTPEP unless directed otherwise by the manufacturer.

4.3 Policies for withdrawing materials from NTPEP evaluation programs:

4.3.1 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.

4.4 Policy for review of NTPEP reports:
4.4.1 The coating manufacturer will be given access to the AASHTO/NTPEP Data Mine and asked to review the data from their product(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.

4.4.2 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.

4.4.3 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 supersedes the NTPEP Operating Policy and Procedures on this topic and is project panel specific in nature.

4.5 **Policy on manufacturer publication of NTPEP test data:**

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

4.5.1.1 Only test data for the manufacturer’s own product may be reproduced.

4.5.1.2 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.

4.5.1.3 Whenever NTPEP test data are used or presented, the following statement must be used.

4.5.1.4 “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”.

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

4.5.2.1 To indicate that the product was tested by NTPEP in their product bulletins and brochures.

4.5.2.2 Use as references on Product Evaluation Forms required by many government agencies.

5. **PROPERTIES REPORTED BY THE MANUFACTURER**

5.1 The following properties shall be determined on individual component and mixed condition as applicable and as indicated and reported on the NTPEP Product Evaluation Form:

5.1.1 Total solids percent by mass in accordance with ASTM D 2369.

5.1.2 Volatile organic compound content in accordance with ASTM D 3960.

5.1.3 EPA exempt solvents, identify compound and percent by volume.

5.1.4 Water, percent by mass, in accordance with ASTM D 4017.

5.1.5 Pigment, percent by mass in accordance with ASTM D 2371 or ASTM D 3723.
5.1.6 Metallic zinc content, percent by mass in the primer shall be determined in accordance with ASTM D6580. An optional test method is TP 65.

5.1.7 Total solids, percent by volume in accordance with ASTM D 2697.

5.1.8 Mass per volume (grams per liter) in accordance with ASTM D 1475.

5.1.9 Viscosity (Stormer at 25°C) KU in accordance with ASTM D 562 (Not suitable for viscosities above 143 KU).

5.1.10 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.

5.1.11 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.

5.1.12 Sag resistance (Leneta) in micrometers wet film thickness in accordance with ASTM D 4400.

5.1.13 Recommended film thickness in micrometers for each coat. Minimum and maximum wet film thickness. Minimum and maximum dry film thickness.

5.1.14 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.

5.1.15 Mixing ratio for multi-component coatings, by volume.

5.1.16 Mixing ratio for multi-component coatings, by mass.

5.1.17 Shelf life of each component stored at 25°C.

5.1.18 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.

5.1.19 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.

5.1.20 Epoxide values determined in accordance with ASTM D 1652, Method A.

5.1.21 Amine values determined on the amine or amidoamine contained in the appropriate component of two component epoxy coatings, in accordance with ASTM D 2073.

5.1.22 Isocyanate group content determined in accordance with AASHTO T 339.

5.1.23 Hindered amine light stabilizers (HALS) AASHTO T 338.

5.1.24 Ultraviolet (UV) Absorbers.

5.1.25 The minimum and maximum surface profile requirements (height in micrometers).

5.1.26 Application requirements for: ambient temperature, surface temperatures, material temperature, humidity, tip size, and application pressure.
6. COATING IDENTIFICATION TESTING

6.1 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 with stated precision and bias statements. The Test Facility shall complete all coating identification testing of the coating system prior to application to test panels. The facility shall have twenty (20) working days from the date samples are received, to complete all coating identification testing.

6.1.1 Total solids, percent by mass in accordance with ASTM D 2369 of each liquid component.

6.1.2 Volatile organic compound content in accordance with ASTM D 3960.

6.1.3 EPA exempt solvents, identify compound and percent by volume per ASTM D 3960.

Note 1: Those exempt solvents not specifically covered by this test method shall be determined by GC Mass Spectroscopy. The manufacturer is responsible for indicating the solvent in question and the expected quantity in the product under evaluation.

