

## MICRO SURFACING

Micro surfacing shall consist of mixing a polymer modified cationic quickset emulsion, aggregate, mineral filler, set-control additives, and water and spreading the mixture on a pavement surface where shown on the plans, in conformance with the provisions in these special provisions, and as directed by the Engineer.

### MATERIAL

The material for micro surfacing shall conform to the following requirements:

#### Emulsion

The asphalt emulsion shall be a polymer modified cationic quickset (PMCQS-1h), shall be homogenous and shall conform to the provisions of these special provisions. The polymer shall be milled or blended into the asphalt or blended into the emulsifier solution prior to the emulsification process. Polymer solids must be a minimum of 3.0 % by weight of the emulsion's residual asphalt. Provide a certificate of compliance certifying the amount of polymer.

The PMCQS-1h emulsion shall conform to the following requirements when tested in conformance with the following test methods:

<b>Polymer Modified, Cationic Quickset Emulsion</b>		
Specification Designation	Test Method	Requirement
Viscosity SSF @ 77°F (25°C)	AASHTO T 59	15-90 Seconds
Sieve, max.	AASHTO T 59	0.30 Percent
Settlement, 5 days, max.*	ASTM D 244	5 Percent
Residue by Evaporation, min.	AASHTO T59	62 Percent
*Waived if to be used within 48 hours of manufacture.		

<b>Specification Designation for Residue</b>		
Specification Designation	Test Method	Requirement
Penetration @ 77°F (25°C), 100g, 5s ,0.1mm	AASHTO T 51	40-90
Softening Point °F (°C) min.	AASHTO T 53	135 (57)
Torsional Recovery min.	California Test 332	20

#### Water and Additives

The water shall be potable and free of harmful soluble salts or reactive chemicals and other contaminants. If necessary for workability, a set-control agent may be used and must be included as part of the mix design and be compatible with the other components of the mix.

#### Mineral Filler

Mineral filler shall be Portland cement or hydrated lime that is free of lumps. The type of mineral filler shall be determined by the Contractor based on laboratory mix designs and will be considered part of the aggregate gradation.

## Aggregate

The mineral aggregate used shall be of the type and grade specified for the particular use of micro surfacing. Aggregate shall consist of sound, durable, crushed stone or crushed gravel and approved mineral filler. The material shall be free from vegetable matter and other deleterious substances. All aggregate shall be free of caked lumps and oversize particles.

The aggregate, prior to the addition of emulsion, shall conform to the requirements of this section. If aggregates are blended each component aggregate shall meet the sand equivalency and abrasion resistance and shall be 100% crushed.

The percentage composition by weight of the aggregate (including mineral filler) shall conform to the following grading requirements when tested in conformance with AASHTO T 27 and AASHTO T 11:

Type II	
Sieve Size	Percentage Passing
3/8"	100
No. 4	94-100
No. 8	65-90
No. 16	40-70
No. 30	25-50
No. 200	5-15

Type III	
Sieve Size	Percentage Passing
3/8"	100
No. 4	70-90
No. 8	45-70
No. 16	28-50
No. 30	19-34
No. 200	5-15

The aggregate (excluding mineral filler) shall conform to the following quality requirements:

Test	Test Method	Requirements
Sand Equivalent (Min.)	AASHTO T 176	65
Durability Index (Min.)	AASHTO T 210	60
Percentage of Crushed Particles (Min.)	ASTM D 5821	100%
Loss Angeles Rattler Loss at 500 Rev. (Max.) <sup>1</sup>	AASHTO T 96	35%

Notes: 1. Los Angeles Rattler shall be performed on the parent aggregate before crushing

If the results of the aggregate grading do not meet the specified gradation, the micro surfacing represented by the test shall be removed. However, if requested in writing by the Contractor and approved by the Engineer, the micro surfacing may remain in place and the Contractor shall pay to the State \$2.00 per ton for the aggregate represented by the tests and left in place.

If the results of the Sand Equivalent test for aggregate do not meet the specified requirement, the micro surfacing represented by the test shall be removed. However, if requested in writing by the Contractor and approved by the Engineer, the micro surfacing may remain in place and the Contractor shall pay to the State \$2.00 per ton for the aggregate represented by the tests and left in place.

