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

HMA BOND STRENGTH

Page 600-2, subsection 602.1. Add the following bid item:

BID ITEMS	UNITS
Emulsified Asphalt	Square Yard

Page 600-31, delete subsection 602.11c. and replace with the following:

c. Emulsified Asphalt. The Engineer will measure emulsified asphalt used for tack to the unit of measure specified in the Contract Documents. Payment for "Emulsified Asphalt" at the contract unit price is full compensation for the specified work.

The minimum asphalt residue required is 0.03 gallons/square yard.

Page 600-32, add the following new subsection:

602.12 BOND STRENGTH OF HOT MIX ASPHALT TACK COAT

a. General. The Engineer will determine the bond strength of the HMA tack coat according to KT-78 Method for Determining the Tensile Adhesive Strength of Asphalt Pavement Tack Coat. Take random samples from each lift placed, at a frequency determined by the Engineer and at locations selected by the Engineer. The recommended testing frequency is shown in **TABLE 602-19**.

TABLE 602-19: RECOMMENDED BOND TEST FREQUENCY

Tensile Stress (psi)	Bond Condition	Recommended Test Frequency
≥ 70	good	1 test per week
35 - 69	fair	2 tests per week
< 35	poor	test each day

For each test the Engineer will generate one random longitudinal location to obtain the bond strength samples. At the longitudinal test location, obtain two samples according to KT-78. At the random longitudinal location, the Engineer will generate two random transverse locations for each half of the paved lane. The outside lane sample will be obtained at a random location between 6 to 11 feet from the centerline of the roadway. The inside lane sample will be obtained at a random location between 1 to 6 feet from the centerline of the roadway. With the Engineer present, obtain the samples within 24 hours of the material being placed. Present the cores to the Engineer who will immediately transport the cores to the KDOT Field lab.

Dry the core holes, tack the sides and bottom, fill them with a HMA mixture (approved for the project) and properly compact it by the end of the next working day.

The Engineer will evaluate the samples using KT-78, within 48 ± 2 hour after the HMA was placed. The tensile stress for the test will be determined by using the lowest tensile stress of the two samples. When the evaluation of the test falls on a non-working day, then the test will be performed on the next working day. The Engineer will provide a copy of the results to the Contractor by the end of the working day on which the test is performed.

If the tensile stress of a test is less than 35 psi, suspend plant production and paving. Follow the Best Management Processes to verify proper placement of tack material.

APPENDIX A

Kansas Department of Transportation
Best Management Practices: Checklist for Emulsion Bonding Liquid (EBL) for use through a Spray-Paver

Emulsion Bonding Liquid (EBL) is a polymerized emulsion used primarily undiluted at rates dependent on the existing pavements macro-texture to meet the requirements of this specification.

PREPARATION:

- Understand condition (previous use) of delivery tankers and steps taken to minimize risk of contamination to the asphalt emulsion. Cross contamination of cationic EBL and anionic EBL emulsions can cause issues during paving operations including the ability of the nozzles to spray a proper fan pattern and clogging of the nozzles.
- Remove accumulated dust and dirt from the road surface by mechanical brooming.
- At the beginning of each day of paving the spray-paver should demonstrate the ability to spray a proper emulsion fan pattern by setting the EBL quantity to the day's target rate with the screed extended to the lane's paving width. The length of pavement sprayed should be sufficient to determine if all nozzles are working and the pattern is uniform.

STORAGE/HANDLING:

- Prevent contamination by water, oils or other liquids.
- Prevent contamination by other incompatible emulsions. Check with emulsion supplier if there is a question.
- Protect the EBL from freezing and boiling temperatures that break the emulsion and cause separation into asphalt and water. EBL should not be stored on-site (tanker is exposed to the weather) for long periods during cold weather conditions. A good practice is to use material within 24 hours of delivery.
- Protect from localized overheating caused by high temperature heating coils and surface heating pads. Where steam, hot oil or direct fire must be used, controls must keep coil surfaces below 185° F.
- Use bottom loading wherever possible or employ full-length drop hose to eliminate foaming. Foaming may cause a volume gauge error and may be detrimental to the stability of the emulsion.
- Allow surface crust that may form on emulsion in storage to float without disturbance. Return lines should have outlets near the tank bottom and circulating material should not free-fall or disturb the surface crust.
- High shear can break an emulsion. Enlarge clearances on new gear pumps by milling if necessary.
- Prevent unnecessary circulation that can cause drop in emulsion viscosity and stability.
- Do not agitate emulsion with forced air as it may cause the emulsion to break.

