MATERIAL SPECIFICATION FOR
SUPERPAVE AND STONE MASTIC ASPHALT MIXTURES

TABLE OF CONTENTS

1151.01 SCOPE
1151.02 REFERENCES
1151.03 DEFINITIONS
1151.04 DESIGN AND SUBMISSION REQUIREMENTS
1151.05 MATERIALS
1151.06 EQUIPMENT - Not Used
1151.07 PRODUCTION
1151.08 QUALITY ASSURANCE - Not Used
1151.09 OWNER PURCHASE OF MATERIAL - Not Used

APPENDICES

1151-A Commentary

1151.01 SCOPE

This specification covers the requirements for the materials, equipment, and methods to be followed for proportioning and mixing hot mix asphalt, recycled mixes, and mixes for miscellaneous work according to the Superpave and SMA mix design methodology.

1151.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.
1151.01.02 Appendices Significance and Use

Appendices are not a mandatory part of this specification unless invoked by the Owner.

**Appendix 1151-A** is a commentary appendix to provide designers with information on the use of this specification in a Contract.

### 1151.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

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

**Ontario Provincial Standard Specifications, Construction**

OPSS. 313  Hot Mix Asphalt - End Result

**Ontario Provincial Standard Specifications, Material**

OPSS 1001  Aggregates - General
OPSS 1003  Aggregates - Hot Mix Asphalt
OPSS 1101  Performance Graded Asphalt Cement

**Ministry of Transportation, Ontario, 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-284  Recovery of Asphalt from Solution by Abson Method or Rotavapor
- LS-292  Quantitative Determination of Asphalt Cement Content by Ignition and Analysis of Remaining Aggregate From Bituminous Paving Mixtures
- LS-309  Superpave Mix Design
- LS-311  Stone Mastic Asphalt Mix Design
- LS-316  Mix Check
- LS-602  Sieve Analysis of Aggregates
- LS-603  Resistance To Degradation Of Coarse Aggregate By Abrasion And Impact In The Los Angeles Abrasion Machine

**ASTM International**

C 612-04  Standard Specification for Mineral Fiber Block and Board Thermal Insulation

**American Association of State Highway and Transportation Officials (AASHTO)**

MP 8-05  Standard Specification for Designing Stone Matrix Asphalt (SMA)
T 305-01  Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures
For the purpose of this specification, the following definitions apply:

**AMRL** means the AASHTO Materials Reference Laboratory.

**Anti-Stripping Additive** means hydrated lime and liquid anti-stripping additive used to minimize or eliminate stripping of asphalt cement from aggregates in HMA.

**Asphalt Binder** means as defined in OPSS 1101.

**Binder Course** means as defined in OPSS 313.

**CCIL** means the Canadian Council of Independent Laboratories.

**Coarse Aggregate** means that portion of aggregate material retained on the 4.75 mm sieve, when tested according to LS-602.

**Draindown** means as defined in OPSS 313.

**Field Adjustment to the JMF** means as defined in OPSS 313.

**Fine Aggregate** means that portion of aggregate material passing the 4.75 mm sieve when tested according to LS-602.

**Hot Mix Asphalt (HMA)** means as defined in OPSS 313.

**Independent Laboratory** means as defined in OPSS 313.

**Levelling Course** means as defined in OPSS 313.

**Maximum Aggregate Size** means one sieve size larger than the nominal maximum aggregate size.

**Mix Design** means the design of the proportions of aggregates, asphalt cement, and additives, when uniformly mixed, results in an acceptable HMA in accordance with the specified method.

**Nominal Maximum Aggregate Size (NMAS)** means one sieve size larger than the first sieve to retain more than 10% by mass.

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

**Primary Control Sieve (PCS)** means the sieve defining the break point between fine and coarse-graded mixtures for each nominal maximum aggregate size.

**Reclaimed Asphalt Pavement (RAP)** means as defined in OPSS 313.

**Recycled Hot Mix (RHM)** means as defined in OPSS 313.

**Roof Shingle Tabs (RST)** means as defined in OPSS 313.

**SMA Mixes** means as defined in OPSS 313.

**Stone Mastic Asphalt (SMA)** means as defined in OPSS 313.

**Stone Mastic Asphalt (SMA) Mortar** means as defined in OPSS 313.
Superpave means as defined in OPSS 313.

Surface Course means as defined in OPSS 313.

1151.04 DESIGN AND SUBMISSION REQUIREMENTS

1151.04.01 Design Requirements

1151.04.01.01 Mixture Requirements for Design Purposes

The Superpave mix designs shall be according to the requirements specified in Tables 1, 2, and 3; LS-309; and the traffic category specified in the Contract Documents. The JMF for Superpave mixes shall be according to the requirements specified in Tables 1, 2, and 3.

