NTPEP Committee Work Plan for

Evaluation of Warm Mix Asphalt Technologies

NTPEP Designation: WMA-14e1

National Transportation Product Evaluation Program
444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001
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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 field testing. The results of the testing are then shared with member Departments for their use in product quality verification.

This work plan provides the NTPEP member departments information on the Warm Mix Asphalt Technologies 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.

1. SCOPE

1.1 This work plan covers the requirements and testing criteria for the National Transportation Product Evaluation Program (NTPEP) evaluation of Warm Mix Asphalt Technologies. The National Transportation Product Evaluation Program (NTPEP) serves the member departments of the American Association of State Highway and Transportation Officials (AASHTO).

1.2 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 work plan 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 M 320, Standard Specification for Performance-Graded Asphalt Binder
- AASHTO T 11, Standard Method of Test for Materials Finer Than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing
- AASHTO T 27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
- AASHTO T 84, Standard Method of Test for Specific Gravity and Absorption of Fine Aggregate
- AASHTO T 85, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
- AASHTO T 96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- AASHTO T 104, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- AASHTO T 164, Standard Method of Test for Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)
- AASHTO T 166, Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
- AASHTO T 168, Standard Method of Test for Sampling Bituminous Paving Mixtures
- AASHTO T 176, Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- AASHTO T 209, Standard Method of Test for Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA)
- AASHTO T 255, Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying
- AASHTO T 269, Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
- AASHTO T 275, Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Paraffin-Coated Specimens
- AASHTO T 283, Standard Method of Test for Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage
- AASHTO T 304, Standard Method of Test for Uncompacted Void Content of Fine Aggregate
- AASHTO T 312, Standard Method of Test for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
- AASHTO T 315, Standard Method of Test for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
- AASHTO T 320, Standard Method of Test for Determining the Permanent Shear Strain and Stiffness of Asphalt Mixtures Using the Superpave Shear Tester (SST)
- AASHTO T 322, Standard Method of Test for Determining the Creep Compliance and Strength of Hot Mix Asphalt (HMA) Using the Indirect Tensile Test Device
- AASHTO T 324, Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)
- AASHTO T 327, Standard Method of Test for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
- AASHTO T331 Standard Method of Test for Bulk Specific Gravity (Gmb) and Density of Compacted Hot Mix Asphalt (HMA) Using Automatic Vacuum Sealing Method
- AASHTO T 335, Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate
- AASHTO T 340, Standard Method of Test for Determining Rutting Susceptibility of Hot Mix Asphalt (HMA) Using the Asphalt Pavement Analyzer (APA)
- AASHTO R 35, Standard Practice for Superpave Volumetric Design for Hot Mix Asphalt (HMA)
- AASHTO PP 60, Standard Practice for Preparation of Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC)
- AASHTO PP 61, Standard Practice for Developing Dynamic Modulus Master Curves for Asphalt Mixtures Using the Asphalt Mixture Performance Tester (AMPT)
- AASHTO TP 79, Standard Method of Test for Determining the Dynamic Modulus and Flow Number for Asphalt Mixtures Using the Asphalt Mixture Performance Tester (AMPT)

2.2 ASTM Standards:
- ASTM D 3549, Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens
- ASTM D 4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
- ASTM D 5404, Standard Practice for Recovery of Asphalt from Solution Using the Rotary Evaporator

3. TERMINOLOGY

3.1 Accelerated pavement testing (APT) – The controlled application of a wheel loading, at or above the appropriate legal load limit to a prototype or actual, layered, structural pavement system to determine pavement response and performance under a controlled, accelerated accumulation of damage in a compressed time period.

3.2 Air voids (Va) – The total volume of small pockets of air between the coated aggregate particles throughout a compacted paving mixture, expressed as a percent of the bulk volume of the compacted paving mixture.

3.3 Chemically-Processed Warm Mix Asphalt – Asphalt mixing process which includes technologies that use additives to improve coating, mixture workability, and compaction, as well as adhesion promoters.

3.4 Creep – The time-dependent portion of strain that results from stress.
3.5 **Creep compliance** – The time-dependent strain divided by the applied stress.

3.6 **Dynamic modulus** – $|E^*|$, the absolute value of the complex modulus calculated by dividing the peak-to-peak stress by the peak-to-peak strain for a material subjected to a sinusoidal loading.

