NTPEP Committee Work Plan for

Evaluation of Rapid Set Concrete Patching Materials for Portland Cement Concrete

NTPEP Designation: RSCP-03-16

National Transportation Product Evaluation Program
444 North Capitol Street N. W., Suite 249
Washington, DC 20001
INTRODUCTION

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

1. SCOPE

1.1 This work plan describes the requirements and testing criteria for the NTPEP evaluation of rapid set concrete patching materials for Portland cement concrete. The concept of this work plan is to evaluate “off the shelf” products. Products must be packaged as typically sold to consumers. Product samples that are prepared specifically for this program will not be accepted.

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

1.3 Products that are intended for horizontal use or both horizontal and vertical/overhead use shall be subjected to field and laboratory testing. Products that are intended for vertical/overhead use only shall be subjected to laboratory testing with no field trial. Field testing of products for horizontal use will be required for initial product submittals and will not be required for retesting.

1.4 It is intended that products will be submitted for retesting every 5 years based on the year indicated in the NTPEP number (Refer to 4.5). Products that are not submitted for retesting will be removed from DataMine.

1.5 There will be one test cycle per year for these products. The submission cycle will be posted on the NTPEP website (www.ntpep.org) and will typically open in June and close in August.

1.6 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.
1.7  This work plan may involve the handling of hazardous materials, operations, and equipment. It does not purport to address all safety problems associated with its use. When conducting evaluations for the test methods included in this work plan, please use the appropriate personal protective equipment (PPE). It is the responsibility of the user 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, Compressive Strength of Cylindrical Concrete Specimens
   • AASHTO T 27, Sieve Analysis of Fine and Course Aggregates
   • AASHTO T 84, Specific Gravity and Absorption of Fine Aggregate
   • AASHTO T 85, Specific Gravity and Absorption of Course Aggregate
   • AASHTO T 103, Soundness of Aggregates by Freezing and Thawing
   • AASHTO T 131, Time of Setting of Hydraulic Cement by Vicat Needle
   • AASHTO T 160, Length Change of Hardened Hydraulic Cement Mortar and Concrete
   • AASHTO T 161, Resistance of Concrete to Rapid Freezing and Thawing
   • AASHTO T 198, Splitting Tensile Strength of Cylindrical Concrete Specimens
   • AASHTO T 277, Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration
   • AASHTO T 358, Surface Resistivity Indication of Concrete’s Ability to Resist Chloride Ion Penetration

2.2  ASTM Standards:
   • ASTM C 403, Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
   • ASTM C 531, Standard Test Methods for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concretes
   • ASTM C 579, Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concretes
   • ASTM C 881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
   • ASTM C 882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
   • ASTM C 884, Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay
   • ASTM C 928, Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
   • ASTM C 1404, Standard Test Method for Bond Strength of Adhesive Systems Used with Concrete as Measured by Direct Tension
   • ASTM C 1583, 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)
3. SIGNIFICANCE AND USE

This work plan utilizes laboratory testing to determine properties and field trials to provide observed performance 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.

4. APPLICATION FOR PRODUCT TESTING

4.1 The manufacturer shall submit an electronic Product Evaluation Form (ePEF) to the NTPEP Manager through DataMine (http://data.ntpep.org). For each product submitted, the manufacturer must provide the following documents in pdf format:
- Published technical information that describes the product type, usage, performance characteristics, and limitations.
- SDS
- Published mixing and curing directions that provide detailed information on recommended proportions of components including maximum allowable water and extender aggregate. Lab testing will be based on this information.
- Product label that clearly shows manufacturer’s name, product name and any product use directions that are typically included on the product’s label. This may require several views of the label.
- Products submitted for retesting shall include a notarized certification that the product has not changed in formulation since the last time it was tested by NTPEP. (Refer to 13.3)

4.2 Manufacturers must indicate the appropriate product thickness to be used in conducting ASTM C 1583 “Bond Strength by Direct Tension” on their product.

