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.

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
- T 319, Quantitative Extraction of Asphalt Binder from Asphalt Mixtures
- AASHTO Guide Specifications for Highway Construction, 10th Edition, 2020,

408.2.2. *Other Documents*

- Gransberg, D. *National Cooperative Highway Research Program Synthesis 411: Micro surfacing*. Transportation Research Board, Washington, DC, 2010.
- Manual on Uniform Traffic Control Devices for Streets and Highways, (MUTCD), 2009 Edition, US Department of Transportation, Federal Highway Administration, Washington, DC 20590.

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 emulsified asphalt 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 as a wearing surface for medium to heavy traffic. The Type III gradation is used on collectors, arterials, and major highways to improve friction and durability. Rut fill courses using the rut box are recommended to be a Type III. 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 are the typical mineral fillers 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. Adjustments to the water content may be made based on field conditions, however, adjustments that negatively affect mix properties or aesthetics shall not be permitted.

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 system. It is typically used when either placement conditions are very warm, or the aggregate reactivity requires it to delay premature breaking of the mixture.

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) and rising. 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 shall be approved or accepted by the owner Agency prior to equipment calibration and before 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

Commentary

Unique project conditions can be Cul-de-Sacs, ramps, and shoulders, and excessively rich, flushed or bleeding surfaces.

- project documentation
- expectations
- schedule

408.5.4. *Road Surface Preparation*

Clean the pavement surface of all loose material, vegetation, removal of lane striping 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. Remove loose aggregate and dried or broken mixture caused by the operation of the equipment.

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.

Commentary

The sealant should be an asphalt-based material to be compatible. It should be designed to be used under the location and climatic conditions of the project.

Apply a tack coat, if required by the Agency, using an emulsified asphalt (an SS, CSS, or micro surfacing grade) meeting the requirements of M 140, M 208, or M 316. Dilute the emulsified asphalt one-part emulsified asphalt to one to three-part(s) water at the emulsified asphalt supplier's facility 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. (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. (3.18 mm) thick. Tack coat is used prior to micro surfacing by a number of Agencies. 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 such as concrete or brick. Tack coats are not recommended to be placed on leveling courses of micro surfacing nor on rut filling. The contractor should not tack more area that what they plan to pave that day. Tacked areas that are not covered at the end of the paving day should be addressed to prevent slippery pavement surfaces.

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, through a revolving multi-blade, double-shafted mixer. The paver shall have enough storage capacity for all the mixture ingredients to maintain an adequate supply to the mixing chamber.

The continuous-run machine shall be equipped to provide the operator with full control of the forward and reverse speeds during application. It shall be equipped with opposite-side driver stations to assist in alignment. The self-loading device, opposite-side driver stations, and forward and reverse speed controls shall be of original-equipment-manufacturer design
If a continuous run machine is required by the Agency to reduce construction joints, use a paver 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-run machines are generally used for arterials, collectors, highways, and airfield applications.

408.5.5.2. *Proportioning Devices*—The paver 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.

Note 1.

The verification of material rates and proportions are generally accomplished during the calibration of the machine and should be 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 fixed inside of 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. The secondary strike-off shall be made of neoprene rubber or burlap drag depending on the type of texture required by the Agency.

408.5.5.5. *Rut Filling*

A rut box specifically designed and manufactured to fill individual 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. Where ruts exceed 1.0 in. (2.54 mm), multiple passes with the rut box may be necessary.

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.

When ruts depths are less than 0.5in. (12.7 mm), a full width scratch course may be applied with the spreader box using a metal or stiff rubber strike-off.

Commentary

For every inch of micro-surfacing mix, add 1/8 inch (3.18 mm) to 0.25 in. (6.35 mm) as a crown to allow for compaction under traffic.

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 or when extreme heat causes a tender mat. When required, the minimum tire pressure of 90 psi (621 kpa) unless otherwise recommended by the equipment manufacturer. Do not roll until the mat is cured sufficiently to prevent damage, this is typically the morning following application.

408.5.6. *Paver Calibration*

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

Each paver 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 paver 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 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 500 ft (152.4 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.

Note 2.

