

SECTION 331**PLACEMENT AND CONSTRUCTION OF ASPHALT EMULSION MICRO-SURFACING TREATMENTS****331.1 GENERAL:**

The work covered by this specification consists of furnishing all labor, equipment, and materials for the application of a "quick setting polymer solid or latex modified micro-surface."

This specification covers the equipment and construction procedures for rut filling and/or resurfacing of existing paved surfaces. The micro-surface shall be a mixture of cationic polymer solid or latex modified asphalt emulsion, mineral aggregates, mineral filler, water and other additives properly proportioned, mixed and spread on the pavement surface.

331.2 MATERIALS:

The Contractor shall supply all materials necessary for the performance of the work in accordance with the specifications. The asphalt emulsion material, mineral aggregate, and mineral filler shall be as specified in Section [714](#). Materials shall be approved by the Engineer prior to the start of construction. When requested by the Engineer, Certificates of Compliance shall be provided for each delivery of emulsion.

The micro-surface mixture shall conform to the requirements of the contract documents. The mixture shall attain an initial set in not less than 3 minutes and not more than one hour. In cases where the surface is not critical to be open to traffic, a longer set time may be allowed, however not to exceed 12 hours. The setting time may be adjusted by the addition or removal of approved mineral fillers or chemical agents. The mixture shall be one of three (3) types whose combined aggregates conform to the requirements of Table [714-1](#). The mixture shall not segregate during or after laydown. The mixture shall produce a skid-resistant surface.

The Contractor shall be responsible for the safety of all materials of which he has taken delivery until they are in place on the road, and shall take all necessary precautions to avoid loss by fire or theft, or damage by water, and shall bear the cost of replacing any such material that is lost, spilled, destroyed or damaged after delivery.

331.2.1 Material Control:

331.2.1.1 Calibration: Each mixing unit to be used in the performance of the work shall be calibrated prior to construction. Calibration data, if done within the calendar year, using the same material, may be used, providing the verification of the aggregate feed correlates to the existing calibration data. The documentation shall include an individual calibration of each material at various settings that can be related to the machine metering devices and shall be kept on the machine at all times. Individual volume or weight controls for proportioning each material to be added to the mix shall be provided and shall be accessible to the Engineer. Any component replacement affecting material proportioning requires that the machine be recalibrated. No machine shall be allowed to work on the project until the calibration has been completed and/or accepted by the Engineer.

331.3 PROPORTIONING:

The micro-surface shall be proportioned in accordance with the job mix formula. Calibrated flowmeters shall be provided to measure both the addition of water and additives to the pugmill. Emulsion and cement flow shall be tied directly to aggregate flow. All additive flows shall be calibrated.

Mineral filler shall be used in accordance to the job mix formula to adequately control the mixture. The expected mineral filler range shall be between 0.1% and 2.0% by weight of aggregate.

331.3.1 Performance: The micro-surface mixture shall be proportioned per the job mix formula to ensure:

- (A) Trafficability - the material shall permit controlled traffic without damage to the surface within thirty (30) minutes and uncontrolled traffic without damage within three (3) hours minimum.
- (B) Prevent development of bleeding, raveling, separation or other distress for seven (7) days after placing the micro-surface.

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331.4 SAMPLING AND TESTING:

331.4.1 Material Sampling: A representative sample of the mineral aggregate shall be obtained by Arizona Test Method 105. The mineral aggregate shall be sampled from the stockpile at the contractor's yard or staging area.

A representative sample of the asphalt emulsion shall be obtained according to Arizona Test Method 104. The asphalt emulsion mixture shall be sampled from the storage tank at the Contractor's yard or staging area.

A representative sample of the micro-surfacing mixture shall be taken directly from the non-absorbent protective material used to protect a manhole cover. Sampling locations shall be at the discretion of the Engineer. Once cured and prior to the introduction of traffic, care shall be taken by the Contractor to carefully remove the protective material and to include all material within the sampling area. The Contractor shall provide the sample to the Engineer's representative. The sample shall be transported and stored in such a way as to prevent contamination.

Where sampling from a manhole cover is not feasible, the Engineer shall select a 2ft x 2ft sampling area prior to mixture placement. This sampling area shall be determined at the discretion of the Engineer. A non-absorbent protective material shall be placed and secured in the same manner as manhole covers. The contractor shall replace the removed sampling area with micro-surfacing mixture to match the placement area.

331.4.2 Quality Control: To account for aggregate bulking, it is the responsibility of the contractor to check stockpile moisture content and to set the machine accordingly.

The aggregate gradation production tolerances specified in Table [714-1](#) shall be maintained at all times. The gradation of the aggregate stockpile shall not vary by more than the production tolerance from the job mix formula gradation while also remaining within the specification gradation band. The percentage of aggregate passing any two successive sieves shall not change from one end of the specified range to the other end.

331.4.3 Quality Assurance: Samples for quality assurance shall be taken throughout the project and tested per ASTM [D 2172](#) for testing by an AASHTO re:source accredited laboratory as required by the Engineer. The contractor shall be notified immediately if any test fails to meet the specifications. Materials with test results not meeting these specifications shall be corrected. Testing shall be at the expense of the Agency. The material shall meet the requirements specified in Section [714](#) for the following:

Micro-Surfacing Mixture:

(A) Residual Asphalt Content

Polymer Solid or Latex Modified Emulsions:

(B) Softening Point

(C) Elastic Recovery

(D) Penetration

(E) Ductility

(F) Residue by Evaporation

Aggregate:

(G) Aggregate gradation

(H) Sand Equivalent

Data obtained from the proportioning devices on the micro-surfacing machine shall be used to determine individual material quantities and application rate.

331.4.4 Mixture Tolerances: Tolerances for the micro-surfacing mixture are as follows:

(A) After the residual asphalt content is determined, a variation $\pm 1\%$ by weight of dry aggregate shall be permitted.

(B) The rate of application shall not vary more than ± 2 lbs/yd² (± 1.1 kg/m²) when the surface texture does not vary significantly.

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331.4.5 Inspection: The Contractor shall visually inspect the area(s) prior to placement and identify existing pavement conditions such as excessive rutting, shoving, heaving or any other conditions that will be detrimental to the performance of the micro-surfacing. The Contractor shall provide a report of existing pavement condition to the Engineer. Additional pavement remediation measures will be done at the direction of the Engineer.

A post-placement inspection of the project shall be made 7-14 calendar days following placement of the micro-surfacing. Areas exhibiting a non-conformity shall be identified by the Engineer

331.4.6 Non-Conformity: If any two successive tests on the stockpile aggregate and/or the emulsion fail, the job shall be stopped. If any two successive tests on the mix from the same machine fail, the use of the machine shall be suspended. It shall be the responsibility of the contractor, at their expense, to prove to the Engineer that the problems have been corrected. Any failing laboratory test result shall be retested and for validity on the original sample by the Agency. If both samples fail to meet the requirements, the Engineer shall consider the corresponding placement area(s) for corrective action. Corrective action may include patching, seal coating, resurfacing with additional micro-surfacing, extended warranty, removal and replacement of the micro-surfacing or other remedies considered by the Engineer. The Engineer may consider the material acceptable if the failing area(s) exhibits no signs of distress, within thirty (30) days of placement.

