INDEX TO CLAUSES

PART 1 – GENERAL

This section specifies the requirements for polymer modified micro-surfacing.

This standard does not address any safety concerns related to the use of its contents. It is the responsibility of the user of this specification to establish appropriate safe work practices applicable to the work detailed within.

1.1 Work Included

.1 The reference to micro-surfacing shall be understood to include both surface and scratch course application unless otherwise specified.

.2 Micro-surfacing shall consist of thoroughly cleaning the existing surface, applying a homogeneous proportioned mixture of cationic polymer modified emulsified asphalt, high quality mineral aggregate, mineral filler, water and other additives to the existing pavement surface.

.3 Those materials which are not specified and/or indicated but are necessary for the complete installation of the work shall be deemed the responsibility of the Contractor and shall be included at no extra cost to HRM.

1.2 Related Sections

The latest editions of the following shall apply to this specification.

.1	Specification for Hot Mix Asphaltic Concrete	S-1
.2	Specification for Performance Graded Asphalt Binder	S-2
.3	Pavement Markings	S-4

1.3 Reference Standards

The latest editions of all the following references shall apply to this specification.

.1 AASHTO T304, Standard Test Method for Uncompacted Void Content of Fine Aggregate

.2 ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

.3 ASTM C127, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate

.4 ASTM C128, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate

.5 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

.6 ASTM D36, Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)

.7 ASTM D75, Standard Practice for Sampling Aggregates

.8 ASTM D242, Standard Specification for Mineral Filler For Bituminous Paving Mixtures

.9 ASTM D546, Standard Test Method for Sieve Analysis of Mineral Filler for Asphalt Paving Mixtures

.10 ASTM D2170, Standard Test Method for Kinematic Viscosity of Asphalts

.11 ASTM D2397, Standard Specification for Cationic Emulsified Asphalt

.12 ASTM D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate

.13 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

.14 ASTM D4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

.15 ASTM D6928, Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

.16 ASTM D6930, Standard Test Method for Settlement and Storage Stability of Emulsified Asphalts

.17 ASTM D6997, Standard Test Method for Distillation of Emulsified Asphalt

.18 ASTM D7428, Standard Test Method for Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

.19 ISSA TB-139, Classify Emulsified Asphalt/Aggregate Mixture Systems by Modified Cohesion Tester Measurement of Set and Cure Characteristics

.20 ISSA TB-114, Wet Stripping Test for Cured Slurry Seal Mix

.21 ISSA TB-100, Wet Track Abrasion of Slurry Surfaces

.22 ISSA TB-147, Measurement of Stability and Resistance to Compaction, Vertical and Lateral Displacement of Multi-layered Fine Aggregate Cold Mixes - Method A

.23 ISSA TB-109, Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded Wheel Tester and Sand Cushion

.24 ISSA TB-113, Trial Mix Procedure for Slurry Seal Design

.25 ISSA TB-144, Classification of Aggregate Filler - Bitumen Compatibility by Schulze-Breuer and Ruck Procedures

.26 NSTIR TM-2, The Petrographic Analysis of Coarse Aggregate

.27 NSTIR TM-3, Determination of Percent Fractured Particles in Processed Coarse Aggregates

1.4 Codes, Bylaws, Ordinances and Regulations

.1 All work covered by this section shall be performed according to applicable Halifax Regional Municipality Codes, bylaws, Ordinances, and Regulations.

.2 Nova Scotia Department of Public Works “Temporary Work Place Traffic Control Manual” (latest revision).

.3 HRM Traffic Control Manual Supplement (latest edition).

1.5 Quality Control

.1 Quality Control (QC) testing is the responsibility of the Contractor throughout every stage of the work from and including the production of the aggregates and polymer modified asphalt emulsion to the design and placement of the final product.

.2 In the Contractor QMP prepared per Section S-1, the Contractor shall include details regarding micro-surfacing placement methods to be used and QC testing methods and frequency, unless stated otherwise by the Engineer.

.3 The Contractor shall provide the Engineer with a copy of all QC test results within 24 hours of testing.

1.6 Quality Assurance

.1 During the progress of the work, Quality Assurance (QA) testing may be conducted by the Engineer or their representative to ensure compliance with the specifications.

.2 Sampling for all QA testing shall be carried out by the Contractor, under observation by the Engineer. Labelling of the samples obtained shall be the responsibility of the Engineer.

.3 Results of the QA testing shall be available to the Contractor.

.4 QA testing performed by the Engineer or their representative shall not be considered QC testing.

PART 2 - PRODUCTS

2.1 General

.1 No recycled or other waste materials shall be permitted in the micro-surfacing material.

