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# **Volumetrics**

## **Section 3 - Special Provision for High Performance Plant Mix Pavement – Volumetric Acceptance (HPPMPVA)**

### **SP-400UP**

# Description

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- **For the volumetric requirements for the design, production, placement, and testing of plant mix pavements and recycled plant mix pavements for Level of Control 1**

# Materials

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- **Specified in Section 401, Plant Mix Pavements and Recycled Plant Mix Pavements.**
- **Provide a mix design in accordance with Subsection 401.4.1.3, Mix Design, except as follows:**
  - ▶ **Ensure aggregate gradations are within the control points for the designated aggregate size in Table 1, Gradation Control Points**

# Materials (continued)

**Table 1**  
**Gradation Control Points**

<b>Sieve</b>	<b>% Passing, Nominal Maximum Size</b>		
	<b>¾ in</b>	<b>½ in</b>	<b>¾ in</b>
<b>1 in</b>	<b>100</b>	<b>–</b>	<b>–</b>
<b>¾ in</b>	<b>90 – 100</b>	<b>100</b>	<b>–</b>
<b>½ in</b>	<b>90 Max.</b>	<b>90 – 100</b>	<b>100</b>
<b>¾ in</b>		<b>90 Max.</b>	<b>90 – 100</b>
<b>#4</b>			<b>90 Max.</b>
<b>#8</b>	<b>23 - 49</b>	<b>28 – 58</b>	<b>32 – 67</b>
<b>#200</b>	<b>2 - 8</b>	<b>2 – 10</b>	<b>2 – 10</b>

# Equipment

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- **Use equipment and technologies capable of producing an asphalt mixture to meet the requirements of this special provision.**

# Construction

- **Perform sampling and testing of materials in the field with a certified technician (Subsection 114.3.2, Personnel) That is working under the supervision of an AASHTO accredited lab.**
- **Voids in mineral aggregate (VMA) and air voids correlation will be required prior to production.**
- **Collect mix samples in accordance with the Materials Testing Manual, from the windrow, the plant via a swing arm system, or behind the screed prior to rolling.**

# WYDOT 114.3.2 Personnel Requirements

- Only certified technicians can perform sampling and testing of materials in the field.

Table 114.3.2-1  
Testing Certification Requirements

Tests	Minimum Certification
Aggregate gradation	Aggregate
Coarse Aggregate Angularity	Aggregate
Fine Aggregate Angularity	Aggregate
Liquid Limit	Aggregate
Plastic Limit	Aggregate
Sand Equivalent	Aggregate
In-Place Density	Asphalt
Mix Verification Sampling	Asphalt and Aggregate
Asphalt Content	Asphalt
Field Sampling Fresh Concrete	Concrete
Temperature of Fresh Concrete	Concrete
Unit Weight (Density) of Concrete	Concrete
Slump	Concrete
Air Content of Fresh Concrete	Concrete
Making, Curing Concrete Cylinders	Concrete

# Construction (Continued)

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- **Preferred methods of sampling and from the windrow or using a swing arm system.**
- **If a swing arm or windrow method is present, sampling behind the paver is not allowed.**
- **Testing requirements will be in accordance with Level of Control 1**
- **For mix production and in-place density, the Level of Control 1 testing requirements will be followed in accordance with Table 2, Level of Control 1 – QC/QA Testing Requirements**



# Construction (Continued)

**Table 2**  
**Level of Control 1 – QC/QA Testing Requirements**

Test Procedure	Test Frequency	
	Contractor QC Testing	Department QA testing
Air Voids	1 per subplot	3 per lot <sup>3</sup>
VMA <sup>1</sup>	1 per subplot	3 per lot <sup>3</sup>
In-Place Density	3 per subplot	3 per lot <sup>3</sup>
Extracted Aggregate Gradation; D/A; film thickness; Asphalt Binder Content	1 per subplot	3 per lot <sup>3</sup>
Virgin Aggregate—LL; PI; Coarse Aggregate Angularity (Fractured Faces); Fine Aggregate Angularity; Flat & Elongated <sup>2</sup>	1 per subplot for first lot, 1 per lot thereafter	1 per mix design
Moisture Content of Virgin Aggregate/ Hydrated Lime; Moisture Content of Mix	1 per lot	
Combined Aggregate Water Absorption (percent)	1 per lot	

<sup>1</sup> VMA during production will be calculated using the method in ASTM D6995 *Standard Test Method for Determining Field VMA based on the Maximum Specific Gravity of the Mix ( $G_{mm}$ )*.