Areas which exhibit excessive raveling, bleeding, streaking, lumping, roughness or unacceptable lines, regardless of the laboratory test results shall be corrected to the satisfaction of the Engineer, at the expense of the contractor.

Areas which exhibit excessive flushing or other preventable non-conformities, not identified prior to placement of micro-surfacing by the Contractor, shall be corrected to the satisfaction of the Engineer at no additional cost.

331.5 EQUIPMENT:

331.5.1 General: All equipment, tools and machines used in the performance of this work shall be maintained in satisfactory working condition at all times to ensure a high-quality product.

331.5.2 Mixing Equipment: The mixing machine shall be a self-propelled continuous machine or truck mounted mixing machine which shall be able to accurately deliver and proportion the aggregate, mineral filler, water, additive, and polymer solid or latex modified asphalt emulsion to a revolving multi-blade mixer capable of minimum speeds of 200 RPM and discharge the product on a continual flow basis.

The machine shall have sufficient storage capacity for aggregate, polymer solid or latex modified asphalt emulsion, mineral filler, water, and additive to maintain an adequate supply to the proportioning controls.

The mixing machine shall be capable of producing evenly controlled low rates of speed throughout the operation to ensure the micro-surfacing mixture is spread evenly.

331.5.3 Aggregate Feed: The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time.

331.5.4 Emulsion Pump: The emulsion pump shall be the positive displacement type with a jacketed housing for uniform heating. A revolution counter or similar device shall be fitted so that the amount of emulsion used may be determined at any time.

331.5.5 Fines Feeder: An approved fines feeder is required that shall provide a uniform, positive, accurately metered range specified in Section [714](#). The fines feeder shall have a counter so the amount of mineral filler can be determined at any time.

331.5.6 Liquid Additive: The mixing machine shall be equipped with a liquid additive system that provides a pre-determined amount of additive to the mixing chamber. This additive system must be equipped with a counter that can determine the amount used at any time.

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331.5.7 Water System: The mixing machine shall be equipped with a water system that provides a pre-determined amount of water to the mixing chamber. This water system must be equipped with a counter that can determine the amount used at any time.

331.5.8 Operator Controls: Controls shall allow the operator to sequence and proportion the material per the mix design.

331.5.9 Spray Bars: The mixing machine shall be equipped with a water pressure system that provides a water spray immediately ahead of and outside the spreader box.

331.5.10 Micro-Surface Spreading Equipment: The paving mixture shall be spread uniformly by means of mechanical type laydown box attached to the mixer, equipped with agitation, to spread the materials throughout the box without any dead zones. The paddles shall be designed and operated so all the fresh mix shall be agitated. Flexible seals, front and rear, shall be in contact with the road surface to prevent loss of mixture from the box. The spreader box shall be equipped with devices for controlling the thickness of the spread mixture.

The spreading equipment shall be maintained free from build-up of the mixture on the paddles or side walls. Skips, lumps, or tears shall not be allowed in the finished product.

331.5.12 Cleaning Equipment: Power brooms, pick-up brooms, water flushing equipment, and hand brooms shall be suitable for cleaning of the existing surface.

331.5.13 Auxiliary Equipment: Suitable surface preparation equipment, traffic control equipment, hand tools, and other support and safety equipment necessary to perform the work shall be provided by the contractor.

331.6 PREPARATION OF THE SURFACE:

Immediately before applying the micro-surface, the area to be surfaced shall be cleaned of dirt, loose material, and other objectionable materials, including thermoplastic and raised pavement markers. Where existing thermoplastic marking thickness is significant, markings shall only be partially removed and roughened to create a flat surface with the surrounding pavement. In urban areas, the surface shall be cleaned with a self-propelled pick-up sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms. Water flushing shall not be permitted in areas where cracks are present in the pavement surface.

Areas exhibiting considerable irregularities like heaving at joints, whether along the edge of pavement or in travel lanes, and rutting should be addressed prior to application. Rut fill, scratch course or micro-milling of the surface, especially at intersections where rutting is present, should be completed to reduce the likelihood of flushing or shoving of the applied micro-surface.

The micro-surface shall not be applied until an inspection of the surface has been made by the Engineer and determined that it is suitable for placement.

331.6.1 Tack Coat: When specified, a tack coat shall be applied in accordance with Section [329](#) using the same type and grade of asphalt emulsion as specified for the micro-surfacing.

331.6.2 Cracks: When specified, cracks shall be sealed in accordance with the requirements of Section [337](#).

331.7 APPLICATION:

331.7.1 General: The micro-surface shall be of the desired consistency when deposited in the spreader box and nothing more shall be added to it. The mixing time shall be sufficient to produce a complete and uniform coating of the aggregate and the mixture shall be chuted into the moving spreader box at a sufficient rate to maintain an ample supply across the full width of the strike-off squeegee at all times.

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331.7.2 Weather: Micro-surfacing shall not be placed if either the pavement or air temperature is below 50° F and falling, but may be applied if both the air and pavement temperature are at least 45° F and rising. No micro surfacing shall be applied when there is the possibility of freezing temperatures at the project location within 24 hours after application. The mixture shall not be applied during unsuitable weather.

331.7.3 Protection of Existing Surfaces: The Contractor shall take all necessary precautions to prevent micro-surface or other material used from entering or adhering to steel gratings, valve boxes, manhole covers, bridge or culvert decks, and any other road fixtures. The Contractor shall clean off any such material and leave any steel grating, manholes, etc. in a satisfactory condition, within 24 hours of placement.

331.7.4 Fogging Pavement: The surface shall be pre-wetted by fogging ahead of the spreader box. The rate should be adjusted as dictated by the pavement temperature, surface texture, humidity, and dryness of existing pavement. The fogging shall be accomplished in such a manner that the entire surface is damp with no apparent flowing water or puddles.

331.7.5 Mix Stability: The mix shall possess sufficient stability so that premature breaking of material in the spreader box does not occur. If breaking, hardening, segregation, balling or lumping occurs during the mixing process, the batch will be discarded. The mixture shall be homogeneous during mixing and spreading; it shall be free of excess water or emulsion and free of segregation of the emulsion and aggregate fines from the coarser aggregate.

331.7.6 Application Rate: The application rates, pounds per square yard of mix specified, are average rates; the surface texture variation throughout the work shall dictate the actual spreading rates. The strike-off squeegee shall be adjusted to provide a micro-surface thickness which shall completely fill the surface voids and provide an additional thickness not exceeding one and one-half times the largest top-size stone. The requirement of 1-1/2 stone depth does not apply to rut filling operations as these depths vary greatly according to the surface irregularities.

	Type I	Type II	Type III
Application Rate: Pounds of Aggregate per Square Yard (approx.)	10-15	18-24	24-35

331.7.7 Joints: No excessive build-up or unsightly appearance shall be permitted on longitudinal or transverse joints. A maximum of 4.0" overlap shall be permitted on longitudinal joints. The Contractor shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the work. Half passes and odd width passes shall be used in minimal amounts. If half passes are used, they cannot be the last pass on any area. Care shall be taken to ensure straight lines along curbs and shoulders. No runoff shall be permitted on these areas. Construction joints shall be neat in appearance and shall be tapered or feathered to conform to the existing surface. All excess material shall be removed from the surface upon completion of each run.

