

Conventional Micro Surfacing

Sample Construction Specification Guideline

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1. Scope

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

2. Description

Conventional Micro Surfacing is a laboratory-designed mixture of polymer modified asphalt emulsion, aggregate, mineral filler, water, and other additives accurately proportioned, mixed, and uniformly spread over a properly prepared surface. Micro surfacing can be used for both preventive and routine maintenance. It is recommended on pavement with a sound base structure to prevent or correct distresses such as raveling, oxidation, loss of friction, certain types of wheel ruts, and top-down cracking less than 0.25 inches (0.64 cm) in width. Bottom-up cracks, working cracks, and cracks larger than 0.25 inches (0.64 cm) should be sealed with a high-quality sealant prior to application.

3. Materials

3.1 Asphalt Emulsion

The asphalt emulsion shall be designated CSS-1HP and shall meet the requirements shown in Table 1. Asphalt emulsion delivered to the project shall be accompanied by a laboratory Certificate of Analysis and any other certifications as deemed necessary or advisable.

Property	Test Procedure	Value
	AASHTO	
Tests on Emulsion		
Viscosity, Saybolt-Furol, 77°F, seconds	T59	20-100
Storage Stability, 24 hours, % ¹	T59	1
Settlement, 5-Day, % max ²	T59	5
Particle Charge Test	T59	Positive
Sieve Test, % max	T59	0.10
Residue, % min	T59	62
Tests on Residue From Distillation³		
Penetration, 77°F, 100 g, 5 seconds, dmm, range	T49	40-90
Ductility, 77°F, 5 cm/min	T51	40
Solubility in Trichloroethylene, % min ⁴	T44	97
Softening Point, °F, min	T53	135

1. The 24-hour (1-day) storage stability test may be used but does not predict that the 5-day settlement test will pass.
2. The test requirement for settlement may be waived when the emulsified asphalt is used in less than five days time.
3. The residue from the emulsified asphalt shall be obtained in accordance with AASHTO T59 except that the maximum test temperature shall not exceed 350°F and the duration shall not exceed 20 minutes.
4. Solubility test is to be performed on the base asphalt used for emulsion manufacture.

The aggregate shall also meet the properties shown in Table 3. Proven performance may justify the use of aggregates that do not pass all of the requirements. The polishing value of aggregates should be carefully evaluated, especially in higher traffic situations. Local agency experience, guidelines, and specifications should be considered. The polishing value requirement may be waived for ADT volumes less than 1,500.

3.2 Aggregate

3.2.1 Gradation

The gradation type to be used shall be set forth in the plans.

When tested in accordance with AASHTO T27 and AASHTO T11, the mix design aggregate gradation shall meet the requirements of Table 2.

The gradation of the aggregate stockpile shall not vary by more than the stockpile tolerance from the mix design gradation (indicated in the table above) while also remaining within the specification gradation band. The percentage of aggregate passing any two successive sieves shall not change from one end of the specified range to the other end.

The aggregate will be accepted at the job location or stockpile based on five gradation tests sampled according to AASHTO T27. The average of the five tests shall be within the stockpile tolerance from the mix design gradation for the stockpile to be accepted.

Table 2			
Mixture Control Tolerance	Sieve Size	Type II	Type III
+0	3/8"	100	100
+6	No. 4	90-100	70-90
+5	No. 8	65-90	45-70
+5	No. 16	45-70	30-50
+4	No. 30	30-50	20-35
+4	No. 50	18-30	12-25
+3	No. 100	10-21	7-18
+3	No. 200	5-15	5-12

3.2.2 Aggregate Quality Tests

The aggregate shall also meet the properties shown in Table 3. Proven performance may justify the use of aggregates that do not pass all of the requirements. The polishing value of aggregates should be carefully evaluated, especially in higher traffic situations. Local agency experience, guidelines, and specifications should be considered. The polishing value requirement may be waived for ADT volumes less than 1,500.

