

January 1, 2019

MICRO SURFACING

410 Micro Surfacing

410.1 Description

This section covers the materials, equipment, construction and application procedures for placing Micro Surfacing material for filling ruts and for surfacing existing paved surfaces. Micro Surfacing is a mixture of a latex-modified asphalt emulsion, crushed mineral aggregate screenings, mineral filler, water and other additives for control of set time in the field. No limestone aggregate will be permitted in the mixture. All ingredients are to be properly proportioned, mixed and spread on the paved surface in accordance with this Specification and as directed by the Asphalt Materials Engineer (**AME**).

410.2 Materials

410.2.1 Aggregate

Use aggregate screenings meeting the applicable requirements of **Subsection 401.2.2** of the Standard Specifications, except as modified in this subsection. Ensure that aggregates shipped to the project are crushed mineral aggregate screenings that are uniform and do not require blending or pre-mixing at the storage area before use and meet the appropriate gradation as shown in Table 2 and have a Sand Equivalent value that is not less than 65 when tested in accordance with **AASHTO T176**.

410.2.2 Mineral Filler

Use either Portland Cement or Hydrated Lime meeting the following requirements:

- | | |
|----------------------------|--------------------------------------|
| 1. Portland Cement, Type I | Subsection 701.2.1 (QPL 06) |
| 2. Hydrated Lime | Subsection 401.2.1.3 (QPL 39) |

410.2.3 Cationic Quick-Setting Emulsion

Utilize a cationic latex rubber additive (LRA) to modify the emulsified asphalt meeting requirements of a Cationic Quick-Setting (CQS) emulsion as stated in Table 1.

Table 1. -Cationic Quick-Setting Emulsion Properties

CQS Micro Emulsified Asphalt			
Property	Minimum	Maximum	AASHTO Test
Viscosity, Saybolt Furol @ 25° C, Sec.	20.0	90.0	T59
Particle Charge	Positive	-	T59
Sieve Test, %	-	0.1	T59
Distillation			
Oil distillate, by volume, %	-	0.5	T59
Residue from Distillation, %	62.0	-	T59
Penetration, 25°C, 0.1mm (100g, 5 sec.)	40.0	100.0	T49

The LRA will be natural latex or an unvulcanized styrene-butadiene rubber in an emulsified latex form. Provide material certification from the manufacturer to the **AME** that the LRA meets the following requirements:

Total Rubber Solids content, ASTM D1417 (Method A)	60 % Minimum (by weight)
Brookfield Viscosity, AASHTO T316 @ 135°C	5000 cps Maximum
Total Ash, ASTM D297	3.5 % Maximum (by weight)

Co-mill the LRA along with special emulsifiers and the asphalt binder during the manufacture of the emulsified asphalt to produce a homogeneous mixture. Add the LRA in the necessary proportions to result in a minimum of 3.0% neat latex by weight of residual asphalt cement in the emulsion. Ensure that the LRA modified emulsified asphalt, upon standing undisturbed for a period of 24 hours, shows no separation of emulsion and LRA, no color striations, but is a uniform color throughout.

Provide a material that has a minimum softening point of 135°F when tested in accordance with **AASHTO T53**; ensure that the maximum test temperature during the distillation process is held at 350°F for 20 minutes when determining the residue from the LRA modified emulsified asphalt. Use emulsified asphalt that will allow the paving mixture to cure at a rate that will permit traffic on the pavement within one hour after application without damaging the pavement surface.

410.2.5 Asphalt Tack Coat

Use a Cationic emulsion meeting the requirements listed in **AASHTO M208**, or Table 1 of this specification as applicable.

410.2.6 Water

Use potable water free from any contaminants detrimental to the mixture for Micro Surfacing mixture.

410.2.7 Other Additives

Provide other additives as required by International Slurry Surfacing Association (**ISSA**) requirements to control the set time of the mixture in the field.

