

APPROVED:
Division Administrator

By: _____
FEDERAL HIGHWAY ADMINISTRATION

Supplemental Technical Specification for

Warm Mix Asphalt (WMA)

SCDOT Designation: SC-M-408 (01/22)

1. SCOPE

- 1.1 This is a specification intended for use in placing Warm Mix Asphalt (WMA) on highways, primary and secondary routes.

This work consists of an asphalt mixture composed of mineral aggregate, aggregate screening, natural sand, asphalt binder, hydrated lime or liquid anti-strip additive (LASA) mixed in an accepted asphalt hot mix plant. The mixtures will be produced in a SCDOT qualified asphalt plant that has been equipped with a foaming system or uses additives listed on Qualified Product List No. 77 to produce Warm Mix Asphalt (WMA). All foaming asphalt plants and additives used for this type of technology must be accepted by the Asphalt Materials Manager prior to production of this product. The asphalt mixes must be placed on a prepared surface in accordance with these Supplemental Specifications, applicable sections of the Standard Specifications, other appropriate Special Provisions and in conformity with the plans. WMA will use the same acceptance criteria for conventional hot mix asphalt mixes.

2. REFERENCED DOCUMENTS

- 2.1 SCDOT Standard Specifications
- 2.1.1 Division 300, 400, SC-M-401, SC-M-402, SC-M-406, and SC-M-407
- 2.2 AASHTO Standards
- 2.2.1 AASHTO M303 and M320, M332
- 2.3 SCDOT Test Methods
- 2.3.1 SC-T-70, SC-T-75, SC-T-80, SC-T-84, SC-T-88, and SC-T-90

3. MATERIALS

- 3.1 Aggregate: Ensure that aggregates used in the production of Warm Mix Asphalt (WMA) meet the requirements found in the SC-M-402 and in SC-M-407 without exception. Aggregates used in OGFC mixtures must also meet section 409.
- 3.2 Asphalt Binder: Ensure that the binder complies with the requirements of the SCDOT Standard Specifications for Asphalt Binder and Additives. Additives used in the production of the WMA must be pre-blended with the PG Binder at the asphalt terminal. PG binders that have chemical additives added must be heat and storage stable and continue to meet AASHTO M 320 and M332 (64V Grading for PG 76-22).
- 3.3 Anti-Strip Additives: Ensure when hydrated lime is required in mixes by SC-M-402, and the lime meets the requirements of AASHTO M 303 Type 1. Ensure that the hydrated lime if used is blended with the damp aggregate at a rate of 1.0% +/- 0.1 % by weight of dry aggregate. Ensure that blending of the hydrated lime is accomplished according to subsection 401.2.1.3. If SC-M-402 or any

other Standard or Supplemental Specification allows for LASA to be used in the mixture, ensure that the additive is terminally blended as described in SC-M-406.

- 3.4 Water: Ensure that potable water is used in water injection systems for foaming the asphalt binder.

4. MIX DESIGN

- 4.1 Warm mix designs utilize the same asphalt binder grade, aggregate and RAP sources, and material gradations as identically-formulated hot mix asphalt (HMA), although it may be in a HMA Contractor's benefit to provide additional equipment in their mix design laboratories to establish or simulate the foaming process to set optimum binder content and volumetric properties. WMA mix designs utilizing additives will use asphalt that may be pre-blended from the asphalt terminal or may be introduced by adding the correct dosage of additives to establish mix design volumetric properties. Additional equipment may be required by the WMA additive manufacturer in the design process to ensure the proper dosage and to achieve a homogenous mixture. When the WMA additives also provide anti-stripping properties, hydrated lime or additional LASA are not required provided that the mixture meets the requirements of SC-M-406. Additive manufacturers will provide documentation of proper mixing and compaction temperatures to produce and compact WMA mixtures. Ensure that WMA mixtures comply with SC-M-402.

Design WMA job mix formulas in accordance with SC-T-80 and SC-T-88 for OGFC designs. Ensure that all designs are accepted by the Materials and Research Engineer prior to use on SCDOT work. Ensure that mix designs are prepared in a laboratory approved by the Asphalt Materials Manager and by technicians certified as a SCDOT Level 2, HMA Job Mix Technician. Ensure that technicians are trained on the use of foaming equipment if necessary to provide mix designs that will comply with all specifications herein and in the applicable Standard Specifications, Supplemental Specifications, and Special Provisions.

