KANSAS DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION TO THE
STANDARD SPECIFICATIONS, EDITION 2007

SECTION 602

HOT MIX ASPHALT (HMA) CONSTRUCTION
(Quality Control/Quality Assurance (QC/QA))

Page 600-2, replace subsection 602.2a. with the following:

a. General. Provide qualified personnel and sufficient equipment complying with the requirements listed in Part V to conduct quality control testing that complies with Appendix B, Sampling and Testing Frequency Chart for Asphalt Construction Items for Quality Control/Quality Assurance Projects.

Allow the Engineer access to the Contractor's laboratory to observe testing procedures, calculations, test documentation and plotting of test results.

Calibrate and correlate the testing equipment with prescribed procedures, and conduct tests in compliance with specified testing procedures as listed in Section 5.17.10, Part V.

Store and retain the most recent 2 lots per mix designation of quality control samples for KDOT. KDOT will retain the most recent 2 lots per mix designation gyratory compacted air voids (Va) verification samples and the remaining material not previously used for testing (back half of sample). Do not retain more than the previous 3 lots per mix designation of quality control or verification samples. When the hot mix plant shuts down for the winter, discard the samples after 7 days.

Maintain control charts on an ongoing basis. Record all original documentation in a bound field book or other KDOT approved bound record and turn over to KDOT at the end of the project.

At the completion of the project, all documentation shall become the property of KDOT.

Provide the following test data to the KDOT Project Representative:

- Copies of all test results and control charts on a weekly basis, representing the prior week's production;
- Copies of the quality control summary sheet on a daily basis. Include, as a minimum, mix gradation, binder content, theoretical maximum specific gravity (Gmm), Va at Ndes, percent Gmm at Nini and Nmax, voids in mineral aggregate (VMA), voids filled with asphalt (VFA) and dust to effective binder content (D/B) ratio; and
- Copies of all failing test results (based on a moving average of 4 tests, when appropriate). Include all applicable sieves, VMA, VFA, density at Nini and Nmax, and D/B ratio.

Page 600-3, replace subsection 602.2d. with the following:

d. Pre-Production Testing Requirements.

(1) The Engineer will observe the Contractor obtaining and splitting the pre-production test section sample into 3 representative portions. Each sample set shall consist of enough material for 2 gyratory specimens, theoretical G_{mm} and ignition burnoff.

(2) Mold 2 gyratory specimens from the 1st sample set immediately, while still hot. Additional heating may be required to raise the temperature of the sample to compaction temperature. Determine G_{mm}, perform ignition burnoff and complete calculations.

(3) Provide the KDOT Field Representative with the 2nd sample set. The KDOT Field Representative will mold 2 gyratory specimens, determine G_{mm}, perform ignition burnoff and complete calculations.

(4) Retain or provide the 3rd sample set to the KDOT District Materials Representative.

(5) The results of the testing will be compared. If Contractor and KDOT field laboratory test results do not compare favorably, the District Materials Laboratory will test their ⅓ of the sample. This sample will be transported to the KDOT District Materials Laboratory, after it has cooled to ambient air temperature. KDOT personnel will reheat the sample to compaction temperature, mold 2 gyratory specimens, determine G_{mm}, perform ignition burnoff and complete calculations. If the 3rd sample set is collected, transported while hot to the KDOT District Materials

Laboratory and compacted in less than 2 hours, then, at the DME's discretion, the requirement to cool the sample may be waived.

If results are not acceptable to either party, repeat the above steps in **subsections 602.2d.(1)** through **(5)** for the Contractor's Field Laboratory, KDOT's Field Laboratory, and KDOT's District Laboratory until the issues may be resolved satisfactorily by all parties.

Page 600-4, replace subsection 602.2e. with the following:

e. Lot 1 Testing Requirements.

(1) Sequence of Sampling. KDOT field personnel will determine the random truckload for the Contractor for sublots A, B, C and D, and the KDOT verification test.

The verification sample will be sampled and tested by KDOT field personnel. The verification sample shall be randomly taken within the lot and shall not be the same truckload as selected for the Contractor's sublot A, B, C or D.

KDOT field personnel will:

- provide the random spots to sample from behind the paving operations before compaction (KT-25);
- not supply the Contractor the identity of the truckload to be sampled ahead of time;
- notify the Contractor's laboratory of which truck to sample after the aggregate has left the cold feeds, and before the truck is finished loading; and
- determine whether the split sample will be taken from sublot A or B and notify the Contractor.

(2) Split Samples. The Contractor shall:

- obtain a sample large enough to split 3 ways for testing;
- retain and test ⅓ of the sample;
- supply ⅓ of the sample to the KDOT field laboratory for testing; and
- supply ⅓ of the sample to the KDOT District Materials Laboratory for testing.

(3) Results. At a minimum, compare G_{mm} and V_a results. The acceptable differences are 0.019 and 0.5%, respectively. If the results exceed these differences, take an additional split sample in Lot 1 from sublot C or D, as time permits.

If test results do not compare favorably, KDOT and the Contractor will investigate the differences in test results together and take appropriate action. The Contractor's test results will be used for quality control. KDOT Field Laboratory test results and District Materials Laboratory test results will be reported as "information only" samples.

Page 600-4. Add the following to the end of subsection 602.3a.:

Exception: The mixing temperature may be increased no more than 10°F above the maximum mixing temperature shown on the bill of lading provided all the following are met:

1. The air temperature is below 70°F
2. The plant has not produced mix earlier in the day.
3. Do not exceed a mix temperature of 350°F.
4. No truck has returned for its second load of the day.

