Standard Practice for

NTPEP Evaluation of Rapid Set Concrete Patching Materials for Portland Cement Concrete

AASHTO Designation: [RSCP-14]
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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 practice provides the NTPEP member departments information on the rapid set concrete patching materials testing program. 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.

Kentucky is the lead state and is responsible for the oversight of the testing program for the rapid set concrete patching materials.

1. SCOPE

1.1 The National Transportation Product Evaluation Program (NTPEP) serves the member departments of the American Association of State Highway and Transportation Officials (AASHTO). This standard practice covers the requirements and testing criteria for the NTPEP evaluation of rapid set concrete patching materials for Portland cement concrete.

1.2 Products that are evaluated for horizontal applications shall be subjected to field and laboratory testing. Because field testing of vertical/overhead products is not feasible, products that are evaluated for vertical/overhead application only shall only be subjected to laboratory testing.

1.3 The results of this program may be used for product quality verification by individual member Departments. If used for quality verification, a letter of certification from the rapid set concrete patching materials (RSCP) manufacturer indicating testing was conducted by NTPEP that supports published values may be required by member Departments.

1.4 This standard practice 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:

- AASHTO T 22-10, Compressive Strength of Cylindrical Concrete Specimens
- AASHTO T 27-11, Sieve Analysis of Fine and Course Aggregates
- AASHTO T 84-10, Specific Gravity and Absorption of Fine Aggregate
- AASHTO T 85-10, Specific Gravity and Absorption of Course Aggregate
- AASHTO T 103-08, Soundness of Aggregates by Freezing and Thawing
- AASHTO T 160-09, Length Change of Hardened Hydraulic Cement Mortar and Concrete
- AASHTO T 161-08, Resistance of Concrete to Rapid Freezing and Thawing
- AASHTO T 198-09, Splitting Tensile Strength of Cylindrical Concrete Specimens
- AASHTO T 277-07, Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration

2.2 ASTM Standards:

- ASTM C 531-05, Standard Test Methods for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concretes
- ASTM C 579-06, Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concretes
- ASTM C 881-02, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
- ASTM C 882-05, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
- ASTM C 884-05, Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay
- ASTM C 928-09, Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
- ASTM C 1404-06, Standard Test Method for Bond Strength of Adhesive Systems Used with Concrete as Measured by Direct Tension
- ASTM C 1583-04, Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)

2.3 New York State DOT Standards:

- NY502-3P, Freeze-Thaw Loss
3. SUMMARY OF PRACTICE

On an annual basis, rapid set patching materials manufacturers submit their products to be tested and evaluated. These products are evaluated by laboratory testing by a NTPEP contracted laboratory. Test result data is entered into the web-based NTPEP DataMine program.

This standard practice defines the evaluation procedures for rapid set patching materials for concrete which will serve as the standard testing protocol for AASHTO’s National Transportation Product Evaluation Program for these products.

4. SIGNIFICANCE AND USE

This standard practice utilizes laboratory testing to determine properties of rapid set concrete patching materials. This practice is intended to only determine the properties of rapid set concrete patching materials. Acceptability of each material based upon the data generated as a result of the testing and evaluation in this practice is the responsibility of the user.

5. APPLICATION FOR PRODUCT TESTING

5.1 Submittal of Product Evaluation Form(s) and other information.

The manufacturer will submit to the NTPEP Manager the Product Evaluation Form (PEF), Rank Order List, product literature, MSDS information, and program payment for each product submitted for testing. This process is completed electronically through the NTPEP DataMine Program. After review of the PEF(s) for completeness and accuracy, the NTPEP Manager will work with the lead state Coordinator to decide on the products to be tested. The decision will be based upon the number of total products submitted for testing by all the manufacturers and their rank order lists. The manufacturer/supplier will be advised of the products approved for testing within two weeks of receipt of the PEF.

Note 1 – At times, it may be necessary to limit the number of submittals from each manufacturer for an evaluation period to maintain a manageable work load. Any decision by the technical committee to limit submittals for a cycle will be based on the testing capacity of the laboratory(s) contracted.

Note 2 – The deadline for PEF(s) submission will be posted on the NTPEP website.

5.2 Assignment of Test Number

A test number shall be assigned to each product approved for testing. The test number shall indicate the Rapid Set Concrete Patching materials designation (RSCP), the year of submission, and a sequential sample number (RSCP-Year-Sample No.). For example: RSCP-09-31.

