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. The 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. Limestone aggregate will not be permitted. 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
2. Hydrated Lime Subsection 401.2.1.3

410.2.3 Cationic Quick-Setting Emulsion

Utilize a cationic type polymer or latex modified emulsified asphalt meeting requirements of a Cationic Quick-Setting (CQS) emulsion as stated in Table 1.

Table 1. Cationic Quick-Setting Emulsion Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>AASHTO Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, Saybolt Furol @ 25° C, Sec.</td>
<td>20.0</td>
<td>90.0</td>
<td>T59</td>
</tr>
<tr>
<td>Particle Charge</td>
<td>Positive</td>
<td>-</td>
<td>T59</td>
</tr>
<tr>
<td>Distillation</td>
<td>-</td>
<td>0.1</td>
<td>T59</td>
</tr>
<tr>
<td>Oil distillate, by volume, %</td>
<td>-</td>
<td>0.5</td>
<td>T59</td>
</tr>
<tr>
<td>Residue from Distillation, %</td>
<td>62.0</td>
<td>-</td>
<td>T59</td>
</tr>
<tr>
<td>Penetration, 25°C, 100g, 5 sec.</td>
<td>40.0</td>
<td>100.0</td>
<td>T49</td>
</tr>
<tr>
<td>Ductility, 77° F, 50 mm/ sec.</td>
<td>70.0</td>
<td>-</td>
<td>T51</td>
</tr>
</tbody>
</table>
For CQS - Latex Rubber Additive (LRA) - the LRA will be a natural latex or an unvulcanized styrene-butadine 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

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.

Obtain 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. Formulate the emulsified asphalt in such a way to allow the paving mixture to cure at a rate as to permit traffic on the pavement within one hour after application without damaging the pavement surface.

410.2.5 Asphalt Tack Coat

Use a CSS 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 the Micro Surfacing mixture.

410.2.7 Other Additives

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

410.3 Composition Of Mixture

Conduct 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 his responsibility to perform acceptable work under this specification.

Provide uniform mixture of aggregate, LRA-modified 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 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.
Table 2. Job Mix Formula and Design Limits

### MICRO SURFACING (TYPE II)

<table>
<thead>
<tr>
<th>MIXTURE CONTROL TOLERANCES</th>
<th>GRADING REQUIREMENTS (AASHTO T27)</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 0.0</td>
<td>% Passing 3/8&quot; Sieve</td>
<td>100</td>
</tr>
<tr>
<td>± 6.0</td>
<td>% Passing No. 4 Sieve</td>
<td>90 – 100</td>
</tr>
<tr>
<td>± 5.0</td>
<td>% Passing No. 8 Sieve</td>
<td>65 – 90</td>
</tr>
<tr>
<td>± 5.0</td>
<td>% Passing No. 30 Sieve</td>
<td>30 – 55</td>
</tr>
<tr>
<td>± 4.0</td>
<td>% Passing No. 100 Sieve</td>
<td>10 – 25</td>
</tr>
<tr>
<td>± 3.0</td>
<td>% Passing No. 200 Sieve</td>
<td>5 – 15</td>
</tr>
</tbody>
</table>

### DESIGN REQUIREMENTS

<table>
<thead>
<tr>
<th></th>
<th>Optimum Moisture Content of Aggregate</th>
<th>3.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>±0.50</td>
<td>Range for Residual Asphalt</td>
<td>5.00 – 10.50%</td>
</tr>
<tr>
<td>±0.50</td>
<td>Slurry Seal Consistency</td>
<td>3 cm</td>
</tr>
<tr>
<td></td>
<td>ISSA TB 106 (cm of flow)</td>
<td></td>
</tr>
<tr>
<td>Min. Stability, 50 gyrations, AASHTO T245 (150 mm modified) diameter specimens, 95mm height +/- 5 mm</td>
<td>1500 lbs.</td>
<td></td>
</tr>
<tr>
<td>ISSA TB100 1 hour soak</td>
<td>Wet Track Abrasion Loss (Maximum)</td>
<td>1 psy</td>
</tr>
<tr>
<td>ISSA TB100 6 day soak</td>
<td></td>
<td>1.5 psy</td>
</tr>
<tr>
<td>ISSA TB147A or 147C</td>
<td>Vertical Displacement (Maximum)</td>
<td>10%</td>
</tr>
<tr>
<td>Excess Asphalt by LWT (Maximum)</td>
<td>ISSA TB109</td>
<td>1 psy</td>
</tr>
</tbody>
</table>

Note 1: Base the percent residual asphalt and percent mineral filler on weight of dry aggregate.

Note 2: Procedures set forth in AASHTO T245 for determination of Stability will be modified to permit air drying of the mixture at 70° - 77°F for 3 days before reheating and fabricating Gyratory specimens.

Note 3: Ensure that the laboratory report also provides the following information which is within the test parameters given:

- Mixing Time Test, Seconds @ 25°C (77°F), (TB113) ................. 60 minimum*
- Set Time Test, 30 minutes (TB139) ............................................ 12 lb-in minimum
- Early Rolling Traffic Time, 60 minutes (TB139) ..................... 20 lb-in minimum
- Water Resistance Test, 30 minutes (TB102) ................................. No Discoloration
- Wet Striping Test, % Coating (TB114) ...................................... 90 minimum
- System Compatibility (TB115) .................................................. Pass

*For double shafted, multi-bladed mixers and fully agitated spreaders. Conventional mixing and spreading equipment requires 90 to 120 seconds.

