KANSAS DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION TO THE
STANDARD SPECIFICATIONS, 2015 EDITION

Add a new SECTION to DIVISION 600:

PLANT MIX ASPHALT CONSTRUCTION (BM-MIXES)

1.0 DESCRIPTION

Construct 1 or more courses of HMA on the prepared foundation according to the Contract Documents.
Note: Do not use BM-MIXES on State routes.

BID ITEMS	UNITS
Aggregate for Asphalt Surface Course (*)	Ton
Aggregate for Asphalt Base Course (*)	Ton
Aggregate for Asphalt Surface Course (*) (Shoulder)	Ton
Aggregate for Asphalt Base Course (*) (Shoulder)	Ton
Asphalt Cement (**)	Ton
Cutback Asphalt (**)	Ton
Emulsified Asphalt (**)	Ton
Asphalt Core (Set Price)	Each
Material for Asphalt Patching (Set Price)(***)	Ton

* Mix Designation
** Designated Type and Grade
*** For Material for Asphalt Patching, use any HMA mix approved on the project.

2.0 MATERIALS

Provide materials that comply with the applicable requirements.

a. Asphalt Materials. Provide Asphalt Materials that comply with **DIVISION 1200**.

b. Reclaimed Asphalt Pavement (RAP). Provide RAP that complies with **SECTION 1103**. Unless otherwise specified in the contract documents, the BM-2 mixture may contain up to 10% RAP provided the Engineer approves the RAP source. Exceeding 10% RAP in the BM-2 mixture or including RAP in the other mixtures within this specification, is only permitted when stated in the contract documents.

c. Aggregates. Provide aggregates that comply with **SECTION 1103**.

d. Combined Aggregates. Provide combined aggregates for the mixes required in the Contract Documents as shown in **TABLE 1**.

Mixes may use any combination of aggregate and mineral filler supplements complying with the applicable requirements in **TABLES 1103-1** and **1103-2**.

Provide materials with less than 0.5% moisture in the final mixture.

The maximum quantity of crushed steel slag used in the mix is 50% of the total aggregate weight.

Natural sand shall be called SSG-1, SSG-2, etc. in the mix design.

Natural sand is defined as aggregate having an uncompacted void content of fine aggregate "U" value of less than 42.00.

Additional requirements for BM-1T:

- Traveled way mixes shall include a minimum of 40% primary aggregate based on total aggregate weight;
- A minimum of 50% of the plus No. 4 mesh sieve material in the mixture shall be from the primary aggregate;
- A minimum of 45% of the plus No. 8 mesh sieve material in the mixture shall be from the primary aggregate; and

- Primary aggregates are designated as CS-1 (excluding limestone), CS-2 (excluding limestone), CG, CH-1 and CSSL as described in **subsection 1103.2a.(1)**. Primary aggregate requirements do not apply to the mixture used on the shoulder.

e. Contractor Trial Mix Design. A minimum of 10 working days before the start of HMA production, submit in writing to the DME for review and approval, a proposed Job Mix Formula (JMF) for each combination of aggregates. For each JMF submitted, include test data to demonstrate that mixtures complying with each proposed JMF shall have properties specified in **TABLES 1 and 2** for the designated mix type at the Recommended Percent Asphalt (P_{br}). Submit the proposed JMF on forms provided by KDOT. Submit the worksheets used in the design process to include at a minimum the mix properties listed in **TABLE 3**. Contact the DME to determine if additional information should be submitted. Provide sufficient material as identified in **TABLE 4**. Contact the DME to determine if additional material is needed for additional design checks such as the modified Lottman test (KT-56).

Submit for the Engineer's review and approval, the test data listed in **TABLE 5** for each blend and the proposed JMF. In addition, for mixes containing RAP, submit for the Engineer's review and approval, the test data listed in **TABLE 6** for each blend and the proposed JMF. Submit a mix design for each blend and the proposed JMF as outlined in **TABLE 7**.

TABLE 1: COMBINED AGGREGATE REQUIREMENTS

Mix Designation	Percent Retained – Square Mesh Sieves										
	1"	¾"	½"	⅜"	No. 4	No. 8	No. 16	No. 30	No.50	No. 100	No. 200
BM-1			0	0-8	18-39	35-53	50-68	60-80	72-90	82-95	92-98
BM-1A		0	6-13	14-23	32-47	49-65	62-76	72-85	81-91	86-96	92-98
BM-1B		0	0-10	7-22	41-59	61-79	75-89	82-94	86-97	89-99	93-99
BM-1T			0	0-14	39-59	57-72	70-85	78-91	87-99	90-99	92-98
BM-2		0		8-30		42-72		64-88			92-98
BM-2A		0		6-21	23-40	38-56		61-82		88-99	92-99
BM-2B	0	0-5		10-30		42-72		64-88			92-98
BM-2C	0	0-10	12-22	19-39	51-69	65-83	75-91	82-95	87-99	90-99	93-99

Notes:

1. BM-2 used in base construction will be restricted to BM-2, BM-2B or BM-2C gradation.
2. The maximum percent moisture in the final mixture shall not exceed 0.5%.
3. If the District approves MFS-4 (hydrated lime) as an anti-strip agent, then the lower gradation limit on the No. 200 sieve will be reduce by 1 percent. For example: the specification limit for the No. 200 sieve for BM-2A will be changed from 92-99 to 91-99.