2.2 Polymer Modified Emulsified Asphalt (Binder)

.1 The binder shall be a polymer modified cationic type CQS-1HP emulsion.

.2 The polymer modified emulsified asphalt shall be homogeneous after mixing and show no signs of separation within 14 days of delivery. The addition of polymers or other additives after the manufacturing of the emulsified asphalt shall not be permitted.

.3 The emulsified asphalt shall conform to the requirements of ASTM D2397 for CQS-1HP emulsion, with the amendments listed in Table 1 below.

Table 1 - Amendments to ASTM D2397

Test Method	Property	Requirements
ASTM D6997	Residue by Distillation	62% minimum
ASTM D6930	Settlement and Storage Stability of Emulsified Asphalt, 24 hr.	1% maximum
	Tests on Residue	
ASTM D36	Softening Point	57°C minimum
ASTM D2170	Kinematic Viscosity @ 135°C	650 mm²/s minimum

2.3 Aggregates

.1 The aggregates shall consist of 100% crushed, quarried rock material, meeting the physical properties provided in Table 2 below.

Table 2 – Aggregate Physical Properties[1]		
Test Method	**Property**	**Requirements**
Coarse Aggregate		
ASTM C127	Absorption	< 1.75
NSTIR TM-2	Petrographic Number	≤ 120
NSTIR TM-3	% Fracture Particles – Two Face	100
ASTM D4791	Flat or Elongated Particles 5:1	< 10
ASTM D6928	Micro Deval	< 15
ASTM C88	Aggregate Soundness[2]	< 15
Fine Aggregate		
ASTM C128	Absorption	< 2.0
AASHTO T304(A)	Angularity	≥ 45.0
ASTM D2419	Sand Equivalency	≥ 65
ASTM D7428	Fine Aggregate Micro-Deval	< 20
ASTM C88	Aggregate Soundness[2]	< 10
ASTM D4318	Plasticity Index	0 (Non-Plastic)

(1) Applies to individual aggregate sources.
(2) Test to be conducted utilizing Sodium Sulphate ($NaSO_4$)

.2 The aggregate gradation shall conform to the requirements for Type II and Type III M provided below in Table 3.

.3 The aggregate stockpile shall be within the specified tolerances. The Engineer reserves the right to sample aggregate stockpiles to ensure the gradation conforms to the specifications.

.4 Type III M modified shall be used on all streets except for low volume residential streets.

Table 3 – Aggregate Gradation		
Sieve	**Type II**	**Type III M**
9.5 mm	100	100
6.7 mm	---	95-100
4.75 mm	90-100	80-95
2.36 mm	65-90	50-75
1.18 mm	45-70	33-55
600 µm	30-50	25-40
300 µm	18-30	15-30
150 µm	10-21	7-20
75 µm	5-15	5-15

2.4 Mineral Filler .1 The requirement for use of mineral filler, to a maximum of 3% and meeting the requirements of ASTM D242, shall be determined by the mix design.

2.5 Water .1 The water shall be potable and shall be free of harmful salts and contaminants.

2.6 Polymer Modifier .1 The polymer solids shall be milled or blended into the emulsifier solution prior to the emulsification process.

.2 The polymer modifier shall consist of a minimum of 3% polymer solids by mass of asphalt residue.

2.7 Additives .1 Additives may be added to the emulsion mix during construction to provide control of the quick-set properties and increase of adhesion. They shall be included in the mix design and compatible with the other components of the micro-surfacing.

2.8 Tack Coat .1 On Local roads the Contractor is required to use non-tracking emulsion based tack, except when paving at temperatures below 5°C, in which case conventional RS-1 tack shall be used. The requirements of the non-tracking emulsion tack coat prior to dilution, are shown in Table 4.

Table 4 - Local Roads Tack Coat Requirements Non-Tracking Emulsion Requirements (Prior to Dilution)		
Test Type	**Specification Range**	
	Minimum	**Maximum**
Test on Emulsion		
SF Viscosity, 25°C, SFs	20	
Sieve Test		0.1
Dist. Residue	55	
Oil Portion of Dist., %		Trace
Settlement, 5 days, %	-	3
Demulsibility, 35 ml, 0.02 N $CaCl_2$, %	60	
Particle Charge	(-) or (+)	
Test on Residue		
Penetration, 25°C, dmm	20	55
Ash Content, %		1.0

*Non-tracking tack can be used on all other road classifications

On Minor/Major Collectors and Arterials the Contractor is required to use Rapid Setting Emulsified Asphalt (RS-1) as tack coat. The requirements for RS-1 are shown in Table 5.