Note 3 – Rapid Set Concrete Patching materials (RSCP) numbers that are assigned to a Manufacturer’s product will not change for the life of the test. The Product Name that the manufacturer gives the product at the time of application will be allowed to change until the first data is issued to the manufacturer for review. Once this report is submitted to the manufacturer for review no changes to the product name will be allowed.
5.3 Withdrawal of Product Submittal

5.3.1 A written request to withdraw the product from the evaluation cycle must be received by the NTPEP Coordinator at least five business days before scheduled sampling is to occur.

5.3.2 If sampling has occurred, a handling fee of ten (10) percent of the testing fee will be charged in addition to any laboratory test costs that may have been incurred for evaluation.

5.3.3 Results released through DataMine up until the time of withdrawal will be removed. In this event, the material will be listed in the final report with a note that it was withdrawn from the evaluation program.

5.4 Non-Interference Policy

Once the laboratory testing has been started or the installation process is complete, the manufacturer is bound by the Non-Interference Policy as detailed in the General Terms and Conditions Section of submittal documents.

6. MATERIAL CRITERIA

6.1 The Rapid Set Concrete Patching Material must fall into one of the following categories:

6.1.1 *Cementitious Product* is a dry, cementitious mortar or concrete material.

6.1.2 *Polymer Product* is a composite material formed by polymerization of a monomer and aggregate mixture in which the polymerized monomer acts as the sole binder for the aggregate.

6.1.3 *Polymer-Modified Product* is a hydraulic cement combined with organic polymers that are dispersed or re-dispersed in water, with or without aggregates.

**Note 4** – All products that are requested to have an initial cure in air shall be considered to be either a polymer-modified or polymer product. Polymer-modified products may be requested to have an initial cure in moisture/water but shall still be classified as a polymer-modified product.

7. SAMPLING

7.1 Once the manufacturer is notified the system has been accepted for evaluation, the test facility will request that the manufacturer submit clearly marked samples of the products. State Department of Transportation representatives will select samples for the manufacturers to ship to the testing facility.

7.2 The test facility shall notify the Lead State and the AASHTO NTPEP Coordinator of receipt of samples for evaluation.

7.3 The manufacturer shall supply sufficient quantities of each product to perform the required testing. The testing facility determines sufficient quantities for laboratory testing and installation.
7.4 The manufacturer may supply single component products or multi-component products in pre-packaged kits.

7.5 The 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.

7.6 The manufacturer shall indicate the minimum quantity of product to be mixed to assure proper reaction of the components.

7.7 The test materials shall be supplied from manufactured stock with traceable batch numbers.

7.8 The test materials shall not be specifically manufactured for this test program.

7.9 Extender Aggregates

7.9.1 Products may be tested either as supplied (neat), extended with aggregate that must be supplied by the manufacturer, or both. However, the same mix design used in the field installation must be used in the laboratory testing.

Note 5 – Laboratory testing will use the maximum amount of extender aggregate allowed according to the manufacturer’s shipping container or product data sheet. The amount of extender aggregate used in the field installation may vary depending on the manufacturer’s recommendations for the specific field conditions. The mix designs used for both laboratory and field testing will be documented.

7.9.2 Manufacturers may request RSCP products to be extended with up to two aggregate types (coarse and fine for example). If multiple aggregates are supplied, the above extender aggregate tests will be performed (as appropriate) and reported for each aggregate type. Manufacturers are also encouraged to provide data for the extender aggregate(s) test values that represent their specifications for extender aggregate(s) when submitting product data information. This data is not required but may prove useful to other agencies when comparing their locally available aggregate to what was used for NTPEP evaluation and what the manufacturer requires.

7.9.3 Extender aggregates must be available for sampling (shipping containers are to be labeled by State Department of Transportation representatives) at the time the RSCP products are sampled and the manufacturer is responsible for shipping the extender aggregate(s) to the field and laboratory testing facilities.

8. TESTING FACILITY CRITERIA

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

8.1 Facilities Requirements

8.1.1 Provide verification that they have experience performing testing of Rapid Set Concrete Patching materials.

8.1.2 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 Rapid Set Concrete Patching materials.
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.

Identify the administrative procedures that have been implemented to insure a high-quality level of comparative testing results.

Complete all laboratory testing of the rapid set concrete patching materials within 8 months from the date samples are received.

Provide verification that it is in conformance with Federal and State regulations related to health and safety.

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, ISO 17025, or other nationally recognized accreditation program shall 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 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 products for this program.

**LABORATORY TESTING**

The evaluation laboratory(s) shall be selected by the technical committee and may be either a NTPEP member state laboratory or a private independent laboratory. The laboratory shall be accredited by AASHTO or CCRL for the applicable tests.
9.2 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, 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.

