

401.01

**SECTION 400 – ASPHALT PAVEMENTS**

**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**

10 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.

**MATERIALS**

**401.03 Materials**

20 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).	

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**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 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, 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.

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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

#### 401.05 Volumetric Mix Design

50 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 references as listed below.

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

Mixtures Using Automatic Vacuum Sealing ..... ASTM D 6752

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 - 60.0
600 μm					
300 μm					
75 μm	1.0 - 7.0	2.0 - 8.0	2.0 - 10.0	2.0 - 10.0	6.0 - 12.0
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	NA
PCS Control Point	40	47	39	47	NA

Open Graded, Mixture Designation – Control Point (Percent Passing)		
	OG19.0	OG25.0
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	40.0 – 68.0	28.0 – 62.0
9.5 mm	20.0 – 52.0	15.0 – 50.0
4.75 mm	10.0 – 30.0	6.0 – 30.0
2.36 mm	15.0 ± 8.0	15.0 ± 8.0
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	0.0 – 8.0	0.0 – 8.0
Percent of Binder	> 3.0	> 3.0

Dust/Calculated Effective Binder Ratio shall be taken from 0.6 to 1.2, 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 0.9 to 2.0.

70 The optimum binder content for dense graded mixtures shall produce 4.0% air voids at  $N_{des}$  and for open graded mixtures shall produce 15.0% – 20.0% air voids at  $N_{des}$ . 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 of the uncompacted mixture shall be determined in accordance with AASHTO T 209, Section 9.5.1. The bulk specific gravity of the gyratory specimens shall be determined in accordance with AASHTO T 166, Method A for dense graded mixtures and AASHTO T 331 for open graded mixtures.

80 The percent draindown of open graded mixtures shall not exceed 0.30% in accordance with AASHTO T 305. Open graded mixtures may incorporate fibers. The binder for open graded mixtures containing fibers may be reduced by one temperature classification, 6°C, for the upper temperature classification. The fiber type and minimum dosage rate shall be in accordance with AASHTO M 325.

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 h in accordance with AASHTO R 30. The minimum tensile strength ratio, TSR, shall be 80%. The 6 in. (150 mm) 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.

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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. A new DMF shall be submitted for a binder grade change and shall reference the originating DMF/JMF number.

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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.

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The mixture design compaction temperature for the specimens shall be  $300 \pm 9^\circ\text{F}$  ( $150 \pm 5^\circ\text{C}$ ) for dense graded mixtures and  $260^\circ\text{F}$  ( $125^\circ\text{C}$ ) 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	$N_{ini}^*$	$N_{des}^*$	$N_{max}^*$	Max. % Gmm @ $N_{ini}$	Max. % Gmm @ $N_{max}$
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
$\geq 30,000,000$	9	125	205	89.0	98.0
OPEN GRADED					
ALL ESAL	NA	20	NA	NA	NA
* $N_{ini}$ , $N_{des}$ , $N_{max}$ , - definitions are included in AASHTO PP 28					

VOIDS IN MINERAL AGGREGATE (VMA) CRITERIA @ $N_{des}$	
Mixture Designation	Minimum VMA, Percent
4.75 mm	16.0
9.5 mm	15.0
12.5 mm	14.0
19.0 mm	13.0
25.0 mm	12.0

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OG19.0 mm	NA
OG25.0 mm	NA

VOIDS FILLED WITH ASPHALT (VFA) CRITERIA @ $N_{des}$	
ESAL	VFA, Percent
< 300,000	70 – 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
$\geq 30,000,000$	65 – 75
Note 1: For 9.5 mm mixtures, the specified VFA range shall be 73% to 76% for design traffic levels $\geq 3$ million ESALs. Note 2: For 25.0 mm mixtures, the specified lower limit of the VFA shall be 67% for design traffic levels < 0.3 million ESALs. Note 3: For 4.75 mm mixtures, the specified VFA range shall be 75% to 78% for design traffic levels $\geq 3$ million ESALs. Note 4: For OG19.0 mm and OG25.0 mm mixtures, VFA is not applicable.	

**401.06 Recycled Materials**

120 Recycled materials may consist of reclaimed asphalt pavement, RAP, or asphalt roofing shingles, ARS, 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. ARS shall consist of waste from a shingle manufacturing facility. No tear-off materials from roofs will be allowed. ARS shall be stockpiled separately from other materials. The coarse aggregate in the recycled materials shall pass the maximum size sieve for the mixture being produced.

130 Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures. When only RAP is used in the mixture, the RAP shall not exceed 25.0% by weight (mass) of the total mixture. When only ARS is used in the mixture, the ARS shall not exceed 5.0% by weight (mass) of the total mixture. For substitution or use, 1.0% of ARS is considered equal to 5.0% RAP. The percentages of recycled materials shall be as specified on the DMF.

A maximum of 15.0% RAP or 3.0% ARS by weight (mass) of the total mixture may be used in ESAL category 3, 4, or 5 surface mixtures and open graded mixtures. The recycled material for the ESAL category 3, 4, or 5 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.

140 The combined aggregate properties of a mixture with recycled materials shall be determined in accordance with ITM 584 and shall be in accordance with 904. Gradations of the combined aggregates shall be in accordance with 401.05.

Mixtures containing 15.0% or less RAP shall use the same grade of binder as specified. The binder for mixtures containing greater than 15.0% and up to 25.0%

RAP shall be reduced by one temperature classification, 6°C, for both the upper and lower temperature classifications.

150 **401.07 Lots and Sublots**

Lots will be defined as 5000 t (5000 Mg) of base or intermediate mixtures or 3000 t (3000 Mg) of surface mixture. Lots will be further sub-divided into sublots not to exceed 1000 t (1000 Mg) of base or intermediate mixtures or 600 t (600 Mg) of surface mixture. Partial sublots of 100 t (100 Mg) or less will be added to the previous sublot. Partial sublots greater than 100 t (100 Mg) constitute a full sublot. Partial lots of four sublots or less will be added to the previous lot, if available.

**401.08 Job Mix Formula**

160 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  $300 \pm 9^{\circ}\text{F}$  ( $150 \pm 5^{\circ}\text{C}$ ) for dense graded mixtures and  $260 \pm 9^{\circ}\text{F}$  ( $125 \pm 5^{\circ}\text{C}$ ) for open graded mixtures. The JMF for each mixture shall be submitted to the Engineer and shall use the same MAF as the DMF.

**401.09 Acceptance of Mixtures**

170 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. The Engineer will randomly select the location(s) within each sublot for sampling in accordance with ITM 802. The first 300 t (300 Mg) of the first sublot of the first lot for each DMF/JMF will not be sampled. An acceptance sample will consist of two plate samples with the first being at the random location and the second 2 ft (0.6 m) ahead station. A backup sample consisting of two plate samples shall be located 2 ft (0.6 m) towards the center of the mat from the acceptance sample.

Samples from each location shall be obtained from each sublot from the pavement in accordance with ITM 580. The Engineer will take immediate possession of the samples.

180 The binder content will be determined in accordance with ITM 586 or ITM 571 as directed by the Engineer. The maximum specific gravity will be determined in accordance with AASHTO T 209, Section 9.5.1. The air voids will be determined in accordance with AASHTO PP 28 based on the average bulk specific gravity from two gyratory specimens and the MSG for the sublot. The VMA will be determined in accordance with AASHTO PP 28 based on the average bulk specific gravity from two gyratory specimens, the percent aggregate in the mixture from the sublot 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.

190 The bulk specific gravity of gyratory specimens for dense graded mixtures will be determined in accordance with AASHTO T 166, Method A except samples are not required to be dried overnight. The bulk specific gravity of gyratory specimens

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for open graded mixtures, OG19.0, OG25.0 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%.

200 The Engineer's acceptance test results for each subplot will be available after the subplot and testing are complete.

Air voids, binder content and VMA values will be reported to the nearest 0.01%. Draindown test results will be rounded to the nearest 0.01%. Rounding will be in accordance with 109.01(a).

210 Pay factors for dense graded mixtures with original contract pay item quantities greater than or equal to one lot will be determined in accordance with 401.19(a). Partial lots of four sublots or less will have pay factors determined in accordance with 401.19(b) if the previous lot is not available.

Pay factors for dense graded mixtures with original contract pay item quantities less than one lot and open graded mixtures will be determined in accordance with 401.19(b).

The Contractor may request an appeal of the Engineer's test results in accordance with 401.20.

220 Fibers incorporated into the mixture will be accepted on the basis of a type A certification for the specified material properties for each shipment of fibers. Fibers from different manufacturers and different types of fibers shall not be intermixed.

In the event that an acceptance sample is not available to represent a subplot, all test results of the previous subplot will be used for acceptance. If the previous subplot is not available, the subsequent subplot will be used for acceptance.

## CONSTRUCTION REQUIREMENTS

### 401.10 General

230 Equipment for HMA operations shall be in accordance with 409. The Contractor shall submit to the Engineer written documentation that includes the manufacturer's make, model, serial number, manufactured year, and the manufacturer's literature with pictures. The documentation shall be submitted prior to use and shall certify that the paving equipment proposed for the project is new and includes the modifications or have been modified in accordance with the following.

The paver shall be equipped with means of preventing the segregation of the coarse aggregate particles when moving the mixture from the paver hopper to the

240 paver augers. The means and methods used shall be in accordance with the paver manufacturer's instructions and may consist of chain curtains, deflector plates, or other such devices, or any combination of these.

The following specific requirements shall also apply to identified HMA pavers:

1. Blaw-Knox HMA pavers shall be equipped with the Blaw-Knox Materials Management Kit, MMK.
- 250 2. Cedarrapids HMA pavers shall be those that were manufactured in 1989 or later.
3. Barber-Green/Caterpillar HMA pavers shall be equipped with deflector plates as identified in the December, 2000 Service Magazine entitled "New Asphalt Deflector Kit {6630-DFL, 6631-DFL, or 6640-DFL}".

The Contractor is also required to demonstrate to the Engineer prior to use, that the modifications to the paving equipment have been implemented on all pavers to be used on the project.

260 Fuel oil, kerosene, or solvents shall not be transported in open containers on equipment. Cleaning of equipment and small tools shall not be accomplished on the pavement or shoulder areas.

Segregation or flushing or bleeding of HMA mixtures will not be permitted. Corrective action shall be taken to prevent continuation of these conditions. Segregated or flushed or bleeding HMA mixtures shall be removed if directed. All areas showing an excess or deficiency of binder shall be removed and replaced.

270 All mixtures that become loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced.

#### **401.11 Preparation of Surfaces to be Overlaid**

The subgrade shall be shaped to the required grade and sections, free from all ruts, corrugations, or other irregularities, and uniformly compacted and approved in accordance with 207. Milling of an existing pavement surface shall be in accordance with 306. Surfaces on which a mixture is placed shall be free from objectionable or foreign materials at the time of placement.

280 Rubblized concrete pavements shall be primed in accordance with 405. PCCP, milled asphalt surfaces, and asphalt surfaces shall be tacked in accordance with 406. Contact surfaces of curbing, gutters, manholes, and other structures shall be tacked in accordance with 406.

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#### **401.12 Process Control**

The Engineer and Contractor will jointly review the operations to ensure compliance with the QCP. Continuous violations of compliance with the QCP will result in suspension of paving operations.

