ITEM 404.XXYZQ191 – WARM MIX ASPHALT

DESCRIPTION. This work shall consist of developing, producing and paving a Warm Mix Asphalt (WMA) mixture. WMA is standard HMA produced using a WMA technology typically resulting in a production mixture temperature of 135°C or lower. A WMA technology may include an additive, specialty equipment, or both.

WMA pavement course shall be constructed in accordance with this specification and in reasonably close conformity with the required lines, grades, thicknesses, and typical sections shown on the plans or established by the Engineer. The Contractor is responsible for compacting pavement to a specified density requirement.

The words "hot mix asphalt" and "HMA" in the standard specifications and other documents referenced by this specification shall apply to WMA.

MATERIALS. The materials and composition for these mixtures shall meet the requirements specified in §401-2 Materials, except as noted herein.

WMA Technology. Use a WMA technology appearing on the State's Approved List for Warm Mix Asphalt Technologies.

WMA Design. Modify a HMA design, currently in production status according to MM 5.16, *Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedure*, using a WMA technology. Comply with the manufacturer's recommendations for incorporating the WMA technology. Notify the Regional Material Engineer (RME) how the WMA technology will be incorporated prior to fabricating the test specimens. Test specimens may be made from plant produced or laboratory prepared WMA. Test specimens must be made from plant produced WMA if adding the WMA technology in the lab does not simulate the production process. The RME may require a State representative be present during the fabrication and testing. Submit the WMA design to the RME for review and verification at least 14 calendar days before production, including:

- Test data from the one point verification comparing the original HMA design to the WMA design satisfying all design criteria in MM 5.16.
- Name of WMA technology, target rate and acceptable variation (min/max rate)
- AASHTO T 283 moisture susceptibility test results meeting the requirements in MM 5.16 for both the HMA and WMA.
- Samples of the PG Binder, any WMA additive, and MSDS if requested by RME.
- Production Quality Control Plan revisions incorporating the WMA technology if not previously submitted. WMA Quality Control guidelines are available from the Materials Bureau.
- Test results for both the HMA and WMA samples using one of the test methods in Table 1, Allowable Mixture Rut Performance Tests. The HMA and WMA must be tested using the same test.

TABLE 1 ALLOWABLE MIXTURE RUT PERFORMANCE TESTS

Type of Test	AASHTO Test Method	Test Specimen Air Voids[1]	Test Temperature	
			Upstate	Downstate
Asphalt Pavement Analyzer (APA)	TP 63-09	7.0 ± 1.0%	58°C (136°F)	64°C (147°F)
Hamburg Wheel Track (HWT)	T 324-04	7.0 ± 1.0%	50°C (122°F)	50°C (122°F)
Asphalt Mixture Performance Tester (AMPT)	TP 79-09	7.0 ± 1.0%	50°C (122°F)	53°C (127°F)

Note 1: Condition the mixture for 4 hours ± 5 minutes at the desired field compaction temperature.

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Due to the experimental nature of this specification and on-going research, rut performance test result criteria are not listed. The Director, Materials Bureau, will provide Contractors and Producers the current criteria being used to evaluate test results, upon request. When test results do not meet the current criteria, the Contractor and Producer will have the opportunity to meet with Department representatives to discuss additional data and information indicating the mix will perform as expected. Based on additional data and information, the mix may be considered accepted for general use, accepted for restricted use, or unacceptable.

The Director, Materials Bureau will review and make the final decision regarding the status of WMA mix designs. The State reserves the right to suspend any mixture design when the mixture demonstrates unacceptable paving quality or exhibits properties that will affect the anticipated pavement performance. The Contractor may request to use a HMA design if the submitted WMA mixture design is considered unacceptable or is subsequently suspended.

CONSTRUCTION DETAILS. Requirements of §401-3 and §402-3 shall apply. Prior to routine paving, the Engineer will conduct a pre-paving meeting with all parties working under this specification to review the provisions of the specification, Quality Control plan and delivery and compaction temperatures.