3.7 **Dynamic modulus master curve** – A composite curve constructed at a reference temperature by shifting dynamic modulus data from various temperatures along the log frequency axis.

3.8 **Flow number** – The number of load cycles corresponding to the minimum rate of change of permanent axial strain during a repeated load test.

3.9 **Foaming-Processed Warm Mix Asphalt** – Asphalt mixing process which includes processes that introduce small amounts of water to hot asphalt, either via a foaming nozzle, damp aggregate, or a mineral filler such as zeolite to reduce viscosity of the binder.

3.10 **Fracture Energy** – The energy required to create a unit surface area of a crack

3.11 **LMLC** – Lab mixed, laboratory compacted.

3.12 **Organic-Additive Warm Mix Asphalt** – Asphalt mixing process which includes technologies that use synthetic wax additives specifically engineered to achieve the temperature reduction by reducing viscosity of the binder.

3.13 **PMFC** – Plant mixed, field compacted.

3.14 **PMLC** – Plant mixed, laboratory compacted.

3.15 **PMQLC** – Plant-mixed, quality control laboratory-compacted

3.16 **Tensile strength** – The strength shown by a specimen subjected to tension.

3.17 **Voids in the mineral aggregate (VMA)** – The volume of the intergranular void space between the aggregate particles of a compacted paving mixture that include air voids and the effective binder content, expressed as a percent of the total volume of the specimen.

3.18 **Voids filled with asphalt (VFA)** – The percentage of the VMA filled with binder (the effective binder volume divided by the VMA).

3.19 **Warm Mix Asphalt (WMA)** – Warm mix asphalt refers to asphalt concrete mixtures that are produced at temperatures approximately 50°F (28°C) or more cooler than typically used in the production of hot mix asphalt. The goal with warm mix asphalt is to produce mixtures with similar strength, durability, and performance characteristics as hot mix asphalt using substantially reduced production temperatures.

4. **SUMMARY OF WORK PLAN**

4.1 The Warm Mix Asphalt (WMA) Technologies program operates with capabilities of AASHTO member departments and private testing facilities. Individual Manufacturers/suppliers are assessed a testing fee that covers costs for actual laboratory testing and/or field evaluation by either state highway agencies or an approved testing facility. A portion of the testing fee is used for maintaining the online data repository and reports that are accessible to all member departments and other end users.

4.2 This document is furnished for the benefit of Manufacturers interested in participating in the program by submitting their products and AASHTO Member Departments that are interested in
reviewing and utilizing the data generated through this product evaluation. The testing format has been established to provide the end user with test results which can be used to assess the performance of WMA technologies applied to traditional hot-mix asphalt production. Manufacturers are encouraged to submit products that they believe will perform well and meet the demands of the highway industry.

4.3 This work plan defines the evaluation procedures for WMA Technologies which will serve as the standard testing protocol for AASHTO’s National Transportation Product Evaluation Program for these products.

4.4 The testing facility will be either a dedicated accelerated pavement testing facility or a State test section under live traffic. Testing and evaluation will be performed by a state highway laboratory, university laboratory, or a private entity appropriately equipped and capable of performing the required laboratory and/or field evaluations. All laboratories performing these evaluations shall be contracted through AASHTO NTPEP. AASHTO NTPEP testing programs do not provide pass/fail acceptance criteria.

4.5 Evaluation reports will provide performance data and AASHTO does encourage member departments to take advantage of the program. However, the state highway agency will make the final determination regarding specification compliance and use of the products based on the data that is reported. WMA technologies may be evaluated by multiple agencies at different facilities, but for every WMA technology tested, a control section of Hot Mix Asphalt (HMA) with comparable constituents as the WMA must be constructed and exposed to the same traffic for direct comparison.

5. SIGNIFICANCE AND USE

5.1 This work plan utilizes laboratory and field testing to determine properties and evaluate the performance of Warm Mix Asphalt Technologies. Acceptability of each material based upon the data generated as a result of the testing and evaluation in this work plan is the responsibility of the user.

