SPECIAL PROVISION
FOR
HIGH PERFORMANCE PLANT MIX PAVEMENT - VOLUMETRIC ACCEPTANCE (HPPMPVA) and CONTRACTOR TESTING (VOLUMETRIC)

Project No. I803153
Rock Springs - Rawlins
Point of Rocks East EBL/WBL

REFERENCE: The 2021 Edition of the Wyoming Department of Transportation's *Standard Specifications for Road and Bridge Construction*, Report No. FHWA-RD-02-095, *Optimal Procedures for Quality Assurance Specifications,* and the *Materials Testing Manual, Appendix: Volumetrics*.

DESCRIPTION: This special provision describes the volumetric testing requirements for the design, production, placement and testing of plant mix pavements and recycled plant mix pavements for Level of Control 1.

MATERIALS: Provide materials 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.

Table 1
Gradation Control Points

Sieve	% Passing, Nominal Maximum Size		
	¾ in	½ in	⅜ in
1 in	100	–	–
¾ in	90 – 100	100	–
½ in	90 Max.	90 – 100	100
⅜ in		90 Max.	90 – 100
#4			90 Max.
#8	23 - 49	28 – 58	32 – 67
#200	2 - 8	2 – 10	2 – 10

EQUIPMENT: 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 in accordance with Subsection 114.3.2, Personnel, that is working under the supervision of an AASHTO accredited lab.

Take responsibility for development of a mix design as applicable, material sampling, quality control testing, and quality acceptance testing.

Voids in mineral aggregate (VMA) and air voids correlation will be required prior to the production of plant mix pavement. Aggregate correlation is not required.

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. The preferred methods of sampling are from the windrow or using a swing arm system. If a swing arm system or windrow sampling method is present, sampling behind the paver is not allowed.

The 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.

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

Test Procedure	Test Frequency	
	Contractor QC Testing	**Department QA testing**
Air Voids	1 per sublot	3 per lot[3]
VMA [1]	1 per sublot	3 per lot[3]
In-Place Density	3 per sublot	3 per lot [3]
Extracted Aggregate Gradation; D/A; film thickness; Asphalt Binder Content	1 per sublot	3 per lot[3]
Virgin Aggregate—LL; PI; Coarse Aggregate Angularity (Fractured Faces); Fine Aggregate Angularity; Flat & Elongated [2]	1 per sublot 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	no tests req'd
Combined Aggregate Water Absorption (percent)	1 per lot	

[1] 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})*.

[2] 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.

[3] 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 in accordance with Subsection 401.4.18, Test Strip.

For the test strip, the engineer will determine the pay factor based on in-place density as follows:

- Collect two samples from three random locations of the last 300 tons placed 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 unit weight of the three volumetric samples taken during the test strip.
- Test one sample for air voids and VMA and two in-place densities from each location and the engineer will test the corresponding samples for verification.

The engineer will accept the test strip within 24 hours of final compaction if the following conditions are met:

1. The pay factor for density is 1.00 or greater and in accordance with main line production methods;
2. All of the air void tests are within specification limits in accordance with Table 401.4.1-2, Marshall and Superpave Plant Mix Properties; and
3. All of the VMA tests meet limits from 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.

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 department.

Production Mix: The target for air voids (% air voids) in production mix will be the mix design value with a tolerance of ±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 ±1.50%, resulting in specification limits for VMA equal to the target value ±1.50%.

Table 3
Minimum VMA Targets (Production Mix)

VMA %		
Max. Nominal Size (in)	**Class**	
	I-S , II-S	**III-S**
¾	13.25	12.25
½	14.25	13.25
⅜	14.25	13.25

The target for in-place density will be 94.00%, with a lower specification limit (SL_L) of 92.00% and an upper specification limit (SL_U) of 100.00%.

Quality Acceptance and Verification: For mix production and in-place density, the lot size will consist of five sublots. Sublots size will be 1000 tons. The sublot size 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 (G_{mm}) for each sublot will be used for determination of the in-place density and volumetric calculations for that sublot.

The engineer will verify testing procedures by testing three sublots randomly from the sublot samples obtained to represent each acceptance lot. The differences 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 *Materials Testing Manual* and applied as follows:

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.

   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.

Initiate a corrective measure process if the average lot value for asphalt binder content, aggregate gradation, dust to effective asphalt, or film thickness listed in Table 4, Non-pay Factor Specification Items and Limits, is outside the specified limits for two consecutive lots.

