

Rejuvenating Scrub Seal

Sample Construction Specification Guideline

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1. Scope

The scope of this sample construction specification guideline is limited and intended to provide general information regarding the design, component material specification, application, inspection, measurement, and payment of a Rejuvenating Scrub Seal.

2. Description

A Rejuvenating Scrub Seal is an application of a rejuvenating asphalt emulsion scrubbed into the cracks and voids, followed by an application of aggregate. The purpose of this treatment is to extend the service life of a flexible pavement structure. A Rejuvenating Scrub Seal is recommended on flexible pavement exhibiting cracks too numerous to address with normal crack sealing methods and too severe to address with a chip seal.

3. Materials

3.1 Asphalt Emulsion

Asphalt emulsion delivered to the project shall be accompanied by a laboratory Certificate of Analysis. The asphalt emulsion shall meet the following requirements:

Rejuvenating Scrub Seal Product Data Sheet

A cationic asphalt emulsion

Property	Test Procedure	Specification	
	AASHTO	Min	Max
Tests on Emulsion			
Viscosity, Saybolt-Furol, 25°C, (77°F), seconds	T72	50	350
Storage Stability, 24 hours, %	T59	-	1
Sieve Test, %	T59	-	0.1
Distillation Test, 176.6°C (350°F), 20 Minute Hold			
Residue by Distillation %, weight	T59	60	-
Oil Distillate, %, volume	T59	-	0.5
Tests on Residue from Distillation			
Penetration, 4°C, 39.2°F, 200 g, 60 seconds, dmm	T49	30	-
Tests on Residue from Low Temp Evaporation			
AASHTO R78 Procedure B			
MSCR, 52°C, Jnr, at 3.2/kPa	T350	-	4.0
MSCR, 52°C, % Recovery, 0.1/kPa	T350	30	-
Polymer Properties²			
Swelling in Rejuvenating Agent, % Max Weight Increase	ASTM D471 Modified ¹	-	40
Tensile Strength (psi)	ASTM D412A Modified ¹	800	-
Rejuvenating Agent Properties²			
Flash Point, COC, °C	T48	193.3	-
Viscosity, 60°C (140°F), cSt	T201	-	300
Saturate, %, weight	ASTM D4124	-	30
Asphaltenes, %, weight	ASTM D4124	-	1.0
Residue Properties From RTFO			
Mass Change, %	T240	-	6.5
Viscosity Ratio, (RTFO/Original)	T201	-	3

1. Refer to Appendix A for Test Modifications.
2. The emulsion supplier and the contractor will provide the pertinent COAs upon request. The agency shall not accept test results dated more than 120 days from the date of the project start. At any time during the project, the agency may obtain, and have tested at agency expense, samples of the recycling agent being used in manufacturing of emulsion delivered to the project.

3.2 Aggregate

The aggregate shall meet gradation requirements of ASTM section 800 for Size 89 and shall be washed, hard, durable, clean rock such as granite, slag, limestone, or other high-quality aggregate and free from coatings or deleterious material. All of the aggregate shall be crushed with 100% fractured faces. The aggregate shall have maximum loss of 35% when tested with the LA Abrasion procedure as defined by AASHTO T96. The maximum amount of flat and elongated aggregate with a ratio of 3:1 shall not exceed 18% as determined by ASTM D4791.

4. Mix Design

A mix design shall be performed using the Modified Kearby Method or other design method as approved by the agency. The design shall be completed with materials representing those used on the project by a qualified laboratory and submitted by the contractor at least five days prior to the start of the project. The design shall indicate the target asphalt emulsion application rate based on pavement condition metrics such as average daily traffic and surface texture.

5. Equipment

5.1 Asphalt Distributor

The distributor shall be self-powered and capable of providing a uniform application rate of asphalt binder varying from 0.05-1.00 gal/yd² (0.23-4.5 liters/m²) over a variable width up to 16 feet (4.88 m) in a single pass, include computerized application controls, and be capable of heating material to 160°F (71.1°C). Nozzles on the distributor bar shall be fully operational and of the size suggested by the distributor manufacturer to apply the intended application rate.

5.2 Aggregate Spreader

The aggregate spreader shall be self-propelled and supported by at least four tires on two axles capable of providing a uniform application rate of aggregate from 5-50 lb/yd² (2.7-27.1 kg/m²) over a variable width up to 16 feet (4.9 m) in a single pass. The uniformity of this machine shall not vary by more than 1lb/yd² (0.54 kg/m²). The aggregate spreader shall be equipped with the means of applying the aggregate to the surface with computerized application controls so that the required amount of material will be deposited uniformly over the full width of the bituminous material.

