

*New Jersey Department of Transportation*  
1035 Parkway Avenue, PO Box 600, Trenton, New Jersey 08625-0600



## *Baseline Document Change Announcement*

**ANNOUNCEMENT: BDC14S-07**

**DATE: August 29, 2014**

**SUBJECT: Warm Mix Asphalt (WMA) Additives**  
**- Revision to Subparts/Subsections 401.02.01, 401.03.02, 401.03.03, 401.04, 403.02.02, 403.03.01, 403.04, 404.03.01, 406.03.01, 902.01.01, 902.02.01, 902.02.02, 902.02.03, 902.02.04, 902.03.01, 902.04.01, 902.04.02, 902.04.03, 902.05.01, 902.05.02, 902.05.03, 902.06.01 and 902.06.03 of the 2007 Standard Specifications for Road and Bridge Construction. Addition of Subpart 902.01.05 and Subsections 902.07 and 902.08 to the 2007 Standard Specifications.**

Various Subsections/Subparts of Divisions 400 and 900 of the 2007 Standard Specifications for Road and Bridge Construction have been revised to permit the contractors to use the Warm Mix Asphalt (WMA) additives in all HMA mixes.

It is expected that the use of WMA additives in the HMA will promote better compaction results in the paving operations. These additives also reduce the heating temperature requirements which in turn will result into lowered VOC's. Therefore, the HMA containing WMA additives are better for the environment.

In addition, the HMA mixes and the Items designated by compaction level High (H) have been eliminated. The binder designated by PG 76-22 is replaced by PG 64E-22 for the mixes requiring the Polymer modified asphalt. The outdated NJDOT test method B-5, Hot-Bins has been deleted. The subsequent test methods and their corresponding numbers in 'B' series will be maintained. The acceptance of the HMA mixes will be based on sample-by-sample basis, therefore, all the reference to testing "lots" at HMA plants have been eliminated.

**The following revisions have been incorporated into the Standard Input SI2007 as of August 29, 2014.**

**401.02.01 Materials**

THE FOLLOWING IS ADDED TO THE MATERIALS LIST

Polymer Modified Tack Coat..... 902.01.04

**401.03.02 Tack Coat and Prime Coat**

THE ENTIRE TEXT IS CHANGED TO:

Clean the surface where the HMA is to be placed of foreign and loose material. Immediately before beginning paving operations, ensure that the surface is dry. Do not place tack coat or prime coat unless the weather restrictions, as specified in 401.03.03.B, are met.

Do not apply tack coat or prime coat to asphalt-stabilized drainage course.

For curbs, gutters, manholes, and other similar structures, do not apply tack coat or prime coat. Clean the exposed surfaces of these structures and apply a uniform coating of polymerized joint adhesive to contact surfaces before paving.

In areas inaccessible to distributor spray bars, use hand spraying equipment for tack and prime coat. Do not allow traffic on tack coated or prime coated surfaces. Treat surfaces as follows:

1. **Tack Coat.** Uniformly spray tack coat when placing HMA on paved surfaces. Apply tack coat only to areas to be paved in the same day. Apply tack coat as specified in Table 401.03.02-1:

<b>Table 401.03.02-1 Tack Coat Application</b>			
<b>Material</b>	<b>Spraying Temp, °F</b>	<b>Gallons per Square Yard</b>	<b>Season</b>
<b>Cut-Back Asphalt:</b>			
RC-70	120 to 190	0.05 to 0.15	Oct 15 to Apr 15
<b>Emulsified Asphalt:</b>			
RS-1	70 to 140	0.05 to 0.15	All year
CRS-1	125 to 185	0.05 to 0.15	All year
SS-1, SS-1h	70 to 140	0.05 to 0.15	All year
CSS-1, CSS-1h	70 to 140	0.05 to 0.15	All year

Correct uncoated or lightly coated areas. Blot areas showing an excess of tack coat with sand or other similar material. Remove blotting material before paving. Ensure that the material is not streaked or ribboned.

Before paving, allow tack coat to cure to a condition that is tacky to the touch.

2. **Tack Coat 64-22.** When precipitation has occurred within 24 hours before application, the RE will determine whether to allow the work to proceed, or to wait until the surface is completely dry. Only apply tack coat that can be paved over in the same day. Apply tack coat 64-22 at a rate of 0.06 to 0.14 gallons per square yard and at a spraying temperature of 325 °F. Adjust the spraying temperature and application rate to produce a uniform coating, with no excess material.

Correct uncoated or lightly coated areas and remove excess tack coat from affected areas. Ensure that the material is not streaked or ribboned.

3. **Polymer Modified Tack Coat.** Apply polymer modified tack coat with an ultra-thin paver at a temperature of 140 to 175 °F. Continuously monitor rate of spray, ensuring a uniform application rate over entire width to be overlaid. Apply at the rate of 0.20 ± 0.05 gallons per square yard. Do not allow traffic, equipment, tools, or any other disturbance to the polymer modified tack coat before placing the ultra-thin friction course.

4. **Prime Coat.** Apply prime coat of cut-back asphalt on unpaved surfaces as follows:

<b>Table 401.03.02-2 Prime Coat Application</b>			
<b>Cut-Back Asphalt</b>	<b>Spraying Temp, °F</b>	<b>Gallons per Square Yard</b>	<b>Season</b>
MC-30	85 to 150	0.1 to 0.5	Oct 15 to Apr 15
MC-70	120 to 190	0.1 to 0.5	Oct 15 to Apr 15
<b>Emulsified Asphalt:</b>			
CSS-1	70 to 140	0.1 to 0.50	All year

Apply prime coat at least 12 hours before placement of the HMA and when the base courses are not saturated or frozen. Unless the prime coat is under asphalt-stabilized drainage course, the RE may waive the application of prime coat if more than 5 inches of HMA is placed on the unbound aggregate course before the roadway is opened to traffic. Take measures to prevent prime coat from entering into the drainage system or extending beyond the area to be paved.

**401.03.03 HMA Courses**

**A. Paving Plan.**

THE FOLLOWING IS ADDED AT THE END OF THE FIRST PARAGRAPH:

- 15. If applicable, the warm mix asphalt additive or process being used.

**C. Test Strip.**

THE FOLLOWING IS ADDED AT THE END OF THE FIRST PARAGRAPH:

- 7. **Warm Mix Asphalt.** Note the warm mix asphalt additive or process, if used.

**G. Opening to Traffic.**

THE ENTIRE TEXT IS CHANGED TO:

Remove loose material from the traveled way, shoulder, and auxiliary lanes before opening to traffic. Open HMA courses to traffic or construction equipment, including paving equipment, only after the surface temperatures meet the following requirements:

- 1. When using PG 64-22, do not allow traffic or construction equipment on the HMA course until the surface temperature is less than 140 °F.
- 2. When using PG 64E-22, do not allow traffic or construction equipment on the HMA course until the surface temperature is less than 170 °F.
- 3. When using Warm Mix Asphalt, do not allow traffic or construction equipment on the HMA course until the surface temperature is less than 120 °F.

**H. Air Void Requirements.**

THE FIRST PARAGRAPH IS CHANGED TO:

Mainline lots are defined as the area covered by a day’s paving production of the same job mix formula for the traveled way and auxiliary lanes. The RE may combine daily production areas less than 1000 tons with previous or subsequent production areas. If a day’s production is greater than 4000 tons, the RE may divide the area of HMA placed into 2 lots with approximately equal areas.

**401.04 MEASUREMENT AND PAYMENT**

THE FOLLOWING ITEM IS ADDED:

<i>Item</i>	<i>Pay Unit</i>
POLYMER MODIFIED TACK COAT	GALLON

THE FOLLOWING IS ADDED:

The Department will measure POLYMER MODIFIED TACK COAT by the volume delivered, converted to the number of gallons at 60 °F as calculated by the temperature-volume correction factors specified in 902.01.

**403.02.02 Equipment**

THE FOLLOWING IS ADDED TO THE EQUIPMENT LIST

Materials Transfer Vehicle (MTV) .....	1003.01
--	---------

**403.03.01 Ultra-Thin Friction Course**

THE ENTIRE TEXT IS CHANGED TO:

- A. Paving Plan.** At least 20 days before the start of placing the ultra-thin friction course, submit a detailed plan of operation to the RE for approval as specified in 401.03.03.A.
- B. Weather Limitations.** Do not place ultra-thin friction course if it is precipitating. Do not allow trucks to leave the plant when precipitation is imminent. The Contractor may resume operations when the precipitation has stopped and the surface is free of water.

Do not pave if the base temperature is below 50 °F.