5. FIELD REQUIREMENTS

- 5.1 Ensure that all WMA Systems or Additives used are listed on QPL No. 77. WMA foaming systems and additives are used to allow lower asphalt mix temperature. Use foaming equipment or an additive that is compatible with the asphalt plant and acceptable to the Asphalt Materials Manager in producing WMA, and ensure that asphalt plant conforms to SC-M-401 after any modification. Ensure that the burner in the aggregate dryer is properly adjusted so that there is no burner fuel in the WMA and free from excessive moisture.
- 5.2 Ensure that on any WMA foaming system, a trial run is done so all plant controls and metering equipment can be verified to be working accurately prior to production.
- 5.3 Ensure that all WMA mixtures are stored a maximum of 18 hours in a separate storage silo from conventional HMA mixtures.
- 5.4 Ensure that only one WMA foaming system or WMA additive is used during a day of production of WMA mixtures.
- 5.5 **Water Injection Foaming Systems**
- 5.5.1 The use of a water injection system is not permitted on an asphalt batch plant.

- 5.5.2 Ensure that the foaming system manufacturer can provide technical assistance to the WMA producer by having a representative on site in the event of issues arising during use of the system within 24 hours of identifying problem.
- 5.5.3 Ensure that injection equipment is tied into the computer in the plant control room so that metering of the injected water can be continuously monitored by the plant operator.
- 5.5.4 Ensure that injection systems have variable water injection that is automatically controlled by the plant production rate. Do not allow water injection system to exceed 2.0% water by weight of asphalt binder.
- 5.5.5 Ensure that the water injection rate cannot be manually overridden by the plant operator once established in the plant's computer.
- 5.5.6 Ensure that if control or equipment failure in the injection system occurs or if the injection equipment stops water flow, the computer system immediately notifies the plant operator and all WMA production is stopped until the water injection system is repaired and checked by the contractor's quality control manager before WMA production resumes.
- 5.5.7 Ensure that the water injects into the asphalt binder flow before the asphalt binder spray makes contact with aggregate. Do not allow water to come in contact with aggregate prior to binder spray.
- 5.5.8 Ensure that the injection equipment includes water storage and a pump control that is tied into the injection computer controls.
- 5.5.9 Ensure that the water flow alarm is installed in the control room to indicate a shortage of water in the storage tank, or a disruption in the water flow equipment.
- 5.5.10 Provide an additional asphalt binder sampling valve at the injection equipment to sample binder prior to the spray system.
- 5.5.11 Heat and prepare the materials in a manner that produces a warm mixture that, when discharged, is at a mixture temperature that can be maintained from **220°F F - 285°F (for mixes that contain PG 64-22)**. Use SC-T-84 to measure mix temperature at the asphalt plant and on the road in the delivery trucks.
- 5.5.12 Prior to full production of WMA mixtures for the Department; One set of plant produced gyratory specimens will be required to be made as per SC-T-70, and specimens must be submitted to the SCDOT OMR laboratory in Columbia for final job mix verification. The cores must be brought by the contractor to OMR, and once they are received, the ITS verification will be done and reported to the contractor within 5 calendar days. If the results do not meet the field requirements in SC-M-406, the mix design will be rejected by the Department. This will apply when foaming plants are used in conjunction with LASA additives to ensure moisture susceptibility requirements are being met.
- 5.5.13 Production of an OGFC or a Surface Type A using water injection foaming systems will not be permitted.

5.6 **WMA Additives**

- 5.6.1 Ensure that the liquid additive has been pre-blended at the asphalt terminal and has been documented on the Bill of Lading (BOL) coming from the binder supplier. Ensure that the percent additive added to the PG Binder is printed on the BOL. Store the binder in a storage tank without any contamination from

previous loads of asphalt binder. Label binder storage tanks noting the addition of WMA additives. All other WMA non-liquid additives must be clearly identified at the asphalt plant and the WMA producer must have all documentation for the additives readily available for review at the asphalt plant.