6. STATE CONTACTS

6.1 Member departments or selected private laboratories will test warm mix asphalt materials. The lead state will act as coordinator and generate summaries and reports. Approved testing facilities will perform lab tests. The contact persons for the member departments are as follows: Field Testing State (example below):

| Contact Name |
| State Name |
| Title |
| Contact position |
| City, ST zip |
| Phone: |
| Fax: |

6.2 Additional Independent Labs may be included for the testing of WMA materials.

7. MANUFACTURER’S PARTICIPATION

7.1 Manufacturers of Technologies for Warm Mix Asphalt (WMA) who elect to participate in the AASHTO NTPEP program must submit a completed NTPEP Product Evaluation Form (PEF) to the attention of the AASHTO NTPEP Coordinator. This process is completed electronically.
through the NTPEP Data Mine program. For the purposes of this testing program, products intended for vertical or any non-highway applications will not be evaluated.

7.2 Under agreement with The American Road & Transportation Builders Association (ARTBA), this panel has two industry representatives. This ensures that industry concerns, experience, and technical knowledge are considered in the testing and evaluation of products, material, and/or devices that are commonly used by the AASHTO Member Departments.

7.3 The evaluation process requires two tiers of testing by a Laboratory/Accelerated Testing Facility selected by NTPEP. Tier 1 requires laboratory testing on laboratory mixed, laboratory compacted (LMLC) samples provided by the Manufacturer. Tier 2 requires laboratory testing of plant mixed, laboratory compacted (PMLC) samples, plant mixed, field compacted (PMFC) samples, as well as full-scale accelerated pavement testing. When a product has demonstrated compliance with Tier 1 it will be deemed “Laboratory Compliant”, and when the product has demonstrated compliance with Tier 2 it will be deemed “Final Compliant”.

7.4 For Tier 1 testing, the Manufacturer shall supply sufficient laboratory compacted samples, in quantities as defined in Section 15, of each product to perform the required testing. In the case of technologies that use plant modifications to reduce temperature (such as water injection methods) rather than additives, samples shall be prepared from plant produced material. The testing facility determines sufficient quantities for laboratory testing.

7.5 For Tier 2 testing, the Manufacturer shall collaborate with the testing facility to obtain mixture to produce PMLC samples, and to construct the pavement structure for full-scale accelerated testing. PMLC mixture will preferably be compacted immediately after sampling to eliminate the need for mixture reheating (commonly referred to as plant-mixed, quality control laboratory-compact ed (PMQLC) specimens). If reheating is necessary, reheat samples in accordance with AASHTO R35. The Manufacturer shall also collaborate with the testing facility to obtain cores extracted from the testing facility test pavement (commonly referred to as plant-mixed, field-compacted (PMFC) specimens).

7.6 Test materials shall be labeled with traceable sample numbers to WMA produced.

8. TEST METHODS

8.1 The standard tests and methods are detailed in this work plan.

8.2 The Lead State and the NTPEP Evaluation of Warm Mix Asphalt Technologies Technical Committee shall address any questions regarding the testing procedures or exceptions to any testing procedure.

9. TEST REPORT

9.1 The primary testing facility is responsible for entering data generated in its facility and reviewing any data generated at subcontracted facilities in the NTPEP online database.

9.2 All information noted in the Test Report Section of this work plan shall be included in the test report.

10. PRODUCT SUBMISSION GUIDELINES

10.1 This testing program will accept products once in each calendar year. The deadlines for product submission will be posted on the NTPEP website.
10.2 The AASHTO NTPEP Coordinator and Lead State will verify receipt of testing fees and all appropriate documentation.

10.3 Once the Manufacturer is notified the technology has been accepted for evaluation, the testing facility will request that the Manufacturer submit clearly marked samples of the products. State Department of Transportation (DOT) representatives will select samples for the Manufacturer to ship to the testing facility.

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

10.5 When 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. After this time all written or verbal correspondence between the Manufacturer and the Testing Laboratory or Installation Facility 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 or Installation Facility that is not shared with the NTPEP Coordinator or the Lead State will be considered a violation of the Non-Interference Policy.

10.6 Once a Manufacturer has submitted a product and a NTPEP sample ID has been assigned, the Manufacturer and product name will remain the same throughout the reporting cycle.

11. POLICIES FOR WITHDRAWING MATERIALS FROM NTPEP EVALUATION OF WMA TECHNOLOGIES

11.1 A written request to withdraw the product from the evaluation cycle must be received by the NTPEP Coordinator at least five (5) 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 costs that may have been incurred for evaluation. Results released through the NTPEP Data Mine 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.