**C. Test Strip.** Construct a test strip for the first 700 to 1200 square yards placed of ultra-thin friction course. Operate spray paver without mix to determine tack coat application rate for the project. Ensure that the polymer modified tack coat has been placed as specified in 401.03.02. Transport and deliver, spread and grade, and compact as specified in 403.03.02.D, 403.03.02.E, and 403.03.02.F, respectively, and according to the approved paving plan. While constructing the test strip, record the following information and submit to the RE:

1. **Ambient Temperature.** Measure ambient temperature at the beginning and end of each day's paving operation.
2. **Base Temperature.** Measure the surface temperature of the existing base before paving.
3. **Polymer Modified Tack Coat.** Measure to verify the proper application of tack coat and the rate for compliance.
4. **HMA Temperature.** Measure the temperature of the ultra-thin HMA immediately after placement.
5. **Roller Pattern.** Provide details on the number of rollers, type, and number of passes used on the test strip.
6. **Quality Control Cores for Yield and Thickness.** Take 3 randomly selected quality control cores to test for compliance to the specified yield in 403.03.02.E.

Use drilling equipment with a water-cooled, diamond-tipped, masonry drill bit that shall produce 6-inch nominal diameter cores for the full depth of the pavement. Remove the core from the pavement without damaging it. After removing the core, remove all water from the hole. Fill the hole with HMA or cold patching material, and compact the material so that it is 1/4 inch above the surrounding pavement surface.

Submit test strip results to the RE. The RE will analyze the test strip results in conjunction with the ME's results from the HMA plant to approve the test strip. Do not proceed with production paving until receiving written permission from the RE.

If the test strip does not meet requirements, make adjustments and construct a second test strip. If the second test strip does not meet requirements, suspend paving operations until written approval to proceed is received.

Before making adjustments to the paving operations, notify the RE in writing.

**D. Transportation and Delivery of HMA.** Transport and deliver HMA as specified in 401.03.03.D. Use of an MTV is optional.

**E. Spreading and Grading.** Ensure that the surface where the ultra-thin friction course is placed is clean of foreign and loose material. Clean the surface of existing pavement using a self-propelled power broom equipped with a vacuum collection system before placing the ultra-thin friction course. Ensure that the surface is dry when the paving operations are about to start.

Apply polymer modified tack as specified in 401.03.02. Do not allow traffic, equipment, tools, or any other disturbance to the polymer modified tack coat before placing the ultra-thin friction course.

Ensure that the temperature of the ultra-thin friction course behind the screed is between 280 °F and 325 °F. Within 3 seconds of applying the polymer modified tack coat, place ultra-thin friction course at a rate of 65 to 95 pounds per square yard.

Construct longitudinal joints as specified in 401.03.03.E.1. If constructing a cold longitudinal joint, construct a butt joint and do not use polymerized joint adhesive. Construct transverse joints as specified in 401.03.03.E.2.

**F. Compacting.** Compact ultra-thin friction course as specified in 401.03.03.F. Use a minimum of two 10-ton steel-wheel rollers. If vibratory compaction causes aggregate breakdown or forces liquid asphalt binder to the surface, operate rollers in static mode only.

**G. Opening to Traffic.** Remove loose material from the traveled way before opening to traffic. Do not allow construction equipment or traffic on the ultra-thin friction course until the mat cools to a temperature of less than 140 °F.

**H. Thickness Requirements.** When required for thickness determination, drill cores as specified in 401.03.05. The Department will calculate total thickness as specified in 401.03.03.I. The Department will not evaluate surface thickness.

- I. Ride Quality Requirements.** The Department will evaluate the surface course placed in the traveled way as specified in 401.03.03.J.

#### 403.04 MEASUREMENT AND PAYMENT

THE FOLLOWING IS ADDED:

The Department will make payment for POLYMER MODIFIED TACK COAT as specified in 401.04.

#### 404.03.01 SMA

#### H. Air Void Requirements.

THIS PART IS CHANGED TO:

Drill cores as specified in 401.03.05.

Mainline lots are defined as the area covered by a day's paving production of the same job mix formula for the traveled way and auxiliary lanes. The RE may combine daily production areas less than 1000 tons with previous or subsequent production areas. If a day's production is greater than 4000 tons, the RE may divide the area of HMA placed into 2 lots with approximately equal areas.

Ramp pavement lots are defined as approximately 10,000 square yards of pavement in ramps. The RE may combine ramps with less than the minimum area into a single lot. If 2 or more ramps are included in a single lot, the RE will require additional cores to ensure that at least 1 core is taken from each ramp.

Other pavement lots are defined as approximately 10,000 square yards of pavement in shoulders and other undefined areas.

The ME will calculate the percent defective (PD) as the percentage of the lot outside the acceptable range of 1 percent air voids to 7 percent air voids. The acceptable quality limit is 10 percent defective. For lots in which PD < 10, the Department will award a positive pay adjustment. For lots in which PD > 10, the Department will assess a negative pay adjustment.

The ME will determine air voids from 5 cores taken from each lot in random locations. The ME will determine air voids of cores from the values for the maximum specific gravity of the mix and the bulk specific gravity of the core. The ME will determine the maximum specific gravity of the mix according to NJDOT B-3 and AASHTO T 209, except that minimum sample size may be waived in order to use a 6-inch diameter core sample. The ME will determine the bulk specific gravity of the compacted mixture by testing each core according to AASHTO T 166.

The ME will calculate pay adjustments based on the following:

- 1. Sample Mean ( $\bar{X}$ ) and Standard Deviation (S) of the N Test Results ( $X_1, X_2, \dots, X_N$ ).**

$$\bar{X} = \frac{(X_1 + X_2 + \dots + X_N)}{N}$$

$$S = \sqrt{\frac{(X_1 - \bar{X})^2 + (X_2 - \bar{X})^2 + \dots + (X_N - \bar{X})^2}{N - 1}}$$

- 2. Quality Index (Q).**

$$Q_L = \frac{(\bar{X} - 1.0)}{S}$$

$$Q_U = \frac{(7.0 - \bar{X})}{S}$$

- 3. Percent Defective (PD).** Using NJDOT ST for the appropriate sample size, the Department will determine PD<sub>L</sub> and PD<sub>U</sub> associated with Q<sub>L</sub> and Q<sub>U</sub>, respectively. PD = PD<sub>L</sub> + PD<sub>U</sub>

4. **Percent Pay Adjustment (PPA).** Calculate the PPA for traveled way and ramp lots as specified in Table 401.03.03-3.

Table 404.03.01-1 PPA for Mainline Lots and Ramp Lots		
	Quality	PPA
Surface	PD < 10	PPA = 4 - (0.4 PD)
	10 ≤ PD < 30	PPA = 1 - (0.1 PD)
	PD ≥ 30	PPA = 40 - (1.4 PD)
Intermediate and Base	PD < 30	PPA = 1 - (0.1 PD)
	PD ≥ 30	PPA = 40 - (1.4 PD)

Calculate the PPA for other pavement lots as specified in Table 401.03.03-4.

Table 404.03.01-2 PPA for Other Pavement Lots		
	Quality	PPA
All Courses	PD < 50	PPA = 1 - (0.1 PD)
	PD ≥ 50	PPA = 92 - (1.92 PD)

5. **Outlier Detection.** The ME will screen all acceptance cores for outliers using a statistically valid procedure. If an outlier is detected, replace that core by taking an additional core at the same offset and within 5 feet of the original station. The following procedure applies only for a sample size of 5.

1. The ME will arrange the 5 core results in ascending order, in which  $X_1$  represents the smallest value and  $X_5$  represents the largest value.
2. If  $X_5$  is suspected of being an outlier, the ME will calculate:

$$R = \frac{X_5 - X_4}{X_5 - X_1}$$

3. If  $X_1$  is suspected of being an outlier, the ME will calculate:

$$R = \frac{X_2 - X_1}{X_5 - X_1}$$

4. If  $R > 0.642$ , the value is judged to be statistically significant and the core is excluded.

6. **Retest.** If the initial series of 5 cores produces a percent defective value of  $PD \geq 30$  for mainline or ramp lots, or  $PD \geq 50$  for other pavement lots, the Contractor may elect to take an additional set of 5 cores at random locations chosen by the ME. Take the additional cores within 15 days of receipt of the initial core results. If the additional cores are not taken within the 15 days, the ME will use the initial core results to determine the PPA. If the additional cores are taken, the ME will recalculate the PPA using the combined results from the 10 cores.
7. **Removal and Replacement.** If the final lot  $PD \geq 75$  (based on the combined set of 10 cores or 5 cores if the Contractor does not take additional cores), remove and replace the lot and all overlying work. The replacement work is subject to the same requirements as the initial work.

#### 406.03.01 High Performance Thin Overlay (HPTO)

##### H. Air Void Requirements on Roadway.

THE FIRST PARAGRAPH AS IT APPEARS IN THE SI IS CHANGED TO:

Drill cores as specified in 401.03.05. Mainline lots are defined as the area covered by a day's paving production of the same job mix formula for the traveled way and auxiliary lanes. The RE may combine daily production areas less than 500 tons with previous or subsequent production areas. If a day's production is greater than 2000 tons, the RE may divide the area of HMA placed into 2 lots with approximately equal areas.

