

504.01

## Section 504. MICRO-SURFACING

**504.01. Description.** This work consists of preparing existing pavement and providing and placing a micro-surfacing mixture.

**504.02. Materials.** Provide materials in accordance with the following:

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

A. **Aggregate.** Ensure aggregates comply with gradation and physical requirements in Tables 902-7 and 902-8.

Use 3FA fine aggregate in micro-surfacing mixture for rut filling.

Use 3FA or 2FA fine aggregates in micro-surfacing mixtures for standard micro-surfacing.

Use 2FA fine aggregate in micro-surfacing mixture for single-course applications.

B. **Mix Design.** Provide micro-surfacing mixtures consisting of a blend of polymerized asphalt emulsion, fine aggregate, portland cement, water, and other additives.

Submit to the Engineer, at least 5 work days before starting production, a mix design, prepared and certified by a Department-approved laboratory. Ensure the combined material meets the mix design criteria specified in Table 504-1.

Table 504-1 Micro-surfacing Mix Design Criteria		
Test Method	Parameter	Specification
ISSA TB-114	Wet Stripping	≥90%
ISSA TB-100	Wet Track Abrasion Loss	—
	One Hour Soak	≤50 g/ft <sup>2</sup>
	Six Day Soak	≤75 g/ft <sup>2</sup>
ISSA TB-144	Saturated Abrasion Compatibility	≤3 g loss
ISSA TB-113	Mix Time at 77 °F	Controllable to ≥120 s
	Mix Time at 100 °F	Controllable to ≥35 s

Provide a Job Mix Formula (JMF), meeting the limits shown in Table 504-2, to the Engineer at the pre-production meeting.

Submit a new mix design for changes in aggregate or asphalt emulsion sources.

Table 504-2 JMF Limits	
Test Method	Specification
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 aggregate

C. **Mix Design Documentation.** Provide the following information in the final mix design:

1. Proportion of each material;
2. Sources of each material including:
  - a. Aggregate,
  - b. Name and pit number,
  - c. Gradation,
  - d. Sand equivalence, and
  - e. Angularity Index (AI);
3. Field simulation tests including:
  - a. Wet stripping tests,
  - b. Wet track abrasion loss,
  - c. Saturated abrasion compatibility, and
  - d. Trial mix time at 77 °F and 100 °F;
4. Interpretation of results and the determination of a JMF including:
  - a. Mineral filler, percent (minimum and maximum);
  - b. Water, including aggregate moisture, percent (minimum and maximum);
  - c. Mix set additive, percent;
  - d. Modified emulsion in mix, percent;
  - e. Residual asphalt content of modified emulsion, percent; and
  - f. Residual asphalt content in mix, percent;
5. ADT for the pavement sections where placing mix; and
6. Mix designer's signature and date.

D. **Bond Coat.** Use the same emulsion for bond coat as used in production of the mixture.

#### 504.03. Construction.

A. **Equipment.** Provide equipment, in accordance with section 107, that can produce a specification product.

1. **Mixing Machine.** Provide at least one self-propelled, front feed, continuous loading mixing machine equipped and operated as follows:

504.03

- a. A positive connection conveyer belt aggregate delivery system and an interconnected positive displacement, water-jacketed gear pump to proportion aggregate and asphalt emulsion.
- b. Continuous flow, twin shaft, multi-blade type pugmill at least 50 inches long.
- c. Blade sizes and side clearances meeting the equipment manufacturer's recommendations.
- d. Mineral filler feed that drops mineral filler on the aggregate before discharging into the pugmill.
- e. Asphalt emulsion introduced within the first one-third of the mixer length to ensure mixing of materials before exiting the pugmill.
- f. Rate indicators for proportioning each material, readily accessible and positioned to allow determination of the quantity of each material. Calibrate and test each material rate indicator to ensure proper operation before production.
- g. A water pressure system and nozzle type spray bar to provide water spray in front of and outside the spreader box. Apply water to dampen the existing pavement surface without causing free flowing water in front of the spreader box.
- h. Opposite side driving stations on the front to optimize longitudinal alignment during placement.
- i. Remote forward speed control at the rear-mixing platform for the back operator to control forward speed and level of mixture in the spreader box.

Provide enough transports to ensure continuous operation during mix production and application. Use transport units with belt-type aggregate delivery systems, emulsion storage tanks, and water storage tanks to proportionally mix aggregate delivered by each transport.

The Contractor may use truck-mounted batch-type machines on projects or sections of projects smaller than 15,000 square yards. Provide at least two truck-mounted batch-type machines. Do not delay mix production more than 15 minutes. Stop mix production if delays exceed 15 minutes.

