AASHTO'S

National Transportation Product Evaluation Program

Work Plan

Polymer Concrete Overlays For Bridges and Pavements (PCO)

Last Revision: November, 2011
Introduction and Purpose:

This Work Plan was developed by the National Transportation Product Evaluation Program (NTPEP) Committee on Polymer Concrete Overlays for Bridges and Pavements (PCO) to provide AASHTO Member States a list of tested PCO resins and primers, by type and manufacturer, which have been evaluated in accordance with AASHTO, AASHTO-AGC-ARTBA Task Force 34 and ACI materials specifications and guidelines.

The program allows AASHTO member departments to use the data as a single point source of information that offers independent, credible, reliable data. Member departments are encouraged to apply this information to improve their specifications or establish approved or prequalified products lists as they deem appropriate for their individual programs.

This product evaluation consists of a battery of laboratory evaluations and 24 month field evaluation. Field test sites will be selected on asphalt pavement, concrete pavement, and concrete bridge deck. These evaluations are intended to assess the product adhesion properties and any improved skid resistance of the applied products.

The Work Plan will be reviewed annually by the PCO Technical Committee. This annual review will respond to the changing needs of member departments and technical improvements provided by the industry.

Definitions:

**Polymers** – hard, glassy solids commonly called plastics.

**Inhibitor** – materials added to the polymer to prevent polymerization during shipping and storing.

**Initiator** – chemical materials that start the polymerization process.

**Promoters** – chemical materials used to accelerate the polymerization process.

**Neat Material** – no aggregate in the polymer.

**Filled Material** – polymer with aggregate included.

**Surface Aggregate** – aggregate placed on the surface of the uncured polymer to create a skid resistant wearing surface.

**Extender Aggregate** – aggregate added to the polymer to increase the volume of the polymer concrete.

**Multi-Layer** – the overlay is placed in more than one coat, aggregate is typically broadcast applied after the polymer is placed on the deck.

**Slurry** – the overlay is typically placed in one coat, aggregate is mixed in the polymer before placing on the deck.

**Premixed** – the overlay is typically placed in one coat by vibrating screed, aggregate is mixed in the polymer before the placing on the deck.

**Prime Coat** – used to wet the surface, fill and seal cracks, or create a barrier to prevent saponification
of polyester resins.

**Independent Laboratory Acceptable to NTPEP** – a laboratory that is qualified to perform the specific tests as outlined in the work plan and has on site qualified technicians and equipment necessary to perform the tests per ASTM and ASSHTO standard.

**ICRI** – International Concrete Repair Institute

**Overview of the Program:**

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.

Test fees that are paid by the manufacturer for evaluation of their products will be paid to AASHTO. Fees will be based on the cost of laboratory testing and the number of field test applications chosen by the manufacturer. Fees for field testing will include the cost of traffic control and site preparation. The manufacturer is required to submit products within 30 days of acceptance to the program. A manufacturer may have more than one type of aggregate or binder that is used on different surfaces. A change in binder or aggregate constitutes a different product and will require a separate submission. If the products are not submitted for evaluation within this time period a stalled product assessment fee of not less than 15% of the test fee or $500, whichever is greater, per submission will be charged and the remaining test fees will be returned to the manufacturer. At that point the manufacturer will be required to begin the submission process again if they would like to pursue evaluation through the program.

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 database and viewable by our Member Departments.

**Participation and Administration of the Program:**

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](http://www.NTPEP.org).

**Product Evaluation:**

The resin manufacturer will be responsible for reviewing the submittal timelines as posted online at [www.NTPEP.org](http://www.NTPEP.org). All testing will be performed by contracted laboratories as described above. Submittal and product evaluation timelines are contained in Appendix A of this document.

**Test Samples:**

Samples must be submitted to the designated testing facility in sufficient quantity to conduct all testing, as instructed by the NTPEP representative along with:

a. information showing the manufacturer’s name and description of product;

b. manufacturer test results;
c. Sample of the resin and surface aggregate and/or aggregate filler in sufficient quantity to conduct the specified product tests.
d. Materials will be limited to two (2) per manufacturer per year. A generic material composition description and MSDS must accompany the submittal for classification purposes. This information will be kept in confidence by NTPEP unless directed otherwise by the manufacturer.

**Test Data:** The Laboratory evaluation results will include as a minimum the following Information: The results will be compiled and posted on the NTPEP datamine.