When the results of both the aggregate grading and the Sand Equivalent tests do not conform to the

specified requirements, both payments to the State shall apply. The Department may deduct these amounts from any moneys due or to become due to the Contractor.

No single aggregate grading or Sand Equivalent test shall represent more than 300 tons or one day's production, whichever is smaller.

## MIX DESIGN

At least 7 working days before the micro surfacing placement commences, the Contractor shall submit for approval of the Engineer a laboratory report of tests and a proposed mix design covering the specific materials proposed for use on the project.

The percentages of each individual material proposed in the mix design shall be shown in the laboratory report. Individual materials shall be within the following limits:

<b>Residual Asphalt</b>	5.5% to 10.5% by dry weight of aggregate
<b>Mineral Filler</b>	0.5% to 3% by dry weight of aggregate
<b>Additive and Water</b>	As needed

Adjustments may be required during construction based on field conditions.

The mix design and aggregate tests shall be performed by a laboratory capable of performing the applicable International Slurry Surfacing Association (ISSA) tests. The proposed micro surfacing mixture shall conform to the specified requirements when tested in conformance with the following tests:

The laboratory that performed the tests and designed the mixture shall sign the laboratory report and shall be AMRL certified and/or participate in the AASHTO Proficiency Program. The report shall show the results of the tests on individual materials and shall compare their values to those required by these special provisions. The report shall clearly show the proportions of aggregate, mineral filler (minimum and maximum), water, set control additive, and PMCQS-1h solids content (minimum and maximum) based on the dry weight of aggregate. The laboratory shall report the quantitative effects of moisture content on the

<b>Test</b>	<b>ISSA Test Method</b>	<b>Requirements</b>
Wet Cohesion @ 30 Minute (Set) (Min.) @ 60 Minute (Traffic) (Min.)	TB*139	12 kg-cm 20 kg-cm
Excess Asphalt	TB*109	540 g/m <sup>2</sup>
Wet Stripping (Min.)	TB* 114	90%
Wet Track Abrasion 6-day Soak Loss (Max.)	TB*100	810g/m <sup>2</sup>
Displacement Lateral (Max.) Specific Gravity After 1000 Cycles of 125 lbs. (56.8 kg)(Max.)	TB*147A	5% 2.10
Classification Compatibility	TB* 144	(AAA, BAA) 11 Grade Points
Mix Time @ 77°F (25°C)	TB* 113	Controllable to 120 Seconds
TB* = Technical Bulletin		

unit weight of the aggregate (bulking effect) in conformance with the requirements of ASTM Designation C 29M. Previous laboratory reports covering the same materials may be accepted provided the material test reports were completed within the previous 12 months.

The component materials used in the mix design shall be representative of the micro surfacing materials proposed by the Contractor for use on the project.

Once the mix design is approved by the Engineer, no substitution of other material will be permitted unless the materials proposed for substitution are first tested and a laboratory report is submitted for the substituted design in conformance with the provisions of these special provisions. Substituted materials shall not be used until the mix design for those materials has been approved by the Engineer.

The completed mixture, after addition of water and set control agent, if used, shall be such that the micro surfacing mixture has proper workability. At the expiration of the road closure hours, in conformance with the provisions in "Maintaining Traffic" of these special provisions, the micro surfacing mixture shall be sufficiently cured to support unrestricted traffic.

## **PROPORTIONING**

Aggregate, mineral filler, PMCQS-1h, water, and additives, including the set-control agent, if used, shall be proportioned by volume utilizing the mix design approved by the Engineer. If more than one kind of aggregate is used, the correct amount of each kind of aggregate to produce the required grading shall be proportioned separately, prior to adding the other materials of the mixture, in a manner that will result in a uniform and homogeneous blend.

The aggregate shall be proportioned using a belt feeder operated with an adjustable cut off gate. The height of the gate opening shall be determinable. The PMCQS-1h shall be proportioned by a positive displacement pump. Variable rate emulsion pumps, if used, shall be calibrated and sealed in the pump's calibrated condition in conformance with the ISSA Inspector's Manual MA-1 prior to usage.

