Section 408

Construction Guide Specification for Micro Surfacing

408.1. DESCRIPTION

This guide specification is intended to provide information needed for owners or contractors to construct micro surfacing. A micro surfacing is the application of a mixture containing polymer modified emulsified asphalt, mineral aggregate, mineral filler, water, and other additives that are properly proportioned, mixed, and spread on a paved surface. Micro surfacing shall be constructed on a prepared surface.

This guide specification refers to quality requirements for materials and a design method for micro surfacing available in other AASHTO documents. However, the main purpose of this specification is to provide guidance for the construction of micro surfacing.

Commentaries are included in this Guide specification to 1) emphasize and further explain the section, 2) present options to be considered by the user, or 3) provide sources of additional information. An example of these commentaries is shown below:

Commentary

This guide specification covers construction of single-application chip seals. If this process is repeated with another application of emulsified asphalt and another layer of cover aggregate, the process is known as a double chip seal. A triple chip seal would require yet another application of emulsified asphalt and cover aggregate. Other terms have been used referring to chip seals such as "seal coat," "surface treatment," "surface seal," "surface dressing," "sprayed seal," and others. Sometimes, a fog seal is applied over the completed chip seal.

408.2. REFERENCED DOCUMENTS

408.2.1. *AASHTO Standards*

- M 140, Emulsified Asphalt
- M 208, Cationic Emulsified Asphalt
- M 316, Polymer-Modified Cationic Emulsified Asphalt
- MP 28, Materials for Micro Surfacing
- PP 83, Micro Surfacing Design
- T 11, Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
- T 27, Sieve Analysis of Fine and Coarse Aggregates

408.2.2. *Other Document*

- Gransberg, D. *National Cooperative Highway Research Program Synthesis 411: Micro surfacing*. Transportation Research Board, Washington, DC, 2010.

408.3. TERMINOLOGY

408.3.1. *CQS-1P*—a cationic quick-setting polymer modified emulsified asphalt.

408.3.2. *CQS-1hP*—a cationic quick-setting polymer modified emulsified asphalt with a harder asphalt residue.

408.4. MATERIAL

408.4.1. *Emulsified Asphalt*—Emulsified asphalt for micro surfacing shall meet the requirements of MP 28. The emulsified asphalt properties are determined by the Owner Agency utilizing regional climatic and traffic conditions. Only emulsified asphalt from certified or approved sources is allowed. Each load of emulsified asphalt shall have a certificate of compliance/analysis which is to be submitted to the Agency daily.

Commentary

The base asphalt used for micro surfacing emulsion might be a PG 64-22 which is acceptable in moderate to warm climates, whereas in colder climates a PG 58-28 might be more appropriate.

408.4.2. *Aggregate*—Mineral aggregates for micro surfacing shall meet the requirements of MP 28.

Commentary

The Type II gradation is used mainly on roads and streets to correct moderate surface defects, fill surface voids, and for wearing surfaces for medium to heavy traffic. The Type III gradation is used on collectors, arterials, and major highways to improve friction and durability. The Type II gradation is a better choice if traffic noise is a concern.

408.4.3. *Mineral Filler*—Mineral filler for micro surfacing shall meet the requirements of MP 28.

Commentary

Portland cement or aluminum sulfate is the typical mineral filler used in micro surfacing. The amount to be used is determined by the requirements of the mix design.

408.4.4. *Water*—Water for micro surfacing shall meet the requirements of MP 28.

Commentary

The amount of water used in micro surfacing is based on the requirements of the mix design. If the placement conditions are very warm, additional water may be added to the mix based upon field conditions, however, excess water negatively affect the consistency of the mix.

408.4.5. *Additives*—Additives used in micro surfacing shall meet the requirements of MP 28.

Commentary

Additives to control the set of the mixture are applied during placement and are designed to perform with the emulsions that the supplier furnishes. It is typically used when placement conditions are very warm.

408.5. CONSTRUCTION

408.5.1. *Weather Limitations*—Micro surfacing shall not be applied if either the pavement temperature or the air temperature is below 50°F (10°C) and falling but may be applied when both pavement and air temperatures are above 45°F (7°C). No material shall be applied when rain is expected before the mix is cured. No material is to be applied if temperatures below 32°F (0°C) are expected within 24 h.

408.5.2. *Mix Design*—The mix design shall be prepared by an AASHTO-accredited laboratory following the PP 83 and must be submitted to the owner agency prior to beginning the work. Field adjustments to the design are permitted if they are within the overall tolerances set forth in the job mix formula.