#### **401.13 Weather Limitations**

290 HMA courses of less than 138 lb/syd (75 kg/m<sup>2</sup>) shall be placed when the ambient temperature and the temperature of the surface on which it is to be placed is 45°F (7°C) or above. No mixture shall be placed on a frozen subgrade.

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

300 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 (10°C) below the minimum mixing temperature as shown on the JMF for mixtures compacted in accordance with 402.15.

Planned HMA courses greater than 220 lb/syd (120 kg/m<sup>2</sup>) placed under traffic, shall be brought up even with each adjacent lane at the end of each work day. Planned HMA courses less than or equal to 220 lb/syd (120 kg/m<sup>2</sup>) shall be brought forward concurrently, within practical limits, limiting the work in one lane to not more than one work day of production before moving back to bring forward the adjacent lane. Traffic shall not be allowed on open graded mixtures.

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Hydraulic extensions on the paver will not be permitted for continuous paving operations. Fixed extensions or extendable screeds shall be used on courses greater than the nominal width of the paver except in areas where the paving width varies. Hydraulic extensions may be used in tapers and added lanes less than 250 ft (75 m) in length.

Automatic slope and grade controls shall be used as outlined in the QCP.

320 HMA mainline and HMA shoulders which are 8.0 ft (2.4 m) or more in width shall be placed with paving equipment in accordance with 409.03(c)1.

When laying mixtures with density not controlled by cores, the speed of the paver shall not exceed 50 ft (15 m) per min. Rollers shall be operated to avoid shoving of the HMA and at speeds not to exceed 3 mph (4.5 km/h). However, vibratory rollers will be limited to 2.5 mph (4 km/h).

The finished thickness of any course shall be at least two times but not more than four times the maximum particle size as shown on the DMF.

330 **401.15 Joints**

Longitudinal joints in the surface shall be at the lanelines of the pavement. Longitudinal joints below the surface shall be offset from previously constructed joints by approximately 6 in. (150 mm), and be located within 12 in. (300 mm) of the lane line.

Transverse joints shall be constructed by exposing a near vertical full depth face of the previous course. For areas inaccessible to rollers, other mechanical devices shall be used to achieve the required density.

340 If constructed under traffic, temporary transverse joints shall be feathered to provide a smooth transition to the driving surface.

**401.16 Density**

Acceptance will be based on lots and sublots in accordance with 401.07.

Density of the compacted dense graded mixture will be determined from cores except where:

- 350
- (a) the total planned lay rate to be placed over a shoulder existing prior to the contract award is less than 385 lb/syd (210 kg/m<sup>2</sup>); or
  - (b) the first lift of material placed at less than 385 lb/syd (210 kg/m<sup>2</sup>) over a shoulder existing prior to the contract award.

Density of any random core location(s) in these areas will be assigned a value of 92.0 %MSG and compaction shall be in accordance with 402.15.

360 Open graded mixtures shall be compacted with six passes of a static tandem roller and will be assigned a value of 84.0% of MSG. Vibratory rollers shall not be used on open graded mixtures.

Density acceptance by cores will be based on samples obtained from two random locations selected by the Engineer within each subplot in accordance with ITM 802. One core shall be cut at each random location in accordance with ITM 580. The transverse core location will be located so that the edge of the core will be no closer than 3 in. (75 mm) from a confined edge or 6 in. (150 mm) from a non-confined edge of the course being placed. The maximum specific gravity will be determined from the samples obtained in 401.09.

370 The Contractor shall obtain cores in the presence of the Engineer with a device that shall produce a uniform 6 in. (150 mm) diameter pavement sample. Coring shall be completed prior to the random location being covered by the next course. Surface courses shall be cored within two work days of placement. Damaged core(s) shall be discarded and replaced with a core from a location selected by adding 1.0 ft (0.3 m) to the longitudinal location of the damaged core using the same transverse offset.

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380 The Contractor and the Engineer shall mark the core to define the course to be tested. If the core indicates a course thickness of less than two times the maximum particle size, the core will be discarded and a core from a new random location will be selected for testing.

The Engineer will take immediate possession of the cores. If the Engineer's cores are subsequently damaged, additional coring will be the responsibility of the Department. Subsequent core locations will be determined by subtracting 1.0 ft (0.3 m) from the random location using the same transverse offset.

390 The density for the mixture will be expressed as the percentage of maximum specific gravity (%MSG) obtained by dividing the average bulk specific gravity by the maximum specific gravity for the subplot, times 100. Samples for the bulk specific gravity and maximum specific gravity will be dried in accordance with ITM 572. The Engineer will determine the bulk specific gravity of the cores in accordance with AASHTO T 166, Method A. The maximum specific gravity will be determined in accordance with AASHTO T 209, Section 9.5.1.

Within one work day of coring operations the Contractor shall clean, dry, and refill the core holes with HMA of similar or smaller size particles.

400 The Engineer's acceptance test results for each subplot will be available when the subplot testing is complete. Acceptance of the pavement for density (%MSG) will be reported to the nearest 0.01%. Rounding will be in accordance with 109.01(a).

#### **401.17 Shoulder Corrugations**

Shoulder corrugations shall be in accordance with 606.

#### **401.18 Pavement Smoothness**

The pavement smoothness will be accepted by means of a profilograph, a 16 ft (4.9 m) long straightedge, or a 10 ft (3 m) long straightedge.

410 The profilograph shall be used where all of the following conditions are met:

- (a) the design speed is greater than 45 mph (70 km/h)
- (b) the pavement lanes are full width and 0.1 mi (0.16 km) or longer, and
- (c) the HMA is placed on a milled surface or the total combined planned lay rate of surface, intermediate, and base is 385 lb/syd (210 kg/m<sup>2</sup>) or greater.

420 If a pay item, Profilograph, HMA, is included in the contract and the above conditions are met, the Contractor shall furnish, calibrate, and operate an approved profilograph in accordance with ITM 912. The profilogram produced shall become

the property of the Department. The profilograph shall remain the property of the Contractor. When a profilograph, HMA, is not included as a pay item, and the above conditions are met, the Department will furnish, calibrate, and operate the profilograph or the Department will develop a change order in accordance with 109.05 to include profilograph, HMA as a pay item.

430 Within the limits of a smoothness section where the posted speed is 45 mph (70 km/h) or less, smoothness of that section may be measured by a profilograph or a 16 ft (4.9 m) long straightedge. The Contractor shall notify the Engineer of the selected process prior to placement of the HMA. Smoothness pay adjustments are only applicable when measured by a profilograph.

440 The 16 ft (4.9 m) long straightedge is used to check longitudinal profile and shall be used on all overlays where the profilograph is not specified. For contracts that include a profilograph item, the 16 ft (4.9 m) long straightedge shall be used on shoulders, on all full width pavement lanes shorter than 0.1 mi (0.16 km), in length, on tapers, within 50 ft (15 m) of a reinforced concrete bridge approach, and within 50 ft (15 m) of an existing pavement, which is being joined.

440 The 10 ft (3 m) long straightedge shall be used to check transverse slopes, across travel lanes and shoulders, approaches, and crossovers.

All wavelike irregularities and abrupt changes in profile caused by paving operations shall be corrected.

450 Each finished course of base and intermediate shall be subject to approval. The pavement smoothness shall be checked on any new intermediate course located immediately below a surface course and the surface course at the locations as designated in ITM 912.

If grinding of the intermediate course is used for pavement smoothness corrections, the grinding shall not precede the surface placement by more than 30 calendar days if open to traffic.

460 When the 16 ft (4.9 m) straightedge is used on a surface course, the pavement variations shall be corrected to 1/4 in. (6 mm) or less. When the 10 ft (3 m) straightedge is used, the pavement variations shall be corrected to 1/8 in. (3 mm) or less.

460 When the profilograph is being used on a surface course, in addition to the requirements for the profile index, all areas having a high or low point deviation in excess of 0.3 in. (8 mm) shall be corrected. Courses underlying the surface courses that are exposed by corrective actions shall be milled to 1 1/2 in. (38 mm) and replaced with the same type surface materials. The initial profile index shall be determined prior to any corrective action. The final profile index for each section

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requiring corrective action will be determined after all corrective action within that section has been completed.

470 When the profilograph is being used on an intermediate course, all areas having a high or low point deviation in excess of 0.3 in. (8 mm) shall be corrected. After corrective action is taken on an intermediate course, a 16 ft (4.9 m) straightedge may be used to verify the adequacy of the corrective action. When the 16 ft (4.9 m) or 10 ft (3 m) straightedge is being used on an intermediate course, all areas having a high or low point deviation in excess of 1/4 in. (6 mm) shall be corrected.

**401.19 Pay Factors**

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

480 Pay factors (PF) are calculated for 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 Percent Within Limits (PWL) greater than 90:

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

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

490

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

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%, 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).

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

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

where:

Lot PF = Lot Composite Pay Factor for Mixture and Density

$PF_{\text{BINDER}}$  = Lot Pay Factor for Binder Content

$PF_{\text{VOIDS}}$  = Lot Pay Factor for Air Voids at  $N_{des}$

$PF_{\text{VMA}}$  = Lot Pay Factor for VMA at  $N_{des}$

$PF_{\text{DENSITY}}$  = Lot Pay Factor for In-Place Density (%Gmm)

510

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:

520

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

$L$  = Lot quantity

$U$  = Unit price for the material, \$/TON (\$/Mg)

Lot PF = Lot Pay Factor

Lot test results for binder content, air voids, VMA, and density will be used to determine the Lot Pay Factors.

The specification limits for binder content, air voids at  $N_{des}$ , VMA at  $N_{des}$ , and density will be as follows:

530

SPECIFICATION LIMITS				
Mixture				
	LSL*		USL**	
Binder Content, %	- 0.40 from JMF		+ 0.40 from JMF	
Air Voids ( $V_a$ ) at $N_{des}$ , %	2.60		5.40	
Voids In Mineral Aggregate at $N_{des}$ , %	Greater Of		Lesser Of	
	Spec-0.50	JMF-1.20	Spec +2.00	JMF+ 1.20
Density				
	LSL		USL	
Roadway Core Density (% Gmm), %	91.00		Not Applicable	
* 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:

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

where:

540

SCPF = Sublot Composite Pay Factor for Mixture and Density

$\text{PF}_{\text{BINDER}}$  = Sublot Pay Factor for Binder Content

$\text{PF}_{\text{VOIDS}}$  = Sublot Pay Factor for Air Voids at  $N_{des}$

$\text{PF}_{\text{VMA}}$  = Sublot Pay Factor for VMA at  $N_{des}$

$\text{PF}_{\text{DENSITY}}$  = Sublot Pay Factor for Density

401.19

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.

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

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

where:

- q = quality assurance adjustment for the subplot
- L = subplot quantity
- U = unit price for the material \$/TON (\$/Mg)
- SCPF = subplot composite pay factor

560

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 (± %)	Pay Factor
≤ 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
> 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 (± %)	Deviation from JMF (± %)	Pay Factor
≤ 0.5		1.05
> 0.5 and ≤ 1.0	All	1.00
> 1.0 and ≤ 1.5		0.90
> 1.5 and ≤ 2.0		0.70
> 2.0 and ≤ 2.5		0.30
> 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 (± %)	Deviation from JMF (± %)	Pay Factor
≤ 0.5	≤ 1.0	1.05
> 0.5 and ≤ 1.0	> 1.0 and ≤ 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 JMF with the above tolerances will be used to compute quality assurance adjustments.