TRANSFER VEHICLE:

- The Transfer Vehicle can heat the asphalt emulsion to the specified temperature range so that it is fluid enough to spray from the nozzles. The process for increasing the temperature of the EBL should be completed gradually so as not to prematurely break the emulsion.
- For EBL, the specified application temperature is 120°F to 180°F. Excessive heat and/or pumping can cause the emulsion to break thereby causing the nozzles to clog or spray an unsatisfactory pattern.

APPLICATION:

- At the beginning of each day of paving and after prolonged delays the spray-paver should demonstrate the ability to spray a proper emulsion fan pattern (at full width). A prolonged delay may be defined as a 10 minute or longer cessation of HMA placement to the existing paving surface. If a prolonged delay is encountered a header should be built and the existing surface prepped for the continuation of paving operations.
- The initial acceleration of the paver to operating speed can be achieved by manual or automatic control. If automatic is selected the paver operator should ensure that the speed differential is not so great as to leave a screed plate indention in the newly applied material. If manual control is selected care should be taken to ensure that the proper rate and consistency of emulsion is achieved.

- Allowing the EBL to spray slightly wider than the lane's width (~3 inches on the shoulder side) can be a guide for monitoring emulsion application.
- The joint side of the first paving pass should have the EBL extending beyond the HMA.
- The emulsion being sprayed under the paver should always look consistent. If it isn't refer to *Appendix 1 – Trouble shooting*.
- For bonded dense graded projects, the nozzle size is usually smaller than those used in UBAS. Typically, the nozzle size and spray-paver type should be recorded and notice be given if the nozzles are changed during the project.
- For application consistency, the EBL quantities can be measured and calculated each time the spray-paver is refilled from the transfer vehicle.
- Paver speed and HMA material supply is critical to proper spray patterns. A speed too slow can cause irregular spray patterns.
- The proper EBL application will meet the Bond Strength Requirements in **TABLE 602-19**, this specification.
    - An open or rough textured surface may require more EBL than a surface that is tight or one that is flushed with asphalt.
        - Open or rough texture may be milled surfaces, UBAS ,chip seals, and some concrete pavements
        - Tight Texture may be new HMA surfaces, fog seals, hot in-place recycled surface

- The EBL's performance may be reduced if it is allowed to break prior to the placement and compaction of the HMA overlay. If paving operations have stopped momentarily and the EBL has broken prior to the application of HMA then a reduced rate of EBL may be applied over the already broken material prior to the continuation of regular paving operations. One example of this is at the startup of operations when the spray-paver demonstrates the nozzles ability to apply a uniform coverage.

SPECIAL CONSIDERATIONS:

- If the spray nozzles are not delivering a uniform coverage the paver's speed may not be sufficient to supply the necessary spray bar pressure to apply the EBL. For other solutions refer to *Appendix 1 – Trouble Shooting.*

ASPHALT EMULSION SUPPLIER:

- Asphalt particle size has an effect on the nozzles ability to spray a proper fan pattern. If the emulsion is delivered to the project and the particle size is too large the nozzles may clog even through the emulsion is at the higher end of the specified temperature range.

APPENDIX 1 – Trouble Shooting

At no time should the nozzles deliver an inconsistent fan pattern. "Foggy" areas that are momentary may not be severely detrimental as long as corrective action is taken to correct the fan pattern and the issue resolved in a short time. When areas of pavement are not receiving any emulsion and streaks are appearing on the surface paving operations should stop and corrective action taken.

Things to consider when determining inconsistent spray patterns;

1. Are the proper size nozzles installed and being used? Some spray-pavers have the capacity to use several nozzle sizes at a time. If they are large nozzles the fan pattern will not cover the pavement without increasing the EBL gallon per square yard quantity.
2. Is the paver traveling too slow? If the HMA material supply (truck count or plant speed) to the paver is not adequate the paver may travel slower to compensate for the supply issue. If this is the case paving operations should stop until a sufficient amount of trucks are available for proper operations.
3. Is the proper amount of EBL being delivered to the road's surface?
4. What is the temperature of the EBL? Increasing the temperature in a uniform and controlled manner may lower its viscosity and provide a better spray pattern.
5. Height of the spray bar can affect the width of the fan pattern. If all of the nozzles are spraying consistently but gaps of emulsion exist on the pavement the spray bar height may need to be increased.
6. If after refilling the paver with EBL the fan pattern becomes inconsistent switching between spray nozzles may clear the nozzles. Typically, spray-pavers have 2 or more sets of nozzles that are ready for operation.