6.1.4 Water, percent by mass, in accordance with ASTM D 4017.

6.1.5 Pigment, percent by mass in accordance with ASTM D 2371 or ASTM D 3723.

6.1.6 Total solids, percent by volume in accordance with ASTM D 2697 of mixed coating.

6.1.7 Mass per volume (grams per liter) in accordance with ASTM D 1475 of each liquid component.

6.1.8 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.

6.1.9 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.

6.1.10 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.

6.1.11 Sag resistance (Leneta) in micrometers wet film thickness in accordance with ASTM D 4400.

6.1.12 Recommended film thickness in micrometers.

Minimum and maximum wet film thickness
Minimum and maximum dry film thickness
Maximum allowable dry film thickness for the primer on faying surfaces

6.1.13 Minimum (and maximum when applicable) drying time for each coat in accordance with ASTM D 1640 at 25°C and 50 percent relative humidity. Perform testing on both Leneta panels and flat mortar panels.

Dry to touch
Dry to handle
Dry to recoat
6.1.14 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.

6.1.15 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.

6.1.16 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 re-dispersed in 2 or 3 mL of solvent, re-centrifuged, and the supernatant combined with the original supernatant for analysis.

6.1.17 Amine values determined on the amine or amidoamine contained in the appropriate component of two component epoxy coatings, in accordance with ASTM D 2073.

6.1.17.1 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.

6.1.17.2 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 re-dispersed in an additional 2 to 3 mL of methylene chloride, re-centrifuged, and the supernatant combined with the original supernatant for analysis. At this point, follow the titration procedure described in ASTM D 2073.

6.1.18 Isocyanate group content determined in accordance with AASHTO T 339.

6.1.19 Hindered amine light stabilizers (HALS) AASHTO T 338.

Note 2: If light stabilizing compounds are present in the coating the manufacturer is required to provide the compound and quantity for verification by the test facility. The compound and quantity must be provided at the time of product submission.

6.1.20 The infrared spectrum will be determined for structural steel coatings using Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy (ATR-FTIR). The following parameters shall be used to collect the spectrum.

- A single bounce ATR with a diamond crystal accessory.
- The spectrum should contain the Infrared (IR) region of 600-4000 cm⁻¹.
- A minimum of 16 scans per sample should be run.
- For liquid samples, place enough sample to completely cover the diamond crystal on the mounted block.
- For paste samples, use a spatula to cover the diamond crystal with enough sample to cover the crystal. Tap lightly to ensure complete contact between the sample and the crystal.
7. PERFORMANCE TESTS

7.1 Coating evaluation initiation requirements:

7.1.1 Manufacturer—Before any testing, the manufacturer shall contact the NTPEP Lead State or the NTPEP Coordinator and obtain a current copy of the Structural Steel Coatings Work Plan and all necessary application forms for submission of a coating system.

7.1.2 NTPEP Lead State—The NTPEP Lead State will provide reporting criteria and system numbers to the selected testing laboratory. The NTPEP Lead State will also determine the coating systems that shall be used as system monitors for the testing.

7.1.3 Testing Laboratory—The following information will be provided to the NTPEP Lead State by the testing laboratory:

7.1.3.1 Identify what tests the Principal Testing firm will perform. Provide Standard Operating Procedures for each test performed.

7.1.3.2 Identify what tests will be performed by an authorized outside firm, the name, address, and telephone number of the firm and the contact person for the firm. Provide Standard Operating Procedures for each test performed by the authorized outside firm.

7.1.3.3 The Principal Testing firm performing the testing shall be responsible for application of protective coatings to test panels.

7.1.3.4 Upload testing results for all samples, panels, or tests performed to the appropriate SSC Module of DataMine within two-weeks of obtaining the testing results. Notify the Lead State when test results are uploaded to DataMine. Manufacturers will be allowed the option of not having the final test results for their system made public information.

