Amendment to OPSS 331, November 2003

OPSS 331, November 2003, Construction Specification for Full Depth Reclamation with Expanded Asphalt Stabilization, is deleted in its entirety and replaced with the following:

331.01   SCOPE

This Special Provision covers the requirements for in-place full-depth reclamation of the existing asphalt pavement and underlying granular base; shaping and compacting the unstabilized material; if required, adding and blending corrective aggregates and/or active fillers; adding and mixing expanded asphalt; and shaping and compacting the expanded asphalt mix.

331.02   REFERENCES

This Special Provision refers to the following standards, specifications, or publications:

**Ontario Provincial Standard Specifications, General**

OPSS 180  Management and Disposal of Excess Material

**Ontario Provincial Standard Specifications, Construction**

OPSS 301  Restoring Unpaved Roadway Surfaces
OPSS 313  Hot Mix Asphalt - End Result
OPSS 501  Compacting

**Ontario Provincial Standard Specifications, Material**

OPSS 1010  Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1101  Performance Graded Asphalt Cement
OPSS 1301  Material Specification for Cementing Materials

**Ministry of Transportation Publications**

MTO Laboratory Testing Manual:

LS-200  Penetration of Bituminous Materials
LS-282  Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-292  Quantitative Determination of Asphalt Cement Content by Ignition and Analysis of Remaining Aggregate From Bituminous Paving Mixtures
LS-297  Determination of Indirect Tensile Strength of Expanded Asphalt Mixes
LS-602  Sieve Analysis of Aggregates
LS-625  Sampling of Granular Materials
Ontario Traffic Manual

OTM Book 7  Temporary Conditions

American Association of State Highway and Transportation Officials (AASHTO)

R 29-08  Grading or Verifying the Performance Grade of an Asphalt Binder
T40-02  Sampling Bituminous Materials

ASTM International

D 3665-07  Standard Practice for Random Sampling of Construction Materials

Other Publication

Wirtgen Cold Recycling Technology manual, 3rd edition, 2010

331.03   DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Active Filler means substances that chemically alter the mix properties.

CCIL means as defined in OPSS 313.

Corrective Aggregate means virgin aggregate or reclaimed asphalt pavement (RAP) or both added to the reclaimed existing asphalt pavement and granular base to meet the expanded asphalt mix requirements.

Expanded Asphalt means heated asphalt cement expanded from its normal volume by the addition of water.

Expanded Asphalt Mix (EAM) means the mixture of reclaimed existing asphalt pavement; granular base; if required, corrective aggregate; and expanded asphalt.

Performance Graded Asphalt Cement (PGAC) means as defined in OPSS 313.

Quality Assurance (QA) means as defined in OPSS 313.

Quality Control (QC) means as defined in OPSS 313.

Unstabilized Material means the mixture of reclaimed existing asphalt pavement, granular base, and if required, corrective aggregate.

331.04   DESIGN AND SUBMISSION REQUIREMENTS

331.04.01  Design Requirement

For mix design purposes, prior to commencing the work the Contractor shall obtain samples representative of the material that will be produced during in-place full-depth reclamation. These samples shall be used to establish the design rate of expanded asphalt as a percent by mass of the unstabilized material and to establish the necessity for corrective aggregate and/or active filler.
The design rate of the expanded asphalt shall be a minimum of 2.8%. The dry tensile strength shall be a minimum of 225 kPa and the wet tensile strength shall be a minimum of 100 kPa. The tensile strength ratio shall be a minimum of 50%.

Mix design shall be carried out in accordance with the Wirtgen Cold Recycling Technology manual, 3rd edition, 2010 using briquettes produced according to LS-297. The mix design work shall be completed by a laboratory that holds a current certificate from CCIL as Type A and is equipped to carry out expanded asphalt mix designs.

