

Recommended Performance Guidelines For Emulsified Asphalt Slurry Seal

**A105 (Revised)
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NOTICE

It is not intended or recommended that these guidelines be used as verbatim specifications. They should be used as an outline, helping user agencies establish their particular project specifications. Users should understand that almost all areas vary as to the availability of materials. Efforts should be made to determine what materials are reasonably available, keeping in mind system compatibility and specific job requirements. Feel free to contact the ISSA for answers to any questions and also for a list of ISSA contractors and companies who could assist.

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RECOMMENDED PERFORMANCE GUIDELINES FOR EMULSIFIED ASPHALT SLURRY SEAL

1. SCOPE

The intent of this guideline is to aid in the design, testing methods, quality control, measurement and payment procedures for the application of Emulsified Asphalt Slurry Seal Surfacing.

2. DESCRIPTION

The slurry seal shall consist of a mixture of an approved emulsified asphalt, mineral aggregate, water, and specified additives, proportioned, mixed and uniformly spread over a properly prepared surface as directed by the Buyer's Authorized Representative (B.A.R.). The completed slurry seal shall leave a homogeneous mat, adhere firmly to the prepared surface, and have a skid-resistant surface texture throughout its service life.

3. APPLICABLE SPECIFICATIONS

3.1 GENERAL

There are agencies and testing methods listed in the appendix (see Appendix A) which form a part of this guideline.

It is not normally required to run all tests on every project. Some tests are expensive and take substantial time to conduct. If the materials to be used on the project have a past record of good performance, the requirements for testing may be decreased. Paving authorities are often familiar with local materials and should be able to furnish information which would minimize the amount of testing required.

4. MATERIALS

4.1 EMULSIFIED ASPHALT

The emulsified asphalt shall conform to Grade _____ (SS-1, SS-1h, CSS-1, CSS-1h, CQS-1h, Quick-Set Mixing Grade) as specified in _____ (ASTM D977, ASTM D2397, AASHTO M140 and AASHTO M208). The cement mixing test is waived.

4.1.1 QUALITY TESTS

	AASHTO TEST METHOD	ASTM TEST METHOD	QUALITY	SPECIFICATION
TEST ON EMULSION				
	AASHTO T59	ASTM D244	Residue After Distillation	60% Minimum
TEST ON EMULSION RESIDUE				
	AASHTO T49	ASTM 2397	Penetration at 77°F (25°C)	40 - 90*

- Climate conditions should be considered when establishing this band.

Each load of emulsified asphalt shall be accompanied with a Certificate of Analysis/ Compliance to assure that it is the same as that used in the mix design.

4.2 AGGREGATE

4.2.1 GENERAL

The mineral aggregate used shall be the type and grade specified for the particular use of the slurry seal. The aggregate shall be manufactured crushed stone such as granite, slag, limestone, chat, or other high-quality aggregate, or combination thereof. To assure the material is totally crushed, 100 percent of the parent aggregate will be larger than the largest stone in the gradation to be used.

4.2.2 QUALITY TESTS

When tested according to the following tests, the aggregate will meet these requirements.

AASHTO TEST NO.	ASTM TEST NO.	QUALITY	SPECIFICATION
AASHTO T176	ASTM D2419	Sand Equivalent	45 Minimum
AASHTO T104	ASTM C88	Soundness	15% Maximum using Na ₂ SO ₄ or 25% Maximum using MgSO ₄
AASHTO T96	ASTM C131	Abrasion Resistance	35% Maximum

The abrasion test is to be run on the aggregate before it is crushed. The aggregate should meet approved polishing values.