Once a previously loaded truck returns for its next load, reduce the temperature to not higher than the maximum mix temperature shown on the bill of lading, not to exceed 340°F.

Page 600-4, replace subsection 602.3d. with the following:

d. Combined Aggregates. Provide combined aggregates for the mixes required in the Contract Documents as shown in **TABLE 602-1**.

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.

For all mixes used on the traveled way, the maximum quantity of natural sand is 35%.

Natural sand shall be called SSG-1, SSG-2, etc. in the mix design.
Additional requirements for SM-9.5T and SR-9.5T:

- 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.

Page 600-5, replace subsection 602.3e. with the following:

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 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 **TABLE 602-1** 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 602-2**. Contact the DME to determine if additional information should be submitted. Provide sufficient material as identified in **TABLE 602-3**. Contact the DME to determine if additional material is needed for additional design checks such as the modified Lottman test (KT-56).

When more than 25% of the mix is comprised of siliceous virgin aggregates and RAP, add anti-strip to the mix. The minimum amount of anti-strip required in the mix is 0.01% for every percent of natural sand and RAP in the mix. Thus, if 25% natural sand and 10% RAP is in a mix, then 0.35% anti-strip by weight of virgin asphalt binder is required in the mix. The District Materials Engineer will determine the composition of the RAP aggregates.

If during production, the TSR values (both KDOT and Contractor) exceed 85%, then the Contractor and the District Materials Engineer, working together, may decide on a lower amount of anti-strip.

Submit for the Engineer's review and approval, the test data listed in **TABLE 602-4** 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 602-5** for each blend and the proposed JMF. For mixes containing Warm Mix Asphalt (WMA) additives, submit for the Engineer's review and approval, the additive or process used, the recommended rate of application, and the temperature ranges for mixing and compaction. Submit a mix design for each blend and the proposed JMF as outlined in **TABLE 602-6**.

For each aggregate used in the mix design, determine the specific gravity using KT-6. This may be accomplished while the project is being constructed or anytime during the 12 months preceding the start of construction on a project. If construction has not yet begun, notify the DME 5 working days prior to obtaining the material for the specific gravity test so that companion samples may be obtained at the same time. If construction has already begun on the project, then the specific gravity values of the individual aggregates shall be determined before 10,000 tons of HMA is produced. Provide the test results to the DME within 14 days of sampling the material. If the producer of the aggregate has been required to submit material to KDOT for a new Official Quality test, since the time the Contractor ran the specific gravity tests, then perform KT-6 on the aggregate currently produced. The specific gravity values obtained from these tests shall not be used in the mix design calculations for current projects unless mutually agreeable to both parties. The information shall be used, as soon as it becomes available, as part of the process to verify and update the "Monthly Hot Mix Aggregate Specific Gravity Values" posted on KDOT's Internet site.

Page 600-5, add subsection 602.3f:

f. Additives. Provide Warm Mix Asphalt (WMA) additives or processes that comply with **special provision 07-12002, latest revision**. The Contractor is permitted to use WMA unless otherwise shown on the plans.

For mixes containing Warm Mix Asphalt (WMA) additives, submit for the Engineer's review and approval, the additive or process used, the recommended rate of application, and the temperature ranges for mixing and compaction.

Mixing temperature range is provided by the Asphalt Binder Supplier. When using WMA, the mixing temperature may be reduced no more than 30°F for WMA water foaming processes, and no more than 70°F for WMA chemical and organic additives. The minimum mixing temperature for WMA is 220°F.

Page 600-6, replace TABLE 602-1 and its notes with the following:

TABLE 602-1: COMBINED AGGREGATE REQUIREMENTS

Nom. Max. Size Mix Designation	Percent Retained – Square Mesh Sieves									Min. VMA (%)	D/B Ratio
	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 16	No. 200		
SM-4.75A				0	0-5	0-10		40-70	88.0-94.0	16.0	0.9 – 2.0
SR-4.75A			0	0-2	0-5	0-10		40-70	88.0-94.0	16.0	0.9 – 2.0
SM-9.5A				0	0-10	10 min.	33-53		90.0-98.0	15.0	0.6 – 1.2
SR-9.5A			0	0-2	0-10	10 min.	33-53		90.0-98.0	15.0	0.6 – 1.2
SM-9.5B				0	0-10	10 min.	53-68		90.0-98.0	15.0	0.8 – 1.6
SR-9.5B			0	0-2	0-10	10 min.	53-68		90.0-98.0	15.0	0.8 – 1.6
SM-9.5T				0	0-10	10 min.	53-68		90.0-98.0	15.0	0.8 – 1.6
SR-9.5T			0	0-2	0-10	10 min.	53-68		90.0-98.0	15.0	0.8 – 1.6
SM-12.5A			0	0-10	10 min.		42-61		90.0-98.0	14.0	0.6 – 1.2
SR-12.5A		0	0-2	0-10	10 min.		42-61		90.0-98.0	14.0	0.6 – 1.2
SM-12.5B			0	0-10	10 min.		61-72		90.0-98.0	14.0	0.8 – 1.6
SR-12.5B		0	0-2	0-10	10 min.		61-72		90.0-98.0	14.0	0.8 – 1.6
SM-19A		0	0-10	10 min.			51-65		92.0-98.0	13.0	0.6 – 1.2
SR-19A	0	0-2	0-10	10 min.			51-65		92.0-98.0	13.0	0.6 – 1.2
SM-19B		0	0-10	10 min.			65-77		92.0-98.0	13.0	0.8 – 1.6
SR-19B	0	0-2	0-10	10 min.			65-77		92.0-98.0	13.0	0.8 – 1.6