Each mix design shall include the following:

a) Information on the grade, manufacturer, and supplier of the PGAC.

b) The percent by mass of expanded asphalt in the mix, referred to as the design rate, and all calculations performed to determine the design rate of expanded asphalt.

c) The recommended PGAC temperature for foaming, the half life, the expansion ratio and the percent of water added for foaming.

d) The optimum moisture content and mix design bulk relative density.

e) The dry tensile strength, wet tensile strength, and tensile strength ratio.

f) The amount of water to be added to the mix.

g) Maximum field rate adjustment allowed to the design rate without adverse affects to mix properties.

h) Recovered penetration for the binder of the existing pavement.

i) Type, source, gradation and quantity of corrective aggregate, if required.

j) Type, source and quantity of active filler, if required.

331.04.02 Submission Requirement

The mix design shall be submitted by the Contractor to the Contract Administrator at least 7 Working Days prior to the start of the work. Where more than one mix design is required, the area for which each mix design is to be used shall be clearly identified.

A new mix design shall be submitted when the expanded asphalt design rate is adjusted by 0.3% or greater. Separate or new mix designs shall be submitted if the composition of the existing pavement changes significantly.

331.05 MATERIALS

331.05.01 Performance Graded Asphalt Cement

The Contractor shall select a PGAC with suitable expansion characteristics. PGAC shall be according to the requirements of OPSS 1101, excluding PGAC zone requirements.
331.05.02 Corrective Aggregates

If required by the mix design, corrective aggregate shall be incorporated into the reclaimed existing asphalt pavement at the application rate determined in the mix design. Corrective aggregate shall meet the physical property requirements of OPSS 1010 for Granular A.

331.05.03 Active Filler

If required by the mix design, active filler shall be incorporated into the reclaimed existing asphalt pavement at the application rate determined in the mix design.

When Portland cement is used as an active filler it shall be according to the requirements of OPSS 1301. No more than one percent by mass of Portland cement shall be added to the mix.

331.05.04 Water

Water shall be clean and free from oil, acid, alkali, organic matter or other deleterious substances.

331.05.05 Expanded Asphalt Mix

The percent by mass of new PGAC added to the unstabilized material shall be a minimum of 2.8%.

The EAM shall meet the gradation requirements of Table 1 and the tensile strength requirements of Table 2.

Testing of the EAM shall be conducted by a CCIL accredited Type B laboratory.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Gradation Requirements for Expanded Asphalt Mix (LS-602)</th>
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</thead>
<tbody>
<tr>
<td>MTO Sieve Designation</td>
<td>Percentage Passing by Mass</td>
</tr>
<tr>
<td>37.5 mm</td>
<td>98 - 100</td>
</tr>
<tr>
<td>26.5 mm</td>
<td>95 - 100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>35 - 65</td>
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<tr>
<td>600 μm</td>
<td>15 - 40</td>
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<tr>
<td>75 μm</td>
<td>7 - 15</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Expanded Asphalt Mix Physical Requirements</th>
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<tbody>
<tr>
<td>Property</td>
<td>Minimum Requirement</td>
</tr>
<tr>
<td>Dry Tensile Strength (kPa)</td>
<td>225</td>
</tr>
<tr>
<td>Wet Tensile Strength (kPa)</td>
<td>100</td>
</tr>
<tr>
<td>Tensile Strength Ratio (TSR %)</td>
<td>50</td>
</tr>
</tbody>
</table>
331.06 EQUIPMENT

331.06.01 Full-Depth Reclamation and Stabilization Equipment

The reclaimer-stabilizer shall be capable of reclaiming the existing asphalt pavement and underlying granular base to the depths specified in the Contract Documents, incorporating corrective aggregate into the mix, 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 preset depth of cut within a tolerance of 10 mm and shall have a minimum 2.0 m wide cutting drum.

