

SLURRY SEAL SURFACING.
(REV 9-15-14)

SECTION 335
SLURRY SEAL SURFACING

335-1 Description.

Construct a slurry seal with the type of mixture specified in the Plans. Slurry seal is a mixture of polymer-modified emulsified asphalt, mineral aggregate, mineral filler, water, and other additives, properly proportioned, mixed and spread on a paved surface. The mix shall be capable of being spread in a uniform thickness cross-section. The end product shall maintain a skid-resistant surface throughout the service life of the slurry seal. The mix shall be a quick-traffic system that will be able to accept straight rolling traffic in a minimum of one hour after application.

335-2 Materials.

335-2.1 Emulsified Asphalt:

335-2.1.1 General Requirements: Provide a quick-traffic, polymer-modified emulsified asphalt conforming to the requirements specified in AASHTO M 208 for CSS-1h and CQS-1h as listed in Table 335-1. The cement mixing test shall be waived for this product. The polymer material shall be co-milled into the asphalt or added to the emulsifier solution prior to the emulsification process. The amount of polymer modifier shall not be less than 3.0% polymer solids based on the asphalt content (by weight) and will be certified by the emulsified asphalt supplier. The Engineer may waive the five-day settlement test, provided job-stored emulsified asphalt is used within 36 hours from the time of the shipment or the stored material has had additional emulsified asphalt blended into it prior to use.

335-2.1.2 Quality Tests: For CSS-1h, or CQS-1h, it shall meet the requirements of AASHTO M 208 and ASTM D 2397 and Table 335-1:

Tests on Emulsion	Test Method	Specification
Softening point	AASHTO T 53	0135°F min
Elastic Recovery, 10°C, Straight Sided, 5 cm/min, 20 cm elongation, 5 min hold, %	AASHTO T-301	050 min

335-2.1.3 Sampling, Certification, and Verification: For the first load of emulsified asphalt produced for the project, the supplier shall submit a sample to the owning agency's designated laboratory for testing before use. When applicable, a pretest number will then be assigned by the designated laboratory, which shall be furnished with all emulsified asphalt delivered to the project. At any time during application, the Engineer may sample and

test all subsequent loads of emulsified asphalt delivered to the project to verify and determine compliance with specification requirements. Where these tests identify material outside specification requirements, the Engineer may require the supplier to cease shipment of that pre-tested product. Further shipment of that pre-tested product to the owning agency's projects will remain suspended until the cause of the problem is evaluated and corrected by the supplier to the satisfaction of the Engineer. Proper sampling and handling techniques are required, and the testing shall be completed within seven days of the sample being taken. Refer to AASHTO T 40 for emulsified asphalt sampling procedures.

335-2.2 Aggregate:

335-2.2.1 General: Use an aggregate consisting of 100% crushed granite. To assure the material is 100 percent crushed, the parent aggregate will be larger than the largest stone in the gradation used. Use aggregate source(s) from the list of aggregates available on the Florida Department of Transportation's website and also meeting the requirements of this specification. The URL for obtaining the list of aggregates is:

<ftp://ftp.dot.state.fl.us/fdot/smo/website/sources/frictioncourse.pdf>.

335-2.2.2 Aggregate Quality Tests: In addition to the requirements of FDOT Standard Specification Sections 901 and 902, meet the minimum aggregate requirements of Table 335-2.

Test No.		Aggregate Property	Specification Requirements
AASHTO T 176	ASTM 2419	Sand Equivalent	60 Minimum
AASHTO T 104	ASTM C 88	Soundness	15% Maximum using Na ₂ SO ₄ or 25% Maximum using MgSO ₄
AASHTO T 96	ASTM C 131	Abrasion Resistance ⁽¹⁾	30% Maximum

(1) The abrasion test will be performed on the parent aggregate.

335-2.2.3 Gradation Requirements: When tested in accordance with AASHTO T 27 and AASHTO T 11, the target (mix design) aggregate gradation, including the mineral filler, shall be within the gradation range for a Type I, Type II or Type III mixture shown in Table 335-3.