Table 5 - Minor/Major Collectors and Arterials Tack Coat Requirements Rapid Setting Emulsified Asphalt (RS-1) Requirements		
Test Type	**Specification Range**	
	Minimum	**Maximum**
Test on Emulsion		
SF Viscosity, 25°C, SFs	20	100
Dist. Residue	55	
Settlement, 5 days, %		3.0
Storage Stability, %		1.5
Sieve Test, %		0.1
Demulsibility, %	60	
Particle Charge	Negative	
Test on Residue		
Penetration, 0.1 mm	100	200
Ductility, cm	60	
Solubility, %	97.5	

2.9 Mix Design

.1 The Contractor shall designate the mix proportions and prepare the mix design.

.2 The aggregate and the polymer modified emulsified asphalt shall be assessed to confirm compatibility. The Contractor shall supply the results of the physical tests for the aggregate.

.3 All component materials used in the mix design shall be representative of the material proposed by the Contractor for use on the contract.

.4 The Contractor shall submit to the Engineer the mix design and the results of the tests listed in Table 6. The material shall not be placed until the Engineer has received and approved the mix design. The mix proportions shall be within the following limits:

Table 6 - Micro-Surfacing Mix Properties

Residual Asphalt		6.0% - 11.5% by dry mass
Mineral Filler		0.0% - 3.0%
Test	**Property**	**Requirements**
ISSA TB-139	Wet Cohesion	-
	@ 30 minutes min. (set)	12 kg-cm minimum
	@ 60 minutes min. (traffic)	20 kg-cm minimum
ISSA TB-114	Wet Stripping	Pass (90% min.)
ISSA TB-100	Wet Track Abrasion Loss	-
	One Hour Soak	538 g/m² maximum
	Six Day Soak	807 g/m² maximum
ISSA TB-147	Lateral Displacement	5% maximum
	Specific Gravity after 1,000 Cycles of 56.7 kg	2.1 maximum
ISSA TB-109	Excess Asphalt by LWT Sand Adhesion	538 g/m² maximum
ISSA TB-113	Mix Time @ 25ºC	Controllable to 120 sec min.
ISSA TB-144	Classification Compatibility	11 Grade Points Minimum (AAA, BAA)

.5 The micro-surfacing shall be designed so that traffic can be allowed on the surface within one hour.

2.10 Equipment

.1 Rotary Power Brooms shall be capable of cleaning gravel, sand, dirt and other debris from bituminous surfaces.

.2 Mixing Equipment shall be specifically designed and manufactured to place micro-surfacing. The material shall be mixed by an automatic sequenced, self-propelled micro

surfacing mixing machine, which shall be a continuous flow mixing unit, able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive, and water to a revolving multi-blade double shaft mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, control additive and water to maintain an adequate supply to the proportioning controls.

.3 Proportioning Devices shall have individual volume or weight controls for proportioning each material to be added to the mix (i.e. aggregate, mineral filler, emulsified asphalt, additive, and water) shall be provided and properly marked. These proportioning devices are usually revolution counters or similar devices and are used in material calibration and determining the material output at any time.

.4 Calibration of Proportioning Devices – Prior to beginning placement of micro-surfacing on this contract, the Proportioning Devices shall be calibrated to the satisfaction of the Engineer. The Engineer shall be notified 24 hours prior to calibration occurring. A copy of the results of the calibration must be given to the Engineer prior to any micro-surfacing operation.

.5 Re-Calibration of Proportioning Devices. Over the duration of the work, the Proportioning Devices shall be re-calibrated, to the satisfaction of the Engineer, should the following occur:

.1 After every 2000 tonne of aggregate placed throughout the duration of the contract.
.2 A change in the source of aggregate from that used in the previous calibration.
.3 Mechanical failure to the application system and/or Proportioning Devices in which repair is required.

.6 Spreading Equipment shall be used to apply the mixture. The mixture shall be spread uniformly by means of a conventional surfacing spreader box, including an auger, attached to the mixing machine and equipped with paddles to agitate and spread the material evenly throughout the box. A front seal shall be provided to ensure no loss of the mixture at the pavement contact point. The rear seal shall act as final strike-off and shall be adjustable. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved to produce a free flow of material to the rear strike-off. The spreader box shall have suitable means provided to manoeuvre the box to

compensate for variations in the pavement geometry. The rut filling spreader box shall be specifically designed for rut filling applications. Rear strike-off bar shall be one piece of rigid steel or metal (scratch course only). The spreading equipment shall be capable of being re-supplied with the micro-surfacing materials within the working lane to continuously place micro-surfacing for a minimum 2-lane-km distance. The machine shall be equipped to allow the operator to have full control of the forward and reverse speeds during application of the micro-surfacing.

