410-R-642 QC/QA HMA - SMA MIXTURE

(Adopted 06-16-16)

The Standard Specifications are revised as follows:

SECTION 410, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 410 – QUALITY CONTROL/QUALITY ASSURANCE, QC/QA, HMA ~~SURFACE~~ – SMA PAVEMENT

410.01 Description

This work shall consist of one course of QC/QA HMA ~~Surface~~ – SMA mixture constructed on prepared foundations in accordance with 105.03.

SECTION 410, BEGIN LINE 32, DELETE AND INSERT AS FOLLOWS:

410.04 Design Mix Formula

A design mix formula, DMF, shall be prepared in accordance with 410.05 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 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, *ΔPb, determined in accordance with ITM 591*, *the aggregate degradation loss value in accordance with ITM 220* and a Mixture Adjustment Factor, MAF. The DMF shall state the source, type dosage rate of any stabilizing additives. ~~Approval of the~~ *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.~~ *No mixture will be accepted for use until the DMF has been assigned a mixture number by the Engineer.*

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 binder~~s~~ ~~are~~*is* used or *not more than* 325°F whenever ~~PG 70-28 or~~ PG 76-22 binder~~s~~ ~~are~~*is* used. SMA 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.

410.05 SMA Mix Design

The DMF shall be determined for each mixture from a SMA mix design by a design laboratory selected from the Department's list of approved Mix Design Laboratories. A SMA mixture shall be designed in accordance with *ITM 220,* AASHTO M 325 and R 46 *except the design gyrations shall be 75 for all ESAL categories. 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 mixture application, shall have a deleterious content less than 4.0% as determined in accordance with ITM 219.*

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

SMA GRADATION CONTROL LIMITS ~~(Percent Passing By Volume)~~						
Sieve Size	Mixture Designation					
	9.5 mm		12.5 mm		*19.0 mm*	
	Lower	Upper	Lower	Upper	*Lower*	*Upper*
37.5 mm					*100.0*	*100.0*
25.0 mm			*100.0*	*100.0*	*100.0**	*100.0*
19.0 mm	*100.0*	*100.0*	100.0*	100.0	*90.0*	*99.0*
12.5 mm	100.0*	100.0	90.0	99.0	*50.0*	*88.0*
9.5 mm	70.0	95.0	50.0	~~85.0~~ *80.0*	*25.0*	*60.0*
4.75 mm	30.0	50.0	20.0	~~40.0~~ *35.0*	*20.0*	*28.0*
2.36 mm	20.0	30.0	16.0	~~28.0~~ *24.0*	*16.0*	*24.0*
1.18 mm	---	21.0	---	---	---	---
600 µm	---	18.0	---	---	---	---
300 µm	---	15.0	---	---	---	---
75 µm	8.0	12.0	8.0	11.0	*8.0*	*11.0*

* *The lower % passing gradation may be 98.0% when SMA RAP material in accordance with 410.06 is used in the SMA mixture.*

The optimum binder and aggregate gradation content shall produce *a $\Delta Pb \leq 0.20$ as determined in accordance with ITM 591 and* 4.0% air voids. The maximum specific gravity shall be mass determined in water in accordance with AASHTO T 209. The percent draindown for SMA ~~surface~~ mixture shall not exceed 0.30% in accordance with AASHTO T 305.

SECTION 410, BEGIN LINE 76, DELETE AND INSERT AS FOLLOWS:

The 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 h~~*4 h* in accordance with AASHTO R 30. The minimum tensile strength ratio, TSR, shall be 70%. The 6 in. mixture specimens shall be compacted to 6.0 ± 1.0% air voids in accordance with AASHTO T 312. Specimens shall be prepared using freeze-thaw preconditioning. 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.