408.5.3. *Preconstruction Meeting*—Coordinate a preconstruction meeting prior to construction between the agency and the contractor to discuss the following topics:

- the construction process

- the quality control plan
- mix design
- materials control
- materials measurement
- equipment calibration
- traffic control plan
- equipment/process overview
- inspection
- test strip
- unique project conditions
- project documentation
- expectations
- schedule

408.5.4. *Road Surface Preparation*

Clean the pavement surface of all loose material, vegetation, removal of lane stripping and thermoplastic pavement markings, and other objectionable materials immediately before applying the micro surfacing. Allow all pavement surface cracks to dry thoroughly, if water is used, before applying the micro surfacing mixture. Cover service entrances (i.e., manhole covers, valve boxes) with an approved method. Eliminate aggregate, either spilled from the mixing machine or existing on the pavement surface.

Allow crack sealant material to cure for a minimum of 30 days on pavement surfaces that have been crack sealed before application of the micro surfacing. Waive this requirement if a compatible crack sealant is used that does not require a cure time.

Apply a tack coat, if required by the Agency, using an emulsified asphalt meeting the requirements of M 140, M 208, or M 316. Dilute the emulsified asphalt one-part emulsion to one-part water at the plant or the project site as approved by the engineer. Apply the diluted tack coat at the rate of 0.05 to 0.10 gal/yd^2 (0.23 to 0.453 L/m^2). Allow the tack to cure sufficiently before the application of the micro surfacing.

Commentary

Additional surface preparation items to include are removal of raised reflectorized pavement markings, herbicide treatment, oil spot removal and shoulder clippings. Cracks 0.25 in. (0.6.35 mm) or wider shall be sealed. Overbands on the surface shall not exceed 4 in. (101.6 mm) in width and shall not be greater than $^1/_8$ in. (9.53 mm) thick. Tack coat is not typically used prior to micro surfacing. However, if it is specified in the design, it is applied to an existing surface that is moderately raveled or if there is concern the micro surfacing will not properly bond to the existing surface.

408.5.5. *Equipment*

408.5.5.1. *Mixing Equipment*

Mix materials in a specifically designed paver, either truck mounted or continuous run machines, as required by the Agency. The paver shall be a continuous-flow mixing unit able to accurately proportion and deliver the aggregate, emulsified asphalt, mineral filler, water, and additives, to a continuous flow mixing chamber. The machine shall have enough storage capacity for all the mixture ingredients to maintain an adequate supply to the mixing chamber.

If a continuous run machine is required by the Agency to reduce construction joints, use a machine capable of loading materials while continuing to apply micro surfacing.

Figure 1—Continuous Front-Loaded Self-Propelled (Left) and Truck-Mounted (Right) Micro Surfacing Mixing Machines (*Gransberg, 2010*)

Commentary

Truck mounted machines are generally used for residential streets and locations where construction joints are not undesirable. Continuous machines are used for highways and airfield applications.

408.5.5.2. *Proportioning Devices*—The machine shall have controls to meter each individual material into the mixing chamber. The rates of the emulsified asphalt and mineral filler addition shall be interconnected or linked to the aggregate delivery system such that the ratios of these materials remain fixed to the Job Mix Formula during the project.

Commentary

This is generally accomplished during the calibration of the machine and is conducted in the presence of the Agency representative.

408.5.5.3. *Spreading Equipment*—A spreader box shall be equipped with spiral augers that are permanently fixed to the box. The spreader box shall be equipped with a front seal to eliminate any loss of the mixture and an adjustable rear seal to control the application rate of the material. The spreader box and rear seal shall be designed to ensure the delivery of a uniform mixture to the secondary strike-off. The box shall be capable of shifting laterally to compensate for variability in the geometry of the pavement.

408.5.5.4. *Secondary Strike-Off*—The spreading equipment shall be equipped with a secondary strike-off with the same leveling adjustment capabilities as the spreader box to provide a satisfactory surface texture.

408.5.5.5. *Rut Filling*

A rut box specifically designed and manufactured to fill ruts shall be provided for each designated wheel track. Rut boxes are used when filling ruts 0.5 in. (12.7 mm) or more in depth. Ruts deeper than 1.5 in. (38.1 mm) may require multiple lifts.

The rut boxes shall be 5 to 6 ft (1.52 to 1.83 m) wide with a dual chamber and an inner "V" configuration of augers to channel the large aggregate toward the center of the rut and the fines to the edges of the rut fill pass. The box shall be equipped with a dual strike-off plate to control the width and depth of the rut fill. All rut filling material should cure under traffic for at least 24 h before additional material is placed.