The reclaimer-stabilizer shall have an asphalt cement expansion system capable of producing optimum expansion and an 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) A system to control and regulate the application of expanded asphalt in relation to travel speed and mass of material within a tolerance of ± 3.0% by volume of asphalt cement.

b) A system to monitor and control all aspects of the mixing process, including percent expanded asphalt, rate of application, and percent water for optimum compaction.

c) A system of nozzles that provides uniform application of the expanded asphalt across the full width of treatment. The application system shall be adjustable for varying widths of treatment.

The aggregate delivery vehicle shall have a system for controlled application of the corrective aggregate.

Placing of the expanded asphalt mix shall be carried out by means of a self-propelled mechanical paver capable of spreading the mix evenly in front of the screed in one continuous pass to the specified cross-fall and grade. The paver shall be equipped with distributing augers for the full width to be paved. The paver shall have a vibratory screed capable of vibrating the full width of mix placed.

331.06.02 Pilot Vehicle

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

331.07 CONSTRUCTION

331.07.01 In-Place Full-Depth Reclamation

The existing asphalt pavement and underlying granular base shall be reclaimed to the depths and widths specified in the Contract Documents.

The graded surface of the reclaimed material, including existing shoulders shall be according to the surface tolerance requirements of OPSS 301. Reclaimed material exceeding 50 mm in size shall be removed from the work. The material shall be compacted according to OPSS 501.
331.07.02  Expanded Asphalt Trial Section

Prior to carrying out expanded asphalt stabilization on the Contract, the Contractor shall demonstrate to the Contract Administrator the ability to successfully carry out expanded asphalt stabilization according to this special provision by placing a trial section within the Contract limits.

In lieu of a trial section, the Contract Administrator may accept evidence that the Contractor has demonstrated the ability to successfully mix, handle, place, and compact EAM with the same equipment, placing crew, and methodology to meet the Contract requirements for placing EAM on another Contract within the last 12 months.

The trial section shall be a minimum of 3,500 m² or the equivalent of one tanker load of asphalt cement. The Contractor shall propose the location of the trial section to the Contract Administrator for approval. The Contractor shall give the Contract Administrator a minimum of 48 hours notice prior to placing the trial section.

Provided the EAM trial section meets the requirements of this special provision, the trial section shall be considered acceptable. Otherwise, the Contractor shall be required to repeat additional trial sections until the EAM meets the requirements of this special provision. The Contractor shall be responsible for all costs associated with the repair, removal or replacement of an unacceptable trial section, including material, testing and management of surplus materials in accordance with the requirements of OPSS 180.

The Contract Administrator may allow the Contractor to begin expanded asphalt stabilization on the Contract based on a visual assessment of the EAM trial section.

331.07.03  Expanded Asphalt Stabilization

The Contractor shall stabilize to the depth and limits detailed in the Contract Documents. The overlap between successive passes of the reclaimer-stabilizer shall be a minimum of 100 mm and a maximum of 150 mm.

If required, corrective aggregate shall be added to the roadway prior to stabilizing.

In areas that are inaccessible to the reclaimer-stabilizer equipment, existing asphalt pavement shall be removed and replaced with a minimum 100 mm of binder course hot mix placed flush with the adjacent EAM surface.

331.07.04  Grading and Compacting the Expanded Asphalt Mix

The surface of the EAM shall be uniform in texture and free of surface defects.

The material shall be compacted to a minimum of 97% of the target density as determined in OPSS 501 for granular materials.

The compacted surface of the EAM shall be according to the surface tolerances specified in OPSS 301. Regrading of the EAM to correct crossfall deficiencies shall be minimized.

331.07.05  Operational Constraints

In-place full depth reclamation including mixing, shaping and compacting to final grade shall be completed across the full pavement width prior to closing down operations each day.
The existing shoulders shall be shaped and compacted to match the adjacent lane prior to closing down operations each day.

The wearing surface shall not be placed until the EAM has been allowed to cure for a minimum of 2 Days, the Contractor has demonstrated that the EAM meets all the requirements of this special provision, and all defective areas, including ravelling and rutting, have been repaired to the satisfaction of the Contract Administrator.

