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**T E N N E S S E E**

(Rev. 12-10-18)

January 1, 2021

(Rev. 01-11-22)

**SPECIAL PROVISION**

**REGARDING**

**POLYMER MODIFIED ASPHALT REJUVENATING SCRUB SEAL**

**Description**

The work shall consist of furnishing all labor, materials, equipment and transportation for the application of the polymer modified asphalt rejuvenating scrub seal interlayer. All ingredients shall be properly proportioned, mixed, and spread on the paved surface in accordance with these requirements and as directed by the Engineer.

**Materials**

**A. Aggregate**

The cover material for the seal shall be an approved crushed stone meeting the gradation requirements for Size No. 8 or 89 conforming to **903.22**. The aggregate shall be washed after processing so that the amount of material finer than the No. 200 screen does not exceed 1.5%. Gradations are to be verified by the Department prior to use. Testing shall be accomplished by referencing the Materials and Tests Standard Operations Procedure (SOP 1-1) for surface treatment aggregate at the frequencies established or as identified in the Stockpile Site section of this provision. The moisture content of the aggregate shall not exceed that at a SSD condition at the time of placement.

If the scrub seal is to be utilized as an interlayer or for a riding surface of a low volume route, ADT less than or equal to 1000, the aggregate shall meet the quality requirements found in ASTM D692. Aggregate for use as the final riding surface on routes with an ADT greater than 1000 shall meet the quality requirements identified in **903.24**, for polish resistant aggregate.

The maximum amount of flat and elongated aggregate with a ratio of 3:1 shall not exceed 18% as determined by ASTM D4791.

If material is used whose tests indicate that the amount passing the No. 200 is greater than 1.5%, the surface treatment will not be accepted and another scrub seal layer shall be placed on top of the previous layer's lot that was represented by the failing sample.

**B. Emulsion**

The asphalt emulsion shall be a polymer modified asphalt emulsion with a rejuvenating agent, meeting the requirements of AASHTO MP-43 with the following exceptions:

1. The minimum Residue by Distillation at 350°F shall be 60%.
2. The Department waives the Demulsibility requirement.
3. Percent Recovery (AASHTO T 350) shall be the test method used for certifying the emulsion and Elastic Recovery shall not be accepted.

Provide certified material and weigh tickets for each distributor load of emulsion.

**C. Material Certifications and Testing**

The emulsion manufacturer, through the contractor, shall submit to the Department certification that the emulsion meets the specification. The manufacturer of the Rejuvenating Agent, through the emulsion supplier and the contractor, shall submit to the Department test results on the recycling agent and certification that the recycling agent meets the required specifications. The Laboratory shall be certified in Tennessee and comply with TDOT SOP 3-2, Emulsified Asphalt Certified Supplier Requirements.

Prior to work, the supplier shall submit samples of the finished emulsion and rejuvenating agent to the Division of Materials and Tests. The Engineer may request samples of the rejuvenator and the emulsion for testing during the life of the project.

Provide portable scales suitable for use in calibrating the aggregate spreader.

**Equipment**

Provide the following equipment used for the scrub-seal operations:

**A. Asphalt Distributor**

The asphalt distributor for application of the emulsion shall be fully operational, have a full circulation spray bar that is adjustable to at least sixteen feet wide in two feet increments, and be capable of heating and circulating the emulsion simultaneously. It must have a computerized rate control for adjusting and controlling the application from the cab within 0.01 gallons per square yard increments. The distributor shall also be equipped with a volume measuring device and a thermometer for measuring the emulsion temperature in the tank. Nozzles on the distributor bar shall be clean, properly oriented, fully operational, and of the size suggested by the manufacturer to apply the intended application rate with double or triple overlap.

**B. Scrub Broom**

A scrub broom example as identified in Exhibit "A" within this provision shall be used to scrub the emulsion.

The scrub broom frame shall be constructed of metal. The scrub broom shall be attached to and pulled by the distributor truck. The scrub broom must be equipped with a means of raising and lowering the scrub broom at desired points. It shall be towable in the elevated position. The broom assembly shall be such that it will maintain a constant head of emulsion without sweeping the emulsion off the roadway surface.

The main body of the scrub broom shall have a frame size that has a minimum width equal to or larger than the lane width of the slurry seal operation. The nearest and furthest members, paralleling the back of the spreader truck, and diagonal members shall be equipped with street brooms. The leading member and the trailing member shall have broom heads angled at 10° to 15° off the centerline of the supporting member. The diagonal members shall have broom heads attached in line with the centerline of the supporting member. Each individual street broom attached to the scrub broom assembly shall have uniform, stiff nylon bristles. Bristle height is to be maintained at a minimum of 5 inches +/- 0.5 inch and shall be replaced if significantly worn.