Calibrate mixing machines before use. Maintain documentation of the calibrations of each material-metering device at various settings. Supply materials and equipment, including scales and containers, for calibration. Recalibrate mixing machines after changes in aggregate or asphalt emulsion sources.

2. **Spreader Box.** Provide a mechanical-type spreader box, attached to the mixer and equipped with paddles mounted on adjustable

shafts to continually agitate and distribute the mixture. Equip spreader boxes with the following:

- a. Front and rear flexible seals capable of maintaining direct contact with the road;
- b. A secondary strike-off, attached to the spreader box capable of providing a finished smooth surface texture on the final or surface pass; and
- c. A drag capable of producing a uniform finish.

Replace the drag if mixture builds up.

3. **Rut Box.** Use a Department-approved steel V-configuration screed rut box designed and manufactured to fill ruts to perform micro-surface rut filling applications. Ensure a mixture spread width from 5 feet to 6 feet, and use a secondary strike-off to control crown on the rut box. Equip the rut box with a third strike-off to control texture.
  4. **Miscellaneous Equipment.** Provide hand squeegees, shovels, and other equipment to perform the work. Provide cleaning equipment for surface preparation, including power brooms, air compressors, water flushing equipment, and hand brooms.
  5. **Lights on Equipment.** Equip power brooms, distributors, and truck mount spreaders with at least one Department-approved, flashing, rotating, or oscillating amber light, visible in every direction. Equip continuous spreader units with one light on each side of the spreader.
- B. **Pre-Production Meeting.** Before beginning work, conduct an on-site pre-production meeting with the Engineer to discuss the following:
1. Detailed work schedule;
  2. Traffic control plan;
  3. Equipment calibration;
  4. Mix design previously submitted to the Engineer;
  5. Equipment inspection, including transport units;
  6. Test strips to check the material and demonstrate placement procedures;
  7. Permit to Place (Form 1125);
  8. JMF; and
  9. Availability of materials.

If using multiple machines, lay a test strip with each machine at the time of the pre-production meeting. The Engineer will compare each test strip to detect and correct variances in surface texture and appearance.

504.03

**C. Surface Preparation.** Immediately before surfacing operations, remove pavement markings using an abrasion method.

Clean existing surface of loose materials, vegetation, dirt, dust, mud and other deleterious materials. Remove animal remains and wash the surface before placing the mixture.

Protect drainage structures, monument boxes, water shut-offs, and other existing structures during bond coat and mix application.

Apply bond coat on concrete surfaces, unless otherwise directed by the Engineer. Mix bond coat with one part emulsion to two parts water. Apply the bond coat at a rate from 0.035 gallons per square yard to 0.070 gallons per square yard, without excessive run off. Allow the bond coat to cure before placing mixture.

Before placing the mixture, establish, identify, and maintain, 1,000-foot intervals until project completion.

**D. Application Methods and Rates.** Apply micro-surface mixtures to the areas shown on the plans to fill minor cracks and ruts in the roadbed, to construct a uniform surface with straight longitudinal joints, transverse joints, and edges.

1. **Rutfilling.** Fill ruts if the rut is at least  $\frac{1}{2}$  inch deep and the contract includes the pay items for either standard micro-surfacing or rut filling. Use a 3FA mixture for rut filling and apply using a rut box for each wheel track.

Maintain a clean overlap and straight edges between wheel tracks. Limit each pass of rut filling to no deeper than 1 inch. For each 1 inch of mix, provide an additional  $\frac{1}{8}$  inch crown.

2. **Standard Micro-Surfacing.** Select one of the following application methods for standard micro-surfacing:
  - a. Apply at least one course of 3FA mix to the pavement surface at an average application rate of at least 35 pounds per square yard, excluding shoulders, as required. Apply 3FA mix to pavement surface course and shoulders at a rate of at least 22 pounds per square yard.
  - b. Apply at least two courses of 2FA mix to the pavement surface, at an average combined application rate of at least 30 pounds per square yard, excluding shoulders, as required. Apply 2FA mix to pavement surface course and shoulders at a rate of at least 17 pounds per square yard.

3. **Single Course Micro-Surfacing.** Apply a single course using 2FA mix at an average minimum application rate of 24 pounds per square yard  $\pm$  2 pounds per square yard, by weight of dry aggregate, to the pavement surface, including shoulders if required.