1. The requirements for Coarse Aggregate Angularity (CAA); Fine Aggregate Angularity (FAA); Sand Equivalent (SE); Gyratory compaction revolutions N_{ini}, N_{des}, N_{max}, N_{ini} level of compaction and VFA shall be as shown in the Contract Special Provisions for each mix designation.
2. The flat and elongated particles in the combined coarse aggregate shall not exceed 10% for the total sample.
3. The maximum percent moisture in the final mixture shall not exceed 0.5 for any mix designation.
4. The target air voids (V_a) for any mix designation shall be 4.0% at N_{des} gyrations.
5. The minimum tensile strength ratio (%TSR) shall be 80% for any mix designation.
6. The level of compaction of the mix when compacted to N_{ini} gyrations shall be less than the percent of the G_{mm} shown in the Contract Special Provision, and when compacted to N_{max} gyrations shall be a maximum of 98.0% of the G_{mm}

Page 600-6, replace TABLE 602-2 and its notes with the following:

TABLE 602-2: 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 0.3% to 0.5% 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.
Voids Filled with Asphalt	VFA		Calculated from VMA and V_a @ N_{des}.
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.

Page 600-7, replace TABLE 602-4 with the following:

TABLE 602-4: 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. Derive RAS gradation after residual binder is removed or from the standard gradation provided in **Table 2, subsection 1103.2a.(5)**.
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 0.01% based on total weight of the mixture.
Aggregate	Percentage of flat and elongated particles in the coarse aggregate, CAA and FAA.
%TSR	Percent Tensile Strength Ratio of the Mixture (Modified Lottman Test).
Sand Equivalent	SE for the combined virgin aggregates.

Page 600-7, replace TABLE 602-5 with the following:

TABLE 602-5: RAP AND RAS TEST DATA SUBMITTALS	
Submittal	**Information**
RAP and RAS	Source and location where RAP will be obtained. Source and location where RAS will be obtained.
RAP Aggregate	Bulk Specific Gravity (G_{sb}). Use the G_{sb} provided on the Contract Special Provision. If no value is provided, the Effective Specific Gravity (G_{se}) shall be calculated as shown in subsection 5.17.04c.(3), Part V and used as the G_{sb}.
RAS Aggregate	Bulk Specific Gravity (G_{sb}). The Effective Specific Gravity (G_{se}) shall be calculated as shown in subsection 5.17.04c.(3), Part V and used as the G_{sb}.
Asphalt Binder Content of RAP Asphalt Binder Content of RAS	Determined from ignition oven analysis using KT-57.
RAP G_{mm} RAS G_{mm}	Determined by KT-39.
Asphalt Binder Specific Gravity	Specific Gravity of the asphalt binder in the RAP and RAS (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.

Page 600-8, replace TABLE 602-6 with the following:

TABLE 602-6: MIX DESIGN TEST DATA SUBMITTALS	
Submittal	**Information**
Minimum of 2 Mix Designs	As a minimum, 1 mix design at the P_{br} and 1 mix design at 0.3% to 0.5% below the P_{br}
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. (Note: The Contractor is cautioned that plant produced material generally yields a mixture with less VMA than predicted by the design. In such case, the design VMA should be increased above the specified minimum accordingly.)
D/B Ratio	Calculate to the nearest 0.1% at each binder content.

Page 600-8, replace subsection 602.4a.(1)(c) with the following:

(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. If added at the plant, the anti-strip will be added in line with the asphalt binder as it is being transferred from the transit unit to the asphalt binder storage tank. Provide a method for the Engineer to monitor the percent of additive being added.

If hydrated lime is added, mix it in an approved pug mill to coat the combined aggregates. 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.

Page 600-8, add subsection 602.4a.(1)(d).

(d) WMA Additives. If WMA additives are added at the Contractor's plant, install a "totalizer" to monitor the quantity of WMA additive being added. Provide a method for the Engineer to monitor the percent of additive being added.

Page 600-9, add subsection 602.4a.(4).

(4) End of Day Quantities. At the end of each day of production provide the Engineer with a document signed by the Plant Foreman or the Project Manager listing the dry weight of each aggregate, mineral filler, RAP, and WMA chemical or organic additive; the tons of asphalt binder, the tons of anti-strip agent used for the project during the day, and the tons of water used in the WMA foaming process. The dry weight is the tons of the material less the water content.

Page 600-10, subsection 602.4e.(1), delete the second paragraph and replace with the following:

The Engineer will check segregation and uniformity of density using methods outlined in Section 5.21.03, Segregation Check Using the Nuclear Density Gauge, Part V. For shoulders with a plan width of less than or equal to 3 feet, and placed at the same time as the traveled way, do not take nuclear density readings on the shoulder nor within 1 foot of the shoulder unless the pavement section is uniform across the entire roadway. The acceptable criteria for density uniformity are in **TABLE 602-7**.