### **C. Aggregate Spreader**

A self-propelled aggregate spreader with front discharge that can consistently and evenly distribute aggregate shall be used. The aggregate spreader shall be calibrated in the presence of the Engineer off site using aggregate intended to be used on the project as described in the test strip section.

### **D. Rollers**

A minimum of 2 self-propelled pneumatic tire rollers weighing at least 5 tons each shall be used on the project. Tire pressure shall be specified by the manufacturer and shall not vary more than plus or minus 5 pounds per square inch.

### **E. Power Broom**

Provide 2 mechanically powered kick-brooms or other mechanical sweeping equipment that are in good dependable condition and shall be used.

## **Construction Requirements**

### **A. Preparation**

Remove any and all vegetation within the limits of the scrub seal installation. The use of herbicides will be allowed at the discretion of the Engineer.

If used, the herbicide shall be applied at least 10 days prior to the scrub seal operation, or as directed by the manufacturer of the approved herbicide. The application of the herbicide shall be performed in accordance with all applicable regulations. Any and all fines or clean-up costs for unlawful misuse or discarding of herbicides shall be the sole responsibility of the Contractor. Mixtures and spread rates for the herbicides shall be determined by the manufacturer's specifications. Wash down of equipment or discarding of herbicides shall not enter the catch basins or positive drainage facilities.

Remove all markers and adhesives and abrade thermoplastic before applying the emulsion within the scrub seal limits. All removal shall be accomplished without the pavement being gouged or damaged and in a manner which ensures the finished scrub seal will properly adhere in all areas applied. Removal shall be performed to the satisfaction of the Engineer.

All drop inlets, manholes, utility valve covers, monument covers, and any identified areas shall be protected by applying and securing protective cover over the exposed facilities. Other methods may be used if approved by the Engineer. Curb and gutter and private entrances shall be protected from emulsion overspray. All traces of protective cover, residual emulsion and aggregate shall be removed from covered objects after the application of the scrub seal and/or prior to the final inspection of the project.

Immediately prior to the scrub sealing operations, sweep the entire pavement surface.

## **B. Test Strip**

At the beginning of the project calibrate the settings for the distributor and aggregate spreader prior to continuous production. The application rates shall be verified in the presence of the Department to assure that the appropriate target application rate is applied.

The distributor shall be calibrated by applying asphalt emulsion for a minimum 300 feet continuous section. The amount of material distributed shall be within 5% of the intended application rate and shall be verified by use of the strapping stick as supplied by the equipment manufacturer. Neither a visual gauge indicating volume nor the computer readout shall be used as a calibration method.

For aggregate spread rate verification place two square tarps on a location offsite, that measure 1.0 square yard adjacent to each other and in front of the spreader. Allow room for the spreader to reach operating speed and discharge aggregate while passing over the tarps. Carefully collect each tarp at the corners and using an approved scale determine the weight of the aggregate on each tarp. The weight should not vary by more than 5% between tarps.

If the mean difference in the target weight and the actual measured weight is over 2.5 pounds per square yard, the aggregate spreader shall be adjusted such that the spread rate is within the above tolerance. The above procedure shall be repeated until the spread rate is consistently within the allowable tolerance. Verify the aggregate spread rate daily prior to the beginning of each day's production. At the direction of the Engineer, frequency of this verification may be reduced.

Once both spread rates are accepted by the Engineer, do not adjust the settings unless directed by the Engineer to do so.

## **C. Application**

Curb and gutter, identified concrete surfaces, and private entrances shall be protected from emulsion overspray. Hand brooming may be necessary to assure that the surface treatment is uniform along the edges of gutter or curb faces. Where no curb or gutter exists, the scrub seal

shall be applied from edge of pavement to edge of pavement or as identified in the typical sections of the plans. The edges of the scrub seal application shall be maintained in a neat and uniform line.

The asphalt distributor should not be permitted to start spraying until the brooms, aggregate spreader and loaded trucks are in line and ready to apply the cover aggregate, and pneumatic-tire rollers are ready to begin rolling the cover aggregate as soon as it has been spread.

When constructing a scrub seal in half-road widths, a strip of uncovered asphalt emulsion 3 to 4 inches wide shall be left along the inside edge when spraying the first half-width, to create an overlap when spraying the second half width. Other methods may be used if approved by the Engineer.