The delivery rate of aggregate and PMCQS-1h per revolution of the aggregate feeder shall be calibrated at the appropriate gate settings for each mixer-spreader truck used on the project in conformance with ISSA Inspector's Manual MA-1 and in conformance with the provisions of these special provisions.

The aggregate belt feeder shall deliver aggregate to the pug-mill with such volumetric consistency that the deviation for any individual aggregate delivery rate check-run shall not exceed 2.0 percent of the mathematical average of 3 runs of at least three tons each. The emulsion pump shall deliver PMCQS-1h to the pug-mill with such volumetric consistency that the deviation for any individual delivery rate check-run shall be within 2.0 percent of the mathematical average of 3 runs of at least 300 gallons each. The water pump shall deliver water to the pug-mill with such volumetric consistency that the deviation for any individual delivery rate check-run shall be within 2.0 percent of the mathematical average of 3 runs of at least 300 gallons each.

The PMCQS-1h storage tank shall be located immediately before the emulsion pump and shall be equipped with a device which will automatically shut down the power to the emulsion pump and aggregate belt feeder when the PMCQS-1h level is lowered to a point where the pump suction line is exposed.

A temperature-indicating device shall be installed in the emulsion storage tank at the pump suction level. The device shall indicate the temperature of the PMCQS-1h and shall be accurate to within 10°F.

The belt delivering the aggregate to the pug-mill shall be equipped with a device to monitor the depth of aggregate being delivered to the pug-mill. The device for monitoring the depth of aggregate shall automatically shut down the power to the aggregate belt feeder whenever the depth of aggregate is less than the target depth of flow. A second device shall be located where the device will monitor the movement of the aggregate belt by detecting revolutions of the belt feeder. The devices for monitoring no flow or belt movement shall automatically shut down the power to the aggregate belt when the aggregate belt movement is interrupted. The device to detect revolutions of the belt feeder will not be required where the aggregate delivery belt is an integral part of the drive chain. To avoid erroneous shutdown by normal fluctuation, a delay of 3 seconds will be permitted between sensing and shutdown of the operation.

## **MIXING AND SPREADING EQUIPMENT**

The micro surfacing shall be mixed in continuous pug-mill mixers of adequate size and power for the type of micro surfacing to be placed. All indicators shall be in conformance with the provisions of these special provisions and shall be in working order prior to commencing mixing and spreading operations.

Mixer-spreader trucks shall be equipped to proportion the PMCQS-1h, water, aggregate, mineral filler, and set-control additives by volume. Rotating and reciprocating equipment on mixer-spreader trucks shall be covered with metal guards.

The mixer-spreader truck shall not be operated unless low-flow and no-flow devices and revolution counters are in good working condition and functioning and metal guards are in place. Indicators required by these special provisions shall be visible while walking alongside the mixer-spreader truck.

Aggregate feeders shall be connected directly to the drive on the emulsion pump. The drive shaft of the aggregate feeder shall be equipped with a revolution counter reading to the nearest one-tenth of a revolution.

In addition to the requirements of the fourth paragraph of Section 5 1.10, "Equipment and Plants," of the Standard Specifications, the identifying number of mixer-spreader trucks shall be at least three inches in height, located on the front and rear of the vehicle.

The micro surfacing mixture shall be spread by means of a spreader box conforming to the requirements in the "Spreader Box" section of these specifications.

### **Spreader Box**

For Type II micro surfacing the spreader box shall be capable of spreading a lane width and equipped with a material such as flexible rubber belting on each side and in contact with the pavement. If the spread width is wider than 7.5 feet, a spreader box shall be equipped with a means, such as baffles or reversible motor-driven augers, to uniformly apply micro surfacing on super-elevated sections and shoulder slopes. The spreader box shall be equipped with rear flexible strike-off blades making close contact with the pavement and adjustable to various crown shapes in order to apply a uniform micro surfacing. The spreader box shall be equipped with flexible drags attached to the rear and cleaned daily and changed if longitudinal scouring occurs. The spreader box shall be clean and free of excess micro surfacing and/or PMCQS-1h at the start of each work shift.