4.2.3 GRADING

When tested in accordance to AASHTO T27 (ASTM C136) and AASHTO T11 (ASTM C117), the target (mix design) aggregate gradation (including the mineral filter) shall be within one of the following bands (or of one currently recognized by your local paving authority):

SIEVE SIZE	TYPE I PERCENT PASSING	TYPE II PERCENT PASSING	TYPE III PERCENT PASSING	STOCKPILE TOLERANCE
3/8 (9.5 mm)	100	100	100	
# 4 (4.75 mm)	100	90 - 100	70 - 90	± 5%
# 8 (2.36 mm)	90 - 100	65 - 90	45 - 70	± 5%
# 16 (1.18 mm)	65 - 90	45 - 70	28 - 50	± 5%
# 30 (600 um)	40 - 65	30 - 50	19 - 34	± 5%
# 50 (330 um)	25 - 42	18 - 30	12 - 25	± 4%
#100 (150 um)	15 - 30	10 - 21	7 - 18	± 3%
#200 (75 um)	10 - 20	5 - 15	5 - 15	± 2%

The job mix (target) gradation shall be within the gradation band for the desired type. After the target gradation has been submitted (this should be the gradation that the mix design is based on), then the percent passing each sieve shall not vary by more than the stockpile tolerance and still remain within the gradation band.

The aggregate will be accepted at the job location or stockpile. The stockpile shall be accepted based on five gradation tests according to AASHTO T2 (ASTM D75). If the average of the five tests is within the gradation tolerances, then the materials will be accepted. If the tests show the material to be out, the contractor will be given the choice to either remove the material or blend other aggregates with the stockpile material to bring it into specifications. Materials used in blending must meet the quality test before blending and must be blended in a manner to produce a consistent gradation. This may require a new mix design.

Screening shall be required at the stockpile if there are any problems created by having oversize materials in the mix.

4.3 MINERAL FILLER

Portland cement, hydrated lime, limestone dust, fly ash, or other approved filler meeting the requirements of ASTM D242 shall be used if required by the mix design. They shall be considered as part of the dry aggregate.

4.4 WATER

The water shall be free of harmful salts and contaminants.

4.5 ADDITIVES

Additives may be used to accelerate or retard the break-set of the slurry seal or to 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, after approval by the B.A.R.

5. LABORATORY EVALUATION

5.1 GENERAL

Before work begins, the contractor shall submit a signed mix design covering the specific materials to be used on the project. This design will be performed by a laboratory who has experience in designing Emulsified Asphalt Slurry Seal Surfacing. After the mix design has been approved, no substitution will be permitted unless approved by the B.A.R.

ISSA can provide a list of laboratories experienced in testing slurry seal materials for mix designs.

5.2 MIX DESIGN

The contractor shall submit to the B.A.R. for approval a complete mix design prepared and certified by the laboratory. 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 aggregate gradation that the contractor will provide on the project.

Recommended tests and values are as follows:

ISSA TEST NO.	DESCRIPTION	SPECIFICATION
ISSA TB106	Slurry Seal Consistency	
ISSA TB-139 (For quick-traffic systems)	Wet Cohesion 30 Minutes Minimum (Set) Wet Cohesion 60 Minutes Minimum	12 kg-cm Minimum 20 kg-cm Minimum
ISSA TB109 (For heavy-traffic areas only)	Excess Asphalt by LWT Sand Adhesion	50 g/ft ² Maximum (538 g/m ² Maximum)
ISSA TB-114	Wet Stripping	Pass (90% Minimum)
ISSA TB-100	Wet-Track Abrasion Loss, One-hour Soak	75 g/ft ² (807 g/m ²)
ISSA TB-113	Mix Time**	Controllable to 180 Seconds Minimum

** The mixing test and set-time test should be performed at the highest temperatures expected during construction.

The Wet Track Abrasion Test is performed under laboratory conditions as a component of the mix design process. The purpose of this test is to determine the minimum asphalt content of a slurry system. The Wet Track Abrasion Test is not recommended as a field quality control or acceptance test.

The mixing test is used to predict how long the material can be mixed in the machine before it begins to break. It is more for information to be used by the contractor than for the quality of the end product. It is, however, a good field test to check for consistent sources of material, both emulsified asphalt and aggregate.

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.

All the component materials used in the mix design shall be representative of the materials proposed by the contractor to be used on the project.

The percentages of each individual material required shall be shown in the laboratory report. Adjustments may be required during the construction, based on the field conditions. The B.A.R. will give final approval for all such adjustments.

