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

Add a new SECTION to DIVISION 600:

HMA BASE (REFLECTIVE CRACK INTERLAYER (RCI))

1.0 DESCRIPTION

Construct the HMA base (reflective crack interlayer (RCI)) as designated in the Contract Documents.

BID ITEM	UNITS
HMA Base (RCI) (*)	Ton
Quality Control Testing (HMA)	Ton

* Grade

2.0 CONTRACTOR QUALITY CONTROL REQUIREMENTS

Perform quality control testing according to **subsection 602.2 and Special Provision 07-06006 (latest revision)**.

3.0 MATERIALS

Provide performance graded asphalt binder that complies with **SECTION 1202**, with this exception:

Change the PG 70-28 separation test requirement (from 2) to 6 in **TABLE 1202-1: PERFORMANCE GRADE (PG)**.

Provide plant mix HMA that complies with **subsection 602.3 and Special Provision 07-06006 (latest revision)**, with these additions and exceptions:

Page 600-5, in subsection 602.3d., delete the 4th paragraph "For all mixes used on the traveled way, the maximum quantity of natural sand is 35%."

Page 600-5, add the following to the end of subsection 602.3e.:

For Reflective Crack Interlayer (RCI) mixes, the optimum percentage of asphalt material is the percentage that yields the design air voids at N_{max} (50 gyrations) and complies with the other requirements of the specifications. Submit test results for all design criteria. The values from the approved mix design become the values in the initial job mix formula (JMF) for the RCI. These values remain in effect for the JMF until a written request by the Contractor for a change is approved by the Engineer. Provide a new mix design when any change in materials occurs from those used in the mix design, unless waived by the District Materials Engineer.

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

TABLE 602-1: COMBINED AGGREGATE REQUIREMENTS								
Mix Designation	**Percent Retained - Square Mesh Sieves**							
	⅜"	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**	**No. 200**
RCI	0	0-15	1-25	13-47	41-68	74-91	88-99	94-99

1. Aggregate Adjustment Limit: Do not exceed a 7% adjustment on any single sieve from the approved mix design to the Job Mix Formula (JMF). Submit a new mix design when requesting a change beyond this limit.
2. Do not use Reclaimed Asphalt Pavement (RAP) in the RCI design.
3. The flat and elongated particles in the combined coarse aggregate shall not exceed 10% for the total sample.
4. The maximum percent moisture in the final mixture shall not exceed 0.5.
5. There are no criteria for CAA, FAA, or D/B ratio.

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

TABLE 602-5: RCI MIX REQUIREMENTS FOR DESIGN SUBMITTAL	
MIX CHARACTERISTIC	**CRITERIA**
Sand Equivalent (SE), minimum, %	45
Gyratory Compaction Revolutions, N_{max}	50
Air Voids (V_a) target, %(1)	4.5(2)
VMA, minimum, %(1)	18.0
VFA, minimum, %(1)	70
Hveem Stability (AASHTO T-246) @ 140°F), 4" (100 mm) molds, minimum(1)	18.0
Flexural Beam Fatigue (AASHTO T-321) (3), 2000 microstrain, 10 Hz., 98% ± 1.0 of Gmb @ Nmax, 59°F (Age samples for 4 hours at 275°F before compaction, reference AASHTO R30 Section 7.2)	200,000 cycles

1. Criteria based on 50 gyrations (N_{max}).
2. Complete all tests on the mix producing 4.5% air voids at 50 gyrations. If the mix does not meet the requirements for all tests, then change the target air voids to correlate to the mix that does meet all the test requirements. Use this target air voids during production. The target asphalt binder content during production (JMF) will be the asphalt binder content from the approved mix design that yields the target air voids. Submit a new mix design to include the Hveem Stability and Flexural Beam Fatigue Testing when a new target asphalt binder content or target air voids is requested.
3. AASHTO T-321 will be used for analysis with the following exceptions:
   - Section 8.7: Replace the last sentence with the following:
     - This stiffness is the Initial Beam Modulus, which is used as a reference for determining the specimen failure.
   - Section 8.8: Delete the second sentence.
   - Section 8.9: Delete the last sentence.
   - Section 9.1.3: Change “Flexural Stiffness” to “Beam Modulus”
   - Section 9.1.6: Replace this section with the following:
     - Normalized Modulus = (Beam Modulus x Cycle Number) / (Initial Beam Modulus x 50)
     - Figure 6 - Plot the Normalized Modulus x Cycles versus Load Cycles (Repetitions)
   - Section 9.1.7 and Section 9.1.8: Delete
   - Section 9.1.9: Replace with the following:
     - Failure Point – Failure is defined at the maximum or peak Normalized Modulus when Normalized Modulus x Cycles is plotted versus Load Cycles.
   - Section 9.1.10: Delete
   - Section 10.4, Table 2: Change the last two headings to “Normalized Modulus” and “Normalized Modulus x Cycles”, respectively
   - Section 10.7: Delete
   - Section 10.8: Replace with the following:
     - Prepare a plot of Normalized Modulus x Cycles versus load cycles

4.0 CONSTRUCTION REQUIREMENTS

Construct the HMA base (RCI) according to **subsection 602.4 and Special Provision 07-06006 (latest revision)**.