**902.01.01 Asphalt Binder**

THE SECOND PARAGRAPH IS CHANGED TO:

When specified, use PG 64E-22 asphalt binder that is a storage-stable and conforms to AASHTO MP 19 (AASHTO M 332), including compliance with the elastic response requirement in Appendix 1.

THE FOLLOWING SUBPART IS ADDED:

**902.01.05 Warm Mix Asphalt (WMA) Additives and Processes**

Use a WMA additive or process that is listed on the Northeast Asphalt User/Producer Group (NEAUPG) Qualified WMA Technologies List which can be found at the following website: <http://www.neaupg.uconn.edu/>

If an approved HMA mix design is used, a separate mix design with WMA additives or processes is not required.

Submit information on the WMA additive or process with the Paving Plan required in 401.03.06.A. For controlled foaming systems, also submit the operating parameters of the system including accuracy of the meter, operating range, and temperature of the binder. Provide the target and operating tolerances for the percent water injection and temperatures for the binder. Provide a method for validating this with changing production rates.

Ensure that a technical representative of the manufacturer is on-site or available for consultation for the first day or night of production.

**902.02.01 Mix Designations**

THE ENTIRE SUBPART IS CHANGED TO:

The requirements for specific HMA mixtures are identified by the abbreviated fields in the Item description as defined as follows:

**HOT MIX ASPHALT 12.5ME SURFACE COURSE**

1. **“HOT MIX ASPHALT”** “Hot Mix Asphalt” is located in the first field in the Item description for the purpose of identifying the mixture requirements.
2. **“12.5”** The second field in the Item description designates the nominal maximum size aggregate (in millimeters) for the job mix formula (sizes are 4.75, 9.5, 12.5, 19, 25, and 37.5 mm).
3. **“M”** The third field in the Item description designates the design compaction level for the job mix formula based on traffic forecasts as listed in Table 902.02.03-2 (levels are L=low and M=medium).
4. **“E”** The fourth field in the Item description designates the high temperature designation of the performance-graded binder. Options are “64” for PG 64-22 and “E” for PG 64E-22.
5. **“SURFACE COURSE”** The last field in the Item description designates the intended use and location within the pavement structure (options are surface, intermediate, or base course).

**902.02.02 Composition of Mixtures**

THE ENTIRE SUBPART IS CHANGED TO:

Provide materials as specified:

Aggregates for Hot Mix Asphalt.....	901.05
Asphalt Binder .....	902.01.01
Warm Mix Additives and Processes (optional).....	902.01.05

If a WMA additive is pre-blended in the asphalt binder, ensure that the asphalt binder meets the requirements of the specified grade after the addition of the WMA additive. If a WMA additive is added at the HMA plant, ensure that the addition of the additive will not negatively impact the grade of asphalt binder. Follow the manufacturer’s recommendations for percentage of WMA additive needed.

Mix HMA in a plant that is listed on the QPL and conforms to the requirements for HMA Plants as specified in 1009.01.

Composition of the mixture for HMA surface course is coarse aggregate, fine aggregate, and asphalt binder, and may also include mineral filler, WMA additive, and up to 15 percent Reclaimed Asphalt Pavement (RAP). For controlled

asphalt foaming system WMA, the Department may require an anti-stripping additive. Ensure that the finished mix does not contain more than a total of 1 percent by weight contamination from Crushed Recycled Container Glass (CRCG).

The composition of the mixture for HMA base or intermediate course is coarse aggregate, fine aggregate, and asphalt binder, and may also include mineral filler, WMA additive and up to 35 percent of recycled materials. For controlled asphalt foaming system WMA, the Department may require an anti-stripping additive. The 35 percent of recycled materials may consist of a combination of RAP, CRCG, Ground Bituminous Shingle Material (GBSM), and RPCSA, with the following individual limits:

<b>Recycled Material</b>	<b>Maximum Percentage</b>
RAP	25
CRCG	10
GBSM	5
RPCSA	20

Combine the aggregates to ensure that the resulting mixture meets the grading requirements specified in Table 902.02.03-1. In determining the percentage of aggregates of the various sizes necessary to meet gradation requirements, exclude the asphalt binder.

Ensure that the combined coarse aggregate, when tested according to ASTM D 4791, has less than 10 percent flat and elongated pieces retained on the No. 4 sieve and larger. Measure aggregate using the ratio of 5:1, comparing the length (longest dimension) to the thickness (smallest dimension) of the aggregate particles.

Ensure that the combined fine aggregate in the mixture conforms to the requirements specified in Table 902.02.02-2. Ensure that the material passing the No. 40 sieve is non-plastic when tested according to AASHTO T 90.

<b>Tests</b>	<b>Test Method</b>	<b>Minimum Percent</b>
Uncompacted Void Content of Fine Aggregate	AASHTO T 304, Method A	45
Sand Equivalent	AASHTO T 176	45

**902.02.03 Mix Design**

TABLES 902.02.03-2, AND 902.02.03-3 ARE CHANGED TO:

<b>Compaction Level</b>	<b>ESALs<sup>1</sup> (millions)</b>	<b>N<sub>des</sub></b>	<b>N<sub>max</sub></b>
<b>L</b>	< 0.3	50	75
<b>M</b>	≥ 0.3	75	115

1. Design ESALs (Equivalent (80kN) Single-Axle Loads) refer to the anticipated traffic level expected on the design lane over a 20-year period.

<b>Compaction Levels</b>	<b>Required Density (% of Theoretical Max. Specific Gravity)</b>		<b>Voids in Mineral Aggregate (VMA), % (minimum)</b>						<b>Voids Filled With Asphalt (VFA)1 %</b>	<b>Dust-to-Binder Ratio</b>
			<b>Nominal Max. Aggregate Size, mm</b>							
	<b>@N<sub>des</sub><sup>2</sup></b>	<b>@N<sub>max</sub></b>	<b>37.5</b>	<b>25.0</b>	<b>19.0</b>	<b>12.5</b>	<b>9.5</b>	<b>4.75</b>		
<b>L</b>	96.0	≤ 98.0	11.0	12.0	13.0	14.0	15.0	16.0	70 - 80	0.6 - 1.2
<b>M</b>	96.0	≤ 98.0	11.0	12.0	13.0	14.0	15.0	16.0	65 - 78	0.6 - 1.2

1. For 37.5-mm nominal maximum size mixtures, the specified lower limit of the VFA is 64 percent for all design traffic levels.
2. As determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix is determined according to AASHTO T 209. Bulk specific gravity of the compacted mixture is determined according to AASHTO T 166. For verification, specimens must be between 95.0 and 97.0

---

percent of maximum specific gravity at  $N_{des}$ .

---

THE FOURTH PARAGRAPH IS CHANGED TO:

At the ME's request, test the mix design to ensure that it meets a minimum tensile strength ratio of 80 percent, when tested according to AASHTO T 283. The ME will require tensile strength ratio testing for new aggregate sources and for aggregates or mixes suspected of stripping susceptibility.

**902.02.04 Sampling and Testing**

THE ENTIRE TEXT IS CHANGED TO:

- A. General Acceptance Requirements.** The RE or ME may reject and require disposal of any batch or shipment that is rendered unfit for its intended use due to contamination, segregation, improper temperature, lumps of cold material, or incomplete coating of the aggregate. For other than improper temperature, visual inspection of the material by the RE or ME is considered sufficient grounds for such rejection.

For PG 64-22, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 290 °F when the ambient temperature is less than 50 °F or is at least 275 °F when the ambient temperature is greater than or equal to 50 °F. For PG 64E-22, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 10 °F above the manufacturer's recommended laydown temperature. For mixes produced using a WMA additive or process, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 10 °F above the WMA manufacturer's recommended laydown temperature.

Do not allow the mixture temperature to exceed 330 °F at discharge from the plant.

Combine and mix the aggregates and asphalt binder to ensure that at least 95 percent of the coarse aggregate particles are entirely coated with asphalt binder as determined according to AASHTO T 195. If the ME determines that there is an on-going problem with coating, the ME may obtain random samples from 5 trucks and will determine the adequacy of the mixing on the average of particle counts made on these 5 test portions. If the requirement for 95 percent coating is not met on each sample, modify plant operations, as necessary, to obtain the required degree of coating.

If used, ensure that the equipment for controlled asphalt foaming system is running according to the manufacturer's recommendations. Ensure that the metering of water to foam the asphalt is controlled to produce a uniform mixture.

- B. Sampling.** The ME will take a random sample from each 700 tons of production for volumetric acceptance testing and to verify composition. The ME will perform sampling according to AASHTO T 168, NJDOT B-2, or ASTM D 3665.
- C. Quality Control Testing.** The HMA producer shall provide a quality control (QC) technician who is certified by the Society of Asphalt Technologists of New Jersey as an Asphalt Technologist, Level 2. The QC technician may substitute equivalent technician certification by the Mid-Atlantic Region Technician Certification Program (MARTCP). Ensure that the QC technician is present during periods of mix production for the sole purpose of quality control testing and to assist the ME. The ME will not perform the quality control testing or other routine test functions in the absence of, or instead of, the QC technician.