The SMA mix designs shall be according to the requirements specified in Tables 1, 4, and 5 and LS-311. The JMF for SMA mixes shall be according to the requirements specified in Tables 1, 4, and 5.

1151.04.01.02 Reclaimed Asphalt Pavement Proportions

Maximum RAP proportions in the mix design and JMF shall be according to the requirements of Table 6.

If the Contractor modifies the composition of the mix by including RAP to exceed 20% by mass of the total mixture, the high and low grade of the PGAC required shall both be lowered by 6 °C.

1151.04.01.03 Roof Shingle Tabs Proportions

The Contractor may substitute 0.10% RST for each 1.0% RAP permitted in the mix.

The use of up to 3.0% by mass of RST is permitted in SMA.

1151.04.01.04 Mix Design

1151.04.01.04.01 General

The mix design shall be the responsibility of the Contractor. The job-mix formulae selected for use by the Contractor shall produce HMA that meets all the requirements specified in the Contract Documents.

1151.04.01.04.02 Mix Design Method

1151.04.01.04.02.01 General

The Contractor shall use a laboratory that has current CCIL Type A Certification with CCIL Superpave Certified Technicians or AMRL equivalent certification to conduct all mix designs, mix design conformance, designate the mix proportions, and prepare the job-mix formulae. The Contractor may use a laboratory with other equivalent certification, if acceptable to the Owner.

The aggregate gradations used for the mix design may be provided by the Contractor or may be the actual gradations of the mix design aggregate samples. However, when the mix is to be produced from a plant that returns fines to the mixture or the aggregate gradations change during production due to aggregate breakdown, appropriate adjustments shall be made to the mix design gradations.
The Contractor shall conduct density testing of aggregates, RAP, and RST for the purpose of developing the mix design for each mix type in the Contract. Such testing may be performed during production of each aggregate, RAP and RST, or during stockpiling of the materials at the HMA plant. The individual test results, including the date of sampling, shall be included as part of the mix design submission. Only test results generated within 12 calendar months preceding the mix design shall be used.

RAP and RST as processed and ready for use in a HMA shall be tested by the Contractor using test LS-282 or LS-292 to determine the average percentage asphalt cement and the average gradation for the extracted RAP and RST aggregates.

1151.04.01.04.02 Superpave Mix Design Method

Superpave mixes shall be designed using the procedures specified in LS-309.

1151.04.01.04.02.03 Stone Mastic Asphalt Mix Design Method

SMA mixes shall be designed in accordance with LS-311. Cellulose or mineral fibres shall be used as a stabilizing additive in dosage rates of 0.3% or 0.4%, respectively, by mass of the total mixture. Regardless of the type of fibre used, the Contractor shall follow the manufacturer’s recommendations for any product used.

1151.04.01.05 Changes to the Job-Mix Formula and the Mix Design

Changes to the JMF shall be permitted subject to the conditions specified in the Contract Documents.

A new mix design shall be completed according to the Mix Design clause under the Submission Requirements subsection, when:

a) A material is eliminated.

b) A new material is added.

c) A material source is changed.

d) The net impact of all adjustments to the original JMF exceeds any of the maximum field adjustments according to OPSS 313.

1151.04.01.06 Anti-Stripping Additives

1151.04.01.06.01 General

Anti-striping additive shall be added to the mix at the greater of the dosages specified below or as specified in the Contract Documents.

1151.04.01.06.02 Moisture Sensitivity

Moisture sensitivity shall meet the tensile strength ratio requirements specified in Tables 3 and 4.

1151.04.01.06.03 Hydrated Lime

Irrespective of any moisture sensitivity testing that shows that anti-stripping additive is not required, hydrated lime (Ca(OH)\(_2\)) shall be included in all mixes consisting of more than 75% quartzite and dolomitic sandstone aggregates or combinations thereof.

Coarse and fine aggregates crushed within the last 30 Days shall not be incorporated into SMA or Superpave 12.5FC 2, unless hydrated lime is added to the mix.
When moisture sensitivity testing determines that an anti-stripping additive is required for SMA or Superpave 12.5FC 2 mixes, hydrated lime shall be used as the anti-stripping additive.

When hydrated lime is used as the anti-stripping additive, the dosage shall be the greater of

a) the amount determined to meet the moisture sensitivity requirements, or

b) one percent by mass of total dry aggregate.

1151.04.01.06.04 Liquid Anti-Stripping Additive

When hydrated lime is not required as an anti-stripping additive in the mix and is not used as the anti-stripping additive, liquid anti-stripping additive shall be used in the mix, if

a) mix moisture sensitivity testing indicates anti-stripping additive is required, or

b) the Contract Documents note that an anti-stripping additive is required.

