ITEM 421 MICROSURFACING

421.01 Description. This work consists of constructing a cold laid polymer modified emulsified asphalt pavement course to fill ruts or provide a leveling and/or surface course for existing pavements. The paving mixture is composed of a polymer modified emulsified asphalt binder, crushed aggregate, mineral filler, water, and other additives.

421.02 Materials. Use a polymer modified emulsified asphalt binder (Binder) consisting of the following materials milled together:

A. Natural SBR latex modifier or a synthetic SBR latex modifier conforming to 702.14. Use only one type of latex.

B. CSS-1h or CSS-1m (as required below) emulsified asphalt conforming to 702.04, except the cement-mixing test is waived. Use only emulsion certified per City Supplement 1032.

C. Other emulsifiers.

Use CSS-1mL (as defined below) if the project ADTT is less than 2000, otherwise use CSS-1hL (as defined below). Do not use port addition of the polymer to the emulsified asphalt. Provide to the Engineer certified test data and a statement from the Binder manufacturer with each load of Binder that the Binder is the same formulation as used in the mix design. Ensure the Binder meets one of the following.

CSS-1hL: Combine CSS-1h and SBR latex modified (L) to yield 3 percent SBR solids based on the weight of the asphalt binder content of the Binder. Ensure that the SBR latex modified residue conforms to the following requirements:

Test	Description	Specification
AASHTO T 59 (Note 1)	Residue	62 %
AASHTO T 53	Softening Point	60 °C minimum
AASHTO T 202	Absolute Viscosity @ 60 °C	8000 poise minimum

Note 1 - 24 hours at 77 °F (25 °C) in forced draft oven

CSS-1mL: Combine CSS-1m and SBR latex modifier (L) to meet the following properties.

Tests on emulsion, ASTM D 244, unless otherwise designated:	
Viscosity, Saybolt Furol, ASTM D 88, at 25 °C (sec)	20 to 100
Storage Stability Tests, 24-hr (% difference)	1 maximum
Particle Charge Tests	Positive
Sieve Tests (%) (Distilled Water)	0.10 maximum
Distillation to 260 °C, % by Weight, Residue, min[1]	62
Tests on distillation residue:	
Penetration, 25 °C, 100 g, 5 sec (dmm) ASTM D 5	70 to 90
Ductility, 4 °C 5 cm/min, ASTM D 113	40 minimum
Elastic Recovery, 4 °C, 10 cm (%)[2]	65 minimum
Softening Point, Ring & Ball (°C) ASTM D 36	60 minimum

[1] ASTM D 244, with modifications to include a 400 °F ± 10 °F (204 °C ± 6 °C) maximum temperature to be held for 15 minutes.

[2] Straight molds. Hold at test temperature for 90 minutes. Place in ductilometer and elongate 10 cm at 5 cm/min. Hold for 5 minutes and cut. After 1 hour retract the broken ends to touch and measure the elongation (X) in centimeters. Use the following formula to calculate the elastic recovery:

$$\text{Elastic Recovery(percent)} = \left(\frac{10 - X}{10}\right) \times 100$$

Conform to 703.01 and 703.05 for aggregate, except as follows:

Percent by weight of fractured pieces	100
Sand Equivalence (ASTM D 2419)	45 minimum

Conform to Gradation A for the aggregate for leveling and surface courses and to Gradation B for the aggregate for rut fill courses according to the following:

Sieve Size	Total Percent Passing	
	A	**B**
3/8 inch (9.50 mm)	100	100
No. 4 (4.75 mm)	85 to 100	70 to 90
No. 8 (2.36 mm)	50 to 80	45 to 70
No. 16 (1.18 mm)	40 to 65	28 to 50
No. 30 (600 µm)	25 to 45	19 to 34
No. 50 (300 µm)	13 to 25	12 to 25
No. 100 (150 µm)	--	7 to 18
No. 200 (75 µm)	5 to 15	5 to 18

Screen the aggregate for oversize material prior to use. For mineral filler, use portland cement conforming to ASTM C 150, Type I. Use water conforming to 499.02. Use mix set additives as required.

421.03 Proportioning. Provide a mix design that has current ODOT approval. Where one does not exist, submit to the Laboratory a sample of the Binder to be used and a complete mix design prepared by an approved laboratory. Verify the compatibility of the aggregate, Binder, mineral filler, and other additives. Make the mix design with the same materials that will be used on the Project.

Ensure that the mix design:

A. Has aggregate meeting the gradation specified.

B. Has a residual asphalt by dry weight of aggregate of 7.0 to 8.5 percent for leveling and surface courses or 6.5 to 8.0 percent for rut fill courses.