<sup>2</sup> If, during aggregate production, the test results for LL, PI, coarse aggregate angularity, fine aggregate angularity, and flat and elongated were within specification, the department will not require testing during plant mix production.

<sup>3</sup> The engineer will test all three cores on their randomly selected sublots. Further details for Department QA testing requirements for VMA, Air voids and In-place Density are described in the *Materials Testing Manual*.

# Test Strip

- **Construct a 500 ton test strip to evaluate the mix design and compaction effort (Subsection 401.4.18, Test Strip)**
- **For the test strip, the engineer will determine the pay factor based on in-place density:**
  - ▶ **Collect two samples from three random locations of the last 300 tons places for air voids and VMA**
  - ▶ **Collect four samples from three random locations of the last 300 tons for in-place density. The in-place density percentage will be computed from the corresponding voidless unity weight of the three volumetric samples taken during the test strip.**
  - ▶ **Test one sample for air voids and VMA and take in-place densities from each location and the engineer will test the corresponding samples for verification**

# Test Strip (Continued)

- **The engineer will accept the test strip within 24 hours of final compaction if the following conditions are met:**
  - ▶ **The pay factor for density is 1.00 or greater in accordance with main line production methods;**
  - ▶ **All of the air void tests are within specification limits (Table 401.4.1-2, Marshall and Superpave Plant Mix Properties); and**
  - ▶ **All of the VMA tests meet limits ( Table 401.4.1-3, Percent Voids in Mineral Aggregate (Production Mix))**
- **No pay factors for air voids or VMA will be assessed for the test strip**
- **The pay factor for an accepted test strip will be 1.00**

# Table 401.4.1-3

Table 401.4.1-3				
Percent Voids in Mineral Aggregate				
Class	Voids in Mineral Aggregate (%)			
	Maximum Nominal Size			
	1 in [25 mm]	¾ in [19 mm]	½ in [12.5 mm]	⅜ in [9.50 mm]
Laboratory Mix				
I-M, II-M, I-S, II-S	12.0–15.0	13.0–16.0	14.0–17.0	14.0–17.0
III-M, III-S	11.0–14.0	12.0–15.0	13.0–16.0	13.0–16.0
Production Mix				
I-M, II-M, I-S, II-S	11.0–15.0	12.0–16.0	13.0–17.0	13.0–17.0
III-M, III-S	10.0–14.0	11.0–15.0	12.0–16.0	12.0–16.0

# Test Strip

- **Construct a new test strip at no additional cost to the department if the test strip is unacceptable**
- **For density pay factors less than 1.00 and greater than or equal to 0.50, the pavement may be left in place, as approved by the engineer at the reduced price determined by the pay factor**
- **If the density pay factor is less than 0.50, remove the test strip and dispose of material at no additional cost to the department**

# Production Mix

- **The target for air voids (% air voids) in production mix will be the mix design value with a tolerance of  $\pm 1.25\%$  with a minimum lower limit of 2.75% and a maximum upper limit of 6.25%**
- **The target for VMA will be the mean of the first three full production samples (NOT from the test strip) or the value from Table 3, Minimum VMA targets (Production Mix) whichever is greater. The tolerance will be  $\pm 1.50\%$ , resulting in specification limits for VMA equal to the target value  $\pm 1.50\%$**

# Production Mix (Continued)

**Table 3**  
**Minimum VMA Targets (Production Mix)**

Max. Nominal Size (in)	VMA %	
	Class	
	I-S , II-S	III-S
$\frac{3}{4}$	<b>13.25</b>	<b>12.25</b>
$\frac{1}{2}$	<b>14.25</b>	<b>13.25</b>
$\frac{3}{8}$	<b>14.25</b>	<b>13.25</b>

- **The target for in-place density will be 94.00% with a lower specification limit (SL<sub>L</sub>) of 92.00% and a upper specification limit (SL<sub>U</sub>) of 100%**

# Quality Acceptance and Verification

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- **For mix production and in-place density, the lot size will consist of five sublots.**
  - **Sublots will be 1000 tons**
  - **May be reduced to between 500 tons and 1000 tons**
  - **The last lot of a pay item may consist of three to seven sublots**
- **The theoretical maximum specific gravity (Gmm) for each subplot will be used for determination of the in-place density and volumetric calculations for that subplot**



