

Micro Surfacing

1. Scope

The intent of this guideline is to aid in the design, testing, quality control, measurement and payment procedures for the application of a micro surface.

2. Description

This work consists of the surface preparation and application of a single course micro surfacing or multiple course micro surfacing pavement preservation treatment.

The intent of this guideline is to aid in the design, testing, quality control, measurement, and payment procedures for the application of micro surfacing pavement preservation treatment.

Micro surfacing consists of a mixture of polymer-modified emulsified asphalt, mineral aggregate, water, and additives, proportioned, mixed and uniformly spread over a properly prepared surface as directed by the agency/owner. Micro surfacing can be performed in variable thickness cross-sections such as ruts, scratch courses, and milled surfaces. After curing and initial traffic consolidation, it should resist further compaction. The micro surfacing applied as a homogeneous mat, adheres firmly to the prepared surface, and has a skid-resistant texture throughout its service life.

Micro surfacing is a quick-traffic system that allows traffic to return shortly after placement. Normally, these systems are required to accept straight, rolling traffic on a 0.5 in (12.7 mm) thick surface within one hour after placement. In specific application conditions stopping and starting traffic may require additional cure time.

3. Materials

Provide materials as follows.

- Portland Cement, Type 1L or PLC
- Fine Aggregates, 2FA, 3FA
- Asphalt Emulsion, CSS-1hM, MSEA
- Water

A. Aggregate. Provide aggregates complying with the following gradation and physical requirements.

Micro Surfacing Final Aggregate Blend Gradation Requirements

Mechanical Analysis, Total % Passing

Material	3/8"	No. 4	No. 8	No. 16	No.30	No. 50	No.100	No.200 ^(a)
2FA	100	90-100	65-90	45-70	30-50	18-30	21-Oct	5-15 ^(b)
3FA	100	70-90	45-70	28-50	19-34	12-25	7-18	5-15 ^(b)

^(a) Includes mineral fillers.

^(b) No. 200 limits are significant to the nearest whole percent.

Micro Surfacing Aggregate Blend Physical Requirements

Material	Angularity Index (Min.)	LA Abrasion (% Loss Max.)	Sand Equivalent (% Min.)
	MTM 118	MTM 102	AASHTO T176
2FA	4.0 ^(a)	45	60
3FA	4	45	60

^(a) If a blend of different aggregate sources, the abrasion value applies to the final mixture.

Aggregate used for micro surfacing must be screened at the project site to ensure the aggregate introduced into the micro surface mixture is not larger than the top size aggregate allowed in the mix design. The aggregate must be screened directly into the material transport units or micro surface machine(s). The aggregate screening unit must be capable of producing adequate tonnage to maintain project production.

B. Binder**Emulsion Requirements**

Test	CSS-1hM	MSEA
Viscosity, Saybolt Furol, T59/D7496 at 25°C, sec	20-100	20-100
Storage stability test, T59/D6930, 24-hour, % difference max	1	1
Sieve test, T59/D6933, % max.	0.1	0.1
Distillation to 260°C, T59/D6997, % by weight: Residue, min.	62	62
Tests on distillation residue:	(b)	
Penetration, 25°C, 100 g, 5 sec, dmm, T49/D5	40-90	90-140
Ductility, 25°C, 5cm/min, cm, T51/D113	40	40
Ash content, % max., D128	2	2
Softening point, ring, and ball, °C, min., T53/D36	57.2	55
Elastic Recovery, 10°C, % min., T 301/D 6084		60.0
Toughness/Tenacity, 25°C, 50 cm/min., Nm, min., D 5801		9.0/7.0

(a) Samples of emulsified asphalt will be taken in accordance with ASTM D140/D140M. Samples must be stored at a temperature of not less than 4°C until tested.

(b) Softer penetration can be employed to a maximum of 120 dmm as climate requires and ADT and or commercial traffic allows.

Temperatures for Asphaltic Materials

Asphalt Type	Designation	Temperature °F Distributor
Emulsified	CSS-1hM	85-135
Emulsified	MSEA	85-135

Elevated or cooler temperatures, whether ambient, surface or of any mix component, will cause a reduction or increase of available mix time and may require additional or less water or chemical additive in the mix to counteract the emulsion temperatures. Emulsion temperature may require adjustment as well.

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

The mixture must be designed by a laboratory that participates in AASHTO Resources Proficiency Sample Program. Submit the mix design to the agency/owner at least 7 days before beginning construction.