Page 600-10, replace TABLE 602-8 with the following:

TABLE 602-8: JOINT DENSITY REQUIREMENTS	
Nuclear Gauge Readings	**Requirement**
Interior Density minus Joint Density	≤ 3.0 lbs./cu. ft.
OR	
Joint Density	≥ 90.00% of G_{mm}

Page 600-12, subsection 602.4e.(7)(a), delete the first paragraph and replace with the following:

(a) For mixes with a specified thickness greater than or equal to 1 ½ inches:

For lots 1 and 2, control density as shown in **subsection 602.4e.(7)(b)**. Before beginning production, the Contractor has the option to accept the pay adjustment for density on both Lots 1 and 2, or only Lot 2. If the Contractor chooses to accept the pay adjustments for density on both Lots 1 and 2, or only Lot 2, control the density as shown in **subsections 602.4e.(7)(a)(i-ii)**. If the Contractor chooses to accept pay adjustment for density on Lot 1, the pay adjustment can not be rejected on Lot 2.

Page 600-12, replace subsection 602.4e.(7)(c) with the following:

(c) For all lots, achieve the maximum density before the temperature of the HMA falls below 175°F. When using WMA, achieve the maximum density before the temperature of the WMA falls below 165°F. Do not crush the aggregate. When the mat temperature falls below 175°F or 165°F for WMA, roller marks may be removed from the mat with a self-propelled static steel roller.

Page 600-14, replace TABLE 602-12 and its notes with the following:

TABLE 602-12: SPECIFICATION WORKING RANGES (QC/QA)				
Mix Characteristic	**Tolerance from JMF**			
	Single Test Value	**Plot**	**4 Point Moving Average Value**	**Plot**
Binder Content	±0.6%	*	±0.3%	*
Mix Characteristic	**Tolerance for Specification Limits**			
	Single Test Value	**Plot**	**4 Point Moving Average Value**	**Plot**
Gradation (applicable sieves in **TABLE 602-1**)	N/A	*	zero tolerance	*
Air Voids @ N_{des} gyrations	±2.0%	*	N/A	
Voids in Mineral Aggregate (VMA)	1.0% below min.	*	zero tolerance	*
Voids Filled with Asphalt (VFA)	N/A		zero tolerance	*
Course Aggregate Angularity (CAA)	zero tolerance		N/A	
Sand Equivalent (SE)	zero tolerance		N/A	
Fine Aggregate Uncompacted Voids (FAA)	zero tolerance		N/A	
%Tensile Strength Ratio (%TSR)	zero tolerance	*	N/A	
Density @ N_{ini} and N_{max}	N/A		zero tolerance	
Dust to Effective Binder (D/B) Ratio	zero tolerance	*	zero tolerance	*

* Plot data according to **subsection 106.4d.(2)**.
For gradations, as a minimum, plot the No. 4, 8, 30 and 200 sieves.
Plot G_{mm} to third decimal point.
Indicate Job Mix Formula (JMF) and specification working range limits for single test results on the control charts using a green ink dotted line.
Indicate the specification working range limits for the 4-point moving average results with a green ink solid line.

Page 600-14, replace subsection 602.5d. with the following:

d. Mixes with Reclaimed Asphalt Pavement (RAP). The intent of this section is to prevent more RAP going into a mix than is allowed in the Contract Documents. Totalizers are used to determine the %RAP in mix; however, this does not preclude the Engineer from using other methods for determining the %RAP in a mix.

Provide the Engineer with the totalizer readings at the end of each day of production. These shall include the final daily readings for the RAP, virgin aggregates and asphalt binder.

The %RAP will be checked a minimum of twice a day by the Engineer. Take the readings a minimum of 2 hours apart and a maximum of 6 hours apart. Do not take the readings within the first hour of start-up as adjustments to the plant are most frequent within this time frame.

Calculate RAP percentages using the plant totalizers for the virgin aggregates (AGG_v), and the RAP. It shall be calculated as follows:

Equation A: $$\%RAP = \frac{RAP}{RAP + AGGv} * (100)$$

%RAP is the percent RAP in the total aggregates (Virgin and RAP) rounded to the nearest tenth.
RAP is the difference between the current and last reading of the RAP totalizer in tons.
AGG_v is the difference between the current and last reading of the Virgin Aggregate totalizer in tons.

%RAP is considered out of compliance when any of the following occurs:

- Any single test exceeds the maximum percentage allowed by specs by 3%.
- The 4-point moving average exceeds the maximum percentage allowed by specifications.

Actions to be taken if the %RAP is out of compliance:

- If any single test exceeds 3% of the maximum allowed %RAP stop production, perform the "0 check run" on the belts in the presence of the Engineer, and make adjustments to correct the discrepancy.

- If the 4-point moving average exceeds the maximum allowed %RAP three consecutive times, stop production, perform the "0 check run" on the belts in the presence of the Engineer, and make adjustments to correct the discrepancy.
- If the 4-point moving average exceeds the maximum allowed %RAP by more than 1% then the Contractor will be assessed the following penalty.

Equation B: $$\text{Deduct} = \frac{BP * Q * (\%RAP_4 - \%RAP_{max})}{100}$$

Deduct is the Dollar amount to be subtracted from the contract.
BP is the Bid Price of the mix.
Q is the Quantity, in tons, of material represented by the 4-point moving average. This value shall be based on the weigh tickets taken from the time of the 1st test of the 4-point moving average through the time of 4th test.
$\%RAP_4$ is the 4-point moving average of %RAP.
$\%RAP_{max}$ is the Maximum %RAP from the Project Special Provision.

Any time production is stopped due to non-compliant %RAP, restart the 4-point moving average provided the belt had the "0 check run" performed in the presence of the Engineer, and adjustments were made to the mix proportioning to correct previous discrepancies. The initial start-up at the beginning of each work day does not constitute a stop in production due to non-compliant %RAP.