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

(1) 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.

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

(b) For mixes with a specified thickness less than 1½ inches:

These mixes will not have a density pay adjustment. Control density using an approved rolling procedure with random nuclear gauge density determinations. Include a method for controlling density in the QCP.

Designate a "Compaction Foreman". This person shall control compaction procedures, review nuclear gauge results as they are obtained, adjust compaction procedures as needed to optimize compaction and report any changes in the compaction process and results of nuclear gauge testing to the Engineer. The compaction foreman may also be the nuclear gauge operator. The nuclear gauge operator shall continuously monitor compaction procedures. As a minimum, take 10 random nuclear gauge density determinations per day and report results to the Engineer. Throughout the day, nuclear gauge results shall be available for review by the Engineer. The compaction foreman shall document at a minimum of once every 2 hours that the approved rolling sequence is being followed. Documentation shall include roller passes, the mat temperature at each pass, amplitude setting of rollers and roller speed. Provide the documentation to the Engineer.

An approved rolling procedure shall be determined and periodically updated as outlined in this section. As a minimum, the initial rolling procedure shall be evaluated using 3 rollers. If the hot mix plant is operating at over 275 tons per hour, a minimum of 4 rollers shall be used in the initial evaluation. The number of rollers may be reduced to 2 (or 3 if the plant is operating at over 275 tons per hour) provided cores (minimum of 3 sets of 3) are taken from both a segment (single truck load) using 3 rollers and a segment (single truck load) using 2 rollers (4 and 3 rollers, respectively if plant is running over 275 tons per hour). Determine the G_{mb} of the cores using KT-15. If the G_{mb} of the segment with less rollers is equal to or greater than the G_{mb} of the segment with more rollers, then the minimum number of rollers may be reduced by 1. Vibratory rollers shall be operated in the static mode only. RCI paver screed operation shall be evaluated with the nuclear gauge at various vibration settings. For screed evaluation, the nuclear gauge readings shall be taken directly behind the screed and before rolling. The Compaction Foreman and Engineer will evaluate the densities obtained with the various roller combinations and screed settings to determine the initial approved rolling procedure.

Together, the Compaction Foreman and Engineer will determine when new rolling procedures are required. RCI production may be stopped by the Compaction Foreman or Engineer whenever rolling is not being performed according to the approved rolling procedure.

Page 600-13, add the following to the end of subsection 602.4:

h. Special RCI Requirements:

Technical Support: Personnel familiar with the process will provide technical support for production and placement of the RCI.

Tack Coat: Place a tack coat prior to the placement of the RCI.

Thickness: Compact the RCI to a minimum thickness of 1 inch. Thicknesses less than this are not acceptable and may result in removal and replacement at no additional cost to KDOT.

Longitudinal Joint: Overlap the PCCP or HMA longitudinal joint with the RCI by at least 6 inches.

Compaction and Density: Control the in-place density of all lots of the RCI using an approved rolling procedure as outlined in **subsection 602.4e**. If cores are taken use extreme care when handling the cores. Use a solid flat and un-textured surface to transport and store the cores prior to testing.

Release to Traffic and Overlay Placement: Cover the RCI with a hot mixture overlay within 10 days after placement. The RCI may be opened to traffic or covered with the hot mix overlay after cooling to less than 140°F or as determined by the Engineer.

Unacceptable work: Remove and replace areas determined unacceptable by the Engineer, in accordance with this specification, at no additional cost to KDOT.

Damaged Areas: Replace any traffic-damaged or marred areas at no additional cost to KDOT.

Blisters: Perforate blisters that are a minimum of 8" in diameter or a minimum of 1" high that have not disappeared by the time of the overlay using a method approved by the Engineer.

Page 600-14, delete Subsection 602.5c and replace with the following:

c. Specification Working Ranges. Establish acceptable limits for field test results by applying the tolerances shown in **TABLE 602-12** to the JMF or adjusted JMF for binder content and air voids. Establish acceptable limits for the other listed mix characteristics by applying the tolerances shown in **TABLE 602-12** to the requirements of **TABLE 602-1**.