4.3 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. The selection of both freeze/thaw methods will result in an additional fee.

4.4 Product submittals (ePEF) will be reviewed for completeness and accuracy. The manufacturer/supplier will be advised of the products approved for testing within two weeks of receipt of the ePEF. 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(ies) contracted.

4.5 A test number will be assigned to each product approved for testing. The test number will indicate the Rapid Set Concrete Patching materials designation (RSCP), the year of submission, submission cycle for the year, and a sequential sample number (RSCP-Year-Cycle-Sample No.). For example: RSCP-2014-01-18.

4.6 Rapid Set Concrete Patching materials (RSCP) numbers that are assigned to a Manufacturer’s product will not change for the life of the test. As the intent is to evaluate only “off-the-shelf” products, the Product Name that the manufacturer provides at the time of application will remain the same throughout the evaluation.
4.7 Withdrawal of Product Submittal Prior to Start Data Collection

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. If sampling has occurred, a handling fee of ten (10) percent of the testing fee will be charged in addition to any laboratory test or field trial costs that may have been incurred for evaluation. The procedure for withdrawal after data collection has started is described in Section 12.2.

4.8 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.

5. TERMINOLOGY

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

5.2 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. Polymer concrete uses a polymer binder in place of Portland cement.

5.3 Polymer-Modified Concrete is Portland cement concrete with polymer solutions added to the mix to achieve certain properties. Like Portland cement concrete, the primary curing mechanism for polymer-modified concrete is hydration of the cement binder.

5.4 Neat refers to a product that is tested as packaged with no added components except for water or liquid.

5.5 Extended refers to a product that is tested with the specified addition of aggregate to the packaged product, along with the water or liquid.

5.6 Product Category indicates whether the product is a “Cementitious”, “Polymer-modified”, or “Polymer” product.

5.7 Product Use indicates how the product is intended to be used. Use can be “Horizontal”, “Vertical/Overhead”, or “Both Horizontal and Vertical/Overhead.”

5.8 Product Application indicates whether the product has been evaluated as a “neat” product, an “extended” product, or as both “neat and extended”.

5.9 DataMine is the NTPEP online database where results from this program can be viewed. The website is http://data.ntpep.org/.

6. SAMPLING

6.1 Once the manufacturer is notified that a product has been accepted for evaluation, the lead state will contact the manufacturer to request samples. Samples must be provided in typical “off-the-shelf” packaging. Samples must be clearly labeled with product name, manufacturer name, and the assigned NTPEP number. Samples that are specially prepared for NTPEP testing will not be accepted.
6.2 The test facility shall notify the Lead State and the AASHTO NTPEP Coordinator of receipt of samples for evaluation.

6.3 The manufacturer shall supply sufficient quantities of each product to perform the required testing. The testing facility will determine the required sample size for laboratory testing. Quantities sampled for lab testing shall be of sufficient size to allow for retesting, as described in 12.1, if necessary. The lead state will indicate required lab sample size, including the quantity needed for retesting, in the sample request. It is the responsibility of the manufacturer to determine the necessary quantity for the field trial based on patch dimensions specified in 8.5.

6.4 Samples shall be supplied from manufactured stock with traceable batch numbers. The samples shall be obtained from at least 2 product lots or production dates by providing “off the shelf” packaged product from each lot or date of production. The production lot/date shall be clearly labeled on the product.

6.5 Extender Aggregates

6.5.1 Products may be tested either as supplied (neat), extended with aggregate that must be supplied by the manufacturer, or both. Aggregate used in the lab testing must be from the same source as that used in the field test. It is the manufacturer’s responsibility to determine the quantity of aggregate needed for the field test.

6.5.2 Manufacturers may submit up to two aggregate types, (coarse and fine for example), to extend their product.

7. TESTING FACILITY CRITERIA

7.1 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 inspected by AASHTO or CCRL for the applicable tests. Candidate facilities to be considered for classification as an authorized test facility for AASHTO/NTPEP shall meet the following requirements:

7.2 Facilities Requirements

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

7.2.2 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.