For Type III micro surfacing the spreader box shall be capable of placing a minimum of 12 feet wide and

shall have strips of flexible rubber belting or similar material on each side of the spreader box and in contact with the pavement to prevent the loss of micro surfacing from the box. Spreader boxes over eight feet in application width shall have baffles and be double shafted reversible motor driven augers. Spreader box skids shall be maintained in such manner as to prevent chatter (wash boarding) in the finished mat. The spreader box in use shall be clean and free of micro surfacing and PMCQS-1h at the start of each work shift.

For Type III micro surfacing the spreader box shall have a series of strike-off devices at the rear of the box. The leading strike-off device shall be fabricated of steel, stiff rubber or other suitable material. The number of strike-off devices shall be determined by the Contractor. The first strike-off device shall be designed to maintain close contact with the pavement during the spreading operations, shall obtain the thickness required, and shall be capable of being adjusted to the various pavement cross sections for application of a uniform micro surfacing finished surface. The final strike-off device shall be fabricated of flexible material and shall be designed and operated to ensure a uniform texture is achieved in the finished surface of the micro surfacing. The final strike-off device shall be cleaned or changed daily if problems with longitudinal scouring occur.

#### **Wheel Path Depression (Rut) Box**

The wheel path depression (rut) box shall be designed to have adjustable strike-off devices to regulate the depth and shall have a width of between five feet and six feet. Hydraulic augers, or similar devices, shall be installed and shall be capable of moving the mixed material from the rear to the front of the filling chamber. These devices shall also be capable of guiding the larger aggregate into the center, deeper section of the wheel path depression, and forcing the finer material toward the outer edges of the spreader box.

The micro surfacing mixture, to be spread in areas inaccessible to the controlled spreader box, may be spread by other methods upon approval of the Engineer.

### **PREPARATION FOR MICRO SURFACING**

Before placing the micro surfacing, the pavement surface shall be cleaned by sweeping, flushing or by other means necessary to remove loose particles of paving, dirt, and other extraneous material. When required, the roadway surface may be fogged with water ahead of the spreader box. The application of the fog spray may be adjusted to suit temperatures, surface texture, humidity and dryness of pavement.

A tack coat of asphaltic emulsion shall be applied to all Portland cement concrete surfaces when there is a contract item for the work or when the work is required in these special provisions. The asphaltic emulsion for tack coat shall be grade SS-1, SS-1h, CSS-1 or CSS-1h and shall conform to the provisions in Section 94, "Asphaltic Emulsions," of the Standard Specifications. The asphaltic emulsion shall be mixed in the proportion of one part of emulsion (which contains up to 43 percent water) to 3 parts water. The mixture shall be applied at the approximate rate of 0.04 – 0.08 gal/yd<sup>2</sup>. When asphaltic emulsion is used as a tack coat, micro surfacing shall not be placed until the asphaltic emulsion has cured.

### **PLACING**

The micro surfacing mixture shall be uniformly spread on the existing surface within the rate specified without spotting, re-handling or otherwise shifting of the mixture.

The micro surfacing mixture shall not be placed when the ambient temperature is below 50 °F or during unsuitable weather. Micro surfacing shall not be placed if rain is imminent or if there is the possibility that there will be freezing temperatures within 24 hours.

When wheel path depressions have a cross section that is deformed ½ inch or more, the individual wheel

paths shall first be filled with micro surfacing utilizing a wheel path depression (rut) box in conformance with the provisions of the special provisions. The depth of the wheel path depression shall be determined after the adjacent ridges have been removed, when applicable. The maximum single application for wheel path depressions shall be one inch. Wheel path depressions of depths greater than one inch shall require multiple applications in each depression.

Wheel path depression repair shall be constructed with a slight crown to allow for initial compaction by traffic on the micro surfacing.

Freshly filled wheel path depressions shall be compacted by traffic for a minimum of 12 hours before additional lifts of micro surfacing material are placed for rut filling purposes or as surface courses.