The B.A.R. shall approve the mix design and all slurry seal materials and methods prior to use. The component materials shall be within the following limits:

COMPONENT MATERIALS	LIMITS
Residual Asphalt	Type I: 10 - 16% Type II: 7.5 - 13.5% Type III: 6.5 - 12% (Based on dry weight of aggregate)
Mineral Filler	0.5 - 2.0% (Based on dry weight of aggregate)
Additives	As needed
Water	As needed to achieve proper mix consistency (Total mix liquids should not exceed the loose aggregate voids. ISSA T106 should be used to check optimum liquids.)

5.3 RATE OF 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, as measured by the B.A.R., shall be in accordance with the following table:

AGGREGATE TYPE	LOCATION	SUGGESTED APPLICATION RATE
Type I	Parking Areas Urban and Residential Streets Airport Runways	8 - 12 lb/yd ² (4.3 - 6.5 kg/m ²)
Type II	Urban and Residential Streets Airport Runways	12 - 20 lb/yd ² (6.5 - 10.8 kg/m ²)
Type III	Primary and Interstate Routes	18 - 30 lb/yd ² (9.8 - 16.3 kg/m ²)

Suggested application rates are based upon the weight of dry aggregate in the mixture. 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. ISSA Technical Bulletin 112 gives a method to determine expected application rates.

5.4 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.
- 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 ± 2 inches (± 0.5 cm) from the job mix formula after field adjustments.
- e. The rate of application, once determined by the B.A.R., shall not vary more than ± 2 lb/yd² (± 1.1 kg/m²) while remaining within the design application rate.

6. **EQUIPMENT**

6.1 **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.

6.2 **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 to 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.

The B.A.R. must decide which type of equipment best suits their specific project, and if that type of equipment is readily available and utilized in their area. Generally, truck-mounted machines or continuous-run machines may be used on similar projects. In some cases, truck-mounted machines may be more suited, i.e. cul-de-sacs, small narrow roadways, parking lots, etc. On major highways, interstates, etc., continuous-run equipment may be the desired choice due to the continuity of mix and the reduction of start-up joints.

If continuous run equipment is used, the machine shall be equipped to allow the operator to have full control of the forward and reverse speeds 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.

6.3 **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 usually revolution counters or similar devices and are used in material calibration and determining the material output at any time.

6.4 **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 insure 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.

6.5 AUXILIARY EQUIPMENT

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

7. CALIBRATION

Each mixing unit to be used in performance of the work shall be calibrated in the presence of the B.A.R. prior to construction. Previous calibration documentation covering the exact materials to be used may be acceptable, provided they were made during the 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/or accepted.

7.1 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 buyer, 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.

8. WEATHER LIMITATIONS

The slurry seal shall not be applied if either the pavement or air temperature is below 50°F (10°C) and falling, but may be applied when both pavement and air temperatures are above 45°F (7°C) 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.

9. NOTIFICATION AND TRAFFIC CONTROL

9.1 NOTIFICATION

All homeowners and businesses affected by the paving shall be notified one day in advance of the surfacing. Suitable tow-away signs may be posted prior to the surfacing. Should work not occur on the specified day, a new notification will be distributed.

The notification shall be in a form of written posting, stating the time and date that the surfacing will take place.

9.2 TRAFFIC CONTROL

Suitable methods shall be used by the contractor to protect the slurry seal from damage from all types of vehicular traffic. Opening to traffic does not constitute acceptance of the work. The B.A.R. shall be notified of the methods to be used.

In areas that 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. Slight tire marks may be evident in these areas after opening but will diminish over time with rolling traffic. If these areas are not severely rutted, they should be considered as normal characteristics of a slurry seal and should be accepted.

10. SURFACE PREPARATION

10.1 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 B.A.R. shall approve the surface preparation prior to surfacing.

10.2 TACK COAT

Normally, tack coat is not required unless the surface to be covered is extremely dry and raveled, or is concrete or brick. If required, the tack coat should consist of one part emulsified asphalt/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 0.05 to 0.10 gal/yd² (0.23 to 0.45 l/m²). The tack coat shall be allowed to cure before application of the slurry seal.

10.3 CRACKS

It is advisable to pre-treat cracks in the pavement surface with an acceptable crack sealer prior to application of the slurry seal.