Sublot test results for density will be assigned pay factors in accordance with the following.

DENSITY		
Percentages are based on %MSG		Pay Factors – Percent
Dense Graded	Open Graded	
≥ 97.0		Submitted to the Office of Materials Management *
95.6 - 96.9		1.05 - 0.01 for each 0.1% above 95.5
94.0 - 95.5		1.05
93.1 - 93.9		1.00 + 0.005 for each 0.1% above 93.0
92.0 - 93.0	84.0	1.00
91.0 - 91.9		1.00 - 0.005 for each 0.1% below 92.0
90.0 - 90.9		0.95 - 0.010 for each 0.1% below 91.0
89.0 - 89.9		0.85 - 0.030 for each 0.1% below 90.0
≤ 88.9		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.		

The pay factors will be rounded to the nearest 0.01.

**(c) Smoothness**

580 When the pavement smoothness is tested with a profilograph, payment will be based on a zero blanking band on the final profile index in accordance with the following table. A Quality Assurance Pay Factor, PFs, for smoothness will apply to the planned typical section including the aggregate base, and the HMA base, intermediate, and surface courses. The quality assurance adjustment for each section will include the total area of each pavement lane excluding shoulders for 0.1 mi (0.16 km) long section represented by the profile index calculated by the following formula.

$$q_s = (PF_s - 1.00) \sum_{i=1}^n \left( A \times \frac{S}{T} \times U \right)$$

590 where:

- q<sub>s</sub> = quality assurance adjustment for smoothness for one section
- PF<sub>s</sub> = pay factor for smoothness
- n = number of layers
- A = area of the section, syd (m<sup>2</sup>)
- S = planned spread rate for material, lb/syd (kg/m<sup>2</sup>)

T = conversion factor: 2000 lb/ton (1000 kg/Mg)

U = unit price for the material, \$/ton (\$/Mg)

600 The quality assurance adjustment for smoothness,  $Q_s$ , for the contract will be the total of the quality assurance adjustments for smoothness,  $q_s$ , on each section by the following formula.

$$Q_s = \sum q_s$$

ADJUSTMENT FOR SMOOTHNESS ( $PI_{0.0}$ ) ZERO BLANKING BAND	
Design Speed Greater Than 45 mph (70 km/hr)	
Profile Index in./0.1 mi. (mm per 0.16 km)	Pay Factor
Over 0.00 to 1.20 in. (Over 0 to 30 mm)	1.06
Over 1.20 to 1.40 in. (Over 30 to 35 mm)	1.05
Over 1.40 to 1.60 in. (Over 35 to 40 mm)	1.04
Over 1.60 to 1.80 in. (Over 40 to 45 mm)	1.03
Over 1.80 to 2.00 in. (Over 45 to 50 mm)	1.02
Over 2.00 to 2.40 in. (Over 50 to 60 mm)	1.01
Over 2.40 to 3.20 in. (Over 60 to 80 mm)	1.00
Over 3.20 to 3.40 in. (Over 80 to 85 mm)	0.96
All pavement with a profile index ( $PI_{0.0}$ ) greater than 3.40 in. (85 mm) shall be corrected to 3.40 in. (85 mm).	

610 Quality assurance pay factors greater than 1.00 will be applicable only to the initial measured profile index, prior to any corrective work. Regardless of the pay factor tabulated above, quality assurance pay factors for individual sections that require corrective action for high or low points in excess of 0.3 in. (8 mm) will not be greater than 1.00. Quality assurance pay factors of 1.00 or less will be applied to pavement sections where corrective work has been completed.

The total quality assurance adjustments is to be calculated as follows:

$$Q = Q_s + (\sum q)$$

401.20

where:

Q = total quality assurance adjustment

$Q_s$  = quality assurance adjustment for smoothness

620 q = lot or subplot quality assurance adjustment

#### 401.20 Appeals

If the QC test results do not agree with the acceptance test results, a request, along with the QC test results, may be made in writing for additional testing. The appeal sample will be analyzed in a lab different than the lab that analyzed the original sample when requested by the Contractor. 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 that subplot. The subplot and specific test(s) shall be specified at the time of the appeal request. Only one appeal request per subplot is permitted. Upon approval of the appeal, the Engineer will perform additional testing as follows.

The backup or new sample(s) will be tested in accordance with the applicable test method for the test requested.

##### (a) MSG

640 The backup MSG sample will be dried in accordance with ITM 572 and tested in accordance with AASHTO T 209, Section 9.5.1.

##### (b) BSG of the Gyratory Specimen

New gyratory specimens will be prepared and tested in accordance with AASHTO T 312 from the backup sample.

##### (c) Binder Content

The backup binder content sample will be prepared and tested in accordance with the test method that was used for acceptance or as directed by the Engineer.

##### 650 (d) BSG of the Density Core

Additional cores shall be taken within seven calendar days unless otherwise directed. Additional core locations will be determined by adding 1.0 ft (0.3 m) longitudinally of the cores tested using the same transverse offset. The appeal density cores will be dried in accordance with ITM 572 and tested in accordance with AASHTO T 166, Method A.

The appeal results will replace all previous test result(s) for acceptance of mixture in accordance with 401.09 and density in accordance with 401.16. The results will be furnished to the Contractor.

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**401.21 Method of Measurement**

HMA mixtures will be measured by the ton (megagram) of the type specified, in accordance with 109.01(b). The measured quantity will be divided by the MAF to determine the pay quantity.

Milled shoulder corrugations will be measured in accordance with 606.02.

**401.22 Basis of Payment**

670 The accepted quantities for this work will be paid for at the contract unit price per ton (megagram) for QC/QA-HMA, of the type specified, complete in place.

Payment for furnishing, calibrating, and operating the profilograph, and furnishing profile information will be made at the contract lump sum price for profilograph, HMA.

Adjustments to the contract payment with respect to mixture, density, and smoothness for mixture produced will be included in a quality assurance adjustment pay item in accordance with 109.05.1.

680 Milled shoulder corrugations will be paid for in accordance with 606.03.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit Symbol</b>
Profilograph, HMA .....	LS
QC/QA-HMA, $\frac{\text{mm}}{(\text{ESAL}^{(1)}) (\text{PG}^{(2)}) (\text{Course}^{(3)}) (\text{Mix}^{(4)})}$ .....	TON (Mg)

- 690
- (1) ESAL Category as defined in 401.04
  - (2) Number represents the high temperature binder grade. Low temperature grades are -22.
  - (3) Surface, Intermediate, or Base
  - (4) Mixture Designation

Preparation of surfaces to be overlaid shall be included in the cost of other pay items.

700 Coring and refilling of the core holes shall be included in the cost of other pay items within this section.

No payment will be made for additional anti-stripping additives, appeal coring or traffic control expenditures related to coring operations.

Corrections for pavement smoothness shall be included in the cost of other pay items within this section.

402.01

The price for Profilograph, HMA will be full compensation regardless of how often the profilograph is used or how many profilograms are produced.

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If QC/QA-HMA intermediate over QC/QA-HMA base mixtures are specified, QC/QA-HMA intermediate mixture may be permitted as a substitute for the QC/QA-HMA intermediate and QC/QA-HMA base mixtures upon a written request by the Contractor. The request for the substitution shall be prepared in advance of the work. A computation will be made in order to obtain a unit price for the QC/QA-HMA intermediate mixture. The quantity and amount for QC/QA-HMA intermediate mixture shall equal the sum of the contract quantities and amounts shown for QC/QA-HMA intermediate and QC/QA-HMA base mixtures. The unit price for QC/QA-HMA intermediate mixture shall be equal to the sum of contract amounts divided by the sum of contract quantities. Payment for the QC/QA-HMA intermediate mixture will be made at the unit price per ton (megagram) for QC/QA-HMA intermediate mixture. No payment will be made for additional work or costs which may result due to this change.

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**SECTION 402 – HOT MIX ASPHALT, HMA, PAVEMENT**

**402.01 Description**

This work shall consist of one or more courses of HMA base, intermediate, or surface mixtures, and miscellaneous courses for rumble strips, and wedge and leveling constructed on prepared foundations in accordance with 105.03.

**402.02 Quality Control**

The HMA shall be supplied from a certified HMA plant in accordance with ITM 583; Certified Volumetric 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.

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**MATERIALS**

**402.03 Materials**

Materials shall be in accordance with the following:

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- Asphalt Materials
  - PG Binder, PG 58-28\*, PG 64-22,
  - PG 64-28\*, PG 70-22, PG 76-22 ..... 902.01(a)
  - Coarse Aggregates..... 904
  - Base Mixtures, – Class D or Higher
  - Intermediate Mixtures – Class C or Higher
  - \*\* Surface Mixtures – Class B or Higher
  - Fine Aggregates..... 904

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- \* Only for use in mixtures containing greater than 15% RAP. Refer to 402.05.
- \*\* Surface aggregate requirements are listed in 904.03(d).

#### 402.04 Design Mix Formula

A DMF shall be prepared in accordance with 402.05 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 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.

Mixture Type	Type A	Type B	Type C	Type D
Design ESAL	200,000	2,000,000	9,000,000	11,000,000
Surface	9.5 mm	9.5 mm	9.5 mm	9.5 mm
	12.5 mm	12.5 mm	12.5 mm	12.5 mm
Surface – PG Binder	64-22	64-22	70-22	70-22
Intermediate	12.5 mm	12.5 mm	12.5 mm	12.5 mm
	19.0 mm	19.0 mm	19.0 mm	19.0 mm
Intermediate – PG Binder	64-22	64-22	64-22	70-22
Base	19.0 mm	19.0 mm	19.0 mm	19.0 mm
	25.0 mm	25.0 mm	25.0 mm	25.0 mm
Base – PG Binder	64-22	64-22	64-22	64-22

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The Engineer will assign a mixture number. No mixture will be accepted until the DMF has been approved.

#### 402.05 Volumetric Mix Design

The DMF shall be determined for each mixture from a volumetric mix design in accordance with 401.05.

A DMF developed for a QC/QA-HMA mixture may be used and the source or grade of the binder may be changed; however, the high temperature grade shall meet the minimum requirements of 402.04.

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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.

#### 402.06 Job Mix Formula

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

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402.07

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.

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For mixtures containing 0.0% to 15.0% RAP, changes in the source and grade of specified binders will be permitted; however, the high temperature grade shall meet the minimum requirements of 402.04.

**402.07 Mix Criteria**

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

Rumble strip mixtures shall be type A 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.

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**(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 type B in accordance with 402.04. A MAF in accordance with 402.05 will not apply.

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

The mixture shall be HMA surface type A 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.

HMA Curbing Gradations	
Sieve Size	Percent Passing Sieves
1/2 in. (12.5 mm)	100.0
3/8 in. (9.5 mm)	80.0 - 100.0
No. 4 (4.75 mm)	73.0 ± 5.0
No. 30 (600 µm)	20.0 - 50.0
No. 200 (75 µm)	6.0 - 12.0

A DMF shall be prepared in accordance with the above table and submitted in a format acceptable to the Engineer one week prior to use. The DMF shall state the calibration factor and test temperature to be used for the determination of binder content using ITM 586 or ITM 571.

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#### 402.08 Recycled Materials

Recycled materials may consist of reclaimed asphalt pavement, RAP, or asphalt roofing shingles, ARS, 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. ARS shall consist of waste from a shingle manufacturing facility. No tear-off materials from roofs will be allowed. ARS shall be stockpiled separately from other materials. The coarse aggregate in the recycled materials shall pass the maximum size sieve for the mixture being produced.

Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures. When only RAP is used in the mixture, the RAP shall not exceed 25.0% by weight (mass) of the total mixture. When only ARS is used in the mixture, the ARS shall not exceed 5.0% by weight (mass) of the total mixture. For substitution or use, 1.0% of ARS is considered equal to 5.0% RAP. The percentages of recycled materials shall be as specified on the JMF.

A maximum of 15.0% RAP or 3.0% ARS by weight (mass) of the total mixture may be used in type C and D surface mixtures provided the recycled material is 100% passing the 3/8 in. (9.5 mm) sieve and 95% to 100% passing the No. 4 (4.75 mm) sieve.

The combined aggregate properties of a mixture with recycled materials shall be determined in accordance with ITM 584 and shall be in accordance with 904. Gradations of the combined aggregates shall be in accordance with 402.03.

Mixtures containing 15.0% or less RAP shall use the same grade of binder as specified. The binder for mixtures containing greater than 15.0% and up to 25.0% RAP shall be reduced by one temperature classification, 6°C, for both the upper and lower temperature classifications.

#### 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.

Single test values and averages will be reported to the nearest 0.1%. Rounding will be in accordance with 109.01(a).

Test results exceeding the tolerance limits will be considered as a failed material and adjudicated in accordance with 105.03.

## CONSTRUCTION REQUIREMENTS

### 402.10 General

150 Equipment for HMA operations shall be in accordance with 409. The Contractor shall submit to the Engineer prior to use a written Certificate of Compliance that the proposed paving equipment has been modified in accordance with 401.10 or is new and includes the modifications.

Fuel oil, kerosene, or solvents shall not be transported in open containers on any equipment at any time. Cleaning of equipment and tools shall not be accomplished on the pavement or shoulder areas.

160 Segregation, flushing or bleeding of HMA mixtures will not be permitted. Corrective action shall be taken to prevent continuation of these conditions. Areas of segregation, flushing or bleeding shall be corrected, if directed. All areas showing an excess or deficiency of asphalt materials shall be removed and replaced.

All mixtures that become loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced.

Mixture shall not be dispatched from the plant that cannot be spread and compacted before sundown of that day, unless otherwise permitted.

### 402.11 Preparation of Surfaces to be Overlaid

170 The subgrade shall be shaped to the required grade and sections, free from all ruts, corrugations, or other irregularities, and uniformly compacted and approved in accordance with 207. Milling of an existing surface shall be in accordance with 306. Surfaces on which a mixture is placed shall be free from objectionable or foreign materials at the time of placement.

180 Compacted aggregate bases and rubblized bases shall be primed in accordance with 405. PCCP, milled asphalt surfaces, and asphalt surfaces shall be tacked in accordance with 406. Contact surfaces of curbing, gutters, manholes, and other structures shall be tacked in accordance with 406.

### 402.12 Weather Limitations

190 HMA courses less than 110 lb/syd (60 kg/m<sup>2</sup>) are to be placed when the ambient and surface temperatures are 60°F (16°C) or above. HMA courses equal to or greater than 110 lb/syd (60 kg/m<sup>2</sup>) but less than 220 lb/syd (120 kg/m<sup>2</sup>) are to be placed when the ambient and surface temperatures are 45°F (7°C) or above. HMA courses equal to or greater than 220 lb/syd (120 kg/m<sup>2</sup>) and HMA curbing are to be placed when the ambient and surface temperatures are 32°F (0°C) or above. Mixture shall not be placed on a frozen subgrade. However, HMA courses may be placed at lower temperatures, provided the density of the HMA course is in accordance with 402.16.

All partially completed sections of roadway that are 8 in. (200 mm) or less in thickness shall be proofrolled prior to the placement of additional materials the following spring. Proofrolling shall be accomplished in accordance with 203.26. The contact pressure shall be 70 to 80 psi (480 to 550 kPa). Soft yielding areas shall be removed and replaced.

#### 402.13 Spreading and Finishing

200 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 (10°C) below the minimum mixing temperature as shown on the DMF or JMF.

210 Planned HMA courses greater than 220 lb/syd (120 kg/m<sup>2</sup>) placed under traffic shall be brought up even with each adjacent lane at the end of each work day. Planned HMA courses less than or equal to 220 lb/syd (120 kg/m<sup>2</sup>) shall be brought forward concurrently, within practical limits, limiting the work in one lane to not more than one work day of production before moving back to bring forward the adjacent lane. Traffic shall not be allowed on open graded mixtures.

220 Hydraulic extensions on the paver will not be permitted for continuous paving operations. Fixed extensions or extendable screeds shall be used on courses greater than the nominal width of the paver except in areas where the paving widths vary. Hydraulic extensions may be used on approaches, tapers, and added lanes less than 250 ft (75 m) in length.

HMA shoulders which are 8.0 ft (2.4 m) or more in width shall be placed with automatic paving equipment.

HMA mixtures in hauling equipment shall be protected by tarps from adverse weather conditions or foreign materials. Adverse weather conditions include, but will not be limited to, precipitation or temperatures below 45°F (7°C).

230 The speed of the paver shall not exceed 50 ft (15 m) per min when spreading mixtures.

Automatic slope and grade controls shall be required except when placing mixtures on roadway approaches which are less than 200 ft (60 m) in length or on miscellaneous work. The use of automatic controls on other courses where use is impractical due to project conditions may be waived by the Engineer.

402.14

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 1.5 times but not more than six times the maximum particle size as shown on the DMF or JMF.

240 Feathering may be less than the minimum thickness requirements.

Rumble strips shall be placed to ensure uniformity of depth, width, texture, and the required spacing between strips. A tack coat in accordance with 406 shall be applied on the pavement surface prior to placing the mixture. The tack coat may be applied with a paint brush or other approved methods.

**402.14 Joints**

250 Longitudinal joints in the surface shall be at the lane lines of the pavement. Longitudinal joints below the surface shall be offset from previously constructed joints by approximately 6 in. (150 mm), and be located within 12 in. (300 mm) of the lane line.

Transverse joints shall be constructed by exposing a near vertical full depth face of the previous course.

If constructed under traffic, temporary transverse joints shall be feathered to provide a smooth transition to the driving surface.

**402.15 Compaction**

260 The HMA mixture shall be compacted with equipment in accordance with 409.03(d) immediately after the mixture has been spread and finished. Rollers shall not cause undue displacement, cracking, or shoving.

A roller application is defined as one pass of the roller over the entire mat. Compaction operations shall be completed in accordance with one of the following options.

Number of Roller Applications						
Rollers	Courses ≤ 440 lb/syd (240 kg/m <sup>2</sup> )				Courses > 440 lb/syd (240 kg/m <sup>2</sup> )	
	Option 1	Option 2	Option 3	Option 4	Option 1	Option 2
Three Wheel	2		4		4	
Pneumatic Tire	2	4			4	
Tandem	2	2	2		4	
Vibratory Roller				6		8

270 A reduced number of applications on a course may be approved if detrimental results are being observed.

Compaction equipment shall be operated with the drive roll or wheels nearest the paver and at speeds not to exceed 3 mph (4.5 km/h). However, vibratory rollers will be limited to 2.5 mph (4 km/h). Rolling shall be continued until applications are completed and all roller marks are eliminated.

Compaction operations shall begin at the low side and proceed to the high side of the mat. The heaviest roller wheel shall overlap its previous pass by a minimum of 6 in. (150 mm).

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Longitudinal joints shall be compacted in accordance with the following:

- (a) For confined edges, the first pass adjacent to the confined edge, the compaction equipment shall be entirely on the hot mat 6 in. (150 mm) from the confined edge.
- (b) For unconfined edges, the compaction equipment shall extend 6 in. (150 mm) beyond the edge of the hot mat.

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All displacement of the HMA mixture shall be corrected at once by the use of lutes and/or the addition of fresh mixture as required. The line and grade of the edges of the HMA mixture shall not be displaced during rolling.

The wheels shall be kept properly moistened with water or water with detergent to prevent adhesion of the materials to the wheels.

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Areas inaccessible to rollers shall be compacted thoroughly with hand tampers or other mechanical devices in accordance with 409.03(d)6 to achieve the required compaction. A trench roller, in accordance with 409.03(d)5, may be used to obtain compaction in depressed areas.

The final two roller applications shall be completed at the highest temperature where the mixture does not exhibit any tenderness.

Vehicular traffic will not be permitted on a course until the mixture has cooled sufficiently to prevent distortions.

Rumble strips shall be compacted with vibratory compacting equipment in accordance with 409.03(d)6 unless otherwise stated.

310

#### **402.16 Low Temperature Compaction Requirements**

Compaction for mixtures placed below the temperatures listed in 402.12 shall be controlled by density determined from MSG of the plate samples and cores cut from the compacted pavement placed during a low temperature period. Samples shall be obtained in accordance with ITM 580. Acceptance will be based on a plate sample and two cores. The Engineer will randomly select the locations in accordance with ITM 802. The transverse core location will be located so that the edge of the core

402.17

will be no closer than 3 in. (75 mm) from a confined edge or 6 in. (150 mm) from a non-confined edge of the course being placed.

320

For compaction of HMA during low temperature periods with quantities less than 100 t (100 Mg) per day, acceptance may be visual.

The Contractor shall obtain cores in the presence of the Engineer with a device that shall produce a uniform 6 in. (150 mm) diameter pavement sample. Coring shall be completed prior to the random location being covered. The final HMA course shall be cored within one work day of placement. Damaged cores shall be discarded and replaced with a core from a location selected by adding 1.0 ft (0.3 m) to the longitudinal location of the damaged core using the same transverse offset.

330

The Contractor and the Engineer shall mark the core to define the course to be tested. If the core indicates a course thickness of less than two times the maximum particle size, the core will be discarded and a core from a new random location will be selected for testing.

The Engineer will take immediate possession of the cores. If the Engineer's cores are subsequently damaged, additional coring within a specific section will be the responsibility of the Department. Subsequent core locations will be determined by subtracting 1.0 ft (0.3 m) from the random location using the same transverse offset.

340

The density for the mixture shall be expressed as:

$$\text{Density} = 100 \times \text{BSG/MSG}$$

where:

BSG = average bulk specific gravity

MSG = maximum specific gravity

350

The Engineer will determine the bulk specific gravity of the cores in accordance with AASHTO T 166 Method A. The maximum specific gravity will be determined in accordance with AASHTO T 209, Section 9.5.1. Density shall not be less than 92.0%.

Within one work day of coring operations, the Contractor shall clean, dry, refill, and compact the core holes with suitable HMA of similar or smaller size particles.

#### **402.17 Shoulder Corrugations**

Shoulder corrugations shall be in accordance with 606.

360

#### **402.18 Pavement Smoothness**

Pavement smoothness will be in accordance with 401.18 except profilograph requirements will not apply.

**402.19 Method of Measurement**

HMA mixtures will be measured by the ton (megagram) of the type specified, in accordance with 109.01(b). The measured quantity will be divided by the MAF to determine the pay quantity.

370 HMA rumble strips will be measured by the linear foot (meter) of each transverse strip, complete in place.

Milled shoulder corrugations will be measured in accordance with 606.02.

**402.20 Basis of Payment**

The accepted quantities for this work will be paid for at the contract unit price per ton (megagram) for HMA, of the type specified complete in place.

