



# INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

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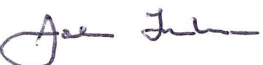
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**Eric Holcomb, Governor**  
**Joe McGuinness, Commissioner**

March 31, 2017

## CONSTRUCTION MEMORANDUM 17-06

TO: District Deputy Commissioners  
District Construction Directors  
District Technical Services Directors  
District Area Engineers  
District Project Management Director  
Project Management Director  
District Traffic Engineers  
District Testing Engineers  
District LPA Coordinators  
Project Engineers/Supervisors  
Field Engineers  
Office of Material Management

FROM: John Leckie, Director   
Division of Construction and Materials Management

SUBJECT: QC/QA Hot Mix Asphalt Test Result Appeals

The Department has reviewed Recurring Special Provision 400-R-641, effective for contracts with a letting date on or after October 1, 2016. It has resulted in a revision to the Recurring Special Provision, which can be found on the Department's website and is attached to this memo.

The revised RSP modifies the requirements in 401.07 regarding the definition of a Lot. It also makes changes in 401.09 regarding when the Contractor shall make available the subplot quality control results. Lastly, it alters 401.20 regarding how appeals are handled.

The new requirements shall be applied to any contract containing RSP 400-R-641.

In order to use the revised RSP 400-R-641 on contracts where it is not in the original contract documents, a no cost change order will need to be generated and approved to cover the specification change.

If you should have any questions on the issue of QC/QA HMA, please contact the Office of Materials Management.

ATTACHMENT: Revised RSP 400-R-641 HMA PAVEMENT

JL/ddh/stt

## 400-R-641 HMA PAVEMENT

(Revised 03-31-17)

The Standard Specifications are revised as follows:

SECTION 401, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

**SECTION 401 – QUALITY CONTROL/QUALITY ASSURANCE, QC/QA, HOT MIX ASPHALT, HMA, PAVEMENT**

**401.01 Description**

This work shall consist of one or more courses of QC/QA HMA base, intermediate, or surface mixtures constructed on prepared foundations in accordance with 105.03.

**401.02 Quality Control**

The HMA shall be supplied from a certified HMA plant in accordance with ITM 583; Certified Hot Mix Asphalt Producer Program. The HMA shall be transported and placed according to a Quality Control Plan, QCP, prepared and submitted by the Contractor in accordance with ITM 803; Contractor Quality Control Plans for Hot Mix Asphalt Pavements. The QCP shall be submitted to the Engineer at least 15 days prior to commencing HMA paving operations.

When a safety edge is required for a project, the QCP shall identify the device or devices in accordance with 409.03(c) to be used for constructing the safety edge.

**MATERIALS**

**401.03 Materials**

Materials shall be in accordance with the following:

Asphalt Materials	
PG Binder.....	902.01(a)
Coarse Aggregates .....	904
Base Mixtures – Class D or Higher	
Intermediate Mixtures – Class C or Higher	
Surface Mixtures* – Class B or Higher	
Fibers.....	AASHTO M 325
Fine Aggregates .....	904
*Surface aggregate requirements are listed in 904.03(d).	

**401.04 Design Mix Formula**

A design mix formula, DMF, shall be prepared in accordance with 401.05 and submitted in a format acceptable to the Engineer one week prior to use. *The DMF shall be based on the ESAL category identified in the pay item and shall state the mixture designation and maximum particle size in the mixture. No mixture will be accepted for use until the DMF has been assigned a mixture number by the Engineer.* ~~The DMF shall state the maximum particle size in the mixture.~~

The DMF shall state the calibration factor, test temperature, and absorption factors to be used for the determination of binder content using the ignition oven in accordance with ITM 586, the binder content by extraction in accordance with ITM 571, the  $\Delta P_b$  determined in accordance with ITM 591 and a Mixture Adjustment Factor, MAF. The DMF shall state the source, type, and dosage rate of any stabilizing additives. ~~Approval of the DMF will be based on the ESAL and mixture designation. A mixture number will be assigned by the Engineer. No mixture will be accepted until the DMF has been approved.~~

The ESAL category identified in the pay item correlates to the following ESAL ranges.

ESAL CATEGORY	ESAL
1	< 300,000
2*	300,000 to < 3,000,000
3	3,000,000 to < 10,000,000
4*	≥ 10,000,000 to < 30,000,000
5	≥ 30,000,000

\*A category 2 mixture shall replace a category 1 mixture and a category 4 mixture shall replace a category 5 mixture.

The plant discharge temperature for any mixture shall not be more than 315°F whenever PG 58-28, PG 64-22, ~~PG 64-28~~ or PG 70-22 binders are used or *not more than* 325°F whenever ~~PG 70-28~~ or PG 76-22 binders are used. QC/QA HMA may be produced using a water-injection foaming device. The DMF shall list the minimum and maximum plant discharge temperatures as applicable to the mixture.