Plant Production and Delivery. A delivery ticket indicating the quantity being delivered to the nearest 0.01 of a metric ton must accompany each delivery vehicle supplying WMA. The method of determining the delivered quantity is subject to the approval of the RME. Make one legible copy of the delivery ticket available to the State's paving inspector prior to the placement of the mixture. The delivery ticket shall show the following minimum information:

- Ticket number
- Plant identification
- Contract number
- SiteManager Mix ID (as outlined in MP 401)
- Mix Code (as outlined in MP 401)
- Quantity of material in vehicle to the nearest 0.01 metric ton
- Date and Time

Pavement Density Samples for 60 Series Compaction Method. Take pavement density samples according Table 2, PTD Verification Samples, as directed by the Engineer. A certified gauge operator shall be present before and during paving. Pavement samples will be used to verify PTD.

TABLE 2 PTD VERIFICATION SAMPLES

Production Days	Required Pavement Samples
2 or Less	Standard Specification Requirements Only
3 – 5	Standard Specification Requirements + 1 Additional Pavement Sample Set
More than 5	Standard Specification Requirements + 2 Additional Pavement Sample Sets

METHOD OF MEASUREMENT. The WMA will be measured by the number of metric tons of compacted mixture in the accepted work. In addition, quality payment adjustments are applicable for all warm mix asphalt in accordance with this specification.

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Plant Production Quality Payment Adjustment. The quality assurance technician (QAT) will determine the quality adjustment factor (QAF) for each day's production in accordance with MP 401 and this section. Production meeting the specification requirements will be assigned a QAF of 1.00. Production failing to meet the specification requirements will be assigned a QAF of 0.85 and be subject to evaluation according to Evaluation of Sublots Represented by 0.85 QAF, below. The Engineer will use the Daily QAF to calculate the quality payment adjustment for each day's production and apply it to the accepted quantity.

Evaluation of Sublots Represented by 0.85 QAF. When any material results in a plant production QAF of 0.85, the Engineer will evaluate the subject material to determine if it will be left in place. The Engineer may require the Contractor to core the pavement to determine if the in-place density is acceptable. When cores are required, the Engineer will divide the pavement area being evaluated into 4 sublots. Follow the requirements of §402-3.08, Pavement Density Samples, at no cost to the State. The material will be left in-place when the calculated plant air voids used for payment are greater than 5.5% and less than or equal to 7.0%, the asphalt content, based on automation, is within 0.2% of the production target, the contractor achieved field density of 92% to 97%, and there are no defects such as, but not limited to, cracking, raveling, rutting, shoving, or bleeding.

If the material does not meet the above conditions or it is unknown, such as for mixes accepted based on gradation or if QA testing was not required, the Engineer will determine if the material in question may remain in-place considering, but not limited to, the following:

- Type of material produced
- The layer in which the material was placed
- The location and traffic volume
- Laboratory test results
- Field test results, such as density

If the subject material is left in-place, it will be paid at 0.85 based on the bid price. If determined the subject material will not be left in-place, the Contractor shall remove and replace the material at no cost to the State and the material will not be included in the Daily QAF calculation.

Pavement Density Quality Payment Adjustment. The quantity of the WMA mixture subject to possible adjustment will be determined from actual quantity placed on the mainline and ramps of uniform width longer than 400 meters. When shoulders and mainline are placed together, the mainline quantity may be determined using typical sections shown in the contract documents. The pavement density QAF for material placed on ramps with a uniform full width section of less than 400 meters in length, shoulders, maintenance widenings and crossovers, and bridges will be 1.00 based on satisfactory placement and compaction as determined by the Engineer.

To calculate the pavement density QAF, use the method of measurement in Table 3, Method of Measurement, corresponding to the item used on the project.

TABLE 3 METHOD OF MEASUREMENT

Method Type	Pay Item Number	Description
A. 50 Series	404.XX5FZR	QAF based on calculated PWL using four cores.
B. 60 Series	404.XX6FZR	QAF based on average of four core densities.