1. Testing lab name, location, and certification status.
2. Manufacturer’s Name and Address and phone number (including contact person).
3. Product Identification:
   a. Product Name
   b. Product Series, product number, lot number or identification.
4. Resin Description
5. Resin Type, Grade and Class
6. Aggregate Filler Description if applicable.
7. Surface Aggregate Description
8. Test Results for Resin and Aggregate(s) as established in this work plan.
9. Related documentation submitted by the manufacturer
STATE CONTACTS

The contact persons for the member departments are as follows:

Lead State(s):

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kenberg@utah.gov

Scott Phelps PE, CFM (Vice-Chair)
Kentucky Transportation Cabinet
1227 Wilkinson Boulevard
Frankfort, KY 40601
PHONE: 502-564-3160
Scott.phelps@ky.gov

Testing Facility:

Derrick Castle, PCS
Kentucky Transportation Cabinet
1227 Wilkinson Boulevard
Frankfort, KY 40601
PHONE: 502-564-3160
Derrick.Castle@ky.gov

Additional Member Departments or Private Labs may be included for the testing of the PCO resins.
## TEST/PRACTICES TO BE INCLUDED:

### Multiple-layer Polymer Concrete Overlays
(Epoxy, and Polyester Binders)

#### Uncured Binder

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity</td>
<td>ASTM D2196-05,</td>
</tr>
<tr>
<td>Gel Time</td>
<td>ASTM C881-02, para. 11.2 modified</td>
</tr>
<tr>
<td>Flash point</td>
<td>ASTM D3278-96 (2004)</td>
</tr>
<tr>
<td>Infrared spectrum</td>
<td>AASHTO T237-05, para. 4 and 5</td>
</tr>
<tr>
<td>Epoxide Number</td>
<td>ASTM D1652-04</td>
</tr>
<tr>
<td>Amine Content</td>
<td>ASTM D2073-98</td>
</tr>
</tbody>
</table>

#### Cured Binder (Neat)

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Tensile strength (neat)</td>
<td>ASTM D638-08 (Type1)</td>
</tr>
<tr>
<td>Tensile elongation</td>
<td>ASTM D638-08 (Type1)</td>
</tr>
<tr>
<td>Modulus of elasticity</td>
<td>ASTM D638-08 (Type1)</td>
</tr>
<tr>
<td>Absorption (neat)</td>
<td>ASTM D570-98 (2005) 24 hour % gain</td>
</tr>
<tr>
<td>Weight Solids (MMA)</td>
<td>ASTM D2369-10</td>
</tr>
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</table>

#### Cured Binder (Filled/Aggregate)

<table>
<thead>
<tr>
<th>Test</th>
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<tbody>
<tr>
<td>Compressive Strength (w/ agg.)</td>
<td>ASTM C579-01 (2006) Method B*</td>
</tr>
<tr>
<td>Flexural Yield strength</td>
<td>ASTM D790-07</td>
</tr>
<tr>
<td>Thermal compatibility</td>
<td>ASTM C884-98 (2005) Method B*</td>
</tr>
<tr>
<td>Bond strength</td>
<td>ASTM C1583-04</td>
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<tr>
<td>Resistance to Chloride Ion Penetration</td>
<td>AASHTO T259/ AASHTO T260</td>
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### Premixed/Slurry Polymer Concrete Overlay
(Epoxy, Methyl Methacrylate, and Polyester Binders)

#### Uncured Binder/Primer/Top Coat

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<tr>
<td>Gel Time (at application temperature)</td>
<td></td>
</tr>
<tr>
<td>Flash point</td>
<td>ASTM D3278-96 (2004)</td>
</tr>
<tr>
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</tr>
</tbody>
</table>
### Extender Aggregate and Surface Aggregate

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation</td>
<td>AASHTO T27-06</td>
</tr>
<tr>
<td>Soundness</td>
<td>AASHTO T103-08, Procedure A</td>
</tr>
<tr>
<td>Absorption</td>
<td>AASHTO T84-08 or T85-08</td>
</tr>
<tr>
<td>Shore D Hardness</td>
<td>ASTM D2240-05</td>
</tr>
<tr>
<td>LA Wear Test</td>
<td>AASHTO T-96</td>
</tr>
<tr>
<td>Field Test</td>
<td>Specification</td>
</tr>
<tr>
<td>Bond Strength</td>
<td>ASTM C1583-04</td>
</tr>
<tr>
<td>Skid Resistance</td>
<td>AASHTO T242-06</td>
</tr>
</tbody>
</table>

X-Ray Florescence Appendix B

Test material as supplied (neat) will be extended with the maximum amount of extender aggregate allowed as per the manufacturer's written instructions. Manufacturer will supply Extender Aggregate and Surface Aggregate for test purposes.

