

**ITEM 16
SLURRY SEAL**

16.1 DESCRIPTION

The slurry seal shall consist of a mixture of an approved emulsified asphalt, mineral aggregate, water and specific additives, proportioned, mixed and uniformly spread over a properly prepared surface in accordance with the plans and specifications. The complete slurry seal shall leave a homogeneous mat, adhere firmly to the prepared surface, and have a friction resistant surface texture throughout its service life.

Traffic control shall be provided at no additional cost and shall be in accordance with the *Uniform Traffic Control Devices*, latest edition. A traffic control plan shall be submitted to the **AGENCY** at least 10 days before any work is performed. The **AGENCY** will review the plan and may require adjustments to accommodate local conditions. There shall be no additional cost to the **AGENCY** for traffic control.

16.2 MATERIALS

16.2.1 Emulsified Asphalt

The emulsified asphalt shall conform to Grade SS-1h, CSS-1h, CQS-1h as specified in ASTM D 977, D 2397, AASHTO M 140 and M 208. The cement mixing test is waived. Each load of emulsified asphalt shall be accompanied with a Certificate of Compliance.

**TABLE 16.2.1
EMULSIFIED ASPHALT**

Test	Quality	Specification
AASHTO T59	Residue after distillation	60% Min.
AASHTO T49 ¹	Penetration at 77° F (25° C)	40 to 90
AASHTO T 59	Saybolt Furol Viscosity 77° F (25° C)	15 to 90 Sec.

¹Test on Residue

16.2.2 Aggregate

The aggregate shall be manufactured 100 percent crushed stone such as granite, slag, limestone, chert, or other high quality aggregate, or combination thereof. All aggregates shall have at least two fractured faces.

**TABLE 16.2.2a
AGGREGATES**

Test	Quality	Specification
AASHTO T176*	Sand Equivalent	55 Min.
AASHTO T104	Soundness	15% Max. using NA2 SO4 or 25% Max. using MgSO4
AASHTO T96	Abrasion Resistance	25% Max. Grading D

* Moisture condition sample at least 24 hours prior to running the test.

When tested in accordance to AASHTO T 27 and AASHTO T 11, the aggregate gradation (including the mineral filler) shall be within the following bands. Note: Selection of Type 11 or Type III shall be designated by the **AGENCY** and shown on the plans.

**TABLE 16.2.2b
AGGREGATE GRADATION**

Sieve Size	Percent Passing		Job Tolerance
	Type II	Type III	
1/2"	100	100	± 0
No. 4	90 to 100	70 to 90	± 4
No. 8	65 to 90	45 to 70	± 4
No. 16	45 to 70	28 to 50	± 3
No.30	30 to50	19 to 34	± 3
No. 50	18 to 30	2 to 25	± 3
No. 100	10 to 21	7 to 18	± 3
No 200	5 to 15	5 to 15	± 2

The stockpile shall be accepted based on an average of five gradation tests according to AASHTO T 2. Note requirement of 16.16.B.

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16.2.3 Mineral Filler

Portland cement, hydrated lime, limestone dust, fly ash or other approved filler meeting the requirements of AASHTO M 17 or ASTM D 242 shall be used if required by the mix design. They shall be considered as part of the dry aggregate.

16.2.4 Water

The water shall be free of salts and contaminants and shall be tested and conform to AASHTO T 26. Potable water testing is not required.

16.2.5 Additives

Liquid additives may be used to accelerate or retard the break-set of the slurry seal, or improve the resulting finished surface. The use of liquid additives in the slurry mix (or individual materials) shall be made initially in quantities predetermined by the mix design with field adjustments if required, after approval by the **AGENCY**.

16.3 MIX DESIGN

The **CONTRACTOR** shall submit to the **AGENCY**, for approval, a mix design prepared and signed by a Professional Engineer registered in the State of Colorado, performed by a laboratory who has experience in designing Emulsified Asphalt Slurry Seal Surfacing. Compatibility of the aggregate, emulsion, mineral filler, and other additives shall be verified by the mix design. The mix design shall be made with the same materials and gradation that the **CONTRACTOR** will provide on the project. After the mix design has been approved, no substitution will be permitted. Minimum requirements are as follows:

**TABLE 16.3
RECOMMENDED MIX PROPERTIES**

Test	Description	Specification
ISSA T106	Slurry Seal Consistency	--
ISSA TB-139 (for quick-set systems)	Wet Cohesion 30 minutes Min. (set) 4 hour Min. (traffic)	12 kg-cm Min. 20 kg-cm Min.
ISSA TB-139 (for quick- traffic systems)	Wet Cohesion 60 minutes Min	20 kg-cm Min.
ISSA TB-109	Excess Asphalt by LWT Sand Adhesion	50 g/ft ² Max.
ISSA TB-114	Wet Stripping 10 minutes boiling water	Pass (90% Min.)
ISSA TB-100	Wet Track Abrasion Loss One hour soak 6-Day soak	50 gm ² Max. 75 g/ft ² Max.
ISSA TB-113	Mix Time	*
Residual Asphalt	6.5% to 12.0%	---
Mineral Filler	0.5% to 2.0%	

* The mixing test and set time test shall be done to anticipate the highest temperatures expected during construction. This will include 180 seconds mix time at 77° F and 70 seconds mix time minimum at 100° F.