**E. Surface Quality.**

1. **Joint Construction.** Place longitudinal construction joints and lane edges to coincide with the planned painted lane lines. Construct longitudinal joints with less than 3 inches overlap on adjacent passes and no more than  $\frac{3}{8}$  inch thick overlap as measured with a 10-foot straight edge. To prevent water from collecting on the pavement surface, place successive passes on the up-slope side of the overlap.

Construct neat and uniform transverse joints with less than a  $\frac{1}{8}$  inch difference in elevation across the joint as measured with a 10-foot straight edge. Provide neat and uniform lane edges with no greater than 2 inches of horizontal variance over 100 feet. Immediately stop work to correct defective joints or edges and obtain the Engineer's approval before resuming work.

2. **Cross Section.** For standard micro-surface, restore the driving lane cross section to within  $\frac{1}{8}$  inch of the planned elevation, measured transversely across the pavement with a 7-foot straight edge, except pavement segments designed with a quarter crown cross slope or areas of the segment within 6 inches of the edge line, lane line, or centerline.
3. **Ride Quality.** Before construction, the Department will determine the ride quality of the pavement surface, except shoulders, using the International Roughness Index (IRI). The Department will retain the plots of the original roadway profiles.

Ensure the ride quality of the pavement does not diminish after applying micro-surfacing. The Engineer may initially accept the finished pavement surface without measuring the new roadway profile if, in the Engineer's opinion of the Engineer, the final ride quality at least equals that of the original pavement.

If the ride quality appears diminished after placing micro-surfacing, correct the ride quality. If the Contractor disputes a diminished ride quality determination, the Department will re-measure the pavement profile and compare the IRI values for the finished pavement surface to the original IRI values. Correct reductions in the ride quality, as directed by the Engineer, to produce a finished pavement surface with an IRI at least equal to the original pavement IRI.

**F. Cure Time and Repair.** Do not allow traffic on the mixture until it cures, preventing pickup by vehicle tires. Ensure the new surface can carry normal traffic without damage within 1 hour of application. Protect the new surface from damage at intersections and driveways. Repair damage to the mixture caused by traffic at no additional cost to the Department.

**G. Weather and Seasonal Limitations.**

1. **Weather Limitations.** Place the mixture when the air and pavement temperatures reach at least 45 °F.

Do not place mixture in rain, inclement weather, or when the air temperature is forecast to be below 32 °F within 24 hours of work completion.

2. **Seasonal Limitations.** Place mixture from June 1 to September 15 in the Upper Peninsula and from May 1 to October 1 in the Lower Peninsula.

**H. Quality Control (QC).** Provide a finished surface free of excessive scratch marks, tears, rippling, and other surface irregularities, as determined by the Engineer. Do not leave ripples greater than ¼ inch as measured by a 10-foot straight edge in accordance with MTM 722. Do not leave tear marks greater than ½ inch wide and 4 inches long, or other marks greater than 1 inch wide and 1 inch long. If the finished surface exceeds the specified tolerances, stop work immediately and correct irregularities. Review corrective action with the Engineer before resuming production.

Produce a mixture that will meet the JMF and the QC tolerances specified in Table 504-3. Notify the Engineer immediately if QC test results exceed the tolerances specified in Table 504-3, and stop mix production. Identify the cause of the deviation and determine the corrective action necessary to bring the mixture into compliance. Obtain the Engineer's approval before resuming work.

The Engineer reserves the right to verify QC test accuracy and production controls.

If the Engineer identifies a condition that causes an unsatisfactory micro-surfacing treatment, immediately stop production work and correct the defect at no additional cost to the Department.

Table 504-3 Micro-Surfacing Quality Control Tolerances							
Aggregate Gradation Tolerances (±)							
Sieve Size	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
Tolerance	5.0%	5.0%	5.0%	5.0%	4.0%	3.0%	2.0%
General Quality Control Tolerances (±)							
Parameter				Tolerance			
Asphalt Cement Content Single Test				0.5% from JMF			
Asphalt Cement Content Daily Average				0.2% from JMF			
Application Rate (as determined by 1,000 ft yield checks)				2 lb/yd <sup>2</sup>			
Sand Equivalent Test (ASTM D2419)				7% from JMF			

1. **QC Plan Contents.** Provide and follow a QC plan, in accordance with requirements of section 501, that will maintain QC for production and construction processes, as required. Provide the Engineer a copy of the QC plan for review and approval, before the pre-production meeting.