331.7.8 Scratch or Leveling Course: When project plans require, Micro-surfacing material may be used to fill irregularities such as ruts, utility cuts, depressions in the existing surface, etc. Irregularities of 0.5 inches or greater in depth, should be filled independently with a scratch or leveling course. Irregularities that are more than 1.0 inches in depth may require multiple applications to restore the cross-section. When irregularities are less than 0.5 inches a full width scratch course may be applied with the spreader box using a metal or stiff rubber strike-off.

Apply at a sufficient rate to level the pavement surface. The scratch or leveling course may, or may not, meet the suggested application rate specified in Subsection [331.7.6](#). All scratch and leveling material should cure for at least twenty-four (24) hours before additional material is placed. The scratch and leveling course will be measured and paid as specified in Subsection [331.8](#).

331.7.8 Handwork: Approved squeegees and lutes shall be used to spread the mixture in areas inaccessible to the spreader box and in other areas where hand spreading may be required. If necessary, the area to be hand worked shall be lightly dampened prior to mix placement. As much as possible, handwork shall exhibit the same finish as that applied by the spreader box.

Care shall be taken to prevent segregation of the mixture due to excessive hand work. Excessive handwork may result in increased raveling of the cured micro-surface.

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Large areas requiring handwork should be applied in small sections, allowing sufficient time to place and finish the material without causing segregation or sizeable areas to break.

331.7.9 Protection of the Micro-surface: Adequate means shall be provided by the Contractor to protect the uncured product. Any damage done to the product shall be repaired at the Contractor's expense.

331.7.10 Damage to the Micro-surface: The Contractor's responsibility to replace micro-surface damaged by unexpected rain after spreading shall be limited to the period within four (4) hours of placement of the micro-surface.

331.7.11 Power Broom Sweeping: Within 7 to 14 days following the placement, the entire surface area shall be swept with a power broom to remove any loose material.

331.7.12 Trial Applications: At the discretion of the Engineer, the Contractor shall place a test strip of 1,000 square yards in the area designated by the Engineer for all projects 35,000 square yards and larger. The test section shall be placed using the same equipment and methods as shall be used on the job. The micro-surfacing mixture placed in a test strip shall conform to the design mix with minor variations to obtain set time, pavement bond and a skid resistant texture. If the materials do not meet the requirements for fluidity, non-segregation, or surface texture, adjustments shall be made to the mixture within the allowable production tolerances. Work shall not proceed until approval of mixture and acceptance of a test strip by the Engineer.

331.8 MEASUREMENT:

Quantities and materials for this work shall be paid for at the contract price per unit of measurement for each of the following pay items as indicated in the proposal.

(A) Bituminous tack coat if specified	Ton (Diluted)
(B) Emulsified asphalt for micro-surfacing	Ton (Undiluted)
(C) Aggregate for micro-surfacing	Ton (Surface Dry)

Micro-milling, edge-milling, removal of thermoplastic markings, crack sealing, and pavement replacement completed as part of surface preparation will be measured and paid as a separate bid item.

331.9 PAYMENT:

The micro-surfacing shall be paid for by the weight of the aggregate and weight of emulsified asphalt, as shown on certified weight tickets from the supplies delivered to the project, less weigh backs and waste material. If crack seal is required it will be specified and paid for as a separate item. The price shall be full compensation for furnishing, mixing and applying all materials; and for all labor, equipment, tools, design tests, all other surface preparation not excluded in Section [331.8](#) and incidentals necessary to complete the job as specified herein.

- End of Section -

SECTION 331

PLACEMENT AND CONSTRUCTION OF ASPHALT EMULSION MICRO-SURFACING TREATMENTS

331.1 GENERAL:

The work covered by this specification consists of furnishing all labor, equipment, and materials for the application of a "quick setting polymer solid or latex modified micro-surface."

This specification covers the equipment and construction procedures for rut filling and/or resurfacing of existing paved surfaces. The micro-surface shall be a mixture of cationic polymer solid or latex modified asphalt emulsion, mineral aggregates, mineral filler, water and other additives properly proportioned, mixed and spread on the pavement surface.

331.2 MATERIALS:

The Contractor shall supply all materials necessary for the performance of the work in accordance with the specifications. The asphalt emulsion material, mineral aggregate, and mineral filler shall be as specified in Section [714](#). Materials shall be approved by the Engineer prior to the start of construction. When requested by the Engineer, Certificates of Compliance shall be provided for each delivery of emulsion.

The micro-surface mixture shall conform to the requirements of the contract documents. The mixture shall attain an initial set in not less than 3 minutes and not more than one hour. In cases where the surface is not critical to be open to traffic, a longer set time may be allowed, however not to exceed 12 hours. The setting time may be adjusted by the addition or removal of approved mineral fillers or chemical agents. The mixture shall be one of three (3) types whose combined aggregates conform to the requirements of Table [714-1](#). The mixture shall not segregate during or after laydown. The mixture shall produce a skid-resistant surface.

The Contractor shall be responsible for the safety of all materials of which he has taken delivery until they are in place on the road, and shall take all necessary precautions to avoid loss by fire or theft, or damage by water, and shall bear the cost of replacing any such material that is lost, ~~spit~~ spilled, destroyed or damaged after delivery.

331.2.1 Material Control:

331.2.1.1 Calibration: Each mixing unit to be used in the performance of the work shall be calibrated prior to construction. Calibration data, if done within the calendar year, using the same material, may be used, providing the verification of the aggregate feed correlates to the existing calibration data. The documentation shall include an individual calibration of each material at various settings that can be related to the machine metering devices and shall be kept on the machine at all times. Individual volume or weight controls for proportioning each material to be added to the mix shall be provided and shall be accessible to the Engineer. Any component replacement affecting material proportioning requires that the machine be recalibrated. No machine shall be allowed to work on the project until the calibration has been completed and/or accepted by the Engineer.

331.3 PROPORTIONING:

The micro-surface shall be proportioned in accordance with the job mix formula. Calibrated flowmeters shall be provided to measure both the addition of water and additives to the pugmill. Emulsion and cement flow shall be tied directly to aggregate flow. All additive flows shall be calibrated.

Mineral filler shall be used ~~as needed~~ in accordance to the job mix formula to adequately control the mixture. The expected mineral filler range shall be between 0.01% and 2.0% by weight of aggregate.

331.3.1 Performance: The micro-surface mixture shall be proportioned per the job mix formula to ensure:

- (A) Trafficability - the material shall permit controlled traffic without damage to the surface within thirty (30) minutes and uncontrolled traffic without damage within three (3) hours minimum.
- (B) Prevent development of bleeding, raveling, separation or other distress for seven (7) days after placing the micro-surface.

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331.4 SAMPLING AND TESTING:

331.4.1 Material Sampling: A representative sample of the mineral aggregate shall be obtained by Arizona Test Method 105. The mineral aggregate shall be sampled from the stockpile at the contractor's yard or staging area.

A representative sample of the asphalt emulsion shall be obtained according to Arizona Test Method 104. The asphalt emulsion mixture shall be sampled from the storage tank at the Contractor's yard or staging area.