The QC technician shall perform sampling and testing according to the approved quality control plan, to keep the mix within the limits specified for the mix being produced. The QC technician may use acceptance test results or perform additional testing as necessary to control the mix.

To determine the composition, perform ignition oven testing according to AASHTO T 308 and aggregate gradation according to AASHTO T 30.

For each acceptance test, perform maximum specific gravity testing according to AASHTO T 209 on a test portion of the sample taken by the ME. Sample and test coarse aggregate, fine aggregate, mineral filler, and RAP according to the approved quality control plan for the plant.

When using RAP, ensure that the supplier has in operation an ongoing daily quality control program to evaluate the RAP. As a minimum, this program shall consist of the following:

1. An evaluation performed to ensure that the material conforms to 901.05.04 and compares favorably with the design submittal.
2. An evaluation of the RAP material performed using a solvent or an ignition oven to qualitatively evaluate the aggregate components to determine conformance to 901.05.
3. Quality control reports as directed by the ME.

**D. Acceptance Testing and Requirements.** The ME will determine volumetric properties at Ndes for acceptance from samples taken, compacted, and tested at the HMA plant. The ME will compact HMA to the number of design gyrations (Ndes) specified in Table 902.02.03-2, using equipment according to AASHTO T 312. The ME will determine bulk specific gravity of the compacted sample according to AASHTO T 166. The ME will use the most current QC maximum specific gravity test result in calculating the volumetric properties of the HMA.

The ME will determine the dust-to-binder ratio from the composition results as tested by the QC technician.

Ensure that the HMA mixture conforms to the requirements specified in Table 902.02.04-1, and to the gradation requirements in Table 902.02.03-1. If 2 samples in 5 consecutive samples fail to conform to the gradation or volumetric requirements, immediately initiate corrective action.

The ME will test a minimum of 1 sample per 3500 tons for moisture, basing moisture determinations on the weight loss of an approximately 1600-gram sample of mixture heated for 1 hour in an oven at  $280 \pm 5^\circ\text{F}$ . Ensure that the moisture content of the mixture at discharge from the plant does not exceed 1.0 percent.

**Table 902.02.04-1 Hot Mix Asphalt Requirements for Control**

Compaction Levels	Required Density (% of Theoretical Max. Specific Gravity)	Voids in Mineral Aggregate (VMA), % (minimum)						Dust-to-Binder Ratio
		Nominal Max. Aggregate Size, mm						
	@Ndes <sup>1</sup>	37.5	25.0	19.0	12.5	9.5	4.75	
<b>L, M</b>	95.0 – 97.0	11.0	12.0	13.0	14.0	15.0	16.0	0.6 - 1.3

1. As determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix is determined according to AASHTO T 209. Bulk specific gravity of the compacted mixture is determined according to AASHTO T 166.

**902.03.01 Composition of Mixtures**

THE ENTIRE TEXT IS CHANGED TO:

Mix OGFC and MOGFC in a plant that is listed on the QPL and conforms to the requirements for HMA plants as specified in 1009.01.

Composition of mixture for OGFC and MOGFC is coarse aggregate, fine aggregate and asphalt binder and may include a WMA additive. Ensure that the mixture conforms to the following requirements:

1. Use aggregate for OGFC and MOGFC that conforms to 901.05, except, for coarse aggregate, use broken stone of gneiss, granite, quartzite, or trap rock. Do not use RAP, CRCG, GBSM, or RPCSA.
2. Use asphalt binder for OGFC and MOGFC that is PG 64E-22 as specified in 902.01.01.
3. If used, ensure that WMA additives or processes conform to 902.01.05. If a WMA additive is pre-blended in the asphalt binder, ensure that the asphalt binder meets the requirements of the specified grade after the addition of the WMA additive. If a WMA additive is added at the HMA plant, ensure that the addition of the additive will not negatively impact the grade of asphalt binder. Follow the manufacturer’s recommendations for percentage of WMA additive needed. For controlled asphalt foaming system WMA, the Department may require an anti-stripping additive.
4. For MOGFC, add a stabilizing additive consisting of mineral fiber or cellulose fiber to the mix. Use a stabilizing additive that conforms to the requirements for stabilizing additives in AASHTO M 325. Use only 1 type per mix design. If using mineral fibers, use a dosage rate of 0.4 percent by weight of total mix. If using cellulose fibers, use a dosage rate of 0.3 percent by weight of total mix. The dosage rate may be increased, as necessary, to prevent draindown as measured by the visual draindown determination of asphalt content in NJDOT B-8. Accurately control proportioning the fibers into the mixture within  $\pm 10$  percent of the required weight, and use equipment that ensures uniform dispersion of the fibers. Store fibers in a dry location with a

storage temperature not to exceed 120 °F. The supplier of the cellulose or mineral fibers shall provide a certification of compliance, as specified in 106.07, that the material supplied conforms to AASHTO M 325. Ensure that a technical representative from the additive supplier is at the work site for the first full day of construction for technical assistance.

#### 902.04.01 Composition of Mixture

THE ENTIRE SUBSECTION TEXT IS CHANGED TO:

Mix ultra-thin HMA in a plant listed on the QPL conforming to the requirements for HMA plants specified in 1009.01.

Use ultra-thin HMA that consists of coarse aggregate, fine aggregate, and polymer modified asphalt binder and that may contain mineral filler and a WMA additive. Do not add RAP, CRCG, GBSM, or RPCSA. Combine the material in such proportions that the total aggregate and asphalt binder conform to the composition percentages specified in Table 902.04.02-1.

To produce the ultra-thin HMA, use aggregates and asphalt binder that conforms to the following:

1. For asphalt binder, use PG 64E-22 conforming to the requirements of 902.01.01.
2. If used, ensure that WMA additives or processes conform to 902.01.05. If a WMA additive is pre-blended in the asphalt binder, ensure that the asphalt binder meets the requirements of the specified grade after the addition of the WMA additive. If a WMA additive is added at the HMA plant, ensure that the addition of the additive will not negatively impact the grade of asphalt binder. Follow the manufacturer's recommendations for percentage of WMA additive needed. For controlled asphalt foaming system WMA, the Department may require an anti-stripping additive.
3. For fine aggregate, use 100 percent stone sand conforming to 901.05.02. Ensure that the combined gradation with coarse aggregate conforms to Table 902.04.02-1.
4. Use coarse aggregate that conforms to 901.05.01 and Table 902.04.01-1. Permissible geologic classifications for coarse aggregate are argillite, gneiss, granite, quartzite, or trap rock. Ensure that the combined gradation with fine aggregate conforms to Table 902.04.02-1.

<b>Table 902.04.01-1 Coarse Aggregate Properties</b>			
<b>Tests</b>	<b>Test Method</b>	<b>Minimum Percent</b>	<b>Maximum Percent</b>
Percentage of wear, Los Angeles Abrasion Test	AASHTO T 96	-	25
Flakiness Index	BS <sup>1</sup> 812, part 105.1	-	20
Clay Lumps and Friable Particles	ASTM C 142	-	2
Asphalt Affinity*	ASTM D 3625	95	-

<sup>1</sup> British Standard Test Method

5. Use mineral filler, if necessary, that conforms to 901.05.03.

#### 902.04.02 Mix Design

THE ENTIRE SUBSECTION TEXT IS CHANGED TO:

For the mix design of the ultra-thin HMA, submit lab qualifications and references to the ME for approval prior to beginning work. Ensure that a technical representative from the lab which will perform the mix design is present during production to make adjustments as needed for mix compliance.

At least 30 days before the initial production date, submit the mix design to the ME for approval on forms supplied by the Department, including JMF for the ultra-thin HMA performed by an AASHTO accredited lab with at least five successfully completed ultra-thin HMA friction course projects greater than 5,000 tons each. Include a statement naming the source of each component and a report with the results for the criteria specified in Table 902.04.01-1 and 902.04.02-1.

If the source of any component material changes, submit a new JMF and obtain ME approval before using the new material. When unsatisfactory results or other conditions make it necessary, the ME may require a new JMF.

Design the ultra-thin HMA so that it has a draindown of less than 0.1 percent when tested according to AASHTO T 305.

When tested for moisture sensitivity according to AASHTO T 283, ensure that the ultra-thin HMA has a tensile strength ratio of at least 80 percent. Prepare specimens according to AASHTO T 312, and test according to T 283 except for the following:

1. Before compaction, condition the mixture for 2 hours according to AASHTO R 30, Section 7.1.
2. Compact specimens with 75 gyrations.
3. Extrude specimens as soon as possible without damaging.
4. Use AASHTO T 269 to determine void content.
5. Record the void content of the specimens.
6. If less than 55 percent saturation is achieved, repeat the procedure, unless the difference in tensile strength between duplicate specimens is greater than 25 pounds per square inch.
7. If visual stripping is detected, modify or readjust the mix.