7.2 Test Panel Requirements for Test:
7.2.1 All steel test panels shall be ASTM A 36, A 572 hot-rolled cold-rolled steel or equivalent with dimensions as shown below. Certified mill test reports shall be provided as prepared by the steel manufacturer or testing laboratory for all A 36 or A 572 steel identifying actual physical and chemical analysis of the material.

<table>
<thead>
<tr>
<th>Test Panel Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (mm)</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

7.2.2 Three test panels shall be prepared for each complete system for each test. Adhesion testing requires three additional test panels to be prepared with the primer only. Cyclic weathering testing requires three additional test panels to be prepared. The additional panels shall not be scribed.

7.2.3 Control panels shall be coated in bulk lots by a single applicator. The location and date of application shall be reported. All control panels utilized during the testing evaluation of a system shall be from the same lot. The quantity of control panels to be coated, the control system to be used, and the application parameters shall be approved by NTPEP. During transportation and storage, control panels shall be protected such that coating damage will not occur. Beyond 30 days, the storage temperature and relative humidity for these panels shall be 25 ± 5°C and 50 ± 20 percent.

7.2.4 The panels shall be cleaned in accordance with SSPC-SP 5 using recyclable metallic abrasives. 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 abrasive mixture shall be approximately 60 percent SAE shot number S230 and 40 percent SAE grit number G40. Both the shot and grit shall have a Rockwell hardness of C 45 ± 3. The surface profile of the cleaned panels shall be 65 to 90 µm when determined in accordance with ASTM D 4417, Method C. The profile shall be clean, sharp and free of embedded friable material, with adequate roughness to insure effective adhesion of the applied primer.

Note 3—The SP 5 is required rather than SP 10 only for the convenience of the laboratory in order to guarantee that all panels are prepared identically and to assure comparative testing results. Steel surfaces prepared to a lesser degree may not yield same performance.

7.2.5 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 530 mm 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.

7.2.6 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 ± 13 µm.

7.2.7 Dry Film Paint Thickness—The dry film paint thickness shall be taken in accordance with ASTM D 7091 and the following requirements:

7.2.7.1 Measure the dry film coating thickness on each test panel utilizing a Type 2 (electronic) dry film thickness gage according to SSPC-PA 2, Appendix 4. To facilitate consistent measurements at fixed positions on the panel, the laboratory shall use a template, providing six fixed locations on the panels. Recommended maximum dry film thickness must be detailed on the product submission.

7.2.8 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

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will have a minimum height of 10 mm and will identify the following information, which will be part of the final report:

7.2.8.1 Replica test being performed (i.e., salt fog No. 3).

7.2.8.2 Date that the test evaluation was performed.

7.2.9 Coatings shall be applied to test panels at the minimum (laboratory) recoat time as defined in Section 3 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 ± 2°C and 55±5 percent relative humidity. The back of all test panels shall be coated with the primer for one and two coat systems and primer and intermediate for three coat systems.

7.2.10 After preparation of the test panels with the coating system to be evaluated the edges shall be sealed and protected by applying vinyl tape around the entire outside edge. The vinyl tape shall extend 5 mm onto the coated surface from the edge of the panel and shall be applied after the coating has cured. The vinyl tape shall meet the requirements of CID A-A-1689B and have an approximate vinyl thickness of 110 µm with an approximate neoprene adhesive thickness of 25 µm.

7.2.11 Test panels shall be scribed in accordance with ASTM D 1654 with parallel 100 mm lines centered on the panel, 25 mm from the edges of the panel and separated by 50 mm. The scribing tool shall be a straight-shank tungsten carbide tip, lathe cutting tool (ANSI B94.50, Style E). The entire length of the scribe shall expose the steel substrate as verified with a microscope.

7.3 Petrographic Requirements:

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

7.3.1.1 All photographs shall include the code identification number for each sample or panel and the number of hours.

7.3.1.2 A photograph of the coated surface of each sample or panel shall be taken after the application of the entire system to be evaluated, at each intermediate evaluation period and at the completion of each test.

