

Section 507. MICRO-SURFACING

507.01 Description. This work consists of surface preparation and application of a properly proportioned micro-surfacing mixture.

507.02 Materials. Micro-surfacing mixture shall consist of a properly designed and proportioned blend of polymerized asphalt emulsion, fine aggregate, Portland cement, water and other additives. The materials shall meet the following requirements as modified.

Portland Cement, Type I	901
Fine Aggregates, 2FA, 3FA	902
Asphalt Emulsion, CSS-1hM	904
Asphalt Emulsion, CSS-1 mM	904
Water	911

- A. **Aggregates for Micro-Surfacing.** The minimum AWI of 260 (MTM 111) shall apply to surface course aggregate only.
- B. **Asphalt Emulsion for Micro-Surfacing.** Either CSS-1hM or CSS-1mM must be used in designing micro-surfacing mixtures. Asphalt emulsion selection is based on two way commercial ADT for the roadway.
- C. **Mixture Requirements.**

1. **Asphalt Emulsion.** The contractor shall select the emulsion type to be used, based on the two-way commercial ADT stated in the proposal. CSS-1mM emulsion shall be used on all micro-surfacing projects with commercial traffic counts at or below those listed here, except when ruffilling is required. When micro-surface ruffilling is specified the Contractor has the option of using CSS-1mM or CSS-1hM. CSS-1hM emulsion shall be used on all other micro-surfacing projects.

Pavement sections with two lanes:	2,000	two-way commercial ADT
Pavement sections with four lanes:	3,500	two-way commercial ADT
Pavement sections with six (plus) lanes:	5,000	two-way commercial ADT

2. **Mix Design.** At least five (5) working days prior to the start of production, the Contractor shall submit to the Engineer a complete mix design, prepared and certified by an MDOT approved laboratory. A job mix formula (JMF) shall be provided to the Engineer at the pre-paving meeting and will show that the individual proportions of each of the materials, when combined, will meet the following mix design criteria. A change in aggregate or asphalt emulsion source will require a new mix design.

Table 507-1 Microsurfacing Mix Design Criteria

Test Method	Parameter	Specification
ISSA TB-114	Wet Stripping	90% min
ISSA TB-100	Wet Track Abrasion Loss One Hour Soak Six Day Soak	50 g/ft ² max 75 g/ft ² max
ISSA TB-144	Saturated Abrasion Compatibility	3 g loss, max
ISSA TB-113	Mix Time at 77 °F Mix Time at 100 °F	Controllable to 120 sec, min Controllable to 35 sec, min
The JMF shall be within the following limits		
Asphalt Binder Content (Residual)	7.0% - 8.5%, dry weight, 2FA aggregate 6.5% - 8.0%, dry weight, 3FA aggregate	
Mineral Filler	0.25% - 3.0%, dry weight, of aggregate	

3. **Mix Design Format.** The final mix design shall contain the following information.

- a. Source of each individual material.
- b. Aggregate
 - Name and pit number
 - Gradation
 - Sand equivalence
 - Angularity index (A.I.)
- c. Field Simulation Tests
 - Wet stripping test
 - Wet track abrasion loss
 - Saturated abrasion compatibility
 - Trial mix time at 77 °F and 100 °F
- d. Interpretation of results and the determination of a JMF
 - Mineral filler (minimum and maximum), percent
 - Water, including aggregate moisture (minimum and maximum), percent
 - Mix set additive (if required), percent
 - Modified emulsion, percent
 - Residual content of modified emulsion
 - Residual, percent
- e. ADT for the pavement sections on which the mix will be used
- f. Mix designer's signature and date

D. **Quality Control.** The Contractor shall produce a mixture that will be in compliance with the JMF and the quality control tolerances shown in Table 507-2. If the Contractor's quality

control test results exceed any of the tolerances, then the Engineer shall be notified immediately and mixture production shall stop. The Contractor shall identify the cause of the excess deviation and determine the corrective action necessary to bring the mixture into compliance. The Engineer will give approval prior to the resumption of work.