SECTION 410, BEGIN LINE 99, DELETE AND INSERT AS FOLLOWS:

VOIDS IN MINERAL AGGREGATE, VMA, CRITERIA	
Mixture Designation	Minimum VMA, %
19.0 mm	*15.0*
12.5 mm	~~17.0~~ *16.0*
9.5 mm	17.0

410.06 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. The RAP shall be processed so that 100% will pass the 2 in. (50 mm) sieve when entering the HMA plant. RAS shall be 100% passing the 1/2 in. (12.5 mm) sieve. RAP~~ *shall be in accordance with 401.06 for dense graded mixtures except non-SMA RAP material for use in the SMA mixture* shall be 100% passing the 3/8 in. (9.5 mm) sieve and 95 to 100% passing the No. 4 (4.75 mm) sieve.

SMA RAP material shall be the product derived by exclusively milling an existing SMA mixture. The SMA RAP material shall pass the maximum size sieve for the mixture being produced as follows:

SMA RAP GRADATION, %						
Sieve Size	*Mixture Designation*					
	9.5 mm		*12.5 mm*		*19.0 mm*	
	Lower	*Upper*	*Lower*	*Upper*	*Lower*	*Upper*
1 1/2 in. (37.5 mm)					*100.0*	*100.0*
1 in. (25 mm)			*100.0*	*100.0*	*95.0*	*100.0*
3/4 in. (19 mm)	*100.0*	*100.0*	*95.0*	*100.0*	---	---
1/2 in. (12.5 mm)	*95.0*	*100.0*	---	---	---	---

The Contractor may request the use of SMA RAP material in the SMA mixture provided the material is stockpiled separately at the plant and the material properties were determined in accordance with ITM 584 during stockpile construction. The request shall include all QC test results describing the stockpile composition. The Engineer will obtain a representative sample of the SMA RAP material in accordance with ITM 207 for testing in accordance with ITM 590 to verify the proposed design value.

~~Recycled materials may be used as a substitute for a portion of the new materials required to produce SMA 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 SMA mixtures and shall be stockpiled separately from other materials.

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

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

MAXIMUM BINDER REPLACEMENT, %		
SMA Surface		
Mixture Category	12.5 mm	9.5 mm
1	40.0*	40.0*
2	40.0*	40.0*
3	25.0	25.0
4	25.0	25.0
5	25.0	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 410.05 for the SMA mixture specified.

SMA 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.

SMA 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 SMA mixture.

410.07 Lots and Sublots

Lots will be defined as *4,000 t of SMA intermediate mixture or* 2,400 t of SMA surface mixture. Lots will be further sub-divided into sublots not to exceed *1,000 t of SMA intermediate mixture or* 600 t of SMA 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.

410.08 Job Mix Formula

A job mix formula, JMF, shall be developed by a certified HMA producer in accordance with ITM 583. A JMF used for SMA mixture *in* the current ~~or previous~~ calendar year will be allowed.

The aggregate and recycled materials blend percentage and the amount passing all sieves on the DMF may be adjusted provided the gradation limits do not exceed the requirements of 410.05. Adjustments to the aggregate and recycled materials blend percentage, gradation and the new combined aggregate bulk specific gravity shall be included on the JMF.

The total binder content on the JMF may be determined by adjusting the DMF a maximum of ± 0.3 percent. The recycled materials binder content may be adjusted as part of the total binder content provided the binder replacement percentage is in accordance with 410.06.

The mixture compaction temperature shall be 300 ± 9°F. 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.

SECTION 410, BEGIN LINE 190, DELETE AND INSERT AS FOLLOWS:

~~The Engineer's acceptance test results for each sublot will be available after the sublot and testing are complete. During the adjustment period the test results will be made available after testing is complete.~~ *The Engineer will make available the sublot acceptance test results after receiving the sublot quality control results from the Contractor.*

ACCEPTANCE TOLERANCE FOR MIXTURES (Percent Mass)									
Mixture	Number of Tests	Sieve Size							
		**25.0 mm*	**19.0 mm*	*12.5 mm	*9.5 mm	*4.75 mm	2.36 mm	600 µm	75 µm
Surface	1	---	---	---	---	---	8.0	4.0	2.5
	2	---	---	---	---	---	5.7	2.8	2.1
	3	---	---	---	---	---	4.6	2.3	1.8
	4	---	---	---	---	---	4.0	2.0	1.5
Intermediate	*1*	---	---	---	---	---	*10.0*	*6.0*	*2.0*
	2	---	---	---	---	---	*7.0*	*4.2*	*1.4*
	3	---	---	---	---	---	*5.8*	*3.5*	*1.2*
	4	---	---	---	---	---	*5.0*	*3.0*	*1.0*
* The acceptance tolerance for this sieve shall be the applicable composition limits specified in 410.05.									