#### 401.05 Volumetric Mix Design

The DMF shall be determined for each mixture from a volumetric mix design by a design laboratory selected from the Department's list of approved Mix Design Laboratories. A volumetric mixture shall be designed in accordance with AASHTO R 35 and the respective AASHTO reference as listed below. *All loose mixture shall be conditioned for 4 h in accordance with AASHTO R 30 prior to testing. Steel furnace slag coarse aggregate, when used in an intermediate or base mixture application, shall have a deleterious content less than 4.0% as determined in accordance with ITM 219.*

#### Bulk Specific Gravity and Density of Compacted Asphalt

Mixtures Using Automatic Vacuum Sealing ..... AASHTO T 331

The single percentage of aggregate passing each required sieve shall be within the limits of the following gradation tables:

Dense Graded, Mixture Designation – Control Point (Percent Passing)					
	25.0 mm	19.0 mm	12.5 mm	9.5 mm	4.75 mm**
Sieve Size					
50.0 mm					
37.5 mm	100.0				
25.0 mm	90.0 - 100.0	100.0			
19.0 mm	< 90.0	90.0 - 100.0	100.0		

12.5 mm		< 90.0	90.0 - 100.0	100.0	100.0
9.5 mm			< 90.0	90.0 - 100.0	95.0 - 100.0
4.75 mm				< 90.0	90.0 - 100.0
2.36 mm	19.0 - 45.0	23.0 - 49.0	28.0 - 58.0	32.0 - 67.0*	
1.18 mm					30.0 - 55.0
600 µm					
300 µm					
75 µm	1.0 - 7.0	2.0 - 8.0	2.0 - 10.0	2.0 - 10.0	3.0 - 8.0
* The mix design gradation shall be less than or equal to the PCS control point for <del>all</del> 9.5 mm category 3, 4 and 5 surface mixtures. <i>The mix design gradation can be greater than the PCS control point when used on non-Department maintained facilities.</i>					
** The total blended aggregate gradation for the 4.75 mm mixture shall have a fineness modulus greater than or equal to 3.30 as determined in accordance with AASHTO T 27.					

PCS Control Point for Mixture Designation (Percent Passing)					
Mixture Designation	25.0 mm	19.0 mm	12.5 mm	9.5 mm	4.75 mm
Primary Control Sieve	4.75 mm	4.75 mm	2.36 mm	2.36 mm	n/a
PCS Control Point	40	47	39	47	n/a

Open Graded, Mixture Designation – Control Point (Percent Passing)			
	OG9.5 mm	OG19.0 mm	OG25.0 mm
Sieve Size			
37.5 mm			100.0
25.0 mm		100.0	70.0 – 98.0
19.0 mm		70.0 – 98.0	50.0 – 85.0
12.5 mm	100.0	40.0 – 68.0	28.0 – 62.0
9.5 mm	75.0 – 100.0	20.0 – 52.0	15.0 – 50.0
4.75 mm	10.0 – 35.0	10.0 – 30.0	6.0 – 30.0
2.36 mm	0.0 – 15.0	7.0 – 23.0	7.0 – 23.0
1.18 mm		2.0 – 18.0	2.0 – 18.0
600 µm		1.0 – 13.0	1.0 – 13.0
300 µm		0.0 – 10.0	0.0 – 10.0
150 µm		0.0 – 9.0	0.0 – 9.0
75 µm	0 – 6.0	0.0 – 8.0	0.0 – 8.0
% of Binder	> 3.0	> 3.0	> 3.0

Dust/Calculated Effective Binder Ratio shall be ~~taken from 0.6 to 1.2~~ *1.4*, ~~when the aggregate gradation passes above the primary control sieve, PCS, control point and 0.8 to 1.6 when the aggregate gradation is less than or equal to the PCS.~~ The Dust/Calculated Effective Binder Ratio for 4.75 mm mixtures shall be ~~0.8 to 2.0~~ *in accordance with AASHTO M 323.*

The optimum binder content shall produce a  $\Delta Pb \leq 0.20$  as determined in accordance with ITM 591 and the following air voids at  $N_{des}$ :

AIR VOIDS AT OPTIMUM BINDER CONTENT								
	Dense Graded					Open Graded		
Mixture	25.0	19.0	12.5	9.5	4.75	25.0	19.0	9.5

Designation	mm	mm	mm	mm	mm	mm	mm	mm
Air Voids	4.0%	4.0%	4.0%	4.0%	5.0%	15.0% - 20.0%	10.0% - 15.0%	

The design for dense graded mixtures shall have at least four points, including a minimum of two points above and one point below the optimum. A one point design may be used for open graded mixtures.

The maximum specific gravity shall be mass determined in water in accordance with AASHTO T 209. The bulk specific gravity of the gyratory specimens shall be determined in accordance with AASHTO T 166, Method A or AASHTO T 275, if required, for dense graded mixtures and AASHTO T 331 for open graded mixtures.

The percent draindown of open graded mixtures shall not exceed 0.30% in accordance with AASHTO T 305. Open graded mixtures may incorporate recycled materials and fibers. The recycled materials shall be in accordance with 401.06, and the fiber type and minimum dosage rate shall be in accordance with AASHTO M 325. The binder for open graded mixtures may have the upper temperature classification reduced by 6°C from the specified binder grade if fibers are incorporated into the mixture or if a ~~minimum~~ of 3.0% reclaimed asphalt shingles by weight of the total mixture ~~are~~ is used.

Dense graded mixture shall be tested for moisture susceptibility in accordance with AASHTO T 283 except that the loose mixture curing shall be replaced by mixture conditioning for ~~2-4~~ *h* in accordance with AASHTO R 30. The minimum tensile strength ratio, TSR, shall be 80%. The 6 in. mixture specimens shall be compacted in accordance with AASHTO T 312. If anti-stripping additives are added to the mixture to be in accordance with the minimum TSR requirements, the dosage rate shall be submitted with the DMF.

A PG binder grade or source change will not require a new mix design. If the upper temperature classification of the PG binder is lower than the original PG grade, a new TSR value is required.

