1.0 DESCRIPTION

This item covers requirements for the in-place full depth reclamation of the existing asphalt concrete pavement and underlying granular base; shaping and compacting the unstabilized material, adding and blending corrective aggregate if required, adding expanded asphalt, mixing, placing and compacting the expanded asphalt mix in accordance with the following specifications and the lines, grades, thicknesses, and cross-sections described in the Contract. 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 2, Performance Graded Asphalt Binder (PGAB)
- 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
- 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 D1188, Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
- ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
- ASTM D2041, Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
- ASTM D2216, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D2950, Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
- ASTM D4791, Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
- ASTM D5444, Test Method for Mechanical Size Analysis of Extracted Aggregate
- 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 PGAB Requirements. The Contractor shall be responsible for sampling and providing the samples to the Department’s representative and ensuring that the Performance Graded Asphalt Binder (PGAB) meets the requirements of the Departments Standard Specification, Division 4, Section 2.

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 Performance Graded Asphalt Binder (PGAB). The Contractor shall utilize a PG58-28 Asphalt Binder with suitable expansion characteristics. The PG58-28 shall conform to the requirements of Division 4, Section 2 of the Standard Specification.
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 Expanded Asphalt Mix (EAM). The total asphalt binder content of the design mix includes the existing aged binder and virgin expanded PG58-28. The percent by mass of the virgin PG58-28 added to the unstabilized material shall be determined by mix design. 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 Expanded 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 4.1: Combination Gradation

<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>

Samples of Expanded Asphalt Mix will be tested for bulk density, maximum theoretical density, air void content, dry tensile strength, wet 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 Expanded Asphalt Mix shall meet the requirements of Table 4.2.

### Table 4.2: Expanded Asphalt Mix Strength Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum Strength (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Indirect Tensile Strength</td>
<td>300</td>
</tr>
<tr>
<td>Wet Indirect Tensile Strength</td>
<td>150</td>
</tr>
<tr>
<td>Tensile Strength Ratio</td>
<td>50</td>
</tr>
</tbody>
</table>


4.5 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 Full Depth Reclamation and Stabilizing Equipment. The reclaimer / stabilizer shall be capable of reclaiming the existing pavement and underlying granular material to a minimum depth of 300 mm, incorporating the corrective aggregate into the mix if required, adding expanded asphalt in a controlled manner, and producing a uniform mix.

The reclaimer / stabilizer shall be fitted with an automatic sensor system to accurately maintain a pre-set depth of cut and have a minimum 2.0 m wide cutting drum.

The aggregate delivery vehicle shall have a system for controlled applications of the corrective aggregates to be incorporated into the mix.

The reclaimer / stabilizer shall have an expanded asphalt injection system capable of injecting and blending expanded asphalt uniformly throughout the unstabilized material.

In order to mix the unstabilized material with the expanded asphalt, the reclaimer / stabilizer shall include the following features:
• A system to control and regulate the application of expanded asphalt in relation to the travel speed and mass of material
• A system to monitor and control all aspects of the mixing process (% of asphalt binder, rate of application, % water for optimum compaction)
• A heating system to maintain operating temperature
• A system of nozzles that provides a uniform application of the expanded asphalt across the full width of the treatment area. The application system shall be adjustable for varying widths of treatment
• The system shall be equipped with a test nozzle capable of producing a replicate sample of the foamed bitumen being injected into the recycling machine.

5.1.2 Spreading Equipment. Distribution of the processed material shall be carried out by a means of a grader capable of spreading the mix to the specified cross-fall and grade. The grader shall be equipped with an automated grade control system. Construction of windrows and use of material pick-up equipment shall not be allowed.

5.1.3 Placement Equipment. Placement of the Expanded Asphalt Mix (EAM) shall be carried out by means of a self-propelled mechanical paver capable of spreading the material in one continuous pass or a grader as specified in section 5.1.2 of this specification. 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 consolidating the full width of mix placed. Construction of windrows and use of material pick-up equipment shall not be allowed.

5.1.4 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. The compaction process shall also include a vibrating/tamping foot roller in the compaction train as specified in table 5.1.

<table>
<thead>
<tr>
<th>Thickness of Compacted Layer (mm)</th>
<th>Minimum Static Mass of Rollers (tons)</th>
<th>Drum Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 150</td>
<td>12</td>
<td>Smooth</td>
</tr>
<tr>
<td>&gt;150 and &lt;200</td>
<td>15</td>
<td>Smooth or Padfoot</td>
</tr>
<tr>
<td>≥200 and &lt;250</td>
<td>18</td>
<td>Padfoot</td>
</tr>
<tr>
<td>≥250</td>
<td>20</td>
<td>Padfoot</td>
</tr>
</tbody>
</table>

5.1.5 Tankers for the Supply of PGAB. Only tankers with a capacity exceeding 10,000 litres shall be employed to supply the recycling machine with PGAB. 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 calibrated dipstick, marked at intervals of no more than 100 litres, for measuring the contents of the tank.

The Contractor shall ensure that the supplier of the PGAB certify that anti-foaming agents have not been added to loads destined for use in expanded asphalt.