380 HMA rumble strips will be paid for at the contract unit price per linear foot (meter), of each transverse strip complete in place.

Milled shoulder corrugations will be paid for in accordance with 606.03.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit Symbol</b>
HMA Surface, Type <u>  *</u> .....	TON (Mg)
HMA Intermediate, Type <u>  *</u> .....	TON (Mg)
390 HMA Base, Type <u>  *</u> .....	TON (Mg)
HMA Rumble Strips.....	LFT (m)
HMA for Temporary Pavement.....	TON (Mg)
HMA Wedge and Level, Type <u>  *</u> .....	TON (Mg)
* Mixture type	

Preparation of surfaces to be overlaid shall be included in the cost of other pay items in this section.

400 No payment will be made for additional anti-stripping additives.

The cost of removing and replacing soft yielding areas discovered by proofrolling shall be included in the cost of other pay items in this section.

No payment will be made for coring operations and related traffic control expenditures required in 402.16.

Corrections for pavement smoothness including removal and replacement of pavement, shall be included in the cost of other pay items in this section.

403.01

410 If HMA intermediate over HMA base mixtures are specified, HMA intermediate may be permitted as a substitute for the HMA intermediate and HMA base mixtures upon a written request by the Contractor. The request for the substitution shall be prepared in advance of the work. A computation will be made in order to obtain a unit price for the HMA intermediate. The quantity and amount for HMA intermediate shall equal the sum of the contract quantities and amounts shown for HMA intermediate and HMA base mixtures. The unit price for HMA intermediate shall be equal to the sum of contract amounts divided by the sum of contract quantities. Payment for the HMA intermediate will be made at the unit price per ton (megagram) for HMA intermediate. No payment will be made for additional work or  
420 cost which may result due to this change.

**SECTION 403 – COLD MIX ASPHALT, CMA, PAVEMENT**

**403.01 Description**

This work shall consist of the construction of one or more courses of CMA base, intermediate, or surface for immediate use or stockpiled in accordance with 105.03.

**MATERIALS**

**403.02 Materials**

10 Materials shall be in accordance with the following:

Asphalt Materials	
For Immediate Use,	
Asphalt Emulsion AE -150, AE-90.....	902.01(b)
For Stockpiling,	
Asphalt Emulsion AE-150 .....	902.01(b)
Course Aggregates .....	904
Base, Class D or Higher	
Intermediate, Class C or Higher	
20 Surface, Class B or Higher	
Fine Aggregates.....	904

Acceptance of the mixture will be in accordance with the Frequency Manual on the basis of a type D certification in accordance with 916.

**CONSTRUCTION REQUIREMENTS**

**403.03 Weather Limitations**

30 CMA pavements shall not be placed on a wet surface, when the ambient temperature is below 40°F (4°C), or when other unsuitable conditions exist, unless approved by the Engineer.

**403.04 Equipment**

Mixing plant, hauling trucks, pavers, and rollers shall be in accordance with 409.

### 403.05 Preparation of Mixtures

The size of the aggregate and the grade of asphalt materials shall be as specified. The gradations and percent of asphalt shall be as follows.

Composition Limits for CMA Mixtures						
Sieve Size	Total Percent of Aggregates Passing Sieves Based on Total Weight (Mass) of Aggregates					
	Size 2	Size 5	Size 8	Size 9	Size 11	Size 5D
2.5 in. (63 mm)	100					
2 in. (50 mm)	95-100					
1.5 in. (37.5 mm)		100				100
1 in. (25 mm)	0-25	85-100	100			80-99
3/4 in. (19.0 mm)	0-10	60-90	75-100	100		68-90
1/2 in. (12.5 mm)	0-7	30-65	40-75	65-90	100	54-76
3/8 in. (9.5 mm)		15-50	20-55	30-65	75-100	45-67
No. 4 (4.75 mm)		0-20	0-20	0-20	10-35	30-50
No. 8 (2.36 mm)		0-15	0-15	0-15	0-15	20-45
No. 30 (600 μm)						7-28
No. 200 (75 μm)	0-5	0-5	0-5	0-6	0-6	0-6
Minimum Percent Crushed	95	95	95	95	95	95
Percent of Asphalt*	2.0-3.5	2.5-4.0	3.0-4.5	3.5-5.0	4.0-6.0	3.5-5.0
* Percent of asphalt shall be calculated on the basis of the total weight (mass) of the mixture, exclusive of water or solvent. When slag is used, the asphalt content will be adjusted to compensate for the specific gravity and surface area.						

40

The moisture condition of the aggregate shall be such that the aggregate is uniformly coated and satisfactorily retains the required amount of asphalt during the stockpiling, hauling, and spreading operations. Mixtures shall not be produced at temperatures exceeding 180°F (80°C).

### 403.06 Preparation of Subgrade or Base

Mixtures for CMA base may be placed on an earth subgrade, on an existing pavement surface to be used as a base, or on a previously prepared base or subbase as specified. If such material is to be laid on a newly prepared subgrade, then all applicable requirements of 207 shall apply.

50

### 403.07 Spreading Mixture

The CMA mixture shall be spread in accordance with 402.13.



**404.02 Quality Control**

10 Seal coat shall be constructed according to a quality control plan, QCP, prepared and submitted by the Contractor in accordance with ITM 803; Contractor Quality Control Plan for Seal Coat. The QCP shall be submitted to the Engineer at least 15 days prior to commencing seal coat operations.

**MATERIALS**

**404.03 Asphalt Material**

The type and grade of asphalt material shall be in accordance with the following:

Asphalt Emulsion, RS-2, AE-90, AE-90S, or HFRS-2 ..... 902.01(b)

20

**404.04 Cover Aggregate**

Aggregate shall be in accordance with the following requirements. When slag is used as an alternate to natural aggregate, adjustments will be made in accordance with 904.01, to compensate for differences in specific gravity.

Coarse Aggregates, Class B or Higher

Size No. 8, 9, 11, or 12 ..... 904

Fine Aggregate

Size No. 23 or 24 ..... 904

30

The types of seal coats shall be as follows:

TYPE (see Note 1)	APPLICATION	COVER AGGREGATE SIZE NO. AND COURSE	RATES OF APPLICATION PER SQUARE YARD (SQUARE METER)	
			AGGREGATE lb (kg)	ASPHALT MATERIAL GALLON (LITER) AT 60°F (16°C)
1 or 1P (see Note 2)	Single	23, 24	12-15 (5.4-6.8)	0.12-0.16 (0.45-0.61)
2 or 2P	Single	12	14-17 (6.4-7.7)	0.29-0.33 (1.09-1.25)
3 or 3P	Single	11	16-20 (7.3-9.1)	0.36-0.40 (1.36-1.51)
4 or 4P	Single	9	28-32 (12.7-14.5)	0.63-0.68 (2.38-2.57)
5 or 5P	Double	Top – 12	16-19 (7.3-8.6)	0.33-0.37 (1.25-1.40)
		Bottom – 11	16-20 (7.3-9.1)	0.36-0.40 (1.36-1.51)

404.05

6 or 6P	Double	Top – 11	18-22 (8.2-10.0)	0.41-0.46 (1.55-1.74)
		Bottom – 9	28-32 (12.7-14.5)	0.63-0.68 (2.38-2.57)
7 or 7P	Double	Top – 11	18-22 (8.2-10.0)	0.41-0.46 (1.55-1.74)
		Bottom – 8	28-32 (12.7-14.5)	0.63-0.68 (2.38-2.57)
Note 1 – AE-90S shall be used for Type P Seal Coats.				
Note 2 – HFRS-2 shall not be used with Type 1 Seal Coat.				

## CONSTRUCTION REQUIREMENTS

### 404.05 Weather Limitations

40 Asphalt material shall not be applied on a wet surface, or when other weather conditions would adversely affect the seal coat. Seal coat shall not be placed when the ambient or pavement temperature is below 60°F (14°C). Seal coat shall not be applied to travel lanes or auxiliary lanes before May 1 or after October 1, but may be applied to shoulders within the above temperature range.

### 404.06 Equipment

A distributor, rotary power broom, pneumatic tire roller, and aggregate spreader in accordance with 409.03 shall be used.

### 404.07 Preparation of Surface

50 Surfaces to be sealed shall be patched as shown on the plans or as directed, brought to proper section and grade, and compacted.

The surface shall be cleaned of all loose material prior to seal coat application. Sealing operations may not commence until the surface is approved.

All castings, detector housings, and snowplowable raised pavement markers shall be covered prior to applying the asphalt material to prevent coating with seal coat. These coverings shall be removed prior to opening to unrestricted traffic.

### 404.08 Applying Asphalt Material

60 Asphalt material shall be applied in a uniform continuous spread over the section to be treated. The quantity of asphalt material to be applied per square yard (square meter) shall be in accordance with the QCP. During application, minor adjustments to the application rate shall be made in accordance with the QCP.

The asphalt material shall not be spread over a greater area than that which can be covered with the cover aggregate that is in trucks at the site.

The spread of the asphalt material shall be no wider than the width covered by the cover aggregate from the spreading device. Operations shall not proceed such

70 that asphalt material is allowed to chill, set up, dry, or otherwise impair retention of the cover coat.

#### 404.09 Application of Cover Aggregate

Within 1 min of the application of the asphalt material, cover aggregate shall be spread in quantities as required. Spreading shall be accomplished such that the tires of the trucks or aggregate spreader do not contact the uncovered and newly applied asphalt material.

#### 404.10 Rolling Operation

80 The aggregate shall be seated with at least three roller applications. A roller application is defined as one pass of the roller over the width sealed. The first roller application shall be completed within 2 min of aggregate application, with the final application completed within 30 min after the cover aggregate is applied. The rollers shall not be operated at speeds that will displace the cover aggregate from the asphalt material.

#### 404.11 Sweeping Operation

90 Excess cover aggregate shall be removed from the pavement surface by brooming no later than the morning after placement of the seal coat. The brooming shall not displace the imbedded aggregate. A second brooming operation shall be performed prior to opening to unrestricted traffic in accordance with 101.33.

#### 404.12 Protection of Surface

Traffic shall not be permitted on the freshly sealed surfaces until final rolling application is complete. The seal coat shall be protected by keeping traffic off of the freshly sealed surface or by controlling traffic speed in accordance with the QCP. Traffic shall not displace the imbedded aggregate.

Any areas with minor bleeding will be covered with fine aggregate or other approved blotting material.

100

#### 404.13 Method of Measurement

Seal coat will be measured by the square yard (square meter) of the seal coated surface.

Patching will be measured in accordance with 304.06.

#### 404.14 Basis of Payment

Seal coat will be paid for at the contract unit price per square yard (square meter) complete in place.

110

Patching will be paid for in accordance with 304.07.

Payment will be made under:

405.01

**Pay Item** **Pay Unit Symbol**

Seal Coat, \_\_\_\_\_ type .....SYS (m2)

120

Seal Coat, \_\_\_\_\_ P type .....SYS (m2)

The cost of determination of asphalt material and cover aggregate application rates, sweeping and rolling operations, blotting material, and other incidentals shall be included in the cost of the pay items.

The Contractor shall adjust application rates as required by the Engineer within the limits set out herein. No additional payment will be made for additional materials necessary to meet the required application rates within the specified limits.