To construct transverse joints, the asphalt distributor shall start spraying and should stop spraying (if ending at a sensitive point) on a sufficient length of secured building paper, felt, or other suitable material placed transversely across the roadway.

The polymer modified rejuvenating emulsion shall be applied at a temperature of 140 to 180 °F only when the ambient temperature is 60°F and rising. The emulsion shall not be placed if the forecast ambient temperature during a 24-hour curing period is expected to be below 50°F.

The emulsion shall be applied undiluted with a distributor truck at a rate of 0.25 to 0.35 (gallons per square yard). If the emulsion is being placed on a milled surface, the application rate shall be 0.30 to 0.40 (gallons per square yard). The actual emulsion application rate shall be determined from the surface demands and aggregate used. This target rate shall be determined with a test strip in the presence of the Engineer and manufacturer's representative if necessary.

In small areas, the emulsion may be applied with the hand wand to minimize overlap. Spread rates of emulsion shall be verified daily by the contractor in the presence of the Engineer. The strapping stick as supplied by the equipment manufacturer shall be utilized to measure the gallons of emulsion used.

Immediately following the application of the emulsion to the road surface, the material shall be scrubbed with a scrub broom for the purpose of forcing the emulsion into the existing surface and distributing the emulsion evenly transversely and over variable road surface cracks and contours.

The application of the polymer modified asphaltic rejuvenating emulsion and scrub broom operation shall cease 40 feet prior to the end of the application. The remaining polymer modified asphaltic rejuvenating emulsion shall be drug out by the scrub broom, and the remaining emulsified material required to complete the pass shall be applied only by the distributor truck, at the specified rate if needed.

Immediately following the scrubbing of emulsion, cover aggregate shall be applied and spread evenly by a mechanical spreader at an application rate of 18 to 25 pounds per square yard. The actual aggregate application rate shall be as required by the surface demands and the emulsion

used. The rate shall be adjusted, within the specified limit, so that no “bleed through” occurs during rolling. The application rate of the aggregate shall be determined with a test strip in the presence of the Engineer.

If at any point during production, excessive aggregate is noted, the aggregate application rate should be re-verified and the spread rate adjusted. The intent is to minimize the amount of excess aggregate. Excess aggregate removed from the roadway surface after brooming shall be removed from the job site and should not be reused in the aggregate operation. All deficient areas shall be covered by additional material.

A minimum of two self-propelled pneumatic tire rollers shall be used for the required rolling of the aggregate. The pneumatic tire rollers shall be in good working condition and actively rolling at all times during the scrub seal operation. The pneumatic tire rollers shall be operated in such a manner to properly seat and prevent the dislodging of newly applied aggregate. Depending on the speed of the scrub seal operation and the width of coverage, additional rollers may be required. At no time shall the rollers travel more than 10 mph.

Sweeping must be done before opening to uncontrolled traffic after scrub seal operations to remove any excess loose aggregate and prepare the roadway for temporary pavement marking. A second sweeping may be directed by the Engineer on the previous days seal operation to remove any loose aggregate. Sweeping must be done prior to any additional application of temporary pavement marking. Additional sweeping may be required as directed by the engineer. Control excessive dust as directed by the engineer.

For inner-layer applications the scrub seal shall be cured prior to placing a bituminous overlay, micro-surfacing or other asphalt surface treatments. The work shall be staged such that any scrub seal inner-layer placed shall be covered by the succeeding surface treatment within 72 hours or as approved by the Engineer.

Do not allow uncontrolled traffic on the treatment until it has cured. The status of being cured shall be determined by the ability to sweep all loose aggregate from the surface without removing any aggregate adhered to the bituminous emulsion.

### **Maintenance and Protection**

Maintain in a satisfactory condition for each completed section of seal coat until the entire Project is complete. Maintenance shall include making repairs where failures occur, and maintaining the seal coat in a smooth uniform condition; and brooming, dragging, and rolling when required.

After the final application, maintain the work in a satisfactory condition for at least 10 calendar days. If all other requirements of the Contract have been fulfilled, the Department will not charge working time during the 10-day maintenance period against the Contract time.

For final cleanup, sweep up all excessive quantities of loose, dislodged cover aggregate that may have collected along the edge of the completed seal coat, and dispose of this material as directed by the Engineer.

