



**CONSTRUCTION SPECIFICATION FOR
MICRO-SURFACING**

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336.01 SCOPE

This specification covers the requirements for micro-surfacing.

336.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 710 Pavement Marking

Ontario Provincial Standard Specifications, Material

OPSS 1001 Aggregates - General
OPSS 1003 Aggregates - Hot Mixed Asphalt
OPSS 1103 Emulsified Asphalt
OPSS 1301 Cementing Materials

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

- LS-601 Materials Finer than 75 μm Sieve in Mineral Aggregates by Washing
- LS-602 Sieve Analysis of Aggregates
- LS-609 Petrographic Analysis of Coarse Aggregate
- LS-625 Guidelines for Sampling of Granular Materials

Ontario Traffic Manual (OTM):

Book 7 - Temporary Conditions

- SP-024 Manual for Condition Rating of Flexible Pavements

International Slurry Surfacing Association (ISSA)

- TB-100-18 Test Method for Wet Track Abrasion of Slurry Surfaces
- TB-109-18 Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded Wheel Tester and Sand Adhesion
- TB-113-17 Trial Mix Procedure for Slurry Seal Design
- TB-114-17 Wet Stripping Test for Cured Slurry Seal Mix
- TB-139-17 Test Method to Classify Emulsified Asphalt/Aggregate Mixture Systems by Modified Cohesion Tester Measurement of Set and Cure Characteristics
- TB-144-13 Test Method for Classification of Aggregate Filler - Bitumen Compatibility by Schulze-Breuer and Ruck Procedures
- TB-147-08 Test Methods for Measurement of Stability and Resistance to Compaction, Vertical and Lateral Displacement of Multi-layered Fine Aggregate Cold Mixes - Method A

336.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Appurtenances mean maintenance holes, catch basins, valve chambers, and water valve covers and similar Utility access covers located within the paved portion of the roadway.

Double Application means a scratch coat placed on the existing pavement to form a uniform surface followed by a surface coat in a consistent thickness.

Micro-Surfacing means the application of a pavement surface composed of polymer-modified asphalt emulsion, high quality aggregate, mineral filler, and water.

Rut Filling means a layer of micro-surfacing placed on the existing pavement using a rut-filling box on the longitudinal wheel path rut.

Scratch Coat means a levelling layer of micro-surfacing mixture placed on the existing pavement prior to placing a surface coat.

Siliceous Aggregate means rock aggregate containing or composed of silica (SiO_2) or minerals with silica in the crystal structure as silicate (SiO_4).

Single Application means a single layer of micro-surfacing mixture placed on the existing pavement as a surface coat in a consistent thickness.

Surface Coat means a top layer of micro-surfacing mixture laid on a scratch coat or directly on the existing pavement.

336.04 DESIGN AND SUBMISSION REQUIREMENTS

336.04.01 Design Requirements

336.04.01.01 Mix Design

A laboratory equipped and staffed to carry out mix designs for micro-surfacing shall designate the mix proportions and prepare the job mix formula.

The compatibility of the aggregate and the polymer modified emulsified asphalt shall be confirmed by the laboratory designing the mix.

All component materials used in the mix design shall be representative of the material to be used on the Contract.

The mix design proportions shall be within the following limits.

Residual Asphalt: 6.0 to 11.5% by dry mass of aggregate
Mineral Filler: 0 to 3.0% by dry mass of aggregate

The micro-surfacing mixture shall be designed to carry traffic within one hour of placement.

336.04.02 Submission Requirements

336.04.02.01 Mix Design

Two weeks prior to the start of micro-surfacing, the mix design shall be submitted in writing to the Contract Administrator together with the results of the tests listed in Table 1.

Material for micro-surfacing shall only be placed after the Contract Administrator has issued confirmation in writing. The Contract Administrator shall review and issue the written confirmation within 5 Business Days that the mix design has been submitted and meets the specified requirements.

336.04.02.02 Submission of Test Data

The Contractor shall provide Quality Control (QC) test results of all aggregates and filler used in the Work from a laboratory meeting the requirements of the Laboratory Requirements clause. Test results showing complete conformance with the physical property requirements of this specification shall be provided to the Contract Administrator at the time of submission of the mix design.