~~A representative sample of the micro-surfacing mixture shall be taken directly from the micro-surfacing machine. Using a suitable container, the contractor shall sample as much of the discharge stream as possible. The container shall be sealed immediately following the sampling of the mixture. Care shall be taken to transport and store the sample in such a way as to prevent contamination.~~

A representative sample of the micro-surfacing mixture shall be taken directly from the non-absorbent protective material used to protect a manhole cover. Sampling locations shall be at the discretion of the Engineer. Once cured and prior to the introduction of traffic, care shall be taken by the Contractor to carefully remove the protective material and to include all material within the sampling area. The Contractor shall provide the sample to the Engineer's representative. The sample shall be transported and stored in such a way as to prevent contamination.

Where sampling from a manhole cover is not feasible, the Engineer shall select a 2ft x 2ft sampling area prior to mixture placement. This sampling area shall be determined at the discretion of the Engineer. A non-absorbent protective material shall be placed and secured in the same manner as manhole covers. The contractor shall replace the removed sampling area with micro-surfacing mixture to match the placement area.

331.4.2 Quality Control: To account for aggregate bulking, it is the responsibility of the contractor to check stockpile moisture content and to set the machine accordingly.

The aggregate gradation production tolerances specified in Table [714-1](#) shall be maintained at all times. The gradation of the aggregate stockpile shall not vary by more than the production tolerance from the job mix formula gradation while also remaining within the specification gradation band. The percentage of aggregate passing any two successive sieves shall not change from one end of the specified range to the other end.

331.4.3 Quality Assurance: Samples for quality assurance shall be taken throughout the project and tested per ASTM [D 2172](#) for testing by an AASHTO re:source accredited laboratory as required by the Engineer. The contractor shall be notified immediately if any test fails to meet the specifications. Materials with test results not meeting these specifications shall be corrected ~~immediately~~. Testing shall be at the expense of the Agency. The material shall meet the requirements specified in Section [714](#) for the following:

Micro-Surfacing Mixture:

(A) Residual Asphalt Content

Polymer Solid or Latex Modified Emulsions:

(B) Softening Point

(C) Elastic Recovery

(D) Penetration

(E) Ductility

(F) Residue by Evaporation

Aggregate:

(G) Aggregate gradation

(H) Sand Equivalent

Data obtained from the proportioning devices on the micro-surfacing machine shall be used to determine individual material quantities and application rate.

331.4.4 Mixture Tolerances: Tolerances for the micro-surfacing mixture are as follows:

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- (A) After the residual asphalt content is determined, a variation $\pm 1\%$ by weight of dry aggregate shall be permitted.
- (B) The rate of application shall not vary more than ± 2 lbs/yd² (± 1.1 kg/m²) when the surface texture does not vary significantly.

331.4.5 Inspection: The Contractor shall visually inspect the area(s) prior to placement and identify existing pavement conditions such as excessive rutting, shoving, heaving or any other conditions that will be detrimental to the performance of the micro-surfacing. The Contractor shall provide a report of existing pavement condition to the Engineer. Additional pavement remediation measures will be done at the direction of the Engineer. ~~Local conditions, specific project requirements and existing roadway conditions should be considered when determining the parameters of field inspection.~~

A post-placement inspection of the project shall be made 7-14 calendar days following placement of the micro-surfacing. Areas exhibiting a non-conformity shall be identified by the Engineer

331.4.6 Non-Conformity: If any two successive tests on the stockpile aggregate and/or the emulsion fail, the job shall be stopped. If any two successive tests on the mix from the same machine fail, the use of the machine shall be suspended. It shall be the responsibility of the contractor, at their expense, to prove to the Engineer that the problems have been corrected. Any failing laboratory test result shall be retested and for validity **on the original sample by the Agency**. If both samples fail to meet the requirements, the Engineer shall consider the corresponding placement area(s) for ~~removal~~. **corrective action. Corrective action may include patching, seal coating, resurfacing with additional micro-surfacing, extended warranty, removal and replacement of the micro-surfacing or other remedies considered by the Engineer.** The Engineer may consider the material acceptable if the failing area(s) exhibits no signs of distress, within thirty (30) days of placement.

Areas which exhibit excessive raveling, **flushing**, bleeding, streaking, lumping, roughness or unacceptable lines, regardless of the laboratory test results shall be corrected to the satisfaction of the Engineer, at the expense of the contractor.

Areas which exhibit excessive flushing or other preventable non-conformities, not identified prior to placement of micro-surfacing by the Contractor, shall be corrected to the satisfaction of the Engineer at no additional cost.

331.5 EQUIPMENT:

331.5.1 General: All equipment, tools and machines used in the performance of this work shall be maintained in satisfactory working condition at all times to ensure a high-quality product.

331.5.2 Mixing Equipment: The mixing machine shall be a self-propelled continuous machine or truck mounted mixing machine which shall be able to accurately deliver and proportion the aggregate, mineral filler, water, additive, and polymer solid or latex modified asphalt emulsion to a revolving multi-blade mixer capable of minimum speeds of 200 RPM and discharge the product on a continual flow basis.

The machine shall have sufficient storage capacity for aggregate, polymer solid or latex modified asphalt emulsion, mineral filler, water, and additive to maintain an adequate supply to the proportioning controls.

The mixing machine shall be capable of producing evenly controlled low rates of speed throughout the operation to ensure the micro-surfacing mixture is spread evenly.

331.5.3 Aggregate Feed: The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time.

331.5.4 Emulsion Pump: The emulsion pump shall be the positive displacement type with a jacketed housing for uniform heating. A revolution counter or similar device shall be fitted so that the amount of emulsion used may be determined at any time.

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331.5.5 Fines Feeder: An approved fines feeder is required that shall provide a uniform, positive, accurately metered range specified in Section [714](#). The fines feeder shall have a counter so the amount of mineral filler can be determined at any time.

331.5.6 Liquid Additive: The mixing machine shall be equipped with a liquid additive system that provides a pre-determined amount of additive to the mixing chamber. This additive system must be equipped with a counter that can determine the amount used at any time.

331.5.7 Water System: The mixing machine shall be equipped with a water system that provides a pre-determined amount of water to the mixing chamber. This water system must be equipped with a counter that can determine the amount used at any time.

331.5.8 Operator Controls: Controls shall allow the operator to sequence and proportion the material per the mix design.

331.5.9 Spray Bars: The mixing machine shall be equipped with a water pressure system that provides a water spray immediately ahead of and outside the spreader box.

331.5.10 Micro-Surface Spreading Equipment: The paving mixture shall be spread uniformly by means of mechanical type laydown box attached to the mixer, equipped with agitation, to spread the materials throughout the box without any dead zones. The paddles shall be designed and operated so all the fresh mix shall be agitated. Flexible seals, front and rear, shall be in contact with the road surface to prevent loss of mixture from the box. The spreader box shall be equipped with devices for controlling the thickness of the spread mixture.

The spreading equipment shall be maintained free from build-up of the mixture on the paddles or side walls. Skips, lumps, or tears shall not be allowed in the finished product. ~~The use of burlap drags or other drags shall be approved by the Engineer.~~

331. 5.12 Cleaning Equipment: Power brooms, pick-up brooms, water flushing equipment, and hand brooms shall be suitable for cleaning ~~the surface and cracks~~ of the ~~old existing~~ surface.