Table 507- 2 Micro-Surfacing Quality Control Tolerances

Aggregate Gradation Tolerances							
Sieve Size	# 4	# 8	# 16	# 30	# 50	# 100	# 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 JMF			
Asphalt Cement Content Daily Average				± 0.2 % from JMF			
Application Rate (as determined by 1,000 ft yield checks)				±2 lbs/syd			
Sand Equivalent Test (ASTM D2419)				± 7% from JMF			

The following are minimum measures to be taken by the Contractor to verify and document quality control.

1. **Fine Aggregate.** Sample from the project stockpile and test for gradation at a rate of one test per 500 tons of aggregate used. A minimum of one test per day of mixture production must be conducted.
2. **Sand Equivalent Test (ASTM D 2419).** A minimum of one test shall be performed for each aggregate gradation used in producing micro-surface mixture for the project.
3. **Asphalt Content.** At least three times per day, on a random basis, calculate the percent asphalt content of the mixture using the equipment counter readings.
4. **Application Rate.** At least three times per day, on a random basis, calculate the yield of the course being placed using the equipment counter readings.
5. **Documentation.** Complete a daily report which includes the following information. If truck mounted machines are used, a separate daily report is required for each machine.
 - a. Control section, job number, route, engineer
 - b. Date, air temperature
 - c. Control settings, calibration values

- d. Unit weight of emulsion (lbs/gal), percent residue in emulsion
 - Beginning and ending intervals
 - Counter readings (beginning, ending, and total)
 - Length, width, total area (syds), pounds of aggregate, gallons of emulsion
 - Percent of each material including asphalt cement
 - Application rate, (lbs/syd), combined application rate, (lbs/syd)
 - JMF (percent Portland cement, percent emulsion, gradations, percent asphalt cement)
 - Contractor's authorized signature
 - Calibration forms
 - QC aggregate gradations
 - Aggregate certification or Shipment of Tested Stock Report, (Form 1922)
 - Asphalt emulsion bill of lading
 - QC sand equivalent test results

507.03 Construction.

- A. **Equipment.** Equipment shall be safe, environmentally acceptable and capable of producing a specification product.

1. **Mixing Machine.** The mixing machine shall be equipped with a positive connection conveyer belt aggregate delivery system and an interconnected positive displacement, water-jacketed gear pump to accurately proportion aggregate and asphalt emulsion. The pugmill must be a continuous flow twin shaft multi-blade type and a minimum of 50 inches long. The blade size and side clearance must meet the equipment manufacturer's recommendations. The mineral filler feed must be located so the proper amount of mineral filler is dropped on the aggregate before discharging into the pugmill. The asphalt emulsion shall be introduced within the first one-third of the mixer length to ensure proper mixing of all materials prior to exit from the pugmill.

Rate indicators for proportioning each material to be mixed, shall be provided. The rate indicators shall be readily accessible and positioned so the amount of each material used can be determined at any time. Each material rate indicator shall be calibrated and tested to ensure proper operation prior to production.

The mixing machine will be equipped with a water pressure system and nozzle type spray bar to provide water spray ahead of and outside the spreader box when required. Water will be applied at a rate to dampen the surface without resulting in free flowing water ahead of the spreader box.

The mixing machine shall be self propelled, front feed and continuous loading. It shall be equipped with opposite side driving stations on the front to optimize longitudinal alignment during placement. The machine shall be equipped with a remote forward speed control at the back mixing platform so that the back operator can control forward speed and level of mixture in the spreader box.

Sufficient transport units shall be used to assure a continuous operation during mix production and application. These transport units shall be equipped with belt type

aggregate delivery systems, emulsion and water storage tanks of adequate size to proportionally mix aggregate delivered by each transport.

Truck mounted batch type machines may be used on projects or sections of projects not larger than 15,000 square yards. A minimum of two will be required at all times. The Contractor shall cycle these truck mounted machines so that mixture production is never delayed by more than 15 minutes. If at any time there is noncompliance with this requirement, production shall stop.