QC test results shall be submitted using MTO forms as applicable.

Only aggregate sample test data obtained from stockpiled material to be used in the Work and tested within the past 14 months shall be submitted.

336.04.02.03 Laboratory Requirements

An acceptable laboratory conducting tests for physical properties or consensus properties shall be one that holds a certificate from the Canadian Council of Independent Laboratories (CCIL) as Type D for the applicable test methods and also participates in the annual MTO Proficiency Sample Testing Program.

An acceptable laboratory conducting tests for LS-601 and LS-602 shall be one that holds a valid certificate from CCIL as Type C. Testing for LS-601 and LS-602 shall be conducted by qualified laboratory staff who hold a valid certificate from CCIL in aggregate testing. Testing for LS-609 shall be conducted by a person holding a valid certificate from CCIL showing them qualified in petrographic examination.

Equivalent alternate laboratory and technician certifications or laboratory proficiency sample testing programs may be used to demonstrate similar requirements, provided they are acceptable to the Owner.

336.05 MATERIALS

336.05.01 Polymer Modified Emulsified Asphalt

The emulsified asphalt shall be CQS-1HP according to OPSS 1103.

The polymer modifier shall be a minimum of 3% polymer solids by mass of asphalt cement residue in the emulsion.

The emulsion shall be homogeneous after mixing. To facilitate sampling and testing, the emulsion shall be stable for 14 Days after delivery to the job site. The polymer material shall be milled or blended into the asphalt cement or blended into the emulsifier solution prior to the emulsification process. The addition of polymers or other additives after the manufacture of the polymer modified emulsified asphalt is not permitted.

336.05.02 Aggregates

Aggregates shall be according to OPSS 1001.

Aggregates shall meet the coarse and fine aggregate requirements of Table 2.

Aggregates shall meet the gradation requirements of Table 3.

336.05.03 Mineral Filler

Mineral filler shall be Portland cement Type GU according to OPSS 1301.

336.05.04 Water

The water shall be free from oil, acid, alkali, organic matter, or other deleterious substances.

336.05.05 Mix Additives

Additives shall be compatible with the other components of the micro-surfacing mix.

336.05.06 Tack Coat

Tack coat shall be the same polymer modified emulsified asphalt used in the micro-surfacing mix and diluted to 1 part emulsion to 3 parts water by volume.

336.06 EQUIPMENT

336.06.01 Mixing Equipment

The mixing equipment shall be specifically designed and manufactured to mix and place micro-surfacing mixture. The mixture shall be mixed by an automatic sequenced, self-propelled, continuous flow micro-surfacing mixing machine. The mixing machine shall be capable of accurately delivering and proportioning the aggregate, emulsified asphalt, mineral filler, additives, and water to a revolving multi-blade double shaft mixer and discharging the mixed product in a continuous flow. The mixing equipment shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, additives, and water to maintain an adequate supply to meet mix design proportions.

336.06.02 Proportioning Devices

Individual volume or weight controls for proportioning aggregate, mineral filler, emulsified asphalt, additives, and water to be added to the mix shall be provided and properly marked.

336.06.03 Spreading Equipment

The mix shall be spread uniformly by means of a conventional augured surfacing spreader box attached to the mixing machine and equipped with paddles to agitate and spread the mix evenly throughout the box. A front seal shall be provided to ensure no loss of the mix 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 designed to ensure that a uniform consistency is achieved to produce a free flow of material to the rear strike-off. The spreader box shall be equipped with a suitable means to adjust the box to compensate for variations in the pavement geometry. Rut filling spreader boxes shall be specifically designed for rut filling applications.

The spreading equipment shall be capable of being re-supplied with the micro-surfacing mixture 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 mixture.

336.06.04 Pilot Vehicle

The pilot vehicle shall be according to the requirements of the OTM, Book 7.