7.4 Performance Tests Performed by Selected Laboratory:

7.4.1 Slip Coefficient and Tension Creep.

7.4.1.1 All primers shall be tested and the results reported for slip coefficient according to the AASHTO Standard Specifications for Highway Bridges, Division I, Section 10.32.3.2.3. Tests are to be performed in accordance with “Appendix A, Testing Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints,” Specification for Structural Joints Using High Strength Bolts, as adopted by the Research Council on Structural Connections (RCSC).

7.4.2 Sample Preparation Requirements for Slip Coefficient:

7.4.2.1 The surface shall be prepared in accordance with SSPC-SP 5. Surface profile shall be between 50 and 90 µm. Surface preparation shall be shot blasted using 100 percent steel shot (selected to create a worst-case scenario). The steel shot shall conform to the requirements of SSPC AB-3, SAE shot number S 280. Hardness shall be Rockwell C 45 ± 3.

7.4.2.2 The thickness of coating to be tested on each surface shall be 50 µm greater than the film thickness recommended in Section 6.4.3.10.1. The maximum thickness tested shall be reported by the testing laboratory.
7.4.2.3 A minimum cure time as recommended by the manufacturer is required for primer testing. Curing of the coated test panels shall be at 25 ± 2°C and 65±5 percent relative humidity.

7.4.3 Salt Fog Resistance ASTM B 117.

7.4.3.1 A salt fog resistance test shall be performed in accordance with ASTM B 117. The complete system shall be exposed for a duration of 5,000 hours.

7.4.3.2 Evaluation—Evaluate each panel for Blistering and Rust Creepage at each 1,000 hour increment of exposure and after scraping in accordance with ASTM D 1654, Method 2, Scraping, (where applicable after cleaning).

7.4.3.3 Blistering shall be evaluated in accordance with ASTM D 714. Blister size and frequency shall be converted to a numerical value using Table 1.

7.4.3.4 Table 1—Blister Value Conversion Table (No blisters equals a conversion number of 10.)

<table>
<thead>
<tr>
<th>Blister Size</th>
<th>Few</th>
<th>Medium</th>
<th>Med Dense</th>
<th>Dense</th>
</tr>
</thead>
<tbody>
<tr>
<td>#8</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>#6</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>#4</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>#2</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>#1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

“Adjustment Values for “Few” Blister Frequency

<table>
<thead>
<tr>
<th>Number of Blisters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>x.8</td>
</tr>
<tr>
<td>2</td>
<td>x.6</td>
</tr>
<tr>
<td>3</td>
<td>x.4</td>
</tr>
<tr>
<td>4</td>
<td>x.2</td>
</tr>
<tr>
<td>5 or more</td>
<td>x.0</td>
</tr>
</tbody>
</table>

7.4.3.5 If a specific number of blisters is reported under the frequency “Few” then use the appropriate decimal “Value” provided above. Example: A report of two #6 blisters converts to a value of 8.6.

7.4.3.6 Rust Creepage at the Scribe—Rust creepage (a.k.a cutback, undercut, loss of adhesion, deterioration, disbondment) shall be measured perpendicular from the center of the scribe to the furthest point of cutback. Cutback shall be measured in millimeters to the nearest 0.5 mm. For both intermediate and final evaluations, the maximum cutback shall be measured at 5-mm intervals along the scribe on each side of the scribe. (For each 100 mm scribe line, 42 measurements are required.) Report the average and maximum cutback measurements. Defects at the scribe having the appearance of a “blister” will be defined to be rust creepage (cutback).

7.4.4 ASTM D 5894 Cyclic Weathering Resistance.

7.4.4.1 A cyclic weathering resistance test shall be performed in accordance with ASTM D 5894. The complete system shall be exposed for a duration of 15 - 336 hour cycles.