5.3 Broom Sled

Scrub emulsion with an emulsion broom sled frame constructed of metal. The emulsion broom sled shall be attached to and pulled by the distributor truck. The emulsion broom sled must be equipped with a means of raising and lowering the emulsion broom sled at desired points. It shall be towable in the elevated position. The broom sled assembly shall be adjustable so that it does not push the emulsion off the roadway surface or outside the framework of the broom sled. Effective broom sled designs for the purpose of mass crack sealing shall be approved by the engineer and demonstrate the capability of mass crack sealing during the 500' test strip the desired width of the lane.

5.4 Rollers

A minimum of two 10-16 ton (9.1-14.5 metric tons) self-propelled pneumatic tired rollers shall be used on the project unless otherwise requested by the agency. Tire pressure shall be specified by the manufacturer and shall not vary more than +/- 5 psi. Depending on the speed of the Rejuvenating Scrub Seal operation and the width of coverage, additional rollers may be required. At no time shall the rollers travel more than 10 mph (16.1 kmph).

5.5 Broom

Self-propelled four-wheeled rotary mechanical brooms and/or vacuum brooms capable of operating in both forward and reverse are recommended. Brooms should be in good condition and meet applicable environmental standards.

5.6 Aggregate Handling Equipment

Standard bucket loader capable of transferring aggregate to the haul trucks is required. Standard rear discharge dump trucks of sufficient number to maintain adequate production relative to the size of the project are required.

6. Equipment Calibration

6.1 Asphalt Distributor

The distributor shall be calibrated by applying asphalt emulsion for a minimum 300 foot (91.4 m) continuous section. The amount of material distributed shall be within 5% of the intended application rate at the intended width to be used on the project 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.

Asphalt emulsion application rate is expressed in gal/yd² (L/m²).

Alternate calibration methods may be utilized as approved by the agency.

6.2 Aggregate Spreader

The aggregate spreader shall be calibrated using aggregate intended to be used on the project. Place two square tarps (typically supplied with the spreader) that measure exactly 1 yd² (1 m²), 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 a hand-held scale (typically supplied with the spreader), determine the weight of the aggregate on each. The weight should not vary by more than 5% between tarps. Aggregate spread rate is expressed in lb/yd² (kg/m²).

Alternate calibration methods may be utilized as approved by the agency.

7. Test Strip

Prior to the beginning of the project, the contractor may be required to perform a test strip in a suitable area such as a parking lot or staging area to assure the materials, contractor personnel, and equipment are suitable to produce a satisfactory Rejuvenating Scrub Seal. The location for the test strip shall be approved by the owner. The test strip may be conducted as part of the calibration procedure and may be considered as part of the project.

8. Weather

The Rejuvenating Scrub Seal shall not be placed when rain is possible prior to curing of the product or when freezing conditions are expected within 24 hours of application. Both ambient temperature and roadway surface temperature in all areas shall be minimum 50°F (10°C) and rising before beginning application.

9. Traffic Control

Prior to start of the project, a traffic control plan shall be developed to address all aspects of traffic control, including without limitation, coordination with local officials and traffic control equipment and methods. The traffic control plan is intended to promote controlled traffic flow through the project in order to protect the safety of the contractor and owner personnel, the public, and the product. The traffic control plan shall remain in place until the product has sufficiently cured to withstand traffic without damage. Any damage to the newly applied Rejuvenating Scrub Seal due to construction traffic or the premature release of traffic shall be repaired to the satisfaction of the owner at the contractor's expense.

10. Surface Preparation

10.1 General

Immediately prior to applying the Rejuvenating Scrub Seal, the pavement surface shall be cleared of all loose material, silt spots, vegetation, and other objectionable material. If water is used, cracks shall be allowed to dry thoroughly before applying the asphalt emulsion. Manholes, valve boxes, drop inlets, and other service entrances shall be protected from the asphalt emulsion by a suitable method. Prior to application of the Rejuvenating Scrub Seal, thermoplastic striping should be roughened or removed, without damaging the integrity of the existing pavement, unless one or more of the following factors are identified:

- The application is not intended to be the final wearing course.
- The striping is significantly worn and/or cracked.
- The application is on a low-volume route.
- Application history and/or experience indicate the striping is not a concern.

The owner shall approve the surface preparation prior to application of the asphalt emulsion.

10.2 Patching

Prior to application, all failed pavement sections should be removed and patched using accepted best practices. The perimeter of excavated areas should be milled or saw cut to form a neat vertical face. Unstable areas of sub-grade should be backfilled with well-graded and compacted aggregate and filled flush with the pavement surface with an appropriate asphalt aggregate mixture. Patching should be completed 30 days prior to application of the Rejuvenating Scrub Seal. Patches may require an individual application of asphalt emulsion prior to the full-width application.