**SECTION 405 – PRIME COAT**

**405.01 Description**

This work shall consist of preparing and treating a rubblized PCCP with asphalt material in accordance with 105.03.

**MATERIALS**

**405.02 Asphalt Materials**

10 The type and grade of asphalt material shall be in accordance with the following:

Asphalt Emulsion, AE-PMP ..... 902.01(b)

**405.03 Cover Aggregate**

Aggregate shall be in accordance with the following:

20 Coarse Aggregate, Class B or Higher,  
Size No. 12 ..... 904  
Fine Aggregate, Size No. 23 or 24 ..... 904

**CONSTRUCTION REQUIREMENTS**

**405.04 Weather Limitations**

Asphalt material shall not be applied on a wet surface, when the ambient temperature is below 50°F (10°C), or when other unsuitable conditions exist, unless approved by the Engineer.

**405.05 Equipment**

30 A distributor and aggregate spreader in accordance with 409.03 shall be used.

**405.06 Preparation of Surface**

The existing surface to be treated shall be shaped to the required grade and section, free from all ruts, corrugations, or other irregularities; uniformly compacted; and approved.

**405.07 Application of Asphalt Material**

AE-PMP shall be uniformly applied at the rate of 0.50 to 0.75 gal./syd (2.2 to 3.3 L/m<sup>2</sup>) placed in a single application. When placing material on a rubblized base, a carpet drag shall be utilized behind the distributor.

When traffic is to be maintained within the limits of the section, approximately half of the width of the section shall be treated in one application. Complete coverage of the section shall be ensured. Treated areas shall not be opened to traffic until the asphalt material has been absorbed.

**405.08 Cover Aggregate**

If the asphalt material fails to penetrate and the primed surface must be used by traffic, cover aggregate shall be spread to provide a dry surface.

**405.09 Method of Measurement**

Asphalt for prime coat will be measured by the ton (megagram), or by the square yard (square meter). Cover aggregate will be measured by the ton (megagram).

**405.10 Basis of Payment**

The accepted quantities of prime coat will be paid for at the contract unit price per ton (megagram), or per square yard (square meter) for asphalt for prime coat. The accepted quantities of cover aggregate will be paid for at the contract unit price per ton (megagram), complete in place.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit Symbol</b>
Asphalt for Prime Coat.....	TON (Mg) SYS (m2)
Cover Aggregate, Prime Coat.....	TON (Mg)

**SECTION 406 – TACK COAT**

**406.01 Description**

This work shall consist of preparing and treating an existing pavement or concrete surface with asphalt material in accordance with 105.03.

**MATERIALS**

**406.02 Materials**

10 The type and grade of asphalt material shall be in accordance with the following:

- Asphalt Emulsion, AE-T, AE-PMT, SS-1h..... 902.01(b)
- PG Asphalt Binder, PG 64-22 ..... 902.01(a)

**CONSTRUCTION REQUIRMENTS**

**406.03 Equipment**

A distributor in accordance with 409.03(a) shall be used.

20

**406.04 Preparation of Surface**

The existing surface to be treated shall be free of foreign materials deemed detrimental by the Engineer.

**406.05 Application of Asphalt Material**

The asphalt material shall be uniformly applied at the rate of from 0.03 to 0.08 gal./syd (0.14 to 0.36 L/m<sup>2</sup>), or as otherwise specified or directed.

30 Tack coat shall not be applied to a wet surface. The rate of application, temperature, and areas to be treated shall be approved prior to application. Excessive tack coat shall be corrected to obtain an even distribution.

**406.06 Method of Measurement**

Asphalt for tack coat will be measured by the ton (megagram) or by the square yard (square meter).

**406.07 Basis of Payment**

40 The accepted quantities of tack coat will be paid for at the contract unit price per ton (megagram), or per square yard (square meter) for asphalt for tack coat, complete in place.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit Symbol</b>
Asphalt for Tack Coat .....	TON (Mg) SYS (m2)

## SECTION 407 – DUST PALATIVE

### 407.01 Description

This work shall consist of preparing and treating an existing aggregate surface with asphalt material in accordance with 105.03.

## MATERIALS

### 407.02 Asphalt Material

10 The type and grade of asphalt material shall be in accordance with the following:

Asphalt Emulsion, AE-PL ..... 902.01(b)

## CONSTRUCTION REQUIREMENTS

### 407.03 Weather Limitations

20 Asphalt material shall not be applied on a wet surface, when the ambient temperature is below 50°F (10°C), or when other unsuitable conditions exist, unless approved by the Engineer.

### 407.04 Equipment

A distributor in accordance with 409.03(a) shall be used.

### 407.05 Preparation of Surface

The surface to be treated shall be shaped to the required section and be free from all ruts, corrugations, or other irregularities.

### 407.06 Application of Asphalt Material

30 The asphalt material shall be uniformly applied at the rate of 0.25 to 1.00 gal./syd (1.5 to 5 L/m<sup>2</sup>) in a uniform continuous spread over the section to be treated or as directed.

When traffic is to be maintained within the limits of the section, approximately half of the width of the section shall be treated in one application. Complete coverage of the section shall be ensured. Treated areas shall not be opened to traffic until the asphalt material has been absorbed.

### 407.07 Method of Measurement

40 Asphalt for dust palative will be measured by the ton (megagram).

### 407.08 Basis of Payment

The accepted quantities of this work will be paid for at the contract unit price per ton (megagram) for asphalt for dust palative, complete in place.

408.01

Payment will be under:

	<b>Pay Item</b>	<b>Pay Unit Symbol</b>
50	Asphalt for Dust Palative.....	TON (Mg)

**SECTION 408 – SEALING CRACKS AND JOINTS**

**408.01 Description**

This work shall consist of sealing longitudinal and transverse cracks and joints in existing asphalt pavement in accordance with 105.03.

**MATERIALS**

**408.02 Materials**

10 Materials shall be in accordance with the following:

Asphalt Emulsion for	
Crack Sealing, AE-90, AE-90S, AE-150.....	902.01(b)
Fine Aggregates, No. 23 or 24.....	904
Joint Sealing Materials .....	906.02

**CONSTRUCTION REQUIREMENTS**

**408.03 Equipment**

20 A distributor in accordance with 409.03 shall be used when crack sealing and an indirect-heat double boiler kettle with mechanical agitator shall be used when routing and filling. Air compressors shall be capable of producing a minimum air pressure of 100 psi (690 kPa).

**408.04 Weather Limitations**

Sealing or filling operations shall not be conducted on a wet surface, when the ambient temperature is below 40°F (4°C), or when other unsuitable conditions exist, unless approved by the Engineer.

**408.05 Routing and Filling Cracks and Joints**

30 Cracks and joints shall be routed when specified, with a vertical-spindle router with carbide-tipped or diamond router bits to form a reservoir not exceeding 0.5 in. (13 mm) wide with a minimum depth of 0.75 in. (19 mm). The operation shall be coordinated such that routed materials do not encroach on pavement lanes carrying traffic and all routed materials are disposed of in accordance with 104.07. Cracks and joints shall be filled with asphalt rubber to within 0.25 in. (7 mm) of the surface in accordance with the manufacturer’s recommendations.

**408.06 Sealing Cracks and Joints**

40 Cracks and joints shall be cleaned by blowing with compressed air or by other suitable means. Asphalt material shall be placed utilizing a “V” shaped wand tip, to allow the penetration of the materials into the cracks and joints. The cracks and joints shall be completely filled or overbanded not to exceed 5 in. (125 mm), or as required. All excess asphalt material shall be removed from the pavement. The sealed cracks and joints shall be covered with sufficient fine aggregate to prevent tracking of the asphalt materials. All excess cover material shall be removed from the pavement.

50 Application of asphalt materials shall be completed without covering existing pavement markings. When traffic is to be maintained within the limits of the section, temporary traffic control measures in accordance with 801 shall be used. Treated areas shall not be opened to traffic until the asphalt material has been absorbed.

**408.07 Method of Measurement**

Sealing and filling of cracks and joints in asphalt pavements will be measured by the ton (megagram) of material used. Routing of cracks and joints will not be measured.

60 Temporary traffic control measures will be measured in accordance with 801.17.

**408.08 Basis of Payment**

Sealing and filling of cracks and joints in asphalt pavements will be paid for by the ton (megagram) of material used for the type specified.

Temporary traffic control measures will be paid for in accordance with 801.18.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit Symbol</b>
Cracks and Joints in Asphalt Pavement, Seal.....	TON (Mg)
Cracks and Joints in Asphalt Pavement, Rout and Seal.....	TON (Mg)

The cost of all materials, cover aggregate, cleaning, and all necessary incidentals shall be included in the cost of the pay items in this section.

**SECTION 409 – EQUIPMENT**

**409.01 Production, Transportation, and Laydown of Asphalt Mixtures**

For production of asphalt mixtures, the Contractor shall provide all equipment necessary for the production, transportation, and laydown operations.

**409.02 Mixing Plant**

The mixing plant shall be capable of producing a uniform mixture.

10           **(a) Certified HMA Plant**

A certified HMA plant shall be in accordance with ITM 583.

**(b) CMA Mixing Plant**

The mixing plant shall be of sufficient capacity and coordination to adequately handle the proposed CMA construction. The mixing unit shall be a twin shaft pugmill or other approved mixer, including the drum type capable of producing a consistent uniform mixture. The outlet of the mixer shall be such that it prevents segregation of the material when discharged.

20           A certified HMA plant in accordance with 409.02(a) may be utilized as a CMA mixing plant.

**409.03 HMA Laydown Operations**

**(a) Distributor**

The distributor shall be equipped, maintained, and operated to provide uniform heating and application rates as specified. The distributor shall have a volume measuring device and a thermometer to monitor the asphalt material.

30           Distributors shall also be equipped with a power unit for the pump and with a full circulation spray bar with vertical controls.

**(b) Hauling Equipment**

The mixtures shall be transported to the laydown operation in trucks that have tight, clean, and smooth beds.

40           Truck beds may be treated with approved anti-adhesive agents. The truck beds shall be raised after application of non-foaming anti-adhesive agents to drain liquids from the bed prior to HMA being loaded into the truck. The Department will maintain a list of approved Anti-Adhesive Materials.

Hauling equipment shall be equipped with a watertight cover to protect the mixture.

**(c) Laydown Equipment**

**1. Paver**

50           The paver shall be self-propelled, and equipped with a material receiving system, and equipped with heated and vibrating screeds. The paver may also include automatic slope and grade controls, extendable screeds and extendable augers.

Automatic control devices shall be separated from the paver screeds, paver tracks or wheels and be capable of adjusting both sides of the screeds automatically

to maintain a constant angle of attack in relation to the grade leveler device or grade line.

A grade leveling system may be used to activate the control devices on each HMA course, including matching lays. The leveling system shall be attached to the paver and operated parallel to the paver's line of travel.

60

Extendable screeds shall be rigid, heated, and vibrating, and be capable of maintaining the cross slope, and line and grade of the pavement, to produce uniform placement of the materials.

Auger extensions shall be used when required to distribute the HMA uniformly in front of the screed.

## **2. Widener**

A device capable of receiving, transferring, spreading, and striking off materials to the proper grade and slope.

70

## **3. Other Mechanical Devices**

Inaccessible or short sections of HMA may be placed with specialty equipment approved by the Engineer.