11. APPLICATION

11.1 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 temperature, 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 B.A.R. 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 lay-down operation.

11.2 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 six inches (6") (152 mm) shall be allowed for overlap of longitudinal lane line joints.

11.3 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 will not be permitted.

11.4 HANDWORK

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 handworked 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 the machine applying process.

11.5 LINES

Care shall be taken to measure straight lines along curbs and shoulders. No run-off on these areas will be permitted. Lines at intersections will be kept straight to provide good appearance.

11.6 ROLLING

Rolling is usually not necessary for slurry seal surfacing on roadways. Airports and parking areas should be rolled by a self-propelled, 10-ton pneumatic roller with a tire pressure of 50 PSI (3.4 ATMS), equipped with a water spray system. The surfaced areas shall be subjected to a minimum of two (2) 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.

11.7 CLEANUP

All areas, such as man-ways, gutters and intersections, shall have the slurry seal removed as specified by the B.A.R. The contractor shall remove any debris associated with the performance of the work on a daily basis.

12. QUALITY CONTROL

12.1 INSPECTION

To insure quality, inspectors assigned to projects must be familiar with the materials, equipment and application of slurry seal.

Local conditions and specific project requirements must be considered when determining the parameters of field inspection.

12.2 MATERIALS

The contractor will permit the B.A.R. to take samples of the aggregate and asphalt emulsion used in the project at the B.A.R.'s discretion. Gradation and sand equivalent tests may be run on the aggregate and residual asphalt content tests on the emulsion. Test results will be compared to specifications. Tests will be run at the expense of the buyer.

The buyer must notify the contractor immediately if any test fails to meet the specifications.

12.3 SLURRY SEAL

Samples of the slurry seal will be taken directly from the slurry unit(s) at a minimum rate of one sample per mixing unit per each day's use. Consistency and residual asphalt content tests may be made on the samples and compared to the specifications. Tests will be run at the expense of the buyer. The buyer must notify the contractor immediately if any test fails to meet specifications.

The B.A.R. may use the recorders and measuring facilities of the slurry seal unit to determine application rates, asphalt emulsion content, mineral filler and additive(s) content for an individual load.

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

12.4 NON-COMPLIANCE

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 B.A.R. 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 to the B.A.R. that the problems have been corrected and that the machine is working properly.

13. PAYMENT

The slurry seal shall be measured and paid for by the unit area or weight of aggregate and the weight of emulsion used on the work completed and accepted by the buyer. If paid by the weight of the aggregate and emulsion, the contractor shall submit to the B.A.R. a certified affidavit and delivery tickets which show quantities of each material delivered to the job site and used on the project.

The price shall be full compensation for furnishing all materials; for preparation, mixing and applying these materials; and for all labor, equipment, tools, test design, cleanup and incidentals necessary to complete and warrant the job as specified herein.

APPENDIX A

AGENCIES AND TEST METHODS

AGENCIES

AASHTO: American Association of State Highways and Transportation Officials
ASTM: American Society for Testing and Materials
ISSA: International Slurry Surfacing Association

AGGREGATE AND MINERAL FILLER

AASHTO TEST NO.	ASTM TEST NO.	TEST
AASHTO T2	ASTM D75	Sampling Mineral Aggregates
AASHTO T27	ASTM C136	Sieve Analysis of Aggregates
AASHTO T11	ASTM C117	Materials Finer than No. 200 in Mineral Aggregates
AASHTO 176	ASTM D2419	Sand Equivalent Value of Soils and Fine Aggregate
AASHTO T84	ASTM C128	Specific Gravity and Absorption of Fine Aggregate
AASHTO T19	ASTM C29	Unit Weight of Aggregate
AASHTO T96	ASTM C131	Resistance to Abrasion of Small-Size Coarse Aggregate by Use of the Los Angeles Machine
AASHTO T37	ASTM D546	Sieve Analysis of Mineral Filler
AASHTO T104	ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
-----	ASTM D242	Mineral Filler for Bituminous Paving Mixtures
AASHTO T127	ASTM C183	Sampling Hydraulic Cement

