



PRACTICE AND PROCEDURE DIRECTIVE

PPD No. 23b

EFFECTIVE DATE: August 28, 2025

SUBJECT: Requirements for the use of Warm Mix Asphalt (WMA) Technologies in Asphaltic Concrete

1. GENERAL

1.1. This Practice and Procedure Directive (PPD) outlines the requirements for the addition of Warm Mix Asphalt (WMA) technologies in dense-graded asphaltic concrete mixes (ADOT specifications Section 416 and Section 417). These requirements are used in conjunction with, and in addition to, ADOT specifications.

1.2. Warm Mix Asphalt (WMA) is the generic term used to describe the reduction in production, placement, and compaction temperatures, achieved through the application of one, or a combination of several WMA technologies. For purposes of the ADOT specifications, WMA is defined as asphaltic concrete that is produced within the temperature range of 215 to 275 °F. WMA can be produced by one or a combination of several ADOT approved WMA technologies including plant water foaming processes, mineral additives, and chemical additives.

1.3. WMA technologies may be used at the contractor's option provided all requirements of the specifications are met and the WMA technology is approved by ADOT for use in asphaltic concrete. WMA technologies may be used to produce WMA as described above, or may be used in standard asphaltic concrete mixes as a compaction aid or as a component to allow workability in long haul applications.

2. WARM MIX ASPHALT TECHNOLOGY APPROVAL PROCESS

2.1. WMA technologies must be approved by ADOT Materials Group for use in production of asphaltic concrete.

2.2. The "Approved Warm Mix Asphalt (WMA) Technologies List" is maintained by ADOT Materials Group, Pavement Materials Testing Section. The current approved

list is available on the Materials Group homepage through the ADOT intranet (ADOTNet) and the ADOT internet website.

2.3. The following requirements must be met before a WMA technology will be added to the “Approved Warm Mix Asphalt (WMA) Technologies List”:

2.3.1. The WMA technology must be a recognized WMA technology with successful projects constructed nationally, with production of at least 100,000 tons of WMA produced and placed on State DOT highways.

2.3.2. The WMA technology manufacturer must submit documentation from a minimum of three construction projects using the WMA technology on State DOT highways. The documentation must include a mix design with mechanical property test results and the Quality Control/Quality Assurance test results measured during production for each project. The documentation must include DOT contacts and phone numbers, product name and supplier, dates of construction, and the location and highway for each project submitted.

2.3.3. The WMA technology manufacturer must provide documentation and test results showing the effect that the WMA technology has on the rheological properties of virgin asphalt binders beyond such time needed to produce, place, compact, and allow the WMA mixture to cool. Documentation must include asphalt binder performance grade test data over the range of WMA technology percentages recommended by the WMA technology manufacturer and used on past projects.

2.3.4. On a project where WMA is allowed by specification, the WMA technology manufacturer must partner with a contractor and an ADOT Construction District/Project to construct a test section, using the WMA technology. The WMA technology representative must be present for the construction of the test section. The WMA test section must be a separate Lot and the tonnage must be at least 1000 tons, but less than 2000 tons. The Engineer must approve the location of the test section. During construction of the test section, the WMA must meet all ADOT construction acceptance specifications and the test section must show successful performance after construction.

2.3.5. Requests to be included on the “Approved Warm Mix Asphalt (WMA) Technologies List” must be accompanied with the required documentation, and shall be submitted in electronic format (pdf) to the Pavement Materials Testing Engineer at WMA@azdot.gov.

2.3.6. ADOT Materials Group will make the final decision on the approval of WMA technologies.

3. MIX DESIGN REQUIREMENTS FOR WMA MIX DESIGNS

3.1. When a WMA technology is used in the mixture, all specified mix design requirements shall apply to the development of the asphaltic concrete mix design. With the exception of Immersion Compression Testing (Arizona Test Method 802), the mix design may be developed without the WMA technology for all mix design requirements.

3.2. If the contractor, supplier, or WMA technology representative recommends that a full mix design be performed to include the WMA technology, the mix design shall be performed in accordance with the WMA manufacturer's recommended laboratory mixing and laboratory compaction temperatures.

3.3. When a full mix design, including Immersion Compression testing, is performed with the WMA technology, the WMA technology must be added to the mix before testing. The WMA technology must be added to the mix in accordance with the specific type of technology and the recommendations in the National Cooperative Highway Research Program (NCHRP) Report 691 "Mix Design Practices for Warm Mix Asphalt", Appendix A, Section 7. The WMA technology shall be added at the rate anticipated to be used in production of asphaltic concrete.

3.4. Immersion Compression testing shall be performed in accordance with ARIZ 802 (as modified below) with and without the WMA technology in the mix design testing. The test results, both with and without the WMA technology, shall meet the minimum requirements of the specifications and shall be reported in the mix design.

3.4.1. Subsection 3(c) of ARIZ 802 is revised to read:

(a) The temperature of the asphalt, aggregate, and mineral admixture at the time of mixing begins shall be in accordance with the following:

3.4.1.a.1. For testing with WMA technologies, the mixing temperature for the laboratory prepared samples shall be per the WMA technology manufacturer's recommendations, but shall not exceed the maximum anticipated mixing temperature during field production. In making laboratory mixing temperature

recommendations, the WMA technology manufacturer should consider the mixing temperature based on the viscosity-temperature curve for the asphalt which has been modified with the WMA technology as well as the minimum mixing temperature required for adequate coating.