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	±0.5%	*	±0.3%	*
Air Voids @ N_{max} gyrations	±1.0%	*	±1.0%	*
Mix Characteristic	**Tolerance for Specification Limits**			
	Single Test Value	**Plot**	**4 Point Moving Average Value**	**Plot**
Gradation (applicable sieves shown in **TABLE 602-1**)	**	*	zero tolerance	*
Voids in Mineral Aggregate	1.0% below min.	*	zero tolerance	*
Voids Filled with Asphalt	zero tolerance		n/a	
Sand Equivalent	zero tolerance		n/a	

*Values to plot. For gradations, as a minimum, plot the No. 8, No. 16, No. 50, and No. 200 sieves.
** The maximum deviation from the JMF shall be ±4.0% for No. 16 sieve and ±1.0% for No. 200 sieve.

Page 600-17, add the following to TABLE 602-13: MINIMUM HMA PLACEMENT TEMPERATURES:

Paving Course	Thickness (inches)	Air Temperature (ºF)	Road Surface Temperature (ºF)
RCI	All	50	55

Page 600-17, replace subsection 602.8 with the following:

602.8 MIXTURE ACCEPTANCE

a. General. Test the RCI at each plant for compliance with **TABLE 602-1**. Acceptance will be made on a lot by lot basis contingent upon satisfactory test results. Obtain quality control and verification samples of the RCI

using KT-25 sampling procedure D.2 Truck Bed. The sampling device and procedures used to obtain and split the samples must be approved by the Engineer. The Contractor's quality control tests will be used for acceptance.

A load or loads of mixture which, in the opinion of the Engineer, are unacceptable for reasons such as being segregated, aggregate being improperly coated, foaming aggregate or being outside the mixing temperature range may be rejected. The Engineer will take verification samples using the same sampling and splitting procedure as approved for the Contractor's quality control tests.

The P_b test values will also be used to determine P_b pay adjustments according to **subsection 602.9d**. P_b pay adjustments apply to the RCI placed on the traveled way and shoulders (including ramps and acceleration and deceleration lanes).

b. Lot Definition for Mix Production Sampling and Testing. A lot is defined as an isolated quantity of a specified material produced from a single source or operation. Each lot shall normally be represented by 4 contiguous test results. A lot may be represented by test results on samples taken from 1 or more day's production.

c. Lot Investigation. The Engineer may examine materials represented by individual test results which lie beyond the Contractor's normal quality control testing variation. The investigation may be based on either Contractor or KDOT test results. The information from additional testing (including testing of in-place RCI) may be used to define unacceptable work according to **subsection 105.5**. The Engineer may apply appropriate price reductions or initiate corrective action.

For any test, if a dispute exists between the Engineer and Contractor about the validity of the other's test results, the KDOT District Materials Laboratory or the MRC will perform referee testing, except for P_b dispute resolution. If the disputed KDOT test results were generated at the District Laboratory, the MRC will perform the referee tests. If the disputed KDOT test result was generated at the MRC, an independent laboratory agreeable to both parties will be selected. The Laboratory shall be accredited by the AASHTO Accreditation Program in the appropriate testing category. If referee testing indicates that KDOT test results are correct, the Contractor pays for the additional testing, including referee testing performed at the MRC. If the referee testing indicates that Contractor test results are correct, KDOT pays for the additional testing.

For P_b 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 P_b testing for this lot. (When production is completed for any mix, the last lot may be challenged the day production is completed).
- Discard P_b and P_b pay adjustment factors previously determined within the lots being questioned.
- All back halves of samples within the lot in question will be taken by KDOT to the District Materials Laboratory. All back halves 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 P_b calculations for the disputed lots will also be taken to the District Materials Laboratory.

The following retesting will be completed by KDOT:

- Determine the P_b using the back half of all samples within the lot being questioned using KT-57. Normally, there will be 5 back halves (4 Contractor's and 1 KDOT) to test within each lot.
- Using the retest P_b 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.

When a deficiency within a lot is determined to exist for properties other than P_b (P_b deficiencies are addressed elsewhere in the specification), the Engineer will decide on the disposition of each lot as to the acceptance, rejection or acceptance at an adjusted payment. The Engineer's decision is final.

d. Resampling of Lots. Take no samples for retest for pay adjustment purposes except as noted in **subsection 602.8c**.

e. Multiple Projects. If multiple projects are supplied from 1 or more plants using the same mix, carry over the lots at each hot mix plant from project to project.

f. Lot Size. A standard size mix production lot (density test lots are defined in **subsection 602.6a.(5)**) consists of 4 equal sublots of 750 tons of RCI (lot size is 3,000 tons).