408.5.5.6. *Brooms*—Motorized brooms shall have a positive means of controlling vertical pressure and be capable of cleaning the road surface prior to placing micro surfacing.

408.5.5.7. *Rolling*—Where required by the Agency, a self-propelled, 10-ton (0.907-mt) (maximum) pneumatic tire roller equipped with a water spray system shall be used. All tires shall be inflated per the manufacture's specifications.

Commentary

Rolling of micro surfacing is typically not required except for airfield applications and parking lots. When required, the minimum tire pressure of 90 psi (621 kpa) unless otherwise recommended by the equipment manufacturer.

408.5.6. *Mix Paver Calibration*

Calibrate the mix paver to be used for the placement of micro surfacing in the presence of the representative from the specifying agency according to the method recommended by the mix paver manufacturer.

Each unit shall be calibrated prior to the beginning of each project for each aggregate type, or as required by the agency. The calibration procedure shall include a metered verification for each material used. No machine will be permitted to work until the calibration has been completed or accepted.

408.5.7. *Test Strip*—A test strip shall be constructed on or near the project site. If near the site, the pavement conditions must be very similar. Construct the test strip under similar placement conditions of time of day, temperature, and humidity as expected for the duration of the project. The test strip shall be a minimum of 300 ft (91.44 m) in length and shall be constructed, after completion of the calibration, with the job mix proportions, materials, and equipment to be used on the project. Adjustments to the mixture formula shall be permitted provided they do not exceed the values stated in the mix design. The test strip shall be evaluated by the Agency to determine whether project specifications are met. If specifications are not met, additional test strips will be constructed until specifications are met, at no additional cost to the Agency.

408.5.8. *Application of Mixture*

For mix consistency and performance, adjustments to the job mix formula are allowed and must remain within the tolerances set forth in the mix design.

Wet the surface of the pavement by fogging a fine mist of water ahead of the spreader box, when necessary. The rate of application shall not result in pooling of water on the surface to be paved.

In irregular areas, not accessible to the spreader box, use hand tools to provide a complete and uniform coverage. These areas shall be cleaned and lightly dampened before placing the mix. The finished texture shall be uniform and have a neat appearance.

Where required in the plans, use the rut box to fill ruts and depressions equal to or greater than 0.5 in. (12.7 mm). For ruts of less than 0.5 in. (12.7 mm), a full width scratch course using the conventional spreader box is acceptable. Where ruts exceed 1in. (25.4 mm), multiple passes with the rut box may be necessary.

All rut filling shall be allowed to cure under traffic for at least 24 h before the final surface course is placed. Mixtures for filling ruts shall meet the requirements of Type III in MP 28. The mixture must meet the longitudinal and transverse profile noted in the project plans.

When required in the plans, roll pavement surfaces with a minimum of two full coverage passes after the mixture has cured to the point where it will not be damaged by the roller following the requirements of Section 408.5.5.7.

All areas including service entrances, gutters, and intersections shall be cleaned of any debris associated with the placement of the micro surfacing daily. At the direction of the engineer, sweep raveled aggregate.

408.5.9. *Aggregate Stockpiling, Testing and Moisture Control*

The gradation of the aggregate stockpile shall not vary by more than the stockpile tolerance from the mix formula while also remaining within the specification grading band. Sampling and testing

of the aggregate shall be a minimum of one per each 500 tons (453.6 mt) with a sample consisting of three test portions tested in accordance with T 11 and T 27.

Stockpile moisture can vary due to weather conditions and the contractor shall take the necessary precautions to protect the aggregate stockpiles and, if necessary, re-work the stockpiles to reach an acceptable moisture content contained in the mix design.

Commentary

For example, the gradation of the minus 8 sieve for Type III micro surfacing aggregate is 45 to 70 percent passing with a ±5 percent stockpile tolerance. If the mix design for Type III aggregate for material passing the minus 8 sieve from the stockpile gradation is 62 percent, the allowable variation is 57 to 67 percent passing. If the percentage passing is 67 percent, the allowable variation is 62 to 70 percent.

408.5.10. *Application of Aggregate and Emulsified Asphalt*—Verify the application rate of the aggregate and emulsified asphalt using the paver's calibration records. Provide material certification and quality control test results for each load of emulsified asphalt used on the project. Include the supplier name, plant location, emulsion grade, and batch number on all reports.

