1.0 DESCRIPTION

This item covers requirements for the in-place partial depth reclamation with emulsified asphalt stabilization of the existing asphalt concrete pavement, sizing, and mixing with binder and water (if required). The work also consists of spreading and compacting the recycled cold mixed bituminous mixture, in accordance with this Specification, to the lines, grades, thicknesses and cross sections as directed by the Engineer. The reclaimed asphalt pavement shall be recycled using a mobile recycling train. The Contractor is equally responsible for all other related operations that are necessary for completion of the work.

2.0 REFERENCES

All reference standards shall be current issue or latest revision at the first date of tender advertisement. This specification refers to the following standards, specifications or publications:

- Division 4, Section 1, Emulsified Asphalt
- Division 4, Section 4, Asphalt Concrete Hot Mixed - Hot Placed
- Superpave Asphalt Concrete End Product Specification
- AARA Basic Asphalt Recycling Manual
- Wirtgen Cold Recycling Manual
- Asphalt Institute; A Basic Asphalt Emulsion Manual - Manual Series No. 19
- ASTM C117, Test Method for Material Finer Than 75 μm Sieve in Mineral Aggregates by Washing
- ASTM C127, Test Method for Specific Gravity and Absorption of Coarse Aggregate
- ASTM C136, Test Method for Sieve Analysis of Fine and Coarse Aggregates
- ASTM D75, Practices for Sampling Aggregates
- ASTM D140, Practice for Sampling Bituminous Materials
- ASTM D244, Test Method for Emulsified Asphalts
- ASTM D1188, Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
- ASTM D2041, Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
- ASTM D2216, Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock
- ASTM D5821, Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
- CSA-A23.1M
- Occupational Health and Safety Act of Nova Scotia
- TPW TM-2 Test Method for the Petrographic Analysis of Coarse Aggregate
- TPW TM-12 Test Method for Determination of Indirect Tensile Strength of Recycled Asphalt Mixes

3.0 SUBMISSIONS

3.1 Emulsified Asphalt Requirements. The Contractor shall be responsible for sampling and providing the samples to the Department’s representative and ensuring that the asphalt emulsion meets the requirements of Division 4 Section 1 and those stipulated in this document.

4.0 MATERIALS

4.1 Reclaimed Asphalt Pavement. The reclaimed asphalt pavement material shall have one hundred percent (100%) passing the 37.5 mm sieve.

4.2 Emulsified Asphalt. The binder shall meet the requirements of the Departments Standard Specification, Division 4, Section 1 and those for the slow-setting cationic emulsions, CSS-1 or CSS-1H.

4.3 Corrective Aggregate. Corrective aggregate includes imported granular material spread on the road in order to improve the grading of the recycled material. The corrective aggregate shall conform to the physical requirements
stipulated in Division 4, Section 4 of the Standard Specification and a maximum 25% loss during the Micro-Deval test.

4.4 Emulsified Asphalt Mix. The percent by mass of the asphalt emulsion added to the unstabilized material shall be determined by the mix design, conducted by the Department, in accordance with the Wirtgen design procedure. The combined material constituents shall produce a mix conforming to the gradation requirements of Table 4.1. The Marshall air void content of the compacted Emulsified Asphalt Mix shall be within 9-15%. Corrective aggregate shall be incorporated into the mix if the existing aggregate blend does not conform to the specified gradation as referenced in Table 4.1.

<table>
<thead>
<tr>
<th>Sieve Designation (mm)</th>
<th>Cumulative Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5</td>
<td>100</td>
</tr>
<tr>
<td>4.75</td>
<td>35 - 65</td>
</tr>
</tbody>
</table>

Table 4.1: Combination Gradation

Samples of Emulsified Asphalt Mix will be tested for bulk density, maximum theoretical density, air void content, dry indirect tensile strength, wet indirect tensile strength and tensile strength ratio. Laboratory prepared samples shall be prepared and cured in accordance with the Wirtgen Cold Recycling Manual before determining the strength properties. The Emulsified Asphalt Mix shall meet the requirements of Table 4.2.

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum Strength (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Indirect Tensile Strength</td>
<td>200</td>
</tr>
<tr>
<td>Wet Indirect Tensile Strength</td>
<td>100</td>
</tr>
<tr>
<td>Tensile Strength Ratio</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 4.2: Emulsified Asphalt Mix Strength Requirements


4.6 Supplementary Additives. At the discretion of the Department, and as identified in the Mix Design, conditions at the time of stabilization, may require the addition of hydrated lime or Portland cement.

