

APPENDIX A - LATEX MODIFIED EMULSIFIED ASPHALT SLURRY SEAL SURFACE TREATMENT SPECIFICATIONS

A. DESCRIPTION

1. GENERAL:

The slurry seal shall consist of a mixture of latex modified emulsified asphalt, mineral aggregate, water, and approved additives. The materials shall be properly proportioned, mixed, and uniformly spread over a properly prepared surface as outlined in the special provisions. The completed slurry seal shall leave a homogeneous mat, adhere firmly to the prepared surface, and have a friction resistant surface texture throughout its service life.

2. PROJECT EXTENT:

The extent of the slurry seal shall conform to the dimensions shown on the plans or as directed by the Engineer.

B. SPECIFICATIONS

1. MATERIALS:

- a. Asphalt Emulsion: The emulsified asphalt shall be grade LM-CQS-1h, as specified in ASTM D 5840, with the following exception: the allowed polymer shall be Ultrapave SBR Latex, or approved equal, only. The latex shall be co-milled into the emulsion through the water phase during manufacturing. It shall be homogeneous and shall show no separation after thorough mixing with the other materials. It shall break and set on the aggregate within five (5) minutes and be ready for traffic within 90 minutes.

Each load of polymer modified asphaltic emulsion shall be accompanied with a certificate of analysis/compliance from the manufacturer to assure that it is the same as that used in the mix design. The certificate shall state the percentage of polymer added by weight of the asphalt as well as the composition of the polymer. The addition of latex to the emulsion after emulsion manufacturing is prohibited.

The polymer modified asphalt emulsion shall conform to the following specifications:

Tests on Emulsions

<u>Test</u>	<u>Test Method</u>	<u>Requirement</u>
Viscosity, SSF @77°F, seconds	ASTM D244 or AASHTO T59	15 – 90
Asphalt Content (residual)	ASTM D244	62% minimum
Particle Charge	ASTM D244	Positive

Test on Residue from Distillation Test

<u>Test</u>	<u>Test Method</u>	<u>Requirement</u>
Penetration	ASTM D5	40-90
SBR Polymer Content	CTM 401	3% minimum

*Solid polymer content based on weight of residual asphalt.

- b. Polymer Modifier: The amount of latex polymer modifier shall be determined by the laboratory performing the mix design. The amount required will be based on bitumen weight content and will be certified by the emulsion supplier. A minimum of 3 percent (3%) polymer solids, based on asphalt weight, is required.
- c. Aggregate: Aggregate shall be for Type II slurry seal. It shall come from sources approved by the City and consist of manufactured crushed stone such as granite, slag, limestone, or other high-quality aggregates or a combination thereof. To assure the material is totally crushed, 100 percent (100%) of the parent aggregate will be larger than the largest stone in the gradation. The aggregate shall be free of organic matter.

The aggregate, (including the mineral filler) shall conform to the following gradation, per ASTM C136 and ASTM C117:

<u>Sieve Size</u>	<u>%Passing</u>
3/8"	100
#4	90-100
#8	65-90
#16	45-70
#30	30-50
#50	18-30
#100	10-21
#200	5-15

The aggregate shall meet the following test requirements:

<u>Test</u>	<u>Test Method</u>	<u>Requirements</u>
Sand Equivalent	ASTM D2419	60 Minimum
Soundness	ASTM C88	15% max using Na ₂ SO ₄ Or 25% Max using MgSO ₄
Abrasion Resistance	ASTM C131	35% Max

The mix design shall set the target gradation. The stockpile(s) shall meet the gradation as set in the mix design, within the ranges specified above.

Aggregate shall be stockpiled at a single location obtained by the Contractor. Precautions shall be taken to prevent segregation of the aggregate during storage and handling. The Contractor shall have written permission from the owner of the property and supply the City with a copy of that written permission. A plan outlining the proposed stockpiling, including protection from contamination and moisture, shall be submitted to and meet the approval of the City prior to stockpiling. Any streets or private property surrounding the stockpile area shall be kept clean and dust-free.

The aggregate will be accepted at the stockpile. The stockpile shall be accepted based on the average of five samples per 500 tons of aggregate tested in conformance with ASTM D75. If the average of the five tests is within the gradation set by the mix design, the material will be accepted. If the material is outside this specification, the Contractor shall remove the material or blend it with other aggregates to bring it into compliance with the specification. Materials used to blend must meet all specifications as stated herein. The Contractor shall pay the cost of retesting the stockpile until it meets this specification. A new mix design may be required by the Engineer if the original stockpile does not pass the gradation tests.