9.3 The amount of water to be used for testing shall be the maximum allowed as designated on the manufacturers' shipping container or product data sheet whichever is greater.

9.4 Manufacturers of Cementitious and Polymer-modified products must select a method for Freeze/Thaw testing as described in AASHTO T161. Manufacturers are encouraged to review the applicable specifications maintained by member states in order to determine which procedure(s) should be selected. Either Procedure A (freeze and thaw in water), Procedure B (freeze in air, thaw in water), or the combination of both procedures must be selected.

9.5 The NY502-3P (Freeze/Thaw test is optional for all product types. This test will not be performed unless requested by manufacturer.

9.6 Summary of Tests:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>CEMENTITIOUS</th>
<th>POLYMER</th>
<th>POLYMER-MODIFIED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond Strength</td>
<td>ASTM C 1583-04</td>
<td>ASTM C 1583-04</td>
<td>ASTM C1583-04</td>
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</tr>
<tr>
<td>Bond Strength Using Slant Shear (wet cure)</td>
<td>ASTM C 882-051</td>
<td>ASTM C 882-051</td>
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<tr>
<td>Chloride Ion Penetration</td>
<td>AASHTO T 277-07</td>
<td>AASHTO T 277-07</td>
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<tr>
<td>Compressive Strength</td>
<td>AASHTO T 22-101</td>
<td>ASTM C 579-06</td>
<td>AASHTO T 22-101</td>
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</tr>
<tr>
<td>Gel Time (Pot Life)</td>
<td>--</td>
<td>ASTM C 881-02</td>
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<tr>
<td>Length Change</td>
<td>AASHTO T 160-091</td>
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<tr>
<td>Linear Shrinkage &amp; Coefficient of Thermal Expansion</td>
<td>--</td>
<td>ASTM C 531-05</td>
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<tr>
<td>Resistance to Freeze/Thaw</td>
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<tr>
<td>Tensile Strength</td>
<td>AASHTO T 198-09</td>
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<tr>
<td>Thermal Compatibility</td>
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<td>ASTM C 884-05</td>
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<tr>
<td>Freeze/Thaw New York Method</td>
<td>NY502-3P</td>
<td>NY502-3P</td>
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<td></td>
</tr>
</tbody>
</table>

1As modified by ASTM C 928
2Compressive strength shall be determined using 4 inch x 8 inch cylinders tested at 1 hour, 3 hours, 1 day, 7 days, and 28 days in accordance with applicable test for the product category.
3Linear Shrinkage and Coefficient of Thermal Expansion for polymer products shall be measured in accordance with ASTM C 531-05 with the following modifications: “Measure at 1 day, 3 days, 7 days, and 11 days. The samples are stored at 73°F for the first 7 days, then placed in oven at 210°F for 3 more days, then let cool a minimum of 16 hours at 73°F”.

**EXTENDER AGGREGATE TEST PROCEDURES**

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
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<tbody>
<tr>
<td>Gradation</td>
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</tr>
<tr>
<td>Soundness</td>
<td>AASHTO T 103-08, Procedure A</td>
</tr>
<tr>
<td>Specific Gravity (Oven Dry) and Absorption</td>
<td>AASHTO T 84-10 and/or T 85-10</td>
</tr>
</tbody>
</table>
10. SITE SELECTION FOR FIELD PERFORMANCE SERVICE TEST

One test bridge location will be selected for field performance testing of horizontal patching products. Sites will generally have the following characteristics:

10.1 Full depth Portland Cement Concrete bridge deck surface, no overlays or membranes.

10.2 Wet freeze climate.

10.3 Patches should be located away from expansion joints and end dams.

10.4 Boundaries of the patch area will be original sound concrete.

10.5 Patch areas will be of similar size and characteristic (Nominal 9 ft x 3 ft x 4 inches).

10.6 All patch edges will be saw cut.

11. INSTALLATION FOR FIELD PERFORMANCE SERVICE TEST

11.1 Only one patch will be installed for each material submitted.

11.2 The manufacturer will supply all labor and equipment to completely install the properly sampled and marked material (water, and extender aggregate if required). The testing state will provide site preparation using concrete saws and jack hammers. Additional surface preparation required for product installation will be the manufacturer’s responsibility. At the time of installation the manufacturer will provide written instructions for the proper installation of the material.