5.0 CONSTRUCTION METHODS

5.1 Equipment.

5.1.1 Partial Depth Reclamation and Stabilizing Equipment. Partial Depth Reclamation shall be undertaken by use of a single unit or multi-unit recycling train. The recycling unit shall consist of a cold milling machine, material sizing and mixing capability and a means to convey the processed material directly to the paver. The single unit or multi-unit recycling train shall be capable of ensuring that 100% of the reclaimed asphalt concrete passes the 37.5 mm sieve by way of sizing or screening the oversize material.

5.1.2 Cold Milling Machine. A self-propelled cold milling unit with a cutting drum capable of reclaiming a lane width of asphalt pavement in a single pass, to the depth specified in the Special Provisions, shall be used. The unit shall also be automatically controlled for grade and slope.

5.1.3 Mixing Unit. The mixing unit shall be equipped with a means of measuring the mass or volume of material being deposited into the mixer prior to the addition of the binder. The mixing unit shall have an emulsified asphalt control system equipped with a flow metre calibrated in litres per tonne and a total delivery metre calibrated in litres to continuously maintain the required amount of emulsified asphalt added to within 0.2% by mass of the reclaimed material feed. The mixing unit shall be equipped with a means of monitoring and controlling the addition of water. The mixing unit shall also be equipped with a device capable of producing a uniform and thoroughly blended stabilized mix.
5.1.4 Placement Equipment. Placement of the stabilized mix shall be carried out by means of a self-propelled mechanical paver capable of spreading the material in one continuous pass. The stabilized mix shall be conveyed directly to the paver. The paver shall be equipped with distributing screws for distributing the mixture evenly in front of the screed. The paver shall have a vibratory or tamping bar screed capable of vibrating the full width of mix placed. Construction of windrows and use of material pick-up equipment shall not be allowed.

5.1.5 Compaction Equipment. The Contractor shall select the appropriate compaction equipment to achieve the required compaction. Along curbs, manholes and similar structures and locations not accessible to full size rollers, the mix shall be compacted with smaller compaction equipment, such as vibrating plate tampers, or by hand tampers.

5.1.6 Tankers for the Supply of Emulsified Asphalt. Only tankers with a capacity exceeding 10,000 litres shall be employed to supply the recycling machine with emulsion. Each tanker shall be fitted with two recessed pin-type tow hitches, one in front and the other behind, thereby allowing the tanker to be pushed from behind by the recycling machine, and to push a water tanker in front. Leaking tankers shall not be permitted on the site. In addition, each tanker shall be equipped with:

- A thermometer to show the temperature of the contents in the bottom third of the tank;
- A rear feed valve, with a minimum internal diameter of 75 mm when fully opened, that is capable of draining the contents of the tank;
- All-round cladding to retain heat;
- A heating system capable of raising the temperature of the contents of the tank 200°C per hour; and
  A calibrated dipstick, marked at intervals of no more than 100 litres, for measuring the contents of the tank.

5.1.7 Water Tankers. The number of tankers shall be balanced with the size of the job: Pumps for filling with water shall have a minimum capacity of 500 litres per minute. The minimum internal capacity of the supply hoses shall be 100 mm. The hoses shall be flexible and non-collapsing under suction. The hoses shall also have quick-release couplings.

5.2 Placement and Compaction. The surface of the stabilized mix shall be uniform in texture and free of segregation, contamination, ravelling, rutting, pot-holing, cracking and other surface defects. The mix shall be spread to the profile and cross section as directed by the Engineer. The compacted surface of the mix shall be smooth and true to the specified crown and grade.

The stabilized mix shall be compacted to ensure that the density of the mix is in accordance with Section 6.6 determined from the recovery and testing of representative field samples.

5.3 Operational Constraints. In-place partial depth reclamation including mixing, shaping and compacting shall be completed across the full pavement width prior to terminating operations each day.

The Contractor shall ensure the temperature of the emulsion is maintained in accordance with the manufacturer’s recommendation. In no case shall the temperature of the emulsion fall below 60°C. Temperature of emulsion shall be checked on every load. The emulsion stabilized mix shall cure for a minimum of 48 hours.

Soft spots or areas of compacted emulsified asphalt mix exhibiting deflection, rutting, sagging or cracking shall be removed full depth and repaired with suitable, free-draining granular material. The repair work shall be approved by the Engineer prior to placement of the wearing surface.

The Contractor shall not place the emulsified asphalt mix during rain, when the surface is frozen, when there is free-standing water present, or when the ambient temperature is below 10°C.

Traffic, including construction traffic, shall be kept off the freshly placed emulsion stabilized mat until it is able to carry traffic without damage. The Contractor shall be responsible for repair of the damaged mat.