The MAF equals the Gmm from the mixture design divided by the following: 2.465 for 9.5 mm mixtures and 2.500 for 12.5 mm, 19.0 mm, and 25.0 mm mixtures. If the MAF calculation results in a value where  $0.980 \leq \text{MAF} \leq 1.020$ , then the MAF shall be considered to be 1.000. If the MAF is greater than 1.020, the calculated MAF value shall have 0.020 subtracted from the value. If the MAF is less than 0.980, the calculated MAF value shall have 0.020 added to the value. The MAF does not apply to OG mixtures.

Changes in the source or types of aggregates shall require a new DMF. ~~A new DMF shall be submitted to the District Testing Engineer for approval one week prior to use.~~

The mixture design compaction temperature for the specimens shall be  $300 \pm 9^\circ\text{F}$  for dense graded mixtures and  $260^\circ\text{F}$  for open graded mixtures.

Design criteria for each mixture shall be based on the ESAL shown in the contract documents and shall be as follows:

GYRATORY COMPACTION EFFORT					
ESAL	N <sub>ini</sub> *	N <sub>des</sub> *	N <sub>max</sub> *	Max. % Gmm @ N <sub>ini</sub>	Max. % Gmm @ N <sub>max</sub>
Dense Graded					
<300,000	6	50	75	91.5	98.0
300,000 to < 3,000,000	7	75	115	90.5	98.0
3,000,000 to < 10,000,000	8	100	160	89.0	98.0
≥ 10,000,000 to < 30,000,000	8	100	160	89.0	98.0
≥ 30,000,000	9	125	205	89.0	98.0
Open Graded					
All ESAL	n/a	20	n/a	n/a	n/a
* N <sub>ini</sub> , N <sub>des</sub> , N <sub>max</sub> - definitions are included in AASHTO R 35					

VOIDS IN MINERAL AGGREGATE, VMA, CRITERIA @ N <sub>des</sub>	
Mixture Designation	Minimum VMA, %
4.75 mm	<del>16.0</del> 17.0
9.5 mm	15.0
12.5 mm	14.0
19.0 mm	13.0
25.0 mm	12.0
OG19.0 mm	n/a
OG25.0 mm	n/a

VOIDS FILLED WITH ASPHALT, VFA, CRITERIA @ N <sub>des</sub>	
ESAL	VFA, %
<300,000	<del>70</del> —80
300,000 to < 3,000,000	65 – 78
3,000,000 to < 10,000,000	65 – 75
≥ 10,000,000 to < 30,000,000	65 – 75
≥ 30,000,000	<del>65</del> —75
Notes: 1. For 9.5 mm mixtures, the specified VFA range shall be 73% to 76% for design traffic levels ≥ 3 million ESALs. 2. For 25.0 mm mixtures, the specified lower limit of the VFA shall be 67% for design traffic levels < 0.3 million ESALs. 3. For 4.75 mm mixtures, the specified VFA range shall be <del>66</del> 67% to 79%. 4. For OG9.5 mm, OG19.0 mm, OG25.0 mm mixtures, VFA is not applicable.	

#### 401.06 Recycled Materials

Recycled materials may consist of reclaimed asphalt pavement, RAP, or reclaimed asphalt shingles, RAS, or a blend of both. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. *Before entering the plant, The RAP shall be processed so that 100% will pass the 2 in. (50 mm) sieve and RAS shall be processed so that 100% will pass the 3/8 in. (9.5 mm) sieve when entering the HMA plant.* The RAP coarse aggregate shall pass the maximum size sieve for the mixture being produced and the RAS shall be 100% passing the 1/2 in. (12.5 mm) sieve.

RAP for the ESAL category ~~3, 4 and 5~~ 3 and 4 surface mixtures shall be 100% passing the 3/8 in. (9.5 mm) sieve and 95 to 100% passing the No. 4 (4.75 mm) sieve.

Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures. The amount of total binder replaced by binder in the recycled material shall be computed as follows:

$$\text{Binder Replacement, \%} = \frac{(A \times B) + (C \times D)}{E} \times 100\%$$

where:

- A = RAP, % Binder Content by Mass of RAP
- B = RAP, % ~~in Mixture~~ by Total Mass of Mixture
- C = RAS, % Binder Content by Mass of RAS
- D = RAS, % ~~in Mixture~~ by Total Mass of Mixture
- E = Total, % Binder Content ~~in Mixture~~ by Total Mass of Mixture

RAS may be obtained from either pre-consumer or post-consumer asphalt shingles ~~but the two RAS types shall not be blended together for use in HMA mixtures. Post-consumer asphalt shingles shall be in accordance with AASHTO MP 15 and prepared by a processing company with an IDEM Legitimate Use Approval letter. A copy of this letter shall be submitted to the Engineer. Deleterious material present in post-consumer asphalt shingles shall be limited to the percentages stated in AASHTO MP 15. Pre-consumer and post-consumer asphalt shingles shall not be blended for use in HMA mixtures.~~

*Post-consumer asphalt shingles shall be in accordance with the following:*

- (a) *post-consumer asphalt shingles shall be essentially nail-free*
- (b) *extraneous metallic materials retained on or above the No. 4 (4.75 mm) sieve shall not exceed 0.5% by mass*
- (c) *extraneous non-metallic materials such as glass, rubber, soil, brick, paper, wood and plastic retained on or above the No. 4 (4.75 mm) sieve shall not exceed 1.5% by mass*
- (d) *post-consumer shingles shall be prepared by a processing company with an IDEM Legitimate Use Approval letter. The approval letter shall be submitted with the DMF to the Engineer.*

The recycled material percentages shall be as specified on the DMF. HMA mixtures utilizing recycled materials shall be limited to the binder replacement percentages in the following table:

HMA mixtures utilizing RAP or RAS or a blend of RAP and RAS		
MAXIMUM BINDER REPLACEMENT, %		
Mixture Category	Base and Intermediate	Surface