The mixing machines shall be calibrated prior to use. The Contractor will maintain documentation of calibration of each material metering device at various settings. The Contractor shall supply all materials and equipment, including scales and containers necessary for calibration. A change in aggregate or asphalt emulsion source will require recalibration.

2. **Spreader Box.** The mixture shall be spread uniformly by a mechanical type spreader box, attached to the mixer and equipped with augers to continually agitate and distribute the mixture. The equipment will provide sufficient agitation to the mixture to prevent stagnation, excessive build-up, or lumps. The spreader box shall be equipped with front and rear flexible seals to achieve direct contact with the road. The final pass or surface pass shall use a secondary strikeoff attached to the spreader box to provide a finished smooth surface texture. A drag shall produce a uniform finish. A drag having excessive mixture build-up shall be replaced.
 3. **Rut Box.** The micro-surface, rutfilling application will be achieved with a steel V-configuration screed rut box specifically designed and commercially manufactured to fill ruts. The rut box shall achieve a mixture spread width of 5 to 6 feet and have a secondary strikeoff to control crown. The rutbox shall also be equipped with a third strikeoff that may be used to control texture.
 4. **Miscellaneous Equipment.** Hand squeegees, shovels and other equipment shall be provided as necessary to perform the work. Cleaning equipment such as power brooms, air compressors, water flushing equipment, and hand brooms shall be adequate for surface preparation.
 5. **Lights on Equipment.** Power brooms, distributors and truck mount spreaders shall be equipped with at least one approved, flashing, rotating or oscillating amber light that is visible in all directions. Continuous spreader units shall be equipped with one such light on each side.
- B. **Pre-paving Meeting.** A pre-paving meeting between the Contractor and Engineer will be held on-site prior to beginning work to discuss the following.
1. Contractor's detailed work schedule
 2. Traffic control plan
 3. Calibration of equipment

4. Mix design previously submitted to the Engineer
5. Equipment inspection, including transport units
6. Test strip(s) to check the material and demonstrate placement procedures. When multiple machines are used, each machine shall be used to lay a test strip. All test strips will be compared to detect and correct variances in surface texture and appearance.
7. Permit to Place (Form 1125)
8. Review of the job mix formula
9. Availability of materials

- C. **Surface Preparation.** All plastic pavement markings shall be removed by the Contractor using an abrasion method. Markings shall not be removed until just prior to the surfacing operation.

The existing surface shall be thoroughly cleaned of all loose materials, vegetation, dirt, dust, mud and other objectionable materials by the Contractor at the time of placing the mixture. Animal remains shall be removed and the surface thoroughly washed prior to placing the mixture.

Bond coat shall be applied on concrete surfaces or as directed by the Engineer. Bond coat shall consist of one part emulsion to two parts water. The emulsion used shall be the same as that used in the production mixture. Rate of application shall be 0.035 - 0.070 gallons per square yard. The equipment used to place the bond coat shall be capable of uniformly placing the material without excessive run off. The bond coat shall be allowed to cure before placement of mixture.

Drainage structures, monument boxes, water shut-offs, etc., shall be protected during application of bond coat and mixture.

The Contractor shall establish 1,000-foot intervals for the entire project, prior to placing the mixture. These intervals shall be clearly identified and maintained until project completion.

- D. **Application.** Micro-surface mixtures shall be applied in a manner to fill ruts, when specified, and minor cracks and leave a uniform surface with straight longitudinal joints, transverse joints and edges

1. **Rutfilling.** Rutfilling shall use a micro-surface mix with fine aggregate 3FA applied with an approved rut box for each designated wheel track. A clean overlap and straight edges shall be required between wheel tracks. Each pass of rutfilling shall be limited to a maximum depth of 1 inch. For each 1 inch of applied mix, an additional 1/8 inch crown is required for traffic consolidation. A second course of micro-surface mix with fine aggregate 2FA shall be applied to the full lane width over the rutfilling course. Application rate for this second course shall be 20 pounds per square yard (± 2 lbs/syd)