TABLE 2: MIX REQUIREMENTS		
Mix Criteria	**Low Traffic (LT)[1]**	**High Traffic (HT)[1]**
AGGREGATE		
Coarse Angularity, min	50	75
Uncompacted Voids-Fine, min	40	42
Sand Equivalent	45	45
Natural sand (max. %)	50	35
COMPACTION REVOLUTIONS		
N_{ini} (level of compaction)	6 (≤91.5)	7(≤90.5)
N_{des}	50	75
N_{max} (level of compaction)	75 (≤98.0)	115 (≤98.0)
MIX		
Design VMA Range (BM-1 and BM-1T) [2]	14.0 to 17.5	14.0 to 17.5
Design VMA Range (All other Mixes) [2]	13.0 to 16.5	13.0 to 16.5
Target Air Voids at N_{des}, %	4.0	4.0
Tensile Strength Ratio (%TSR), min [3]	80	80

1. Use Higher Traffic (HT) criteria unless Low Traffic (LT) criteria is required by the Contract Documents.
2. Design VMA Range is different than plant produced VMA requirements.
3. BM-1 produced for maintenance stockpiles is not subject to the TSR requirements.

TABLE 3: MIX PROPERTIES			
Property	**Abbreviation**	**Test Method**	**Additional Information**
Air Voids	V_a	KT-15 & KT-58	Calculated from G_{mm} and G_{mb}. Run at the P_{br}.
Recommended Percent Asphalt	P_{br}		Produce a mix with a V_a of 3.5% to 4.5%.
Theoretical Maximum Specific Gravity	G_{mm}	KT-39	Rice Test.
Percent Tensile Strength Ratio	%TSR	KT-56	Run test at P_{br} or at a lower percent asphalt (up to 0.75% less than P_{br}).
Sand Equivalent	SE	KT-55	
Bulk Specific Gravity of HMA	G_{mb}	KT-15	Compacted Mix Property.
Percent G_{mm} at N_{ini} and N_{des} and N_{max}	$\%G_{mm}$ @ N_{ini} $\%G_{mm}$ @ N_{des} $\%G_{mm}$ @ N_{max}	KT-15	Use G_{mm} value from KT-39. Calculated from Gyratory Compaction height data, G_{mm}, and G_{mb}.
Voids in Mineral Aggregate	VMA	KT-15 & KT-6	Calculated from G_{mb}, G_{sb}, P_b.
Coarse Aggregate Angularity	CAA	KT-31	
Fine Aggregate Angularity	FAA	KT-50	

Formulas for calculations are in the Superpave Volumetric Mixture Design and Analysis Handbook.

TABLE 4: MATERIAL SUBMITTALS			
Submittal	**Quantity**	**Description**	**Additional Information**
Aggregate for KT-15	3 Samples	Sized for 6 inch Plugs	Comply with Job Mix Gradation.
Aggregate for KT-39	2 Samples	Sized for G_{mm} Testing	Comply with Job Mix Gradation.
Binder for KT-15	As Needed	Sized for 3 Plugs at P_{br}	
Binder for KT-39	As Needed	Sized for 2 G_{mm} Tests	
Each Aggregate for KT-6	As Needed	Specific Gravity Test	
Uncompacted HMA Sample	35 lbs	Sample shall be cooled to room temperature	If transported hot and compacted within 2 hours, then requirement to cool sample may be waived by the DME.
Gyratory Plugs at N_{max}	2 Plugs	Compacted at P_{br}	Compacted to N_{max} .

TABLE 5: TEST DATA SUBMITTALS	
Submittal	**Information**
Asphalt Binder	Source, Grade, Specific Gravity, Mixing and Compaction Temperature from the Producer of the asphalt binder.
Each Aggregate	Source and Producer, including Legal Description.
Gradation of Each Aggregate	Percentage Retained to nearest 1% (except nearest 0.1% for No. 200 sieve) Derive RAP gradation after residual binder is removed.
Material Proportioning	Proportion of each material is shown in percentage of aggregate.
Composite Gradation	Based on Gradation of Each Aggregate and Material Proportioning.
Composite Gradation Plot	Plotted on KDOT Form 712 (0.45 power graph paper).
Asphalt Binder Added	Percentage to nearest 0.1% based on total weight of the mixture.
Aggregate	Coarse Aggregate Angularity and Fine Aggregate Angularity.
%TSR	Percent Tensile Strength Ratio of the Mixture (Modified Lottman Test).
Sand Equivalent	SE for the combined virgin aggregates.

TABLE 6: RAP TEST DATA SUBMITTALS	
Submittal	**Information**
RAP	Source and location where RAP will be obtained.
RAP Aggregate	Bulk Specific Gravity (G_{sb}). The Effective Specific Gravity (G_{se}) shall be calculated as shown in subsection 5.10.4, Part V and used as the G_{sb}.
Asphalt Binder Content of RAP	Determined from ignition oven analysis using KT-57.
RAP G_{mm}	Determined by KT-39.
Asphalt Binder Specific Gravity	Specific Gravity of the asphalt binder in the RAP (G_b) shall be set equal to 1.035.
Corrected Asphalt Binder Content of the total recycled mixture	Determined from ignition oven analysis using KT-57.

TABLE 7: MIX DESIGN TEST DATA SUBMITTALS	
Submittal	**Information**
Minimum of 4 Mix Designs with uniformly spaced binder contents	1 mix design at the P_{br}, a minimum of 2 mix designs above the P_{br}, and a minimum of 1 mix design below the P_{br}. The binder contents shall be uniformly spaced with a maximum of 0.5% between each point.
G_{mm}	Determined at each binder content.
Individual and Bulk Specific Gravity Tests	Provide results for a minimum of 2 specimens at each binder content.
Percent Air Voids	Provide $\%V_a$ in the mixture for each binder content when compacted to N_{ini}, N_{des} and N_{max} gyratory revolutions along with copies of the Gyratory graphs.
Percent VMA	Provide %VMA at each binder content.

3.0 CONSTRUCTION REQUIREMENTS

a. Plant Operation.

(1) General. Adjust plant to operate as continuously as possible.