The laboratory shall also report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effect). The report must clearly show the proportions of aggregate, mineral filler (minimum and maximum), water (minimum and maximum), additive(s) (usage), and asphalt emulsion based on the dry weight of the aggregate. The report shall be sealed and signed by a Professional Engineer registered in the State of Colorado.

16.4 EQUIPMENT

16.4.1 General

All equipment, tools, and machines used in performance of this work shall be maintained in satisfactory working condition at all times to ensure a high quality product.

16.4.2 Mixing Equipment

The machine shall be specifically designed and manufactured to lay slurry seal. The material shall be mixed by a self-propelled slurry seal mixing machine of either truck mounted or continuous run design. Continuous run machines are those that are equipped to self load materials while continuing to lay slurry seal. Either type machine shall be able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive, and water to a revolving mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, control additive and water to maintain an adequate supply to the proportioning controls.

If continuous run equipment is used, the machine shall be equipped to allow the operator to have full control of the forward and reverse speed during application of the slurry seal. It shall be equipped with a self-loading device, opposite side driver stations, and forward and reverse speed controls.

16.4.3 Proportioning Devices

Individual volume or weight controls for proportioning each material to be added to the mix (i.e. aggregate, mineral filler, emulsified asphalt and additive) shall be provided and properly marked. The proportioning devices are required to be in working order and shall be capable of determining the material output at any time.

16.4.4 Spreading Equipment

The mixture shall be spread uniformly by means of 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 ensure no loss of the mixture at the road contact point. The rear seal shall act as final strike-off and shall be adjustable. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved to produce a free flow of material to the rear strike-off. The spreader box shall have suitable means provided to side shift the box to compensate for variations in the pavement geometry. A burlap drag or other approved screed may be attached to the rear of the spreader box to provide a uniform, highly textured mat. The drag pulled behind the spreader box shall not be stiffened or hardened by slurry or asphalt.

16.4.5 Auxiliary Equipment

Suitable surface preparation equipment, traffic control equipment, hand tools, power brooms, sweepers, and any other support equipment shall be provided as necessary to perform the work.

Equipment shall be approved by the **AGENCY**. All equipment and machinery shall be kept in good working order, free of leaks and properly muffled. All taxes, licenses and fees shall have been paid and proper licenses and permits shall be posted as required by law.

16.5 CALIBRATION

Each mixing unit to be used in performance of the work shall be calibrated in the presence of the engineer prior to construction. Previous calibration documentation covering the exact materials to be used may be acceptable, provided they were made

during the calendar year. A one-point calibration check may be required at the start of production. 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/or accepted.

16.5.1 Verification

Test strips will be made by each machine after calibration and prior to construction. Test strips shall be a portion of the project. Samples of the slurry seal will be taken and verification made as to mix consistency and proportioning. Verification of rate of application will also be made. Upon failure of any of these tests, additional test strips, at no cost to the **AGENCY**, will be required until each unit is authorized to work. Any unit failing to pass the tests after the third trial, will not be permitted to work on the project. Test strips must be accepted or rejected within 24 hours after application.

16.6 WEATHER LIMITATIONS

The slurry seal shall not be applied if either the pavement or air temperature is below 50° F and falling, but may be applied when both pavement and air temperature are above 45° F and rising. No slurry seal shall be applied when there is danger that the finished product will freeze before 24 hours. The mixture shall not be applied when weather conditions prolong opening to traffic beyond a reasonable time.

16.7 TRAFFIC CONTROL

Suitable methods shall be used by the CONTRACTOR to protect the slurry seal from all types of vehicular traffic without damage. Opening to traffic does not constitute acceptance of the work. The engineer shall be notified of the methods to be used. In areas which are subject to an increased rate of sharp turning vehicles, additional time may be required for a more complete cure of the slurry seal mat to prevent damage.

16.8 SURFACE PREPARATION

16.8.1 General

Immediately prior to applying the slurry seal the surface shall be cleared of all loose material, oil spots, vegetation, and other objectionable material. Any standard cleaning method will be acceptable. If water is used, cracks shall be allowed to dry thoroughly before slurry surfacing. Manholes, valve boxes, drop inlets and other service entrances shall be protected from the slurry seal by a suitable method. The **AGENCY** shall approve the surface preparation prior to surfacing.

16.8.2 Tack Coat

If a tack coat is required it should consist of one part emulsified asphalt and three parts water. The emulsified asphalt should be the same as used in the mix. The distributor shall be capable of applying the dilution evenly at a rate of .05 to .10 gallons per square yard (0.15 to 0.35 liters per square meter). The tack coat shall be allowed to cure before application of the slurry seal.

16.8.3 Joint and Crack Sealant

Joints and crack shall be sealed in accordance with the requirements in Item 13.

