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

Delete SECTION 614 and replace with the following:

SECTION 614

HMA BASE (REFLECTIVE CRACK INTERLAYER (RCI))

614.1 DESCRIPTION

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

BID ITEMS	UNITS
HMA-RCI (PG 70-28 RCI)	Ton
Quality Control Testing (HMA)	Ton

614.2 CONTRACTOR QUALITY CONTROL REQUIREMENTS

Perform quality control testing according to **subsection 602.2**. Develop control charts for the mix characteristics listed in **TABLE 614-7**.

614.3 MATERIALS

a. Asphalt Binder. Provide PG 70-28 RCI binder that complies with **SECTION 1202**, with this exception:

Post a legible copy of the latest bill of lading for the Asphalt Binder on or near the gyratory compactor. Use the mixing and compaction temperatures shown on the bill of lading; however, the maximum mixing or compaction temperature is 340ºF, unless otherwise approved by the Field Materials Engineer. Notify the Engineer if the mixing or compaction temperature changes.

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

1. The air temperature is below 70ºF
2. The plant has not produced mix earlier in the day.
3. Do not exceed a mix temperature of 350ºF.
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 340ºF.

b. Reclaimed Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS). Do not use RAP or RAS in the RCI.

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 614-1**.

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.

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 614-1** and **TABLE 614-5** 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 614-2**. Contact the DME to determine if additional information should be submitted. Provide sufficient material as identified in **TABLE 614-3**. Submit for the Engineer's review and approval, the test data listed in **TABLE 614-4** for each blend and the proposed JMF. Provide a mix that meets the requirements in **TABLE 614-5**.

For each aggregate used in the mix design, determine the specific gravity using KT-06. 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 determine the specific gravity values of the individual aggregates 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-06 on the aggregate currently produced. Do not use the specific gravity values obtained from these tests in the mix design calculations for current projects, unless mutually agreeable to both parties. Use the information, 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.

For RCI mixes, the optimum percentage of asphalt material is the percentage that yields the target air voids at N_{des} (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 DME.

TABLE 614-1: 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	94.0-99.0

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 RAP or RAS 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.

TABLE 614-2: 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 4.5%. The minimum P_{br} is 8.3%.
Theoretical Maximum Specific Gravity	G_{mm}	KT-39	Rice Test.
Sand Equivalent	SE	KT-55	
Bulk Specific Gravity of HMA	G_{mb}	KT-15	Compacted Mix Property.
Percent G_{mm} at N_{des}	$\%G_{mm}$ @ N_{des} %	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-06	Calculated from G_{mb}, G_{sb}, P_b.
Voids Filled with Asphalt	VFA		Calculated from VMA and V_a @ N_{des}.

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

TABLE 614-3: 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-06	As Needed	Specific Gravity Test	
Uncompacted HMA Sample	35 lbs	Cool sample 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_{des}	2 Plugs	Compacted at P_{br}	Compacted to N_{des}

TABLE 614-4: 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)
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
Sand Equivalent	SE for the combined virgin aggregates.

TABLE 614-5: RCI MIX REQUIREMENTS FOR DESIGN SUBMITTAL	
MIX CHARACTERISTIC	**CRITERIA**
Sand Equivalent (SE), minimum, %	45
Asphalt Binder Content (P_b), minimum, %	8.3
Gyratory Compaction Revolutions, N_{des}	50
Air Voids (V_a), %[(1)]	4.5-5.0[(2)]
VMA, minimum, %[(1)]	18.0
VFA, minimum, %[(1)]	70
Hveem Stability (AASHTO T-246) @ 140ºF), 4" (100 mm) molds, minimum[(1)]	18.0
Flexural Beam Fatigue (AASHTO T-321) [(3)], 2000 microstrain, 10 Hz., 98% ± 1.0 of Gmb @ N_{des}, 59ºF (Spread loose mix samples in a pan to an even thickness of 1" to 2", and age for 4 hours at 275ºF before compaction)	200,000 cycles

1. Criteria based on 50 gyrations (N_{des}).
2. Complete all tests on the mix producing 4.5% to 5.0% air voids at 50 gyrations during the mix design phase. The target air voids during production (JMF) is 4.5%. The target asphalt binder content during production (JMF) is the recommended percent asphalt from the approved mix design. Submit a new mix design to include the Hveem Stability and Flexural Beam Fatigue Testing when a new target asphalt binder content is requested.
3. AASHTO T-321 will be used for analysis with the following exceptions:
   Section 8.9.3: Change "Flexural Stiffness" to "Beam Modulus"
   Section 8.10: Replace this section with the following:
      For each load cycle at which data are collected, compute the product of the Beam Modulus and load cycles (S x n).
      Normalized Modulus = (Beam Modulus x Cycle Number) / (Initial Beam Modulus x 50)
   Figure 7 - Plot the Normalized Modulus x Cycles versus Load Cycles (Repetitions)
   Section 9.1: 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 10.4, Table 3: Change the last heading to "Normalized Modulus" and add a column titled "Normalized Modulus x Cycles", respectively
Section 10.5: Change flexural stiffness to beam modulus
Section 10.7. Change flexural stiffness to beam modulus
Section 10.8: Replace with the following:
Prepare a plot of Normalized Modulus x Cycles versus load cycles as shown in Figure 7.