If at any time the Contractor chooses to stop production in order to correct discrepancies in the mix proportioning concerning the %RAP, the most recent data (not to exceed 4 points) will be averaged. If the average exceeds the maximum allowed %RAP by more than 1% then a penalty will be assessed as calculated above with the following substitutions:

In the case where less than 4-points are available for the 4-point moving average, the most recent test is substituted for the 4th test, and the $\%RAP_4$ may be a single test, a 2-point moving average or a 3-point moving average.

Page 600-16, subsection 602.6b., delete the first paragraph and replace with the following:

b. Nuclear Density Tests (For mixes with a specified thickness of 1½ inches or greater.). Take 2 nuclear density tests at random within each sublot. The Engineer will take 1 random nuclear density verification test per sublot. Perform nuclear density testing to be used in the determination of the traveled way pay adjustment factors and control of shoulder density. Do not take nuclear gauge readings within 1 foot of a longitudinal joint or edge, nor within 20 feet of a transverse joint. For shoulders with a plan width of less than or equal to 3 feet, and placed at the same time as the traveled way, do not take nuclear density readings on the shoulder nor within 1 foot of the shoulder unless the pavement section is uniform across the entire roadway. Mark the outline of the nuclear gauge on the pavement at each location tested with a method of marking that shall last a minimum of 24 hours. Take the nuclear density test at the random location. Do not move the gauge from this location to maximize or minimize the density results. If the Contractor doubts the accuracy of any of the nuclear density test results, the pavement may be cored at the nuclear gauge test locations. If coring is chosen to determine the density for pay adjustment purposes, then all nuclear density test results representing the lot shall be voided and cores taken as prescribed in **subsection 602.6c**.

Page 600-17, subsection 602.6c, delete the third paragraph and replace with the following:

Do not take cores within 1 foot of a longitudinal joint or edge, nor within 20 feet of a transverse joint. For shoulders with a plan width of less than or equal to 3 feet, and placed at the same time as the traveled way, do not take cores on the shoulder nor within 1 foot of the shoulder unless the pavement section is uniform across the entire roadway.

Page 600-17, replace TABLE 602-13 with the following:

TABLE 602-13: MINIMUM HMA PLACEMENT TEMPERATURES							
Paving Course	**Thickness (inches)**	**Air Temperature (ºF)**			**Surface Temperature (ºF)**		
		HMA	**WMA Foam**	**WMA Chem**	**HMA**	**WMA Foam**	**WMA Chem**
Surface	All	50	45	40	55	50	45
Subsurface	<1.5	50	45	40	55	50	45
Subsurface	≥1.5 and < 3	40	35	30	45	40	35
Subsurface	≥ 3	30	30	30	35	32	32

Page 600-18, replace subsection 602.8c.(2) with the following:

(2) For V_a dispute resolution (the statistical comparison fails and the Contractor questions KDOT results), the following procedure applies for the lots in question:

- Determine which lots to dispute. Only dispute the lot produced immediately prior to the lot currently under production and being tested. Notify the Engineer, prior to the completion of all Contractor V_a testing for this lot. (When production is completed for any mix, the last lot may be challenged the day production is completed). When the hot mix plant shuts down for the winter, the Contractor has a maximum of 7 calendar days to dispute the last lot produced prior to winter shut down.
- Discard V_a and V_a pay adjustment factors previously determined within the lots being questioned.
- All saved gyratory compacted V_a quality control and verification samples and back half of samples within the lots in question will be taken by KDOT to the District Materials Laboratory. All back half of samples shall be a minimum of 35 pounds. Failing to obtain enough material removes the right to dispute resolution. Copies of all paperwork, including work sheets, associated with previous V_a calculations for the disputed lots will also be taken to the District Materials Laboratory.

The following retesting will be completed by KDOT:

- Check the samples to be sure they are dry before retesting. Reweigh the original gyratory compacted V_a quality control and verification samples. Determine the G_{mb} at N_{des} revolutions for all saved gyratory plugs. Compare retest results with original test results. Use this information to isolate potential testing errors, but continue with the remainder of the retesting steps.
- Determine the G_{mm} using the back half of all samples within each lot being questioned. Normally, there will be 5 back halves (4 Contractor's and 1 KDOT) to test within each lot.
- Compact the back halves to N_{max} revolutions and determine the G_{mb} at N_{des} revolutions.
- Use G_{mm} determined above and the G_{mb} determined from the recompacted samples to calculate V_a at N_{des} revolutions for the lots in question.
- Using the retest V_a results, a statistical comparison will be made. If the t-test passes, the Contractor's retest results will be used to calculate the pay factor and KDOT will pay for all retesting. Use the procedures shown in **subsection 602.9d**. If the t-test fails, KDOT's retest results will be used to calculate the pay factor, and the Contractor will pay for all retesting.

Page 600-19, replace subsection 602.8g. with the following:

g. Increased Lot Size. After 8 consecutive sublots have been produced within the tolerance shown for all mix characteristics listed in **TABLE 602-12** and without a V_a penalty, the sublot size may be increased to 1,000 tons (lot size of 4,000 tons), provided the normal production rate of the plant is greater than 250 tons per hour. Provide immediate notification of lot size changes to the Engineer any time a change is made.