7.2.3 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.

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

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

7.2.6 Provide verification that it is in conformance with Federal and State regulations related to health and safety.
7.3 **Personnel Requirements**

7.3.1 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.

7.3.2 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.

7.3.3 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.

7.4 **Quality Control/Quality Assurance**

7.4.1 The laboratory shall identify the procedures being used to ensure 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.

7.4.2 Testing proficiencies of all technicians shall be evaluated and documented by the laboratory Quality Control Manager. These evaluations shall be performed at twelve-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.

7.5 Laboratory testing shall be conducted using the mix proportions that are given in the manufacturer’s published literature.

7.5.1 The amount of water to be used for testing shall be the maximum allowed as described on the manufacturer’s product label or product data sheet whichever is greater.

7.5.2 When the product is to be tested in extended form, the amount of extender aggregate used shall be the maximum allowed as described on the manufacturer’s product data sheet or product label, whichever is greater. The extender aggregate used for lab testing shall be from the same source as that used for the field test.
### Summary of Tests:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>CEMENTITIOUS</th>
<th>POLYMER</th>
<th>POLYMER-MODIFIED</th>
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</thead>
<tbody>
<tr>
<td>Bond Strength by Direct Tension 1</td>
<td>ASTM C 1583</td>
<td>ASTM C 1583</td>
<td>ASTM C 1583</td>
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<tr>
<td>Bond Strength Using Slant Shear (wet cure)</td>
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<td>ASTM C 882</td>
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<tr>
<td>Surface Resistivity</td>
<td>AASHTO T 358</td>
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<td>AASHTO T 358</td>
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<tr>
<td>Compressive Strength 3 (^3)</td>
<td>AASHTO T 22(^2)</td>
<td>ASTM C 579</td>
<td>AASHTO T 22(^2)</td>
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<td>ASTM C 531</td>
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<tr>
<td>Resistance to Freeze/Thaw 5</td>
<td>AASHTO T 161(^5)</td>
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<td>AASHTO T 161-5</td>
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<tr>
<td>Tensile Strength</td>
<td>AASHTO T 198</td>
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<td>Thermal Compatibility</td>
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<td>ASTM C 884</td>
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<td>Time of Setting by Vicat Needle</td>
<td>AASHTO T 131</td>
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<tr>
<td>Time of Setting by Penetration Resistance</td>
<td>ASTM C 403</td>
<td>ASTM C 403</td>
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</tr>
</tbody>
</table>

\(^1\) ASTM C 1583 will be performed at a sample age of 28 days. Substrate material will be prepared to a CSP 3-5 profile as per ICRI guidelines. Product will be applied at the mid-point between manufacturer’s ranges of allowable thicknesses, not to exceed 3 inches.

\(^2\) As modified by ASTM C 928.

\(^3\) Compressive strength specimens for polymer materials shall be prepared in accordance with ASTM C 579. All other compressive strength specimens shall be determined using 4 inch x 8 inch cylinders. Tests shall be conducted at 1 hour, 3 hours, 1 day, 7 days, and 28 days in accordance with applicable test for the product category.

\(^4\) Linear Shrinkage and Coefficient of Thermal Expansion for polymer products shall be measured in accordance with ASTM C 531 with the following modifications: “Measure at 1 day, 3 days, 7 days, and 11 days. The samples are stored at 73ºF for the first 7 days, then placed in oven at 210ºF for 3 more days, then let cool a minimum of 16 hours at 73ºF”.

\(^5\) AASHTO T161 will be started when samples have reached an age of 28 days. Images of freeze/thaw specimens will be added to DataMine when test is completed.