Size, uniformly grade, and combine aggregate fractions in proportions so that the grading of total aggregate and asphalt binder in the JMF conform to the composition by mass percentages specified in Table 902.04.02-1.

**Table 902.04.02-1 JMF Requirements for Ultra-Thin Friction Course**

Sieve Size	Total % Passing By Mass	Production Control Tolerances from JMF
1/2"	100	±6.0
3/8"	75-100	±5.5
¼"	30-45	±5.5
No. 4	24-37	±5.5
No. 8	21-26	±4.5
No. 16	15-23	±4.0
No. 30	11-16	±4.0
No. 50	8-14	±4.0
No. 100	5-10	±3.0
No. 200	5.0-7.0	±2.0
Asphalt %	4.9-6.0	Ignition Oven ±0.40

During the construction of the test strip, take samples to confirm that the plant mixed material meets the requirements of the mix design. The ME will not grant final approval of the mix design until a successful verification of the plant produced mix and construction test strip.

#### **902.04.03 Sampling and Testing**

THE ENTIRE SUBSECTION TEXT IS CHANGED TO:

Ensure that the mix meets the requirements as specified in 902.02.04.A, otherwise the RE or ME will reject the material. Maintain the temperature of the mix between 300 °F and 330 °F. Perform and meet requirements for quality control testing as specified in 902.02.04.C.

Ensure that a technical representative from the lab which designed the mix is present during production to make adjustments as needed for mix compliance. During production, the ME will take one random acceptance sample from each 700 tons of production to verify composition. Conduct draindown tests as directed by the ME.

If the composition testing results are outside of the production control tolerances specified in Table 902.04.02-1 for an acceptance sample, determine if a plant adjustment is needed and immediately run a quality control sample. If the quality control sample is also outside of the control tolerances in Table 902.04.02-1, immediately take corrective action to bring the mix into compliance. Take additional quality control samples after the corrective action to ensure that the mix is within the production control tolerances. If 2 consecutive acceptance samples are outside the tolerances specified in Table 902.04.02-1, immediately stop production. Obtain ME approval of a plant correction plan before resuming production. Upon restarting production, do not transport mixture to the Project Limits before the results of a QC sample from the mixture indicate that the mixture meets JMF tolerances. The ME will reject mixture produced at initial restarting that does not meet tolerances.

The ME will perform sampling according to NJDOT B-2 or ASTM D 3665, and will perform testing for composition according to AASHTO T 308. Perform testing for draindown according to NJDOT B-7 or NJDOT B-8.

**902.05.01 Composition of Mixture**

THE ENTIRE TEXT IS CHANGED TO:

Mix SMA in a plant that is listed on the QPL and conforms to the requirements for HMA plants as specified in 1009.01.

The composition of the SMA mixture is coarse aggregate, fine aggregate, mineral filler, mineral fibers or cellulose fibers, and polymer modified asphalt binder and may include a WMA additive.

Use asphalt binder for SMA that is PG 64E-22 as specified in 902.01.01.

For coarse aggregate in SMA, use crushed stone conforming to 901.05.01 and Table 902.05.01-1. Use at least 2 stockpiles of crushed stone with differing gradations to allow adjustments to meet the JMF.

**Table 902.05.01-1 Coarse Aggregate Properties for SMA**

Tests	Test Method	Maximum Percent
Percentage of wear, Los Angeles Abrasion Test	AASHTO T 96	30
Flat and Elongated, 5 to 1 (Material Retained on the No. 4 Sieve)	ASTM D 4791	5
Flat and Elongated, 3 to 1 (Material Retained on the No. 4 Sieve)	ASTM D 4791	20

For fine aggregate, use 100 percent stone sand conforming to 901.05.02. Ensure that the combined fine aggregate in the mixture conforms to the requirements in Table 902.02.02-2.

For mineral filler, use rock dust or crushed limestone conforming to AASHTO M 17. Ensure that the mineral filler has a plasticity index of less than 4 percent when tested according to AASHTO T 90.

Do not add RAP, CRCG, GBSM, or RPCSA to the mixture.

Add stabilizing fibers consisting of mineral fiber or cellulose fiber conforming to AASHTO M 325. Use only one type per mix design. If using mineral fibers, use between 0.4 and 0.6 percent by weight of total mix. If using cellulose fibers, use between 0.3 and 0.4 percent by weight of total mix. Provide control to accurately proportion the fibers into the mixture within ±10 percent of the required weight, and use equipment that ensures uniform dispersion of the fibers. If using pre-packaged bags of fibers added to the pugmill during the dry mix cycle, follow the manufacturer’s recommendations for the dry and wet mixing time. Store fibers in a dry location with a storage temperature not to exceed 120 °F. The supplier of the cellulose or mineral fibers shall provide a certification of compliance, as specified in 106.07, for the fibers. Ensure that a technical representative from the fiber supplier is at the HMA plant for the first full day of production for technical assistance.

If used, ensure that WMA additives or processes conform to 902.01.05. If a WMA additive is pre-blended in the asphalt binder, ensure that the asphalt binder meets the requirements of the specified grade after the addition of the WMA additive. If a WMA additive is added at the HMA plant, ensure that the addition of the additive will not negatively impact the grade of asphalt binder. Follow the manufacturer’s recommendations for percentage of WMA additive needed. For controlled asphalt foaming system WMA, the Department may require an anti-stripping additive.

**902.05.02 Mix Design**

THE ENTIRE TEXT IS CHANGED TO:

Design the SMA to meet the requirements in Table 902.05.02-1 and Table 902.05.02-2. Prepare the JMF according to AASHTO R 46. Determine the JMF at 4 percent air voids and 75 gyrations of the Superpave gyratory compactor.

**Table 902.05.02-1 SMA Specification Band (% passing) nominal-maximum aggregate size**

Production Control Tolerances <sup>1</sup>	Sieve Size	19 mm % Passing	12.5 mm % Passing	9.5 mm % Passing
0%	1"	100	100	100
±5%	3/4"	90-100	100	100
±5%	1/2"	50-88	90-100	100

±5%	3/8"	25-60	50-80	70-95
±4%	No. 4	20-28	20-35	30-50
±4%	No. 8	16-24	16-24	20-30
±4%	No. 16	–	–	0-21
±3%	No. 30	–	–	0-18
±3%	No. 50	–	–	0-15
±2%	No. 200	8.0-11.0	8.0-11.0	8.0-12.0
	Coarse Aggregate Fraction	Portion Retained on No. 4 Sieve	Portion retained on No. 4 Sieve	Portion retained on No. 8 Sieve
	Minimum Lift Thickness	2 inches	1-1/2 inch	1 inch

1. Production tolerances may fall outside of the wide band gradation limits.

**Table 902.05.02-2 SMA Mixtures Volumetrics For Design and Plant Production**

Property	Production Control Tolerances	Requirement
Air Voids	±1%	4.0%
Voids in Mineral Aggregate (VMA)	–	17.0% minimum
VCA <sub>mix</sub>	–	Less than VCA <sub>dry</sub>
Draindown @ production temperature	–	0.30% maximum
Asphalt Binder Content (AASHTO T 308)	±0.40%	6% minimum
Tensile Strength Ratio (AASHTO T 283)	–	80% minimum

### 902.05.03 Sampling and Testing

THE ENTIRE TEXT IS CHANGED TO:

Perform quality control testing as specified in 902.02.04.C. Ensure that the mix meets the requirements as specified in 902.02.04.A, otherwise the RE or ME will reject the material.

During production at the plant, the ME will take a sample from each 700 tons of production to verify composition and air voids. Conduct draindown, VCA<sub>mix</sub>, VCA<sub>dry</sub>, and VMA testing as directed by the ME. Perform tests according to AASHTO R 46.

If the testing results are outside of the production control tolerances specified in Table 902.05.02-1 and Table 902.05.02-2 for an acceptance sample, determine if a plant adjustment is needed and immediately run a quality control sample. If the quality control sample is also outside of the control tolerances in Table 902.05.02-1, immediately take corrective action to bring the mix into compliance. Take additional quality control samples after completing the corrective action to ensure that the mix is within tolerances. If 2 consecutive acceptance samples are outside the tolerances specified in Table 902.05.02-1 and Table 902.05.02-2, immediately stop production. Obtain ME approval of a plant correction plan before resuming production. Upon restarting production, do not transport mixture to the Project Limits before the results of a QC sample from the mixture indicate that the mixture meets JMF tolerances. The ME will reject mixture produced at initial restarting that does not meet tolerances.

The ME will perform sampling according to NJDOT B-2 or ASTM D 3665, and will perform testing for composition according to AASHTO T 308. The ME will determine bulk specific gravity of the compacted sample according to AASHTO T 166 or AASHTO T 331. The ME will use the most current QC maximum specific gravity test result, obtained according to AASHTO T 209, in calculating the volumetric properties of the SMA. Perform testing for draindown according to AASHTO T 305.