	Dense Graded				Open Graded		Dense Graded		
	25.0 mm	19.0 mm	12.5 mm	9.5 mm	25.0 mm	19.0 mm	12.5 mm	9.5 mm	4.75 mm
1	40.0*				25.0		40.0*		
2	40.0 25.0 *				25.0*		40.0 25.0 *		
3	40.0 25.0 *				25.0*		25.0*		
4	40.0 25.0 *				25.0*		25.0*		
5	40.0*				25.0		25.0		

\* ~~RAS materials shall not contribute more than 25% by weight of the total binder content for any HMA mixture.~~ *The contribution of RAS to any HMA mixture shall be  $\leq 3.0\%$  by total mass of mixture and  $\leq 15.0\%$  binder replacement.*

The combined aggregate properties shall be in accordance with 904. The combined aggregate bulk specific gravity shall be determined in accordance with ITM 584 and the combined aggregate gradation shall be in accordance with 401.05 for the HMA mixture specified.

~~HMA mixtures with a binder replacement less than or equal to 25.0% by weight of the total binder content by utilizing RAP or RAS or a blend of RAP and RAS materials shall use the specified binder grade.~~

~~HMA mixtures with a binder replacement greater than 25.0% and less than or equal to 40.0% by weight of the total binder content by utilizing RAP or a blend of RAP and RAS shall use a binder grade with upper and lower temperature classifications reduced by 6°C from the specified binder grade. RAS materials shall not contribute more than 25.0% by weight of the total binder content for any HMA mixture.~~

#### 401.07 Lots and Sublots

Lots will be defined as 5,000 t of base or intermediate mixtures or 3,000 t of surface mixture. Lots will be further sub-divided into sublots not to exceed 1,000 t of base or intermediate mixtures or 600 t of surface mixture. Partial sublots of 100 t or less will be added to the previous sublot. Partial sublots greater than 100 t constitute a full sublot. Partial lots of four sublots or less will be added to the previous lot, ~~if available to create an extended lot.~~

#### 401.08 Job Mix Formula Blank

~~A job mix formula, JMF, shall be developed by a certified HMA producer. A JMF used in the current or previous calendar year that was developed to  $N_{des}$  will be allowed. The mixture compaction temperature shall be  $300 \pm 9^\circ\text{F}$  for dense graded mixtures and  $260 \pm 9^\circ\text{F}$  for open graded mixtures. The JMF shall list the minimum and maximum plant discharge temperatures as applicable to the mixture. The JMF for each mixture shall be submitted to the Engineer and shall use the same MAF as the DMF. A JMF of the same gyratory compactive effort ESAL category or higher approved in the current calendar year may be submitted for use.~~

#### 401.09 Acceptance of Mixtures

Acceptance of mixtures for ~~binder content~~ VMA at  $N_{des}$  and air voids at  $N_{des}$  for each lot will be based on tests performed by the Engineer for dense graded 9.5 mm, 12.5 mm, 19.0 mm and 25.0 mm mixtures with original contract pay item quantities greater



than or equal to 300 t. Acceptance of mixtures for binder content and air voids at  $N_{des}$  will be based on a type D certification in accordance with 402.09 for dense graded mixtures with original contract pay item quantities less than 300 t. Acceptance of mixtures for binder content and air voids at  $N_{des}$  for each lot will be based on a type D certification in accordance with 402.09 for dense graded 4.75 mm mixtures.

Acceptance of mixtures for binder content and air voids at  $N_{des}$  for each lot will be based on tests performed by the Engineer for open graded mixtures with original contract pay item quantities greater than or equal to 300 t. Acceptance of mixtures for binder content and air voids at  $N_{des}$  will be based on a type D certification in accordance with 402.09 for open graded mixtures with original pay item quantities less than 300 t, except the air voids tolerance shall be  $\pm 3.5\%$  from the DMF ~~or JMF~~.

The Engineer will randomly select the location within each subplot for sampling in accordance with ITM 802. The first 300 t of the first subplot of the first lot for each mixture pay item will not be sampled. An acceptance sample will consist of plate samples obtained in accordance with ITM 802 and ITM 580. The Engineer will take immediate possession of the samples.

Acceptance samples will be reduced to the appropriate size for testing in accordance with ITM 587. The binder content *and gradation* will be determined in accordance with ITM 586 or ITM 571 as directed by the Engineer. The maximum specific gravity will be mass determined in water in accordance with AASHTO T 209.

*The effective specific gravity,  $G_{se}$ , of the mixture will be determined in each subplot and reported from the acceptance sample testing.*

The air voids will be determined in accordance with AASHTO R 35 based on the average bulk specific gravity from two gyratory specimens and the MSG for the subplot. The VMA will be determined in accordance with AASHTO R 35 based on the average bulk specific gravity from two gyratory specimens, the percent aggregate in the mixture from the subplot and the BSG of the aggregate blend from the DMF/JMF as applicable. The gyratory pills will be prepared in accordance with AASHTO T 312.

*The dust/calculated effective binder ratio and the volume of effective binder in the mixture will be determined and reported from the acceptance sample testing conducted in each subplot. The volume of effective binder will be the difference between VMA and air voids. The Contractor shall take action in accordance with ITM 583 to address a dust/calculated effective binder ratio greater than 1.4 or a volume of effective binder in the mixture below design minimums.*

The bulk specific gravity of gyratory specimens for dense graded mixtures will be determined in accordance with AASHTO T 166, Method A or AASHTO T 275, if required, except samples are not required to be dried overnight. The bulk specific gravity of gyratory specimens for open graded mixtures, OG19.0 mm, OG25.0 mm will be determined in accordance with AASHTO T 331.