12. POLICY FOR REVIEW OF NTPEP REPORTS

12.1 The NTPEP Information and Operations Guide contains policies for review of reports. A copy of the guide may be viewed and downloaded from the NTPEP website at: www.ntpep.org.

13. TESTING AND REPORTING REQUIREMENTS

13.1 The following information defines the laboratory and field evaluation procedures consisting primarily of AASHTO and ASTM tests for the evaluation of Warm Mix Asphalt Technologies. It should be noted that this evaluation program is intended for structural asphalt mixtures; thus, bituminous seals, coatings, preservation, or other experimental materials are not included as part of this work plan. The evaluation procedures included herein will serve as the standard for NTPEP in serving the AASHTO states.

13.2 Results of the laboratory and field evaluations will be entered directly into the Warm Mix Asphalt Technologies module of Data Mine. A timeline for product evaluations is included on the last page of this document.
14. **MATERIAL CRITERIA**

14.1 The study will accept submittals from the following categories:

14.1.1 **Foaming-Processes** include processes that introduce small amounts of water to hot asphalt, either via a foaming nozzle, damp aggregate, or through mineral filler such as zeolite to reduce binder viscosity.

14.1.2 **Chemical-Additives** include technologies that use a combination of emulsification agents, surfactants, polymers, and additives to improve coating, mixture workability, compaction, and adhesion. The chemical additive is used either in the form of emulsion or added to binder prior to or during the mix production process.

14.1.3 **Organic-Additives** include technologies that use synthetic wax additives engineered specifically to achieve the temperature reduction by reducing viscosity of binder.

14.2 **Other technologies** – Technologies that do not fit into the above categories, but allow the producers of asphalt pavement material to lower the temperatures at which the material is mixed and placed on the road.

14.3 Submittals to NTPEP may be limited per Manufacturer per year. A generic material composition description and Material Safety Data Sheet (MSDS) must accompany the submittal for classification purposes. Any additives used in addition to the WMA technology shall be documented by the manufacturer. The aggregates used will be 100% virgin - no recycled asphalt or shingles will be used.

15. **LABORATORY EVALUATION OF WARM MIX ASPHALT**

**For Tier 1,** laboratory testing will be performed on LMLC samples provided by the Manufacturer as part of an initial qualification.

**For Tier 2,** laboratory testing will be performed on PMLC samples from material produced during the field installation of the accelerated pavement facility. Tier 2 also includes testing of cores extracted from the field installation.

There are certain standard tests which should be used to evaluate WMA technologies. There are also some provisional non-standard procedures which can assist in assuring materials are tested to best evaluate their quality. Any testing of bulk mixture or cores sampled during production must be conducted after 5 days but before 30 days after specimen fabrication. An exception to the 30-day maximum can be applied only if specimens are vacuum-sealed and stored under controlled temperature and humidity conditions.

15.1 **Binder Testing:** Determine the continuous grade of the base binder, the warm mix modified binder, and the extracted binder from plant mix from WMA and HMA per AASHTO M320. Also report the asphalt binder complex shear modulus G* in Pascals and phase angle, δ, in degrees at an angular frequency of 10 rads/sec for a minimum of three temperatures as determined by AASHTO T315. Asphalt binder extraction and recovery shall be performed using AASHTO T 164 Method A and ASTM D5404. The use of Trichloroethylene (TCE) solvent is not permitted for extraction. For binders containing a WMA modifier, one 1-gallon sealed bucket of asphalt binder without the modifier, and one 1-gallon bucket with the WMA modifier will be sampled from the binder production facility, and one 1-gallon bucket with the WMA modifier will be sampled from the plant.

15.2 **Aggregate Testing:** Contractor quality control (QC) data shall be submitted by the Manufacturer from aggregate tests conducted prior to production of the test mixtures. Data must be furnished...
for the following aggregate properties: gradation, bulk specific gravity, absorption, stockpile moisture content, coarse aggregate angularity, fine aggregate uncompacted void content, flat and elongated particles, and sand equivalent value. For gradation properties, AASHTO T 27 will be employed, while bulk specific gravity and absorption details will be obtained through AASHTO T 84 and T 85 procedures.