11. Application

11.1 Asphalt Emulsion

The asphalt emulsion shall be applied by means of a pressure distributor. Application shall be a uniform, continuous, full-coverage spread, and under such pressure as to thoroughly coat the surface at the specified rate. The temperature of the asphalt emulsion during application shall be maintained from 140°F-180°F (60°C-82.2°C). All nozzles within the intended width of spray shall be free of clogs and operating properly, applying a full fan of asphalt emulsion to the pavement. At any time the nozzles are not functioning properly, application is to be stopped immediately and repairs made to the equipment. The width of the emulsion application shall be no greater than the width of the aggregate spreader except where additional passes are required, then the emulsion shall be four inches beyond the aggregate spread at a 50% application rate. At no time shall the emulsion be allowed to break, chill, set up, harden, or otherwise impair the aggregate retention before the aggregate has been properly applied and rolled.

11.2 Broom Sled

The broom sled shall be attached to the distributor in such manner as not to interfere with the distributor operation. The broom sled shall be adjusted to allow for even distribution of weight across the broom heads. The broom sled shall contain all emulsion applied by the distributor and carry an excess amount or wave of material ahead of the broom heads that will be forced into the cracks and voids by the mechanical forces of forward motion and downward pressure of the broom sled.

11.3 Aggregate

The aggregate shall be spread evenly onto the asphalt emulsion, as soon as possible and within two minutes, within 10% of the application rate specified in the mix design. Spreading shall be accomplished in such a manner that the tires of the trucks and aggregate spreader do not contact the newly applied asphalt emulsion. The width of the aggregate spreader shall be equal to the width of the emulsion spread, except where additional passes are required. Areas that are deficient in aggregate shall be covered immediately with additional material.

11.4 Rolling

Initial rolling shall begin immediately after the application of aggregate. Rollers shall work in tandem and complete a minimum of three passes with a sufficient overlap. Should the rolling operation be delayed, the aggregate and emulsion application shall be halted until the operation regains proper sequencing and timing. The maximum speed of the rolling operations shall be 10 mph (16.1 kmph).

11.5 Sweeping

Within 24 hours of curing, excess aggregate shall be swept from the roadway and adjacent areas. High-traffic areas may require sweeping prior to release of traffic control. A minimum of six hours is required for the Rejuvenating Scrub Seal to retain aggregate in normal conditions. Sweeping shall be delayed if damage to the seal occurs as a result of the broom operation.

12. Material Storage and Handling

12.1 Asphalt Emulsion

Asphalt emulsion stored on the jobsite must be agitated and heated using the distributor prior to use. Stored emulsion shall be inspected by the contractor for suitability prior to use on the project. The contractor shall comply with all material handling, storage, and safety requirements outlined in any applicable SDS or other product label.

12.2 Aggregate

Aggregate intended for use on the project shall be maintained in such manner as to protect it from contamination by debris and excess moisture. Large or oversized particles shall be removed from the aggregate by screening or other acceptable method prior to use on the project.

13. Inspection

Assure all equipment operations are functional. The nozzles shall be clean and producing a consistent fan of material, providing full and complete coverage of material across the asphalt surface with no overlap or excessive material. Assure the aggregate is evenly applied within design target and with no bare spots. Assure emulsion is within required temperature range prior to application. Assure operation of broom sled is providing the necessary wave of excess asphalt emulsion to fill large cracks and voids. Assure broom heads are not excessively worn. Assure aggregate is not extremely wet or dusty. Assure the Rejuvenating Scrub Seal is sufficiently cured prior to brooming of excessive aggregate. Document job progress reporting, including weather conditions, material test results, application rates, quantities used, the location of any areas of concern, and reason for concern. Assure traffic control measures are in place and are adequate to satisfy all safety and product requirements.

14. Measurement

The Rejuvenating Scrub Seal shall be measured in square yards (square meters) covered.

15. Payment

Payment shall be in consideration of all materials, tools, labor, and other items as necessary to complete the project as required by the plans. The Rejuvenating Scrub Seal shall be paid for by one of the following options:

- By the square yards (square meters) covered
- By the gallons (liters) of emulsion and ton of aggregate used

APPENDIX A

Test Modifications

ASTM 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 1/2 inch of Rejuvenating Agent into a 3 oz penetration tin.
6. Place the “button” on the Rejuvenating Agent, and add another 1/2 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 1/4."
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 three or four 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 minutes. Dried film thickness should be 25 mils +/- 5 mils. Discard films <20 mils.
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-head speed.

ASTM D7426 Standard Test Method for Assignment of the DSC Procedure for Determining Tg 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 D6937 Standard Test Method for Determining Density of Emulsified Asphalt: Modifications

Replace "Emulsified Asphalt" with "Latex" in text of test method. The testing temperature used should be 25 +/- 3°C. The calculation in Section 7 should be as follows:

Calculation:

$$D = (W_f - W_t) * 0.1$$

$$S.G. = D / 8.337$$

Where: W_f = Weight of filled cup (g)

W_t = Weight of empty cup (g)

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. In Section 9, 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.