A binder draindown test in accordance with AASHTO T 305 for open graded mixtures shall be completed once per lot in accordance with 401.07 and shall not exceed 0.50%.

*The Contractor shall make available the subplot quality control results within seven calendar days from the date the acceptance sample was taken.*

~~The Engineer's acceptance test results for each subplot will be available after the subplot and testing are complete. The Engineer will make available the subplot acceptance test results after receiving the subplot quality control results from the Contractor.~~

SECTION 401, BEGIN LINE 301, DELETE AND INSERT AS FOLLOWS:

2. ~~Cedarapids~~ Cedarapids HMA pavers shall be those that were manufactured in 1989 or later.

SECTION 401, BEGIN LINE 358, DELETE AND INSERT AS FOLLOWS:

#### **401.14 Spreading and Finishing**

The mixture shall be placed upon an approved surface by means of laydown equipment in accordance with 409.03(c). Prior to paving, both the planned quantity and lay rate shall be adjusted by multiplying by the MAF. When mixture is produced from more than one DMF or JMF for a given pay item, the MAF will be applied to the applicable portion of the mixture for each. The temperature of each mixture at the time of spreading shall not be more than 18°F below the minimum mixing temperature as shown on the JMF for mixtures compacted in accordance with 402.15 315°F whenever PG 64-22 or PG 70-22 binders are used or not more than 325°F whenever PG 76-22 binder is used.

SECTION 401, BEGIN LINE 649, DELETE AND INSERT AS FOLLOWS:

#### **401.19 Pay Factors**

##### **(a) Dense Graded Mixture ≥ One Lot**

Pay factors, PF, are calculated for the binder content, air voids at  $N_{des}$  VMA at  $N_{des}$  and in-place density, % Gmm. The Percent Within Limits, PWL, for each lot will be determined in accordance with ITM 588. The appropriate pay factor for each property is calculated as follows:

Estimated PWL greater than 90:

$$PF = (105.00 - 0.50 \times (100.00 - PWL)) / 100$$

$$PF = ((0.50 \times PWL) + 55.00) / 100$$

Estimated PWL greater than or equal to 50 and equal to or less than 90:

$$PF = (100.00 - 0.000020072 \times (100.00 - PWL)^{3.5877}) / 100$$

$$PF = ((0.625 \times PWL) + 43.75) / 100$$

If the Lot PWL for any one of the properties is less than 50 or a subplot has an air void content less than 1.0% or greater than 7.0%, the lot will be referred to the Office of

Materials Management for adjudication as a failed material in accordance with normal Department practice as listed in 105.03.

~~Binder content~~, Air voids, VMA, and in-place density, % Gmm, PF values will be reported to the nearest 0.01. Rounding will be in accordance with 109.01(a).

A composite pay factor for each lot based on test results for mixture properties and density is determined by a weighted formula as follows:

$$\text{Lot PF} = \del{0.20}(\text{PF}_{\text{BINDER}}) + \del{0.35} 0.30(\text{PF}_{\text{VOIDS}}) + \del{0.10} 0.35(\text{PF}_{\text{VMA}}) + 0.35(\text{PF}_{\text{DENSITY}})$$

where:

Lot PF = Lot Composite Pay Factor for Mixture and Density

~~PF<sub>BINDER</sub>~~ = ~~Lot Pay Factor for Binder Content~~

PF<sub>VOIDS</sub> = Lot Pay Factor for Air Voids at N<sub>des</sub>

PF<sub>VMA</sub> = Lot Pay Factor for VMA at N<sub>des</sub>

PF<sub>DENSITY</sub> = Lot Pay Factor for In-Place Density, %Gmm

The lot quality assurance adjustment for mixture properties and density is calculated as follows:

$$q = L \times U \times (\text{Lot PF} - 1.00) / \text{MAF}$$

where:

q = quality assurance adjustment for mixture properties and density of the lot

L = Lot quantity

U = Unit price for the material, \$/ton

Lot PF = Lot Pay Factor

Lot test results for ~~binder content~~, air voids at N<sub>des</sub>, VMA at N<sub>des</sub>, and density will be used to determine the Lot Pay Factors.

The specification limits for ~~binder content~~, air voids at N<sub>des</sub>, VMA at N<sub>des</sub>, and density will be as follows:

SPECIFICATION LIMITS			
MIXTURE			
	LSL*		USL**
<del>Binder Content, %</del>	<del>-0.40 from JMF</del>		<del>+ 0.40 from JMF</del>
Air Voids at N <sub>des</sub> , %	2.60		5.40
Voids In Mineral Aggregate at N <sub>des</sub> , %	Greater of		Lesser of
	Spec -0.50	JMF -1.20	Spec + 2.00   JMF + 1.20
DENSITY			
	LSL*		USL**
Roadway Core Density	91.00		n/a

(% Gmm), %		
* LSL, Lower Specification Limit		
** USL, Upper Specification Limit		

**(b) Dense Graded Mixture < One Lot and Open Graded Mixture**

A composite pay factor for each subplot based on test results for mixture properties and density is determined in a weighted formula as follows:

*Dense Graded Mixture:*

$$SCPF = 0.20(PF_{BINDER}) + 0.35(0.30(PF_{VOIDS}) + 0.10(0.35(PF_{VMA}) + 0.35(PF_{DENSITY}))$$

*Open Graded Mixture:*

$$SCPF = 0.20(PF_{BINDER}) + 0.35(PF_{VOIDS}) + 0.45$$

where:

SCPF = Sublot Composite Pay Factor for Mixture and Density  
 PF<sub>BINDER</sub> = Lot Pay Factor for Binder Content  
 PF<sub>VOIDS</sub> = Sublot Pay Factor for Air Voids at N<sub>des</sub>  
 PF<sub>VMA</sub> = Sublot Pay Factor for VMA at N<sub>des</sub>  
 PF<sub>DENSITY</sub> = Sublot Pay Factor for Density

If the SCPF for a subplot is less than 0.85, the Office of Materials Management will evaluate the pavement. If the Contractor is not required to remove the mixture, quality assurance adjustments of the lot will be assessed or other corrective actions taken as determined by the Office of Materials Management.