Traffic, including construction traffic, shall be kept off the freshly placed EAM until such time as it is able to carry traffic without damage. Expanded asphalt stabilization shall not proceed during periods of rain or when the surface is in a saturated condition.

331.07.06 Sampling

The Contractor shall be responsible for all sampling.

331.07.06.01 Lot Size

The lot size shall be a maximum of 50,000 m² of expanded asphalt stabilization divided into 10 sublots of equal size. The lot size may be adjusted at the discretion of the Contract Administrator and after discussion with the Contractor, prior to starting the work and when changes occur in the mix design or in the sequence of expanded asphalt stabilization. The maximum subplot size shall be 5,000 m². The minimum number of sublots in a lot shall be three.

331.07.06.02 Performance Graded Asphalt Cement

For information purposes, samples of PGAC to be used in the mix shall be taken in the presence of the Contract Administrator at the source prior to loading the tankers at a frequency of one set of samples per Contract. Each set of samples shall be a minimum of 2 full one-litre portions.

Sample containers supplied by the Contractor shall be triple tight steel containers or suitable containers that can be sealed to prevent leakage or contamination.

Samples of the PGAC used in the mix shall be obtained, properly labelled and identified, and delivered to the designated QA testing laboratory as specified in the Contract Documents. Samples of PGAC shall be taken according to AASHTO T40 and ASTM D 3665 and tested according to AASHTO R29-08 Section 7.

331.07.06.03 Corrective Aggregate

Where the quantity of corrective aggregate is greater than 5,000 tonnes, two 25 kg samples shall be taken in the presence of the Contract Administrator for each 25,000 tonnes of material produced, and whenever material is produced from a new source or new bench in a quarry, or whenever a significant change in production of materials occurs.

QA samples shall be taken in accordance with procedures given in LS-625 and at the time and location determined by the Contract Administrator.

Samples of the corrective aggregate shall be obtained, properly labelled and identified, and delivered to the designated QA testing laboratory as specified in the Contract Documents.
331.07.06.04 Active Filler

The Contract Administrator may take samples of active filler to demonstrate conformance to the requirements of this special provision.

331.07.06.05 Expanded Asphalt Mix

Samples of unstabilized material and EAM shall be taken at a minimum frequency of one set of samples per sublot. To obtain a set of samples, the Contractor shall take one 15 kg sample of unstabilized material immediately following in-place full depth reclamation and, from the same approximate location, a second 15 kg sample of EAM immediately following stabilization. The maximum sampling depth shall be 100 mm. The second sample may be obtained after placement and prior to compaction.

The samples shall be packaged in non-absorptive materials to protect sample integrity, sealed, appropriately labelled, and delivered by the Contractor in good condition to the designated QA testing laboratory specified in the Contract Documents.

331.07.07 Traffic Convoy

The Contractor shall convoy traffic according to the OTM, Book 7.

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

331.08 QUALITY ASSURANCE

331.08.01 General

Acceptance shall be based on QA testing. QA samples shall be obtained by the Contractor in the presence of the Contract Administrator. The Contract Administrator may apply security seals to the QA samples. The Contractor is responsible for transporting these samples in a manner to avoid damage to the samples.

331.08.02 Acceptance of Corrective Aggregate

QA testing shall be carried out to ensure that corrective aggregate to be used in the work conforms to the physical property requirements of Granular A according to OPSS 1010.

331.08.03 Acceptance of the Expanded Asphalt Mix

331.08.03.01 Asphalt Cement Content

For each sublot, the sample of unstabilized material taken immediately following in-place full depth reclamation and the sample of EAM taken immediately after stabilization, shall be tested for total asphalt cement content in accordance with LS-282 or LS-292. The total asphalt cement content of the EAM includes existing aged binder and new asphalt cement. The percent by mass of new asphalt cement added to the unstabilized material shall be determined from the two samples at each location by subtracting the total asphalt cement content of the unstabilized material from the total asphalt cement content of the EAM.