ACCEPTANCE TOLERANCE FOR BINDER				
Binder Content	Number of Tests			
	1	2	3	4
% Binder	0.7	0.5	0.4	0.3

Acceptance of mixtures for range will be determined using the results of sublot tests performed by the Engineer from each lot. If the range is not in accordance with the requirements, adjustment points will be assessed in accordance with 410.19(a).

ACCEPTANCE TOLERANCE FOR RANGE (± Percent Mass)		
Sieve Size and Binder Content	Percentage Points	
	Surface	*Intermediate*
2.36 mm	12.0	*15.0*
600 µm	6.0	*9.0*
75 µm	2.0	*3.0*
% Binder	1.0	*1.0*

SECTION 410, BEGIN LINE 276, INSERT AS FOLLOWS:

410.14 Spreading and Finishing

The mixture shall be placed upon an approved surface by means of a paver or other mechanical devices in accordance with 409.03. Mixtures in areas inaccessible to mechanical devices may be placed by other methods. *The temperature of mixture at the time of spreading shall be no more than 315°F whenever PG 70-22 binder is used or no more than 325°F whenever PG 76-22 binder is used.*

SECTION 410, BEGIN LINE 304, INSERT AS FOLLOWS:

The rollers shall be operated to avoid shoving of the SMA and at speeds not to exceed 3 mph. Rollers shall be in accordance with 409.03(d)1, 2, or 7. Vibratory rollers meeting the requirements of 409.03(d)4 may be used but shall not be operated in vibratory mode. *Oscillatory rollers in accordance with 409.03(d)5 will be allowed for use but the vertical impact force capability shall not be used.*

SECTION 410, BEGIN LINE 315, DELETE AS FOLLOWS:

410.15 Joints

Longitudinal joints in the surface shall be at the lane lines of the pavement.

Hot poured joint adhesive in accordance with 906 shall be applied to longitudinal joints constructed between two adjacent HMA courses in the top course of dense graded intermediate mixtures and all 9.5 mm and 12.5 mm SMA ~~surface~~ mixture courses. This includes joints within the traveled way as well as between any of the following: traveled way and an auxiliary lane; traveled way and a paved shoulder; and auxiliary lane and a paved shoulder.

SECTION 410, BEGIN LINE 441, INSERT AS FOLLOWS:

(a) Mixture

When test results for the mixture furnished exceeded the allowable tolerances, adjustment points will be assessed as follows:

ADJUSTMENT POINTS FOR GRADATION								
Adjustment Points	Sieve Size							
	25.0 mm	*19.0 mm*	12.5 mm	9.5 mm	4.75 mm	2.36 mm	600 µm	75 µm
For each 0.1% up to 1.0% out of tolerance	*0.1*	*0.1*	0.1	0.1	0.1	0.1	0.2	0.3

For each 0.1% > 1.0% out of tolerance	*0.1*	*0.1*	0.1	0.1	0.1	0.2	0.3	0.6

SECTION 410, BEGIN LINE 539, INSERT AS FOLLOWS:

Pay Item **Pay Unit Symbol**

Joint Adhesive, _____ ..... LFT
course type

QC/QA-HMA, _____, _____, _____, _____ mm, - SMA ..... TON
(ESAL[(1)]) (PG[(2)]) (Course[(3)]) (Mix[(4)])

Quality Assurance Adjustment ..... DOL

(1) ESAL Category as defined in 410.04
(2) Number represents the high temperature binder grade. Low temperature grades are - 22
(3) Surface *or Intermediate*
(4) Mixture Designation