Sieve Size	Type I Mix Design Range Percent Passing	Type II Mix Design Range Percent Passing	Type III Mix Design Range Percent Passing	Stockpile Tolerance from Mix Design Percent Passing
3/8 inch	100	100	100	N/A
No. 4	100	90 – 100	70 – 90	± 5%
No. 8	90-10	65 – 90	45 – 70	± 5%
No. 16	65-90	45 – 70	28 – 50	± 5%

No. 30	40-65	30 – 50	19 – 34	± 5%
No. 50	25-42	18 – 30	12 – 25	± 4%
No. 100	15-30	10 – 21	7 – 18	± 3%
No. 200	10-20	5 – 15	5 – 15	± 2%

The aggregate will be accepted from the stockpile located at the project. The stockpile will be accepted based on five quality control gradation tests conducted in accordance with AASHTO T 2 and one sand equivalency test conducted in accordance with AASHTO T 176. If the average of the five gradation tests is within the stockpile tolerances shown in Table 335-3 for all of the sieve sizes, and the one sand equivalent test meets the requirement shown in Table 335-2, then the stockpile is accepted. If the average of the five gradation tests is not within the stockpile tolerances shown in Table 335-3 for any sieve size, remove the stockpiled material and replace it with new aggregate or blend other aggregate sources with the stockpiled material. Aggregates used in blending must meet the quality tests shown in Table 335-2 before blending and must be blended in a manner to produce a consistent gradation and sand equivalent value. If the sand equivalent quality control test does not meet the criteria shown in Table 335-2, remove the stockpiled material and replace it with new aggregate. If new aggregate is obtained or blending of aggregates is performed resulting in an aggregate that is not represented by the mix design, submit a new mix design to the Engineer for approval prior to production of the mix.

The Engineer may obtain stockpile samples at any time. If the average of five gradation tests conducted in accordance with AASHTO T 2 is not within the gradation tolerances shown in Table 335-3 for any sieve size, or if the sand equivalent value does not meet the requirements of Table 335-2, cease production until the problem is corrected to the satisfaction of the Engineer.

All stockpiled aggregates shall be screened at the stockpile area prior to delivery to the paving machine to remove oversize material and non-desirable particles. The screened aggregate will be placed directly into the nurse truck or into the slurry surfacing mixing machine, depending on whether continuous or truck mounted machines are used. Screened aggregate may not be placed on the ground prior to mixture laydown.

335-2.3 Mineral Filler: Utilize non air-entrained Portland cement or hydrated lime that is free from lumps. The owner will accept the mineral filler by visual inspection. The type and amount of mineral filler shall be determined by a laboratory mix design and will be considered as part of the aggregate gradation. An increase or decrease of less than one percent mineral filler may be permitted during production if it is found to result in better consistency or set times. Any changes to the percentage of mineral filler must meet the requirements of Table 335-5.

335-2.4 Water: Utilize water that is potable and free of harmful soluble salts, reactive chemicals, or any other contaminants.

335-2.5 Additives: Additives may be added to the mixture or any of the component materials to provide control of quick-trafficking properties. The additives to be used should be indicated on the mix design and be compatible with the other components of the mix.

335-3 Mix Design.

Before work begins, the Contractor shall submit a mix design to the Engineer. The mix design must have been developed within the last year using the specific materials to be used on the project. Mix designs shall be developed by laboratories with experience in designing slurry

seal mixtures. When requested by the Engineer, the mix design shall be verified by an independent laboratory not affiliated with the emulsion supplier or the contractor. Verification shall include confirmation of the mix design results for wet cohesion and 1 hour wet track abrasion loss.

Submit the proposed mix design with supporting test data indicating compliance with all mix design criteria. Allow the Engineer a maximum of one week to either conditionally verify or reject the mix design. Meet the requirements provided in Table 335-4. After the mix design has been approved, no substitutions to the mix design will be permitted, unless approved by the Engineer. The Engineer will consider inadequate field performance of a mix as sufficient evidence that the properties of the mix related to the mix design have changed. The project will be stopped until it is demonstrated that those properties, or issues, have been sufficiently addressed.