408.5.11. *Workmanship*

When placing micro surfacing, the longitudinal and transverse joints shall be uniform, neat in appearance, and shall not contain material build-up or uncovered areas. Longitudinal joints shall be placed on lane lines, edge lines, or shoulder lines and shall have a maximum overlap of 3 in. (75 mm). Longitudinal joints shall be straight in appearance along the centerline, lane lines, shoulder lines, and edge lines.

Longitudinal lines at intersections, curbs, shoulders, and street ends shall be straight to provide a good appearance. Longitudinal edge lines shall not vary by more than ±2 in. (50.8 mm) in 100 linear ft (30.5 m).

The finished surface shall have a uniform texture free from excessive surface defects, ripples, or drag marks. A single drag mark exceeding 0.5 in. (12.7 mm) in width and 6 in. (152.4 mm) in length or a total of four drag marks within 100 linear ft (30.5 m) in a single pass are excessive.

The contractor shall produce neat and uniform longitudinal and transverse joints. Transverse joints shall be constructed as butt-type joints. Joints are acceptable if there is no more than 0.25 in. (6.35 mm) vertical space for longitudinal joints, and no more than 0.25 in. (6.35 mm) for a transverse joint between the pavement surface and a 10-ft (3.05 m) straightedge placed perpendicular to the joint.

If these criteria are exceeded, the contractor shall stop work and correct them.

408.5.12. *Opening to Traffic*

Do not allow traffic on the newly completed surface course until the mix has set sufficiently to prevent pick-up as determined by the contractor. Stopping and starting traffic will require additional curing time. Construct the micro surfacing so that adjacent lanes are placed on the same day when possible. Barricades, signage and traffic control shall follow the current MUTCD standards.

Place temporary pavement markings after the micro surfacing cures. The permanent pavement markings shall not be placed for 10 to14 days for water borne pavement markings or per manufacturer's recommendations for other types.

408.5.13. *Project Documentation*—The contractor shall supply daily documentation to the Agency that includes the following:

- Aggregate used, tons (dry)
- Micro surfacing emulsified asphalt used, tons
- Emulsified asphalt for tack coat used, if specified, tons
- Mineral filler used, pounds

- Water used in mixture, gallons
- Additive used in mixture, gallons
- Surface area completed, square yards
- Surface area application rate, dry pounds of aggregate per square yard
- Percentage of emulsified asphalt based on dry aggregate

408.5.14. *Quality Control*

408.5.14.1. *General*

The Contractor is responsible for quality control (QC) sampling and testing and shall submit a QC plan including materials and procedures for verifying the quality of the micro surfacing aggregates and emulsified asphalt(s). The Contractor's QC plan shall include but is not limited to sampling, testing, inspection, monitoring, documentation, and corrective action procedures during transport, stockpiling and placement operations. The plan shall include, as a minimum, the following:

- Sampling and testing procedures for in accordance with MP 28.
- Sampling and testing procedures for asphalt emulsion.
- Sampling and testing procedures for residual binder content.
- Actions the contractor will take to correct any deficiencies and who will be responsible to the make corrections.

A written Quality Control Plan (QCP) shall be developed which details the Contractor's QC program that meets the requirements of these specifications. The QCP shall be contract specific and signed by the Contractor's representative. Micro surfacing construction shall not proceed without Agency approval of the QCP and QC personnel present on the project. Failure to comply with these provisions will result in shutdown of the operations until the Contractor's operations are in compliance.

408.5.14.2. *Personnel*—The QC staff shall include the following as a minimum:

a) *QCP Administrator*—The person with overall responsibility of the QCP.

b) *QCP Manager*—The person responsible for the execution of the QCP and liaison with the Agency. This person shall be on the project and have the authority to stop or suspend construction operations.

c) *QC Technicians*—The person(s) responsible for conducting QC tests and inspection to implement the QCP. QC technicians shall have Level 2 Aggregate Testing Certification from the American Concrete Institute (ACI) or other accrediting body approved by the Agency.

d) *Certified Crew Members*—Three crew members (job foreman, aggregate spreader operator and asphalt distributor operator), at a minimum, shall possess a valid micro surfacing certification and be on the project at all times the micro surfacing is being constructed. The micro surfacing certification is administered by the National Center for Pavement Preservation (NCPP) on behalf of AASHTO TSP·2 (Transportation System Preservation· Technical Services Program).

408.5.14.3. *Testing Facilities and Equipment*—The Contractor shall provide the name of the laboratory conducting QC tests. The laboratory shall maintain accreditation by the AASHTO Accreditation Program (AAP) for all tests within the relevant scope of testing, or other accrediting body approved by the agency. Sampling, testing and measuring devices shall meet the requirements of the specified standards and test methods. The laboratory shall maintain records of the calibration and maintenance of all sampling, testing and measuring equipment.