The purpose of a test strip is to assure adequate workmanship, aesthetics and cure time of the mixture is achievable when applied with the personnel, equipment and materials intended for use during execution of the project. The requirement of a test strip and an explanation of any specific evaluation methods that will be used should be outlined in the project plans.

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 or helpful to promote bonding or reduce surface temperature. 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

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.

Commentary

A mist of water also assists with "pick-up" of crack sealant.

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 27 and T 11.

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.

The aggregate shall be handled in such a manner as to prevent segregation, mixing of the various materials or sizes, and contamination with foreign materials. The grading of aggregates proposed for use and as supplied to the project shall be uniform. Suitable equipment of acceptable size shall be furnished by the Contractor to maintain the stockpiles and prevent segregation of aggregates. The aggregate shall be passed over a scalping screen immediately (not prescreened) prior to transfer to the micro surfacing mixing machine to remove oversized material.

Commentary

For example, the gradation for Type III micro surfacing aggregate is 45 to 70 percent passing of the # 8 sieve with a ±5 percent stockpile tolerance. If the mix design shows the Type III aggregate to be 62 percent passing the # 8 sieve, 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 over a known area by using the paver's proportions device meters and calibration documents. Provide material certification and

quality control test results for each load of emulsified asphalt used on the project. Include the supplier name, plant location, emulsified asphalt grade, and batch number on all reports.

Commentary

The term "yield checks" is sometimes used by industry to refer to application rate. The overall performance of the micro surfacing is related to the proper application rate of the material. It is recommended that the application rate be verified a minimum of four (4) times per day. The factors determined during the calibration process are necessary for the verification of the application rate. In most cases, application rates are based upon pounds of dry aggregate per square yard.

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. All transverse joints shall be clean and straight. At the start of each day(s) of production and at approaches, place a 5 ft. minimum width of paper/plastic on the existing pavement. Cover all bridge ends with paper/plastic to ensure no micro surfacing is placed on the bridge. Remove the paper/plastic once the micro surfacing has cured and properly dispose of the excess material from the project site. Place and spread all courses as continuously as possible, keeping the number of construction transverse joints to a minimum. When a construction transverse joint is necessary, the paving box shall be full of material. Do not spread (drag) the remaining material, emptying the paving box. Once the end of the mat and a straight line is created, the paving box shall be lifted, and the remaining material shall be removed and properly disposed of from the project site.

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). If the contractor is unable to meet this requirement, they shall be required to establish a pilot line.

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.

Commentary

Correction of defects are typically made by applying full lane width passes of a sufficient length to promote an aesthetic surface. No partial width corrections should be permitted.

408.5.12. *Opening to Traffic*

Do not allow traffic on the newly completed surface course until the mix has set sufficiently to prevent damage to the mixture as determined by the contractor. Stopping and starting traffic and turning traffic may 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 Manual on Uniform Traffic Control Devices (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.

Commentary

Prior to allowing traffic, the contractor shall broadcast micro surfacing sand or other approved materials as directed by the engineer over turnouts, intersections, and/or crossovers as the micro surfacing cures. Once the micro surfacing has properly cured, sweep all loose sand and debris from the intersections/crossovers, and properly dispose of the material. The contractor shall repair any damaged areas prior to project completion.

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 Assurance*

Referred to COMP TS 5c. The "Slurry Systems Quality Assurance Guide" is being balloted by COMP TS 5c. Action approved by chairs of TS 5b and TS 5c.

408.6. MEASUREMENT

The Engineer will measure work acceptably completed as specified in Subsection 109.1 of the *AASHTO Construction Guide Specifications*.

Emulsified Asphalt for micro-surfacing shall be measured by the gallon. The Contractor will be required to submit certified bill of ladings from the emulsified asphalt manufacturer indicating total gallon delivered. In addition, the Contractor will be responsible for submitting a way-back ticket representing un-used material at the conclusion of the project.

Aggregate for micro-surfacing shall be measured by the ton of dry aggregate used. The aggregate usage shall be determined by using the calibration factors. The mineral filler will be counted by the 94-pound sack and will be included in the payment for aggregate.

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, 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 device.