C. Has a mineral filler content of 0.25 to 3.5 percent by dry weight of aggregate.

D. Meets the specified properties of the following International Slurry Seal Association (ISSA) tests:

ISSA Test No.	Description	Specification
TB-139 (1-90)	Wet Cohesion	
	30 minutes min. (set time)	12 kg-cm min.
	60 minutes min. (traffic)	20 kg-cm min or near spin
TB-114 (1-90)	Wet Stripping	90 percent min.
TB-100 (90)	Wet Track Abrasion Loss 1-hour soak 6 day soak	 450 g/m^2 max. 650 g/m^2 max.
TB-144 (2-89)	Saturated Abrasion Compatibility	3 g loss max.
TB-113 (1-90)	Mix Time @ 25 °C	Controllable to 120 seconds
	Mix Time @ 40 °C	Controllable to 35 seconds

Check the ISSA TB-139 (set time) and ISSA TB-113 (mix time) tests at the highest temperature expected during construction. For the ISSA TB-113 test at 104 °F (40 °C), preheat all ingredients and containers.

Ensure that the final mix design states the following (all percentages are based on the dry weight of the aggregate):

A. Source of each individual material.

B. Aggregate gradation.

C. Percentage of aggregate.

D. Sand equivalence of the aggregate.

E. Percentage of mineral filler (minimum and maximum).

F. Percentage of water (minimum and maximum).

G. Percentage of mix set additives (if required).

H. Percentage of Binder and type.

I. Quantitative effects of moisture content on the unit weight of the aggregate.

421.04 Weather Limitations. Apply the mixture only when it is not raining and the existing pavement surface temperature is a minimum of 40 °F (5 °C) and there is no forecast of an atmospheric temperature below 32 °F (0 °C) within 24 hours from the time the mixture is applied. Between September 30 and May 1, do not apply the mixture if the existing pavement surface temperature is less than 50 °F (10 °C).

421.05 Mixing Equipment. Produce the mixture in a self-propelled, front feed, continuous loading mixing machine equipped with a conveyer belt aggregate delivery system and an interconnected positive displacement, water jacketed gear pump to accurately proportion aggregate and asphalt emulsion. Locate the mineral filler feed so the proper amount of mineral filler is dropped on the aggregate before discharge into the pugmill. Provide a spray bar to completely pre-wet the aggregate dropping down to the pugmill with additive and water before introduction of asphalt emulsion. The twin-shaft, multi-blade pugmill will be a continuous flow type and minimum of 49 inches (1.25 m) long. Ensure that the blade size and side clearances meet the equipment manufacturer's recommendations. Introduce the emulsion within the first one-third of the mixer length to ensure proper mixing of all materials before exit from the pugmill.

Equip the machine with opposite side driving stations to allow full control of the machine from either side. Equip the mixer with a remote forward speed control at the back mixing platform so the back operator can control forward speed and level of mixture in the paving or rut box. Provide material control devices that are readily accessible and positioned so the amount of each material used can be determined at any time.

Equip the mixing machine with a water pressure system and nozzle type spray bar to provide a water spray ahead of and outside the spreader box when required. Apply water at a rate that will dampen the surface, but will not create free flowing water ahead of the spreader box.

The Contractor may use truck-mounted machines with a conveyer belt aggregate delivery system and without the front feed, continuous loading feature on project segments of less than 15,500 square yards (13,000 m^2) or on spot repairs.

421.06 Equipment Calibration. Before mix production, calibrate the mixing equipment in the presence of the Engineer. Generate documentation for the Engineer, including individual calibrations of each material at various settings. Perform a new calibration if there is any change in the mix design. Supply all of the equipment, materials, and scales necessary to perform the calibration. Following calibration and adjustments for changes in the mix design, do not make any further calibration adjustments to the mixing equipment without the Engineer's approval.

421.07 Spreading Equipment. If a leveling or surface course is specified, apply the mixture uniformly by means of a conventional spreader box.

If a rut fill course is specified, apply the mixture with a V-shaped rut filling spreader box. Equip the rut filling spreader box with a steel strike-off.

Attach either type of spreader box to the mixer and equip it with paddles mounted on an adjustable shaft to continually agitate and distribute the materials throughout the box. Ensure that the equipment provides sufficient turbulence to prevent the mix from setting in the box or causing excessive side build-up or lumps. To prevent loss of the mixture from the box, attach flexible seals, front and rear, in contact with the road. Operate the spreading equipment in such a manner as to prevent the loss of the mixture on super-elevated curves.

For surface courses, attach a secondary strike-off to the spreader.

The Contractor may use burlap drags or other drags, if necessary, to obtain the desired finish. Replace drags having excessive build-up.

421.08 Surface Preparation. Before applying the mixture, thoroughly clean the surface.

Apply a tack coat conforming to Item 407, consisting of one part asphalt emulsion and three parts water. Apply the tack coat at a rate of 0.06 to 0.12 gallon per square yard (0.25 to 0.45 L/m^2).

Remove raised pavement markers according to 621.08. The Contractor may fill the depression caused by the removal of the casting with material meeting this specification.

Remove any existing longitudinal pavement markings 740.03 (polyester), 740.04 (thermoplastic) and 740.07 (epoxy) using an abrasion method conforming to 641.10. Protect drainage structures, monument boxes, water valves, and similar structures during material application.

421.09 Test Strip. Construct a test strip for the Engineer to evaluate. Construct this test strip 1000 feet (300 m) long, and include all of the application courses specified. Construct the test strip at the same time of day or night the full production will be applied. The Contractor may construct the test strip in 2 days or nights if multiple course applications are specified.