After 8 additional consecutive sublots have been produced at the 1,000 ton sublot size, the sublot size may again be increased to 1,250 tons per sublot (lot size of 5,000 tons), provided all 8 consecutive 1,000 ton sublots have been produced within the tolerances shown for all mix characteristics listed in **TABLE 602-12**, without a V_a penalty, production rates for the previous 2 days have been greater than 3,750 tons per day, and a minimum of 2 of the last 3 segregation profile checks comply with **TABLE 602-14.**

TABLE 602-14: SEGREGATION PROFILE CHECKS FOR INCREASED SUBLOT SIZE		
Mix Designation	**Maximum Density Range (highest minus lowest)**	**Maximum Density Drop (average minus lowest)**
All	3.1 lbs./cu. ft.	1.9 lbs./cu. ft.

If subsequent test results fall outside the tolerances shown for any mix characteristic listed in **TABLE 602-12** or a V_a penalty is incurred, the sublot size shall be decreased to 750 tons. If the production rates fall below 3,750 tons per day for 2 consecutive days or a minimum of 2 of the last 3 segregation profile checks fail the above requirements, then the 1,250 ton sublots size shall be reduced to 1,000 ton per sublot provided the **TABLE 602-12** criteria is met and no V_a penalty is incurred.

When the increased lot size criteria are again met for 4 consecutive sublots, the sublot may be increased as the limits given above.

Page 600-21, replace subsection 602.9.b. with the following:

b. Density Pay Adjustment for "HMA Overlay". Mixes with specified thickness of less than 1½ inches are not subject to density pay adjustments.

For mixes with specified thickness of 1½ inches or greater: Density pay adjustment for compaction of the completed pavement shall be by lot, based on the percentage of G_{mm} obtained. Density pay adjustment (incentive or disincentive) shall be computed by multiplying the density pay adjustment factor (P_D) times the number of tons included in the lot times $40 per ton. (Air voids lots and density lots are normally of different sizes.)

Density pay factors will be determined from **TABLE 602-15**. (For **TABLE 602-15**, average the percent of G_{mm} values to 0.01% and calculate the density pay adjustment factors rounded to the thousandths).

TABLE 602-15: DENSITY PAY FACTORS FOR SPECIFIED THICKNESS[4]			
Specified Thickness →	**≥ 2"**	**≥ 1½"**	
	All	**Continuous Action[5]**	**No Continuous Action[6]**
% of G_{mm} Average of 10 Density Tests[1]	**Pay Factor[2]**		**Pay Factor[2]**
93.00% or greater	1.040		1.040
92.00 to 92.99%	A1		A1
91.00 to 91.99%	1.000		1.000
90.00 to 90.99%	A2		1.000
89.00 to 89.99%	0.840 or Remove[3]		A3
less than 89.00%	0.840 or Remove[3]		0.840 or Remove[3]

[1]For low daily production rates less than 1000 tons, or when the Engineer's verification tests are to be used for density pay determination, the lot sample size is as determined in **TABLE 602-11**.

[2]Shoulders: For shoulders with a plan width greater than 3 feet and any shoulder not placed at the same time as the traveled way, compact the HMA in the lot to a minimum of 90.00% (if specified thickness is ≥2") or 89.00% (if the specified thickness is from 1½" to 1⅞") of the G_{mm}. Otherwise, the Engineer will determine whether the HMA in the lot may remain in place or be removed. Any such material left in place shall have a density pay factor of 0.950 or less.

[3]Low Density: The Engineer will determine if the traveled way, shoulders with a plan width of 3 feet or less and placed with the traveled way, ramps, acceleration and deceleration lanes may remain in place or be removed. The Engineer will notify the Contractor before 11:00 AM of the next working day if the area is to be removed. Any such material left in place shall have a density pay factor of 0.840.

[4]Specified thickness is the total thickness shown in the Contract Documents for the mix being placed.

[5]Use for ≥1½" when another continuous action, such as milling, surface recycling, cold recycling or overlay is completed ahead of this overlay.

[6]Use for ≥1½" when another continuous action is not completed before the overlay.

Calculations for Density Pay Factors A1, A2 and A3:

A1 = [100 + 4 (% of lot G_{mm} - 92.00)] ÷ 100

A2 = [84 + 16 (% of lot G_{mm} - 90.00)] ÷ 100

A3 = [84 + 16 (% of lot G_{mm} - 89.00)] ÷ 100

Density Pay Adjustment Factor Calculation:

Density Pay Adjustment Factor (P_D)* = Density Pay Factor - 1.000

*P_D shall be rounded to the nearest thousandth

Page 600-22, replace subsection 602.9c. with the following:

c. Density Pay Adjustment for Bid Items "HMA Surface", "HMA Base" and "HMA Pavement".

Density pay adjustment for compaction of the completed pavement shall be by lot, based on the percentage of G_{mm} obtained. Density pay adjustment (positive or negative) shall be computed by multiplying the density pay adjustment factor ($\boldsymbol{P_D}$) times the number of tons included in the lot times $40 per ton. The density pay adjustment will be added or subtracted on the pay estimate. For shoulders with a plan width of less than or equal to 3 feet, and placed at the same time as the traveled way, the $\boldsymbol{P_D}$ for the traveled way will apply. The $\boldsymbol{P_D}$ does not apply to sideroads, entrances, crossovers and other incidental surfacing. Use KDOT test results for the lot to determine the $\boldsymbol{P_D}$ when the statistical comparison between the quality control and the verification tests fail (see **subsection 602.9a.**).

Lot Size: A lot shall normally be comprised of the results of 10 tests performed on a day's placement of a given mix placed in a given lift. Lot size is defined in **subsection 602.6**. (Air void lots and density lots are normally of different sizes).