It is anticipated that lot size shall be as specified. However, with the Engineer's approval, the Contractor may re-define lot size for reasons such as, but not limited to, change in contract quantities or interruption of the work. Take 1 sample during production of each sublot and utilize it to determine disposition of the lot in which it occurs.

g. Increased Lot Size. After 8 consecutive sublots have been produced within the tolerances shown for all mix characteristics listed in **TABLE 602-12** and without a P_b 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.

If subsequent test results fall outside the tolerances shown for any mix characteristic listed in **TABLE 602-12** or a P_b penalty is incurred, the sublot size shall be decreased to 750 tons. When the increased lot size criteria are again met, the sublot size may be increased to the limits given above.

h. Decreased Lot Size for Small Quantities. This is to be used when a small quantity (less than 3,000 tons) of RCI will be used. Use the plan quantity for the lot size. Reduce the sublot size below 750 tons by dividing the lot into 3 or 4 equal sublots. Before beginning production, provide the Engineer with the number and size of the sublots.

i. Pre-Production Mix. Test and evaluate a pre-production mix, limited to a maximum of 200 tons from each plant and type of mix before production of that mix. Evaluate the pre-production mix at initial start-up and after suspension of production resulting from failing test results. P_b payment shall not be adjusted for pre-production mixes. Provide a pre-production mix that complies with the gradation, P_b, VMA, and laboratory V_a requirements prior to starting or resuming production. For P_b, V_a, and VMA, use the "Single Test Value" listed in **TABLE 602-12** for comparison. For the other tests listed, use the values listed in **TABLE 602-1** for each mix. Except for initial start-up, normal delivery of material to the project before completion of certain test results on pre-production mixes may be authorized by the DME.

Place the material produced for the pre-production mix in locations approved by the DME. The Engineer will pay for material as the material produced. At the direction of the Engineer, remove the pre-production mix if it is both out of specification and the material shortens the pavement life or changes the intended function. The Engineer will pay for the replacement of one pre-production mix at 100% of the contract unit price for the RCI. The payment will be full compensation to the Contractor for the placement and removal of that pre-production mix. KDOT will not be financially responsible for any subsequent failed pre-production mixes (that require removal) for the RCI. The removed material is the property of the Contractor.

The Engineer will not pay for pre-production mixes that are required to be replaced due to poor workmanship or equipment failure. The Engineer will make the final decision to remove a failed pre-production mix with input from the Contractor.

j. Suspension of Mix Production. Suspend production of the mix until appropriate corrections have been made, if 2 consecutive test results for any single mix characteristic fail to fall within the limits established by the tolerances shown in the single test value column of **TABLE 602-12**. Additionally, suspend production of the mix until appropriate corrections have been made, if any 4-point moving average value for any single mix characteristic fails to fall within the limits established by the tolerances shown in the 4-point moving average value column of **TABLE 602-12**. Production remains suspended pending the satisfactory results of a pre-production mix, unless waived by the DME.

The Engineer may stop production of RCI at any time the mix or process is determined to be unsatisfactory. Make the necessary corrections before production will be allowed to resume. Failure to stop production of RCI shall subject all subsequent material to rejection by the Engineer or acceptance at a reduced price, as determined by the Engineer.

k. Non-Complying Materials. Establish and maintain an effective and positive system for controlling non-complying material, including procedures for its identification, isolation and disposition. Reclaim or rework

non-complying materials according to procedures acceptable to the Engineer. This could include removal and replacement of in-place pavement.

Positively identify all non-complying materials and products to prevent use, shipment and intermingling with complying materials and products. Provide holding areas, mutually agreeable to the Engineer and Contractor.

Page 600-20, delete subsection 602.9. and replace with the following:

602.9 BASIS OF ACCEPTANCE

a. General. Acceptance of the mixture will be contingent upon test results from both the Contractor and KDOT. The Engineer will routinely compare the variances (F-test) and the means (t-test) of the verification test results with the quality control test results for P_b using a spreadsheet provided by KDOT. If KDOT verification test results do not show favorable comparison with the Contractor's quality control test results, then KDOT test results will be used for material acceptance, material rejection and the determination of any pay adjustment on the P_b. Disputed test results will be handled according to **subsection 602.8c**.

KDOT will use a spreadsheet program to calculate pay adjustments for P_b, and to compare Contractor QC and KDOT QA test results. KDOT will provide a copy of this program to the Contractor, when requested. Microsoft Excel software is required to run this program; it is the Contractor's responsibility to obtain the correct software. Values computed using equations referenced in this specification may vary slightly from the spreadsheet values due to rounding of numbers. In such cases, the numbers computed by the spreadsheet will govern.