15.3 **Mixture Volumetric Testing:**

15.3.1 Sealed metal buckets totaling 660 lbs (300 kg) of loose asphalt mixture should be sampled from multiple points in the truck bed at the production site or plant per AASHTO T 168. From the roadway, 150-mm outside diameter cores should be extracted to include all asphalt layers down to the interface with the aggregate base. Reheat bulk mixture sampled during production from ambient temperature for 2.5 hours at the WMA compaction temperature to fabricate PMLC samples.

15.3.2 Conduct mixture design verification (with test data from specimens produced by contractor or state DOT laboratory) with 150-mm diameter and 115-mm high Superpave gyratory specimens at the design number of gyrations (N_{design}). Conduct as-constructed density and thickness tests on cores extracted from the WMA test section to compare with properties tested on PMLC samples.

15.4 **Mixture Performance Testing:** All laboratory test specimens shall be prepared from bulk mixture sampled during production of the test materials (PMLC) and cores extracted from the paved surface (PMFC). The Manufacturer will have the option of providing PMLC or plant-mixed QC laboratory-compacted (PMQLC) material for mixture testing. It is preferred that the Contractor producing mixture for the evaluation have a Superpave gyratory compactor equipped to compact tall specimens in its quality control laboratory.

15.4.1 **Compactability:** The mix shall meet the recommended compactability criteria for WMA stated in AASHTO R35 Appendix X2.

15.4.2 **Dynamic Modulus:** Bulk mixture test specimens shall be conditioned in accordance with AASHTO R35 Appendix X2. Prepare test samples in accordance with AASHTO PP 60. A target air void level of 7 ± 1 percent shall be used for compacting bulk mixture test specimens. AASHTO TP 79/PP 61 shall be followed to determine the dynamic modulus of the mixture.

15.4.3 **Rutting:** Various tests shall be performed to evaluate the test mixture’s propensity to rut. The rutting analysis shall be done on both PMLC samples and extracted cores from the testing facility’s field section. Air void tolerance for test specimens and specimen size shall be in accordance with AASHTO TP 79. Conditioning of specimens shall be in accordance with AASHTO R35, Appendix X2.

15.4.3.1 **Flow Number:** Repeated load testing (triaxial confined) shall be done on PMLC samples. Perform conditioning and testing in accordance with AASHTO R35 Appendix X2 and AASHTO TP 79 Flow Number for HMA using Asphalt Mixture Performance Tester (AMPT).

15.4.3.2 **Hamburg:** AASHTO T 324 shall be conducted on PMLC samples conditioned in accordance with AASHTO R35 Appendix X2. Specimens shall be prepared in accordance with AASHTO PP 60, followed by measurement of bulk specific gravity (AASHTO T 166, T 275 or T331) and calculation of air voids per specimen (AASHTO T 269). For comparison, laboratory-compacted samples shall be compacted to a common air void content for verification purposes.

15.4.3.3 **Asphalt Pavement Analyzer (APA):** AASHTO T 340 shall also be conducted on PMLC samples and extracted core specimens at standard conditions using the APA. Six (6) cylindrical specimens, with 150-mm diameter, are required to be tested at the high grade temperature of the Performance-Grade (PG) binder to evaluate rutting susceptibility of the mixture. Air voids shall
be determined through the measurement of the bulk specific gravity (AASHTO T 166, T275 or T331) after sawing. For test result verification purposes, laboratory-compacted specimens shall be compacted to a common air void content in accordance with T340.

15.4.4 **Durability:** Bulk mixture test specimens shall be compacted to 150-mm diameter. The amount and type of anti-strip additive included in test mixture shall be recorded and the WMA Appendix to AASHTO R 35 shall be followed for evaluation of moisture sensitivity using AASHTO T 283. Specimens shall be conditioned in accordance with AASHTO R30 long-term conditioning requirements. One (1) freeze/thaw cycle shall be included in the test sequence. AASHTO T 283 and T 324 tests shall be run on both specimens prepared from bulk mixture sampled during production and on those extracted from the pavement mat at the accelerated pavement testing facility.