408.5.14.4. *Materials Testing*—Aggregates and asphalt emulsion shall be tested for compliance with the specifications as follows:

408.5.14.4.1. *Aggregate*

408.5.14.4.1.1. *Stockpile*—Test the aggregate gradation a minimum of once per day, or every 1,500 tons, whichever is less in accordance with MP 28. If the material is hauled from the production site to a temporary stockpile, test at the temporary stockpile.

408.5.14.4.1.2. *Construction*—Test the aggregate gradation from the delivery vehicle a minimum of once per day, or every 1500 tons, whichever is less in accordance with MP 28.

408.5.14.4.2. *Emulsified Asphalt*—Provide material certification and quality control test results for each batch of emulsified asphalt used on the project. Include the supplier name, plant location, emulsion grade, and batch number on all reports.

408.5.14.5. *Records and Documentation*

The Contractor shall maintain complete records of all QC tests and inspections.

All QC test results shall be submitted to the Agency within 24 hours. A material certification shall be submitted from each supplier for each batch of material delivered to the project, including test results.

The QC records shall contain all test and inspection reports, forms and checklists, equipment calibrations, supplier material certificates, and non-conformance and corrective action reports. The QC records shall indicate the nature and number of observations made, the number and type of deficiencies found, the quantities conforming and non-conforming, and the nature of corrective action taken as appropriate for materials as well as workmanship. All the QC records shall be given to the Agency at the end of the contract. The Contractor's documentation procedures will be subject to approval by the Agency prior to the start of work, and to compliance checks by the Agency during the progress of the work.

408.5.14.6. *Compliance with Specifications*—The Contractor shall attest in writing to the Agency that the micro surfacing has been constructed in accordance with and meets the requirements of the specifications at the end of the project.

408.5.14.6.1. *Agency Acceptance*—The Agency will conduct acceptance sampling, testing, and inspection activities to ensure material quality, correct application rates, rolling, sweeping, and traffic control are within specification requirements. These activities will be done randomly by the Agency.

408.5.14.6.1.1. *Materials Testing*

a) *Aggregate*—Sample aggregate taken from the delivery vehicle or stockpile once per day. Samples will be stored and tested for gradation at the discretion of the Agency. If the results vary from MP 28, acceptance or removal will be based on the Agency's specification.

b) *Emulsified Asphalt*—Sample the first shipment and provide one sample for every 50,000 gal (189 271 L) thereafter. Testing of emulsions shall be in accordance with MP 28.

c) *Residual Binder Content*—A State Agency Representative shall obtain a sample of the completed micro surfacing mixture to determine the residual binder content.

408.5.14.6.1.2. *Equipment*—All equipment to be used on the project shall be evaluated by the Agency to assure it is in acceptable operating condition, calibrated correctly and will provide the quantities of material specified. If the equipment is operating outside of calibration, the project will be shut down immediately and the equipment shall be recalibrated.

a) *Final Inspection*—A final inspection will be done to assure that no bleeding, flushing, or drag marks have occurred. Longitudinal and transverse joints will be inspected to assure that no excessive overlap has occurred.

408.6. MEASUREMENT

The Engineer will measure work acceptably completed as specified in Subsection 109.01 of the *AASHTO Construction Guide Specifications*.

The engineer shall not measure mix water or water used to pre-wet the pavement surface.

408.7. PAYMENT

The Agency will pay for accepted quantities at the contract price as follows:

408.7.1. Payment will be made in accordance with the schedule set forth below at the contract bid price for the specified unit of measure.

Item No.	Item	Unit
State ##	Aggregate for micro surfacing	ton (mt)
State ##	Polymer modified emulsified asphalt for micro surfacing	ton (mt), gal (L)
State ##	Diluted emulsified asphalt for tack coat	ton (mt), gal (L)
State ##	Filler	ton (mt)

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified. If the materials placed on the project fail to meet the specification requirements, they shall be repaired, or replaced, by the contractor to the satisfaction of the Agency at no additional cost to the Agency.

Commentary

Some current specifications require the basis of payment be by the square yard of material placed because it is easy to measure. If the application rate specified is not verified by the agency inspector, it is possible they can get an application that is deficient in thickness or low in binder content. Some agencies measure the placement by the amount of material placed by the ton, but they must monitor the materials by using the measurements provided by the mixing machine.