(2) Preparation of the Asphalt Binder. Heat the asphalt binder to within a range as specified in **SECTION 601**. When heating the asphalt binder to the specified temperature, avoid local overheating. At all times, provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. Asphalt binder received from the refinery at temperatures less than 375°F may be used as received, if the requirements regarding the reheating of asphalt binder in **SECTION 601** are met.

(a) Commingling of Asphalt Binders. Do not add or commingle asphalt binders from 2 or more sources into a storage tank. If this occurs, the contents of the storage tank are considered contaminated. Do not use the contents of the storage tank on the project, except as follows: It is permissible, at the Contractor's option, to thoroughly mix the contents of the tank and request

sampling of the mixture. Submit the sample to the MRC for testing. Do not use the asphalt binder until approved, and when needed, a new mix design evaluation is completed.

(b) Asphalt Binder Sources. Before changing asphalt binder sources on a project, obtain approval from the DME. A new JMF may be required.

(c) Anti-Strip Additives. If liquid anti-strip additives are added at the Contractor's plant, install a "totalizer" to monitor the quantity of anti-strip additive being added. The Engineer may approve alternative methods for including anti-strip additives in a batch plant. Provide a method for the Engineer to continually monitor the percent of additive being added. The addition of anti-strip additives is subsidiary to the bid item "Asphalt Cement".

If hydrated lime is added, moisten the combined virgin aggregate to a minimum of 3% above the saturated surface dry condition prior to, or during the addition of the hydrated lime. Mix it in an approved pug mill to coat the combined aggregates.

(3) Preparation of Mineral Aggregate.

(a) General. When the mineral aggregate is composed of 2 or more ingredients, combine as shown in the approved JMF.

(b) Temperature Requirements. Dry the aggregate for the mixture and heat to a temperature which shall provide an asphalt-aggregate mixture temperature immediately after mixing within the 75 to 150 second Saybolt viscosity range of the asphalt binder used. Obtain the temperature for this viscosity range from the MRC or the Asphalt Binder Producer. No mixing or compaction temperatures are to exceed 340ºF without approval from the Bureau Chief of Construction and Materials. The minimum temperature may be revised by the DME provided it is demonstrated that satisfactory results may be obtained at a lower temperature. In such event, deliver the HMA to the paver at a temperature sufficient to allow the material to be satisfactorily placed and compacted to the specified density and surface tolerance requirements.

(4) Preparation of HMA.

(a) General. Introduce asphalt binder into the prepared aggregate in the proportionate amount determined by the P_{br} in the JMF.

(b) Basis of Rejection. HMA will be rejected if the aggregate, as it is discharged from the drum or the pugmill, contains sufficient moisture to cause foaming of the mixture, or if the temperature of the aggregate is such that the asphalt-aggregate mixture temperature is outside the range specified in **SECTION 601**.

(c) Mixing Time. Operate drum mixers at a rate to provide uniform aggregate coating in a continuous operation. For batch and continuous type plants, the minimum wet mixing time is 40 seconds. In all cases, the mixing time shall be sufficient to produce a uniform mixture in which all the aggregate particles are thoroughly coated. On batch plants, begin the timing at the start of the asphalt binder introduction into the pugmill, and end upon the opening of the discharge gate. Mixing time in seconds for continuous flow plants shall equal:

[pugmill dead capacity in pounds] divided by [pugmill output in pounds per second].

(d) Manufacturers Specifications. Operate all drying, pumping and mixing equipment within the limits specified by the manufacturer, unless it can be demonstrated to the satisfaction of the Engineer that such limits may be exceeded without detriment to the HMA.

(e) Batcher Operation. Coordinate HMA batchers (Gob Hoppers) with the plant production rate at all times so the hopper shall be more than ¾ full before the gates open, and the gates close before material can drop through the gob hopper directly into the surge bin, weigh hopper or truck.

(f) Wasted Material. Wasted material is not measured for pay.

If after an interruption of production, the drum-mixer contains cold, uncoated or otherwise unsuitable material, waste material through a diversion chute. In a continuous or batch plant drier, waste unsuitable material through the pugmill.

At the end of a production run, waste any segregated material in the cone of the storage bin.

(5) Testing Facilities. Provide equipment needed for the Engineer to perform Kansas Test Method KT-39, Theoretical Maximum Specific Gravity of Asphalt Paving Mixes, Part V.

b. Road Surface Preparation.

(1) Preparation of Earth Subgrade. When the HMA is placed on a prepared subgrade, and unless other subgrade preparation is called for in the Contract Documents, perform the following:

At all grade control points, such as existing pavements and bridges, excavate the subgrade according to the specified grades and lines, prior to any subgrade treatment. Prior to the delivery of materials for the base course, prepare the subgrade surface by sprinkling with water, lightly scarifying where necessary, and blading and rolling, until the proper crown is obtained. Disturb the originally compacted crust or top portion of the subgrade as little as possible.

Maintain the subgrade as prepared until it is covered with the base course. Repair any defects which may develop, at the Contractor's expense, to the satisfaction of the Engineer.

(2) Trimming of Subgrade (Untreated, Treated or Modified), Aggregate Base or Granular Subbase for HMA Pavement. Before placing the subsequent layer of the pavement structure, trim the subgrade (untreated, treated or modified), aggregate base or granular subbase. Use an automated, electronically controlled machine that trims with a rotary cross-shaft trimmer. The Engineer may waive the use of automatically controlled equipment on areas of narrow width or irregular dimensions. Operate all trimming equipment far enough in advance of the paving operation to allow ample opportunity to check the grade and make any needed corrections.

Prior to paving, construct ditches and drains to drain the highway effectively. Maintain the finished subgrade in a smooth and compacted condition to readily drain.

Do not place pavement upon a frozen or muddy subgrade.

(3) Preparation of an Existing Asphalt Pavement. Clean the surface to remove all foreign material and broom to remove dust. Excavate areas shown in the Contract Documents to be patched to a depth directed by the Engineer. Fill with HMA and compact.