Placement of the surfacing course may commence at such time when the stabilized mix can support a fully loaded, tandem truck with minimum deflection, extracted representative specimens have met mix design targets, and all defective areas, including contamination, ravelling, rutting, pot-holing, cracking, have been repaired to the satisfaction of the Engineer. Asphalt concrete repaving shall commence, in a continuous operation until completion, within a time limit of ten (10) calendar days of completion of the Partial Depth Reclamation operation provided the mix meets the requirements of this specification.
Asphalt pavement in areas inaccessible to the reclaiming equipment shall be removed and replaced with an equivalent thickness of Type B-HF or Type C-HF asphalt concrete mix or equivalent mix approved by the Engineer.

5.4 Joint Preparation. All deleterious and loose milled material shall be removed from the milled surfaces at longitudinal and transverse joints after reclaiming operations are completed and before placing the stabilized mix.

5.5 Surface Appearance. The surface of the mat shall be of uniform texture and free of segregation, longitudinal streaks, fat spots, oil spills, roller or other heavy equipment marks and other defects. Final smoothness is the responsibility of the Contractor.

5.6 Heating. The stabilized mix may be heated with drying units. Overheating or charring of the mix shall not be allowed.

6.0 QUALITY CONTROL / QUALITY ASSURANCE

At the completion of a 48-hour curing period, representative specimens measuring 150 mm by 150 mm will be extracted from the stabilized mix. Testing shall be carried out by the Department. Samples will be used to determine compliance for thickness, tensile strength, asphalt binder content and compaction. In-situ moisture contents and compacted density shall be determined by the recovery and testing of slab samples of the cured mixture at locations and frequencies determined by the Department.

6.1 Mix Design Formulation. Sample recovery and mix design formulation will be conducted by the Department or its representative. Mix designs will be conducted in accordance with procedures outlined in the latest version of the Wirtgen Cold Recycling Manual.

6.2 Emulsified Asphalt. The supplied emulsified asphalt samples shall be in accordance with the Department's Standard Specification, Division 4 Section 1 or as outlined in this Specification.

Failure of the sample to conform to any of the material requirements shall be cause for rejection of the material. The mix that has incorporated emulsified asphalt represented by the failed test result shall be deemed unacceptable and remedial measures shall include removal and replacement of the deficient mix shall apply, as directed by the Engineer.

Samples of emulsified asphalt shall be taken by the Contractor at the job site from the tanker(s). The number of tankers sampled will be at the Engineer’s discretion. The sampling will be witnessed by the Engineer or the Engineer’s representative. The sample shall be taken from a sampling spigot on the transfer line, if available, or from the end of the transfer line. The sample will comprise two full 4 litre containers, and shall be properly labelled. Samples shall be delivered within three (3) days of sampling to the designated testing laboratory at no additional cost to the Department.

The sample containers as supplied by the Contractor shall be triple tight epoxy lined pails or suitable leak proof plastic containers.

6.3 Sampling and Testing of Corrective Aggregate. The Department shall conduct sampling and testing to ensure that corrective aggregate incorporated into the mix meets the physical property requirements of Division 4 Section 4.

6.4 Sampling and Testing of the Emulsified Asphalt Mix. The Department or its representative shall conduct sampling and testing to ensure that the Emulsified Asphalt Mix meets the requirements of this specification. Samples shall be taken at a frequency determined by the Engineer.

6.5 Thickness. The Department or its representative shall conduct all testing to ensure that the Emulsified Asphalt Mix meets the thickness requirements specified in the Contract Documents. Thickness measurements will be taken by the Engineer at a frequency determined by the Engineer. Thickness will be checked during production by hand excavation and also will be measured by collecting representative specimens measuring 150 mm by 150 mm. Thickness requirements are met when no individual thickness measurement is 20 mm less than the specified thickness. Individual sub-lots failing to meet the requirements shall be subject to reprocessing to the satisfaction of the Engineer.

6.6 Compaction. The Department or its representative shall conduct all testing to ensure that the Emulsified Asphalt Mix meets 83% of the maximum theoretical density. The frequency of maximum theoretical density testing as well as
the frequency of compaction testing shall be determined by the Engineer. The testing shall be conducted by the use of a properly calibrated nuclear gauge in accordance with ASTM D2950 using the direct transmission procedure. At each test location the material will be tested at a depth of at least 50 mm above the bottom of the stabilised layer. At least 4 readings will be taken at each test location, each reading being 90° to the previous reading. The field moisture content will be determined by procedures outlined in ASTM D2216. Compaction will also be measured by collecting representative specimens measuring 150 mm by 150 mm. Individual sub-lots failing to meet the requirements, shall be subject to reprocessing to the satisfaction of the Engineer. Compaction requirements are met when:

- The mean compaction is greater than or equal to 83% of the maximum theoretical density; and
- No individual compaction measurement for the lot is less than 79% of the maximum theoretical density.