### Participation and Program Governance:

Any manufacturer of Polymer Concrete Overlay Resin may participate in the program. All costs for participation in the program, including sample shipping and testing and other NTPEP administrative fees are to be borne by the manufacturers. Product withdrawal, review of test results and other significant program requirements are governed by the NTPEP Information and Operations Guide. A current copy of this document may be accessed at [www.NTPEP.org](http://www.NTPEP.org).

Manufacturers will not be responsible for surface preparation. The testing program will clean the entire test deck surface by abrasive blasting and other means to remove asphaltic material, oils, dirt, rubber, curing compounds, paint carbonation, laitance, weak surface mortar and other potentially detrimental materials that may interfere with the bonding or curing of the overall system.

Surface profile range for concrete shall between CSP 5- CSP 7 in accordance with ICRI Guideline #310.2 as compared to surface profile replica coupons. Surface profile shall be evaluated after cleaning and drying, remove all dust and other loose material prior to overlay. Asphalt surfaces will be cleaned by pressure washing with a pressure between 3,000psi and 4,000psi. Asphalt pavement will be allowed to dry for 24 hours prior to placement of product.

Manufacturers will be required to provide sufficient quantities of materials for each field installation. Each field installation will be approximately 2,500 square feet.

Manufacturers will be required to remove excessive material after the initial set and prior to removal of traffic control. Initial field evaluation shall be conducted between 30 to 60 working days after installation. Additional evaluations will occur at 12 months and 24 months from the date of installation. Due to safety concerns manufacturers will not be allowed to be present during the field evaluations. The test state may elect to have a day for manufacturers to evaluate their product.

Products will be exposed to two winter seasons and may incur plowing, salting, and brining. Ambient air temperatures may vary from below 0°c in wintertime to above 35°c during summer months with pavement surfaces becoming much hotter.
Photographs will be recorded immediately after installation and at each of the evaluation periods. Delaminated areas will be measured and reported as a percentage of the whole installed area.

Laboratory Testing will be completed in approximately 150 days.

Resubmission Cycle

Products evaluated in this program must be resubmitted every 5 years (from release of data) for current data to remain available to the manufacturer or the state members of AASHTO.
| Stage                        | Description                        | Details                     | Duration (Months) | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| 1 Submission Administration| Testing Cycle is Posted           |                             |                   | 0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                             | Application and Acceptance        |                             |                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                             | Submissions are due               |                             |                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                             | Assignment Letters               |                             |                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 2 Product Sampling          | Coordination sampling             |                             |                   | 2 | 1 | 2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 4 Product Lab Testing       | Lab Testing                       |                             |                   | 5 | 1 | 2 | 3 | 4 | 5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 5 Product Field Testing     | Coordination Field Installation   |                             |                   | 1 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                             | Product Installation             |                             |                   | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                             | Field Evaluation                 |                             |                   | 24| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10| 11| 12| 13| 14| 15| 16| 17| 18| 19| 20| 21| 22| 23| 24|   |   |   |   |   |   |
| 5 Product Reporting         | Lab Testing Results               |                             |                   | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                             | Field Evaluation Results          |                             |                   | 2 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 6 Manufacturer’s Review     | Lab Testing Review                |                             |                   | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                             | Field Evaluation Review          |                             |                   | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 7 Report Data Release       | Lab Report Release                |                             |                   | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                             | Field Evaluation Release         |                             |                   | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
APPENDIX B
1. SCOPE: This test method covers aggregate intended for use in various highway construction projects. Chemical analysis of aggregates are required only when specified on plans, proposals, bidding invitations, or by special provisions covering any particular material or projects. This method is a modification of ASTM C-25 for the chemical testing of limestone, fine aggregate, quicklime and hydrated lime by x-ray spectroscopy.

2. APPARATUS AND MATERIALS:

2.1. Wet Chemical: All wet chemical analysis will be performed in accordance with ASTM C-25 current edition.

   2.1.1. 30ml Porcelain crucible
   2.1.2. Balance: capable of accurately weighing to 0.0001g
   2.1.3. Oven: maintained at 110°C
   2.1.4. Dessicator

2.2. X-Ray Fluorescence:

   2.2.1. Philips MagiX PRO Wavelength Dispersive X-Ray Fluorescence Spectrometer
   2.2.2. SuperQ software
   2.2.3. Philips Perl’x 3 fused bead machine
   2.2.4. Platinum dish and crucible set
   2.2.5. Lithium Bromide (LiBr) – 10% solution non-wetting agent
   2.2.6. 67% Lithium Tetraborate (Li$_2$B$_4$O$_7$):33% Lithium Metaborate (LiBO$_2$) flux
   2.2.7. Lithium Tetraborate (Li$_2$B$_4$O$_7$) flux
   2.2.8. 27mm Steel sample cup and insert