7.4.4.2 Color change testing shall be performed in accordance with ASTM D2244. Measurement of color shall be performed in accordance with either ASTM E1349, which uses bidirectional (45°:0° or 0°:45°) geometry, or ASTM E1331, which uses hemispherical geometry; however, ASTM E1331 is the preferred method. The method, whether ASTM E1349 or ASTM E1331, and color meter used to obtain color measurements shall not vary over the contract period without written approval from the AASHTO NTPEP Technical Committee Chairman. Measurements using hemispherical geometry shall be made with the specular component of reflection included. Illuminant D65 and ten-degree observer shall be used. Report color changes as ∆ECMC(2:1).
7.4.4.3 Evaluation—Follow evaluation procedures as described above for ASTM B 117 Salt Fog, except evaluations shall be performed at each 3 cycle increment of Testing.

7.4.5 ASTM D 4541 Tensile Adhesion.

7.4.5.1 A test for adhesion shall be performed in accordance with ASTM D 4541, using a Type IV tester as described in Annex A, Section A4. The adhesive used to perform this test shall be a two-component epoxy, containing no solvents (e.g., 100 percent solids). The test shall be performed on panels having the primer coat only and on panels having the complete system. A minimum of four tests shall be performed on each panel.

7.4.6 Freeze Thaw Stability.

7.4.6.1 Prepared panels shall be exposed to a 30-day freeze/thaw/immersion cycle. One 24-hour cycle shall consist of 16 hours at −30°C ± 5°C followed by four hours of thawing at 50°C ± 5°C and four hours tap water immersion at 25°C ± 2°C. This work is done with the panels remaining in the freezer mode on weekends and holidays. Upon completion of the test, adhesion tests shall be performed as described under Adhesion Test.

7.5 Coating Identification Tests:

7.5.1 An analysis of vehicle solids by Fourier transform infrared (FTIR) spectroscopy consisting of 32 scans minimum per sample shall be performed as follows:

7.5.1.1 For zinc primer solvent-based coats infrared spectrum (2.5 to 15 µm) of each liquid vehicle component via the potassium bromide sandwich technique.

7.5.1.2 For two-component, solvent-based finish coats infrared spectrum (2.5 to 15 µm) 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.

7.5.1.3 For zinc primer water-based coats infrared spectrum (2.5 to 15 µm) of the liquid vehicle component after drying and applying the potassium bromide single-pellet technique.

7.5.1.4 For two-component water-based finish coats infrared spectrum (2.5 to 15 µm) of each single component after drying and applying the potassium bromide single-pellet technique and also, of the mixed and dried components in appropriate mixing ratios (dried film) via the single-pellet technique.

7.5.2 The Volatile Organic Compound (VOC) content shall be determined on unthinned, mixed coatings in accordance with ASTM D 3960 for primers, intermediates, and finish coats. Multi-component coatings will be blended together in the specified mixing ratios prior to testing.

7.5.3 Analyze mixed coatings for total heavy metals content (lead, chromium, and cadmium) in accordance with ASTM D 3335 and D 3718.

7.5.4 Dry film analysis for leachable heavy metals shall include Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver for each coating. The dried film shall be removed from a non-metallic glass test panel and pulverized to pass through a 250 mesh sieve. The pulverized film passing the 250 mesh sieve shall be extracted in accordance with the TCLP, method 1311 of EPA SW-846. The extract shall then be analyzed for heavy metals using the appropriate EPA SW-846 test method for each metal.

7.5.5 Epoxide values can be determined in accordance with ASTM D 1652, Method A. This method measures a quantity called the weight per epoxy equivalent (WPE), which is defined as the grams of resin containing one gram equivalent of epoxy groups. However, since this method was intended for raw materials, the WPE of the epoxy component of a two-component coating will actually be the grams of that component (not the grams of actual resin) which contains one gram equivalent of epoxy groups.
7.5.5.1 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.

7.5.5.2 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.

7.5.6 Amine values can be determined on the amine or amidoamine contained in the appropriate component of two component epoxy coatings, in accordance with ASTM D 2073-92. This method is only applicable to clear, unpigmented component. If the component is pigmented, the following modification to D 2073-92 will be necessary:

7.5.6.1 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.