Shoulders: For all shoulders with a plan width greater than 3 feet and any shoulder not placed at the same time as the traveled way, the lower specification limit (LSL) is 90.00%. When the lower percent within limits ($\boldsymbol{PWL_{LD}}$) is 50.00% or more for the lot, $\boldsymbol{P_D}$ is zero. When the $\boldsymbol{PWL_{LD}}$ is less than 50.00% for the lot, the Engineer will determine whether the HMA in the lot may remain in place or be removed. Any such material left in place will have a $\boldsymbol{P_D}$ of -0.050, unless the Engineer establishes lower values for $\boldsymbol{P_D}$ (-0.100, -0.200, -0.300, etc.) as a condition of leaving the material in place.

Determination of $\boldsymbol{P_D}$ and $\boldsymbol{PWL_{LD}}$: Calculate the lower density quality index ($\boldsymbol{Q_{LD}}$) for each lot using Equation 1 and round to hundredths. Locate the $\boldsymbol{Q_{LD}}$ value in the left column of the Percent Within Limits (PWL) Table in Section 5.17.09, Part V. Select the appropriate $\boldsymbol{PWL_{LD}}$ value by moving across the selected quality index row to the column representing the number of samples in the lot.

If $\boldsymbol{Q_{LD}}$ is greater than the largest quality index value shown in the table, use 100.00 as the value for $\boldsymbol{PWL_{LD}}$.

If $\boldsymbol{PWL_{LD}}$ is less than 50.00% for the lot, the Engineer will determine if the material in the lot may remain in place. If the material is left in place, the value of $\boldsymbol{P_D}$ for the lot will be equal to -0.160, unless the Engineer establishes lower values for $\boldsymbol{P_D}$ (-0.200, -0.300, etc.) as a condition of leaving the material in place. Otherwise, calculate $\boldsymbol{P_D}$ using Equation 2 and round to thousandths.

Equation 1: $$\boldsymbol{Q_{LD}} = \frac{\overline{X} - LSL}{S}$$

$\overline{X}$ is the average measured percent of G_{mm} of all samples within a lot rounded to hundredths.

LSL is the lower specification limit for density and is defined as 91.00% of G_{mm} for traveled way plan thickness 2 inches and less and 92.00% of G_{mm} for traveled way plan thickness greater than 2 inches.

S is the standard deviation of the measured density of all samples within a lot and is calculated using equation (4) in Section 5.17.09, Part V, rounded to hundredths.

Equation 2: $$\boldsymbol{P_D} = \left(\boldsymbol{PWL_{LD}} * 0.004\right) - 0.360$$

Page 600-22, replace subsection 602.9d. with the following:

d. Air Void Pay Adjustment. Air void (V_a) pay adjustment will be made on a lot basis and based on measured V_a from samples of plant produced material. The V_a pay adjustment factor ($\boldsymbol{P_V}$) (positive or negative) will be determined and used to compute the V_a pay adjustment by multiplying $\boldsymbol{P_V}$ times the number of tons included in the lot times $40 per ton. The V_a pay adjustment will be added or subtracted on the pay estimate. When the statistical comparison between the quality control and the verification tests pass, use the procedures in **subsection 602.9d.(1)** to compute $\boldsymbol{P_V}$. When the statistical comparison fails, calculate $\boldsymbol{P_V}$ using procedures in **subsection 602.9d.(2)**.

Lot Size: A lot shall normally be comprised of the results of 4 contiguous individual V_a tests performed on gyratory compacted samples of a given mix design. Lot size is defined in **subsections 602.8f.**, **602.8g.** and **602.8h**. When there are 1 or 2 tests remaining, such as at the end of a project or season, combine them with the previous 4 tests to create a 5 or 6 test lot, respectively. When there are 3 tests remaining, combine the 3 tests into a lot. (Air voids lots and density lots are normally of different sizes).

(1) Air Voids Pay Adjustment Factor (Passing t-test). Calculate the upper and lower V_a quality indices ($\boldsymbol{Q_{UV}}$ and $\boldsymbol{Q_{LV}}$) for each lot using Equations 3 and 4, respectively and round to hundredths. Locate the $\boldsymbol{Q_{UV}}$ value in the left column of the Percent Within Limits (PWL) Table in Section 5.17.09, Part V. Select the appropriate upper percent within limit value ($\boldsymbol{PWL_{UV}}$) by moving across the selected quality index row to the column representing the number of samples (N) in the lot. Repeat the process using the $\boldsymbol{Q_{LV}}$ value and select the appropriate value for the lower percent within limits ($\boldsymbol{PWL_{LV}}$). If the $\boldsymbol{Q_{UV}}$ or $\boldsymbol{Q_{LV}}$ value is greater than the largest quality index value shown in the table, then a value of 100.00 is assigned as the value for $\boldsymbol{PWL_{UV}}$ or $\boldsymbol{PWL_{LV}}$, respectively. If both $\boldsymbol{Q_{UV}}$ and $\boldsymbol{Q_{LV}}$ exceed the values shown in the table, a value of 100.00 is assigned as the value for both $\boldsymbol{PWL_{UV}}$ and $\boldsymbol{PWL_{LV}}$. If either $\boldsymbol{Q_{UV}}$ or $\boldsymbol{Q_{LV}}$ is a negative value or $\boldsymbol{PWL_{UV}} + \boldsymbol{PWL_{LV}}$ is less than 150.00, the Engineer will determine if the material in the lot may remain in place. If the Engineer determines that the material may remain in place then the maximum value of $\boldsymbol{P_V}$ for the lot will be equal to –0.120. The Engineer may establish lower values for $\boldsymbol{P_V}$ (-0.200, -0.300, etc.) in such instances. Otherwise, calculate $\boldsymbol{P_V}$ using Equation 5 and round to thousandths.