3. PROCEDURE:

3.1. Prepare moisture free sample.

   3.1.1. Prepare porcelain crucibles by igniting in a muffle furnace at 950°C to constant weight. Cool and store crucibles in a dessicator to avoid absorption of moisture
   3.1.2. Weigh approximately 2 grams of sample into a prepared porcelain crucible.
   3.1.3. Dry the sample to a constant weight in an oven at 110°C.
   3.1.4. Cool the sample to room temperature in a desiccator to avoid absorption of moisture. DO NOT DISCARD the sample.

3.2. Determine loss on ignition (LOI) by weight percent.
3.2.1. Weigh approximately 1 gram of original sample into a prepared porcelain crucible. Record the sample weight to the nearest 0.0001g.

3.2.2. Ignite sample to a constant weight in a muffle furnace at 950°C and cool in a dessicator.

3.2.3. Re-weigh the cooled sample. DO NOT DISCARD the sample. Record the ignited sample weight to the nearest 0.0001g.

3.2.4. Calculate the loss on ignition (LOI) in accordance with Section 4.1.

3.3. Prepare and analyze aggregate sample (limestone or fine aggregate).

3.3.1. Weigh 6.0g to the nearest 0.0001g of 67% Li2B4O7:33% LiBO2 flux directly into platinum crucible.

3.3.2. Weigh 0.6g to the nearest 0.0001g of aggregate sample retained from 3.1 directly into the platinum crucible.

3.3.3. Add 3 drops of LiBr solution to the sample.

3.3.4. Place the platinum crucible and dish in the Perl’x 3 machine and select to run program 9 (Note 5.1).

3.3.5 Access SuperQ software and open the ledgrock application.

3.3.6 Enter the sample identification and LOI in the measure sample screen of the measure and analyze program.

3.3.7 Place the prepared sample into a 27mm steel cup and load into the x-ray instrument.

3.3.8 Click measure at the bottom of the measure and analyze screen (Note 5.2).

3.4 Prepare and analyze lime sample (hydrated lime or quicklime).

3.4.1. Weigh 6.0g to the nearest 0.0001g of Li2B4O7 flux directly into platinum crucible.

3.4.2. Weigh 0.6g to the nearest 0.0001g of lime sample retained from 3.2 directly into the platinum crucible.

3.4.3. Add 3 drops of LiBr solution to the sample.

3.4.4. Place the platinum crucible and dish in the Perl’x 3 machine and select to run program 9 (Note 5.1).

3.4.5 Access SuperQ software and open the lime application.

3.4.6 Enter the sample identification and LOI in the measure sample screen of the measure and analyze program.

3.4.7 Place the prepared sample into a 27mm steel cup and load into the x-ray instrument.

3.4.8 Click measure at the bottom of the measure and analyze screen (Note 5.2).

4. CALCULATION:

\[
\text{LOI} = \left( \frac{A}{B} \right) \times 100
\]

where: \( A \) = weight of sample after ignition, \( B \) = weight of original sample.
5. NOTES:

5.1 Program 9 includes: One oxidation for 2 minutes, temperature 1100°C, generator power 77, agitation angle 25, and agitation speed 10. One fusion for 6 minutes, temperature 1100°C, generator power 77, agitation angle 50, and agitation speed 15. Then a pause before casting for 10 seconds at a temperature of 1100°C. Casting time 2 minutes, temperature 1100°C, casting angle 123, casting speed 10, and time for solidification 30 seconds. Lastly there is natural air cooling for 1 minute and forced air cooling for 3 minutes at a flow rate of 40. The setting of the dish height dial is 40/12 and is dependent on the size of the platinum dish being used.

5.2 Program quantifies data by using a least squares program. Similar samples with known chemical analyses are used as standards in the quantification technique. As many standards as possible are used for best quantification. The results are reported as oxides in weight percents.

6. REPORT:

6.1. Report the following values for aggregate samples.

6.1.1. % Silica: upon request only

6.1.2. % Combined Oxides for all except "silica" sand. (Al₂O₃ + TiO₂ + MnO + Fe₂O₃)

6.1.3. % CaCO₃: for all except "silica" sand

6.1.4. % MgCO₃: for all except "silica" sand

6.1.5. % CaO: for slags only

6.1.6. SiO₂

6.1.7. % Ca

6.1.8. % Mg

6.1.9. % LOI

6.2. Report the following values for lime samples.

6.2.1. % CaO

6.2.2. % MgO