2. **Standard Micro-Surfacing.** The Contractor shall apply two courses of mixture, each applied separately, for a total application rate of 30 pounds per square yard (± 2 lbs/syd cumulative total tolerance) by weight of dry aggregate. The first course shall be 14 pounds per square yard (± 2 lbs/syd) by weight of dry aggregate with fine aggregate 2FA or 3FA. The second course shall be 16 pounds per square yard (± 2 lbs/syd) by weight of dry aggregate with fine aggregate 2FA and shall be applied to the entire paving pass including the shoulder as shown on the plans.
 3. **Single Course.** Micro-surface, single course shall be applied full lane width in one course a rate of 20 pounds per square yard (± 2 lbs/syd) by weight of dry aggregate. All micro-surface, single course shall be made with fine aggregate 2FA or 3FA. There shall be no excess buildup or uncovered areas.
- E. **Surface Quality.** The finished surface shall be free from excessive scratch marks, tears, rippling, and other surface irregularities. The surface area shall not contain ripples greater than $\frac{1}{8}$ inch measured by a 10-foot straight edge according to MTM 722. The surface shall not exhibit tear marks greater than $\frac{1}{2}$ inch wide and 4 inches long, or a mark greater than one inch wide and one inch long. If the finished surface exceeds the described tolerance, work shall immediately stop and corrective action shall be taken by the Contractor and reviewed by the Engineer before production resumes.
- The longitudinal construction joints and lane edges shall coincide with the proposed painted lane lines. Longitudinal joints shall be constructed with less than a 3-inch overlap on adjacent passes and no more than $\frac{1}{4}$ inch overlap thickness as measured with a 10-foot straight edge. If applicable, overlapping passes to prevent ponding of water on the upslope side. Construct neat and uniform transverse joints with no more than a $\frac{1}{8}$ inch difference in elevation across the joint as measured with a 10-foot straight edge. The edge shall be neat and uniform with no more than 2 inches of horizontal variance in any 100-foot section. If defective joints or edges are placed, work shall stop and corrective action shall be taken by the Contractor and reviewed by the Engineer.
- F. **Traffic Control.** Traffic shall not be allowed on the mixture until it has cured sufficiently to prevent pickup by vehicle tires. The new surface shall be capable of carrying normal traffic without any damage within one hour of application. The Contractor shall protect the new surface from potential damage at intersections and driveways. Any damage by traffic to the mixture shall be repaired at the Contractor's expense.
- G. **Weather Limitations.** The mixture can be placed only when the air and pavement surface temperature is 45 °F or above. Placement is not permitted if there is rain or threatening weather or if temperatures are forecast to be below 32 °F within 24 hours of completion of the work. Placement of mixture is not permitted before May 1 or after October 1 in the Lower Peninsula, or before June 1 or after September 15 in the Upper Peninsula.
- H. **Delayed Acceptance.** A minimum of 30 days after completion of the micro-surface ruffilling, standard or single course, the Engineer shall inspect the project with the Contractor for surface flushing, raveling or delamination. If these deficiencies are found, corrective work is required. All corrective work shall be completed within seven working days of this review, or by an agreed upon date. The Contractor shall furnish all materials,

equipment and labor to make the identified corrections to the satisfaction of the Engineer at no additional cost to the Department.

507.04 Measurement and Payment.

Contract Item (Pay Item)	Pay Unit
Micro-Surface, Rutfilling	Ton
Micro-Surface, Std.	Square Yard
Micro-Surface, Single Course	Square Yard

Micro-surface includes removal of existing plastic pavement markings, cleaning existing pavement, temporary pavement markings, stationing, application of a bond coat if required. Traffic control and corrective action are also included in these items.

- A. **Micro-Surface, Rutfilling** will be measured based on the dry weight of fine aggregate in the mixture placed. This work includes placement of mix over each wheel rut creating full lane coverage and applying a single course of mixture for full width coverage as shown on the plans.
- B. **Payment for Micro-Surface, Std** includes placement of two courses of mixture for full width coverage as shown the plans.
- C. Payment for **Micro-Surface, Single Course** includes placement of one course of mixture for full width coverage as shown the plans.