Screening shall be required at the stockpile.

- d. Mineral Filler: Mineral filler shall be either Portland Cement, hydrated lime, limestone dust, fly ash, or other approved filler meeting the requirements of ASTM D242 and shall be used if required by the mix design. The mineral filler shall be considered part of the aggregate.
- e. Water: The water used in the slurry seal shall be potable, free of harmful salts and contaminants.
- f. Additives: Additive may be used to accelerate or retard the mixing and setting characteristics of the slurry seal or improve the resulting finished surface. The use of additives in the slurry mix (or individual materials) shall be made initially in quantities predetermined by the mix design with field adjustments if required. If the use of additive during application exceeds ± 1 percent ($\pm 1\%$) deviation from the recommendations of the mix design, a new mix design will be required to verify system performance at the altered additive levels.

2. MIX DESIGN

The mix design shall cover the specific materials to be used on the project. Compatibility of the aggregate, emulsion, mineral filler, and additives shall be verified by the mix design. Liquid retardants and mineral fillers may be used when their amounts can be metered; the mix design shall determine the maximum amounts that can be used to improve the workability of the mix or gradation of the aggregate. The mix design shall include the same aggregate gradation that the Contractor shall provide on the project. (Aggregate sources will be approved after submission of the mix design.) A lab certified mix design shall be submitted by the Contractor at the preconstruction conference.

The lab shall also report the quantitative effects of moisture content on the unit weight of the aggregate. The report must show the proportions of aggregate, mineral filler, water, additives, use for each additive, and asphalt emulsion based on the dry weight of the aggregate. The proportions may be adjusted slightly during construction only upon approval of the Engineer. No application may take place until the Engineer approves the mix design in writing. Proportions of the materials shall be within the following limits:

RESIDUAL ASPHALT	7.5%-13.5% Based on the dry weight of the aggregate
MINERAL FILLER	0%-3% Based on the dry weight of the aggregate
ADDITIVES	As needed to control mixing and setting times. To be determined by the mix design.
WATER	As needed for mix consistency. To be determined by the mix design.

After the mix design has been approved, no substitution of materials shall be permitted. If changes in materials are required, a new mix design, using the new materials, shall be submitted to the City for approval prior to the start of application. A new mix design will be required if any of the materials delivered to the site deviate from those in the mix design.

The mix design shall be current to within 30 days of the start of slurry seal application. The laboratory performing the mix design shall have at least two years' experience with slurry seal mix design and shall be capable of performing all tests outlined below.

The following are International Slurry Seal Association (ISSA) tests:

<u>Test</u>	<u>Description</u>	<u>Specification</u>
TB-113	Mix Time*	Controllable to 150 seconds minimum
TB-139	Wet Cohesion 60 minutes minimum	20kg-cm minimum
TB-109	Excess Asphalt By LWT sand adhesion	50g/ft ² maximum (538 g/m ² maximum)
TB-114	Wet Striping	Pass (90% minimum)
TB-100	Wet Track Abrasion* Loss – one-hour soak	60g/ft ² maximum (647 g/m ² maximum)
*The Mix Time and set time test should be done at the maximum temperatures expected during construction. **The Wet Track Abrasion test is used to determine the minimum asphalt content.		

At the request of the Engineer, the Contractor shall submit samples of the materials in the mix design. The Contractor shall submit each material in the following quantity with its corresponding MSDS Sheet(s):

Asphalt - 1 Gallon
SBR Latex - 1 Pint
Asphalt Emulsion - 1 Quart
Aggregate - 50 Pounds

3. CONSTRUCTION METHODS

- a. Pavement Preparation and Cleaning: It shall be the responsibility of the Contractor to prepare pavement surfaces to ensure proper bonding. The surface shall be free of any loose dust, dirt, or debris.

All cracks shall be free of organic and loose material. This shall include the joint between the curb/gutter and the pavement. Organic material shall be removed by flame torch or mechanical means. Chemical removal will not be allowed. All foreign and loose material shall be completely removed with compressed air, flushing, sweeping, or other repairs as necessary to ensure cleanliness, immediately prior to slurry application. **Inspection emphasis shall be placed on a clean street with all cracks free of organic matter.**

The Contractor shall remove pavement markings by microgrinding to ensure that the slurry properly bonds to the street. Raised reflectorized pavement markers shall be removed and replaced.