The subplot quality assurance adjustment for mixture properties and density is calculated as follows:

$$q = L \times U \times (SCPF - 1.00)/MAF$$

where:

q = quality assurance adjustment for the subplot  
 L = subplot quantity  
 U = unit price for the material \$/ton  
 SCPF = subplot composite pay factor

Sublot test results for mixture properties will be assigned pay factors in accordance with the following:

BINDER CONTENT		
Dense Graded	Open Graded	Pay Factor
Deviation from JMF (± %)	Deviation from JMF DMF (± %)	
≤ 0.2	≤ 0.2	1.05

0.3	0.3	1.04
0.4	0.4	1.02
0.5	0.5	1.00
0.6	0.6	0.90
0.7	0.7	0.80
0.8	0.8	0.60
0.9	0.9	0.30
1.0	1.0	0.00
$\geq 1.0$	$> 1.0$	Submitted to the Office of Materials Management*
* Test results will be considered and adjudicated as a failed material in accordance with normal Department practice as listed in 105.03.		

VMA		
Dense Graded	Open Graded	Pay Factor
Deviation from JMF ( $\pm$ %)	Deviation from JMF ( $\pm$ %)	
$\leq 0.5$		1.05
$> 0.5$ and $\leq 1.0$	All	1.00
$> 1.0$ and $\leq 1.5$		0.90
$> 1.5$ and $\leq 2.0$		0.70
$> 2.0$ and $\leq 2.5$		0.30
$\geq 2.5$		Submitted to the Office of Materials Management*
* Test results will be considered and adjudicated as a failed material in accordance with normal Department practice as listed in 105.03.		

VMA		
Dense Graded	Open Graded	Pay Factor
Deviation from Spec Minimum	Deviation from Spec Minimum	
$> + 2.5$		Submitted to the Office of Materials Management*
$> + 2.0$ and $\leq + 2.5$		0.25
$> + 1.5$ and $\leq + 2.0$		0.65
$> + 0.5$ and $\leq + 1.5$		1.05
$\geq 0.0$ and $\leq + 0.5$	All	1.00
$\geq - 0.5$ and $< 0.0$		0.85
$\geq - 1.0$ and $< - 0.5$		0.65
$\geq - 1.5$ and $< - 1.0$		0.45
$\geq - 2.0$ and $< - 1.5$		0.25
$\geq - 2.5$ and $< - 2.0$		0.00
$< - 2.5$		Submitted to the Office of Materials Management*
* Test results will be considered and adjudicated as a failed material in accordance with normal Department practice as listed in 105.03.		

AIR VOIDS		
Dense Graded	Open Graded	Pay Factor
Deviation from $JMF$ $DMF (\pm \%)$	Deviation from $JMF$ $DMF (\pm \%)$	
$\leq 0.5$	$\leq 1.0$	1.05
$> 0.5$ and $\leq 1.0$	$> 1.0$ and $\leq 3.0$	1.00
1.1	3.1	0.98
1.2	3.2	0.96
1.3	3.3	0.94
1.4	3.4	0.92
1.5	3.5	0.90
1.6	3.6	0.84
1.7	3.7	0.78
1.8	3.8	0.72
1.9	3.9	0.66
2.0	4.0	0.60
$> 2.0$	$> 4.0$	Submitted to the Office of Materials Management*
* Test results will be considered and adjudicated as a failed material in accordance with normal Department practice as listed in 105.03.		

For mixtures produced during a plant's adjustment period, pay factors based on the  $JMFDMF$  with the above tolerances will be used to compute quality assurance adjustments.

SECTION 401, BEGIN LINE 803, DELETE AND INSERT AS FOLLOWS:

#### **401.20 Appeals**

If the QC test results do not agree with the acceptance test results *in a subplot*, a request, along with a *comparison of the QC and acceptance* test results, may be made in writing for additional testing *of that subplot*. The appeal sample will be analyzed in a lab different than the lab that analyzed the original sample ~~when requested by the Contractor at the discretion of the Engineer. Additional testing may be requested for one or more of the following tests: MSG, BSG of the gyratory specimens, binder content, or BSG of the density cores. The request for the appeal for MSG, BSG of gyratory specimens, binder content or BSG of the density cores shall be submitted within seven calendar days of receipt of the Department's written results for the lot accepted under 401.19(a) or the subplot accepted under 401.19(b). The subplot and specific test(s) shall be specified at the time of the appeal request. Only one appeal request per lot for mixture accepted under 401.19(a) or subplot for mixture accepted under 401.19(b) is allowed. Upon approval of the appeal, the Engineer will perform additional testing as follows.~~

*The Contractor may appeal an individual subplot for the binder content, the MSG, the BSG of the gyratory specimens or the BSG of the density cores when the QC results are greater than one standard deviation from the acceptance test results as follows: 0.25 for binder content, 0.010 for the MSG and 0.010 for both the BSG of the gyratory specimens and the density cores.*

A \$500.00 credit adjustment will be included in a quality adjustment pay item in accordance with 109.05.1(e) for each appealed subplot that did not result in an improvement to the SCPF or Lot PF.