(4) Preparation of an Existing Concrete or Brick Pavement. Clean all foreign material and broom to remove dust. Clean and fill cracks and joints according to **SECTION 835**, and construct surface leveling as shown in the Contract Documents.

(5) Tack Coat. Prior to placing the HMA, apply a tack coat to the existing surface, as shown in the Contract Documents. When warranted by weather conditions, the Engineer may authorize a change in the asphalt for tack coat. When such changes are made, the price per ton of material being used will be the unit price bid for the material designated in the contract plus or minus the difference in the invoice price per ton of the 2 materials at the refinery as determined at the time of application.

c. Weighing Operations. See **SECTION 109** for details regarding weighing operations.

d. Hauling Operations. Schedule operations to minimize hauling over a surface course.

Deliver HMA to the paver at a temperature sufficient to allow the material to be placed and compacted to the specified density and surface tolerance.

e. Paving Operations.

(1) General. Except when placing BM-1 or BM-1A asphalt mixtures, remix the material transferred from the hauling unit, prior to placement. Use equipment such as a mobile conveyor, material transfer device, shuttle buggy material transfer vehicle, material transfer paver or paver with remixer conveyor system. After starting the project with the equipment listed above, and after producing HMA pavement density within the limits specified in **TABLE 8**, the Engineer will consider other types of equipment or modifications to pavers that will produce less segregation. The use of equipment as noted above shall not relieve the Contractor of the responsibility to comply with **TABLE 8**. The Engineer will check the pavement for longitudinal streaks and other irregularities. Make every effort to prevent or correct any irregularities in the pavement, such as changing pavers or using different and additional equipment.

Do not raise (dump) the wings of the paver receiving hopper at any time during the paving operation. The Engineer may waive this requirement if it is determined that raising (dumping) the wings will not produce detrimental segregation. If segregation or irregularities in the pavement surface or density are noted, review the plant, hauling and paving operations and take corrective action. The recommendations made in KDOT's "Segregation Check Points" should reduce the segregation and irregularities to an acceptable level. Copies of KDOT's "Segregation Check Points" may be obtained from the KDOT District Office or Field Engineer.

Spread the HMA and finish to the specified crown and grade using an automatically controlled HMA paver. Operate the paver at a speed which shall provide a uniform rate of placement without undue interruption. At all times, keep the paver hopper sufficiently full to prevent non-uniform flow of the HMA to the augers and screed.

If the automatic grade control devices break down, the Engineer may allow the paver to operate to the close of the working day, provided the surface is satisfactory. Do not operate the paver without working automatic control devices upon another lift that was laid without automatic controls.

As needed, the Engineer will obtain representative samples of the asphalt mixture from behind the laydown

machine (unless approved otherwise by the Engineer), before the mixture is compacted. Use Kansas Test method KT-25 for obtaining the asphalt mixture and splitting of the sample. Repair the holes when the samples are taken behind the laydown machine.

(2) Surface Quality. Spread the HMA without tearing the surface. Strike a finish that is smooth, free of segregation, true to cross section, uniform in density and texture and free from surface irregularities. If the pavement does not comply with all of these requirements, plant production and paving will be suspended until the deficiency is corrected.

The Engineer will check segregation and uniformity of density using methods outlined in Section 5.8.3, Segregation Check Using the Nuclear Density Gauge, Part V. The acceptable criteria for density uniformity are in **TABLE 8**.

TABLE 8: SEGREGATION AND UNIFORMITY OF DENSITY CHECK		
Mix Designation	**Maximum Density Range (highest minus lowest)**	**Maximum Density Drop (average minus lowest)**
All	4.4 lbs./cu. ft.	2.2 lbs./cu. ft.

Whenever the results from 2 consecutive density profiles fail to comply with both of the requirements listed in **TABLE 8**, plant production and paving will be suspended. Follow the procedures listed in the Profile Evaluation Subsection of Section 5.8.3, Segregation Check Using the Nuclear Density Gauge, Part V until production may be resumed.

Joint density testing and the associated requirements listed below do not apply for HMA lift thicknesses less than or equal to 1 inch.

Evaluate the longitudinal joint density using methods outlined in Section 5.8.4 Joint Density Evaluation Using the Nuclear Density Gauge, Part V. Although it is the Contractor's responsibility to perform the joint density evaluation, the Engineer may make as many independent joint density verifications as deemed necessary at the random sample locations. The Engineer's results will be used for acceptance for joint density, whenever available. The acceptable criteria for joint density are in **TABLE 9**.

TABLE 9: JOINT DENSITY REQUIREMENTS	
Nuclear Gauge Readings	**Requirement**
Interior Density minus Joint Density	$\leq$ 3.0 lbs./cu. ft.
OR	
Joint Density	$\geq$ 90.00% of G_{mm}

If the results of 2 consecutive density profiles fail to comply with **TABLE 9**, the plant production and paving operations will be suspended. Follow the procedures listed in the Joint Evaluation Subsection of Section 5.8.4 Joint Density Evaluation Using the Nuclear Density Gauge, Part V, until production may be resumed.

(3) Leveling Courses. In general, spread leveling course mixtures by the method which shall produce the best results under prevailing conditions to secure a smooth base of uniform grade and cross section. The leveling course may be spread with a properly equipped paver or motor grader.

(4) Lift Thickness. Except for leveling courses or when shown otherwise in the Contract Documents, **TABLE 10** applies. The Engineer may adjust lift thickness to utilize the most efficient method of acquiring specified density and surface quality. The minimum lift thickness for any HMA mixture is 3 times the nominal maximum aggregate size, unless otherwise designated in the Contract Documents or approved by the Engineer. The minimum total HMA thickness that may be placed on subgrade (untreated, treated or modified), aggregate base or granular subbase for HMA projects is 4 inches.