Table 4
Non-Pay Factor Specification Items and Limits

Non-Pay factor item	Specification limits
Asphalt Content (%)	± 0.5 of the target asphalt content[4]
Aggregate Gradation (% passing)	Within the Gradation Control Points in Table 1, Gradation Control Points
Dust to Effective Asphalt Binder	0.8 – 1.4
Film Thickness (μm)	6 - 12

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 in accordance with Subsection 401.4.24 Corrective Action Plan.

Suspend production if the requirements in Subsection 401.4.22.2, Quality Acceptance are not met.

MEASUREMENT and PAYMENT: The engineer will measure:

1. Contractor Testing (Volumetric) as a complete unit.

2. High Performance Plant Mix Pavement - Volumetric Acceptance (HPPMPVA) will not be paid separately, but is considered incidental to the contract plant mix pavement item(s). The engineer will measure and the department will pay for plant mix pavement item(s) in accordance with Subsection 401.5, Measurement and Payment, except as follows:

The department will pay as follows:

Pay Item	Pay Unit	Measure to the Nearest	Pay to the Nearest
Contractor Testing	LS	LS	LS

The department will divide and pay out the lump sum as follows:

1. Twenty-five percent with the first monthly progress payment;

2. Twenty-five percent with the monthly progress payment that follows the engineer's written acceptance of the contractor mix design or the beginning of placement of tested material(s); and

3. The final 50 percent upon completion of the sampling and quality control and quality acceptance testing.

Pay factors for volumetrics will be applied to plant mix pavements and recycled plant mix pavements.

The volumetric pay factors will be calculated based on percent within limits (PWL) and will be determined as follows.

Calculate the quality limits and PWL for air voids, VMA, and in-place density in accordance with Section 113, *Acceptance*:

$$Q_U = \frac{SL_U - \bar{X}}{s}$$

$$Q_L = \frac{\bar{X} - SL_L}{s}$$

where: Q_U = quality index for the upper specification limit
Q_L = quality index for the lower specification limit
SL_U = upper specification limit
SL_L = lower specification limit
$\bar{X}$ = average for the lot
s = standard deviation for the lot
n = number of samples for the lot

Determine the percent within limits:

$$PWL = PU + PL - 100$$

where: PU = percent within the upper specification limit
PL = percent within the lower specification limit
PWL = percent within the specification limits

Calculate volumetric pay factors:

$$PF_{VOIDS} = 0.55 + 0.50 \times \frac{PWL_{VOIDS}}{100}$$

$$PF_{VMA} = 0.55 + 0.50 \times \frac{PWL_{VMA}}{100}$$

$$PF_D = 0.55 + 0.50 \times \frac{PWL_D}{100}$$

where: PF_{VOIDS} = pay factor for air voids
PWL_{VOIDS} = percent within limits for air voids
PF_{VMA} = pay factor for VMA
PWL_{VMA} = percent within limits for VMA
PF_D = pay factor for in-place density
PWL_D = percent within limits for in-place density

If the pay factor for any of the quality characteristics (air voids, VMA, or in-place density) 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 (air voids, VMA, or in-place density) is less than 0.75, the engineer will determine whether to accept or reject the material and, if accepted, the pay factor that will apply.

Calculate the composite pay factor (CPF) with the two equations below and use the equation that results in the largest pay factor:

$$CPF = 3 \times [(WF_{VOIDS} \times PF_{VOIDS}) + (WF_{VMA} \times PF_{VMA}) + (WF_D \times PF_D)] - 2.00$$

$$CPF = [(WF_{VOIDS} \times PF_{VOIDS}) + (WF_{VMA} \times PF_{VMA}) + (WF_D \times PF_D)]$$

where:
- CPF = composite pay factor
- WF_{VOIDS} = weight factor for air voids (see table 5)
- WF_{VMA} = weight factor for VMA (see table 5)
- WF_D = weight factor for in-place density (see table 5)
- PF_{VOIDS} = pay factor for air voids
- PF_{VMA} = pay factor for VMA
- PF_D = pay factor for in-place density

Table 5
Weight Factors

Property	Weight Factor
Air Voids	0.40
VMA	0.20
In-Place Density	0.40

Calculate the pay adjustment (PA) as follows:

$$PA = (CPF - 1.00) \times PMP \times LS$$

where:
- PA = pay adjustment
- CPF = composite pay factor
- PMP = Unit Contract Price for the Plant Mix Pavement Pay Item ($$)
- LS = Lot Size (short ton)

No payment will be made for the asphalt binder in excess of the mix design shown in the contract plus 0.50 percent.

Table 401.5.3-3, Asphalt Binder Content Pay Factors, does not apply.

11-29-23