TABLE 614-6: MIX DESIGN TEST DATA SUBMITTALS	
Submittal	**Information**
Minimum of 1 Mix Design	As a minimum, 1 mix design at 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_{des} gyratory revolutions along with copies of the Gyratory graphs.
Percent VMA	Provide %VMA at each binder content.

614.4 CONSTRUCTION REQUIREMENTS

a. Plant Operation. Adjust all plant operations to operate continuously.

(1) 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.

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

(a) Temperature Requirements. Dry the aggregate for the mixture and heat to a temperature to obtain 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 Field Materials Engineer. 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.

(3) Preparation of HMA. Introduce asphalt binder into the prepared aggregate in the proportionate amount determined by the P_{br} in the JMF.

(a) 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**.

(b) 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, mix a sufficient time 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. For continuous flow plants, mixing time in seconds shall equal:

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

(c) Manufacturer's 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.

(d) Batcher Operation. Coordinate HMA batchers (Gob Hoppers) with the plant production rate at all times so the hopper is 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.

(e) 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.

(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 and the tons of asphalt binder. The dry weight is the tons of the material less the water content.

b. Road Surface Preparation. Clean all foreign material and broom to remove dust from existing concrete pavement. Clean and fill cracks and joints, and construct surface leveling as shown in the Contract Documents.

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 for the RCI.

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. 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 to 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.

(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. The Engineer may verify segregation and uniformity of density requirements in **TABLE 602-7** are met by using methods outlined in Section 5.8.3 – Segregation Check Using the Nuclear Density Gauge, Part V.

(2) 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.

(3) 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. 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 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.

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.

(4) Density Requirements. RCI 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.

Determine and periodically update an approved rolling procedure as outlined in this section. As a minimum, evaluate the initial rolling procedure using 3 rollers. If the hot mix plant is operating at over 275 tons per hour, use a minimum of 4 rollers 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. Operate vibratory rollers in the static mode only. Evaluate RCI paver screed operation with the nuclear gauge at various vibration settings. For screed evaluation, take the nuclear gauge readings 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.

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

(5) 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.

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

(7) Construction Joints.

(a) Transverse Construction Joints. Use a method of making transverse construction joints to provide a thorough and continuous bond, provide an acceptable surface texture and meet density requirements. Do not vary the surface elevation more than 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.

f. 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.

g. 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, as a minimum, to the depth shown in the Contract Documents. Thicknesses less than the plan thickness 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 614.4e**. 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.

h. Pavement Smoothness. Evaluate pavement smoothness according to **SECTION 603**.

614.5 PROCESS CONTROL

a. General. Establish gradation limits and proportions for each individual aggregate and mineral filler. Specify the limits and proportions such that the material produced complies 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. KDOT will collect and test verification samples and assurance samples and inspect the Contractor’s quality control operations.

b. JMF Adjustments. Produce a mixture of uniform composition closely complying with approved design JMF to obtain the specified properties when compacted. If, during production, results from quality control tests demonstrate a need to make adjustments to the mix design, then make adjustments to the design JMF single point gradation to achieve the specified properties. The JMF adjustments shall produce a mix that complies with **TABLE**

614-1 and **TABLE 614-5** for the specified mix designation. When necessary, adjust on a sublot basis. Report the new JMF to KDOT's field representative and the DME before making such changes, and submit a new mix design for review and approval if required by the DME.

c. Specification Working Ranges. Establish acceptable limits for field test results by applying the tolerances shown in **TABLE 614-7** to the JMF for binder content and air voids. Establish acceptable limits for the other listed mix characteristics by applying the tolerances shown in **TABLE 614-7** to the requirements of **TABLE 614-1** and **TABLE 614-5**.

TABLE 614-7: SPECIFICATION WORKING RANGES (QC/QA)

Mix Characteristics	Tolerance from JMF			
	Single Test Value	Plot	4 Point Moving Average Value	Plot
Binder Content	±0.5%	*	±0.3%	*
Air Voids @ N_{des} gyrations	±1.0%	*	±1.0%	*
Mix Characteristics	**Tolerance for Specification Limits**			
	Single Test Value	**Plot**	**4 Point Moving Average Value**	**Plot**
Gradation (applicable sieves shown in **TABLE 614-1**)	**	*	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% for No. 16 sieve and ±1.0% for No. 200 sieve.