Include, at a minimum, the following items:

- a. The source of materials used on the project.
  - b. Sampling and testing methods used to determine compliance with material specifications.
  - c. A detailed description of how field crews will determine pavement rut depths and locations. Detail each section of multiple pavement sections separately.
  - d. The equipment to be used on the project.
  - e. Calibration method used to determine compliance with the mix design (JMF).
  - f. Pavement cleaning and preparation procedure.
  - g. Plan for protecting micro surfacing mixture from damage by traffic.
  - h. Procedure for monitoring initial acceptance requirements.
  - i. An action plan demonstrating adjustments of the micro-surfacing operation for adverse environmental conditions.
2. **Minimum QC Sampling and Testing Frequency.** Include the following minimum QC sampling and testing frequencies in the QC Plan.
    - a. **Fine Aggregate Gradation.** Sample fine aggregate from the project stockpile and test for gradation. Perform one test per 500 tons of fine aggregate or one test per day of mixture production, whichever is greater.
    - b. **Sand Equivalent Test (ASTM D 2419).** Perform at least one sand equivalency test for each mixture design.



504.03

- c. **Asphalt Content.** Calculate the percent asphalt content of the mixture at least three times per day, on a random basis, using the equipment counter readings.
  - d. **Application Rate.** Calculate the yield of the course placed at least three times per day, on a random basis, using the equipment counter readings.
3. **Documentation.** Complete a daily report that includes the following information:
- a. Control section;
  - b. Job number;
  - c. Route;
  - d. Engineer;
  - e. Date;
  - f. Air temperature;
  - g. Control settings;
  - h. Calibration values;
  - i. Unit weight of emulsion (pounds per gallon);
  - j. Percent residue in emulsion;
  - k. Beginning and ending intervals;
  - l. Counter readings (beginning, ending, and total difference);
  - m. Length and width;
  - n. Total area (square yards);
  - o. Aggregate weight;
  - p. Gallons of emulsion;
  - q. Percent of each material including asphalt cement;
  - r. Application rate, (pounds per square yard);
  - s. Combined application rate, (pounds per square yard);
  - t. JMF (percent portland cement, percent emulsion, gradations, percent asphalt cement);
  - u. Contractor's authorized signature;
  - v. Calibration forms;
  - w. QC aggregate gradations;
  - x. Materials acceptance documentation;
  - y. Asphalt emulsion bill of lading; and
  - z. QC and equivalent test result.
- If truck-mounted machines are used, complete a separate daily report for each machine.
4. **Field Tests.** Before opening micro-surfacing to traffic, perform both of the following field tests:

- a. Probe the entire depth of the micro-surfacing to verify no free emulsion exists in the mixture.
  - b. Place a white absorbent paper blotter on the micro-surfacing to confirm the presence of clear water without brown staining from unbroken emulsion.
- I. **Acceptance.** Allow the Engineer access to in-progress work for quality assurance review and testing.
1. **Field Inspection Acceptance.** Upon completion of work, schedule an inspection with the Engineer. The Engineer will note deficiencies, including areas exhibiting adhesion or cohesion failure. Reconstruct work identified by the Engineer as unacceptable.
  2. **Delayed Acceptance.** At least 30 days after completion of the micro-surface rutfilling, standard or single course, the Engineer will inspect the surface with the Contractor for surface flushing, raveling, or delamination. If the Engineer determines that these surface deficiencies exist, correct the work within 7 working days of the review, or by an agreed upon date, and at no additional cost to the Department.

#### 504.04. Measurement and Payment.

Pay Item	Pay Unit
Micro-Surface, Rutfilling .....	Ton
Micro-Surface, Std .....	Square Yard
Micro-Surface, Single Cse.....	Square Yard

A. **General.** The unit prices for **Micro-Surface**, regardless of the type required, include the cost of providing traffic control, including traffic control to complete corrective action; cleaning existing pavement; applying a bond coat; temporary pavement markings; stationing; and corrective action.

B. **Micro-Surface Rutfilling.** The Engineer will measure **Micro-Surface, Rutfilling** based on the dry weight of fine aggregate in the mix. The unit price for **Micro-Surface, Rutfilling** includes placing mix over each wheel rut to create full lane coverage.

C. **Micro-Surface, Standard.** The unit price for **Micro-Surface, Std** includes the cost of preparing the surface, placing temporary pavement markings, placing the micro-surfacing mixture, applying a rut filling course, a leveling course, a surface course, or all, for full width coverage.

D. **Single Micro Surface.** The unit price for **Micro Surface, Single Cse** includes the cost of preparing the surface, placing temporary

504.04

pavement markings, placing the micro-surfacing mix, and applying a single course of mixture for full width coverage.

E. **Pavement Marking Removal.** The Department will pay separately for removing pavement markings in accordance with subsection 812.04.