336.07 CONSTRUCTION

336.07.01 Operational Constraints

Micro-surfacing mixture shall be placed only when the atmospheric temperature is at least 10 °C and rising and the weather is free of fog or rain and there is no forecast of temperatures below 0 °C within 24 hours from the time of application. The mix proportions shall be adjusted when weather conditions prolong opening to traffic beyond one hour.

Micro-surfacing shall commence no earlier than May 15 and shall be completed no later than September 30.

Traffic, including construction traffic, shall be kept off the freshly placed mixture.

The centreline shall be delineated with short term pavement markings at the end of each Day of micro-surfacing. Short term pavement markings shall be according to OPSS 710.

336.07.02 Trial Area

A trial area 100 m in length and one lane wide shall be placed at the commencement of the micro-surfacing operation to demonstrate the ability to produce a surface in conformance with that meets the requirements of this specification. Within 1 hour of placement, the Contract Administrator shall inspect the Work for acceptance. The trial areas shall be repeated until the micro-surfacing meets the requirements of this specification. The location of the trial area shall be approved by the Contract Administrator.

336.07.03 Surface Preparation

The area to be surfaced shall be thoroughly cleaned using a rotary power broom to remove all sand, dirt, and other debris. Areas inaccessible to a rotary power broom shall be manually cleaned.

Existing crack sealing material shall be removed.

Existing durable pavement markings shall be removed.

Unless specified in the Contract Documents, all pavement surfaces to be micro-surfaced shall be tack coated. Where tack coating is not required, water shall be applied to the pavement surface immediately ahead of the spreader to dampen the pavement surface without allowing any free-standing or free-flowing water.

Surfaces to be tack coated shall be free of standing water and contamination, such as mud, loose aggregate, and debris. Tack coat shall be applied at a rate of 0.25 to 0.40 kg/m² as determined by the Contractor based on the condition of the existing pavement surface. Tack coating shall be allowed to cure sufficiently before micro-surfacing.

All roadway appurtenances within the area of micro-surfacing shall be properly covered and protected immediately prior to micro-surfacing.

336.07.04 Mix Application

Micro-surfacing mixture shall be placed as a scratch and surface coat (double application) or a surface coat only (single application), as specified in the Contract Documents.

Additives may be added to the micro-surfacing mix during construction to provide control of the quick-set properties and to increase adhesion.

A sufficient amount of mixture shall be carried in all parts of the spreader box at all times so that complete coverage is obtained. Water used to spray the spreader box to facilitate spreading shall not harm the mix. Lumping, balling, or unmixed aggregate shall not be permitted in the finished surface. Any oversized aggregate or foreign materials shall be screened from the aggregate prior to delivery to the mixing equipment.

The application rates for a single layer of micro-surfacing mix shall meet the requirements of Table 4.

Ruts of 13 mm or greater in depth shall be filled with micro-surfacing mixture using a rut-filling spreader box prior to micro-surfacing. Ruts greater than 25 mm in depth shall be filled with micro-surfacing mixture 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 metres.

When specified in the Contract Documents, micro-surfacing mixture shall be applied as a scratch coat to fill ruts less than 13 mm in depth, cracks and shallow potholes to leave a uniform surface.

336.07.04.01 Handwork

In restricted areas where hand spreading is necessary, adjustments to the mix formula may be made to retard the setting time. The mixture shall be placed along one edge of the surface to be covered and spread uniformly with squeegees or other suitable Hand Tools.

336.07.04.02 Appearance

After micro-surfacing, the surface shall have a uniform texture free from excessive scratch marks, tears, indentations, or other surface irregularities. Tear marks or other surface irregularities in any 12 m² area per lane are considered excessive if there are:

- a) four or more marks \geq 12 mm wide and \geq 100 mm long.
- b) any marks \geq 25 mm wide and \geq 25 mm long.

There shall be no transverse ripples or longitudinal streaks of 6 mm or greater in depth when measured by placing a 3 m straight edge in any direction over the finished surface.

The edges of the micro-surfaced surface shall be finished uniformly, with a neat appearance along the roadway centreline, lane lines, shoulder, pavement edge, and curb lines.