614.6 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 614-8** is met.

TABLE 614-8: MINIMUM RCI PLACEMENT TEMPERATURES

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

614.7 MIXTURE ACCEPTANCE

a. General. Test the RCI at each plant for compliance with **TABLE 614-1** and **TABLE 614-5**. 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 provided those results are verified by KDOT.

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 614.8b**. 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. This will be paid using the bid item Contract Deduct which will be an item added to the contract.

If the referee testing indicates that Contractor test results are correct, KDOT pays for the additional testing. Pay the independent lab for the testing and submit the paid invoice to KDOT. The Engineer will reimburse the Contractor (based on the invoice price) as Extra Work, **SECTION 104.**

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 614.8b.** 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 614.7c**.

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 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 614-7** 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 614-7** 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 614-7** for comparison. For the other tests listed, use the values listed in **TABLE 614-1** and **TABLE 614-5** 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 614-7**. 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 614-7**. 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.

614.8 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 614.7c**.

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 5.2.6, Part V. Additional information on the program may be obtained from the Bureau of Construction and Materials.

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 (***P_B***) (positive or negative) will be determined and used to compute the P_b pay adjustment by multiplying ***P_B*** times the number of tons included in the lot times $75 per ton. This adjustment will be paid for under the bid item Asphalt Binder Pay Adjustment. When the statistical comparison between the quality control and the verification tests pass, use the procedures in **subsection 614.8b.(1)** to compute ***P_B***. When the statistical comparison fails, calculate ***P_B*** using procedures in **subsection 614.8b.(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). Lot size is defined in **subsections 614.7f.**, **614.7g.** and **614.7h**. 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.

(1) Asphalt Binder Pay Adjustment Factor (Passing t-test). Calculate the upper and lower P_b quality indices (***Q_{UB}*** and ***Q_{LB}***) for each lot using Equations 3 and 4, respectively and round to hundredths. Locate the ***Q_{UB}*** value in the left column of the Percent Within Limits (PWL) Table in Section 5.2.1, Part V. Select the appropriate upper percent within limit value (***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 ***Q_{LB}*** value and select the appropriate value for the lower percent within limits (***PWL_{LB}***). If the ***Q_{UB}*** or ***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 ***PWL_{UB}*** or ***PWL_{LB}***, respectively. If both ***Q_{UB}*** and ***Q_{LB}*** exceed the values shown in the table, a value of 100.00 is assigned as the value for both ***PWL_{UB}*** and ***PWL_{LB}***. If either ***Q_{UB}*** or ***Q_{LB}*** is a negative value or ***PWL_{UB}*** + ***PWL_{LB}*** 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 ***P_B*** for the lot will be equal to –0.060. The Engineer may establish lower values for ***P_B*** (-0.100, -0.200, etc.) in such instances. Otherwise, calculate ***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 5.2.1, 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 614.8b.(1)** to determine the ***P_B*** or disposition

of the lot. Use the values from **TABLE 614-9** to calculate Q_{UB}, Q_{LB}, PWL_{UB} and PWL_{LB} in Equations 1, 2 and 3 in **subsection 614.8b.(1)**.

TABLE 614-9: 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

614.9 MEASUREMENT AND PAYMENT

a. HMA-RCI (PG 70-28 RCI). The Engineer will measure HMA -RCI by the ton of material at the time of delivery to the road. Batch weights will not be allowed as a method of measurement unless all the following conditions are met:

- the plant is equipped with an automatic printer system approved by the Engineer;
- the automatic printer system prints the weights of material delivered; and
- the automatic printer system is used in conjunction with an automatic batching and mixing control system approved by the Engineer.

Provide a weigh ticket for each load. 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 variances.

Payment for "HMA -RCI" at the contract unit prices is full compensation for the specified work. Any pay adjustments will both be applied and the payment adjusted accordingly.

b. Emulsified Asphalt. The Engineer will measure emulsified asphalt used for tack by the ton. Payment for "Emulsified Asphalt" at the contract unit price is full compensation for the specified work.

c. Quality Control Testing (HMA). The Engineer will measure Quality Control Testing (HMA) performed by the Contractor on a per ton basis of HMA-RCI placed on the project. No adjustment in the bid price will be made for overruns or underruns in the contract quantity. The bid price will constitute payment for all necessary mix design testing, field process control testing, the testing laboratory and all necessary test equipment.

Payment for "Quality Control Testing (HMA)" at the contract unit price is full compensation for the specified work.

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