**Stockpile Sites**

Sites for stockpiles of materials shall be grubbed, cleaned, and approved prior to storing the aggregates. The ground shall be firm, smooth, and well drained. Stockpiles shall be checked for gradation prior to its incorporation into the work. As stockpiles are replenished, they shall be separated daily to verify daily gradations.

**Method of Measurement**

The Department will measure Mineral Aggregate and Asphalt Emulsion by the Ton in accordance with **109**. Certified weigh tickets shall be provided for both materials per **109.01**.

The Department will base the measurement of mineral aggregate on calculations derived from the observed spread rates and is not to exceed the certified weigh tickets provided for the mineral aggregate.

The Department will base the measurement of asphalt emulsion on calculations derived from the certified weigh tickets of the distributor(s) for pre and post application.

**Basis of Payment**

The Department will pay for the accepted quantities, complete in place, at the contract bid price as follows:

Item No.	Description	Unit
414-04.03	ASPHALT EMULSION( SCRUB SEAL)	TON
414-04.04	MINERAL AGGREGATE (SCRUB SEAL)	TON

Such payment shall be full compensation for furnishing all labor and materials, equipment, surface preparation, application, rate verifications, rolling, pre-sweeping, post-sweeping, protection, and all incidentals necessary to complete the work.

Appendix A Test ModificationsASTM D471 Standard Test Method for Rubber Property-Effect of Liquids: Modifications for Polymer Testing, Resistance to Swelling:

1. Using a syringe, place 0.8 gm of latex into an 18 mm diameter DSR mold.
2. Allow the sample to dry at ambient lab conditions (air conditioned) on the bench for 72 hours. Sample should be easily removable from the mold.
3. Take the “button” out of the mold and place the sample into a forced air oven at 40°C (104°F) for 48 hours (on release paper). If at the end of the ambient dry, the sample sticks to the mold, place it into the oven and check it after 1-2 hours.
4. After 48 hours, cool and weigh the sample to the nearest 0.0001 gram and record the weight.
5. Put ½ inch of Rejuvenating Agent into a 3 oz. penetration tin.
6. Place the “button” on the Rejuvenating Agent, and add another ½ inch of Rejuvenating Agent, so that the “button” is covered.
7. Put the cap on the penetration tin and place it into the 40°C oven for 48 hours.
8. Remove the “button” from the Rejuvenating Agent, blot surface of the “button” to remove excess Rejuvenating Agent, cool the “button” to room temperature and weigh it.
9. Calculate weight gain of the “button”, express as %.

ASTM D412A Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension: Modifications

1. To prepare the polymer film, dilute the waterborne polymer to 40% Total Solids Content and pour 57 g into a Teflon or silicone release mold of dimensions 7’’x 7’’ x ¼’’.
2. Allow to dry at 23°C (73 °F) and 50% RH (controlled conditions) for 7 – 10 days total time, during which time the film should be flipped around once, preferably after 3 or 4 days. The film should be transparent in the end.
3. To drive out any residual water, place the film in an oven at 50°C for 30 min. Dried film thickness should be 25 mil +- 5 mils. Discard films <20 mil.
4. Cut out dumbbell-shaped test specimens of dimension 75 mm total length, 25 mm mid-section (L) and 4 mm width of mid-section.
5. Grip in Instron machine with gap size 1 inch, use 8 inch/min cross-headspeed.

ASTM D7426 Standard Test Method for Assignment of the DSC Procedure for Determining T<sub>g</sub> of a Polymer or an Elastomeric Compound Modifications

Use between 3 – 30 mg dry polymer. Instrument used is TA Q2000 Differential Scanning Calorimeter (DSC). Heating rate is 20°C/min.

ASTM E70 Standard Test Method for pH of Aqueous Solutions with the Glass Electrode: Modifications

1. A pH meter with automatic temperature measurement should be used in the evaluation with a calomel cell assembly or combination electrode. Calibration should be made using the procedure with the pH meter, according to ASTM method, prior to testing the pH of the latex. The procedure for measuring pH of the latex should be as follows:
  - (a) Place the electrode and probe into the dispersion that is to be measured and swirl the sample cup or beaker gently. (You may also use the probe in a stirring motion.)
  - (b) Wait for the reading to stabilize (usually less than a minute) and read/record this value. Note the temperature if not utilizing an ATC probe.
  - (c) Take the Electrode and ATC probes from the sample and rinse thoroughly with de-ionized water. Pat dry and place back into appropriate solution recommended by electrode manufacturer for storage.

EXHIBIT "A" - SCRUB BROOM EXAMPLE