EMULSIFIED ASPHALT

AASHTO TEST NO.	ASTM TEST NO.	TEST
AASHTO T40	ASTM D140	Sampling Bituminous Materials
AASHTO T59	ASTM 244	Testing Emulsified Asphalt
AASHTO M140	ASTM D977	Specification for Emulsified Asphalt
AASHTO M280	ASTM D2397	Mixing, Setting and Water Resistance Test To Identify AQuick-Set Emulsified Asphalt

RESIDUE FROM EMULSION

AASHTO TEST NO.	ASTM TEST NO.	TEST
AASHTO T59	ASTM D244	Residue by Evaporation
AASHTO T49	ASTM C2397	Penetration 3.5 oz (100 gm) at 5 Seconds 77°F (25°C)

SLURRY SEAL SYSTEM

ASTM TEST NO.	ISSA TEST NO.	Test
-----	ISSA TB 101	Guide for Sampling Slurry Mix for Extraction Test
-----	ISSA TB 106	Measurement of Slurry Seal Consistency
-----	ISSA TB 109	Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded-Wheel Tester
-----	ISSA TB 111	Outline Guide Design Procedure for Slurry Seal
-----	ISSA TB 112	Method of Estimate Slurry Seal Spread Rates and To Measure Pavement Macrotecture
-----	ISSA TB 114	Wet Stripping Test for Cured Slurry Seal Mixes
-----	ISSA TB 115	Determination of Slurry Seal Compatibility
-----	ISSA TB 139	Method of Classified Emulsified Asphalt, Aggregate Mixtures by Modified Cohesion Test Measurement of Set and Cure Characteristics
ASTM D3910	-----	Design, Testing, and Construction of Slurry Seal
ASTM D2172	-----	Quantitative Extraction of Bitumen for Bituminous Paving Mixtures

APPENDIX B
INSTRUCTIONS TO THE WRITER

- A. This specification is written as a guideline and should be used as such. It is not intended to be copied verbatim. The writer should thoroughly read the guideline and determine what is and is not applicable. Feel free to contact the ISSA for answers to any questions and also for a list of ISSA member contractors and companies who could assist.
- B. This specification is written to cover a conventional slurry seal system. It is not applicable to micro-surfacing. Consult the ISSA for information on modified systems.

TECHNICAL NOTES

- A. **#3.4 SLURRY SEAL:** To be sure all the water is removed from the slurry before running, ASTM D2172, ASTM D95 or ASTM D1461 should be run. Some laboratories have modified ASTM D95 to permit removing of the water and bitumen at the same time.
- B. **#4.1 EMULSIFIED ASPHALT:** The cement mixing test determines the emulsion mixability. However, this is best determined by the laboratory using the job materials rather than cement. Also, many emulsions designed especially for slurry seal will not pass the cement mixing test, yet give good results in the field.
- C. **#4.2.1 GENERAL:** It is recommended a 100 percent crushed material be used for airfields and major roadways. The use of natural, non-angular sand will give poor results. If materials are to be blended, be sure the contractor provides suitable means. Wet materials are difficult to blend. Materials with a great difference in unit weights are hard to blend. Where blended materials are used, stockpile sampling and testing should be increased.
- D. **#4.2.3 GRADING:** Select only one gradation. Experience has taught that it is better to limit the top sieve of each gradation (No. 8 - Type I; No. 4 - Type II; 3/8 - Type III) to 98 to 100 percent passing to improve surface appearance. The following is additional information on the three gradations:

Type I. This aggregate blend is used to fill surface voids and correct moderate surface conditions. It gives an approximate application rate of 8 to 12 lb/yd² (4.3 to 6.5 kg/m²) and a theoretical asphalt content of 10 to 16 percent based on dry aggregate weight. The fineness of this design provides it with the ability for crack penetration. A typical example of this type of slurry surface would be on areas where only protection from the elements is desired. If Type I gradation is used for streets, it is recommended that maximum poundage be required.

Type II. This aggregate blend is used when it is desired to fill surface voids, to correct severe surface conditions, and to provide sealing and a wearing surface. It gives an approximate application rate of 12 to 20^{***} lb/yd² (6.5 kg to 10.8 kg/m²) and a theoretical asphalt content of 7.5 to 13.5 percent based on the dry aggregate weight.