Table 335-4 Mix Design Testing Requirements		
ISSA Test No.	Property	Specification Requirements
ISSA TB-139 ⁽¹⁾	Wet Cohesion: @ 30 Minutes Minimum (Set) @ 60 Minutes Minimum(Traffic)	12 kg-cm Minimum 20 kg-cm or Near Spin Minimum
ISSA TB-109	Excess Asphalt by Loaded Wheel Tester (LWT) Sand Adhesion	50 g/ft ² Maximum
ISSA TB-114	Wet Stripping	90% Minimum
ISSA TB-100	Wet-track Abrasion Loss: One-hour Soak	60 g/ft ² Maximum
ISSA TB-113 ⁽¹⁾	Mix Time @ 77°F (25°C)	Controllable to 180 Seconds Minimum
The Cohesion test and Mixing Time test should be checked and reported for 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 required in a slurry seal system. The Wet Track Abrasion Test is not recommended as a field quality control or acceptance test. The mixing test is used to predict the time the material can be mixed before it begins to break. The laboratory should verify that mix and set times are appropriate for the climatic conditions expected during the project. The mix design must clearly show the proportions of aggregate, emulsified asphalt, mineral filler, water, and additive usage based on the dry weight of the aggregate. Meet the mix design component material requirements provided in Table 335-5.

Table 335-5 Mix Design Component Material Requirements	
Component Materials	Specification Requirements
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 to 3.0% (by dry weight of aggregate)
Polymer-based Modifier	Minimum of 3.0% (solids based on asphalt weight content)
Additives	As needed
Water	As required to produce proper mix consistency

The materials (aggregates, emulsified asphalt, mineral filler, and additives) must be from the same source, grade and type used to develop the approved mix design. Any substitutions or alternate supplies must be preapproved by the Engineer. Changes in the aggregate source or emulsified asphalt source requires re-validating the mix design and the performance properties. Blending, co-mingling and otherwise combining materials from two or more sources, grades or types not noted in the approved Mix Design is strictly prohibited. Aggregate stockpiles and emulsified asphalt material should be located at or near the job site in sufficient quantity for the job or designated parts of the job.

335-4 Equipment.

335-4.1 General: Maintain all equipment, tools, and machines used in the performance of this work in satisfactory working condition at all times to ensure a high-quality product.

335-4.2 Mixing Equipment: Use a machine specifically designed and manufactured to place slurry seal. Truck mounted and self-loading continuous machines are acceptable. Mix the material with an automatic-sequenced, self-propelled slurry seal paver. It shall be a continuous-flow mixing unit able to accurately deliver and proportion the mix components through a revolving mixer and to discharge the mixed product on a continuous-flow basis. The paver shall have sufficient storage capacity for all mix components to maintain an adequate supply to the proportioning controls.

Self-loading continuous paver shall be capable of loading materials while continuing to lay slurry seal, thereby minimizing construction joints. Self-loading continuous paver shall be equipped to allow the operator to have full control of the forward and reverse speeds during applications of the slurry seal material and shall be equipped with opposite-side driver stations to assist in alignment. The self-loading device, opposite-side driver stations, and forward and reverse speed controls shall be original equipment-manufacturer design. The Engineer shall decide which type of equipment best suits the specific project.

335-4.3 Proportioning Device: Provide and properly mark individual volume or weight controls for proportioning each material to be added to the mix (i.e., aggregate, mineral filler, emulsified asphalt, additives, and water).

335-4.4 Spreading Equipment: The mixture shall be placed uniformly by means of a spreader box attached to the paver and mechanically equipped, if necessary, to agitate and spread the material evenly throughout the box. With some quick-set systems, mechanical agitation may extend mix time. The slurry seal mixture shall have the proper consistency as it enters the spreader box. Spraying of additional water into the spreader box will not be permitted. A front seal shall be utilized 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 seal shall be designed and operated to provide uniform mix consistency behind the box. The spreader box shall have suitable means to side shift to compensate for variations in the pavement width. As approved by the Engineer, a burlap drag or alternate finishing screed may be attached to the rear of the

spreader box to provide a highly textured uniform surface. A drag stiffened by hardened slurry is ineffective and should be replaced immediately.