### **(d) Compaction Equipment**

Compaction equipment shall be self-propelled, steel wheel or pneumatic tire types, in good condition, and capable of reversing direction without backlash. All roller wheels shall be equipped with scrapers to keep the wheels clean, have water spraying devices on the wheels, and steering devices capable of accurately guiding the roller.

80

### **1. Tandem Roller**

A roller having two axles and a minimum weight (mass) of 10 t (9 Mg).

### **2. Three Wheel Roller**

A roller having three wheels with a minimum bearing of 300 lb/in. (5.3 kg/mm) on the rear wheels. The crown of the wheels shall not exceed 2.5 in. (63 mm) in 18 ft (5.5 m).

90

A tandem roller which has a drive wheel bearing of no less than 300 lb/in. (5.3 kg/mm) may be used in lieu of the three wheel roller.

### **3. Pneumatic Tire Roller**

A pneumatic tire roller shall have a minimum rolling width of 5.5 ft (1.65 m). The roller shall be equipped with compaction tires, minimum size 7:50 by 15, exerting a uniform, average contact pressure from 50 to 90 psi (345 to 620 kPa) uniformly over the pavement by adjusting ballast and tire inflation pressures. The wheels on at least one axle shall be fully oscillating vertically, and mounted as to

409.03

- 100 prevent scuffing of the pavements during rolling or turning operations. Charts or tabulations showing the contact areas and pressures for the full range of tire inflation pressures and for the full range of tire loadings for each compactor shall be furnished to the Engineer.

**4. Vibratory Roller**

A vibratory roller shall be equipped with a variable amplitude system, a speed control device, and have a minimum vibration frequency of 2000 vibrations per min. A reed tachometer shall be provided for verifying the frequency of vibrations.

- 110 **5. Trench Roller**

A trench roller shall have a compaction wheel bearing of no less than 300 lb/in. (5.3 kg/mm).

**6. Specialty Roller/Compactor**

Inaccessible or short sections of HMA may be compacted with specialty equipment approved by the Engineer.

**(e) Miscellaneous Equipment**

- 120 **1. Aggregate Spreader**

A spreader shall be a self-propelled, pneumatic tired, motorized unit with a front loading hopper and a transportation system for distributing the aggregates uniformly across the pavement.

**2. Rotary Power Broom**

A motorized, pneumatic tired unit with rotary bristle broom head.

**(f) Smoothness Equipment**

- 130 **1. Profilograph**

The profilograph shall be in accordance with ITM 912.

**2. Straightedge – 16 ft (4.9 m)**

A 16 ft (4.9 m) straightedge shall be a rigid beam mounted on two solid wheels on axles 16 ft (4.875 m) apart. The straightedge has a mounted push bar to facilitate propelling the device along or across the pavement. Tolerance points are located at the 1/4, 1/2, and 3/4 points and may be composed of threaded bolts capable of being adjusted to the tolerance required.

- 140 **3. Straightedge – 10 ft (3 m)**

A 10 ft (3 m) straightedge is the same as a 16 ft (4.9 m) straightedge except that the wheels are mounted 10 ft (3.048 m) apart. A handheld rigid beam may be substituted.

**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.

**410.02 Quality Control**

- 10 The SMA mixture shall be supplied from a certified HMA plant in accordance with ITM 583; Certified Volumetric Hot Mix Asphalt Producer Program. The QCP shall be modified to include the requirements for the SMA mixtures. The SMA 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 SMA paving operations.

**MATERIAL**

**410.03 Materials**

- 20 Materials shall be in accordance with the following:

Asphalt Materials	
PG Binder, PG 76-22, PG 70-22 .....	902.01(a)
Coarse Aggregates, Class AS .....	904
Fibers .....	AASHTO M 325
Fine Aggregates (sand, mineral filler) .....	904

**410.04 Design Mix Formula**

- 30 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, and a Mixture Adjustment Factor (MAF). The DMF shall state the source, type 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.

- 40 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

#### 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 AASHTO M 325 and R 35.

- 50 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	
	Lower	Upper	Lower	Upper
25.0 mm				
19.0 mm			100.0	100.0
12.5 mm	100.0	100.0	90.0	99.0
9.5 mm	70.0	95.0	50.0	85.0
4.75 mm	30.0	50.0	20.0	40.0
2.36 mm	20.0	30.0	16.0	28.0
1.18 mm	---	21.0	---	---
600 μm	---	18.0	---	---
300 μm	---	15.0	---	---
75 μm	8.0	12.0	8.0	11.0

The optimum binder and aggregate gradation content shall produce 4.0% air voids. The maximum specific gravity of the uncompacted mixture shall be determined in accordance with AASHTO T 209, Section 9.5.1. The percent draindown for SMA surface mixture shall not exceed 0.30% in accordance with AASHTO T 305.

- 60 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 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.

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 in accordance with AASHTO R 30. The minimum tensile strength ratio, TSR, shall be 70%. The 6 in. (150 mm) mixture specimens shall be compacted to  $6.0 \pm 1.0\%$  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.

The fine aggregate portion of the aggregate blend shall be non-plastic as determined in accordance with AASHTO T 90.

A change in the source or types of aggregates, change in source or type of stabilizing additives, or a change in the source of the specified binder shall require a new DMF. A new DMF shall be submitted to the District Materials and Tests Engineer for approval one week prior to use.

The specific gravity of SF and the Gsb of the aggregate blend containing SF may be adjusted once per contract upon notification by the SF source and approval by the District Materials and Tests Engineer. A new DMF is not required for this adjustment.

The mixture design compaction temperature for the specimens shall be  $300 \pm 9^\circ\text{F}$  ( $150 \pm 5^\circ\text{C}$ ).

VOIDS IN MINERAL AGGREGATE (VMA) CRITERIA	
Mixture Designation	Minimum VMA, Percent
12.5 mm	17.0
9.5 mm	17.0

#### 410.06 Recycled Materials

Recycled materials may consist of reclaimed asphalt pavement, RAP, or asphalt roofing shingles, ARS, or a blend of both. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The recycled material shall be 100% passing the 3/8 in. (9.5 mm) sieve and 95% to 100% passing the No. 4 (4.75 mm) sieve when entering the HMA plant. ARS shall consist of waste from a shingle manufacturing facility. No tear-off materials from roofs will be allowed. ARS shall be stockpiled separately from other materials.

Recycled materials may be used as a substitute for a portion of the new materials required to produce mainline surface. When only RAP is used in the mixture, the RAP shall not exceed 15.0% by weight (mass) of the total mixture. When only ARS is used in the mixture, the ARS shall not exceed 3.0% by weight (mass) of the total mixture. For substitution or use, 1.0% of ARS is considered equal to 5.0% RAP. The percentages of recycled materials shall be as specified on the DMF.

410.07

110 The combined aggregate properties of a mixture with recycled materials shall be determined in accordance with ITM 584 and shall be in accordance with 904. Gradations of the combined aggregates shall be in accordance with 410.05.

Mixtures containing RAP shall use the same grade of binder as specified.

#### **410.07 Lots and Sublots**

120 Lots will be defined as 2400 t (2400 Mg) of SMA surface mixture. Lots will be further sub-divided into sublots not to exceed 600 t (600 Mg) of SMA surface mixture. Partial sublots of 100 t (100 Mg) or less will be added to the previous sublot. Partial sublots greater than 100 t (100 Mg) 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 the current or previous calendar year will be allowed. The mixture compaction temperature shall be  $300 \pm 9^{\circ}\text{F}$  ( $150 \pm 5^{\circ}\text{C}$ ). The JMF for each mixture shall be submitted to the Engineer.

#### **410.09 Acceptance of Mixtures**

130 Acceptance of mixtures for binder content and gradation for each lot will be based on tests performed by the Engineer. The Engineer will randomly select the location(s) within each sublot for sampling in accordance with ITM 802. An acceptance sample will consist of one plate sample at the random location. A backup sample will consist of one plate sample located 2 ft (0.6 m) towards the center of the mat from the acceptance sample.

Samples from each location shall be obtained from each sublot from the pavement in accordance with ITM 580. The Engineer will take immediate possession of the samples.

140 A maximum specific gravity sample and a binder content and gradation sample will be obtained from the plate sample in accordance with ITM 587. The binder content will be determined in accordance with ITM 586 or ITM 571 as directed by the Engineer and the gradation will be determined in accordance with AASHTO T 30. The maximum specific gravity will be determined in accordance with AASHTO T 209, Section 9.5.1. The test results of the sublots will be averaged and shall meet the requirements for tolerances from the JMF for each sieve and binder content.

150 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.

ACCEPTANCE TOLERANCE FOR MIXTURES (Percent Mass)							
MIXTURE	NUMBER OF TESTS	SIEVE SIZE					
SURFACE		*12.5 mm	*9.5 mm	*4.75 mm	2.36 $\mu\text{m}$	600 $\mu\text{m}$	75 $\mu\text{m}$
	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
* 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 subplot 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 ( $\pm$ Percent Mass)	
SIEVE SIZE & BINDER CONTENT	PERCENTAGE POINTS
	SURFACE
2.36 mm	12.0
600 $\mu\text{m}$	6.0
75 $\mu\text{m}$	2.0
% BINDER	1.0

160 Acceptance tolerances for binder content and gradation will be as set out above for the number of tests performed. The acceptance tolerance for range will be as set out above for lots of more than one subplot. The range of binder shall be the difference between the highest subplot binder content and the lowest subplot binder content in one lot. The range of gradation shall be the difference between the highest subplot percent passing and the lowest subplot percent passing each required sieve in one lot.

Single test values and averages will be reported to the nearest 0.1%. Rounding will be in accordance with 109.01(a).

170 Lot adjustment points will be assessed in accordance with 410.19(a) when the average or range for binder content or gradation are not met.

The Contractor may request an appeal of the Engineer's test results in accordance with 410.20.

410.10

A binder draindown test in accordance with AASHTO T 305 shall be completed once per lot in accordance with 410.07 and shall not exceed 0.30%.

180 Stabilizing additives incorporated into the mixture will be accepted on the basis of a type A certification for the specified material properties for each shipment of fibers. Stabilizing additives from different manufacturers and different types of additives shall not be intermixed.

In the event that an acceptance sample is not available to represent subplot(s), all test results of the previous subplot will be used for acceptance. If the previous subplot is not available, the subsequent subplot will be used for acceptance.

### CONSTRUCTION REQUIREMENTS

190 **410.10 General**

Equipment for SMA operations shall be in accordance with 409. The Contractor shall submit to the Engineer prior to use a written Certificate of Compliance that the proposed paving equipment has been modified in accordance with 401.10 or is new and includes the modifications.

Fuel oil, kerosene, or solvents shall not be transported in open containers on equipment. Cleaning of equipment and small tools shall not be accomplished on the pavement or shoulder areas.

200 Segregation, flushing or bleeding of SMA mixtures will not be permitted. Corrective action shall be taken to prevent continuation of these conditions. Segregated, flushed or bleeding of SMA mixtures shall be removed if directed. All areas showing an excess or deficiency of binder shall be removed and replaced.

All mixtures that become loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced.

**410.11 Preparation of Surfaces to be Overlaid**

210 Milling of an existing pavement surface shall be in accordance with 306.05. Surfaces on which a mixture is placed shall be free from objectionable or foreign materials at the time of placement.

Milled asphalt surfaces and asphalt surfaces shall be tacked in accordance with 406. Contact surfaces of curbing, gutters, manholes, and other structures shall be tacked in accordance with 406.