Provide a JMF that meets the criteria and limits shown to the agency/owner upon request.

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

Micro Surfacing Performance Design Criteria

Test Method	Parameter	Specification
ISSA TB-100	Wet track abrasion loss	—
	1-hour soak	≤50 g/ft ²
	6-day soak	≤75 g/ft ²
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
ISSA TB 139	Wet Cohesion at 30 minutes (Set)	12 kg-cm minimum
	Wet Cohesion at 60 minutes (Traffic)	20 kg-cm or Near Spin minimum

JMF Limits

Test Method	Specification
Asphalt binder content (residual)	6.5%-9.0%, dry weight, 2FA aggregate 6.0%-8.5%, dry weight, 3FA aggregate
Mineral filler	0.25%-3.0%, dry weight aggregate

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

- Proportion of each material.
- Sources of each material, including:
 - Aggregate
 - Name and pit number
 - Gradation
 - Sand equivalence
 - Angularity index
- Field simulation tests, including:

- a. Wet Cohesion
 - b. Wet track abrasion loss
 - c. Saturated abrasion compatibility
 - d. Trail 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. Average daily traffic (ADT) for the pavement sections to receive micro surfacing
 6. Mix designer's signature and date.

4. Construction

A. Equipment. Provide equipment that can produce a product according to specification.

1. **Mixing Machine.** Provide at least one self-propelled, front-feed, continuous-loading mixing machine and/or one or more truck-mounted batch-type machines.
 - a. A positive-connection conveyor 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. Mineral filler feed that drops mineral filler on the aggregate before discharging into the pugmill
 - d. Asphalt emulsion introduced within the first one-third of the mixer length to ensure mixing of materials before exiting the pugmill
 - e. 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
 - f. 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
 - g. Opposite-side driving stations on the front to optimize longitudinal alignment during placement;
 - h. 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 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.

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 or
 - c. A drag capable of producing a uniform finish. Replace the drag if mixture builds up
 3. **Rut Box.** Use a 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 to 6 feet and use a secondary strike-off to control crown on the rut box.
 4. **Longitudinal Box.** Provide a steel screed box designed and manufactured to distribute the mixture to perform micro-surface longitudinal application.
 5. **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.
 6. **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. Plan for parking restrictions and notification
 4. Plan for filling corrugations
 5. Equipment inspection, including transport units
 6. JMF (Job Mix Formula)
 7. Availability of materials
- C. Calibration.** Calibration of the equipment is necessary for proper application rates of emulsified asphalt and aggregate. Upon request, the contractor may provide documentation verifying machine calibration. A yield check should be conducted periodically.

Previous calibration documentation covering the exact materials to be used may be acceptable, provided that no more than 60 days have lapsed. The documentation must include an individual calibration of each material at various settings that can be related to

the machine metering devices. Any component replacement affecting material proportioning requires that the machine be recalibrated. No machine will be allowed to work on the project until the calibration has been completed and/or accepted.

Refer to the ISSA Inspector's Manual description of a method of machine calibration. ISSA contactors and/or machines manufacturers may also provide methods of machine calibration.

D. Surface Preparation. Pavement markings may need to be removed.

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

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

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

The micro surfacing mixture will always be of proper consistency to provide the application rate required by the surface condition. The application rate will be in accordance with the table below.

Application Rate

Aggregate Type	Location	Application Rate
2FA	Urban/Residential Streets	16-32 lb/yd ²
3FA	Primary/Interstate Routes & Rut filling	16-32 lb/yd ²

Suggested application rates are based upon the weight of dry aggregate in the mixture. Application rates are affected by the unit weight and gradation of the aggregate and the demand of the surface to which the micro surfacing is being applied.

- 1. Rutfilling.** Fill ruts if the rut is at least ½-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 ½-inch crown.

- 2. Micro Surfacing.** Select one of the following application methods for micro-surfacing:

- a. Apply at least one course of 3FA mix to the pavement surface, as indicated in the plans, at an average application rate of at least 35 pounds per square yard, by weight of dry aggregate. Apply 3FA mix to pavement surface, as indicated in the plans, at a rate of at least 22 pounds per square yard, by weight of dry aggregate.
- b. Apply at least two courses of 2FA mix to the pavement surface, as indicated in

the plans, at an average combined application rate of at least 30 pounds per square yard, by weight of dry aggregate. Apply 2FA mix to pavement surface, as indicated in the plans, at a rate of at least 17 pounds per square yard, by weight of dry aggregate.