Agitate and spread the mixture uniformly in the spreader box by means of twin-shafted paddles or spiral augers fixed in the spreader box. Provide a front seal to ensure 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 so designed and operated that a uniform consistency is achieved and a free flow of material is provided to the rear strike-off. The spreader box shall have suitable means to hydraulically adjust the box width automatically while traveling behind the paver, and be able to side shift the box to compensate for variations in the pavement geometry.

335-4.5 Auxiliary Equipment: Provide suitable surface preparation equipment, traffic control equipment, hand tools, and any other support and safety equipment necessary to perform the work.

335-6 Calibration.

Calibrate each paver to be used in the performance of the work in the presence of the Engineer prior to the start of construction. Previous calibration documentation covering the exact materials to be used may be acceptable, provided that no more than 60 days have lapsed. Document the individual calibration of each material at various settings, which can be related to the paver metering devices. Do not utilize any paver on the project until the calibration has been completed and approved by the Engineer. Any component replacement affecting material proportioning requires that the paver be recalibrated. No paver will be allowed to work on the project until the calibration has been completed and accepted.

335-7 Weather Limitations.

Do not apply slurry seal if either the pavement or air temperature is below 50°F and falling. Slurry seal may be applied when both pavement and air temperatures are 45°F and rising. Do not apply slurry seal when there is the possibility that the finished product will freeze within 24 hours. Do not apply slurry seal in the rain or when there is standing water on the pavement. The mixture shall not be applied when weather conditions prevent opening to traffic within a reasonable amount of time, as determined by the Engineer.

335-8 Surface Preparation.

335-8.1 General: Remove any thermoplastic striping materials in the areas to be slurry seal. Provide temporary striping as necessary to comply with plan requirements. Immediately prior to applying the slurry seal, clear the surface of all loose material, silt spots, vegetation, and other material that will negatively affect the quality of the slurry seal, utilizing any standard cleaning method. If water is used for cleaning, allow any unsealed cracks to dry thoroughly before applying slurry seal. Protect manholes, valve boxes, drop inlets and other service entrances from the slurry seal mixture by a suitable method. The Engineer will approve the surface preparation prior to placing the slurry seal. No loose aggregate, either spilled from the lay-down machine or existing on the road, will be permitted.

335-8.2 Cracks: If the plans call for crack filling prior to construction of the slurry seal, pre-treat any cracks in the surface of the pavement with a crack filler meeting the material requirements of FDOT Developmental Specification Section 305 prior to the application of the slurry surfacing. Fill any cracks with a width greater than 1/4 inch. Do not overfill the cracks. Crack filling material must cure for a minimum of 30 days prior to application of the slurry seal.

335-8.3 Rumble Strips: Where shoulders are not to be slurry sealed, prevent material from being applied to or entering any rumble strip depressions. If necessary, remove any material that enters the depressions.

335-8.4 Tack Coat: Place a tack coat on all concrete or brick pavement prior to constructing a slurry seal course. In general, the asphalt pavements will not require a tack coat except in areas that are extremely dry or raveled, as determined by the Engineer. If required, the tack coat should be type SS, type CSS, or the slurry seal emulsified asphalt. It may consist of one part emulsified asphalt to three parts water and should be applied with a standard distributor. The distributor shall be capable of applying the dilution evenly at a rate of 0.05-0.15 gallons per square yard.

335-9 Test Strip: Construct a test strip for the Engineer to evaluate. The test strip should be performed in similar conditions as those expected during actual application. The test strip shall be a minimum of 300 feet in length at a location not associated with the project within reasonable proximity to the project staging area. The intention of the test strip is to assure adequate workmanship, aesthetics and that the cure time of the mixture is achievable when applied with the personnel, equipment and materials intended for use during execution of the project. Acceptable cure time is defined by the ability of the test strip to accept rolling traffic within one hour after placement. Full production may begin once the test strip has been accepted by the Engineer. If the Engineer deems the test strip to be unacceptable, the Contractor shall make any necessary changes. Once the Engineer is satisfied that the cause of the problem has been remedied, the Contractor may resubmit a new test strip for evaluation.

335-10 Application.