TABLE 10: NOMINAL COMPACTED THICKNESS	
Lift	**Maximum Nominal Compacted Thickness**
Surface	2 inches
Base	4 inches

(5) Grade Control. Achieve grade control by use of 1 or more of the following grade reference devices. Approval of any of these devices will be based upon satisfactory performance.

(a) Traveling Stringline. Attach a traveling stringline or ski type attachment, a minimum length of 30 feet, to the paver and operate parallel with its line of travel.

(b) Reference Shoe. Attach a short reference shoe or joint matching device to the paver for control in matching surface grades along longitudinal joints.

(c) Erect Stringline. Use an erected stringline consisting of a tightly stretched wire or string offset from and parallel to the pavement edge on 1 or both sides. Erect the stringline parallel to the established pavement surface grade and support at intervals as necessary to maintain the established grade and alignment.

(d) Stringless Paving. Control line, grade and pavement cross-section as shown in the Contract Documents. Use electronic guidance systems that meet the requirements and tolerances listed in **SECTION 802**. Horizontal control is guided by GPS. Vertical control is guided by Total Stations. GPS will not be allowed for Vertical control.

When paving on a fresh subgrade that has not been trimmed by an automatically controlled machine, use an erected stringline or stringless paving to establish grade. Use either of these options on the first or second lift. When directed by the Engineer, use an erected stringline or stringless paving to match grade control points such as bridges.

(6) Surface Tolerances. KDOT may test the surface for smoothness using a 10 foot straightedge or 25 foot stringline. The maximum surface variation is 3/16 inch in 10 feet and 5/16 inch in 25 feet. Correct all humps or depressions exceeding the specified tolerance by removing the defective work and replacing it with new material, by overlaying (not patching) or by other means approved by the Engineer.

(7) Compaction of Mixtures. Uniformly compact the HMA as soon after spreading and strike-off as possible without shoving or tearing. Use self-propelled rollers operated at speeds slow enough to avoid displacement of the HMA. Equipment and rolling procedures which result in excessive crushing of the aggregate are prohibited. Use a sufficient number and weight of rollers to compact the HMA to the required density, using a minimum of 2 rollers. The Engineer may require 1 of the rollers to be a pneumatic roller. If the contract includes pay factors for roadway density, the Contractor (not the Engineer) shall determine if a pneumatic roller is necessary. Perform final rolling with a steel roller unless otherwise specified. On the final pass, operate finishing, vibratory rollers in the static mode.

Coordinate the frequency, amplitude and forward speed of the vibratory roller to achieve satisfactory compaction without objectionable undulations. For HMA lifts with a compacted thickness less than 1¼ inch, operate vibratory rollers in the static mode.

Keep rollers in operation as necessary so all parts of the pavement shall receive substantially equal compaction at the proper time. The Engineer will suspend HMA delivery to the project at any time proper compaction is not being performed.

The specified percentage of theoretical maximum specific gravity (G_{mm}) will be the absolute minimum density permitted.

Remove, replace with suitable material and finish according to these specifications any mixture that becomes loose, broken, mixed with foreign material or which does not comply in all respects with the specifications.

(8) Density Requirements. For plan mix thickness greater than 1 ½ inches, compact the HMA to a Road Density equal to or greater than the percent of G_{mm} as set forth in **TABLE 11**.

TABLE 11: DENSITY REQUIREMENTS

Type of Construction	Required Percent of G_{mm}
Base Course (1st lift on fresh untreated subgrade)	90.00
Base Course (Except 1st lift on untreated subgrade)	92.00
Surface Course	92.00
Shoulders	90.00

The Engineer will determine Road Density and run the Gmm test according to **subsection 5.0**.

When the specified lift thickness is 1 ½ inches or less, compact the HMA using the approved rolling procedure.

The Engineer will evaluate different rolling procedures by determining (with a nuclear meter) the density achieved by each and will establish an approved rolling procedure. The evaluation may include the effect of an additional roller. For each procedure tested, the maximum density must be achieved before the temperature of the HMA falls below 175ºF. If there is a significant change in controlling factors, such as weather or compaction equipment, the rolling procedure will be reevaluated and modified, as needed. Use the approved rolling procedure at all times.

(9) Contact Surfaces. Coat contact surfaces of curbing, gutters, manholes and similar structures with a thin uniform coating of asphalt material. Place the HMA uniformly high near the contact surfaces so that after compaction it shall be approximately ¼ inch above the edge of such structures.

(10) Adjustment of Manholes (Set Price). When required, this work will be performed and paid for under **SECTION 816**.

Salvage existing manhole covers and reuse in the adjustment.

(11) Construction Joints.

(a) Transverse Construction Joints. Use a method of making transverse construction joints which shall provide a thorough and continuous bond, provide an acceptable surface texture and meet density requirements. Do not vary the surface elevation more that 3/16 inch in 10 feet, when tested longitudinally across the joint. When required, repair the joints or paving operations will be suspended.

(b) Longitudinal Joints. Construct well bonded and sealed longitudinal joints to obtain maximum compaction at the joint. If deemed necessary by the Engineer to properly seal the joint, apply a light coat of asphalt emulsion or asphalt binder to the exposed edge before the joint is made.

Before placing the fresh HMA against a cut joint or against old pavement, spray or paint the contact surface with a thin uniform coat of asphalt emulsion or asphalt binder. Where a finishing machine is used, make the longitudinal joint by depositing a sufficient amount of HMA to form a smooth and tight joint.

Offset the longitudinal joint in successive courses by 6 to 12 inches. Comply with traffic lane edges for the width of the surface of top course placement.

(12) Shoulder Surfacing and Widening. When the placement width of shoulders or uniform width widenings is less than can be accomplished with a regular paver, spread each course with a mechanical spreading device.