The Engineer will evaluate the completed test strip after 24 hours of traffic to determine if the mix design is acceptable. The Contractor may begin full production after the Engineer accepts the test strip.

If the microsurfacing is not being applied between September 30 and May 1, the City will waive the test strip if the Contractor has constructed a City approved test strip this construction season with the same materials and mix design.

421.10 Application. Apply the paving mixture in a manner to fill cracks, shallow potholes, and minor surface irregularities and achieve a uniform surface without causing skips, lumps, or tears. Carry a sufficient amount of material at all times in all parts of the spreader box to ensure complete coverage. Avoid overloading of the spreader box. Do not allow lumping, balling, or unmixed aggregate in the spreader box.

If a rut fill course is specified, apply enough material to fill the wheel paths without excess crowning (overfilling). An excess crown is defined as 1/8 inch (3 mm) after 24 hours of traffic compaction. Apply rut fill courses in widths from 5 to 6 feet (1.5 to 1.8 m) for each wheel path. Provide a smooth, neat seam where two rut fill passes meet. Take care to restore the designed profile of the pavement cross-section. Feather the edges of the rut fill course to minimize the use of excess material.

If a leveling course is specified, apply the paving mixture at 14 ± 2 pounds per square yard (7.6 ± 1.1 kg/m^2).

If a surface course is specified and it is placed on another microsurfacing course, apply the paving mixture at 16 ± 1 pounds per square yard (8.7 ± 0.6 kg/m^2). If a surface course is specified and it is not placed on another microsurfacing course, apply the paving mixture at a minimum of 18 pounds per square yard (9.8 kg/m^2).

For leveling and surface courses, provide a smooth, neat seam of 1 to 3 inches (25 to 75 mm) where two passes meet. Immediately remove excess material from the ends of each run.

Construct surface courses wide enough to cover the outside edges of rut fill and leveling courses. Maintain straight edge lines along curbs and shoulders. Do not allow runoff of these areas. Ensure that lines at intersections are straight.

Use squeegees and lutes to spread the mixture in areas inaccessible to the spreader box and areas requiring hand spreading. The Contractor may adjust the mix set additive to provide a slower setting time if hand spreading is needed. Do not adjust the water content to adjust the setting time. If hand spreading, pour the mixture in a small windrow along one edge of the surface to be covered and spread it uniformly by a hand squeegee or lute.

Ensure that the microsurfacing cures at a rate that will permit traffic on the pavement within 1 hour after application without damaging the pavement surface. However, should the Contractor have concerns about adequate cure, work out an arrangement agreeable to the Engineer before releasing traffic on the pavement.

If there is an excessive streaking problem created by high amounts of oversize material in the mix, stop applying the mixture and take steps to correct the streaking problem. Do not resume work until the Engineer is satisfied the problem has been corrected.

If a section of pavement is not going to be exposed to traffic within 48 hours, compact it with a pneumatic tire roller after curing. Use a pneumatic tire roller conforming to 401.13, and inflate the tire pressure to 40 to 60 pounds per square inch (275 to 400 kPa).

421.11 Acceptance. Maintain continuous control of the Binder to dry aggregate proportioning to conform to the approved mix design within a tolerance of ±2 gallons per ton (±8.5 L/metric ton). Control the spread rate to not less than the specified quantity of aggregate per square yard (square meter) on a dry weight basis.

The Engineer will base acceptance of the Binder to dry aggregate proportion and spread rate on the Engineer’s summary of quantities used each day. The Engineer will approve and accept a day’s application of microsurfacing provided:

A. The Engineer’s summary indicates conformance with the above control requirements for proportioning and spread rate and

B. The pavement is free from excessive scratch marks, tears, rippling and other surface irregularities, longitudinal joints and lane edges coincide with any lane lines, and edge lines and transverse joints are uniform, neat and provide a smooth transition.

The spread rate requirement does not apply to rut fill courses if the Contractor filled the wheel paths according to this specification.

421.12 Method of Measurement. The City will measure Microsurfacing, Surface Course and Microsurfacing, Leveling Course by the number of square yards (square meters), complete and accepted in place. The City will base the width of the pavement course on the width shown on the plans, specified in this specification, or directed by the

Engineer. The City will measure the length along the centerline of each roadway or ramp.

The City will measure the number of raised pavement markers removed.

The City will measure Microsurfacing, Rut Fill Course by the number of tons (metric tons) of dry aggregate used, complete and accepted in place. The City will base the weight of the dry aggregate used on the ticket net weight of individual loads from an approved scale.

421.13 Basis of Payment. The cost of tack coat is incidental to Microsurfacing.

The cost of any removal of any existing longitudinal pavement markings according to 421.08 is incidental to Microsurfacing.

The City will pay for removal of existing raised pavement markers according to Item 621 Raised Pavement Markers Removed.

The City will pay for the construction of accepted test strips at the individual bid prices for the courses constructed.

The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
421	Square Yard (Square Meter)	Microsurfacing, Surface Course
421	Square Yard (Square Meter)	Microsurfacing, Leveling Course
421	Ton (Metric Ton)	Microsurfacing, Rut Fill Course