16. **SUMMARY OF LABORATORY TESTS:**

**Binder:**

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>STANDARD</th>
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<tbody>
<tr>
<td>Continuous Grade of Asphalt Binder</td>
<td>AASHTO M320 and T315</td>
</tr>
<tr>
<td>Continuous Grade of Warm Mix modified asphalt binder</td>
<td>AASHTO M320 and T315</td>
</tr>
<tr>
<td>Continuous Grade of Extracted Binder</td>
<td>T164 Method A, AASHTO M320 and T315</td>
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**Aggregates:**

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<tr>
<th>PROPERTY</th>
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<tr>
<td>Gradation</td>
<td>AASHTO T 27</td>
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<tr>
<td>Bulk specific gravity and absorption</td>
<td>AASHTO T 84 and T 85</td>
</tr>
<tr>
<td>Flat and elongated or AIMS method</td>
<td>ASTM D 4791 or use state or contractor data</td>
</tr>
<tr>
<td>Sand equivalent</td>
<td>AASHTO T 176 or use state or contractor data</td>
</tr>
<tr>
<td>Stockpile moisture content</td>
<td>AASHTO T 255 or use state or contractor data</td>
</tr>
<tr>
<td>Coarse aggregate angularity</td>
<td>AASHTO T 335 or use state or contractor data</td>
</tr>
<tr>
<td>Fine aggregate uncompacted voids</td>
<td>AASHTO T 304 or use state or contractor data</td>
</tr>
<tr>
<td>Geologic type</td>
<td>Use state or contractor data</td>
</tr>
<tr>
<td>Soundness</td>
<td>AASHTO T 104 or use state or contractor data</td>
</tr>
<tr>
<td>LA abrasion or Micro Deval test</td>
<td>AASHTO T 96 and T 327, or use state or contractor data</td>
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**Mixture Volumetric:**

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>STANDARD</th>
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<tr>
<td>Theoretical maximum specific gravity and density of HMA</td>
<td>AASHTO T 209 or D6857</td>
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<tr>
<td>Preparing and Determining Density of HMA Specimens by Means of Superpave Gyratory Compactor</td>
<td>AASHTO R35 and T 312</td>
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Mixture Performance

<table>
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<th>PROPERTY</th>
<th>STANDARD</th>
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<tbody>
<tr>
<td>Mixture design verification with 150-mm diameter</td>
<td>AASHTO T 320</td>
</tr>
<tr>
<td>Rutting</td>
<td>AASHTO TP 79, T 324, and T 340</td>
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<tr>
<td>Dynamic modulus</td>
<td>AASHTO TP 79 / PP 61</td>
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<tr>
<td>Compactability</td>
<td>AASHTO R35 Appendix X2, Section 8.3</td>
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<tr>
<td>Durability</td>
<td>AASHTO T 283 and T 324</td>
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<td>Creep compliance</td>
<td>AASHTO T322</td>
</tr>
<tr>
<td>Fracture energy</td>
<td>ASTM D7313</td>
</tr>
</tbody>
</table>

17. FIELD PERFORMANCE SERVICE TEST:

17.1 Accelerated Pavement Testing: One pavement location will be selected at an accelerated pavement testing facility. Sites will generally have the following characteristics:

- 4-inch (102-mm) WMA surface layer placed in 2 lifts.
- Surface layer mixture will have a nominal maximum aggregate size of 9.5 mm
- Wet, no freeze climate or wet, freeze climate.
- 8-inch (205 mm) stabilized granular aggregate base, suitable for rutting and fatigue cracking testing applications.
- Subgrade conditioned to optimal water content and maximum dry unit weight.
- Field test areas will be a minimum of 200 feet (60-m) long and 12 feet (3.7-m) to 14 feet (4.2-m) wide with sufficient additional area to conduct destructive sampling.
- Equivalent HMA control section shall be adjacent to the WMA section and have the same dimensions, compaction target, aggregate source, mixture design (excepting any elements of the WMA Technology), structure, and traffic applications.
- Load level of 10-kips (44-kN) on single axle and frequency of loading to produce significant distress in the pavement structures within a 12 month period.
- Testing conducted at ambient temperature of the facility location.

17.2 Installation:

17.2.1 The Manufacturer will supply all labor and equipment to completely install the properly sampled and produced WMA mixture. The testing facility will provide site preparation, preparing the subgrade and stabilized base layers. Paving of the WMA and HMA surfaces will be the
Manufacturer’s responsibility in coordination with the testing facility. All materials used in the production of mix shall meet the requirements of the State DOT. At the time of installation the Manufacturer will provide written instructions to the paving contractor for the proper installation of the material.