The average new asphalt cement content of a lot shall not be less than 0.4% or more than 0.6% of the established mix design.
331.08.03.02  Tensile Strength

Samples of EAM shall also be tested for dry tensile strength, wet tensile strength, and tensile strength ratio in accordance with LS-297.

Dry tensile strength requirements for the lot are met when the following are satisfied:

a) The mean dry tensile strength of the lot is equal to or greater than 225 kPa; and
b) No individual sublot dry tensile strength is less than 200 kPa.

Wet tensile strength requirements for the lot are met when the following are satisfied:

a) The mean wet tensile strength of the lot is equal to or greater than 100 kPa; and
b) No individual sublot wet tensile strength is less than 75 kPa.

The tensile strength ratio shall not be less than 50%.

331.08.04  Acceptance of Thickness

Thickness of the EAM shall be measured by the Contract Administrator at a minimum frequency of one QA thickness measurement per sublot. Measurements shall be taken by excavating along the edge of the stabilized pass with a shovel and measuring the depth of stabilization from the bottom of the EAM to the surface of the adjacent unstabilized material. Thickness requirements for the lot are met when the following are satisfied:

a) At least 90% of all thickness measurements are equal to or greater than the specified thickness minus 20 mm, and
b) No individual thickness measurement for the lot is less than the specified thickness minus 30 mm.

331.08.05  Acceptance of Compaction

Compaction measurements shall be taken by the Contract Administrator according to OPSS 501 for granular materials and at a frequency of one QA measurement per sublot. Compaction requirements for the lot are met when the following are satisfied:

a) The lot average of all compaction measurements is greater than or equal to 97% of the target density; and
b) No individual compaction measurement for the sublot is less than 95% of the target density.

Mixes that cannot be compacted to the specified density shall be removed to a minimum depth of 50 mm and replaced by an appropriate HMA approved by the Contract Administrator. Where it is determined that the compaction cannot be achieved due to poor subgrade conditions, the Owner will be responsible for the cost of repairs.
331.08.06  Repairing and Re-Decisioning

With the exception of repairs for surface tolerance, the minimum width of repair shall be the full width of the reclaimer-stabilizer equipment. The minimum length shall be sufficient for the repair to be carried out. All repairs shall be made using the same equipment as was used during initial production and placement.

To meet the specified surface tolerance, all deficient areas shall be re-profiled by milling or padded with the same hot mix type to be used in the overlying hot mix lift.

Unacceptable EAM, including any area damaged or contaminated by traffic or by natural or added water shall be reprocessed and if required, additional expanded asphalt added. Alternatively, the Contractor shall remove and replace damaged or otherwise unacceptable EAM with the same hot mix type to be used in the overlying hot mix lift to a minimum depth of 50 mm in accordance with OPSS 313.

331.09  MEASUREMENT FOR PAYMENT

331.09.01  Full-Depth Reclamation with Expanded Asphalt Stabilization

Measurement shall be by Plan Quantity as may be revised by Adjusted Plan Quantity of the horizontal areas in square metres of the expanded asphalt stabilization.

331.10  BASIS OF PAYMENT

331.10.01  Full-Depth Reclamation with Expanded Asphalt Stabilization - Item

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

The addition of corrective aggregate, active filler or other additives to the mix shall be at no additional cost to the Owner.

HMA required to replace unacceptable EAM shall be at no extra cost to the Owner.

PGAC shall be included in the FDR with EAM item.

Repair of unacceptable EAM shall be carried out at no extra cost to the Owner.

Repair of areas of EAM damaged by traffic shall be completed at no extra cost to the Owner.

Repair, removal, or replacement of an unacceptable trial section shall be completed at no extra cost to the Owner.