Table 3		
Test	AASHTO Method	Specification
Sand Equivalent	T176	65 Minimum
Soundness	T104	15% Maximum using Sodium Sulfate 25% Maximum using Magnesium Sulfate
LA Abrasion	T96	30% Maximum
Polish Value	T278, T279	31 Minimum

3.3 Polymer Modifier

The polymer modifier shall be either SBR or SBS in composition. It shall be co-milled with the asphalt cement during the manufacture of the emulsified asphalt to produce a homogeneous mixture. The polymer modifier shall be added in the necessary proportions to result in a minimum 3.0% polymer solid by weight of residual asphalt cement in the emulsion.

3.4 Mineral Filler

Mineral filler may be a Type I or I/II Portland cement, hydrated lime, limestone dust, fly ash, or other approved filler.

3.5 Water

The water shall be from a potable source, free of harmful salts, chemicals, and contaminants. If the quality of the water is in question, it should be submitted to the laboratory with the other raw materials for the mix design.

3.6 Additives

An additive may be used to control the breaking and setting characteristics of the micro surfacing. The additive should be supplied by the asphalt emulsion manufacturer or approved by the laboratory as part of the mix design.

3.7 Tack Coat

Normally, a tack coat is not required unless the surface to be covered is concrete, is extremely dry and raveled, or does not receive typical traffic as in an airport pavement. When required, the emulsified asphalt shall be designated as CSS-1HP and meet the requirements set forth in Table 1. The asphalt emulsion shall be diluted at the rate of one part emulsion to three parts water and shall be applied with an asphalt distributor capable of evenly applying the emulsion. The application rate shall be 0.05 to 0.10 gallons of diluted emulsion per square yard. The tack coat shall be allowed to cure sufficiently before the application of micro surfacing. If the tack coat is required, it will be noted on the plans or in the contract documents.

4. Mix Design

The contractor shall submit a mix design to the agency a minimum of 10 days prior to the start of the project. As a minimum, the design shall include the following: aggregate properties, aggregate gradation, the results of Table 4 design requirements, design asphalt residue, and mineral filler percentages based on dry weight of the aggregate. The contractor shall submit to the agency representative samples of each ingredient to be used in the micro surfacing mixture for design verification. The samples shall include information relative to sources, type of materials, and project number. No work shall begin until the agency has approved the mix design.

Table 4		
	Mixture Control Tolerance	Type II and III
Range for Residual Asphalt, % ¹	+0.5%	6.0-9.0
Range for Mineral Filler, % ¹	+0.5%	0.5-3.0
Test	Method – ISSA TB ²	Value
Wet Track Abrasion Loss, maximum 1-hour soak	TB 100	50 g/ft ²
Wet Track Abrasion Loss, 6-day soak	TB 100	75 g/ft ²
Vertical Displacement, maximum	TB 147A or TB 147C	10%
Excess Asphalt by Loaded Wheel Test, maximum	TB 109	50 g/ft ²
System Compatibility, minimum grade	TB 144	11 points
Mixing Time, seconds, 77°F, minimum	TB 113	120
Set Time, 30 minutes, minimum	TB 139	12 kg-cm
Early Rolling Traffic Time, 60 minutes, minimum	TB 139	20 kg-cm
Water Resistance, 30 minutes	TB 102	No Discoloration
Wet Stripping Test, % Coating, minimum	TB 114	90
System Compatibility	TB 115	Pass

1. Percent residual asphalt and percent mineral filler shall be based on weight of dry aggregate.
2. Reference to ISSA TB means International Slurry Surfacing Association Technical Bulletin.