410.3 Composition of Mixture

Develop the mix design in a laboratory by a technician with Micro Surfacing experience. Supply a certified mix design to the **AME** that includes the following information: aggregate test properties, aggregate target gradation, results of Table 2 design requirements, design asphalt residue and mineral filler percentages based on dry weight of the aggregate. Include information relative to sources, type of materials and project number. Do not begin Micro Surfacing work until the **AME** has reviewed the submitted design. Acceptance of the design by the **AME** is solely for the purpose of quality control and in no way releases the Contractor from the responsibility to perform acceptable work under this specification.

Provide uniform mixture of aggregate, CQS-Micro emulsion, mineral filler, water and other additives as required to control set time in the field. Ensure compatible emulsion and aggregate so that a complete, uniform coating of the aggregate is obtained in the mixing unit and sufficient working life is present to allow for proper placement at the existing ambient temperature and humidity. The Resident Construction Engineer (**RCE**) or **AME** may require the mixture to be redesigned if replacement of a constituent, or change in gradation, is needed to produce an acceptable mixture. Proportion the constituents to produce a uniform mixture meeting the requirements of Table 2.

SUPPLEMENTAL SPECIFICATION

Table 2. -Job Mix Formula and Design Limits

MICRO SURFACING (Type II)		
MIXTURE CONTROL TOLERANCES	GRADING REQUIREMENTS (AASHTO T27)	RANGE
± 0.0	% Passing 3/8" Sieve	100
± 6.0	% Passing No. 4 Sieve	90 – 100
± 5.0	% Passing No. 8 Sieve	65 – 90
± 5.0	% Passing No. 30 Sieve	30 – 55
± 4.0	% Passing No. 100 Sieve	10 – 25
± 3.0	% Passing No. 200 Sieve	5 – 15

DESIGN REQUIREMENTS		
	Optimum Moisture Content of Aggregate	2.5-3.5%
±0.50	Range for Residual Asphalt (by weight of dry aggregate)	5.00 – 10.50%
	Range for Mineral Filler (by weight of dry aggregate)	0.5-3.0%
	Wet Track Abrasion Loss (Maximum) ISSA TB100 1 hour soak ISSA TB100 6 day soak	538 g/m ² 807 g/m ²
	Lateral Displacement (Maximum) ISSA TB147A or 147C	5%
	Excess Asphalt by LWT (Maximum) ISSA TB109	538 g/m ²
	Mixing Time Test, @ 25° C TB113 * Double shaft, multi-bladed mixers and fully agitated spreaders. **Conventional mixing and spreading equipment	60 seconds minimum* 90-120 seconds**
	Set Time Test, 30 minutes TB139	12 kg-cm minimum
	Early Rolling Traffic Time, 60 minutes TB139	20 kg-cm minimum

Note 1: ISSA TB notation is a reference to the specifications of the International Slurry Surfacing Association Technical Bulletins.

410.4 Equipment

Do not attempt to use equipment that is malfunctioning or not in excellent working condition. The RCE can order that the work be discontinued if sufficient equipment and tools are not in use to place the materials satisfactorily.

410.4.1 Mixing Equipment

Blend the paving mixture by a self-propelled Micro Surfacing mixing machine by means of a continuous flow mixing unit capable of accurately delivering and proportioning the aggregate, LRA-modified emulsion, mineral filler, field control additives and water to a revolving multi-blade, twin shaft mixer and discharge the mixed product on a continuous flow basis. Thoroughly blend the mixture so that no uncoated aggregate is visible upon discharge from the mixing unit. Equip the machine with self

loading devices which provide for the loading of all materials while continuing to lay Micro Surfacing, thereby minimizing construction joints. Ensure that the machine is equipped with opposite side driving stations to optimize longitudinal alignment and allow the operator to have full hydrostatic control of the forward and reverse speed during the application of the Micro Surfacing material. Equip the mixing machine with a water pressure system and nozzle type spray bar to provide a water spray ahead of and outside of the spreader box when required. A spray nozzle must also be readably available on the spreader unit to assist with cleaning equipment and strike-offs.