Equation 3: $$\boldsymbol{Q_{UV}} = \frac{USL - \overline{X}}{S}$$

Equation 4: $$\boldsymbol{Q_{LV}} = \frac{\overline{X} - LSL}{S}$$

$\overline{X}$ is the average measured V_a of all samples within a lot rounded to hundredths.
USL is the upper specification limit for V_a and is defined as 5.00%.
LSL is the lower specification limit for V_a and is defined as 3.00%.
S is the standard deviation of the measured V_a for all samples within a lot and is calculated using equation (4) in Section 5.17.09, Part V, rounded to hundredths.

Equation 5: $$\boldsymbol{P_V} = ((\boldsymbol{PWL_{UV}} + \boldsymbol{PWL_{LV}} - 100.00)(0.003)) - 0.270$$

$\boldsymbol{PWL_{UV}}$ is the upper percent within limits value for V_a.
$\boldsymbol{PWL_{LV}}$ is the lower percent within limits value for V_a.

(2) Air Voids Pay Adjustment (Failing t-Test). If the t-test fails, KDOT's test result will be used to calculate the $\boldsymbol{P_V}$ for the lot. Follow the procedures given in **subsection 602.9d.(1)** to determine the $\boldsymbol{P_V}$ or disposition of the lot. Use the values from **TABLE 602-16** to calculate $\boldsymbol{Q_{UV}}$, $\boldsymbol{Q_{LV}}$, $\boldsymbol{PWL_{UV}}$ and $\boldsymbol{PWL_{LV}}$ in Equations 3, 4 and 5 in **subsection 602.9d.(1)**.

TABLE 602-16: Statistical Values for Air Voids Pay Adjustment for Failing t-Test

Term	Definition	Value
$\overline{X}$	Average or Mean	KDOT's test result for the lot
S	Standard Deviation	0.50
USL	Upper Specification Limit	5.50%
LSL	Lower Specification Limit	2.50%
N	Sample Size	3

Page 600-23, subsection 602.10b. Delete the fifth paragraph and replace with the following:

The Engineer will determine the total core thickness for pay by taking 3 caliper measurements at approximately 120° apart and record each to the nearest 0.1 inch. The average of the 3 caliper measurements rounded to the nearest 0.1 inch shall represent the average measured thickness. The Engineer will use the total pavement thickness measurements to determine thickness pay adjustment factors.

Page 600-24, subsection 602.10b. In the third full paragraph (For Percent Within Limits…), change all "1 inch" to "1.0 inch".

Page 600-24, subsection 602.10c. In the first paragraph, replace "1 inch" with "1.0 inch". In the second and third paragraphs, replace all "½ inch" with "0.5 inch".

Page 600-24, subsection 602.10d. In the first paragraph, replace "1 ½ inches" with "1.5 inches". In the second and fourth paragraphs, replace all "¾ inches" with "0.8 inches".

Page 600-26, subsection 602.10e. Replace Equation 9 with the following:

Equation 9: $$P_T = \left(\frac{(PWL_T) * 0.3}{100} \right) - 0.270$$

Page 600-26, subsection 602.10e. In the definition for $\overline{X}$ following Equation 8, change "1/8 inch" to "0.1 inch". In the definition for LSL, change "½ inch" to "0.5 inch" and change "¾ inch" to "0.8 inch".

Page 600-27, subsection 602.10e. Replace Equation 14 with the following:

Equation 14: $$\text{Minimum Quantity (Tons)} = \frac{0.93\,(A)\,(T)\,(G_{mm})}{42.7}$$

Page 600-27, subsection 602.11b. In the second and fourth paragraphs, replace all "¼ inch" with "0.01 feet". In the third paragraph, replace the both "3.0 inches" with "0.25 feet".

Page 600-28, delete subsection 602.11e. and replace with the following:

e. Material for HMA Patching (Set Price). When the Contractor is required to remove any existing base course, subgrade or surface course (unless damaged by the Contractor) and provisions are not made in the Contract Documents, the Engineer will measure the material used for repair and patching (either HMA-Commercial Grade or a specified mix on the project) separately, by the ton at the time of delivery to the road. The Engineer will not measure the quantity of material used in the repair of damage due to the Contractor's negligence. The Engineer will measure HMA materials by the ton. For mixes containing Reclaimed HMA Pavement (RAP), compute the HMA material contained in the RAP using the binder content determined from ignition oven testing. Maintain this information for materials tracking purposes. No separate payment for HMA material in RAP will be made. Combined gradation results will be used for acceptance in accordance with **TABLE 602-1**.

Payment for "Material for HMA Patching (Set Price)" at the contract set unit price includes all excavation, compaction of subgrade or subbase if required, disposal of waste material and all material (including emulsified asphalt for tack), all labor, equipment, tools, supplies, incidentals and mobilization necessary to complete the work. Pay adjustments will not be applied to this material.

Page 600-28, subsection 602.11f. Add the following paragraph:

The Engineer will not measure for payment Quality Control Testing (HMA) for the bid item Material for HMA Patching (Set Price).

Part V Sec. 5.9.56 KT-56 delete 3.7 and replace with the following:

3.7. Freezer maintained at 0° ± 10°F (-18° ± 6°C).