A. 50 Series Method. The 50 Series pavement density quality payment adjustments are measured in Quality Units. The Engineer will determine the paving lot's Percent Within Limits (PWL)in accordance with Material Procedure (MP) 96-04. T his PWL will be used to determine the density QAF as shown in Table 4, Quality Schedule for 50 Series.

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The pavement density QAF from Table 4, Quality Schedule for 50 Series, will apply to the appropriate metric tons in the paving lot to determine the payment adjustment.

TABLE 4 QUALITY SCHEDULE FOR 50 SERIES	
Percent Within Limits (PWL)	Quality Adjustment Factor (QAF)
$PWL_{92\text{-}97} > 93$	1.05
$PWL_{92\text{-}97} \leq 93$	$\Sigma\,(PWL_{segment} \times PayFactor_{segment})$

NOTES:

1. Where $PWL_{Segment}$ will be calculated for each of the nine density ranges in Table 5, Density Segment Pay Factors, using the standard deviation and average density for the lot.
2. If the QAF is determined to be 0.60 or less, then the lot will be evaluated by the Engineer to determine if it may remain in-place. The type of material produced (i.e. binder, top), the layer in which it was used, and the location of use (i.e., mainline or a non-critical area) will be primary considerations in the determination of whether the WMA can be left in-place. If the WMA cannot be left in-place, it will be removed at no cost to the State. If the Engineer determines that the WMA can be left in-place, the QAF will be 0.60.

TABLE 5 DENSITY SEGMENT PAY FACTORS	
Density Segment	Segment Pay Factor
88 - 89	0.60
89 - 90	0.70
90 – 91	0.80
91 – 92	0.90
92 – 93	1.00
93 - 96	1.05
96 – 97	1.00
97 – 98	0.90
98 - 99	0.80

Quality Units will be determined for each day's placement by using the daily pavement density Quality Adjustment Factor ($QAF_{Density}$) and the appropriate WMA metric tons accepted by the Engineer.

$$\text{Quality Units} = (QAF_{Density} - 1.00) \times \text{Appropriate WMA Metric Tons Accepted}$$

B. 60 Series Method. The State will test all pavement density samples for this item. Payment adjustment will only apply when one or more of the following situations occur:

- Option 2 on the initial paving day is selected and the Engineer determines density readings taken using the Interim PTD are unacceptable and requires cores as outlined in the §402-3.07 B. 60 Series Compaction Method
- Insufficient number of density readings recorded, either at a specific location or at the required frequency
- Paving without a density gauge on site
- Paving completed after the only calibrated density gauge on site breaks down
- Density readings do not seem to accurately represent the HMA density

Payment adjustment, when applicable, will be made based on the bid price and in accordance with Table 7, Density Quality Adjustment Factors for 60 Series, to all the material placed on the mainline for the day the cores represent, excluding the material placed on the test section.

TABLE 7 DENSITY QUALITY ADJUSTMENT FACTORS FOR 60 SERIES

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Average Core Density (percent of mixtures average daily maximum theoretical density)	Quality Adjustment Factor
92.0 ≤ Density ≤ 97.0 91.0 ≤ Density < 92.0 or 97.0 < Density ≤ 98.0	1.00 0.95
90.0 ≤ Density < 91.0	0.90
88.0 ≤ Density < 90.0	0.85
Density < 88.0 or Density > 98.0	0.60*

*The lot will be evaluated by the State to determine if it may remain in-place. The type of material produced (i.e. binder, top), the layer in which it is used, and the location of use (i.e., mainline or a non-critical area) will be primary considerations in the determination of whether the WMA can be left in-place. If the WMA cannot be left in-place, it will be removed at no cost to the State. However, if the State determines that the WMA can be left in-place, the Quality Payment Adjustment will be calculated using a QAF of 0.60.