331.5.13 Auxiliary Equipment: Suitable surface preparation equipment, traffic control equipment, hand tools, and other support and safety equipment necessary to perform the work shall be provided by the contractor.

331.6 PREPARATION OF THE SURFACE:

Immediately before applying the micro-surface, the area to be surfaced shall be cleaned of dirt, loose material, and other objectionable materials, ~~including thermoplastic and raised pavement markers. Where existing thermoplastic marking thickness is significant, markings shall only be partially removed and roughened to create a flat surface with the surrounding pavement.~~ In urban areas, the surface shall be cleaned with a self-propelled pick-up sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms. Water flushing shall not be permitted in areas where cracks are present in the pavement surface.

~~Areas exhibiting considerable irregularities like heaving at joints, whether along the edge of pavement or in travel lanes, and rutting should be addressed prior to application. Rut fill, scratch course or micro-milling of the surface, especially at intersections where rutting is present, should be completed to reduce the likelihood of flushing or shoving of the applied micro-surface.~~

The micro-surface shall not be applied until an inspection of the surface has been made by the Engineer and ~~he has~~ determined that it is suitable ~~for placement~~.

331.6.1 Tack Coat: When specified, a tack coat shall be applied in accordance with Section [329](#) using the same type and grade of asphalt emulsion as specified for the micro-surfacing.

331.6.2 Cracks: ~~When specified,~~ cracks shall be sealed in accordance with the requirements of Section [337](#).

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331.7 APPLICATION:

331.7.1 General: The micro-surface shall be of the desired consistency when deposited in the spreader box and nothing more shall be added to it. The mixing time shall be sufficient to produce a complete and uniform coating of the aggregate and the mixture shall be chuted into the moving spreader box at a sufficient rate to maintain an ample supply across the full width of the strike-off squeegee at all times.

331.7.2 Weather: Micro-surfacing shall not be placed if either the pavement or air temperature is below 50° F and falling, but may be applied if both the air and pavement temperature are at least 45° F and rising. No micro surfacing shall be applied when there is the possibility of freezing temperatures at the project location within 24 hours after application. The mixture shall not be applied during unsuitable weather.

331.7.3 Protection of Existing Surfaces: The Contractor shall take all necessary precautions to prevent micro-surface or other material used from entering or adhering to steel gratings, valve boxes, manhole covers, bridge or culvert decks, and any other road fixtures. ~~Immediately after resurfacing,~~ The Contractor shall clean off any such material and leave any steel grating, manholes, etc. in a satisfactory condition, within 24 hours of placement.

331.7.4 Fogging Pavement: The surface shall be pre-wetted by fogging ahead of the spreader box. The rate should be adjusted as dictated by the pavement temperature, surface texture, humidity, and dryness of existing pavement. The fogging shall be accomplished in such a manner that the entire surface is damp with no apparent flowing water or puddles.

331.7.5 Mix Stability: The mix shall possess sufficient stability so that premature breaking of material in the spreader box does not occur. If breaking, hardening, segregation, balling or lumping occurs during the mixing process, the batch will be discarded. The mixture shall be homogeneous during mixing and spreading; it shall be free of excess water or emulsion and free of segregation of the emulsion and aggregate fines from the coarser aggregate.

331.7.6 Application Rate: The application rates, pounds per square yard of mix specified, are average rates; the surface texture variation throughout the work shall dictate the actual spreading rates. The strike-off squeegee shall be adjusted to provide a micro-surface thickness which shall completely fill the surface voids and provide an additional thickness not exceeding one and one-half times the largest top-size stone. The requirement of 1-1/2 stone depth does not apply to rut filling operations as these depths vary greatly according to the surface irregularities.

	Type I	Type II	Type III
Application Rate: Pounds of Aggregate per Square Yard (approx.)	10-15	18-24	24-35

331.7.7 Joints: No excessive build-up or unsightly appearance shall be permitted on longitudinal or transverse joints. A maximum of 4.0" overlap shall be permitted on longitudinal joints. The Contractor shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the work. Half passes and odd width passes shall be used in minimal amounts. If half passes are used, they cannot be the last pass on any area. Care shall be taken to ensure straight lines along curbs and shoulders. No runoff shall be permitted on these areas. Construction joints shall be neat in appearance and shall be tapered or feathered to conform to the existing surface. All excess material shall be removed from the surface upon completion of each run.

331.7.8 Scratch or Leveling Course: When project plans require, Micro-surfacing material may be used to fill irregularities such as ruts, utility cuts, depressions in the existing surface, etc. Irregularities of 0.5 inches or greater in depth, shall should be filled independently with a scratch or leveling course. Irregularities that are more than 1.0 inches in depth may require multiple applications to restore the cross-section. When irregularities are less than 0.5 inches a full width scratch course may be applied with the spreader box using a metal or stiff rubber strike-off.

Apply at a sufficient rate to level the pavement surface. The scratch or leveling course may, or may not, meet the suggested application rate specified in Subsection 331.7.6. All scratch and leveling material should cure under traffic for at least twenty-four (24) hours before additional material is placed. The scratch and leveling course will be measured and paid as specified in Subsection 331.8.

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331.7.8 Handwork: Approved squeegees and lutes shall be used to spread the mixture in areas inaccessible to the spreader box and in other areas where hand spreading may be required. If necessary, the area to be hand worked shall be lightly dampened prior to mix placement. As much as possible, handwork shall exhibit the same finish as that applied by the spreader box.

Care shall be taken to prevent segregation of the mixture due to excessive hand work. Excessive handwork may result in increased raveling of the cured micro-surface.

Large areas requiring handwork should be applied in small sections, allowing sufficient time to place and finish the material without causing segregation or sizeable areas to break.

331.7.9 Protection of the Micro-surface: Adequate means shall be provided by the Contractor to protect the uncured product. Any damage done to the product shall be repaired at the Contractor's expense.

331.7.10 Damage to the Micro-surface: The Contractor's responsibility to replace micro-surface damaged by unexpected rain after spreading shall be limited to the period within four (4) hours of placement of the micro-surface.

331.7.11 Power Broom Sweeping: Within 7 to 14 days following the placement, the entire surface area shall be swept with a power broom to remove any loose material.

331.7.12 Trial Applications: At the discretion of the Engineer, the Contractor shall place a test strip of 1,000 square yards in the area designated by the Engineer for all projects ~~50,000~~ 35,000 square yards and larger. The test section shall be placed using the same equipment and methods as shall be used on the job. The micro-surfacing mixture placed in a test strip shall conform to the design mix with minor variations to obtain set time, pavement bond and a skid resistant texture. If the materials do not meet the requirements for fluidity, non-segregation, or surface texture, adjustments shall ~~be made to the mixture within the allowable production tolerances and tested~~. Work shall not proceed until approval of mixture and acceptance of a test strip by the Engineer.

331.8 MEASUREMENT:

Quantities and materials for this work shall be paid for at the contract price per unit of measurement for each of the following pay items as indicated in the proposal.