APPENDIX B

Kansas Department of Transportation
Best Management Practices: Checklist for Tack

PREPARATION:

- Consult with the emulsion supplier with respect to a particular asphalt-aggregate combination as there are few absolute rules that will work the same under all circumstances.
- Understand condition (previous use) of delivery tankers and steps taken to minimize risk of contamination to the asphalt emulsion.
- Remove accumulated dust and dirt by mechanical brooming or by flushing with air and/or water.

STORAGE/HANDLING:

- Prevent contamination by water, oils or other liquids.
- Prevent contamination by other incompatible emulsions.
- Protect from freezing and boiling temperatures that break the emulsion and cause separation into asphalt and water.
- If water is added by contractor, then water is to be clean, potable water, free from detectable solids or incompatible soluble salts. Test for dilution incompatibility, whenever in doubt, by diluting the emulsion in the severest conditions anticipated (e.g., high dilution, cold water, hard water, high shear pumps). No instability or coagulation should appear.
- Protect from local overheating caused by high temperature heating coils and surface heating pads. Use of hot water is recommended for heating emulsion. Where steam, hot oil or direct fire must be used, controls must keep coil surfaces below 85° C (185° F).
- Use bottom loading wherever possible or employ full-length drop hose to eliminate foaming. Foaming may cause a volume gauge error.
- Allow surface crust that may form on emulsion in storage to float without disturbance. Vertical tanks can help maintain constant and minimal surface area. Return lines into tanks should have outlets near the tank bottom and circulation should not free-fall or disturb surface crust.
- Reduce high shear that can break emulsions by enlarging clearances on new gear pumps by milling if necessary.
- Prevent unnecessary circulation that can cause drop in emulsion viscosity and emulsion instability.
- Do not agitate emulsion with forced air as it may cause the emulsion to break.

DISTRIBUTOR:

- Review appropriate maintenance practices of distributor with driver.
- Apply tack by a pressure distributor.
- All nozzles on the distributor are open and functioning.
- Nozzles are turned at the same angle to the spray bar; approximately 30º, depending on the manufacturer of the distributor.
- Proper height above the pavement surface provides a double or triple lap of the liquid asphalt material.
- Distributor heats the asphalt emulsion to the proper temperature so that it is fluid enough to be sprayed from the nozzles; not coming out in strings.

APPLICATION:

- Proper asphalt emulsion is used; material adheres to the existing surface.
- Correct amount of tack coat is sprayed on the surface, so some of the existing surface will still be visible through the tack coat—not all of the existing pavement surface will be covered with the tack coat. Use of a diluted asphalt emulsion tack coat (slow-setting asphalt emulsion diluted 1:1 with water) will result in complete coverage of an extremely thin residual asphalt film.
- The proper tack coat application will leave ***residual asphalt cement content*** of approximately 0.03 to 0.06 gal/yd2 on the roadway.

  - An open-textured surface requires more tack coat than a surface that is tight or one that is "fat" or flushed.
  - More tack coat material may be needed on a milled surface because of the increased surface area. In this case, the application rate could be as great as 0.08 gal/yd2 of residual asphalt cement.
- The emulsion must break (change color from brown to black) and the water must evaporate from the emulsion before the new mix can be placed over the tack coat material.
- If the overlay is to be constructed under traffic, the tack coat is normally placed only a short distance in front of the paver; within the lane closure and far enough ahead for the tack to cure properly before the mix is laid on top of it.

SPECIAL CONSIDERATIONS:

- Do not dilute rapid setting (RS) emulsions with water. RS emulsions require dilution with specific chemical emulsifier solutions to produce stable dilutions.

ASPHALT EMULSION SUPPLIER:

Variables that may be causing issues are, but not limited to, the following:

- Ionic charge on the asphalt emulsion
- Type and concentration of the emulsifying agent
- Addition of chemical modifiers
- Asphalt particle size in the emulsion
- Hardness and quantity of the base asphalt cement
- Chemical properties of the base asphalt cement
- Manufacturing variables

NOTE: Most of the list is derived from the Hot-mix Asphalt Paving Handbook (AASHTO/FAA/FHWA/NAPA/US Corp), A Basic Emulsion Manual (Asphalt Institute) and Performance Guidelines, Section 11(AEMA)