BASIS OF PAYMENT. The unit price bid for WMA mixtures shall meet the requirements specified in §402-5 Basis of Payment

Item No.	Item	Pay Unit
404.01790191	True & Leveling F9, Superpave WMA, 70 Series Compaction	Metric Ton
404.01890191	True & Leveling F9, Superpave WMA, 80 Series Compaction	Metric Ton
404.05890191	Shim Course F9, Warm Mix Asphalt	Metric Ton
404.09510191	9.5 mm F1 Superpave WMA, 50 Series Compaction	Metric Ton
404.09512191	Pavement Density Quality Adjustment to 404.09510191	Quality Units
404.09520191	9.5 mm F2 Superpave WMA, 50 Series Compaction	Metric Ton
404.09522191	Pavement Density Quality Adjustment to 404.09520191	Quality Units
404.09610191	9.5 mm F1 Superpave WMA, 60 Series Compaction	Metric Ton
404.09620191	9.5 mm F2 Superpave WMA, 60 Series Compaction	Metric Ton
404.09630191	9.5 mm F3 Superpave WMA, 60 Series Compaction	Metric Ton
404.09710191	9.5 mm F1 Superpave WMA, 70 Series Compaction	Metric Ton
404.09720191	9.5 mm F2 Superpave WMA, 70 Series Compaction	Metric Ton
404.09730191	9.5 mm F3 Superpave WMA, 70 Series Compaction	Metric Ton
404.09810191	9.5 mm F1 Superpave WMA, 80 Series Compaction	Metric Ton
404.09820191	9.5 mm F2 Superpave WMA, 80 Series Compaction	Metric Ton
404.09830191	9.5 mm F3 Superpave WMA, 80 Series Compaction	Metric Ton
404.09890191	9.5 m F9 Superpave WMA, Shoulder Course, 80 Series Compaction	Metric Ton
404.12510191	12.5 mm F1 Superpave WMA, 50 Series Compaction	Metric Ton
404.12512191	Pavement Density Quality Adjustment to 404.12510191	Quality Units
404.12520191	12.5 mm F2 Superpave WMA, 50 Series Compaction	Metric Ton
404.12522191	Pavement Density Quality Adjustment to 404.12520191	Quality Units
404.12610191	12.5 mm F1 Superpave WMA, 60 Series Compaction	Metric Ton
404.12620191	12.5 mm F2 Superpave WMA, 60 Series Compaction	Metric Ton
404.12630191	12.5 mm F3 Superpave WMA, 60 Series Compaction	Metric Ton
404.12710191	12.5 mm F1 Superpave WMA, 70 Series Compaction	Metric Ton
404.12720191	12.5 mm F2 Superpave WMA, 70 Series Compaction	Metric Ton
404.12730191	12.5 mm F3 Superpave WMA, 70 Series Compaction	Metric Ton
404.12810191	12.5 mm F1 Superpave WMA, 80 Series Compaction	Metric Ton
404.12820191	12.5 mm F2 Superpave WMA, 80 Series Compaction	Metric Ton
404.12830191	12.5 mm F3 Superpave WMA, 80 Series Compaction	Metric Ton
404.12890191	12.5 mm F9 Superpave WMA, Shoulder Course, 80 Series Compaction	Metric Ton

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404.19590191	19 mm F9 Superpave WMA, 50 Series Compaction	Metric Ton
404.19592191	Pavement Density Quality Adjustment to 404.19590191	Quality Units
404.19690191	19 mm F9 Superpave WMA, 60 Series Compaction	Metric Ton
404.19790191	19 mm F9 Superpave WMA, 70 Series Compaction	Metric Ton
404.19890191	19 mm F9 Superpave WMA, 80 Series Compaction	Metric Ton
404.25590191	25 mm F9 Superpave WMA, 50 Series Compaction	Metric Ton
404.25592191	Pavement Density Quality Adjustment to 404.25590191	Quality Units
404.25690191	25 mm F9 Superpave WMA, 60 Series Compaction	Metric Ton
404.25790191	25 mm F9 Superpave WMA, 70 Series Compaction	Metric Ton
404.25890191	25 mm F9 Superpave WMA, 80 Series Compaction	Metric Ton
404.37690191	37.5 mm F9 Superpave WMA, 60 Series Compaction	Metric Ton
404.37790191	37.5 mm F9 Superpave WMA, 70 Series Compaction	Metric Ton
404.37890191	37.5 mm F9 Superpave WMA, 80 Series Compaction	Metric Ton

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