11.3 The manufacturer will have approximately four (4) hours to place their material(s). If the manufacturer fails to complete their installation within this time frame and a delay is caused which requires additional lane closure time, the manufacturer will be charged an additional fee for the actual cost incurred by the DOT for this increase in lane closure time. This will include all labor, material and equipment costs and possible user costs for the location.

11.4 Traffic control and installation scheduling will be provided by the Field Testing State. The manufacturer's representative will certify that their patching material is installed in accordance with the written instructions and to their satisfaction. If the representative feels their installation was unsatisfactory, they will inform the representative of the Field Testing State of this fact in writing, within one week of the installation. Upon notification, the Field Testing State may drop that manufacturer's installation from further testing without a refund of fees. If no written notification is received within the first week, the installation will be accepted and included in the field testing.

11.5 If the manufacturer is not present during the scheduled installation of products, all costs associated with labor, materials and equipment, for preparation of the test site and repair of same will be charged to the manufacturer. If an alternate date can be arranged it will be the manufacturer’s responsibility to furnish traffic control, prepare the patch hole, and place their material in the patch.
12. OBSERVATIONS FOR FIELD PERFORMANCE SERVICE TEST

12.1 The field testing shall be performed by an appropriate testing facility as designated by the AASHTO/NTPEP Rapid Set Concrete Patching Technical Committee.

12.2 Testing will commence upon completion of the installation and continue for two years. Field observations will be made during the installation, at 12 months (interim) and at 24 months (final).

12.3 Field performance service test results shall be compiled into an electronic report that will be provided to all participating states on the NTPEP website. That report shall include, as a minimum, the following information:
   - Mix designs and mixing procedures
   - Material characteristics, installation procedures, and cleanup procedures
   - Product installation and evaluation photographs
   - Patch dimensions
   - Percentage delamination
   - Percentage spalling
   - Edge debonding – average width and % of total length
   - Mid panel cracking – average width and total length
   - Site characteristics - AADT, % trucks, number of lanes, bridge description, and weather data

Note 4 – During this field evaluation period, if a product fails to the extent that it becomes a safety issue for the traveling public, as determined by the Lead Field State representative, the manufacturer will be charged for the actual cost incurred by the DOT to fix the patch. This charge will include all labor, materials and equipment costs.

13. REPORTING OF TEST DATA

13.1 Test result data will be compiled and made available to all participating states and testing companies through the AASHTO/NTPEP DataMine. This report will include data only. No judgment as to a product’s acceptability will be made in this report. End user participants will establish individual criteria for product acceptability.

13.2 The final report issued by the technical committee shall contain the test data generated by the contracted NTPEP laboratory(s) and the manufacturer sponsored certified test results from an independent laboratory. The primary testing facility is responsible for entering data generated in their facility and reviewing any data generated at subcontracted facilities in the NTPEP online database.

13.3 Test results will be reported to the NTPEP Manager in the web-based data base – DataMine as follows. Once the data is reported to the manager, he will forward each manufacture’s data for their review. When the manufacturer reviews and accepts the data, the NTPEP manager will release the data to the public.

13.4 DataMine – This web-based data base can be accessed through the AASHTO-NTPEP web site link at www.ntpep.org.
14. TEST REPORT REVIEW AND TEST RESULT APPEALS

14.1 Each NTPEP contract laboratory lab will submit the DataMine data to the lead state Coordinator and the NTPEP Manager within 20 business days after completion of all testing. Each manufacturer will receive a copy of the portion of the report dealing with their specific products. The manufacturer will review the data and may appeal the results of the testing program in accordance with the AASHTO/NTPEP appeals procedures. Re-testing of the materials will be performed by the NTPEP contract laboratory, and only on the relevant sample and parameter being questioned. No additional sample material will be received for re-testing. Prior to re-test, the manufacturer/supplier making the appeal shall submit a fee to NTPEP to cover the costs of re-testing. The NTPEP Manager will determine if the results of the re-test uphold the appeal. Upon agreement between the organization appealing the test results and the NTPEP Manager, either the original set or re-test set of data shall be published. If the appeal is upheld and the re-test data is published, the re-testing fee shall be reimbursed to the submitting organization.

15. RESUBMITTAL TESTING FREQUENCY

15.1 Rapid Set Concrete Patching Materials are required to be resubmitted and tested (lab only) every five (5) years. A signed certification from the manufacturer will be required with the five year submittal stating that the formulation has not changed since the original submission.

16. TESTING FEES

Testing fees are to be paid at time of application. 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.

17. KEYWORDS

17.1 Concrete Patching; DataMine; NTPEP; Rapid Set Concrete Patching Materials