6.7 Emulsified Asphalt Mix. The Department will test retrieved Emulsified Asphalt Mix samples for total asphalt binder content, aggregate gradation and tensile strength with the relevant ASTM Test Methods outlined in this specification. Samples of Emulsified Asphalt Mix will also be tested for bulk density, maximum theoretical density, and air void content. Field samples shall be tested for wet and dry indirect tensile strength.

6.8 Surface Defects. The Department will assess the completed work prior to application of the riding surface. Defects such as ravelling, segregation, contamination, bleeding shall be evaluated by the Engineer. Corrective action shall be undertaken by the Contractor in accordance with the required remedial action outlined in Table 6.1 and at no cost to the Department. It is the responsibility of the Contractor to meet the established cross-slopes and grades. After compaction, the surface of the mat shall be free from deviations exceeding 6 mm, as measured in any direction with a 3 metre straight edge. Final smoothness of the recycled mat is the full responsibility of the Contractor. Repairs shall be for the full width of the recycled area to the depth specified in the Contract documents. Reprocessing may be considered as a repair method, upon submission of a proposal by the Contractor and approval by the Engineer.

### Table 6.1: Required Remedial Actions

<table>
<thead>
<tr>
<th>Defect</th>
<th>Severity</th>
<th>Remedial Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ravelling / Coarse Aggregate Loss</td>
<td>Very slight to slight</td>
<td>Corrective action required</td>
</tr>
<tr>
<td></td>
<td>Moderate to severe (1)</td>
<td>Mill 50 mm and replace with the same asphalt concrete mix and spread rate specified for the surface course</td>
</tr>
<tr>
<td></td>
<td>Very severe (2)</td>
<td>Remove all stabilized mix and return to grade with asphalt concrete mix specified for the surface course</td>
</tr>
<tr>
<td>Segregation</td>
<td>Slight to moderate</td>
<td>Corrective action required</td>
</tr>
<tr>
<td></td>
<td>Severe (3)</td>
<td>Mill 50 mm and replace with the same asphalt concrete mix and spread rate specified for the surface course</td>
</tr>
</tbody>
</table>

(1) Moderate to severe ravelling is defined as shallow disintegration of pavement structure with shallow potholes.
(2) Very severe ravelling is defined as significant disintegration of pavement structure with full depth potholes.
(3) Severe segregation is defined as a distinctly inconsistent texture, having an absence of aggregate fines in the matrix and coarse aggregate (stone on stone contact).
*Alternate repair methods proposed by the Contractor must be approved by Highway Construction Services*

7.0 METHOD OF MEASUREMENT

The quantity of Emulsified Asphalt Mix to be measured for payment will be the area in square metres placed at the specified depth outlined in the Contract Documents. The quantity of emulsion and corrective aggregate to be measured for payment shall be in tonnes.
8.0 BASIS OF PAYMENT

Partial Depth Reclamation with Emulsified Asphalt Stabilization will be paid for at the Contract unit price per square metre for the stabilized mix actually incorporated and accepted in the work which price shall be full compensation for furnishing and transporting all of the materials including, handling, placing and compacting of all materials, water where required, the supply of all equipment, labour and incidentals necessary to complete the work. The Contractor is also responsible for costs associated with providing a fully loaded tandem truck and appropriate traffic control for the purposes of proof rolling. Payment also includes removal of existing asphalt concrete and supply and placement of hot mix asphalt concrete in areas inaccessible to the reclaiming equipment.

Asphalt emulsion will be paid as a separate item, based on residual asphalt content, and verified by the Contractor’s daily weigh slips plus appropriate documentation from the supplier to verify the amount in the last tanker.

Hot mix asphalt required to replace unacceptable stabilized mix shall be considered incidental to this item and no additional payment shall be made.

Corrective aggregate, for gradation modification, will be paid up to a maximum allowable unit price per tonne, as detailed in the Contract Special Provisions, plus the truck haul rate per tonne for gravel, established in the Special Provisions, for approved corrective aggregate incorporated and accepted in the work. The price shall be full compensation for furnishing of all materials, equipment, plant, labour and incidentals, including traffic control, necessary to complete the work to the satisfaction of the Engineer.

The Contractor is fully responsible to bear all costs associated with repair of areas rejected by the Engineer, including all materials, equipment, plant, labour, traffic control and incidentals necessary to complete the to the satisfaction of the Engineer.

9.0 WARRANTY