# **Quality Acceptance and Verification (Continued)**

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- **The engineer will verify testing procedures by testing three sublots randomly from samples obtained to represent each acceptance lot**
- **The difference between the contractor's quality acceptance test results and the engineer's corresponding verification test results will be evaluated in accordance with the values in the Manual Testing Manual and applies as follows:**

# **Quality Acceptance and Verification (Continued)**

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- 1. If the verification samples pass, the contractor's test results will be used for quality acceptance; or**
- 2. If the verification samples fail, the engineer will test the remaining samples from the lot. Once the tests have been completed, the results will be evaluated using the statistical evaluation procedures for the correlation of testers to decide if both groups represent the sample population. If the contractor's and engineer's results represent the same sample population, the contractor's test results will be used for quality acceptance.**
- 3. If the contractor's and the engineer's results do not represent the same sample population, the engineer's verification test results will be used for acceptance for the lot, and a new correlation will be performed on the next lot. The contractor's test results will not be used for quality acceptance until the correlation is completed and is acceptable.**

# Quality Acceptance and Verification (Continued)

- **Initiate a corrective measure process if the average lot value for asphalt binder content, aggregate gradation, dust to effective asphalt, or film thickness is outside the specified limits for two consecutive lots**

**Table 4  
Non-Pay Factor Specification Items and Limits**

<b>Non-Pay factor item</b>	<b>Specification limits</b>
<b>Asphalt Content (%)</b>	<b><math>\pm 0.5</math> of the target asphalt content<sup>†</sup></b>
<b>Aggregate Gradation (% passing)</b>	<b>Within the Gradation Control Points in Table 1, Gradation Control Points</b>
<b>Dust to Effective Asphalt Binder</b>	<b>0.8 – 1.4</b>
<b>Film Thickness (<math>\mu\text{m}</math>)</b>	<b>6 - 12</b>

# Quality Acceptance and Verification

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- **With concurrence from the engineer, select the target asphalt content upon acceptance of the test strip and prior to production.**
- **Corrective action may require a new mix design (Subsection 401.4.24 Corrective Action Plan)**
- **Suspend production if the requirements aren't met (Subsection 401.4.22.2, Quality Acceptance)**

# **Corrective Action Plan**

## **WYDOT 401.4.24**

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- **Take immediate corrective action when the production of material falls outside of specification parameters. Do not continue producing material that does not meet specifications.**
- **Aggregate Gradation, Density, and Asphalt Binder Content. If two consecutive lots have a pay factor less than 1.00, Determination of Pay Factors, make changes and adjustments to produce the specified material.**

# Mix Volumetrics (Corrective Action)

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- **Immediately resample and retest. If the resample exceeds specification limits, begin valid corrective action(s) immediately. After corrective action, immediately resample and retest. Suspend production if two corrective actions fail to result in the production of specification material. Obtain the engineer's approval of further proposed actions before resuming production.**

# Valid Corrective Actions for Mix

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- **1.1. A change in the percentage of aggregate addition from any one storage bin by at least 5 percent;**
- **1.2. A change in the target asphalt binder content by at least 0.2 percent;**
- **1.3. A change in the minus No. 200 [75  $\mu\text{m}$ ] material in the mix by at least 1 percent; or**
- **1.4. Other actions approved by the engineer.**

# Corrective Actions for Other Properties

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- **2. Liquid Limit and Plastic Index. Reprocess until the material is within limits.**
- **3. Moisture Content of Virgin Aggregate/Hydrated Lime. Adjust moisture immediately.**
- **4. Moisture Content of Plant Mix. Adjust mix production immediately.**
- **5. Coarse and Fine Aggregate Angularity. Adjust mix production immediately.**



# Measurement and Payment

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- **The engineer will measure and the department will pay in accordance with Subsection 401.5, Measurement and Payment, except as follows:**
  - ▶ **Pay factors for volumetrics will be applied to plant mix pavements and recycled plant mix pavements**
  - ▶ **The volumetric pay factors will be calculated be based on percent within limits (PWL) and will be determined as follows:**

# Measurement and Payment (Continued)

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- **If the pay factor or any of the quality characteristics is less than 1.00, then the maximum allowable composite pay factor will be 1.00**
- **If the pay factor for any of the quality characteristics is less than 0.75, the engineer will determine whether to accept or reject the material and, if accepted, the pay factor will apply**