Oil, grease, or other material detrimental to the adhesion of the slurry seal shall be removed with non-toxic chemical remover. The chemical shall be specifically formulated for oil and grease removal without damage to the pavement. The Contractor shall submit the proposed product name, sample label, and MSDS sheets to the Engineer for approval prior to use.

The Contractor shall sweep and clean the street from curb to curb immediately prior to application of the slurry seal. Sweeping shall be done with a vacuum-type sweeper and be completed no more than 24-hours prior to application of the slurry seal. If the Contractor is delayed more than 24 hours between cleaning and sealing, the Contractor shall re-clean at no additional cost. Flushing and hand cleaning of streets shall be done as needed or as directed by the Engineer.

- b. Utility Covers: Before slurry seal is to be applied to any area, all utility lids, including manholes, catch basins, valve boxes, and vault covers shall be securely covered. The cover shall be secure and leak-free and shall protect the utility. The lids shall be cleaned as quickly as possible after the application of the slurry seal and not later than the final set. If necessary, slurry residual shall be cleaned from the interior of the utilities.
- c. Water: Water, in proportions shown in the approved mix design, shall be used to develop a good mix. The City will provide water free of charge. At the preconstruction conference, the City and the Contractor shall agree on a fire hydrant to be used as the water source for the project. The Contractor shall then take water only from the approved hydrant and no other. The Contractor's equipment shall be equipped with approved backflow prevention devices in good working order. The City shall strictly enforce the backflow device requirement.
- d. Mixing and Spreading Equipment: All machines, equipment, and tools used in the performance of this work shall be maintained in satisfactory working order at all times. In addition to the slurry application equipment, suitable surface preparation equipment, traffic control equipment, hand tools, and other needed support equipment shall be provided in sufficient quantity to perform the work.

The slurry mixing and spreading equipment shall be specifically designed and manufactured for slurry seal application. The slurry shall be mixed with a self-propelled slurry-mixing machine. The unit shall be capable of accurately delivering and proportioning the aggregate, emulsified asphalt, mineral filler, control setting additive, and water to the mixing chamber. The mixing unit shall be capable of thoroughly blending all ingredients together. The aggregate shall be proportioned using a belt feeder operated with an adjustable cutoff gate. The height of the gate opening shall be readily determinable. The aggregate shall be moistened immediately prior to mixing with the emulsion. The mixing unit shall be equipped with an approved fines

feeder that provides an accurate metering device to add the mineral filler to into the mixer at the same time and location as the aggregate. The emulsion shall be proportioned by a positive displacement pump. A variable rate emulsion pump, if used, shall be equipped with a mechanism that locks the pump in its calibrated position.

The mixing unit shall be equipped with a water pressure system and fog type spray bar. It shall be capable of completely fogging the pavement surface with between 0.05 - 0.10 gal/sy of water. The fog spray shall precede the spreading equipment.

The mixing unit shall have sufficient storage capacity for each material used in the mix design to maintain an adequate supply to the proportioning controls. The proportioning controls must be clean and easy to read and properly marked. The appropriate settings/readings will have been determined during calibration of the equipment. No slurry seal shall be applied until the slurry mixing and spreading units have been calibrated to the satisfaction of the Engineer. Excessive mixing shall not be permitted. The mixed slurry shall be discharged in a uniform continuous flow.

The slurry shall be spread with a conventional surfacing spreader box attached to the mixer and equipped to agitate and spread the material evenly throughout the box. A front seal shall be provided to insure no loss of the mixture at the road contact point. The rear seal shall act as a final strike-off and shall be adjustable. The spreader box and rear strike-off shall be designed and operated to provide a free flow of uniformly consistent slurry to the rear strike-off. The spreader box shall have adjustable controls to compensate for variation in the pavement geometry, width, crown, and grade. The box shall be kept clean. Buildup of asphalt and aggregate shall not be permitted. A burlap drag or other approved screed may be attached to the rear of the spreader box to provide a uniform, highly textured mat.

- e. Calibration: Before application can begin the City and the Contractor shall calibrate each mixer-spreader truck to be used on the job. Each truck shall be calibrated to determine the delivery rate of aggregate, mineral filler, emulsion, water and other additives. The calibration shall confirm appropriate gauge readings/settings for each material. The Contractor shall arrange for scales to be used during calibration. Each application truck shall be weighed empty and after loading of the aggregate. Calibration of each unit shall provide the Engineer with a visual reference between tons of aggregate and fill level for each application truck. The calibration shall demonstrate that delivery rates of each material are within the limits of the approved mix design.