410.4.2 Proportioning Devices

Equip the mixing machine with a computer system with the capability to record, display and print the following information:

- Individual sensor counts for emulsion, aggregate, cement, water and additive
- Aggregate, emulsion, and cement output in lbs/minute
- Ground travel distance - a radar ground metering device or similar to measure distance.
- Spread rate in lbs/SY
- Percentages of emulsion, cement, water and additive
- Cumulative totals of aggregate, emulsion, cement, water and additive
- Scale factor for all materials

Ensure that the computer system is functional prior to beginning the work, and continues to be functional during the performance of the work. In the event that printers or other computer controls are not functioning correctly once the work begins, the inspector may be given manual readouts from the equipment every 2000 feet for the remainder of the day. The **RCE** will determine whether paving will continue based on sufficient data and effort to correct the computer system malfunction prior to beginning paving the next day. All information collected by the **RCE** must be available throughout the day, and if any rate is found to be outside of tolerance, production will be stopped immediately. At no time should the contractor be permitted to continue placing micro surfacing that does not meet SCDOT requirements.

The mixing machine will include controls for proportioning and calibrating the aggregate feed. The aggregate feed device is equipped with a revolution counter so that the amount of aggregate used can be determined at any time and will have a positive locking feed gate. The emulsion pump must be of the positive displacement type and will be equipped so that the amount of emulsion used can be determined at any time. The emulsion pump meter and piping must be arranged to afford a means to calibrate the meter by weighing a metered volume. The pump delivers the emulsion to the mixer box at a uniform rate which will not vary more than 2% from the required quantity. Truck mounted machines may be substituted if the roads are under 1200 feet in total length to prevent unnecessary joints in the finished surface. Truck mounted machines are also required to have computer control systems installed.

Equip the water pump with a minimum of 2 valves. One valve will be used to establish the required water flow, and the other valve will be a quick acting valve to start and stop the water flow. The mixing machine will be equipped with sight gauges to indicate the material storage tanks for the asphalt emulsion and water. Equip the mixing machine with metering devices so that it can be accurately calibrated and the quantities of materials used during any time can be closely estimated. In the event that the metering devices stop working properly, the mixing machine will no longer be used until necessary repairs have been made. Calibrate each mixing unit prior to commencement of the work. Once calibrated, the aggregate and emulsion flows will not be changed without the approval of the **RCE**. Adjust the water and additive in the field to control the mix properties to produce an acceptable mix.

410.4.3 Spreading Equipment

Spread the Micro Surfacing mixture uniformly by means of a mechanical type spreader box attached to the mixer, equipped with augers, paddles, or other devices to agitate and spread the materials throughout the box. Design the paddles to maintain sufficient turbulence in the mixture to

prevent the material from setting-up in the box or causing side buildup and lumps. Provide a front seal to ensure no loss of the mixture at the road contact surface. Equip the rut filling equipment with an adjustable steel strike-off plate to ensure a level surface. Provide a rear seal to act as an adjustable strike-off plate as well. Maintain the spreader to prevent the loss of the paving mixture in surfacing super-elevated curves.

410.4.4 Strike-Offs

Operate the spreader box and rear strike-off so that a uniform consistency is achieved to produce a free flow of material to the rear strike-off without causing skips, lumps or tears in the finished surface. The spreader box must be capable of lateral movement or have side shift abilities to ensure proper alignment with the roadway. Ensure that the secondary strike-off provides improved surface texture. Acceptable secondary strike-offs include urethane or poly strike off and burlap cloth. The use of burlap is permitted, however if excessive longitudinal lines are found in the finished mat, the use of burlap will be suspended and a urethane or poly strike off will be used. Secondary strike-off must be washed clean frequently or replaced when excessive build-up is evident to provide consistent mat texture.

410.4.5 Auxiliary Equipment

Provide a pressure distributor, power broom, and power blower along with sufficient hand tools and power equipment for cleaning the roadway surface prior to the application of the asphalt tack coat.