- c. Apply a single course using 2FA mix at an average minimum application rate of 24 pounds per square yard, by weight of dry aggregate, to the pavement surface, as indicated in the plans.

F. Surface Quality

1. **Joint Construction.** No excess buildup, uncovered areas, or unsightly appearance is permitted on longitudinal or transverse joints. The contractor must provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the project. When possible, longitudinal joints will be placed on lane lines. Partial width passes will only be used when necessary and cannot be the last pass of any paved area. A maximum of 3.0 in (76.2 mm) is allowed for overlapping of longitudinal joints.

- G. **Cure Time and Repair.** Ensure the new surface can carry normal traffic without damage. Protect the new surface from damage at intersections and driveways.

H. Notification and Traffic Control

1. **Notification.** Homeowners and businesses affected by the construction must be notified at least one day in advance of the surfacing. Should work not occur on the specified day, a new notification will be distributed. The notification will take place in the form of a written posting, stating the time and date that the surfacing will take place. If necessary, signage alerting traffic to the intended project should be posted.

When parking restrictions are necessary, the agency/owner should prepare a plan for communication with residents and removing vehicles to allow the project to continue. Notices to homeowners and businesses should include plan details, including the micro surfacing schedule, agency/owner contact details and the towing company where a towed vehicle is located.

If an agency/owner is aware of abandoned vehicles, these vehicles should be removed in advance of the project allowing for cleanup of any materials or chemicals that could inhibit the bonding of the new surface.

2. **Traffic Control.** A traffic control plan approved by the agency/owner is required before any work begins. The cost of signage, markers and traffic control necessary to complete the project will be included in the unit price of the micro surfacing. Traffic control devices must be in accordance with the agency/owner requirements and, if necessary, conform to the requirements of the Michigan Manual for Uniform Traffic Control Devices.

5. Weather Limitations

Place the mixture when the air and pavement temperatures reach at least 45°F and continue to rise.

6. Quality Control

Provide a finished surface free of excessive scratch marks, tears, rippling, and other surface irregularities. Do not leave tear marks greater than ½ inch wide and 4 inches long.

If the agency/owner identifies a condition that causes an unsatisfactory micro surfacing treatment, immediately stop production work and correct the defect.

The contractor must establish and maintain an effective QC plan and provide it to the agency/owner upon request.

A. Documentation. Complete a daily report that includes the following information:

1. Control section
2. Job number
3. Route
4. Engineer
5. Date
6. Air temperature
7. Control settings
8. Calibration values
9. Unit weight of emulsion (pounds per gallon)
10. Percent residue in emulsion
11. Beginning and ending intervals
12. Counter readings (beginning, ending, and total difference)
13. Length and width
14. Total area (square yards)
15. Aggregate weight
16. Gallons of emulsion
17. Percent of each material including asphalt cement
18. Application rate (pounds per square yard)
19. Combined application rate (pounds per square yard)
20. JMF (percent portland cement, percent emulsion, gradations, percent asphalt cement)
21. Contractor's authorized signature
22. Calibration forms
23. Materials acceptance documentation; and
24. Asphalt emulsion bill of lading

If truck-mounted machines are used, complete a separate daily report for each machine.

B. Acceptance. Allow the agency/owner access to in-progress work for QA 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.

7. Measurement and Payment

Pay Item	Pay Unit
Micro Surface, Rutfilling	Ton
Micro Surface, Single Course	Square Yard

Micro Surface, Multiple Course

Square Yard

- A. General.** The unit prices for **Micro Surface**, regardless of the type required, include cleaning existing pavement, corrective action, and traffic control to complete corrective action.
- B. Micro Surface Rutfilling.** The agency/owner 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.
- C. Micro Surface, Single Course.** The unit price for **Micro Surface, Single Course** includes all material, equipment, and labor for preparing the surface, placing temporary pavement markings, placing the micro-surfacing mix, and applying a single course of mixture for full-width coverage as specified in the contract.
- D. Micro Surface, Multiple Course.** The unit price for **Micro Surface, Multiple Course** includes all material, equipment, and labor for preparing the surface, placing temporary pavement markings, placing the micro-surfacing mixture, and applying a leveling course, and, if specified in the contract, surface course filling shoulder.
- E. Pavement Marking Removal.** The agency/owner may pay separately for removing pavement markings.

Commentary:

For additional information review AASHTO Best Practice documents and the International Slurry Seal Association specifications.