### 902.06.01 Composition

THE ENTIRE TEXT IS CHANGED TO:

Mix ASDC in a plant that is listed on the QPL and conforms to the requirements specified in 1009.01.

The mixture shall consist of asphalt binder and aggregate and may contain a WMA additive. Use asphalt binder that is PG 64-22 as specified in 902.01.01. Use aggregate that conforms to 901.05.01 or 901.05.02 and the gradation requirements specified in Table 902.06.01-1.

If used, ensure that WMA additives or processes conform to 902.01.05. If a WMA additive is pre-blended in the asphalt binder, ensure that the asphalt binder meets the requirements of the specified grade after the addition of the WMA additive. If a WMA additive is added at the HMA plant, ensure that the addition of the additive will not negatively impact the grade of asphalt binder. Follow the manufacturer's recommendations for percentage of WMA additive needed. For controlled asphalt foaming system WMA, the Department may require an anti-stripping additive.

**Table 902.06.01-1 Gradation Requirements and Tolerances for ASDC**

<b>Production Tolerance (Variation From JMF)</b>	<b>Sieve Size</b>	<b>JMF (Percent Passing)</b>
±0.0	1"	100
±6.0	3/4"	95 - 100
±5.5	1/2"	85 - 100
±5.5	3/8"	60 - 90
±5.5	No. 4	15 - 25
±4.5	No. 8	2 - 10
±2.0	No. 200	2 - 5

Design the mixture to have an asphalt binder content of  $3 \pm 1/2$  percent by weight of dry aggregate.

### **902.06.03 Sampling and Testing**

THE ENTIRE TEXT IS CHANGED TO:

Perform quality control testing as specified in 902.02.04.C. Ensure that the mix meets the requirements as specified in 902.02.04.A, except that the temperature of the mix at discharge is required to be between 230 °F and 275 °F, otherwise the RE or ME will reject the material. For mixes produced using a WMA additive or process, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 10 °F above the WMA manufacturer's recommended laydown temperature.

During production, the ME will take one random acceptance sample from each 700 tons of production to verify composition. Conduct draindown tests as directed by the ME.

If the composition testing results are outside of the production control tolerances specified in Table 902.06.01-1 for an acceptance sample, determine if a plant adjustment is needed and immediately run a quality control sample. If the quality control sample is also outside of the control tolerances specified in Table 902.06.01-1, immediately take corrective action to bring the mix into compliance. Take additional quality control samples after the corrective action to ensure that the mix is within tolerances. If 2 consecutive acceptance samples are outside the tolerances specified in Table 902.06.01-1, immediately stop production. Obtain ME approval of a plant correction plan before resuming production. Upon restarting production, do not transport mixture to the Project before the results of a QC sample from the mixture indicate that the mixture meets JMF tolerances. The ME will reject mixture produced at initial restarting that does not meet tolerances.

The ME will perform sampling according to NJDOT B-2 or ASTM D-3665 and will perform testing for composition according to AASHTO T 308. If directed by the ME, perform testing for draindown according to AASHTO T 305.

THE FOLLOWING SUBSECTIONS ARE ADDED

## **902.07 ASPHALT-RUBBER OPEN-GRADED FRICTION COURSE (AR-OGFC)**

### **902.07.01 Composition of Mixture**

Mix AR-OGFC in a plant listed on the QPL and conforming to the requirements for HMA plants specified in 1009.01. Ensure the HMA plant is equipped with asphalt-rubber binder blending equipment as specified in 1009.03.

Composition of mixture for AR-OGFC is coarse aggregate, fine aggregate and asphalt-rubber binder. Ensure that the mixture conforms to the following requirements:

1. Use aggregates that conform to 901.05. Use fine aggregate that is 100 percent stone sand and conforms to Table 902.02.02-2.
2. Do not use RAP, CRCG, GBSM, or RPCSA.
3. Use asphalt-rubber binder that conforms to 902.07.02.

### 902.07.02 Asphalt-Rubber Binder

**A. Materials.** Use the following materials:

1. **Ground Crumb Rubber.** Ensure that the ground crumb rubber has a specific gravity of  $1.15 \pm 0.05$ , is free of wire or other contaminating materials, and contains not more than 0.5 percent fabric. Use crumb rubber that is ambient ground and conforms to the gradation requirements specified in Table 902.07.02-1. Ensure that the moisture content is less than 0.75 percent. The Contractor may add up to four percent calcium carbonate by weight of the granulated rubber, to prevent the particles from sticking together.

Sieve Size	Percent Passing <sup>1, 2</sup>
No. 8	100
No. 16	65 – 100
No. 30	20 – 100
No. 50	0 – 45
No. 200	0 – 5

1. Perform gradation according to AASHTO T 27 using a minimum 50 gram sample.
2. Ensure that the gradation is performed as specified in NJDOT B-11.

Submit to the ME a certification of compliance, as specified in 106.07, for the ground crumb rubber. In addition, ensure that the certificates confirm that the rubber is a crumb rubber, derived from processing whole scrap tires or shredded tire materials; and the tires from which the crumb rubber is produced are taken from automobiles, trucks, or other equipment owned and operated in the United States. Include with the certifications verifications that the processing did not produce, as a waste product, casings, or other round tire material that can hold water when stored or disposed of above ground.

### 2. Asphalt Binder.

- a. Use asphalt binder that conforms to AASHTO M 320, Table 1; PG 64-22, PG 58-28 or an approved blend of both grades. The asphalt binder producer is required to provide the asphalt binder quality control plan annually to the ME for approval. Ensure that the quality control plan conforms to AASHTO R 26. Submit to the ME a certification of compliance, as specified in 106.07, for the asphalt binder. The ME will perform quality assurance sampling and testing of each asphalt binder lot as defined in the approved quality control plan.
- b. Use one or more of the following types of warm mix asphalt (WMA) additives or processes:
  1. Organic additives such as a paraffin wax or a low molecular weight esterified wax.
  2. Chemical additive that acts as a surfactant or dispersing agent.

Do not use controlled asphalt foaming systems or any other steam injection processes or steam introducing additives. WMA is a method of producing asphalt pavement at a mixing and compaction temperatures at least 30 °F lower than Hot Mix Asphalt (HMA) by using one or more of the types of WMA additives listed above. Submit information on the WMA additive or process with the Paving Plan required in 402.03.02.A. Include in the submission, the name and description of the additive or process, the manufacturer's recommendations for usage of the additive or process, recommendations for mixing and compaction temperatures, and details on at least one project on which the additive was successfully used in the United States on a crumb rubber modified asphalt mixture. In the details of a project, include

tonnage, type of mix, dosage, mixing and compaction temperatures, available test results, and contact information for project. If a WMA additive is pre-blended in the asphalt binder, ensure that the asphalt binder meets the requirements of the specified grade after the addition of the WMA additive. If a WMA additive is added at the HMA plant, ensure that the addition of the additive will not negatively impact the grade of asphalt binder. The ME will evaluate the impacts to performance grade of the asphalt binder based upon certification from manufacturer in conjunction with laboratory data indicating the effects of the additive on the asphalt binder properties. Follow the manufacturer's recommendations for the dosage of WMA additive needed and approved blending method(s).

Ensure that a technical representative of the WMA additive manufacturer is on-site or available for consultation during the production and placement of the AR-OGFC with the warm mix additive.

- B. Mixing.** Using the asphalt-rubber binder blending equipment in 1009.03, produce the asphalt-rubber binder to contain at least 17 percent ground rubber by the weight of total asphalt binder (asphalt + crumb rubber). Ensure that the temperature of the asphalt cement is between 350 and 400 °F at the time of addition of the ground rubber. Ensure that there are no agglomerations of rubber particles in excess of two inches in the least dimension in the mixing chamber.

Document that the proportions are accurate and that the rubber has been uniformly incorporated into the mixture. Report as directed by the ME. Ensure that the crumb rubber and asphalt-cement are thoroughly mixed before beginning the one-hour reaction period. Rubber floating on the surface or agglomerations of rubber particles is evidence of insufficient mixing. Maintain the temperature of the asphalt-rubber binder immediately after mixing between 325 and 375 °F. Maintain the temperature of the asphalt-rubber binder for at least one hour before using.

- C. Properties.** Prepare asphalt-rubber binder using the "wet process." Physical properties are required to comply with the requirements of ASTM D 6114, Type II, except for the properties specified in Table 902.07.02-2.