336.07.04.03 Documentation

A summary of the quantity and application rate of micro-surface material placed and a list of the quantities used for each of the mix components (i.e., aggregate, emulsified asphalt, water, mineral filler, and additive) shall be submitted daily to the Contract Administrator.

A summary of the station-to-station limits, quantity, and application rate of the tack coat shall be submitted daily to the Contract Administrator.

336.07.04.04 Joints

The longitudinal and transverse joints shall be neat and uniform in appearance, with no excessive build-up. Longitudinal joints shall be placed on lane lines.

The longitudinal joints in the scratch coat shall be constructed as a butt joint.

The longitudinal joint in the surface course shall have an overlap of 50 to 100 mm.

336.07.05 Clean Up

All areas not to be micro-surfaced, such as shoulders, ditches, and gutters, shall have the micro-surfacing mixture removed on a daily basis.

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

336.07.06 Traffic Convoy

Traffic shall be convoyed according to the OTM, Book 7.

The pilot vehicle shall guide one-way traffic through or around construction. The maximum speed of the convoy shall be 30 km/h. Convoying shall be maintained until such time as the micro-surfacing mixture is able to carry traffic without damage.

336.07.07 Repairs

All repairs to address appearance deficiencies described in the Appearance clause shall consist of an additional application of micro-surfacing mixture for the full lane width over the length of deficiency.

The length of repair shall be sufficient to eliminate all appearance deficiencies. If the distance between repair areas is less than 3 m, then the adjacent repairs shall be treated as one repair.

336.07.08 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

336.08 QUALITY ASSURANCE

336.08.01 Sampling and Testing

Sampling shall be conducted by the Contractor according to LS-625. Quality assurance (QA) samples shall be taken from stockpiles of aggregate to be used in the Work. Sampling locations shall be determined by the Contract Administrator.

Duplicate samples shall be obtained and sealed by the Contractor in the presence of the Contract Administrator. One of the duplicate samples shall be randomly selected for testing by the QA laboratory and the remaining sealed sample shall be retained by the QA laboratory for possible referee testing. In the event that the Contractor is unavailable to take the sample, no further material shall be placed in the Work until the QA sample has been taken. Samples shall be of sufficient mass of the material to conduct the necessary gradation and physical property tests.

All QA samples shall be delivered by the Contract Administrator, within 24 hours of sampling.

Notwithstanding the requirements for QA sampling as indicated in this specification, the Owner reserves the right to obtain a QA sample at any time without notice.

336.08.01.01 Acceptance of Aggregate

If the QA test results of the aggregate sample do not meet all the requirements in this specification, the material shall be considered rejectable and shall not be used in the Work.

336.08.01.02 Referee Testing of Aggregate

The Contractor may invoke referee testing by submitting a written request to the Contract Administrator, within 5 Business Days following notification that a sample does not meet the requirements of this specification.

The retained QA aggregates sample shall be used for referee testing.

In the event the referee testing result shows the sample does not meet the requirement of this specification, the Contractor shall be responsible for the cost of the referee testing, including the cost of transporting the samples to the referee laboratory.

336.08.02 Warranty Requirements

336.08.02.01 Warranty Period

The warranty period shall be 24 months from the date of Contract Completion.

336.08.02.02 Distress Survey

A distress survey will be completed by the Owner one year from the date of Contract Completion according to the severity and density definitions provided in SP-024. A second distress survey will be completed a minimum of 45 Days prior to the end of the warranty period. The results of both surveys shall be sent to the Contractor.

If the Owner determines that any distresses found pose a hazard to the travelling public at any time during the warranty period, the Contractor shall be required to make the repairs according to this specification within 2 weeks of being notified to the approval of the Owner.

336.08.02.03 Performance Requirements

At the end of the warranty period, the surface shall be free from any aggregate loss or ravelling that is slight to very severe and from flushing that is moderate to very severe. The density of flushing that is very slight to slight shall not be greater than intermittent.

If the surface does not meet the performance requirements, the applicable repairs or replacement methods specified in Table 5, shall be completed within 30 days. Acceptance of the areas being repaired or replaced shall be at the sole discretion of the Contract Administrator.