A written request for an appeal shall be submitted within seven calendar days of receipt of the Department's written results for the lot accepted under 401.19(a) or the subplot accepted under 401.19(b). The conditions for an extended lot appeal are as follows:

1. One appeal will be allowed for the entire extended lot if the Contractor informs the Department of the anticipated extended lot condition within seven calendar days of receipt of the lot results, or;
2. One appeal will be allowed only for the extended sublots if the Contractor did not inform the Department of the anticipated extended lot condition within seven calendar days of receipt of the lot results.

The backup or new sample will be tested in accordance with the applicable test method for the test subplot requested for all tests exceeding the subplot standard deviation criteria.

SECTION 402, BEGIN LINE 32, DELETE AND INSERT AS FOLLOWS:

#### **402.04 Design Mix Formula**

A DMF shall be prepared in accordance with ~~402.05~~ 401.04 and submitted in a format acceptable to the Engineer one week prior to use. ~~The DMF shall state the maximum particle size in the mixture, the calibration factor and test temperature to be used for the determination of binder content using ITM 586 or ITM 571, and a MAF. Approval of the DMF will be based on the ESAL and mixture designation as follows.~~

*The DMF will be based on the ESAL and mixture designation as follows:*

Mixture Type	Type A	Type B*	Type C	Type D
Design ESAL	200,000	2,000,000 <3,000,000	9,000,000 3,000,000 to <10,000,000	11,000,000 ≥10,000,000
Surface	<del>4.75 mm</del>	4.75 mm	4.75 mm	4.75 mm
	9.5 mm	9.5 mm	9.5 mm	9.5 mm
	<del>12.5 mm</del>	12.5 mm	12.5 mm	12.5 mm
Surface – PG Binder	<del>64-22</del>	64-22	70-22	70-22
Intermediate	<del>9.5 mm</del>	9.5 mm	9.5 mm	9.5 mm
	<del>12.5 mm</del>	12.5 mm	12.5 mm	12.5 mm
	<del>19.0 mm</del>	19.0 mm	19.0 mm	19.0 mm
	<del>25.0 mm</del>	25.0 mm	25.0 mm	25.0 mm
Intermediate – PG Binder	<del>64-22</del>	64-22	64-22	70-22
Base	<del>19.0 mm</del>	19.0 mm	19.0 mm	19.0 mm
	<del>25.0 mm</del>	25.0 mm	25.0 mm	25.0 mm
Base – PG Binder	<del>64-22</del>	64-22	64-22	64-22

\*A type B mixture shall replace a type A mixture.

Surface 4.75 mm mixtures shall not be used when the required lay rate shown on the plans is greater than 100 lb/sq yd. Surface 12.5 mm mixtures shall not be used when the required lay rate shown on the plans is less than 195 lb/sq yd.

The plant discharge temperature for any mixture shall not be more than 315°F whenever ~~PG 58-28, PG 64-22, PG 64-28 or PG 70-22~~ binders are used ~~or 325°F whenever PG 70-28 or PG 76-22 binders are used~~. HMA may be produced using a water-injection foaming device. The DMF shall list the minimum and maximum plant discharge temperatures as applicable to the mixture.

~~The Engineer will assign a mixture number. No mixture will be accepted until the DMF has been approved. No mixture will be accepted for use until the DMF has been assigned a mixture number by the Engineer.~~

SECTION 402, BEGIN LINE 69, DELETE AND INSERT AS FOLLOWS:

#### **402.06 Job Mix Formula**~~Blank~~

~~The job mix formula, JMF, shall be an approved JMF in accordance with 401.08. of the same gyratory compaction effort ESAL category or higher, and submitted in a format acceptable to the Engineer and shall use the same MAF as the DMF. The JMF shall state the maximum particle size in the mixture and the calibration factor and test temperature to be used for the determination of binder content using the ignition oven. Approval of the JMF will be based on the ESAL and mixture designation. No mixture will be accepted until the JMF has been approved.~~

~~All changes in the type or source of aggregate shall require the submittal of a new DMF for approval.~~

#### **402.07 Mix Criteria**

##### **(a) Composition Limits for HMA Transverse Rumble Strip Mixtures**

Transverse rumble strip mixtures shall be ~~type A~~ *type B* surface in accordance with 402.04. A MAF in accordance with 402.05 will not apply. Aggregate requirements of 904.03(d) do not apply.

##### **(b) Composition Limits for HMA Wedge and Leveling Mixtures**

The mixture shall consist of surface or intermediate mixtures in accordance with 402.04. Aggregate requirements of 904.03(d) do not apply when the wedge and leveling mixture is covered by a surface or intermediate mixture.

##### **(c) Composition Limits for Temporary HMA Mixtures**

Temporary HMA mixtures shall be the type specified in accordance with 402.04. A MAF in accordance with 402.05 will not apply.

##### **(d) Composition Limits for HMA Curbing Mixes**

The mixture shall be HMA surface ~~type A~~ *type B* in accordance with 402 except 402.05 shall not apply and RAP shall not be used. The binder content shall be 7.0% and the gradations shall meet the following.