Micro surfacing shall be spread at a rate within the following ranges of pound of dry aggregate per square yard:

<b>Micro Surfacing Type</b>	<b>Location</b>	<b>Spread Rate (lbs. agg./sq.yd.)</b>
Type II	Full Traffic Width	12-20
Type III	Full Traffic Width	20-30

Longitudinal joints shall correspond with the edges of the traffic lanes. The Engineer may permit other patterns of longitudinal joints if the patterns will not adversely affect the quality of the finished product.

Through traffic lanes shall be spread in full lane widths only. Longitudinal joints common to 2 traffic lanes shall be (butt joints) with overlaps not to exceed 3 inches. Building paper shall be placed at the transverse joints to avoid double placement of the micro surfacing. Other suitable methods to avoid double placement of the micro surfacing will be allowed. Hand tools shall be available to remove spillage.

The mixture shall be uniform and homogeneous after placing on the surfacing and shall not show separation of the PMCQS-1h and aggregate after setting. The completed surface shall be of uniform texture and free from ruts, humps, depressions, or irregularities.

Adequate means shall be provided to protect the micro surfacing from damage by traffic until such time that the mixture has cured sufficiently so that the micro surfacing will not adhere to or be picked up by the tires of vehicles.

When placing multiple layers of micro surfacing (excluding wheel path depressions) the second layer shall not be placed until the following day or later.

After the initial break of the micro surfacing and within a minimum of 2 hours after placement the micro surfacing shall be rolled with a pneumatic tire roller meeting the following requirements:

1. 9.3 tons minimum weight
2. The roller shall be equipped with 7 total wheels, 4 in the rear and 3 in the front of the roller.

The roller shall make a minimum of three passes on the surface.

Placement of the micro surfacing shall cease a minimum of one hour before the expiration of the road closure hours as specified in "Maintaining Traffic" of these special provisions, unless the Contractor proves to the satisfaction of the Engineer that the surface will be ready for unrestricted traffic at the expiration of the road closure hours.

### **TEST STRIP**

The Contractor shall construct a test strip for evaluation by the Engineer. The test strip shall be 300 feet to 500 feet long and shall consist of the application courses specified. The test strip shall be constructed at the same time of day or night that the full production of micro surfacing will be placed and may be constructed in 2 days or nights when multiple course applications are specified.

The Engineer will evaluate the completed test strip after 12 hours of traffic on the completed test strip to determine if the mix design and placement procedure are acceptable. If the mix design or the placement procedure is determined by the Engineer to be unacceptable, the test strip will be rejected, the Contractor shall make modifications, and a new test strip shall be constructed and evaluated by the Engineer. The cost of materials and placement of the test strips, which have been rejected, shall be borne by the Contractor and will not be considered as part of the contract work. If ordered by the Engineer, rejected test strips shall be removed at the Contractor's expense. If approved by the Engineer, the Contractor may continue with production work after placement of the test strip at his own risk. If the test strip is rejected, all production work shall be stopped and evaluated by the Engineer. The production work will be evaluated in the same manner as the placement of the test strip and shall conform to the same requirements for the test strip material.

### **REPAIR OF EARLY DISTRESS**

If bleeding, raveling, delamination, rutting, or wash boarding occurs within 60 days after placing the micro surfacing, the Contractor shall diligently pursue repairs by any method approved by the Engineer. The Contractor shall not be relieved from maintenance until repairs have been completed.

### **MEASUREMENT**

Micro surfacing will be measured by the square yard placed or by the tons of dry aggregate, whichever is specified by the bid item(s).

Quantities of asphaltic emulsion for paint binder (tack coat), to be paid for as contract items of work, will be determined in accordance with the methods provided in Section 94, "Asphaltic Emulsions," of the Standard Specifications.

### **PAYMENT**

The contract price paid per square yard or tons, whichever is specified by the bid item(s), for micro surfacing shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in placing micro surfacing, complete in place, including testing for and furnishing mix design, cleaning the surface, furnishing added water and set-control additives, and protecting the micro surfacing until it has set, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

When there is a contract item for asphaltic emulsion tack coat, the quantity of asphaltic emulsion used as tack coat will be paid for at the contract price per ton for asphaltic emulsion tack coat. When there is no contract item for asphaltic emulsion (paint binder), full compensation for furnishing and applying tack coat shall be paid for by "Extra Work Force Account".