(A) Bituminous tack coat if specified	Ton (Diluted)
(B) Emulsified asphalt for micro-surfacing	Ton (Undiluted)
(C) Aggregate for micro-surfacing	Ton (Surface Dry)

~~Micro-milling, edge-milling, removal of thermoplastic markings, crack sealing, and pavement replacement completed as part of surface preparation will be measured and paid as a separate bid item.~~

331.9 PAYMENT:

The micro-surfacing shall be paid for by the weight of the aggregate and weight of emulsified asphalt, as shown on certified weight tickets from the supplies delivered to the project, less weigh backs and waste material. ~~If crack seal is required it will be specified and paid for as a separate item.~~ The price shall be full compensation for furnishing, mixing and applying all materials; and for all labor, equipment, tools, design tests, ~~all other surface preparation not excluded in Section 331.8~~ and incidentals necessary to complete the job as specified herein.

- End of Section -

SECTION 714

MICRO-SURFACING MATERIALS

714.1 GENERAL:

Micro-surfacing materials shall consist of a properly proportioned mixture of cationic polymer solids or latex modified asphalt emulsion, mineral aggregates, mineral filler, water, and other additives. Micro-surfacing is designed to provide skid resistant texture, improve surface friction and extend the service life of the existing pavement. Micro-surfacing allows for higher than normal application rates and/or multiple layer applications for rut filling and roadway leveling.

All material sources must be approved prior to their use. The Contractor shall submit a job mix formula, and if requested, pre-qualifications for materials at least seven days prior to start of construction. When requested, additional samples shall be furnished during the construction period at no cost to the Agency. This is a non-pay item.

714.2 AGGREGATE:

714.2.1 Mineral Filler: Mineral filler shall consist of finely divided matter, such as hydrated lime, Portland cement, limestone dust or fly ash, conforming to the requirements of ASTM [D242](#). Mineral filler shall be used only when needed to reduce the setting time, to improve the workability or to reduce the stripping characteristics of the aggregate emulsion mixture. The minimum amount of the required filler shall be used and shall be considered as part of the blended aggregate.

A certificate shall be submitted with the job mix formula demonstrating conformance to the requirements of ASTM [D242](#).

714.2.2 Mineral Aggregate: Coarse and fine aggregates shall be per Section [701](#). Aggregates shall be 100% crushed with no rounded particles. No natural sand shall be allowed. The use of recycled asphalt (RAP) may be used with prior approval of the Engineer. The mineral aggregate shall conform to the requirements of Table [714-1](#). Historical test data from source aggregate may be used, if tested within the past year.

Type I. This aggregate gradation is used to seal and fill minor surface voids.

Type II. This aggregate gradation is used to fill surface voids, address surface distresses, seal, and provide a durable wearing surface.

Type III. This aggregate gradation provides maximum skid resistance and an improved wearing surface. This type of surface is appropriate for heavily traveled pavements, rut filling, or for placement on highly textured surfaces requiring larger size aggregate to fill voids.

If more than one kind of aggregate is used, the correct amount of each kind of aggregate needed to produce the required gradation shall be proportioned separately in a manner that shall result in a uniform and homogeneous blend. The final blended aggregate shall meet the requirements of Table [714-1](#).

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TABLE 714-1				
MICRO-SURFACING AGGREGATE				
GRADATION TEST METHOD ASTM C136 / C117				
SIEVE SIZE	TYPE I % PASSING	TYPE II % PASSING	TYPE III % PASSING	PRODUCTION TOLERANCES
3/8	100	100	100	
No. 4	100	85-100	70-90	+/- 5%
No. 8	90-100	65-90	45-70	+/- 5%
No. 16	65-90	45-70	28-50	+/- 5%
No. 30	40-60	30-50	19-34	+/- 5%
No. 50	25-42	18-30	12-25	+/- 4%
No. 100	15-30	10-21	7-18	+/- 3%
No. 200	10-20	5-15	5-15	+/- 2%
ASTM TEST METHOD	TEST		REQUIREMENTS	
D2419	Sand Equivalent		50, minimum	
D5821	Fractured Faces		100%	
D4318	Plasticity Index		NP	
C131	L.A. Abrasion		35 percent, maximum	
Arizona 238	Percent Carbonates		20 percent, maximum	

The gradation of the aggregate stockpile shall not vary by more than the production tolerance from the job mix formula gradation (indicated in the table above) while also remaining within the specification gradation band.

714.3 WATER:

Water shall be potable water, free of any injurious impurities. The Contractor shall identify the water source to the Engineer.

714.4 ADDITIVES:

Additives may be used to accelerate or retard the breaking point and set times of the mix, or to improve the resulting finished surface.

The use of additives in the mix shall be supplied in quantities predetermined by the laboratory job mix formula.

714.5 BITUMINOUS MATERIAL:

The asphalt emulsion used for micro-surfacing shall meet the requirements specified in Section [713](#).

Each tank of emulsion produced shall be certified as to its compliance with these specifications; this certification shall include a certificate of analysis indicating the percent asphalt residue of each tank supplying emulsion to the project. This certificate of analysis shall accompany the placement machine and shall be provided to the Engineer upon request.

When required, the quick setting emulsified asphalt shall be of the cationic quick set type such as PMCQS-1h or LMCQS-1h that shall react to chemically active mineral fillers such as Portland cement in such a way that the applied micro-surfacing mixture can support controlled traffic in 45-60 minutes after application. The amount of chemically active filler shall be determined by job mix formula and field performance.

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714.6 MODIFIER TYPE AND CONTENT:

Modified cationic quick setting emulsion (PMCQS-1h or LMCQS-1h) shall be homogeneous and the modifier used shall consist of either a polymer solid milled into the asphalt or latex blended prior to the emulsification process. The PMCQS-1h and LMCQS-1h shall contain a minimum of 4% polymer solids or latex and shall conform to Section [713](#).

A certification of the polymer solids or latex content and type by the supplier shall be required throughout the duration of the contract. Each tank of emulsion produced shall be certified as to its compliance with these specifications; this certification shall include a certificate of analysis indicating the percent asphalt residue of each tank supplying emulsion to the project. This certificate of analysis shall accompany the placement machine and shall be provided to the Engineer upon request.

Placement of micro-surfacing is temperature dependent and should be tested under field conditions.

714.7 JOB MIX FORMULA:

714.7.1 General: The job mix formula shall be designed to provide a suitable surface for traffic conditions, climate and curing. All materials shall be pre-tested in the laboratory to determine their suitability for use in the micro-surfacing. The job mix formula shall be evaluated using a minimum of three emulsion contents to determine which emulsion content shall yield the optimum emulsion content that meets the requirement of [714-2](#).

The report must clearly show the theoretical recommended proportion of aggregate, mineral filler (Minimum & Maximum), water (Minimum & Maximum), additive(s), and asphalt based on the dry weight of aggregate.

The Contractor shall provide a job mix formula from an AASHTO re:source accredited laboratory and present certified test results for the Engineer's approval. Compatibility of the aggregate and polymer solids or latex modified emulsion shall be certified by the emulsion manufacturer. All the materials used in the job mix formula shall be representative of the materials proposed by the Contractor for use in the project. The job mix formula shall not be older than one (1) calendar year. A new job mix formula shall be required if any material changes are made to the original design.

All the products used in the construction shall have certifications from the suppliers and shall be given to the Engineer upon delivery to the project.

Job mix formula and proportioning shall be approved by the Engineer prior to the start of the project.