The comparison of quality control and verification tests will be completed using the t-tests to compare their population means and the F-test to compare their variances. The F & t tests, along with the Excel Spreadsheet used to compare the Contractor's QC results and KDOT's QA results, are described in Section 5.17.08, Part V. Additional information on the program may be obtained from the Bureau of Materials and Research.

b. Asphalt Binder Pay Adjustment. Asphalt binder (P_b) pay adjustment will be made on a lot basis and based on measured P_b from samples of plant produced material. The P_b pay adjustment factor ($\boldsymbol{P_B}$) (positive or negative) will be determined and used to compute the P_b pay adjustment by multiplying $\boldsymbol{P_B}$ times the number of tons included in the lot times $40 per ton. The P_b 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 602.9b.(1)** to compute $\boldsymbol{P_B}$. When the statistical comparison fails, calculate $\boldsymbol{P_B}$ using procedures in **subsection 602.9b.(2)**.

Asphalt Binder Lot Size: A lot shall normally be comprised of the results of 4 contiguous individual P_b tests as determined from the ignition oven burn-off procedure (KT-57).

(1) Asphalt Binder Pay Adjustment Factor (Passing t-test). Calculate the upper and lower P_b quality indices ($\boldsymbol{Q_{UB}}$ and $\boldsymbol{Q_{LB}}$) for each lot using Equations 3 and 4, respectively and round to hundredths. Locate the $\boldsymbol{Q_{UB}}$ 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 ($\boldsymbol{PWL_{UB}}$) 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 $\boldsymbol{Q_{LB}}$ value and select the appropriate value for the lower percent within limits ($\boldsymbol{PWL_{LB}}$). If the $\boldsymbol{Q_{UB}}$ or $\boldsymbol{Q_{LB}}$ 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 $\boldsymbol{PWL_{UB}}$ or $\boldsymbol{PWL_{LB}}$, respectively. If both $\boldsymbol{Q_{UB}}$ and $\boldsymbol{Q_{LB}}$ exceed the values shown in the table, a value of 100.00 is assigned as the value for both $\boldsymbol{PWL_{UB}}$ and $\boldsymbol{PWL_{LB}}$. If either $\boldsymbol{Q_{UB}}$ or $\boldsymbol{Q_{LB}}$ is a negative value or $\boldsymbol{PWL_{UB}} + \boldsymbol{PWL_{LB}}$ is less than 150, 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 $\boldsymbol{P_B}$ for the lot will be equal to –0.060. The Engineer may establish lower values for $\boldsymbol{P_B}$ (-0.100, -0.200, etc.) in such instances. Otherwise, calculate $\boldsymbol{P_B}$ using Equation 3 and round to thousandths.

Equation 1:

$$Q_{UB} = \frac{USL - \overline{X}}{S}$$

Equation 2:

$$Q_{LB} = \frac{\overline{X} - LSL}{S}$$

$\overline{X}$ is the average measured P_b of all samples within a lot rounded to hundredths.
USL is the upper specification limit for P_b, and is defined as 0.30% higher than the JMF P_b.

LSL is the lower specification limit for P_b, and is defined as 0.30% lower than the JMF P_b.
S is the standard deviation of the measured P_b for all samples within a lot and is calculated using equation (4) in Section 5.17.09, Part V, rounded to hundredths.

Equation 3: $$P_B = ((PWL_{UB} + PWL_{LB} - 100)(0.0015)) - 0.135$$

PWL_{UB} is the upper percent within limits value for P_b.
PWL_{LB} is the lower percent within limits value for P_b.

(2) Asphalt Binder Pay Adjustment (Failing t-Test). If the t-test fails, KDOT's test result will be used to calculate the P_B for the lot. Follow the procedures given in **subsection 602.9b.(1)** to determine the P_B or disposition of the lot. Use the values from **TABLE 602-16** to calculate Q_{UB}, Q_{LB}, PWL_{UB} and PWL_{LB} in Equations 1, 2 and 3 in **subsection 602.9b.(1)**.

TABLE 602-16: Statistical Values for Asphalt Binder Pay Adjustment for Failing t-Test

Term	Definition	Value
$\overline{X}$	Average or Mean	KDOT's test result for the lot
S	Standard Deviation	0.20
USL	Upper Specification Limit	0.50% + JMF P_b
LSL	Lower Specification Limit	JMF P_b - 0.50%
N	Sample Size	3

01-09-09 M&R (RAB)
02-10-09 M&R (RAB) Typographical Correction
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Apr-09 Letting