410.5 Stockpiling and Storage

410.5.1 Aggregate Storage

If the mineral aggregates are stored or stockpiled, handle in such a manner as to prevent segregating, mixing of the various materials or sizes, and contaminating with foreign materials. Ensure that the grading of aggregates proposed for use and as supplied to the project is uniform. Utilize suitable equipment of acceptable size to maintain the stockpiles and prevent segregation of aggregates. Pass the aggregate over a scalping screen immediately prior to transfer to the Micro Surfacing mixing machine to remove oversized material. Blending of aggregates may be necessary to meet mix design criteria. **RCE** will obtain samples of the aggregate from the contractor for specification compliance. In the event that aggregates are blended together, ensure that any samples taken for gradation testing are sampled from the blended material stockpile and not individual stockpiles. Assume the moisture to be at optimum (3%) and add water as necessary.

410.5.2 Storage of Asphalt Material

Provide adequate means of storage to meet the requirements of the production rate for the asphalt material. Maintain all equipment used in the storage and handling of asphalt material in a clean condition at all times and operate in such a manner that there will be no contamination with foreign matter.

410.6 Construction

410.6.1 General

Produce, transport and place the specified materials in accordance with these specifications and as approved by the **RCE**. Ensure that the finished Micro Surfacing has a uniform texture free from excessive scratch marks, tears or other surface irregularities. Ensure that the cured mixture adheres fully to the underlying surface. Based upon a visual examination or test results the **RCE** may reject any work due to poor workmanship, loss of texture, raveling or apparent instability.

410.6.2 Weather Limitations

Ensure that the ambient temperature is 50°F and rising in order to place Micro-Surfacing. Use SC-T-84 to measure ambient temperature at the application site. Do not place any mixture if temperatures are forecasted to drop below 32°F within 24 hours after application.

410.6.3 Surface Preparation

Thoroughly clean the area to be surfaced of any vegetation, loose aggregate and soil as well as all cracks prior to overlay. All pavement markings must be removed flush with the existing surface prior to Micro Surfacing. The removal of pavement markings will be a separate unit bid price for Micro Surfacing. Whenever conditions require pre-wetting the surface, spray water ahead of and outside of the spreader box at a rate to dampen the surface without any free flowing water ahead of the spreader box.

410.6.4 Test Section

Construct a test section to verify the mix design and system performance for acceptability to the **RCE**. The system used for the test section must be identical to all parts of the proposed system.

At the discretion of the **RCE**, in place of construction of a test section, evidence may be submitted to the **RCE** indicating successful construction of a test section on another Department project using the same mix designs, equipment, and procedures. The project must have been constructed the same construction season, and time of day, and be acceptable to the **RCE**.

Construct a minimum 1000 ft. long, one lane width test section to be evaluated for acceptance by the **RCE**. Construct the test section during the same time of day (day or night) that the rest of the work on the contract is scheduled. When multiple machines are used, lay a test section with each machine to compare it to the other machines for variances in surface texture and appearance. Ensure that the Micro-Surfacing test section is capable of carrying normal traffic within one hour after application without any damage occurring. Full production may begin after the **RCE** accepts the test section. Locate the test section within the limits of the project and in a location acceptable to the **RCE**. Do not permit the temperature of the emulsion to exceed 125°F. If the emulsion is above the temperature limit postpone the construction of the test strip until the emulsion temperature is under 125°F. Construct a new test section whenever the system changes or job mix changes, or there is field evidence that the system is out of control. The system includes the following:

- Emulsion
- Aggregate supplier
- Type of mineral filler
- Lay down machine

Construct the test section at no additional cost to the Department. Upon acceptance of the test section, the quantities applied during the construction will be included in the total project quantities. If the test section is not accepted by the **RCE**, remove it at no additional cost to the Department. Reconstruct the test section until the **RCE** deems the mix design acceptable. Only quantities applied on *accepted* test sections will be included in, and paid for, in the total project quantities. Time allotted for the construction of the test section(s) will be included in the contract completion time, which will not be adjusted upon failure of the test section.