5. Composition of Mixture

The micro surfacing material shall be a uniform mixture of aggregate, polymer modified emulsion, mineral filler, water, and other additives as required to control set time in the field. The emulsion and aggregate shall be compatible so that a complete, uniform coating of the aggregate shall be obtained in the mixing unit. The mixture shall have sufficient working life to allow for proper placement at the existing ambient temperature and humidity. The agency shall require the mixture to be redesigned if replacement of a constituent source or change in gradation outside of the tolerance. The constituents shall be proportioned to produce a uniform mixture meeting the requirements of Table 4.

6. Equipment

6.1 Mixing Equipment

The paving mixture shall be blended by a self-propelled, positive, non-slipping aggregate delivery system (belt over chain) micro surfacing mixing machine which shall be a continuous flow mixing unit able to accurately deliver and proportion the aggregate, polymer modified emulsion, mineral filler, field control additives, and water to a revolving multi-blade, twin shafted mixer, and discharge the mixed product on a continuous flow basis. The mixture shall be thoroughly blended so that no uncoated aggregate is visible upon discharge from the mixing unit. The machine shall be equipped with self-loading devices, which provide for the loading of all materials while continuing to lay the micro surfacing, thereby minimizing construction joints. The machine shall be equipped with opposite side driving stations to optimize longitudinal alignment. The machine shall be equipped to allow the operator to have full hydrostatic control of the forward and reverse speed during the application of the micro surfacing material. If truck-mounted units are allowed, they shall be equipped with a positive, non-slipping aggregate delivery system (belt over chain) and have the capability of applying a minimum of 10 tons of aggregate without recharging the aggregate bin.

6.2 Water Pressure System

The mixing machine shall be equipped with a water pressure system and nozzle-type spray bar to provide a water spray ahead of and outside the spreader box.

6.3 Calibration and Proportioning Devices

The machine shall be equipped with individual volume or mass controls or other gauging devices for measuring and proportioning each material added to the mix. Each material control device shall be calibrated, properly marked, and positively interlocked. The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so that the amount of asphalt emulsion, aggregate, and mineral filler used may be determined at any time. Each mixing unit shall be calibrated prior to commencement of the work. The calibrations shall be performed and verified in the presence of the agency or the agency's representative. Once calibrated, the aggregate and emulsion flows shall not be changed without the approval of the agency. The water and additive may be adjusted in the field to control the mix properties to produce an acceptable mix. With agency approval, previous calibration documentation covering the exact materials to be used may be acceptable provided they were made within the last three months.

6.4 Emulsion Pump

The emulsion pump shall be a heated, positive displacement-type pump.

6.5 Spreading Equipment

Attached to the machine shall be a hydraulically adjustable-type spreader box with a positive screed adjustment for yield control. The box shall be attached to the mixer, equipped with ribbon flights mounted on an adjustable shaft to continually agitate and distribute the material throughout the box. The box will be equipped with curb bumpers and replaceable runners with a minimum of five-foot-long end runners. The box shall be equipped with a sufficient walkway to provide access to either side of the spreader box without walking through the freshly applied material. The box must be capable of laying mix to a width of 14 feet. The equipment shall provide sufficient turbulence to prevent the mix from setting in the box or causing excessive build-up or lumps. To prevent the loss of mixture from the box, the contractor shall attach flexible seals, front and rear, in contact with the road. The full-width application box shall be equipped with a secondary strike-off located approximately two to three feet behind the primary strike-off to minimize transverse corrugations. The secondary strike-off shall have elevation and width adjustments similar to the primary strike-off. It shall have a pivot point where it can be tilted for texturing or raised completely off of the surface. The use of burlap drags or other drags necessary to obtain the desired surface texture shall require approval by the agency. Drags having excessive build-up shall be replaced. Drags shall be kept in a completely flexible condition at all times.

6.6 Rut Box

When the plans require that wheel ruts greater than 0.5 inch be filled prior to placing the finished wearing course, material shall be placed with a specially designed rut-filling spreader box. For ruts of less than 0.5 inch, a full-width scratch course using the conventional spreader box is acceptable. Rut boxes are typically designed to be five or six feet wide. Where ruts exceed 1.5 inches, multiple passes with the rut box are necessary. All rut filling should be allowed to cure under traffic for at least 24 hours before the final surface course is placed. Mixtures for filling ruts, depressions, utility cuts, and others shall meet the requirements of Type III.