<b>Table 902.07.02-2 Asphalt-Rubber Binder Properties</b>		
<b>Property</b>	<b>Test Procedure</b>	<b>Requirement</b>
Resilience: 77 °F; %, minimum	ASTM D 5329	25
Rotational Viscosity <sup>1</sup> 350 °F; cP	NJDOT B-12	2000 – 4000
1. The viscotester used must be correlated to a Rion (formerly Haake) Model VT-04 viscotester using the No. 1 Rotor. The Rion viscotester rotor, while in the off position, is required to be completely immersed in the binder at a temperature from 350 ± 3 °F for a minimum heat equilibrium period of 60 seconds, and the average viscosity determined from three separate constant readings (± 500 cP) taken within a 30 second time frame with the viscotester level during testing and turned off between readings. Continuous rotation of the rotor may cause thinning of the material immediately in contact with the rotor, resulting in erroneous results.		

- D. Handling and Testing.** Once the asphalt-rubber binder has been mixed, thoroughly agitate during periods of use to prevent settling of the rubber particles. During production, maintain asphalt-rubber binder between 325 and 375 °F. Ensure that asphalt-rubber binder is not held at 325 °F or higher for more than 16 hours. Allow asphalt-rubber binder held for more than 16 hours to cool. To reuse, gradually reheat to between 325 and 375 °F. Do not cool and reheat more than one time. Do not store asphalt-rubber binder above 250 °F for more than four days.

For each load or batch of asphalt-rubber binder, provide the RE with the following:

1. The source, grade, amount, and temperature of the asphalt cement before the addition of rubber.
2. The source and amount of rubber and the rubber content expressed as percent by the weight of the asphalt cement.
3. Times and dates of the rubber additions and resultant viscosity test.
4. A record of the temperature, with time and date reference for each load or batch. The record begins at the time of the addition of rubber and continue until the load or batch is completely used. Take readings and record every temperature change in excess of 20 °F, and as needed to document other events that are significant to batch use and quality.

### 902.07.03 Mix Design

Submit binder and mix designs including JMF for each mixture performed by an AASHTO accredited lab with at least five successfully completed asphalt-rubber open-graded friction course projects greater than 5,000 tons each. Include a statement naming the source of each component and a report with the results for the criteria specified in Table 902.07.03-1. Include a report detailing the rotational viscosity of the asphalt-rubber binder at 60, 90, 135, 240, and 1440 minutes. Submit lab qualifications and references to the ME for approval prior to beginning work.

Design the mix to meet the criteria in Table 902.07.03-1.

Table 902.07.03-1 JMF Master Ranges and Mixture Requirements AR-OGFC	
Sieve Sizes	Mixture Designations (% Passing <sup>1</sup> )
	AR-OGFC
1/2"	100
3/8"	90 – 100
No. 4	20 – 40
No. 8	5 – 10
No. 200	0 – 3.0
Minimum asphalt-rubber binder, % <sup>2</sup>	8.4
Minimum % Air Voids, design	15

1. Aggregate percent passing to be determined based on dry aggregate weight.  
2. Asphalt-rubber binder content to be determined based on total weight of mix.

Determine and verify the JMF according to NJDOT B-8. Ensure that the JMF is within the master range specified in Table 902.07.03-1.

Prepare compacted test specimens for submittal to the ME at least 30 days before the initial production date. Prepare these specimens from material mixed according to the final JMF, using 50 gyrations of the Superpave gyratory compactor according to AASHTO T 312.

The ME will test 2 specimens to verify stone-on-stone contact according to NJDOT B-8 and that the final JMF produces a mixture that has a minimum void content as specified in Table 902.07.03-1. The ME will determine percent air voids according to AASHTO T 209 and AASHTO T 331.

The ME will test 2 test specimens for abrasion and impact resistance using a modified L.A. Abrasion Test according to NJDOT B-8. The maximum allowable loss as calculated by this method is 30 percent.

Do not modify, which includes changing the asphalt cement supplier, the JMF unless the ME approves the modification.

### 902.07.04 Sampling and Testing

**A. General Acceptance Requirements.** General Acceptance Requirements. The RE or ME may reject and require disposal of any batch or shipment that is rendered unfit for its intended use due to contamination, segregation, improper temperature, lumps of cold material, or incomplete coating of the aggregate. For other than improper temperature, visual inspection of the material by the RE or ME is considered sufficient grounds for such rejection.

For AR-OGFC with WMA additive, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins meets the WMA additive manufacturer's recommendations. Do not allow the mixture temperature to exceed 300 °F at discharge from the plant. For mixes produced using a WMA additive or process, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 10 °F above the WMA manufacturer's recommended laydown temperature.

Combine and mix the aggregates and asphalt-rubber binder to ensure that at least 95 percent of the coarse aggregate particles are entirely coated with asphalt-rubber binder as determined according to AASHTO T 195. If the ME determines that there is an on-going problem with coating, the ME may obtain random samples from 5 trucks and will determine the adequacy of the mixing on the average of particle counts made on these 5 test portions. If the requirement for 95 percent coating is not met on each sample, modify plant operations, as necessary, to obtain the required degree of coating.

- B. Quality Control Testing.** The HMA producer is required to provide a quality control (QC) technician who is certified by the Society of Asphalt Technologists of New Jersey as an Asphalt Technologist, Level 2. The QC technician may substitute equivalent technician certification by the Mid-Atlantic Region Technician Certification Program (MARTCP). Ensure that the QC technician is present during periods of mix production for the sole purpose of quality control testing and to assist the ME. The ME will not perform the quality control testing or other routine test functions in the absence of, or instead of, the QC technician.

The QC technician is required to perform sampling and testing according to the approved quality control plan, to keep the mix within the limits specified for the mix being produced. The QC technician may use acceptance test results or perform additional testing as necessary to control the mix.

For each acceptance test, perform maximum specific gravity testing according to AASHTO T 209 on a test portion of the sample taken by the ME. Sample and test coarse aggregate, fine aggregate and mineral filler according to the approved quality control plan for the plant.

- C. Acceptance Testing.** During production, the ME will take one random acceptance sample from each 700 tons of production to verify composition. The ME will perform sampling according to NJDOT B-2 or ASTM D 3665, and will perform testing for composition according to AASHTO T 308. Perform testing for air voids according to T 209 and either B-6 or T 331. Perform testing for draindown according to NJDOT B-8.

Conduct air voids and draindown tests as directed by the ME.

If the composition testing results are outside of the production control tolerances specified in Table 902.07.04-1 for an acceptance sample, determine if a plant adjustment is needed and immediately run a quality control sample. If the quality control sample is also outside of the control tolerances in Table 902.07.04-1, immediately take corrective action to bring the mix into compliance. Take additional quality control samples after the corrective action to ensure that the mix is within the production control tolerances. If two consecutive acceptance samples are outside the tolerances specified in Table 902.07.04-1, immediately stop production. Obtain ME approval of a plant correction plan before resuming production. Upon restarting production, do not transport mixture to the Project Limits before the results of a QC sample from the mixture indicate that the mixture meets JMF tolerances. The ME will reject mixture produced at initial restarting that does not meet tolerances.

**Table 902.07.04-1 Production Control Tolerances for AR-OGFC Mixtures**

Sieve Sizes	Production Control Tolerances from JMF <sup>1</sup>
1/2"	±6.0
3/8"	±5.5
No. 4	±5.5
No. 8	±4.5
No. 200	±2.0
Asphalt-rubber binder, % (AASHTO T 308)	±0.40
Minimum % Air Voids	1.0% less than design requirement

1. Production tolerances may fall outside of the wide band gradation limits in Table 902.07.03-1.

**902.08 HIGH PERFORMANCE THIN OVERLAY (HPTO)**

**902.08.01 Composition of Mixture**

Mix HPTO in a plant that is listed on the QPL and conforms to the requirements for HMA Plants as specified in 1009.01. The composition of the mixture for HPTO is coarse aggregate, fine aggregate, and asphalt binder, and may also include mineral filler and a WMA additive. Do not use Reclaimed Asphalt Pavement (RAP), Ground Bituminous Shingle Material, Remediated Petroleum Contaminated Soil Aggregate, or Crushed Recycled Container Glass (CRCG). Use asphalt binder and aggregates that meet the following requirements:

1. For the asphalt binder, use PG 64E-22 as specified in 902.01.01.
2. If used, ensure that WMA additives or processes conform to 902.01.05. If a WMA additive is pre-blended in the asphalt binder, ensure that the asphalt binder meets the requirements of the specified grade after the

addition of the WMA additive. If a WMA additive is added at the HMA plant, ensure that the addition of the additive will not negatively impact the grade of asphalt binder. Follow the manufacturer's recommendations for percentage of WMA additive needed. For controlled asphalt foaming system WMA, the Department may require an anti-stripping additive.

3. Use coarse aggregate that is argillite, gneiss, granite, quartzite, or trap rock and conforms to [901.05.01](#).
4. For fine aggregate, use 100 percent stone sand conforming to [901.05.02](#) and having an uncompacted void content of at least 45 percent when tested according to AASHTO T 304, Method A. In addition, the minimum sand equivalent is 45 percent when tested according to AASHTO T 176.
5. If necessary, use mineral filler as specified in [901.05.03](#).