410.6.5 Tack Coat

Use an asphalt emulsion meeting requirements of 410.2.5 of these specifications and dilute at the rate of one part emulsion and three parts water and apply with an asphalt distributor. Ensure an application rate of 0.05 to 0.10 gallons of diluted emulsion per square yard. Apply the tack coat in

accordance with Subsection 401.4.18 of the Standard Specifications. A tack coat is not required between the leveling (scratch) course and the surface course provided the surface course is placed within 30 days of the leveling (scratch) course.

410.6.6 Application

Spread the paving mixture on the prepared surface in such a way as to leave a uniformly finished surface. Take care 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. Use squeegees and lutes to spread the mixture in areas inaccessible to the spreader box and areas requiring hand spreading. Carry a sufficient amount of material at all times in all parts of the spreader box to ensure complete coverage. Ensure that all strike offs are cleaned by washing off with water spray hose after stopping operations or when mat appear is noticeably affected by material buildup adhered to the strike offs.

Adjust additives, if necessary, to provide a slower setting time when hand spreading is needed. Pour a small windrow along one edge of the surface to be covered and then spread uniformly by a hand squeegee or lute. Ensure a smooth, neat seam where two passes meet. Remove excess material immediately from the ends of each run.

410.6.7 Traffic Control

Prohibit traffic on the Micro Surfacing mixture until it has cured sufficiently to prevent pick up and/or marring of the surface. Light amounts of straight-slow flow traffic should be able to proceed after 1 hour of placing mixture. In the event that traffic needs to be established quickly (intersections or driveways) a light dusting of additional aggregate must be applied to the surface to help prevent damage to the finished mixture. Maintain traffic control as necessary to prevent damage to the mixture. Repairs to any such damage done by traffic to the mixture will be at the Contractor's expense.

410.6.8 Rut Filling and Leveling (Scratch) Course

When required on the plans, before the final surface course is placed, use preliminary Micro Surfacing materials to fill ruts, utility cuts, depressions in the existing surface, etc. Conduct rut filling greater than one half inch in depth and any additional leveling/scratch courses as directed by the **RCE**. Construct each full-width leveling/scratch course by utilizing a full width spreader box with a steel strike-off. Open the leveling (scratch) course to traffic for a minimum of 3 hours prior to placement of the final surface. Do not cover rut filling with final surface for at least 12 hours to ensure all water is dissipated from the mixture. Allow traffic to be on rut filled area for a minimum of 3 hours. Ensure all materials, mixture composition, equipment, and construction procedures meet specifications listed herein.

410.6.9 Workmanship

Excessive buildup, uncovered areas, or unsightly appearance will not be permitted on longitudinal or transverse joints. Place longitudinal joints on lane lines and ensure excessive overlap does not occur. Take care to ensure straight lines are made along all the longitudinal and transverse joints. Keep lines at intersections straight to provide a neat and uniform appearance.

410.6.9.1 Finished Surface

Ensure the finished Micro Surfacing has a uniform texture free from excessive scratch/tear marks or other surface irregularities. Excessive scratch/tear marks are considered four marks that are 1/2" wide or wider and 6" or more in length per 100 square yards or any marks 1" wide or wider or 4" in length.

410.6.9.2 Joints and Seams

Ensure the longitudinal and transverse joints are neat in appearance and uniform. Construct transverse joints as butt-type joints. Excessive buildup, uncovered areas or unsightly appearance is not

permitted on longitudinal or transverse joints. Ensure that longitudinal and transverse edge lines are neat and straight in areas such as curbs, driveways and intersections. Gaps between applications are prohibited. Joints are considered acceptable if no more than a 1/2" vertical space exists between the pavement surface and a 4' straight edge placed perpendicular on the longitudinal joint and no more than 1/4" for a transverse joint.

410.6.9.3 Hand Work

Use hand tools to provide complete and uniform coverage in areas that cannot be reached with the mixing machine. These areas will be cleaned and lightly dampened prior to mix placement. Use care 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 will be entirely at the contractor's expense.