(13) Rumble Strips. When designated, construct rumble strips according to the Contract Documents.

f. Maintenance of Traffic. Maintain traffic according to **DIVISION 800** and the following:

Maintain one-way traffic, and restrict traffic speeds to 20 miles per hour in the vicinity of workers, unless otherwise designated. Use pilot cars to lead traffic through the area of paving and rolling operations, and if directed, through a curing area. The use of flaggers is allowed through patching operations, unless the patching area or distance between flaggers exceeds ½ mile, in which case the use of a pilot car shall be required. On overlay projects with 2 lanes or more in each direction for traffic use, the Engineer may waive the pilot car requirements.

Station one flagger ahead of the application of the tack coat and one flagger ahead of the area being protected from traffic. Take adequate protection for traffic on side roads approaching the tack area.

g. Treatment of Adjacent Areas. Pave sideroads, entrances and turnouts for mailboxes as shown in the Contract Documents. Overlay all widening areas designated in the Contract Documents or ordered by the Engineer.

4.0 PROCESS CONTROL

a. Requirements for All Mix Designations.

(1) Establish gradation limits and proportions for each individual aggregate, mineral filler and RAP, when applicable. Specify the limits and proportions such that the material produced shall comply with the applicable requirements of the designated mix type. The Contractor is responsible for all process control operations including testing. At no time will KDOT's representative issue instructions to the Contractor or producer as to setting of dials, gauges, scales and meters. Advise the Engineer when changes to the plant settings are made which could change the proportions of the aggregates or asphalt in the HMA.

(2) Acceptance Tests. Each mix designation will be accepted at each plant, with respect to gradation and percent of natural sand on a Lot to Lot basis. The gradation will be that of the specified mix designation prior to the addition of the asphalt. Acceptable gradation tolerances for each mix is in **TABLE 12**, however, the gradation ranges in **TABLE 1** shall not be exceeded. Samples of the aggregate for the mix designation shall be obtained from the combined cold feed. The Engineer will approve the sampling device and procedures used to obtain the samples. If a mineral filler supplement is added beyond the cold feed, the combined aggregate gradation will be calculated theoretically using the gradations and proportions of the mineral filler supplement and the combined aggregate in the mix. The material will be tested for acceptance according to the Contract Documents. However, any load or loads of HMA which, in the opinion of the Engineer, are unacceptable for reason of being excessively segregated, aggregate improperly coated, foaming aggregate or of excessively high or low temperature will be rejected.

Material sampled from the roadway or other locations approved by the Engineer may be tested by the Engineer for compliance with the mix design requirements. Plant produced material will have a VMA value between 13.5 and 16.0 for BM-1 and BM-1T and between 12.5 and 15.0 for all other mixes.

No asphalt mixture shall be delivered to the project until the necessary tests are completed and the Contractor's JMF gradation has been tentatively approved by the Engineer. If test results show that the mix meets project requirements at an asphalt content that will provide an adequately coated mixture, the Contractor's JMF will be tentatively approved. Working with the Contractor, the asphalt percentage will be established by the Engineer. The initial recommended percent asphalt will normally be lower than the percentage shown on the design for 4% air voids, due to aggregate degradation in the plant. The Contractor may then begin delivery of the asphalt mixture to the project.

Final approval of the Contractor's JMF gradation at the recommended asphalt content shall not be granted until such time as plant-produced materials have been evaluated and determined to be satisfactorily in agreement with the design as to gradation, proportioning, air voids, voids in the mineral aggregated (VMA), asphalt content and coating.

Changes in the individual aggregate gradation limits or aggregate proportions may be made only with the approval of the Engineer. Any revisions in the JMF gradation may require a new laboratory evaluation by the Contractor prior to approval. The Engineer may cease production of HMA at any time the mix or process is determined to be unsatisfactory. Make the necessary corrections before production is resumed.

TABLE 12: SPECIFICATION WORKING RANGES FROM THE JMF

Mix Designation	Percent Retained – Square Mesh Sieves										
	1"	¾"	½"	⅜"	No. 4	No. 8	No. 16	No. 30	No.50	No. 100	No. 200
BM-1					±5	±5	±5	±5	±4	±3	±2
BM-1A					±5	±5	±4	±3	±3	±3	±2
BM-1B				±5	±5	±5	±4	±3	±3	±3	±2
BM-1T					±6	±5	±5	±4	±3	±3	±2
BM-2				±6	±6	±6	±5	±5	±4	±4	±2
BM-2A				±5	±5	±5	±5	±4	±4	±3	±2
BM-2B				±6	±6	±6	±5	±5	±4	±4	±2
BM-2C				±6	±6	±6	±5	±5	±4	±3	±2

(3) Lot Definition. A lot is defined as an isolated quantity of a specified material produced from a single source or operation, or it is a measured amount of specified construction produced by the same process. To change the process, thereby necessitating the termination of the current Lot and starting a new Lot, request in writing to the Field Engineer, approval for the process change, stating why the process should be changed. The Engineer must approve the request prior to the change being made. Process changes to include any change in:

- the JMF;
- the source of materials;
- the plant operation;
- the equipment; or
- the aggregate gradation which could affect the mix characteristics.

(4) Lot Disposition. When a deficiency within a Lot is determined to exist, causing termination of production, the Engineer will apply the applicable payment to the entire Lot and any additional tonnage within the next Lot that has not been sampled. When multiple deficiencies occur within a Lot, only the greater penalty will be applied to that Lot. After the determination of the appropriate pay factor in **TABLE 14**, the Engineer will decide on the disposition of each Lot as to the acceptance, the rejection or the acceptance at an adjusted payment. The Engineer's decision will be final. Lots with Pay Factors footnoted in **TABLE 14** shall be removed and replaced, accepted without payment or accepted at an adjusted payment according to the Contract Documents.