### **902.08.02 Mix Design**

At least 45 days before initial production, submit a job mix formula for the HPTO on forms supplied by the Department. Include a statement naming the source of each component and a report showing the results meet the criteria specified in Tables 902.08.03-1 and 902.08.03-2.

For the job mix formula for the HPTO mixture, establish the percentage of dry weight of aggregate passing each required sieve size and an optimum percentage of asphalt binder based upon the weight of the total mix. Determine the optimum percentage of asphalt binder according to AASHTO R 35 and M 323 with an Ndes of 50 gyrations. Before maximum specific gravity testing or compaction of specimens, condition the mix for 2 hours according to the requirements for conditioning for volumetric mix design in AASHTO R 30, Section 7.1. If the absorption of the combined aggregate is more than 1.5 percent according to AASHTO T 84 and T 85, condition the mix for 4 hours according to AASHTO R 30, Section 7.2 prior to compaction of specimens (AASHTO T 312) and determination of maximum specific gravity (AASHTO T 209). Ensure that the job mix formula is within the master range specified in, Table 902.08.03-1.

Ensure that the job mix formula provides a mixture that meets a minimum tensile strength ratio (TSR) of 85 percent when prepared according to AASTHO T 312 and tested according to AASHTO T 283 with the following exceptions:

1. Before compaction, condition the mixture for 2 hours according to AASHTO R 30 Section 7.1.
2. Compact specimens with 40 gyrations.
3. Extrude specimens as soon as possible without damaging.
4. Use AASHTO T 269 to determine void content.
5. Record the void content of the specimens.
6. If less than 55 percent saturation is achieved, the procedure does not need to be repeated, unless the difference in tensile strength between duplicate specimens is greater than 25 pounds per square inch.
7. If visual stripping is detected, modify or readjust the mix.

For each mix design, submit three gyratory specimens and one loose sample corresponding to the composition of the job mix formula, including the design asphalt content. The ME will use these samples for verification of the properties of the job mix formula. Compact the specimens to the design number of gyrations (Ndes). To be acceptable all three gyratory specimens must comply with the gradation and asphalt content requirements in Table 902.08.03-1 and with the control requirements in Table 902.08.03-2. The ME reserves the right to be present at the time of molding the gyratory specimens.

In addition, submit 6 gyratory specimens and a 5 gallon bucket of loose mix to the ME. Compact the additional gyratory specimens according to AASHTO T 312. Ensure that the 6 gyratory specimens are 77 millimeters high and have an air void content of  $5.0 \pm 0.5$  percent. The ME will use the additional samples for performance testing of the HPTO mix. The ME will test the specimens using an Asphalt Pavement Analyzer according to AASHTO T 340 at 64 °C, 100 pounds per square inch hose pressure, and 100 pound wheel load. The ME will approve the job mix formula if the average rut depth for the 6 specimens in the asphalt pavement analyzer testing is not more than 4 millimeters in 8,000 loading cycles. If the job mix formula does not meet the APA criteria, redesign the HPTO mix.

If unsatisfactory results for any specified characteristic of the work make it necessary, establish a new job mix formula for approval. In such instances, if corrective action is not taken, the ME may require an appropriate adjustment.

If a change in sources is made or a change in the properties of materials occurs, the ME will require that a new job mix formula be established and approved before production can continue.

### 902.08.03 Sampling and Testing

- A. General Acceptance Requirements.** The RE or ME may reject and require disposal of any batch or shipment that is rendered unfit for its intended use due to contamination, segregation, improper temperature, lumps of cold material, or incomplete coating of the aggregate. For other than improper temperature, visual inspection of the material by the RE or ME is considered sufficient grounds for such rejection.

Ensure that the temperature of the HPTO at discharge from the plant or surge and storage bins is maintained between 300 and 330 °F. For mixes produced using a WMA additive or process, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 10 °F above the WMA manufacturer's recommended laydown temperature.

Combine and mix the aggregates and asphalt binder to ensure that at least 95 percent of the coarse aggregate particles are entirely coated with asphalt binder as determined according to AASHTO T 195. If the ME determines that there is an on-going problem with coating, the ME may obtain random samples from 5 trucks and will determine the adequacy of the mixing on the average of particle counts made on these 5 test portions. If the requirement for 95 percent coating is not met on each sample, modify plant operations, as necessary, to obtain the required degree of coating.

- B. Sampling.** The ME will take a sample of HPTO for volumetric acceptance testing from each 700 tons of a mix. The ME will perform sampling according to AASHTO T 168, NJDOT B-2, or ASTM D 3665.
- C. Quality Control Testing.** The HMA producer is required to provide a quality control (QC) technician who is certified by the Society of Asphalt Technologists of New Jersey as an Asphalt Technologist, Level 2. The QC technician may substitute equivalent technician certification by the Mid-Atlantic Region Technician Certification Program (MARTCP). Ensure that the QC technician is present during periods of mix production for the sole purpose of quality control testing and to assist the ME. The ME will not perform the quality control testing or other routine test functions in the absence of, or instead of, the QC technician.

The QC technician is required to perform sampling and testing according to the approved quality control plan, to keep the mix within the limits specified for the HPTO mix being produced. The QC technician may use acceptance test results or perform additional testing as necessary to control the mix.

To determine the composition, perform ignition oven testing according to AASHTO T 308. For each acceptance test, perform maximum specific gravity testing according to AASHTO T 209 on a test portion of the sample taken by the ME. Sample and test coarse aggregate, fine aggregate, mineral filler, and RAP according to the approved quality control plan for the plant.

- D. Acceptance Testing and Requirements.** The ME will determine volumetric properties at Ndes for acceptance from samples taken, compacted, and tested at the HMA plant. The ME will compact HPTO to 50 gyrations, using equipment according to AASHTO T 312. The ME will determine bulk specific gravity of the compacted sample according to AASHTO T 166. The ME will use the most current QC maximum specific gravity test result in calculating the volumetric properties of the HPTO.

The ME will determine the dust-to-binder ratio from the composition results as tested by the QC technician.

Ensure that the HMA mixture conforms to the requirements specified in Table 902.08.03-2, and to the gradation requirements in Table 902.08.03-1. If 2 samples in 5 consecutive samples fail to conform to the gradation or volumetric requirements, immediately initiate corrective action.

The ME will test a minimum of 1 sample per 3500 tons for moisture, basing moisture determinations on the weight loss of an approximately 1600-gram sample of mixture heated for 1 hour in an oven at  $280 \pm 5$  °F. Ensure that the moisture content of the mixture at discharge from the plant does not exceed 1.0 percent.

- E. Performance Testing.** Provide 6 gyratory specimens and a 5 gallon bucket of loose mix to the ME. Compact the additional gyratory specimens according to AASHTO T 312. Ensure that the 6 gyratory specimens are 77 millimeters high and have an air void content of  $5.0 \pm 0.5$  percent. The first sample is required to be taken in the first 1500 tons of production. Thereafter, random samples every 10,000 tons is required to be sampled. The ME will use the samples for performance testing of the HPTO mix. The ME will test the specimens using an Asphalt

Pavement Analyzer according to AASHTO T 340 at 64 °C, 100 pounds per square inch hose pressure, and 100 pounds wheel load. If the HPTO mix exceeds the APA criteria of 5 mm in 8000 loading cycles, the ME may stop production until corrective action is taken. If the HPTO mix exceeds the APA criteria of 12 mm in 8000 loading cycles, the RE may require removal and replacement of the HPTO.

<b>Sieve Size</b>	<b>Percent Passing by Mass</b>
3/8"	100
#4	65-85
#8	33-55
#16	20-35
#30	15-30
#50	10-20
#100	5-15
#200	5.0-8.0
Minimum Percent Asphalt by Mass of Total Mix	7

	<b>Required Density</b> (% of Max. Sp. Gr.)		<b>Voids in Mineral Aggregate</b> (VMA)	<b>Dust to Binder Ratio</b>	<b>Draindown AASHTO T 305</b>
	<b>Ndes (50 gyrations)</b>	<b>Nmax (100 gyrations)</b>			
<b>Design Requirements</b>	96.5	≤ 99.0	≥ 18.0 %	0.6 - 1.2	≤ 0.1 %
<b>Control Requirements</b>	95.5 - 97.5	≤ 99.0	≥ 18.0 %	0.6 - 1.3	≤ 0.1 %

**Implementation Code R (ROUTINE)**

Changes must be implemented in all applicable Department projects scheduled for Final Design Submission at least one month after the date of the BDC announcement. This will allow designers to make necessary plan, specifications, and estimate/proposal changes without requiring the need for an addenda or postponement of advertisement or receipt of bids.

**Recommended By:**

ORIGINAL SIGNED

Richard Jaffe, P.E.  
Director,  
Capital Program Support

**Approved By:**

ORIGINAL SIGNED

Richard T. Hammer  
Assistant Commissioner,  
Capital Program Management