SECTION 714

714.7.2 Specifications:

The specification limits are as follows:

TABLE 714-2			
MICRO-SURFACING JOB MIX FORMULA			
ASTM TEST METHOD	ISSA TECHNICAL BULLETIN	TEST	REQUIREMENTS
D244		Residual Asphalt, % by dry weight of aggregate	6.0 – 11.5
D242		Mineral Filler, % by dry weight of aggregate.	0.1 – 2.0
		Modifier Content, % (see Section 714.6)	4, minimum.
		Additive	As required for mix properties
		Water	As required for mix properties
C136/ C117		Aggregate Grading	Meets requirements of Table 714-1
	TB-106	Consistency, cm.	2.5-3.0
	TB-100	Abrasion Loss (Wet Track Abrasion Test) One Hour Soak, g/ft ² Six Day Soak, g/ft ²	50, maximum 75, maximum
	TB-114	Wet Stripping, %	90, minimum
	TB-139	Wet Cohesion Test, at 77° F Set Time Test: (30 minutes), kg-cm Early Rolling Traffic Time: (60 minutes), kg-cm	12, minimum 20, minimum
	TB-102	Quick Set Emulsion Mix Properties Micro-Surfacing Setting Test, 70-85 ° F. (1-hour cure) Micro-Surfacing Water Resistance Test, 70-85 ° F. (30-minute cure)	No Brown Stain No More Than Slight Discoloration
	TB-115	Split Consistency Test	Uniform
	TB-113	Mix Time Micro-Surfacing Mixing, 70-85 ° F., Sec.	120, minimum
	TB-147	Measurement of Stability and Resistance to Compaction, Vertical and Lateral Displacement of Multi-layered Fine Aggregate Cold Mixes	Lateral Displacement 5%, maximum Specific Gravity 2.10, maximum
	TB-109	Loaded Wheel Sand Adhesion	50 g/ft ² , maximum

714.7.2.1 Bulking Effect (ASTM [C29](#) Modified): The laboratory shall further report the quantitative effects of moisture content in the unit weight of the aggregate (bulking effect).

714.8 TEST CERTIFICATES AND REPORTS:

Test certificates and reports for the bituminous material shall be furnished in accordance with Section [711](#).

714.9 CONVERSION OF QUANTITIES:

Volumetric conversions shall be accomplished in accordance with Section [713](#).

-End of Section -

SECTION 714

MICRO-SURFACING MATERIALS

714.1 GENERAL:

Micro-surfacing materials shall consist of a properly proportioned mixture of cationic polymer solids or latex modified asphalt emulsion, mineral aggregates, mineral filler, water, and other additives. Micro-surfacing is designed to provide skid resistant texture, improve surface friction and extend the service life of the existing pavement. Micro-surfacing allows for higher than normal application rates and/or multiple layer applications for rut filling and roadway leveling.

All material sources must be approved prior to their use. The Contractor shall submit a job mix formula, and if requested, pre-qualifications for materials at least seven days prior to start of construction. When requested, additional samples shall be furnished during the construction period at no cost to the Agency. This is a non-pay item.

714.2 AGGREGATE:

~~714.2.1 Mineral Filler: Mineral filler, as required by the mix design, shall be any recognized brand of non air-entrained Type I/II normal Portland cement that is free of lumps and clods, with a minimum of 85% passing the #200 sieve, added by weight of aggregate as specified by the mix design.~~

~~714.2.1 Mineral Filler: Mineral filler shall consist of finely divided matter, such as hydrated lime, Portland cement, limestone dust or fly ash, conforming to the requirements of ASTM D242. Mineral filler shall be used only when needed to reduce the setting time, to improve the workability or to reduce the stripping characteristics of the aggregate emulsion mixture. The minimum amount of the required filler shall be used and it shall be considered as part of the blended aggregate.~~

~~A certificate shall be submitted with the job mix formula demonstrating conformance to the requirements of ASTM D242.~~

~~714.2.2 Mineral Aggregate: Coarse and fine aggregates or approved mineral filler shall be per Section 701. Aggregates shall be 100% crushed with no rounded particles. No natural sand shall be allowed. The use of recycled asphalt (RAP) may be used with prior approval of the Engineer. The mineral aggregate shall conform to the requirements of Table 714-1. for gradation only. Application rates shall be 18-24 pounds of aggregate/square yard for Type II, and 24-35 pounds/square yard for Type III. Historical test data from source aggregate may be used, if tested within the past year.~~

~~The mineral aggregate and mineral filler shall have a sand equivalency value not less than 50 (ASTM D2419) and be non-plastic.~~

~~**Type I.** This aggregate gradation is used to seal and fill minor surface voids.~~

~~**Type II.** This aggregate gradation is used to fill surface voids, address surface distresses, seal, and provide a durable wearing surface.~~

~~**Type III.** This aggregate gradation provides maximum skid resistance and an improved wearing surface. This type of surface is appropriate for heavily traveled pavements, rut filling, or for placement on highly textured surfaces requiring larger size aggregate to fill voids.~~

If more than one kind of aggregate is used, the correct amount of each kind of aggregate needed to produce the required gradation shall be proportioned separately in a manner that shall result in a uniform and homogeneous blend. The final blended aggregate shall meet the above requirements of Table 714-1.

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TABLE 714-1				
MICRO-SURFACING AGGREGATE				
GRADATION TEST METHOD ASTM C136 / C117				
SIEVE SIZE	TYPE I % PASSING	TYPE II % PASSING	TYPE III % PASSING	PRODUCTION TOLERANCES
3/8	100	100	100	
No. 4	100	85-100	70-90	+/- 5%
No. 8	90-100	65-90	45-70	+/- 5%
No. 16	65-90	45-70	28-50	+/- 5%
No. 30	40-60	30-50	19-34	+/- 5%
No. 50	25-42	18-30	12-25	+/- 4%
No. 100	15-30	10-21	7-18	+/- 3%
No. 200	10-20	5-15	5-15	+/- 2%

ASTM TEST METHOD	TEST	REQUIREMENTS
D2419	Sand Equivalent	50, minimum
D5821	Fractured Faces	100%
D4318	Plasticity Index	NP
C131	L.A. Abrasion	35 percent, maximum
Arizona 238	Percent Carbonates	20 percent, maximum

The gradation of the aggregate stockpile shall not vary by more than the production tolerance from the job mix formula gradation (indicated in the table above) while also remaining within the specification gradation band.

714.3 WATER:

Water shall be potable water, free of any injurious impurities. The Contractor shall identify the water source to the Engineer.

714.4 ADDITIVES:

Additives may be used to accelerate or retard the breaking point and set times of the mix, or to improve the resulting finished surface.

The use of additives in the mix shall be supplied in quantities predetermined by the laboratory job mix formula.

714.5 BITUMINOUS MATERIAL:

~~The Polymerized modified Emulsion is a shall be slow quick setting, cationic type emulsion for mixing applications and seal coats. A minimum of 4% saturated polymer shall be high sheared into the asphalt prior to the emulsification process. The Agency may choose to sample the polymerized modified asphalt emulsion for testing. The amount of polymer shall be based on weight of polymer and asphalt (total weight) and be certified by the supplier. The polymer or latex modified emulsion shall shall meet the following specifications listed requirements specified in Table 714-1. Section 713.~~

The asphalt emulsion used for micro-surfacing shall meet the requirements specified in Section 713.