7.5.6.2 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 2073-92.

Note 4 — Even though the titration is followed potentiometrically and the end points will not be obscured by the color of the pigment, the pigment must still be removed to prevent the possibility of any basic pigments reacting with the hydrochloride acid used in the titration procedure.

7.5.7 Isocyanate group content will be determined in accordance with AASHTO T 339.

7.5.8 The presence of hindered amine light stabilizers (HALS) in the polyol portion of a two-component urethane coating will be verified in accordance with AASHTO T 338.

7.5.9 Verify the following coating characterization tests reported by the manufacturer:

7.5.9.1 Total solids, percent by mass in accordance with ASTM D 2369.

7.5.9.2 Volatile organic compound content in accordance with ASTM D 3960.

7.5.9.3 EPA exempt solvents, identify compound and percent by volume

7.5.9.4 Water, percent by mass, in accordance with ASTM D 4017.

7.5.9.5 Pigment, percent by mass in accordance with ASTM D 2371 or ASTM D 3723.

7.5.9.6 Metallic zinc content, percent by mass in the primer shall be determined in accordance with ASTM D 6580. An optional test method is AASHTO T 337.

7.5.9.7 Total solids, percent by volume in accordance with ASTM D 2697.

7.5.9.8 Mass per volume (grams per liter) in accordance with ASTM D 1475.

7.5.9.9 Viscosity (Stormer at 25°C) KU in accordance with ASTM D 562 (Not suitable for viscosities above 143 KU).
7.5.9.10 Viscosity (Brookfield at 25°C) cP in accordance with ASTM D 2196. The instrument model (i.e. LV, DV, DVII+), spindle size, and revolutions per minute shall be reported.

7.5.9.11 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.

7.5.9.12 Sag resistance (Leneta) in micrometers wet film thickness in accordance with ASTM D 4400.

8. TESTING FACILITY CRITERIA

8.1.1 Tests must be administered or performed by an authorized testing facility as approved by AASHTO’s National Transportation Product Evaluation Program (NTPEP). The principal facility evaluating a specific coating system or any laboratory performing testing for the principal facility must obtain prior approval from the NTPEP before initiating any testing. See Appendix A for the details of testing facility criteria.

9. TEST REPORT & PROTECTIVE COATING INFORMATION

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

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

9.2.1 Certificate of Testing (see Appendix D). Uploaded to DataMine in portable document file (PDF) format.

9.2.2 Digital Color photographs.

9.2.3 Individual test results for each test performed.

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

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

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

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

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

9.2.4.5 The manufacturers recommended minimum and maximum application temperature (ºC) and relative humidity (%), for each coating. All results of ‘Tests to be performed by Selected Test Facility’

10. REPORT

10.1.1 Testing data will be compiled and made available to all participating states and testing companies through the NTPEP Datamine. No judgment as to a product’s acceptability will be made in this report. End user participants will establish criteria for product acceptability.
11. **REQUALIFICATION**

11.1.1 Requalification with the end user shall occur every seven (7) 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. Requalification at seven (7) years will require complete retesting. Continued requalification will require this testing cycle be continued. Significant changes in the testing standard could result in retesting as determined by the end user.

12. **TIMELINE**

12.1.1 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.

13. **KEYWORDS**

13.1.1 NTPEP; Structural Steel Coatings
**APPENDIX A: 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 steel.
2. Provide verification that they have the equipment, facilities and capability to perform the required testing procedures contained in this work plan and AASHTO Designation R 31. 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. The laboratory shall complete all coating identification testing of the coating system prior to application to test panels. Laboratory shall have twenty (20) working days, from the date samples are received, to complete all coating identification testing. Coating identification testing is detailed in AASHTO Designation R-31 and shall be completed in the testing laboratory to provide physical and chemical characteristics of the coating system.
6. Provide verification that it is in conformance with Federal and State regulations related to health and safety.
7. 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 Structural Steel Coatings Technical Committee.