(5) Resampling of Lots. It is the intent of these Contract Documents that Lots of materials, products, items or construction or completed construction will meet the Contract Document requirements at the time of submission. No samples for retest will be taken for acceptance purposes.

(6) Multiple Projects. If multiple projects are supplied from one or more plants, the Lots at each hot mix plant will carry over from project to project.

b. Requirements for HMA mixes. In addition to the requirements in **subsection 4.0a.**, the mix shall meet the following requirements.

(1) Lot Size. A standard size Lot shall consist of 4 equal sublots of 500 tons each of HMA. When the quantity represented is less than 2,000 tons, the number of sublots (N) in a Lot will vary from N=1 to N=4, according to **TABLE 13** (sublot to be approximately equal size).

TABLE 13: HMA STANDARD LOT SIZE

Tons of HMA (Rounded to the nearest ton)	Number of Sublots
0-500	1
501 – 1,000	2
1,001 – 1,500	3
1,501 – 2,000	4

It is anticipated that Lot size will be as specified, however, the Engineer may re-define Lot size for reasons such as, but not limited to, change in contract quantities or interruption of the work. One sample shall be taken during production of each sublot and utilized to determine disposition of the Lot in which it occurs.

(2) Increased Lot Size. After 8 consecutive sublots have been produced within specification and without penalty, the sublot size may be increased by the Engineer to 750 tons (3,000 ton Lot), provided the normal production rate of the plant is greater than 175 tons per hour.

If either Lot termination condition exists as described below in **subsection 4.0b.(3)**, the sublot size will be decreased to 500 tons. When the Increased Lot Size criteria are again met, the sublot size may be increased to 750 tons (3,000 ton Lot).

(3) Lot Termination. When the results of 2 consecutive acceptance tests on any single HMA designation fails to meet the Contract Documents, the production of that mix will be suspended until the requirements can be met or another JMF has been approved. Acceptance tests for this determination will include gradation compliance with the JMF band and percent of natural sand. Such suspension will constitute termination of the Lot. Production will be suspended pending the satisfactory results of a pre-production sample, unless waived by the Engineer.

The process will be considered Out-of-Control when 1 or more test result(s) on any sieve(s) falls within the range set for the 80% pay factor for the values in the "1 Test' column in **TABLE 14**. When this occurs, the Lot will be terminated. Production will be suspended pending the satisfactory results of a pre-production sample.

Whenever the Lot is terminated due to either of the above conditions, the adjusted payment will be determined using the number of completed tests for that Lot and applied to an adjusted Lot size which shall be the number of tons produced up to the point of termination.

(4) Pre-Production Sample. A pre-production sample from each plant will be tested before delivery of HMA from that plant to the project or projects, both at initial startup and after a change in the JMF, unless otherwise directed by the Engineer. Such samples will not be used in determining adjusted payment for a Lot. Pre-production sample test results must be in compliance with the gradation, VMA, and percent of natural sand before delivery of mix to a project will be approved. Delivery before completion of the VMA calculation may be approved by the Engineer.

(5) Change in JMF. The Contractor will be permitted to change the JMF within a Lot, subject to the requirement of this specification. On the first Lot only of production of any mix designation, penalty for the entire Lot will be assessed on the basis of the revised JMF (if any), provided no change in asphalt content is required as a result of the revision. For changes made in the JMF on subsequent Lots, computation of adjusted payment will not be retroactive within the Lot(s).

(6) Basis of Acceptance and Payment. The Engineer will accept the mixture on the basis of test results on consecutive random samples from each Lot. One random sample will be taken from each sublot. Sublots shall normally be of equal size and the number of sublots will be as shown in this specification. Calculated values from acceptance tests for gradation shall be shown to the nearest hundredth percent.

The absolute value of the deviation between the acceptance test results and the JMF single point will be determined for the #4, #8, #30 and #200 pay sieves for each sublot. Using these absolute values, the deviation for each pay sieve will be accumulated (totaled) for each lot to determine the disposition of that Lot. Payment for the Lot will be made on the basis of **TABLE 14**. Adjusted payment will be based on the gradation results obtained on the #4, #8, #30 or #200 sieve, whichever results in the greatest price reduction.