5.1.6 Water Tankers. The number of tankers shall be balanced with the size of the job; generally, at least two 10,000 litre capacity tankers for the supply of compaction water such that one tanker is coupled to the recycling train while the other is filling from the nearest suitable water source. 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 Full Depth Reclamation and Stabilization. The Contractor shall reclaim and stabilize the existing asphalt concrete pavement and underlying granular base to the limits described in the Contract Documents. Corrective aggregate, if required, shall be added to the roadway prior to stabilization. The existing material shall be stabilized to a depth of 150 mm, or as specified in the Contract. The overlap between successive passes of the reclaimer / stabilizer shall be a minimum of 100 mm. Unstabilized material exceeding 37.5 mm in size shall be removed from the surface of the reclaimed material.

The Contractor shall be required to recycle the entire roadway pavement area, including the tapers, radii and widening. This may require modifications or specially adapted equipment to complete the work. All areas not recycled must have existing pavement excavated and replaced with Type C-HF or Type B-HF asphalt concrete, all at the unit price for Expanded Asphalt Stabilization.

5.3 Placing, Grading and Compacting. The surface of the expanded asphalt mix shall be uniform in texture and free of segregation, contamination, ravelling, rutting, pot-holing, cracking, and other surface defects. The expanded asphalt mix shall be spread to the profile and cross section as specified in the Contract Documents or as approved by the Engineer. The compacted surface of the expanded asphalt surface 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.

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

Soft spots or areas of compacted expanded 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.

Traffic, including construction traffic, shall not be allowed on the freshly placed expanded asphalt mix until such time as it is able to carry traffic without damage.

Placement of the surfacing course may commence at such time when the stabilized mix can support a fully loaded, tandem truck with minimum deflection, and all defective areas, including contamination, raveling, 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 Full 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 and/or Type C-HF asphalt concrete mix or equivalent mix approved by the Engineer.

5.5 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 EAM.

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

6.0 QUALITY CONTROL / QUALITY ASSURANCE

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 PGAB Testing. The Contractor shall be responsible for all sampling and ensuring that the PGAB meets the requirements of this specification. QA Samples of PGAB shall be taken by the Contractor at the job site from one tanker randomly selected by the Engineer. The sample shall be taken from a sampling spigot on the tanker. Alternative sampling procedure may be considered at the Contractor’s request and as approved by the Engineer.

The sample will comprise two full one (1) litre containers, and shall be properly labelled.
Sample containers shall be supplied by the Contractor and shall consist of triple tight steel containers or suitable leak-proof containers, which can be sealed to prevent leakage.

QA samples shall be delivered within three (3) working days of sampling to the designated QA testing laboratory.

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 Expanded Asphalt Mix. The Department or its representative shall conduct sampling and testing to ensure that the Expanded 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 Expanded 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 D 2216. 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 Expanded Asphalt Mix. The Department will test retrieved Expanded Asphalt Mix samples for total asphalt binder content, aggregate gradation and tensile strength with the relevant ASTM Test Methods outlined in this specification. The percent by mass of new asphalt binder added to the Expanded Asphalt Mix will be determined from companion samples collected before and after the addition of expanded asphalt. Samples of Expanded 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</td>
<td>Very slight to</td>
<td>Corrective action required</td>
</tr>
<tr>
<td>Aggregate Loss</td>
<td>slight</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate to</td>
<td>Mill 50 mm and replace with the same asphalt concrete mix and spread rate</td>
</tr>
<tr>
<td></td>
<td>severe (1)</td>
<td>specified for the surface course</td>
</tr>
<tr>
<td></td>
<td>Very severe (2)</td>
<td>Remove all stabilized mix and return to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>grade with asphalt concrete mix specified for the surface course</td>
</tr>
<tr>
<td>Segregation</td>
<td>Slight to</td>
<td>Corrective action required</td>
</tr>
<tr>
<td></td>
<td>moderate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severe (3)</td>
<td>Mill 50 mm and replace with the same asphalt concrete mix and spread rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>specified for the surface course</td>
</tr>
</tbody>
</table>

(1) Moderate to severe ravelling is defined as shallow disintegration of pavement structure with shallow pot-holes.
(2) Very severe ravelling is defined as significant disintegration of pavement structure with full depth pot-holes.
(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 Expanded 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 PGAB and corrective aggregate to be measured for payment shall be in tonnes.

8.0 BASIS OF PAYMENT

Full Depth Reclamation with Expanded Asphalt will be paid for at the contract unit price per square metre at the specified depth for mix incorporated and accepted in the work, which price will be full compensation for, mobilization of all equipment, pulverizing the existing asphalt concrete to the specified depth, supply and addition of water to maintain Optimum Moisture Content, supply and addition of water to suppress dust, grading, compaction of mix to the specified density, re-grading and repair as directed by the Engineer, the supply of all equipment, plant, labour and incidentals, including traffic control necessary to complete the work to the satisfaction of the Engineer. 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 material and supply and placement of hot mix asphalt in areas not accessible to the reclaiming equipment.

Performance Graded Asphalt Binder (PGAB) will be paid as a separate item. Compensation to the Contractor will be based on 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 EAM 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