**TESTS/TEST METHODS**

The standard tests and methods are detailed in AASHTO R 31 and the exceptions and additions found in this work plan. The Lead State and the NTPEP Protective 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.

**APPENDIX B: NON-MANDATORY INFORMATIONS:**

**CHARACTERIZATION TESTS FOR PRODUCT VERIFICATION**

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 for Coatings Identification Tests.
- **For zinc-rich prime coats infrared spectrum (2.5 to 15 µm) of non-zinc containing vehicle component(s).**
- **For two-component finish coats infrared spectrum (2.5 to 15 µm) of each single component and also of the mixed components (when applicable) in appropriate mixing ratios.**
- **Viscosity of mixed coating determined in accordance with ASTM D 562.**
- **Mass per volume (grams per liter) of mixed coating in accordance with ASTM D 1475.**
- **Total solids, percent by mass of 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 mixed coating in accordance with ASTM D 2371.**

**Group II Tests—Less frequently used tests because they pertain to zinc content and are useable only with zinc primers.**

- **Metallic zinc, percent by mass in the primer in accordance with ASTM D 6580.**
- **Total zinc, percent by mass of pigment (zinc dust) in accordance with ASTM D 521.**
- **Metallic zinc, percent mass of pigment (zinc dust) in accordance with AASHTO T 337.**
- **Zinc oxide, percent mass of pigment (zinc dust) in accordance with ASTM D 521.**
• Lead and cadmium content of the mixed coating in accordance with ASTM D 3335.
• Note 5 — 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.

GUIDE FOR PROJECT VERIFICATION TESTING:
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.

Vehicle:
The vehicle solids shall not be more than +/- 2 percent from the initially approved batch.
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.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One component</strong> – Little or no settling – easily mixed by hand</td>
<td>10</td>
</tr>
<tr>
<td><strong>One component</strong> – Some settling, but easily mixed by hand.</td>
<td>9</td>
</tr>
<tr>
<td><strong>One component</strong> – 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.</td>
<td>8</td>
</tr>
<tr>
<td><strong>One component</strong> – Mixes with some difficulty, typically requiring more than three minutes with 3/8” drill motor and a jiffy mixer for a gallon sample.</td>
<td>7</td>
</tr>
<tr>
<td><strong>Two components</strong> – Both components and their blend mix easily as defined in Rating 8.</td>
<td></td>
</tr>
<tr>
<td><strong>One component</strong> – 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.</td>
<td>6</td>
</tr>
<tr>
<td><strong>Two components</strong> – Both components settled and mixed as defined in Rating 7, blend mixes easily or one of the components is a powder.</td>
<td></td>
</tr>
<tr>
<td><strong>One component</strong> – Same as Rating 6, but had to scrape bottom of can.</td>
<td>5</td>
</tr>
<tr>
<td><strong>Two components</strong> – One of the components mixes with difficulty as in Rating 6 – Blend settles ten to thirty minutes after mixing, continuous agitation required.</td>
<td></td>
</tr>
<tr>
<td><strong>Multi component systems</strong> – One of the components is a powder – All components and their blend mix easily.</td>
<td></td>
</tr>
<tr>
<td><strong>One component</strong> – Extremely thick – Must first break up settled material by hand, then mix with power equipment.</td>
<td>4</td>
</tr>
<tr>
<td><strong>Two components</strong> – Both components mix with difficulty as in Rating 6.</td>
<td></td>
</tr>
</tbody>
</table>
Multi component systems – One of the components is a powder and one of the liquid components is difficult to mix as in Rating 6.

Two components – One of the components extremely thick – Must first break up settled materials by hand then mix with power equipment.
Multi component systems – 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.
Heavily settled, cannot re-disperse products with normal job site mixing equipment.