6.7 Auxiliary Equipment

Suitable surface cleaning equipment, barricading equipment, hand tools, and other support equipment shall be provided by the contractor as necessary to perform the work.

7. Test Strip

Prior to the beginning of the project, the contractor may be required to perform a test strip in a suitable area such as a parking lot or staging area to assure the materials, contractor personnel, and equipment are suitable to produce a satisfactory micro surfacing mixture. The location for the test strip shall be approved by the owner. The test strip may be conducted as part of the calibration procedure and may be considered as a part of the project. The test strip shall be performed in similar conditions under which the project is expected to take place.

8. Weather

The micro surfacing mixture shall be applied only when both the pavement surface and the ambient temperature are at least 50°F and rising, the weather is not foggy or rainy, and there is no forecast of temperatures below 32°F within 48 hours from the time of placement.

9. Traffic Control

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

10. Surface Preparation

10.1 General

Prior to applying micro surfacing, the pavement surface shall be cleared of all loose material, silt spots, vegetation, and other objectionable material. If water is used, cracks shall be allowed to dry thoroughly before applying the micro surfacing. Manholes, valve boxes, drop inlets, and other service entrances shall be protected by a suitable method. Thermoplastic and other striping should be removed or protected. The agency shall approve the surface preparation prior to application of the asphalt emulsion.

10.2 Cracks

Cracks wider than 0.25 inches (0.64 cm) should be treated with an approved crack sealer 30 days prior to application of the micro surfacing.

10.3 Patching

Prior to application, all failed pavement sections should be removed and patched using accepted best practices and quality materials. The perimeter of excavated areas should be milled or saw cut to form a neat vertical face. Unstable areas of sub-grade should be backfilled with well-graded and compacted aggregate and filled flush with the pavement surface with an appropriate asphalt aggregate mixture.

11. Application

The paving mixture shall be spread on the prepared surface in such a way to leave a uniform finished surface. Care shall be taken when filling ruts to restore the designed profile of the pavement cross section. Excess crowning or overfilling of the rut area will not be permitted; however, best practice requires an approximate 1/8 inch crown per one inch of rut depth to allow for compaction by return traffic. The contractor shall use squeegees and lutes to spread the mixture in areas inaccessible to the spreader box and areas requiring hand spreading. A sufficient amount of material shall be carried at all times in all parts of the spreader box to ensure complete coverage. Adjustments to the additive will be permitted if necessary to control the breaking and setting properties. If hand spreading is necessary, the mixture shall be poured in a small windrow along one edge of the surface to be covered and then spread uniformly by a hand squeegee or lute. A smooth, neat seam shall be provided where two passes meet. Excess material shall immediately be removed from ends of each run.

It shall be the responsibility of the contractor to produce, transport, and place the specified materials in accordance with these specifications and as approved by the agency. The finished micro surfacing shall have a uniform texture free from excessive scratch marks, tears, or other surface irregularities. The cured mixture shall adhere fully to the underlying surface. Based upon a visual examination or test results, the engineer may reject any work due to poor workmanship, loss of texture, raveling, or apparent instability.

Rolling of micro surfacing mixtures is generally not required. Exceptions are airports and possibly parking lots and other pavements where traffic is light or irregular. Rolling may be helpful when excessive surface and ambient temperature result in a tender mat that can take several days to build maximum cohesiveness. In the event rolling is required by the agency, best practice is to use no larger than a 10-ton pneumatic roller with a minimum of three passes over the mat the morning following application.