Each tank of emulsion produced shall be certified as to its compliance with these specifications; this certification shall include a certificate of analysis indicating the percent asphalt residue of each tank supplying emulsion to the project.

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This certificate of analysis shall accompany the placement machine and shall be provided to the Engineer upon request.

When required, the quick setting emulsified asphalt shall be of the cationic quick set type such as QSH, CQSH, PMCQS-1h or LMCQS-1h that shall react to chemically active mineral fillers such as Portland cement in such a way that the applied micro-surfacing mixture can support controlled traffic in 45-60 minutes after application. The amount of chemically active filler shall be determined by job mix formula and field performance.

714.46 MODIFIER TYPE AND CONTENT:

Table 714-1		
Polymerized Emulsion		
Test	AASHTO Method	Specification Limits
Tests on Emulsion		
Viscosity, SSF, @ 77°F. sec.	T59	15-100
Sieve Test, %	T59	0.30 Maximum
Particle Charge	T59	Positive
Storage Stability, 24 hr. %	T59	1.0 Maximum
Evaporation Residue, %	Arizona 512	60 Minimum
Tests on Evaporation Residue — Arizona 504		
Kinematic Viscosity 275°F. est	T201	650 Minimum
Penetration, 77°F 100g @ 5 sec	T49	40-90
Softening Point, degrees F.	T53	140 Minimum
Ductility, 77%, 5 cm/min.	T51	60 Minimum
Tests on Evaporation Residue after RTFO		
Kinematic Viscosity, 275°F. aging ratio, est	T201	2.5 Maximum
Softening Point, degrees F.	T53	140 Minimum
The emulsion, upon standing undisturbed for a period of twenty-four (24) hours, shall show no white or milky colored substance on its surface, and shall be a homogeneous brown color throughout.		

Modified cationic quick setting emulsion (PMCQS-1h or LMCQS-1h) shall be homogeneous and the modifier used shall consist of either a polymer solid milled into the asphalt or latex blended prior to the emulsification process. The PMCQS-1h and LMCQS-1h shall contain a minimum of 4% polymer solids or latex and shall conform to Section 713.

~~The asphalt cement shall contain a minimum of 4% solid polymer or latex by weight of asphalt residue, sheared into the asphalt prior to emulsification.~~

A certification of the polymer solids or latex content and type by the supplier shall be required throughout the duration of the contract. Each tank of emulsion produced shall be certified as to its compliance with these specifications; this certification shall be provided to the Agency. include a certificate of analysis indicating the percent asphalt residue of each tank supplying emulsion to the project. This certificate of analysis shall accompany the placement machine and shall be provided to the Engineer upon request.

Placement of micro-surfacing is temperature dependent and should be tested under field conditions.

714.5 WATER:

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~~Water shall be potable water, free of any injurious impurities. The Contractor shall identify the water source to the Agency.~~

714.6 ADDITIVES:

~~Additives may be used to accelerate or retard the breaking point and set times of the mix, or to improve the resulting finished surface.~~

~~The use of additives in the mix shall be supplied in quantities predetermined by the laboratory mix design.~~

714.7 JOB MIX FORMULA:

714.7.1 General: The job mix formula shall be designed to provide a suitable surface for traffic conditions, climate and curing. All materials shall be pre-tested in the laboratory to determine their suitability for use in the micro-surfacing. The job mix formula shall be evaluated using a minimum of three emulsion contents to determine which emulsion content shall yield the optimum emulsion content that meets the requirement of 714-2.

The report must clearly show the theoretical recommended proportion of aggregate, mineral filler (Minimum & Maximum), water (Minimum & Maximum), additive(s), and asphalt based on the dry weight of aggregate.

The Contractor shall provide a job mix formula from an AASHTO re:source accredited laboratory and present certified test results for the Engineer's approval. Compatibility of the aggregate and polymer solids or latex modified emulsion shall be certified by the emulsion manufacturer. All the materials used in the job mix formula shall be representative of the materials proposed by the Contractor for use in the project. The job mix formula shall not be older than one (1) calendar year. A new job mix formula shall be required if any material changes are made to the original design.

All the products used in the construction shall have certifications from the suppliers and shall be given to the Engineer upon delivery to the project.

Job mix formula and proportioning shall be approved by the Engineer prior to the start of the project.

714.7.2 Specifications:

The specification limits are as follows:

TABLE 714-2			
MICRO-SURFACING JOB MIX FORMULA			
ASTM TEST METHOD	ISSA TECHNICAL BULLETIN	TEST	REQUIREMENTS
D244		Residual Asphalt, % by dry weight of aggregate	6.0 – 11.5
D242		Mineral Filler, % by dry weight of aggregate.	0.1 – 2.0
		Modifier Content, % (see Section 714.6)	4, minimum.
		Additive	As required for mix properties
		Water	As required for mix properties
<u>C136 / C117</u>		Aggregate Grading	Meets requirements of Table 714-1
	TB-106	Consistency, cm.	2.5-3.0
	TB-100	Abrasion Loss (Wet Track Abrasion Test) One Hour Soak, g/ft ² Six Day Soak, g/ft ²	50, maximum 75, maximum
	TB-114	Wet Stripping, %	90, minimum
	TB-139	Wet Cohesion Test, at 77° F Set Time Test: (30 minutes), kg-cm Early Rolling Traffic Time: (60 minutes), kg-cm	12, minimum 20, minimum

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	TB-102	Quick Set Emulsion Mix Properties Micro-Surfacing Setting Test, 70-85 ° F. (1-hour cure) Micro-Surfacing Water Resistance Test, 70-85 ° F. (30-minute cure)	No Brown Stain No More Than Slight Discoloration
	TB-115	Split Consistency Test	Uniform
	TB-113	Mix Time Micro-Surfacing Mixing, 70-85 ° F., Sec.	120, minimum
	TB-147	Measurement of Stability and Resistance to Compaction, Vertical and Lateral Displacement of Multi-layered Fine Aggregate Cold Mixes	Lateral Displacement 5%, maximum Specific Gravity 2.10, maximum
	TB-109	Loaded Wheel Sand Adhesion	50 g/ft ² , maximum

714.7.2.1 Bulking Effect (ASTM C29 Modified): The laboratory shall further report the quantitative effects of moisture content in the unit weight of the aggregate (bulking effect).

~~*714.8.1 Composition of Micro-Surfacing Mixtures: The job mixture shall conform to the requirements of the contract documents. The mixture shall attain an initial set in not less than 5 minutes and not more than one hour. In cases where the surface is not critical to be open to traffic, a longer set time may be allowed, however not to exceed 12 hours. The setting time may be adjusted by the addition or removal of approved mineral fillers or chemical agents. The mixture shall be one of two (2) types whose combined aggregates conform to the graduation requirements of Table 714-L. The mixture shall be sufficiently free flowing to fill cracks in the pavement. The mixture shall not segregate during or after laydown. The mixture shall produce a skid resistant surface.*~~

714.78 TEST CERTIFICATES AND REPORTS:

Test certificates and reports for the bituminous material shall be furnished in accordance with Section [711.3](#).

714.9 CONVERSION OF QUANTITIES:

Volumetric conversions shall be accomplished in accordance with Section [713](#).

-End of Section -