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.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>10</td>
</tr>
<tr>
<td>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.</td>
<td>9</td>
</tr>
<tr>
<td>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.</td>
<td>8</td>
</tr>
<tr>
<td>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.</td>
<td>7</td>
</tr>
<tr>
<td>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.</td>
<td>6</td>
</tr>
<tr>
<td>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.</td>
<td>5</td>
</tr>
<tr>
<td>Poor Atomization with airless, and coating levels poorly – Consistent mist coat impossible to apply – Out-gassing impossible to eliminate.</td>
<td>4</td>
</tr>
<tr>
<td>Cannot be applied using airless equipment, but can be applied satisfactory with conventional equipment.</td>
<td>3</td>
</tr>
<tr>
<td>Can be sprayed with conventional equipment with special effort.</td>
<td>2</td>
</tr>
<tr>
<td>Cannot be sprayed with conventional or airless equipment.</td>
<td>1</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>No agitation required after mixing.</td>
<td>10</td>
</tr>
<tr>
<td>No agitation required after mixing, but settles overnight (16 hours).</td>
<td>9</td>
</tr>
<tr>
<td>Settling Time Description</td>
<td>Value</td>
</tr>
<tr>
<td>-------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>No agitation required after mixing, but settles in 8 hours.</td>
<td>8</td>
</tr>
<tr>
<td>Agitation required, some settling after 4 hours.</td>
<td>7</td>
</tr>
<tr>
<td>Agitation required, some settling after 2 hours but not noticeable settling in 30 minutes.</td>
<td>6</td>
</tr>
<tr>
<td>Agitation required, some settling after 1 hour but not noticeable settling in 30 minutes.</td>
<td>5</td>
</tr>
<tr>
<td>Settles in 10 to 30 minutes, material easily re-dispersed with stirring stick</td>
<td>4</td>
</tr>
<tr>
<td>Settles in 10 to 30 minutes, mechanical agitation required to re-disperse material.</td>
<td>3</td>
</tr>
<tr>
<td>Settles in less than 10 minutes.</td>
<td>2</td>
</tr>
<tr>
<td>Falls out of suspension immediately. Cannot maintain suspension.</td>
<td>1</td>
</tr>
</tbody>
</table>
APPENDIX D: CERTIFICATE OF TESTING:

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 AASHTO R 31, 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)
APPENDIX E: GENERAL NOTES:

*GENERAL NOTES

1. All test materials will be furnished by the manufacturer/supplier at no cost to NTPEP and/or AASHTO member departments.

2. Manufacturers/suppliers shall complete one NTPEP Product Evaluation Form (PEF) for each coating system submitted for testing.

3. Manufacturers/suppliers shall be invoiced for testing fees after the product is accepted to the evaluation program. Invoiced testing fees must be received and processed before evaluation work shall proceed.

4. An incomplete PEF and/or erroneous information as part of the PEF may result in the product evaluation process being delayed until correction(s) have been made by the manufacturer.

5. Testing fees will not be refunded once the testing process has begun unless agreed by the private testing labs, lead testing state and the NTPEP Coordinator. A final determination to refund testing fees is made by the NTPEP Coordinator. The decision is final.

6. A non-interference policy is in effect with regard to manufacturers/suppliers inquiry to the conduct of evaluation of their products/systems. If a manufacturer/supplier has the opinion they have justification for an inquiry prior to the distribution of the report, the justification must be made in writing to the NTPEP Coordinator for consideration.

7. AASHTO member departments may use the field and laboratory test data obtained from NTPEP to establish their qualified products list.

9. AASHTO will copyright the published report with All Rights Reserved. The report or parts thereof, may not be reproduced in any form without written permission of AASHTO.

10. The manufacturer/supplier is hereby notified that NTPEP reserves the right to release or distribute any of the information included in or attached to this form and the test results obtained as part of our field and laboratory test procedures.

Name (print): ___________________________ Title: ___________________________
Signature: ___________________________ Date: ___________________________

• THIS PAGE (“GENERAL NOTES”) MUST BE SIGNED AND RETURNED WITH THE COMPLETED PRODUCT SUBMITTAL PACKAGE.