TABLE 14: SCHEDULE OF ADJUSTED PAYMENT FOR HMA					
		ACCUMULATED DEVIATION OF THE ACCEPTANCE TESTS FROM THE JOB MIX FORMULA SINGLE POINT			
TOLERANCE	PAY FACTOR	FOR 1 TEST	FOR 2 TESTS	FOR 3 TESTS	FOR 4 TESTS
± 7	1.00	0.00-7.00	0.00-9.00	0.00-12.12	0.00-14.00
	0.98	7.01-7.50	9.91-10.60	12.13-12.99	14.01-15.00
	0.95	7.51-8.00	10.61-11.32	13.00-13.86	15.01-16.00
	0.90*	8.01-8.50	11.33-12.02	13.87-14.73	16.01-17.00
	0.80*	Over 8.5	Over 12.02	Over 14.73	Over 17.00
± 6	1.00	0.00-6.00	0.00-8.48	0.00-10.38	0.00-12.00
	0.98	6.01-6.50	8.49-9.20	10.39-11.25	12.01-13.00
	0.95	6.51-7.00	9.21-9.90	11.26-12.12	13.01-14.00
	0.90*	7.01-7.50	9.91-10.60	12.13-12.99	14.01-15.00
	0.80*	Over 7.50	Over 10.60	Over 12.99	Over 15.00
± 5	1.00	0.00-5.00	0.00-7.08	0.00-8.61	0.00-10.00
	0.98	5.01-5.50	7.09-7.78	8.62-9.54	10.01-11.00
	0.95	5.51-6.00	7.79-8.48	9.55-10.38	11.01-12.00
	0.90*	6.01-6.50	8.49-9.20	10.39-11.25	12.01-13.00
	0.80*	Over 6.50	Over 9.20	Over 11.25	Over 13.00
± 4	1.00	0.00-4.00	0.00-5.66	0.00-6.93	0.00-8.00
	0.98	4.01-4.50	5.67-6.36	6.94-7.80	8.01-9.00
	0.95	4.51-5.00	6.37-7.08	7.81-8.67	9.01-10.00
	0.90*	5.01-5.50	7.09-7.78	8.68-9.54	10.01-11.00
	0.80*	Over 5.50	Over 7.78	Over 9.54	Over 11.00
± 3	1.00	0.00-3.00	0.00-4.24	0.00-5.19	0.00-6.00
	0.98	3.01-3.20	4.25-4.52	5.20-5.55	6.01-6.40
	0.95	3.21-3.40	4.53-4.80	5.56-5.97	6.41-6.80
	0.90*	3.41-3.80	4.81-5.38	5.98-6.57	6.81-7.60
	0.80*	Over 3.80	Over 5.38	Over 6.57	Over 7.60
± 2.5	1.00	0.00-2.50	0.00-3.54	0.00-4.32	0.00-5.00
	0.98	2.51-2.70	3.55-3.82	4.33-4.68	5.01-5.40
	0.95	2.71-2.90	3.83-4.10	4.69-5.01	5.41-5.80
	0.90*	2.91-3.30	4.11-4.66	5.02-5.73	5.81-6.60
	0.80*	Over 3.30	Over 4.66	Over 5.73	Over 6.60
± 2	1.00	0.00-2.20	0.00-3.12	0.00-3.81	0.00-4.40
	0.95	2.21-2.40	3.13-3.40	3.82-4.17	4.41-4.80
	0.90*	2.41-2.75	3.41-3.88	4.18-4.77	4.81-5.56
	0.80*	Over 2.75	Over 3.88	Over 4.77	Over 5.56

5.0 COMPACTION TESTING

a. Requirements for Road Densities are specified in **subsection 3.0** as a percent G_{mm}.

b. G_{mm} shall be determined as work progresses, using specimens molded from freshly mixed HMA. Use the average daily G_{mm} for determining the percent G_{mm}. If a G_{mm} is not determined that day, use the G_{mm} from the previous day.

c. At the option of the Engineer, either of the following methods may be used to determine Road Density.

(1) Furnish 3 cores, 4 inches in diameter, suitable for determining Road Density, from each location designated by the Engineer.

(2) A nuclear meter may be used to determine the Road Density at each designated location.

6.0 WEATHER LIMITATIONS

Do not place HMA on any wet or frozen surface or when weather conditions otherwise prevent the proper handling and finishing of the mixture.

Only place HMA when either the minimum ambient air temperature or the road surface temperature shown in **TABLE 15** is met.

TABLE 15: MINIMUM HMA PLACEMENT TEMPERATURES

Paving Course	Thickness (inches)	Air Temperature (ºF)	Road Surface Temperature (ºF)
Surface	All	50	55
Subsurface	<1.5	50	55
Subsurface	≥1.5 and < 3	40	45
Subsurface	≥ 3	30	35

Regardless of the temperatures herein specified, paving will not be allowed unless specified density, either by percent of field mold density or by rolling procedure, can be achieved before the HMA cools to 175ºF.

7.0 METHOD OF MEASUREMENT

a. Aggregates. The Engineer will measure Aggregate for Asphalt Surface Course (*), Aggregate for Asphalt Base Course (*), Aggregate for Asphalt Surface Course (*) (Shoulder) and Aggregate for Asphalt Base Course (*) (Shoulder) by the ton of material at the time of delivery to the road. No deduction will be made for the weight of the asphalt binder in the HMA. Batch weights will not be permitted as a method of measurement, unless the plant is equipped with an approved automatic printer system which will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weigh ticket for each load. The materials used for widening and leveling of the existing surface will be included in the quantities as measured for HMA base.

Due to possible variations in the specific gravity or weight per cubic foot of the aggregates, the tonnage used may vary from the proposal quantities and no adjustment in contract unit price will be made because of such variations.

b. Repair and Patching. When the Contractor is required to remove any base course, subgrade or existing surface course and provisions are not made in the Contract Documents, the Engineer will measure the material used for repair and patching separately, by the ton at the time of delivery to the road and no deduction will be made for the asphalt binder in the HMA.

The Engineer will not measure material used to repair damage due to the Contractor's negligence.

c. Asphalt Materials. The Engineer will measure asphalt materials by the ton. Deductions will be made for the number of tons not placed on the road.

d. Asphalt Core (Set Price). The Engineer will measure each core required to determine Road Density. No payment will be made for cores unsuitable for determining density.

The Engineer will not measure density sampling required for resampling or for additional tests required to determine limits of areas deficient in density.

8.0 BASIS OF PAYMENT

"Aggregate for Asphalt Surface Course (*)", "Aggregate for Asphalt Base Course (*)", "Aggregate for Asphalt Surface Course (*) (Shoulder)" and "Aggregate for Asphalt Base Course (*) (Shoulder)" will be paid for at the contract unit prices or at an adjusted unit price, determined according to **subsection 4.0**, and is full compensation for the specified work. The adjusted unit price, as appropriate will apply to all materials produced within the Lot irrespective of usage.

Payment for "Material for Asphalt Patching" used in repair and patching of the base and/or subgrade, including the existing surface course will be "Hot Mix Asphalt-Commercial Grade" as provided in **special provision 15-06002 (latest revision)**, except the Contractor has the option to use "Aggregate for Asphalt Base Course (*)".

Payment for "Asphalt Cement", "Emulsified Asphalt" and "Cutback Asphalt", at the contract unit prices "Asphalt Core (Set Price)" and "Material for Asphalt Patching (Set Price)" at the contract unit set prices is full compensation for the specified work.

07-01-15 C&M (BTH)
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