335-10.1 General: Pre-wet the surface by fogging ahead of the spreader box with potable water. Adjust the rate of application of the fog spray to suit temperatures, surface texture, humidity, and dryness of the pavement. The slurry seal shall be of the desired consistency upon leaving the mixer. Carry a sufficient amount of material in all parts of the spreader box at all times so that complete coverage is obtained. Avoid overloading of the spreader box. Do not allow lumping, balling, or unmixed aggregate in the slurry seal mixture. Do not leave streaks, such as those caused by oversized aggregate, in the finished surface. If excess streaking develops, stop production until the situation has been corrected. Excessive streaking is defined as more than four drag marks greater than 1/2 inch wide and 4 inches long, or 1 inch wide and 3 inches long, in any 30 square yard area. Do not permit transverse ripples or longitudinal streaks of 1/4 inch in depth or greater, when measured by placing a 10 foot straight edge over the surface.

335-10.2 Rate of Application: The average single application rate, as measured by the Contractor, shall be in accordance with Table 335-6, unless otherwise specified in the plans. Full width application rates must be maintained within plus or minus 2 pounds per square yard of the specified rate. Application rates are based upon the weight of dry aggregate in the mixture.

Table 335-6 Rate of Application		
AGGREGATE TYPE	LOCATION	SUGGESTED APPLICATION RATE ⁽¹⁾
Type I	Urban and Residential Streets Airport runways	8 - 12 lbs/yd ²

Type II	Collectors, Local Roads Airport Runways	10-18 lbs/yd ²
Type III	Interstate, Primary Routes	15-22 lbs/yd ²

(1) Suggested application rates are based upon the weight of dry aggregate in the mixture.

335-10.3 Joints: Prevent excessive buildup, uncovered areas, or unsightly appearance on longitudinal and transverse joints. Provide suitable-width spreading equipment to produce a minimum number of longitudinal joints throughout the project. Place longitudinal joints on lane lines, where possible. Use half passes and odd-width passes only when absolutely necessary. Do not apply a half pass as the last pass of any area. Do not overlap longitudinal lane line joints by more than 6 inches. Construct longitudinal joints so that water is not held at the joint. Construct transverse joints at the beginning and end project limits so that the elevation difference between the slurry seal and the adjacent pavement is a smooth transition does not exceed 1/4 inch.

335-10.4 Mix Stability: Produce a slurry seal mixture that possesses 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. The mixture shall be free of excess water or emulsified asphalt and free of segregation of the emulsified asphalt and aggregate fines from the coarser aggregate. Do not spray water directly into the spreader box while applying slurry seal material under any circumstances.

335-10.5 Handwork: Utilize hand squeegees to provide complete and uniform coverage of slurry sealed areas that cannot be reached with the paver. Lightly dampen the area to be hand worked prior to mix placement, if necessary. Care shall be exercised to leave no unsightly appearance from handwork. When performing handwork, provide the same type of finish as that applied by the spreader box.

335-10.6 Lines: Construct straight lines along curbs and shoulders. Do not permit runoff on these areas. Keep lines at intersections straight to provide a good appearance. If necessary, utilize a suitable material to mask off the end of streets to provide straight lines. Edge lines shall not vary by more than 2 inches horizontally.

335-10.7 Cleanup: Remove slurry seal mixture from all areas such as manholes, gutters, drainage structures, rumble strips, and as otherwise specified by the Engineer. On a daily basis, remove any debris resulting from the performance of the work.

335-10.8 Post Sweeping: If required by the Engineer, broom the surface of any loose material within 48 hours after the completion of the slurry seal. If directed by the Engineer, perform this operation again approximately seven to ten days after completion of the slurry seal as needed. Additionally, clean the surface, as necessary, prior to application of the final pavement markings.

335-11 Quality Control and Assurance.

335-11.1 General: Produce a mixture that will meet the mix design and the quality control (QC) tolerances specified in Table 335-7. Notify the Engineer immediately if QC test results exceed the tolerances specified in Table 335-7, and stop mix production. Identify the cause of the deviation, and determine the corrective action necessary to bring the mixture into compliance. Obtain the Engineer's approval before resuming work. The Engineer reserves the right to verify, at agency cost, QC test accuracy by an independent laboratory not heretofore

associated with the project. If the Engineer identifies a condition that causes an unsatisfactory slurry seal treatment, immediately stop production work and correct the defect at no additional cost.