SECTION 402, BEGIN LINE 108, DELETE AND INSERT AS FOLLOWS:

#### 402.08 Recycled Materials

Recycled materials may consist of reclaimed asphalt pavement, RAP, or reclaimed asphalt shingles, RAS or a blend of both. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP shall be processed so that 100% will pass the 2 in. (50 mm) sieve when entering the HMA plant. The RAP coarse aggregate shall pass the maximum size sieve for the mixture being produced and the RAS shall be 100% passing the 1/2 in. (12.5 mm) sieve. RAP for the type C and D surface mixtures shall be 100% passing the 3/8 in. (9.5 mm) sieve and 95 to 100% passing the No. 4 (4.75 mm) sieve shall be in accordance with 401.06 except type B mixtures shall correspond to category 2 mixtures, type C mixtures shall correspond to category 3 mixtures and type D mixtures shall correspond to category 4 mixtures.

Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures. The amount of total binder replaced by binder in the recycled material shall be computed as follows:

$$\text{Binder Replacement, \%} = \frac{(A \times B) + (C \times D)}{E} \times 100\%$$

where:

- A = RAP, % Binder Content
- B = RAP, % in Mixture
- C = RAS, % Binder Content
- D = RAS, % in Mixture
- E = Total, % Binder Content in Mixture

RAS may be obtained from either pre-consumer or post-consumer asphalt shingles. Post-consumer asphalt shingles shall be in accordance with AASHTO MP 15 and prepared by a processing company with an IDEM Legitimate Use Approval letter. A copy of this letter shall be submitted to the Engineer. Deleterious material present in post-consumer asphalt shingles shall be limited to the percentages stated in AASHTO MP 15. Pre-consumer and post-consumer asphalt shingles shall not be blended for use in HMA mixtures and shall be stockpiled separately from other materials.

The recycled material percentages shall be as specified on the DMF. HMA mixtures utilizing recycled materials shall be limited to the binder replacement percentages in the following table:

HMA mixtures utilizing RAP or RAS or a blend of RAP and RAS

MAXIMUM BINDER REPLACEMENT, %							
Mixture Category	Base and Intermediate				Surface		
	Dense Graded				Dense Graded		
	25.0 mm	19.0 mm	12.5 mm	9.5 mm	12.5 mm	9.5 mm	4.75 mm
A	40.0*				40.0*		
B	40.0*				40.0*		

€	40.0*	25.0
Đ	40.0*	25.0

\* ~~RAS materials shall not contribute more than 25% by weight of the total binder content for any HMA mixture.~~

~~The combined aggregate properties shall be in accordance with 904. The combined aggregate bulk specific gravity shall be determined in accordance with ITM 584 and the combined aggregate gradation shall be in accordance with 401.05 for the HMA mixture specified.~~

~~HMA mixtures with a binder replacement less than or equal to 25.0% by weight of the total binder content by utilizing RAP or RAS or a blend of RAP and RAS materials shall use the specified binder grade.~~

~~HMA mixtures with a binder replacement greater than 25.0% and less than or equal to 40.0% by weight of the total binder content by utilizing RAP or a blend of RAP and RAS shall use a binder grade with upper and lower temperature classifications reduced by 6°C from the specified binder grade. RAS materials shall not contribute more than 25.0% by weight of the total binder content for any HMA mixture.~~

#### **402.09 Acceptance of Mixtures**

Acceptance of mixtures will be in accordance with the Frequency Manual on the basis of a type D certification in accordance with 916. The test results shown on the certification shall be the quality control tests representing the material supplied and include air voids and binder content. Air voids tolerance shall be  $\pm 1.5\%$  and binder content tolerance shall be  $\pm 0.7\%$  from DMF ~~or JMF~~.

SECTION 402, BEGIN LINE 233, DELETE AND INSERT AS FOLLOWS:

#### **402.13 Spreading and Finishing**

The mixture shall be placed upon an approved surface by means of laydown equipment in accordance with 409.03(c). Prior to paving, both the planned quantity and lay rate shall be adjusted by multiplying by the MAF. When mixture is produced from more than one DMF ~~or JMF~~ for a given pay item, the MAF will be applied to the applicable portion of the mixture for each. Mixtures in areas inaccessible to laydown equipment or mechanical devices may be placed by other methods.

~~The temperature of each mixture at the time of spreading shall not be more than 18°F below the minimum mixing temperature as shown on the DMF or JMF 315°F whenever PG 64-22 or PG 70-22 binders are used.~~

SECTION 402, BEGIN LINE 272, DELETE AS FOLLOWS:

The finished thickness of each course shall be at least two times but not more than four times the maximum particle size as shown on the DMF ~~or JMF~~. The finished thickness of wedge and level mixtures shall be at least 1 1/2 times but not more than six times the maximum particle size as shown on the DMF ~~or JMF~~. Feathering may be less than the minimum thickness requirements.

SECTION 507, BEGIN LINE 114, DELETE AND INSERT AS FOLLOWS:

The milled areas shall be filled with HMA partial depth patching. Partial depth patches shall consist of HMA Surface, ~~type A~~ *type B* in accordance with 402.04. MAF in accordance with 402.05 will not apply. The mixture shall be compacted by a vibratory roller in accordance with 409.03(d). A minimum of four passes of the rollers shall be completed. Partial depth patches shall be completed during work hours and opened to traffic at the close of the workday. Mixtures will be accepted in accordance with 402.09.

SECTION 610, BEGIN LINE 25, DELETE AND INSERT AS FOLLOWS:

**610.03 General Requirements**

Subgrade for approaches shall be prepared in accordance with 207. Aggregate base shall be constructed in accordance with 301. HMA for approaches shall be constructed in accordance with 402. HMA mixture for approaches shall be HMA surface or intermediate, type ~~A~~, B, C, or D in accordance with 402.04. A MAF in accordance with 402.05 will not apply.

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