12. Material Storage and Handling

12.1 Asphalt Emulsion

The storage shall be adequate to meet the requirements of the production rate. All equipment used in the storage and handling of bituminous material shall be kept in a clean condition at all times and shall be operated in such a manner that there will be no contamination with foreign matter. The contractor shall comply with all material handling, storage, and safety requirements outlined in any applicable SDS or other product label.

12.2 Aggregate

The mineral aggregate shall be handled in such a manner as to prevent segregation, mixing of the various materials or sizes, and contamination with foreign materials. The grading of aggregates proposed for use and as supplied to the project shall be uniform. Suitable equipment of acceptable size shall be furnished by the contractor to maintain the stockpiles and prevent segregation of aggregates. The aggregate shall be passed over a scalping screen immediately prior to transfer to the micro surfacing mixing machine to remove oversized material. In addition, the scalping screen unit, when payment for micro surfacing is to be by the ton of aggregate and gallon of asphalt emulsion, shall be equipped with certified scales capable of providing an automated ticket printout for each truck load of material delivered to the micro surfacing machine. Each ticket shall include the project number, ticket number, truck number, date, and weight of material loaded.

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

13. Workmanship

13.1 General

Excessive build-up, uncovered areas, or unsightly appearance shall not be permitted on longitudinal or transverse joints. Longitudinal joints shall be placed on lane lines, and excessive overlap shall not be permitted. Care shall be taken to ensure straight lines along the roadway centerline, lane lines, and shoulder or edge lines. Lines at intersections shall be kept straight to provide a neat and uniform appearance.

13.2 Finished Surface

The finished surface shall have a uniform texture free from excessive scratch marks, tears, or other surface irregularities. Excessive tear marks are considered four marks that are 0.5 inches wide or wider and six inches or more in length per 100 square yards or any marks one inch wide or wider or four inches in length. The edges of the micro surfacing shall be neat in appearance, and longitudinal alignment shall be parallel to the roadway centerline.

13.3 Joints and Seams

The longitudinal and transverse joints shall be neat in appearance and uniform. Transverse joints shall be constructed as butt-type joints. No excessive build-up, uncovered areas, or unsightly appearance will be permitted on longitudinal or transverse joints. Longitudinal joints shall be placed on lane lines when possible. Gaps between applications shall not be permitted. Joints will be considered acceptable if no more than a 0.5-inch vertical space exists between the pavement surface and a four-foot straight edge placed perpendicular on the longitudinal joint and no more than 0.25 inches placed across a transverse joint.

13.4 Irregular Areas

Areas that cannot be reached with the mixing machine shall be surfaced using hand tools to provide complete and uniform coverage. The area to be handworked shall be cleaned and lightly dampened prior to mix placement. Care shall be exercised in areas that require handwork so that the finished surface is uniform in texture, dense, and of overall neat appearance comparable to that produced by the spreader box. Micro surfacing material required to repair deficiencies due to unsatisfactory workmanship shall not be paid for but shall be entirely at the contractor's expense. When transitions are included as part of the work, then these areas are to be surfaced prior to application of the main line. This shall include intersections, turnouts, radii, ramps, etc.

14. Measurement

Micro surfacing shall be measured and paid for by the square yard. 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 the work as specified herein and set forth in the plans. In lieu of measurement by the square yard, micro surfacing may be measured by the ton of aggregate and gallon of emulsified asphalt. The aggregate shall be weighed on certified scales. The weight will be based on a 2000-pound ton, and the aggregate will be corrected for moisture. The mineral filler will be counted by the sack of 94 pounds and will be included in the payment for aggregate. Emulsified asphalt for micro surfacing shall be measured by the gallon. The contractor will be required to submit certified bill of ladings from the emulsion manufacturer, indicating total gallons delivered. In addition, the contractor will be responsible for submitting a way-back ticket representing unused material at the conclusion of each project.

Tack coat will be measured by the gallon of undiluted emulsion used and included in the payment for emulsion.

15. Payment

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

- By the square yards covered
- By the gallons of emulsion and ton of aggregate used