The Contractor shall provide written calibration documentation for each mixer-spreader truck to be used on the job. The written calibration documentation must cover the exact materials to be used, as specified in the mix design. The documentation must have been completed within the previous calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machine's metering devices. No machine will be allowed to work on the project until the calibration has been completed and accepted by the Engineer.

It is the responsibility of the Contractor to check stockpile moisture content and to set the machine accordingly to account for aggregate bulking.

- f. Rate of Application: The rate of application of dry aggregate per square yard shall be 10 to 14 pounds for Type II. The application shall be sufficient to provide minimum depths of 3/16-inch for Type II. The depth of the slurry seal will be sufficient to correct surface conditions, fill surface voids, provide sealing, and a minimum-wearing surface.
- g. Weather: Slurry seal shall only be applied when the atmospheric temperature is at least 50°F and rising. Slurry seal shall not be placed after 2:00 p.m. unless authorized by the City. The slurry seal shall not be applied during periods when weather conditions inhibit curing such that streets cannot be opened within three (3) hours of slurry seal application.
- h. Application of Slurry Seal: When required by local conditions, the surface shall be pre-wetted by fogging ahead of the spreader box. The rate of application of the fog spray shall be adjusted during the day as

pavement temperatures and humidity change. No free water shall be on the pavement surface following the fog spray.

The slurry mixture shall have a smooth and uniform consistency upon leaving the mixer. The spreader shall be uniformly full, with no empty pockets, to insure complete coverage of the pavement surface. The slurry shall be applied within the mix time, as determined by the mix design. No excessive breaking of the emulsion will be allowed in the spreader box. The application rate shall be as specified herein and the mixer-spreader truck's speed shall insure the application rate is met. Overloading of the spreader box shall be avoided.

No streaks, such as those caused by oversized aggregate, will be left in the finished surface. No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarse aggregate will be permitted. If the coarse aggregate settles to the bottom of the mix, the slurry will be removed from the pavement surface.

In the case of a concrete gutter, the slurry seal shall cover the crack sealed gutter line joint but shall not overlap onto the gutter. In the case of no concrete gutter, ensure a good seal at curb lines. The flow line at curbs shall allow storm runoff to flow to the catch basins without ponding. Streets that cross this project that have been recently slurry sealed or overlaid will not be slurry sealed. At intersections and curb returns, the sealing shall be to the limits identified by the Engineer.

Longitudinal joints shall correspond with the edges of traffic lanes. All through-lanes shall be spread in full-lane-width pulls only. Longitudinal joints, common to two driving lanes shall be butt joints with overlaps not to exceed three (3") inches. Building paper shall be placed at transverse joints over previously placed slurry seal. No excessive buildup or unsightly appearance shall be permitted on longitudinal or transverse joints. Care shall be taken to insure straight lines along curbs and shoulders. Lines at intersections shall be kept straight.

All incidental work, such as driveway aprons, street returns etc., shall be done concurrently with the street they abut.

Approved hand squeegees with burlap drags shall be used to spread slurry in areas not accessible to the spreader box.

Upon completion of the work, the pavement surface shall be free of holes, bare spots, or cracks. The finished surface shall present a uniform and skid resistant texture satisfactory to the Engineer.

- i. Curing: The cure rate of the polymer modified slurry seal shall allow the area to be opened to traffic within two (2) hours after application without tracking or damage to the surface. Streets shall be opened to traffic upon approval of the Engineer. The City shall not be responsible for any damage to the slurry prior to approval to open the street. Any damage to the slurry shall be repaired at no additional cost to the City.
- j. Clean up: The Contractor shall be responsible for immediate cleanup of any spills caused by the Contractor. Damage caused by the Contractor's operations shall be repaired or replaced to an equal to or better than existing condition, by the Contractor, at the Contractor's expense. Damage restoration must meet the approval of the Engineer.

All material swept or blown onto sidewalks, all trash, all discarded slurry seal materials or other refuse shall be collected daily, removed, and properly disposed of. All project sites must be cleaned to the satisfaction of the Engineer prior to final payment.

4. QUALITY CONTROL AND TESTING

- a. Application Rate Verification: The specified application rate shall be verified with aggregate delivery receipts. The Contractor shall provide the Engineer with receipts for all aggregate delivered to the stockpile. At the end of each day the Contractor shall provide the Engineer the following information:

1. Tons of dry aggregate used that day.
2. Tons of asphalt emulsion consumed that day.
3. The square yards of pavement slurry sealed that day.

This information is due to the Engineer by 10:00 a.m. the following morning.