16.9 APPLICATION

The slurry seal mixture shall be of proper consistency at all times so as to provide the application rate required by the surface condition. The average application rate shall be 18 to 30 pounds per square yard (8.16 to 13.6 kgs/m²).

Application rates are affected by the unit weight of the aggregate, the gradation of the aggregate and the demand of the surface to which the slurry seal is being applied.

16.9.1 General

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 to suit temperatures, surface texture, humidity, and dryness of the pavement.

The slurry seal shall be of the desired consistency upon leaving the mixer. A sufficient amount of material shall be carried in all parts of the spreader at all times so that a complete coverage is obtained. Overloading of the spreader shall be avoided.

No lumping, balling, or unmixed aggregate shall be permitted.

No streaks, such as those caused by oversized aggregate shall be left in the finished surface. If excess oversize develops, the job will be stopped until the **CONTRACTOR** proves to the engineer that the situation has been corrected. Some situations may require screening the aggregate just prior to loading it into the units going from the stockpile area to the laydown operations.

16.10 JOINTS

No excess buildup, uncovered areas, or unsightly appearance shall be permitted on longitudinal or transverse joints. The **CONTRACTOR** shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the project. When possible, longitudinal joints shall be placed on lane lines. Half passes and odd width passes will be used only in minimum amounts. If half passes are used, they shall not be the last pass of any paved area. A maximum of 4 inches (152 mm) shall be allowed for overlap of longitudinal lane line joints. The paper shall be used at transverse joints to ensure a straight line.

16.11 MIX STABILITY

The slurry seal shall possess sufficient stability so that premature breaking of the material in the spreader box does not occur. The mixture shall be homogeneous during and following mixing and spreading. It shall be free of excess water and emulsion and free of segregation of the emulsion and aggregate fines from the coarser aggregate. Spraying of additional water into the spreader box or addition of excess water will not be permitted.

16.12 HAND WORK

Areas which cannot be reached with slurry seal machines shall be surfaced using hand squeegees to provide complete and uniform coverage. The area to be hand worked shall be lightly dampened prior to mix placement and the slurry worked immediately. Care shall be exercised to leave no unsightly appearance from handwork. The same type finish as applied by the spreader box shall be required. Handwork shall be completed during machine applying process.

16.13 LINES

Care shall be taken to ensure straight lines along shoulders. No runoff on these areas will be permitted. Lines at intersections will be kept straight to provide good appearance.

16.14 ROLLING

At the option of the **AGENCY**, the roadway shall be rolled by a self propelled 10 ton pneumatic roller with a tire pressure of 50 psi (3.4 atms.) and equipped with a water spray system. The surfaced areas shall be subjected to a minimum of two full coverage passes by the roller.

Rolling should not commence until the slurry has cured enough so that it will not pick up on the tires of the roller.

16.15 CLEAN-UP

All areas, such as manways, gutters and intersections, shall have the slurry seal removed as specified by the **AGENCY**. The **CONTRACTOR** shall remove any debris associated with the performance of the work on a daily basis.

16.16 TOLERANCES

Tolerances for individual materials as well as the slurry seal mixture are as follows:

- A. After the designed residual asphalt content is determined, a plus or minus one percentage point variation will be permitted.
- B. The percentage of aggregate passing each sieve shall be within stockpile tolerance range as stated and within the master range of Table 16.22b. |

- C. The percentage of aggregate passing shall not go from the high end to the low end of the specified range of any two successive sieves.
- D. The slurry consistency shall not vary more than ± 0.5 cm from the job mix formula after field adjustments.
- E. The rate of application once determined by the engineer shall not vary more than ± 2 pounds per square yard, while remaining within the design application rate.

If any two successive tests fail on the stockpile material, the job shall be stopped. It is the responsibility of the **CONTRACTOR**, at his own expense, to prove to the **AGENCY** that the conditions have been corrected. If any two successive tests on the mix from the same machine fail, the use of the machine shall be suspended. It will be the responsibility of the **CONTRACTOR**, at his own expense, to prove the **AGENCY** that the problems have been corrected and that the machine is working properly.

16.17 MEASUREMENT

The area of slurry seal shall be measured by the square yard per plan quantities completed in place and accepted.

16.18 TESTING AND INSPECTION

Testing and inspection shall be performed in accordance with Table 16.18.

**TABLE 16.18
SCHEDULE FOR MINIMUM MATERIALS SAMPLING AND TESTING
FOR ITEM 16 - SLURRY SEAL**

Test Type	Test Standard	Minimum Frequency of Tests
Residue after distillation	AASHTO T 59	One test each 5,000 square yards of slurry seal
Extraction and Gradation	AASHTO T 164 AASHTO T 30	One test each 5,000 square yards of slurry seal
Application Rate		One test each 5,000 square yards of slurry seal

16.19 PAYMENT

The slurry seal shall be measured and paid for by the unit area per plan quantities. The price shall be full compensation for furnishing all materials and for preparation, mixing and applying these materials, and for all labor, equipment, tools, test design, clean-up and incidentals necessary to complete and warrant the job as specified herein.

<u>Item</u>	<u>Description</u>	<u>Payment</u>
16.1	Slurry Seal	\$/yd ²