- 5.6.2 Ensure that the WMA additive and metering equipment manufacturer can provide technical assistance to the WMA producer or asphalt binder terminal by having a representative on site in the event of issues arising during use of the system within 24 hours of identifying a problem.
- 5.6.3 Heat and prepare the materials in a manner that produces a warm mixture that, when discharged, is at a mixture temperature that can be maintained from **220 °F - 285°F (for mixes that contain PG 64-22)**. Use SC-T-84 to measure mix temperature at the asphalt plant and on the road in the delivery trucks.
- 5.6.4 WMA additives must be pre-approved by the Asphalt Materials Manager prior to being used specifically in OGFC and SMA mixtures containing PG 76-22. Produce the WMA OGFC or SMA mixtures not to exceed the maximum temperature specified on the Job Mix Formula to prevent drain-down of the PG binder in the mixture. SMA mixtures typically use WMA additives as a compaction aid, however are not typically produced in the WMA temperature range due to the abundance of amount of "mastic material" found in these mixtures.

6. QUALITY CONTROL

- 6.1 Provide the Asphalt Materials Manager, at least 30 days prior to starting production, a QC Plan to document the manufacturer's suggestions for target production rates when using water injection equipment in foaming systems or when using WMA additives, and produce an outline with acceptable variations at the asphalt plant and acknowledge that the mixture will remain within 220 °F-285°F (PG 64-22) at all times.
- 6.2 Ensure that laboratory compaction ranges are established in the QC Plan used for making gyratory specimens for mix acceptance.
- 6.3 Ensure that all WMA samples taken for field determination of binder content are dried to constant weight (no moisture present) if necessary prior to running SC-T-75 as outlined in the WMA QC Plan.
- 6.4 Perform Indirect Tensile Strength (ITS) testing using SC-T-70 at least one time during the first day's production, then at least once every 90 calendar days thereafter per SC-M-400. Forward the results by e-mail to the Asphalt Materials Manager immediately upon completion. Failure to comply with requirement will cause Asphalt Materials Manager to immediately suspend production. Re-design will be required for any job mix formula which fails to meet Tensile Strength Ratio (TSR) field requirements.
- 6.5 When using WMA Open Graded Friction Course (OGFC) and Stone Matrix Asphalt (SMA), perform drain-down testing using SC-T-90 at least one time during the first day's production, then at least once every 7 production days thereafter.
 - 6.5.1 If a drain-down test produces a resulting retention coating of less than 95.0%, conduct drain-down testing at least once every 3 production days thereafter until a result of 95.0% or higher is obtained.

6.5.2 If a drain-down test produces a resulting retention coating of less than 90.0%, immediately stop production and contact the Asphalt Materials Manager.

7. CONSTRUCTION

- 7.1 Seasonal and Ambient Air Temperatures: Ensure that ambient air temperatures and seasonal restrictions during placement of WMA follow the requirements set forth in subsection 401.4.4 of the Standard Specifications without exception.
- 7.2 Failure to comply with WMA mix temperature requirements as stated in the section 6.1 and the Contractors QC plan will result in mix being rejected.

8. FIELD ACCEPTANCE

- 8.1 During the production and quality control of WMA, make all necessary provisions to ensure that plant unit operations comply with SCDOT specifications regarding the production of HMA as stipulated in Division 400 and SC-M-401.

9. MEASUREMENT

- 9.1 Measure and accept WMA mixtures by the ton or square yard placed.

10. PAYMENT

- 10.1 WMA Mixtures will be paid for at the contract unit price which will be full compensation for furnishing all materials, equipment, and labor.
Payment will be made under:

Item No.	Pay Item	Unit
4110310	WMA Base Course Type A	TON
4110320	WMA Base Course Type B	TON
4110330	WMA Base Course Type C	TON
4110340	WMA Base Course Type D	TON
4110400	WMA Shoulder Widening Course	TON
4112310	WMA Intermediate Course Type A	TON
4112320	WMA Intermediate Course Type B	TON
4112321	WMA Intermediate Course Type B Special	TON
4112330	WMA Intermediate Course Type C	TON
4113310	WMA Surface Course Type A	TON
4113320	WMA Surface Course Type B	TON
4113340	WMA Surface Course Type C	TON
4113350	WMA Surface Course Type D	TON
4113360	WMA Surface Course Type E	TON

4113630	WMA Preventative Maintenance Course	SY
4114000	WMA Open Graded Friction Course	TON