### EXTENDER AGGREGATE TEST PROCEDURES

<table>
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<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
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<tr>
<td>Gradation</td>
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<tr>
<td>Soundness</td>
<td>AASHTO T 103, Procedure A</td>
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<tr>
<td>Specific Gravity (Oven Dry) and Absorption</td>
<td>AASHTO T 84 and/or T 85</td>
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</table>

### 8. SITE SELECTION FOR FIELD PERFORMANCE SERVICE EVALUATION

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

8.1 Full depth Portland Cement Concrete bridge deck surface, no overlays or membranes.
8.2 Wet freeze climate.

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

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

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

8.6 All patch edges will be saw cut.

9. **INSTALLATION FOR FIELD PERFORMANCE SERVICE EVALUATION**

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

9.2 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.

9.3 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 the field test will be documented in DataMine.

9.4 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.

9.5 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 evaluation 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 evaluation.

9.6 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.

10. **OBSERVATIONS FOR FIELD PERFORMANCE SERVICE EVALUATION**

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

10.2 Evaluations 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).
Field performance service test results will be entered into DataMine. The reported data will 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 (% of total area that is delaminated)
- Edge debonding – average width and % of total length
- Mid panel cracking – average width and total length
- Site characteristics – Annual Average Daily Traffic (ADT), % trucks, number of lanes, bridge description, and monthly weather data

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.

### 11. REPORTING OF TEST DATA

11.1 Test result data will be compiled and made available to all participating states and testing companies through the AASHTO/NTPEP DataMine. DataMine reporting will include data only. No judgment as to a product’s acceptability will be made by NTPEP. End users must establish individual criteria for product acceptability.

11.2 Data will be entered into DataMine by representatives of the testing lab and field test facility. After review by the NTPEP manager and lead state, notification will be provided to the manufacturer that data is ready for their review. Data will be available for review and release at the following intervals:
- Installation of product on the field test deck.
- Lab results completed
- 1-year field review
- 2-year field review

Upon acceptance by the manufacturer, the NTPEP manager will release the data to the public.

### 12. TEST REPORT REVIEW AND TEST RESULT APPEALS

12.1 Each NTPEP contract laboratory lab and field test facility will submit the DataMine data to the lead state Coordinator and the NTPEP Manager within 20 business days after completion of testing. Each manufacturer will receive access to the data 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 up-hold 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 up-held and the re-test data is published, the re-testing fee shall be reimbursed to the submitting organization. It is important to request re-tests as soon as possible to avoid possible issues with the shelf-life of the original material.
12.2 Withdrawal of Product after Testing

If after following the review and appeals process the manufacturer chooses to withdraw a product, the results will be published in DataMine but be restricted to registered state users. Manufacturers can resubmit their product in the next test cycle, but previous results will also remain available to registered state users until those results expire (refer to 1.4).

13. RESUBMITTAL TESTING FREQUENCY

13.1 To remain published in DataMine, Rapid Set Concrete Patching Materials must be submitted for retesting every 5 years based on the year indicated in the NTPEP number (Refer to 4.5). In addition, products intended for horizontal application or both horizontal and vertical/overhead application must be subjected to the field trial every 10 years. Products that don’t meet this retesting frequency will be removed from DataMine until they are retested. Complete retesting will be required at that point.

13.2 Manufacturers are responsible for tracking the status of their products. NTPEP will not provide a notice to manufacturers that resubmittal is due. Products that are not submitted for retesting within the five (5) year window will have to be retested as a new product as described in the work plan.

13.3 Submittal for retesting shall include a notarized certification from the manufacturer stating that the formulation has not changed since the original submission.

14. TESTING FEES

14.1 Testing fees are to be paid at the time of application. Testing fees are assessed to cover all costs associated with laboratory testing, field evaluation, and administrative costs incurred by NTPEP. Specific pricing for submission of products may be found at www.ntpep.org.

Fees paid by the manufacturer will not be refunded once testing or field trial preparations have begun.

15. KEYWORDS

15.1 Concrete Patching; DataMine; NTPEP; Rapid Set Concrete Patching Materials
<table>
<thead>
<tr>
<th>Stage</th>
<th>Details</th>
<th>Duration (Months)</th>
<th>Time Line (months)</th>
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<tbody>
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