.7 A 3 m straightedge shall be available that may be used to check for crossfall.

.8 A stringline or other device must be provided to ensure the longitudinal edges are straight and meet the existing pavement edge or as directed by the Engineer.

PART 3 - EXECUTION

3.1 General

.1 Location and dimensions as indicated on drawings or as directed by the Engineer.

3.2 Trial Area

.1 The Contractor shall place a trial area 100 m in length for the commencement of the micro-surfacing operation, one lane width, to demonstrate the ability to produce micro-surfacing in conformance with this specification. If the trial area meets the requirements of this specification, acceptance shall be provided by the Engineer within 1 hour of completion. The Contractor shall remove and replace any damaged or unsatisfactory micro-surfacing at no cost to HRM. The location of the trial area shall be approved by the Engineer.

3.3 Placement/ Weather Limitations

.1 Micro-surfacing shall not be applied, if either the pavement or air temperature is below 10ºC and falling but may be applied when both pavement and air temperature are above 7ºC and rising. No micro-surfacing shall be applied when it is foggy or when there is precipitation occurring. No micro-surfacing shall be applied when there is danger that the finished product will freeze before 24 hours. The mixture shall not be applied when weather conditions prolong opening to traffic beyond a reasonable time.

3.4 Surface Preparation

.1 Immediately prior to applying the micro-surfacing, the area to be surfaced shall be thoroughly cleaned of all vegetation, loose material, sand, dirt and other debris. Dried mud or other foreign matter, which cannot be removed with the

rotary power broom, shall be removed by hand blade or other approved method.

.2 Existing crack sealing material shall be removed.

.3 Existing pavement markings shall be removed.

.4 Water, if required, shall be applied to pre-wet the surface immediately ahead of the spreader at a rate to dampen the surface without allowing any freestanding or free flowing water. If water is used, cracks shall be allowed to dry thoroughly before applying micro-surfacing.

.5 Manholes, valve boxes, drop inlets and other service entrances shall be protected from the micro-surfacing by a suitable method, as approved by the Engineer.

.6 Tack coat shall be applied at a rate of 0.25 to 0.40 L/m^2. The tack coat should be allowed to cure prior to placement of micro-surfacing.

3.5 Application

.1 The mixture shall be spread to fill cracks and shallow potholes and leave a uniform surface. The application shall consist of a minimum of a scratch coat and a final coat with a rate of application for each layer meeting the requirements of Table 7. Additionally, the combined application rate for both layers shall be a minimum of 18 kg/m^2.

Table 7 – Micro-surfacing single layer application rates

Micro-surfacing Type	Application Rate (kg/m^2)
Type II	5 to 11
Type III M	8 to 16

.2 A sufficient amount of micro-surfacing mixture shall be carried in all parts of the spreader box at all times so that complete coverage is obtained. Spraying of additional water into the spreader box shall not be permitted.

.3 Overloading of the spreader box shall be avoided.

.4 No lumping, balling, or unmixed aggregate shall be permitted in the finished surface. No dry aggregate, either spilled from the lay-down machine or existing on the road, shall be permitted. Any oversized aggregate or foreign materials shall be screened from the aggregate prior to delivery to the mixing machine.

.5 Wheel track ruts of 13 mm or greater in depth shall be filled independently with micro-surfacing using a rut-filling spreader box prior to the application of the micro-surfacing scratch coat and final coat. Ruts greater than 25 mm shall be filled with micro-surfacing applied with two passes of the rut filling spreader box. All rut-filling material shall cure under traffic for at least a 24-hour period before additional material is applied. The minimum width of a rut filling micro-surfacing application shall be 1.5 m.

.6 Handwork – In restricted areas where hand spreading is necessary, slight adjustments to the mix formula may be used to delay the setting time. The mixture shall be poured into a small windrow along one edge of the surface to be covered. The mixture shall be spread uniformly with squeegees or other suitable hand tools. As much as possible, handwork shall exhibit the same finish as that applied by the spreader box. All handwork shall be completed prior to final surfacing.

.7 Appearance as follows:

.1 The finished micro-surfacing shall have a uniform texture free from excessive scratch marks, tears or other surface irregularities.

.8 Joints as follows:

.1 The longitudinal and transverse joints shall be neat and uniform in appearance. No excessive buildup, uncovered areas, non-homogeneous mixture or unsightly appearance shall be permitted on longitudinal or transverse joints.