3.4.1.a.2. For mix design testing without the WMA technology, the temperature of the asphalt, aggregate, and mineral admixture at the time mixing begins shall be the mix design laboratory mixing temperature, which is normally based on the viscosity-temperature curve for the asphalt which has not been modified with the WMA additive.

3.4.2. Subsection 5(a) of ARIZ 802 is revised to read:

- (a) Place the samples in an oven maintained at 255 ± 5 °F.
- (b) A mold and bottom plunger for each sample shall be heated to the compaction temperature specified below:

3.4.2.b.1. For mixtures with WMA technology, the samples shall be at a compaction temperature of 255 ± 5 °F, unless an alternative compaction temperature is recommended by the WMA technology manufacturer and approved by the Engineer.

3.4.2.b.2. For mixtures without the WMA technology, the compaction temperature shall be 255 ± 5 °F.

3.5. For WMA water foaming processes, if laboratory water foaming equipment is not available, the specimens for Immersion Compression testing may be fabricated from plant produced mix. The specimens shall be tested as described above except the specimens shall be compacted without allowing the mixture to cool after the sample is obtained. Reheating, aging, or curing will not be allowed. This process must be explained, and the results reported, in the mix design

3.6. When a WMA technology is used in the mixture, the following additional information shall be included in the mix design.

- 1) WMA technology information and/or WMA additive information.
- 2) Recommended temperature range for mixing during production.
- 3) Recommended temperature range for compaction during

- production.
- 4) WMA technology manufacturer's established target rate for water and additives, and the acceptable variation during production.
 - 5) Actual laboratory mixing and compaction temperatures used during mix design testing.
 - 6) Immersion Compression test results as specified in Section 3.4 above

4. CONSTRUCTION AND HOT PLANT REQUIREMENTS

4.1. For asphaltic concrete with WMA technologies, the contractor shall use equipment and WMA technologies capable of producing an asphaltic concrete mixture that meets specification requirements and is workable at the minimum placement and compaction temperature desired, regardless of storage or haul distances.

4.2. The contractor must modify the hot plant as required by the WMA technology manufacturer to introduce the WMA technology. Plant modifications may include additional plant instrumentation, the installation of asphalt binder foaming systems and/or WMA additive delivery systems, adjusting the plant burner and/or the mixing drum flights in order to operate at lower production temperatures, and/or reducing the production rate of WMA.

4.3. ADOT specifications require that the moisture content of the asphaltic concrete immediately behind the paver does not exceed 0.5 percent. To ensure that this requirement is met, the contractor shall implement best management practices in the control of aggregate moisture prior to the introduction of aggregate into the drying or mixing drum, as well as during WMA production.

4.4. It may be beneficial to produce the asphaltic concrete mixture at conventional temperatures immediately before WMA production at the lower temperatures in order to bring the plant up to temperature and ensure proper baghouse operation.

4.5. The WMA mix shall be inspected at the hot plant and on the grade to ensure that aggregate is fully coated during WMA production. If complete aggregate coating is not achieved, modifications to current production shall be made to produce an asphaltic concrete mixture with fully coated aggregate.

5. ACCEPTANCE TESTING

5.1. When a WMA technology is used in the mixture, all specified acceptance testing requirements in the specifications shall apply to the asphaltic concrete mix. Acceptance testing for the WMA mix will be performed at the same frequency and with the same requirements in the specifications for asphaltic concrete.

5.2. When producing asphaltic concrete with WMA technologies, samples for mixture properties acceptance testing shall be allowed to cool and then be reheated prior to testing. Acceptance samples shall be prepared and split in accordance with AASHTO R 47. Unless the WMA technology remains active in the mix, the compaction temperature for preparing Marshall or Gyratory specimens in accordance with ARIZ 410 or AASHTO T 312, respectively, shall be based on the laboratory compaction temperature of the original binder. If the WMA technology remains active in the mix after the time needed to cool and reheat the sample, the mix designer shall specify alternative laboratory compaction temperatures for AASHTO R 68 ~~ARIZ 410~~ and AASHTO T 312. Additional heating or aging of samples beyond that required in AASHTO R 68, T 245, T R 47, T 209, and AASHTO T 312 shall not be allowed.

5.3. Additional moisture content testing shall be performed when WMA technologies are used in asphaltic concrete. There is additional concern of moisture in the mix during WMA production due to the lower hot plant temperatures, especially with highly absorptive aggregates. To ensure that the moisture content of the asphaltic concrete behind the paver does not exceed the specified maximum of 0.5 percent, separate moisture content samples shall be taken at a frequency determined by the Engineer.

5.4. If the WMA technology alters the asphalt binder rheological properties beyond such time needed to produce, place, compact, and allow the mixture to cool, sampling for acceptance testing of the binder shall occur after the WMA additive is added to the binder. In such case, the mixing of the binder and the WMA technology shall be performed at the asphalt terminal, and sampling will be accomplished after delivery of the binder to the hot plant.