410.7 Acceptance

410.7.1 Micro Surfacing Application Rate

Maintain the gradation on the Micro Surfacing design or as established by the **RCE** within the listed Mixture Control Tolerances. Ensure that additives are maintained or adjusted as needed to provide a stable or uniform mixture during lay down operations. Ensure that residual asphalt emulsion rate and spread rate are calculated as shown in the table below.

Test	Initial Testing 1st 1000 Feet	Additional Testing every 2000 feet	Mix Control Tolerances
Calculated Residual Asphalt Percent	Contractor Test	Contractor Test	See Job Mix Target
Calculated Mixture Spread Rate	Contractor Test	Contractor Test	20-22 lbs/SY

All calculations should be immediately available to the **RCE** for review of test data and all test data must be submitted to the RCE immediately upon completion of each day's production. Calculations will be taken from the mixing unit's computer automated system for continuous operations and calculated manually when truck mounted units are permitted.

The **RCE** will compute the daily average deviation of contractor's test results at the end of the day, and if the results are found to be outside of Job Mixture Control Tolerances for asphalt emulsion, the **RCE** will apply a reduction in Unit Price of 2% for each 0.1% the residual asphalt content that is outside the Mixture Control Tolerances. (Base all calculations for residual asphalt @ 62.0% if BOL tickets are not made available to the RCE for every load of emulsion). Make adjustments as necessary in the mixing operation to maintain production within the tolerances given or the RCE will suspend work.

The **RCE** will apply a 5% reduction in Unit Price for each pound of aggregate per square yard less than 20 lbs/SY for each day's placement of material. In lieu of pay reduction, overlay the deficient area with an additional lift of 20 lbs/SY at no additional expense to the Department. Control the target spread rate for all Micro Surfacing based on the weight of dry aggregate. Do not continue operation and placement of materials outside the spread rate tolerances or the **RCE** will suspend work.

Example:

Days Production: 12,500 feet of Micro Surfacing
 Values from the Contractor's Job Mix for Micro Surfacing:
 Target Emulsion Rate: 9.2% Residual (Job Mix Limits: 8.70% - 9.70%)
 12,500 feet = 7 asphalt rates and aggregate spread rates must be taken by the contractor
 (1 for initial 1000 feet, 6 additional readings for the remaining 11,500 feet)

SUPPLEMENTAL SPECIFICATION

All field readings must be submitted throughout the day's production and given to the Department's road inspector.

Example of initial test (see table below)

64.2 % Residue (BOL tickets were averaged for tanker loads used each day)
 = 0.642 x 14.4% Emulsion = 9.2 % Residual Asphalt Content*

Test Section Distance	+1000 Initial Test To 1000 ft.	+ 2000 ft. To 3000 ft.	+ 2000 ft. To 5000 ft.	+ 2000 ft. To 7000 ft.	+ 2000 ft. To 9000 ft.	+ 2000 ft. To 11000 ft.	+ 2000 ft. To 12500 ft.	Daily Average Limits Payment
Asphalt Rate from Contractor's Computer System, %	14.4	14.7	14.8	14.4	12.7	13.7	14.5	14.17
Calculated Residual Asphalt, %*	9.24	9.44	9.50	9.24	8.15	8.80	9.31	9.10 (8.7-9.7) No Reduction
Mix Rate lbs./SY	18.9	20.9	21.2	22.3	21.1	20.1	19.2	20.53 (20-22) No Reduction

410.8 Measurement

410.8.1 Micro-Surfacing

Measure and accept Micro Surfacing Surface Course, by the square yard placed.

410.8.2 Rut Filling and Leveling (Scratch Course)

Measure and accept rut filling and leveling (scratch) course by the ton of total mix used including asphalt emulsion.

410.9 Payment

Micro Surfacing will be paid for at the Contract Unit Price which will be for full compensation for furnishing all materials, including CQS Micro Emulsion and for all equipment, work and labor. Payment will be made under:

Item Number	Description	Units
4100200	Micro Surfacing Surface Course	Square Yard
4100205	Micro Surfacing Leveling / Rut Fill	Ton
XXXXXXX	Removal of Pavement Markings	Lane Mi.