.2 The longitudinal joints in the scratch course shall be constructed as a butt joint. The longitudinal joints in the surface course shall be placed on lane lines with less than 100 mm overlap on adjacent passes.

.3 Transverse joints shall be constructed with no more than 6 mm difference in elevation across the joint as measured with a 3 m straight edge.

.9 Rolling: The micro-surfacing shall be rolled unless otherwise directed by the Engineer.

.10 Mixture as follows:

.1 The micro-surfacing shall possess sufficient stability so that premature breaking of the material in the

spreader box does not occur. The mixture shall be homogeneous during and following mixing and spreading. It shall be free of excess liquids which create segregation of the aggregate. Spraying of additional water into the spreader box shall not be permitted.

.11 Defects as follows:

.1 Defects in the micro-surfacing will be classified as follows:

- Tear marks in any 12 m² per lane are considered excessive if there are: 1) four or more marks 12 mm wide or wider and 100 mm or more long; or 2) any marks 25 mm wide or wider and 25 mm or more long.
- Longitudinal ripples (raking) or wash-boarding (chatter), 5.0 mm deep, as measured with a 3 m straight edge or other irregularities that will affect the ride quality, with total area exceeding 2% in any 100 m^2 area.
- Total area exhibiting loss of surface (debonding, delamination, potholing) exceeding 2% in any 100 m^2 area.
- Total ruts > 6 mm deep, as measured with a 3-m straight edge, exceeding 2% base on 10 random samples per lane-km.
- Bleeding and flushing exceeding 2% in any 100 m² area.
- Bleeding and/or flushing at joints

.2 Generally, areas of delamination and flushing or bleeding surfaces shall be construed as failure; however, the Engineer shall be the sole judge as to the areas that must be re-treated.

.3 Any 400 m lane segment with repairs or defects exceeding 5% of the area shall require re-application of micro-surfacing over the entire segment.

.4 All deficient areas shall be repaired with additional application of micro-surfacing for the full lane width over the length of deficiency. If the distance between repair areas is less than 3 m, then the adjacent repairs shall be treated as one repair.

.5 Any part of completed micro-surfacing rejected for surface defects shall be repaired within 20 days from

the time the Contractor receives notification of rejection, but in no case later than the conclusion of the same construction year.

.6 If the 20 day period extends past the end of the construction year, the Contractor shall complete the repairs between June 1st and June 16th of the following construction year. All defects shall be repaired using micro-surfacing (this includes any repairs within the two-year warranty).

.7 The Contractor shall guarantee the Work against failure and defects, and shall hold the Owner blameless in all claims arising from the Work, any of which results from factors including, but not limited to poor workmanship, poor or incompatible materials, improper design of application rates, inadequate traffic control, and/or failing to practice proven micro-surfacing procedures.

.8 All work for reconstruction of unacceptable areas shall be at the Contractor's expense.

3.6 Temporary Pavement Markings

.1 Once the micro-surfacing application is capable of supporting traffic, temporary pavement markings shall be installed immediately.

3.7 Clean Up

.1 All areas, including shoulders and gutters, shall have the micro-surfacing mix removed as specified by the Engineer. The Contractor shall, on a daily basis, remove any debris associated with the performance of the work.

.2 Appurtenances shall be free of micro-surfacing and left in operable condition.

.3 After completion of the micro-surfacing, all areas such as gutters, sidewalks, and adjacent asphalt surfaces, shall be thoroughly cleaned of all loose material, sand, dirt and other debris.

.4 All hardware to be removed from site daily.

3.8 Protection of Work

.1 The Contractor shall be responsible for ensuring that the mixture is not damaged by traffic.

.2 Traffic, including construction traffic, shall be kept off the freshly placed mixture for whatever time is required to prevent damage to the surface and until premarking of traffic lines with paint is complete.

3.9 Testing .1 Straight Edges. A 3 m straight edge may be used to check for cross fall at the discretion of the Engineer.

.2 Stringline. A stringline or other device may be required to ensure the longitudinal edges are straight and meet the existing pavement edge or as directed by the Engineer.

3.10 Liability .1 During the period of construction and the two year maintenance period the Contractor shall be responsible for processing any and all claims for property damage and/or bodily injury caused by failure of the Micro-Surfacing including but not limited to motor vehicles or pedestrians. The contractor shall be responsible for the payment of all property damage and bodily injury claims and agrees to save and holds harmless Halifax Regional Municipality from all such claims.

PART 4 – MEASUREMENT FOR PAYMENT

4.1 General .1 Payment for all works carried out in accordance with this specification will be paid for per the payment items detailed in Section 01 22 00 Measurement and Payment, of the Contract.

****** End S-5 ******