The estimate of the aggregate used shall be based on the amount each mixer-spreader truck can hold, obtained from the calibration tests. Payment deductions shall be made for insufficient and excessive application rates as outlined in the bid item description. Payment deductions shall be made, based on the above information supplied to and verified by the Engineer.

- b. Testing: The following tests will be performed by the City daily. The Contractor shall provide access to all materials to be tested.

<u>Component</u>	<u>Test</u>	<u>Specification</u>
Oil	Residue	ASTM D244
Aggregate	Gradation	ASTM C136 & ASTM C117
	Sand Equivalent	ASTM D2419
	Moisture Content	
Slurry Mixture	Extraction	ASTM D2172
	Gradation	ASTM C136 & ASTM C117
	Residue	ASTM D244

Samples of the slurry seal will be taken directly from the slurry units at a minimum rate of one sample per mixing unit per day. Aggregate will be sampled at the stockpile and oil will be sampled from the delivery tanker.

SLURRY SEAL TESTING SUMMARY

A. MANUFACTURER CERTIFICATIONS

The following tests and/or certifications shall be supplied by the Contractor and/or manufacturer:

- Asphalt Emulsion:** A Certificate of Analysis/Compliance must accompany each load of asphalt emulsion supplied. This certificate shall indicate that the results of the following tests on the emulsion:

Tests on Emulsions:

	<u>Test Method</u>	<u>Requirement</u>
Viscosity, SSF #77°F, seconds	ASTM D244 or AASHTO T59	15-90
Asphalt Content (residual)	ASTM D244	60% minimum
Particle Charge	ASTM D244	Positive

Test on Residue from Distillation Test

	<u>Test Method</u>	<u>Requirement</u>
Penetration	ASTM D5	40-90
SBR Polymer Content	CTM 401	2-1/2% minimum*

*Solid polymer content based on weight of residual asphalt.

- Aggregate:** The Contractor shall supply documents showing that the aggregate conforms to the following gradation:

<u>Sieve Size</u>	<u>% Passing</u>	<u>Stockpile Tolerance</u>
3/4"	100	±5%
#4	90-100	± 5%
#8	65-90	±5%
#16	45-70	±5%
#30	30-50	± 5%
#50	18-30	±4%
#100	10-21	±3%
#200	5-15	±2%

The Contractor shall also supply reports showing the aggregate meets the following test requirements:

<u>Test</u>	<u>Test Method</u>	<u>Requirements</u>
Sand Equivalent	ASTM D2419	60 Minimum
Soundness	ASTM C88	15% Maximum using NA ₂ SO ₄ or 25% Maximum using Mg SO ₄
Abrasion Resistance	ASTM C131	30% Maximum

3. **Mix Design:** The mix design submitted for approval shall use the following materials in proportions within the following limits:

Residual Asphalt	7.5%-13.5% Based on the dry weight of the aggregate.
Mineral Filler	0%-3% Based on the dry weight of the aggregate.
Additives	As needed to control mixing and setting times. To be determined by the mix design.
Water	As needed for mix consistence. To be determined by the mix design.

The Mix Design should also show the following International Slurry Seal Association (ISSA) tests:

<u>Test</u>	<u>Description</u>	<u>Specification</u>
TB-113	Mix Time	Controllable to 150 Seconds Minimum
TB-139	Wet Cohesion 60-Minute Minimum	20kg-cm Minimum
TB-109	Excess Asphalt By LWT Sand Adhesion	50g/ft ² Maximum (538 g/m ² Maximum)
TB-114	Wet Stripping	Pass (90% Minimum)
TB-100	Wet Track Abrasion* Loss – One Hour Soak	60g/ft ² Maximum (647 g/m ² Maximum)

*The Wet Track Abrasion test is used to determine the minimum asphalt content.
The mix time and set time test should be done at the maximum temperatures expected during construction.

B. CONSTRUCTION MONITORING TESTS

1. **Daily Testing:** The following tests should be performed by a City-hired testing lab daily:

<u>Component</u>	<u>Test</u>	<u>Specification</u>
Oil	Residue	ASTM D244
Aggregate	Gradation Sand Equivalent Moisture Content	ASTM C136 & ASTM C117 ASTM D2419
Slurry Mixture	Extraction Gradation Residue	ASTM D2172 ASTM C136 & ASTM C117 ASTM D244

Samples of the slurry seal will be taken directly from the slurry units at a minimum rate of one sample per mixing unit per day. Aggregate will be sampled at the stockpile and oil will be sampled from the delivery tanker.