Note 4: 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.

410.4.2 Water Pressure System

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.

410.4.2 Proportioning Devices

Equip the machine with individual volume or mass controls or other gauging devices for measuring and proportioning each material added to the mix. Calibrate each material control device to ensure all are properly marked and positively interlocked. Equip the aggregate feed to the mixer with a revolution counter or similar device so that the amount of emulsion used may be determined at any time. 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 Emulsion Pump

Provide an emulsion pump that is heated and is equipped with a positive displacement type pump.

410.4.4 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. 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.
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. In addition, equip the scalping screen unit with certified scales to record weights of aggregates prior to being shipped to the project. Aggregate scales must be certified and documented every 6 months. The RCE will obtain aggregate samples for moisture testing in accordance with SC-T-22 as necessary for accurate payment.

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

Apply Micro-Surfacing mixture only when the minimum ambient temperature for 48 hours immediately prior to the placement has been at least 50°F. Additionally, both the current pavement surface and the ambient temperature will be at least 50°F and rising with no forecast of temperatures below 32°F within 48 hours from the time of placement. Whenever the relative humidity exceeds 80 percent or the weather is overcast, apply Micro Surfacing at the discretion of the RCE only. Supply a surface temperature thermometer and a sling psychrometer for the purpose of taking temperature and humidity measurements as directed by the RCE.

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. Seal all cracks in excess of ¥\(\frac{1}{8}\)" with crack sealant acceptable to the RCE. Do not perform any Micro Surfacing until at least 2 weeks after crack sealant has been applied. The RCE may waive a portion of this waiting period if the crack sealant has determined to be cured properly and completely. All pavement markings must be removed from existing roadway prior to 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. Ensure that a representative from the asphalt emulsion manufacturing company is present during the placement of the test section.

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 be acceptable to the RCE in consultation with the AME.

Construct a minimum 1000 ft. long, one lane width test section to be evaluated for acceptance by the RCE. Construct the test section after dark, no sooner than one hour after sunset and no later than one hour before sunrise. 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. The RCE will inspect the completed test section after 12 hours of traffic to determine if the mix design is acceptable. 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 125ºF. If the emulsion is above the temperature limit postpone the construction of the test strip until the emulsion temperature is under 125ºF. Construct a new test section when the system used in 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 course and the surface course provided the surface course is placed within 30 days of the leveling course or if the RCE determines that excessive tracking of material is evident.

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.
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 within 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 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 rut filling or leveling (scratch) course to traffic at least 24 hours prior to the beginning of any surfacing. Ensure all materials, mixture composition, equipment, and construction procedures meet specifications listed above.

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 the all 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. 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 nor no more than 1/4” for a transverse joint.

410.6.9.3 Hand Work

Surface areas that cannot be reached with the mixing machine using hand tools to provide complete and uniform coverage. 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 Mixture

Maintain the gradation and percent residual asphalt as shown on the Micro Surfacing design or as established by the RCE within the listed Mixture Control Tolerances.

A mixture adjustment period is provided during the first 2 days of operation. Adjust equipment settings to provide a mixture within the Mixture Control Tolerances if the deviation of sample test results from the first day are outside the Mixture Control Tolerances. Obtain 2 samples from the second day of production (after equipment changes, if any, have been made) and average the test results. If the average deviation of test results from the second day are within Mixture Control Tolerances, full payment for the first 2 days of operation will be given. If the average deviation of test results from the second day are not within Mixture Control Tolerances, each of the first 2 days will be assessed a reduction in Unit Price of 2% for each 0.1% the residual asphalt content is outside the Mixture Control Tolerances.

For each subsequent day of operation apply a 2% reduction in Unit Price for each 0.1% the residual asphalt content is outside the Mixture Control Tolerances given in Table 2. (Base all calculations for residual asphalt @ 62.0%) If more than 1 sample per day is taken, calculate the average deviation of the samples to determine conformance to the Mixture Control Tolerance. Do not continue operation and placement of materials outside the Mixture Control tolerances. Make adjustments as necessary in the mixing operation to maintain production within the tolerances given or suspend work.

410.7.2 Micro Surfacing Application Rate

<table>
<thead>
<tr>
<th>Micro Surfacing Type</th>
<th>Typical Spread Rate</th>
<th>Suggested Target Rate*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type II</td>
<td>10-20 psy</td>
<td>18 psy</td>
</tr>
</tbody>
</table>

Control the target spread rate for all Micro Surfacing to within plus or minus 2 psy of the spread rate specified* based on the weight of dry aggregate. Apply a 5% reduction in Unit Price for each pound of aggregate per square yard less than the spread rate tolerances established above for each day’s placement of material. In lieu of pay reduction, overlay the deficient area at the Contractor's expense. Do not continue operation and placement of materials outside the spread rate tolerances. Make adjustments as necessary in the placement operation to maintain production within the tolerances given.

410.8 Measurement

410.8.1 Micro-Surfacing

Measure and accept Micro Surfacing, Type II 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 dry aggregate used.

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 LRA modified bituminous materials and for all equipment, work and labor. Payment will be made under:

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Description</th>
<th>Units</th>
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<tbody>
<tr>
<td>4100200</td>
<td>Micro Surfacing, Type II</td>
<td>Square Yard</td>
</tr>
<tr>
<td>4100205</td>
<td>Micro Surfacing, Type II Leveling</td>
<td>Ton</td>
</tr>
<tr>
<td>6319505</td>
<td>Removal of Pavement Markings</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>