Table 335-7 Slurry Seal Quality Control Tolerances							
Aggregate Gradation Tolerances (±)							
Sieve Size	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
Tolerance	5.0%	5.0%	5.0%	5.0%	4.0%	3.0%	2.0%
General Quality Control Tolerances (±)							
Parameter				Tolerance			
Asphalt Cement Content Single Test				0.5% from mix design			
Asphalt Cement Content Daily Average				0.2% from mix design			
Application Rate (as determined by 1,000 ft yield checks)				2 lb/yd ²			
Sand Equivalent Test (ASTM D2419)				7% from mix design but not less than 60			

335-11.2 Contractor's Quality Control Plan: Provide and follow a QC plan that will maintain QC for production and construction processes. Provide the Engineer with a copy of the QC plan for review and approval before the pre-construction meeting. Include, at a minimum, the following items:

The source materials used on the project.

Sampling and testing methods used to determine compliance with material specifications.

The equipment to be used on the project.

Calibration method used to determine compliance with the mix design.

Pavement cleaning and preparation procedure.

Plan for protecting slurry seal mixture from damage by traffic.

Procedure for monitoring initial acceptance requirements.

An action plan demonstrating adjustments of the slurry seal operation for adverse environmental conditions.

335-11.3 Minimum Sampling and Testing Frequency:

335-11.3.1 Aggregate Gradation: Sample aggregate from the project stockpile and test for gradation and sand equivalency. Perform one test per 500 tons of aggregate. At the discretion of the Engineer, an alternative would allow certification of an entire stockpile. The stockpile will be accepted based on five quality control gradation tests conducted in accordance with AASHTO T 2 and five sand equivalency tests conducted in accordance with AASHTO T 176. If the average of the five gradation tests is within the stockpile tolerances shown in Table 335-3 for all of the sieve sizes and the five sand equivalent tests meets the requirement shown in Table 335-2, then the stockpile is accepted.

335-11.3.2 Asphalt Content: Calculate the percent asphalt content of the mixture at least three times per day. The Owner's on-site representative shall randomly determine the timing for the readings used to calculate asphalt content.

335-11.3.3 Application Rate: Calculate the yield of the course placed at least three times per day. The Owner's on-site representative shall randomly determine the timing for the readings used to calculate application rate.

335-11.4 Documentation: Complete a daily report that includes the following information:

Job number
Route/Street Name(s)
Owner's On-Site Representative
Date
Air temperature – Min/Max (during application)
Unit weight of emulsified asphalt (pounds per gallon)
Beginning and ending application locations
Counter readings (beginning, ending, and total difference)
Total area (square yards)
Aggregate weight
Gallons of emulsified asphalt
Application rate (pounds per square yard)
Contractor's authorized signature
QC aggregate properties (if required)
Asphalt emulsified asphalt bill of lading(s)

335-12 Acceptance.

Allow the Engineer access to in-progress work for quality assurance review and testing. Upon completion of work, schedule an inspection with the Engineer. The Engineer will note deficiencies. Any deficiencies identified during this process will be addressed by the Contractor at no additional cost.

335-13 Basis of Payment.

335-13.1 General: Payment for the slurry seal at the Contract bid unit prices of measure is compensation in full for all costs of furnishing and applying the material as specified, including cleaning the existing pavement, stationing, purchase of aggregate, delivery of aggregate, all labor, equipment, and materials necessary for the placement of the slurry seal, sweeping of any loose aggregate after construction and other requirements as specified. The cost of removing existing raised pavement markings and installation of temporary paint markings for traffic control shall be considered incidental to the work unless specified elsewhere in the plans or proposal. Payment for the accepted quantity of emulsified asphalt for slurry seal (including any required additives) at the Contract bid price of measure is compensation in full for all costs of furnishing and applying the material as specified.

335-13.2 Payment Items: Payment will be made in accordance with the schedule set forth below at the Contract bid price for the specified unit of measure. Such payment, in each instance, is compensation in full for all costs incidental thereto.

Payment will be made under:
Emulsified Asphalt for Slurry Seal – per Gallon
Aggregate for Slurry Seal – per Ton