**410.12 Process Control**

220 The Engineer and Contractor will jointly review the operations to ensure compliance with the QCP. Continuous violations of compliance with the QCP will result in suspension of paving operations.

#### 410.13 Weather Limitations

SMA courses shall be placed when the ambient temperature and the temperature of the surface on which it is to be placed is 45°F (7°C) or above.

#### 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.

230

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.

240

Planned SMA courses greater than 220 lb/syd (120 kg/m<sup>2</sup>) placed under traffic, shall be brought up even with each adjacent lane at the end of each work day. Planned SMA courses less than or equal to 220 lb/syd (120 kg/m<sup>2</sup>) shall be brought forward concurrently, within practical limits, limiting the work in one lane to not more than one work day of production before moving back to bring forward the adjacent lane.

Hydraulic extensions on the paver will not be permitted for continuous paving operations. Fixed extensions or extendable screeds shall be used on courses greater than the nominal width of the paver except in areas where the paving widths vary. Hydraulic extensions may be used in tapers and added lanes less than 250 ft (75 m) in length.

250

Automatic slope and grade controls will be required and shall be outlined in the QCP.

SMA mainline and SMA shoulders which are 8.0 ft (2.4 m) or more in width shall be placed with automatic paving equipment.

260

The rollers shall be operated to avoid shoving of the SMA and at speeds not to exceed 3 mph (4.5 km/h). Rollers shall be in accordance with 409.03(d)1, 2, or 6. Vibratory rollers meeting the requirements of 409.03(d)4 may be used but shall not be operated in vibratory mode, except the vibratory mode may be used on the first pass to the paver.

The finished thickness of any course shall be at least two times but not more than four times the maximum particle size as shown on the DMF.

#### 410.15 Joints

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

410.16

Transverse joints shall be constructed by exposing a near vertical full depth face of the previous course. For areas inaccessible to rollers, other mechanical devices shall be used to achieve the required density.

270

If constructed under traffic, temporary transverse joints shall be feathered to provide a smooth transition to the driving surface.

**410.16 Density**

Acceptance will be based on lots and sublots in accordance with 410.07.

The Engineer's acceptance test results for each subplot will be available after the subplot and testing are complete.

280

Sublot and lot density values will be reported to the nearest 0.1%. Rounding will be in accordance with 109.01(a).

Density acceptance for all SMA mixtures shall be based on cores cut from the compacted pavement and analysis of pavement samples obtained in accordance with ITM 580. Acceptance will be based on lots and sublots in accordance with 410.07. The Engineer will randomly select two locations in accordance with ITM 802, within each subplot for coring. The transverse core location will be located so that the edge of the core will be no closer than 3 in. (75 mm) from a confined edge or 6 in. (150 mm) from a non-confined edge of the course being placed. The maximum specific gravity will be determined from the sample obtained in 410.09.

290

The Contractor shall obtain cores in the presence of the Engineer with a device that shall produce a uniform 6 in. (150 mm) diameter pavement sample. Surface courses shall be cored within one work day of placement. Damaged core(s) shall be discarded and replaced with a core from a location selected by adding 1.0 ft (0.3 m) to the longitudinal location of the damaged core using the same transverse offset.

300

The Contractor and the Engineer shall mark the core to define the course to be tested. If the core indicates a course thickness of less than two times the maximum particle size, the core will be discarded and a core from a new random location will be selected for testing.

The Engineer will take immediate possession of the cores. If the Engineer's cores are subsequently damaged, additional coring within a specific subplot or sublots will be the responsibility of the Department. Subsequent core locations will be determined by subtracting 1.0 ft (0.3 m) from the random location using the same transverse offset.

310

The density of the mixture will be expressed as the percentage of maximum specific gravity (%MSG) obtained by dividing the average bulk specific gravity by the maximum specific gravity for the subplot, times 100. Samples for the bulk specific gravity and maximum specific gravity will be dried in accordance with ITM 572.

The Engineer will determine the BSG of the cores in accordance with AASHTO T 166, Method A. The maximum specific gravity will be determined in accordance with AASHTO T 209, Section 9.5.1. The target value for density of SMA mixtures of each subplot shall be 93.0%.

320 The Engineer will determine the bulk specific gravity of the cores in accordance with AASHTO T 166, Method A. The maximum specific gravity will be determined in accordance with AASHTO T 209, Section 9.5.1. Density shall not be less than 92.0%.

The densities of the sublots will be averaged to determine the density of the lot.

Within one work day of coring operations the Contractor shall clean, dry, and refill the core holes with SMA of similar or smaller size particles or other approved materials. The Contractor's plan for refilling core holes shall be outlined in the QCP.

#### 410.17 Shoulder Corrugations

330 Shoulder corrugations shall be in accordance with 606.

#### 410.18 Pavement Smoothness

The pavement smoothness will be evaluated and determined in accordance with 401.18.

#### 410.19 Adjusted Points

340 When test results for mixture properties or density exceed the allowable tolerances, adjustment points will be assessed. The adjustment points will be used to calculate a quality assurance adjustment quantity (q) for the lot. Quality assurance adjustment points for smoothness will be in accordance with 401.19(c).

The adjustment for mixture properties and density are calculated as follows.

$$q = (1.00 \times (L \times U \times P/100))/MAF$$

where:

q = quality assurance adjustment quantity

L = lot quantity

U = unit price for the material, \$/TON (\$/Mg)

350 P = total adjustment points

The total quality assurance adjustments is to be calculated as follows:

$$Q = Q_s + \sum (q_m + q_d)$$

where:

Q = total quality assurance adjustment quantity

410.19

$Q_s$  = quality assurance adjustment for smoothness as calculated in 401.19(c)

360  $q_m$  = lot adjustments for mixtures

$q_d$  = lot adjustments for density

If the total adjustment points for a lot are greater than 15, the pavement will be evaluated by the Materials and Tests Division. If the Contractor is not required to remove the mixture, quality assurance adjustments of the lot will be assessed or other corrective actions as determined by the Materials and Tests Division.

**(a) Mixture**

370 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					
	12.5 mm	9.5 mm	4.75 mm	2.36 mm	600 $\mu$ m	75 $\mu$ m
For Each 0.1% up to 1.0% Out of Tolerance	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	0.2	0.3	0.6

Gradation adjustment points for the lot shall be the sum of points calculated for up to 1% out of tolerance and the points calculated for greater than 1% out of tolerance in accordance with 410.09.

Binder content adjustment points for the lot shall be two points for each 0.1% above the tolerance or four points for each 0.1% below the tolerance in accordance with 410.09.

380

When test results for the mixture furnished exceed the allowable range in accordance with 410.09, adjustment points will be assessed as follows:

ADJUSTMENT POINTS FOR RANGE	
Sieve Size and Binder Content	Adjustment Points (For Each 0.1% Out of Range)
2.36 mm	0.1
600 $\mu$ m	0.1
75 $\mu$ m	0.1
% Binder	1.0

For mixtures produced during a certified HMA plant's adjustment period, adjustment points will not be assessed if the mixture produced is in accordance with the following.

- 390
1. The gradation complies with 410.05 with the allowable tolerance limits shown in 410.09.
  2. The range for the binder content and gradation do not exceed the limits shown in 410.09.
  3. The binder content is within the tolerance requirements of 410.09.

If the mixture is not in accordance with these requirements, adjustment points will be assessed in accordance with 410.09 for variations exceeding the requirements shown above.

400

### (b) Density

When the density of the lot is outside the allowable tolerances, adjustment points will be assessed as follows:

DENSITY	
Percentages are based on %MSG	Pay Adjustments – Percent
> 97.0	Submitted to the Materials and Tests Division*
93.0 – 97.0	0.00
92.0 – 92.9	0.20 points for each 0.10% below 93.0
91.0 – 91.9	2.00 + 0.40 points for each 0.10% below 92.0
89.0 – 90.9	6.00 + 1.00 points for each 0.10% below 91.0
≤ 89.0	Submitted to the Materials and Tests Division*
* Test results will be considered and adjudicated as a failed material in accordance with normal Department practice as listed in 105.03.	

### 410.20 Appeals

410 If the QC test results do not agree with the acceptance test results, a request, along with the QC test results, may be made in writing for additional testing. Additional testing may be requested for one or more of the following tests: binder content, gradation, or MSG of the mixture samples and bulk specific gravity of the density cores. The appeal request shall be submitted within seven calendar days of receipt of the Department's written results for that subplot. The subplot and specific tests shall be specified at the time of the appeal request. Only one appeal request per subplot is permitted. Upon approval of the appeal, the Engineer will perform additional testing.

The appeal results will replace all previous test results for acceptance of mixture in accordance with 410.09 and density in accordance with 410.16. The results will be

410.21

420 furnished to the Contractor. The backup mixture samples or density cores will be tested in accordance with the following:

**(a) MSG**

The backup maximum specific gravity sample will be dried in accordance with ITM 572 and tested in accordance with AASHTO T 209, section 9.5.1.

**(b) Binder Content and Gradation**

The backup binder content and gradation sample will be prepared and tested in accordance with the test methods that were used for acceptance.

430

**(c) BSG of the Density Core**

Cores shall be taken within seven calendar days unless otherwise directed. Additional core locations will be determined by adding 1.0 ft (0.3 m) longitudinally of the cores tested using the same transverse offset. The cores will be dried in accordance with ITM 572 and tested in accordance with AASHTO T 166, Method A. The Contractor shall clean, dry, and refill the core holes with SMA or HMA surface materials within one work day of the coring operations.

**410.21 Method of Measurement**

440 SMA mixtures will be measured by the ton (megagram) of the type specified, in accordance with 109.01(b). The measured quantity will be divided by the MAF to determine the pay quantity.

**410.22 Basis of Payment**

The accepted quantities for this work will be paid for at the contract unit price per ton (megagram) for QC/QA-HMA, of the type specified, – SMA, complete in place.

Payment for furnishing, calibrating, and operating the profilograph, and furnishing profile information will be made in accordance with 401.22.

450

Adjustments to the contract payment with respect to mixture, density, and smoothness for mixture produced will be included in a quality assurance adjustment pay item. The unit price for this pay item will be one dollar (\$1.00) and the quantity will be in units of dollars. The quantity is the total calculated in accordance with 410.19. A change order developed in accordance with 109.05 will be prepared to reflect contract adjustments.

Payment will be made under:

460	<b>Pay Item</b>	<b>Pay Unit Symbol</b>
	QC/QA HMA, $\frac{\text{mm}}{(\text{ESAL}^{(1)}) (\text{PG}^{(2)}) (\text{Course}^{(3)}) (\text{Mix}^{(4)})}$ .....	TON (Mg)
	Quality Assurance Adjustment.....	DOL
	<ul style="list-style-type: none"> <li>(1) ESAL Category as defined in 410.04</li> <li>(2) Number represents the high temperature binder grade. Low temperature grades are -22.</li> <li>(3) Surface</li> <li>(4) Mixture Designation</li> </ul>	
470		

Preparation of surfaces to be overlaid shall be included in the cost of other pay items within this section.

Coring and refilling of the pavement holes shall be included in the cost of other pay items within this section.

No payment will be made for additional anti-stripping additives, appeal coring or related traffic control expenditures for coring operations.

480

Corrections for pavement smoothness shall be included in the cost of other pay items within this section.

The price for profilograph, HMA will be full compensation regardless of how often the profilograph is used or how many profilograms are produced.