17.2.2 Traffic control and installation scheduling will be provided by the Field Testing State, if deemed necessary by the nature of the test section construction. The Manufacturer's representative will certify that the WMA mixture produced is constructed in accordance with the construction specifications identified for use and to their satisfaction. If the representative indicates that the installation using their product was unsatisfactory, they will inform the representative of the testing facility of this fact in writing, within one (1) week of the installation. Upon notification, the testing facility 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.

17.2.3 If the Manufacturer is not present during the scheduled production and paving of WMA and HMA sections, all costs associated with labor, materials and equipment, for preparation of the test site, and repair of same will be charged to the Manufacturer.

17.2.4 If an alternate date can be arranged it will be the Manufacturer’s responsibility to furnish traffic control (if necessary), prepare the pavement underlying layers, and provide for the construction and placement of both the HMA control section and the pavement section with WMA manufactured using their technology.

17.3 Field Observations:

17.3.1 Testing will commence upon completion of the installation and continue for one (1) year. Field observations will be made during the installation: at three (3) months and six (6) months (interim); and 12 months (final). Accelerated loading will be applied in equal frequencies and cycles to both the HMA and WMA test sections over a 12-month period.

17.3.2 Field Performance 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 field performance monitoring information:

- Rut depth profile.
- Visual distress survey using Long-Term Pavement Performance (LTPP) manual to capture percentages of fatigue cracking, thermal cracking, and other distress types.
- Falling weight deflectometer (FWD) to predict cracking potential and in situ stiffness.
- In-place thickness and density by extracting 150 mm cores at the frequencies: nine (9) cores at construction; three (3) cores in-wheelpath at three (3), six (6), and 12 months; three (3 cores between three (3), six (6), and 12 months.

17.3.3 During this field evaluation period, if a product fails to the extent that it becomes a safety issue for the traveling public (if installed on an accelerated testing facility that includes real-time traffic), as determined by the Lead Field State representative, the Manufacturer will be charged for the actual cost incurred by the DOT to fix the pavement section. This charge will include all labor, materials, maintenance and protection of traffic (MOT) set-up, and equipment costs.
18. **TESTING FACILITY CRITERIA**

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

18.1 **Facilities Requirements:**

- Provide documentation to demonstrate experience in performing testing of asphalt materials and mixtures.

- Provide verification that it has 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 it uses for testing bituminous materials and mixtures.

- Identify its policies regarding qualifications and training of its staff to ensure 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 ensure a high-quality level of comparative testing results.

- Complete all laboratory testing of the WMA materials within three (3) months from the date samples are received.

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

- Provide verification that the facility has performed all testing procedures in conformance with requirements of the specified individual test methods. The testing facility shall hold accreditation through the AASHTO Accreditation Program, for the testing performed under this program.

18.2 **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.

18.3 **Quality Control/Quality Assurance:**

18.3.1 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.
18.3.2 Testing proficiencies of all technicians shall be evaluated and documented by the laboratory Quality Control Manager. These evaluations shall be performed at six (6)-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.

18.4 Testing Capability:

18.4.1 The testing facility shall be comprised of a single entity or the combination of no more than three (3) entities.

18.4.2 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.

18.4.3 The field testing shall be at an appropriate testing facility as designated by the AASHTO NTPEP Warm Mix Asphalt Technologies Technical Committee.

19. RESUBMITTAL TESTING FREQUENCY

19.1 Any changes made to WMA Technologies require re-submittal to NTPEP for evaluation.

19.2 Technologies that have not changed are required to be resubmitted and tested (in laboratory only) every seven (7) years. A signed certification from the Manufacturer will be required with the seven year re-submittal stating that the technology has not changed since the original submission.

20. TESTING FEES

20.1 Product submittal testing fees are to be paid at time of application.

20.2 Testing fees are assessed to cover all costs associated with laboratory testing, material installation, field evaluation, administrative costs incurred by the NTPEP lead state, report (electronic) 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.

20.3 Laboratories will be reimbursed for testing performed if a system or technology 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.

21. KEYWORDS

DataMine; NTPEP; warm mix asphalt; asphalt
## Warm Mix Asphalt Material Additives

### Time Line (Months)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Details</th>
<th>Duration (Months)</th>
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<td>Coordination Sampling</td>
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