A typical example of this type of slurry surface would be on pavements with a medium-textured surface which would require this size aggregate to fill in the cracks and provide a minimum wearing surface. Another example would be placing a general slurry on flexible base, stabilized base, or soil cement as a sealer prior to final paving.

***For aggregates of ASG#2.65

Type III. This aggregate blend is used to give maximum skid resistance and an improved wearing surface. It is applied at a rate of 18^{***} lb/yd² (9.8 kg/m²) or more and a theoretical asphalt content of 6.5 to 12.0 percent based on dry aggregate weight. A typical example of this type of slurry surface is as the first or second course of a multiple-course slurry treatment on flexible base, stabilized base, or soil cement. Another example of this type of slurry surface would be on pavements that have highly textured surfaces and require this size aggregate to fill in the voids and provide an improved wearing surface.

E. #4.3 MINERAL FILLER: Mineral filler is required with most aggregates. Its use is normally 0.5 to 2.0 percent and is considered part of the aggregate. Mineral filler is primarily used to improve the homogeneity of the slurry seal.

F. #4.5 ADDITIVES: There are many types of additives being tried and used in slurry seal for slurry break and set control. Any additives used should be approved by the laboratory as part of the mix design. The slurry equipment should have 1) accurate means to meter the product into the mix and 2) instrumentation to measure the amount of material that has been added during any particular period.

G. #5.2 LABORATORY REPORT:

ISSA T109, the Loaded Wheel Test for Excessive Asphalt, is most applicable when the slurry seal is to be placed in areas receiving high volumes of traffic. For jobs where the slurry is only being placed on low volume areas, the test could be deleted.

ISSA TB136 describes some of the items to watch for when performing the Wet-Track Abrasion Test.

ISSA TB139 describes a method to classify emulsified asphalt/aggregate mixture systems as to set and cure characteristics by a Modified Cohesion Tester.

ISSA Operation Bulletin 128 describes a method to determine the bulk effect of aggregate and how it relates to machine calibration.

H. #6.2 SLURRY MIXING EQUIPMENT: Counters, flow meters or totalizer meters are the most common instruments used on machines. They should be kept in good working order.

I. #6.4 SLURRY SPREADING EQUIPMENT: Some spreader boxes are equipped with one or more sets of augers to improve the distribution of the slurry seal in the spreader box. In some quick-set systems, these augers also keep the mix from breaking. The important thing is to have the slurry seal the proper consistency as it leaves the mixer and to not to add any water to the mix afterwards. Any type drag pulled behind the spreader box that has been stiffened by hardened slurry or asphalt is ineffective.

J. #7 CALIBRATION: ISSA Inspector's Manual describes a method of machine calibration. ISSA contractors and/or machine manufacturers have proven methods of machine calibration which can be provided.

K. #7 VERIFICATION: The consistency test is sometimes difficult to evaluate in the field, especially if the slurry is setting quickly. If run in the field, it must be performed immediately after the sample is taken. One method used to measure consistency is to take a stick and draw a line through the slurry immediately behind the spreader box. If the line stays, the slurry is at the proper consistency. If it fills up, the mix is not correct.

***For aggregates of ASG#2.65

Keeping the proper consistency should be one of the major areas of inspector concern. An improper mix will cause a number of problems. If mixes are too dry, streaking, lumping and roughness will be present in the mat. Mixes applied too wet will run excessively, not hold straight lane lines, and cause an asphalt-rich surface with segregation evident in the mat.

- L. **#10.2 TACK COAT:** When slurry is being placed over a brick, concrete, or other highly absorbent or polished surface, a one-part emulsion/three-part water tack coat of the same asphalt emulsion (if possible) type and grade as specified for the slurry is recommended. This can be applied with an asphalt distributor. The normal application rate is 0.05 to 0.10 gal./yd² (0.23 to 0.45 l/m²) of the diluted emulsion.
- M. **#11.5 LINES:** Many contractors use 15-lb (6.8-kg) black roofing paper to start and stop at intersections. This insures a straight line and leaves something to hold the excess slurry for easy removal.



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