The length of repair shall be sufficient to eliminate all surficial defects as described. If the distance between repair areas is less than 3 m, then the adjacent repairs shall be treated as one repair.

336.09 MEASUREMENT FOR PAYMENT

336.09.01 Actual Measurement

**336.09.01.01 Micro-Surfacing Type II
Micro-Surfacing Type III Modified
Micro-Surfacing Type III**

Measurement of the micro-surfacing mixture placed shall be by area in square metres.

336.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

336.10 BASIS OF PAYMENT

**336.10.01 Micro-Surfacing Type II - Item
Micro-Surfacing Type III Modified - Item
Micro-Surfacing Type III - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

336.10.02 Trial Area

The accepted trial area shall be paid for at the Contract unit price for micro-surfacing. All costs associated with repairing and replacing unacceptable trial areas shall be at no additional cost to the Owner.

**TABLE 1
Mix Design Requirements**

Test Method	Description	Requirements
ISSA TB-139	Wet cohesion - @ 30 minutes min. (Set) - @ 60 minutes min. (Traffic)	12 kg-cm minimum 20 kg-cm minimum
ISSA TB-109	Excess asphalt by LWT (load wheel test) sand adhesion	538 g/m ² maximum
ISSA TB-114	Wet stripping	90% minimum
ISSA TB-100	Wet track abrasion loss-one hour soak	538 g/m ² maximum
	Loss-six day soak	807 g/m ² maximum
ISSA TB-147 Method A	Lateral displacement	5% maximum
	Specific gravity after 1000 cycles of 57 kg	2.10 maximum
ISSA TB-144	Classification compatibility by S-B-R test	(AAA, BAA) 11 Grade Points minimum
ISSA TB-113	Mix time @ 25 °C	Controllable to 120 seconds minimum

**TABLE 2
Micro-Surfacing Coarse and Fine Aggregates Requirements**

Micro-Surfacing Type	Application (Note 1)	Physical Requirements as Specified in OPSS 1003
II	Low Traffic Volume	Superpave 12.5 (Note 2)
II	High Traffic Volume	Superpave 12.5 FC2
III Modified	High Traffic Volume	Superpave 12.5 FC2
III	High Traffic Volume	Superpave 12.5 FC2

Notes:

- 1) Low Traffic Volume: AADT < 2,500 per lane
High Traffic Volume: AADT ≥ 2,500 per lane
- 2) Aggregates meeting the physical requirements of Superpave 12.5 aggregates shall be produced from quarried bedrock consisting of 100% siliceous aggregate determined in accordance with LS-609.

**TABLE 3
Gradation Requirements**

Percent Passing, LS-602			
MTO Sieve Designation	Micro-Surfacing Type II	Micro-Surfacing Type III Modified	Micro-Surfacing Type III
9.5 mm	100	100	100
6.7 mm	--	95-100	--
4.75 mm	90-100	80-95	70-90
2.36 mm	65-90	50-75	45-70
1.18 mm	45-70	33-55	28-50
600 µm	30-50	25-40	19-34
300 µm	18-30	15-30	12-25
150 µm	10-21	7-20	7-18
75 µm	5-15	5-15	5-15

**TABLE 4
Micro-Surfacing Single Layer Application Rates**

Micro-Surfacing Type	Application Rate kg/m²
Type II	5 to 11
Type III and Type III Mod	8 to 16

TABLE 5
Micro-Surfacing Repair and Replacement Methods

Surface Defects (Note 1)	Severity	Density	Repair/Replacement Method
Flushing	Very slight to slight	Frequent to throughout	Resurface with one layer of micro-surfacing for a full lane width
	Moderate to very severe	Few to throughout	Removal by milling of all flushed areas for a full lane width and replace with two layers of micro-surfacing.
Aggregate Loss / Ravelling	Slight to moderate	Few to throughout	Resurface with one lift of micro-surfacing for a full lane width.
	Severe to very severe	Few to throughout	Fill in delaminations/potholes with micro-surfacing and resurface with two layers of micro-surfacing.
<p>Note:</p> <p>1) Surface defect definitions according to SP-024.</p>			