The amount of liquid anti-stripping additive to be used in the mix shall be the greater of

a) the amount required to meet the required Superpave moisture sensitivity requirements, or

b) 0.5% by mass of asphalt cement.

1151.04.02 Submission Requirements

1151.04.02.01 Mix Design

The Contract Administrator shall be provided with a copy of all mix design and JMF documents, which shall be signed, dated, and certified correct by the person accountable for the engineering and management responsibility for the laboratory that conducted the work.

The mix design submission shall include certification from an independent laboratory stating that:

a) the independent laboratory prepared all samples and conducted all testing required by the laboratory procedure for the mix check according to LS-316 to determine the values of mix and aggregate properties listed in Table 7; and

b) the mix meets the requirements and tolerances given in Table 7.

The certification shall bear the seal and signature of the independent laboratory’s supervising Engineer. It shall be submitted to the Contract Administrator using MTO Form PH-CC-822IMC, Certificate of Independent Check of Mix Design. It shall be accompanied by the test results and calculated values obtained for the properties listed in Table 7.

The Contract Administrator shall review the mix design and the JMF documents. The mix shall not be placed until the Contract Administrator gives a written confirmation of conformance of the submitted mix design documents and JMF to the Contract requirements for the mix design. Within 4 Business Days, commencing after the day of delivery of all required documents and all samples, the Contract Administrator shall provide the above confirmation or advise the Contractor of any non-conformance to the contract requirements in writing.

Confirmation of conformance to Contract requirements of the submitted mix design does not constitute any guarantee that the mix can be produced or constructed or both to Contract requirements, and does not relieve the Contractor of the responsibility for ensuring the specified quality of Materials and workmanship.
1151.04.02.02  Samples for Monitoring Purposes

At the written request of the Contract Administrator, one set of material samples representative of those used for mix design shall be submitted by the Contractor to the laboratory specified in the Contract Documents. The materials shall be delivered within 2 Days of the request made by the Contract Administrator or within 2 Days of submission of the mix design to the Contract Administrator, whichever is the later.

Each material sample shall be packaged separately and each filled sample container shall have a maximum mass of 25 kg.

The sample quantities are specified in Table 8.

1151.05  MATERIALS

1151.05.01  Asphalt Cement

Asphalt cement shall be performance graded asphalt cement according to OPSS 1101.

1151.05.02  Aggregates

Aggregates shall be according to OPSS 1003.

1151.05.02.01  Reclaimed Asphalt Pavement and Roof Shingle Tabs

RAP, when permitted in a HMA, shall be according to the aggregate requirements of OPSS 1003 for the mix type specified in the Contract Documents. Absorption, freeze thaw, and magnesium sulphate requirements do not apply to RAP.

RST, when permitted in a HMA, shall meet the requirements of Table 9.

RAP and RST that are contaminated with deleterious material shall not be used and shall be removed from the work. RAP and RST shall be stockpiled conforming to the stockpiling requirements for coarse aggregates according to OPSS 1001, except that when the material is stockpiled on a compacted granular pad, the top 75 mm of the pad shall be the coarse aggregate that is required for a new (virgin) mixture of the tendered hot mix item.

The use of RAP and RST that are obtained from existing stockpiles that do not have a foundation conforming to the above paragraph shall be permitted, provided that the bottom 0.3 m of the stockpile is not incorporated into the work.

Process control sampling and testing of the RAP and RST shall be as specified in the Contract Documents.

When RST is used in the HMA, it shall be processed solely from manufactured shingle scrap and shall be free of all contamination.

1151.05.03  Silicone

When added to the asphalt cement, silicone oil shall be less than five parts per million of asphalt cement.

1151.05.04  Filler

Filler shall be according to OPSS 1003.
Fibres shall be either cellulose or mineral fibres. Cellulose and mineral fibres shall meet the requirements shown in Tables 10 and 11, respectively. The use of fiberglass, rock wool, and asbestos is prohibited.

1151.07 PRODUCTION

1151.07.01 Anti-Stripping Additives

1151.07.01.01 Liquid Anti-Stripping Additives

If the liquid anti-stripping additive is added by the asphalt cement supplier at the refinery depot, for each tanker of asphalt cement, the Contractor shall provide the Contract Administrator with the anti-stripping additive and PGAC Document and documentation from the asphalt cement supplier, in the form of a weighbill or bill of lading, confirming the type and concentration of the liquid anti-stripping agent.

If the liquid anti-stripping additive is added at the HMA plant, the Contractor shall provide the Contract Administrator with documentation from the HMA plant confirming the type and concentration of the liquid anti-stripping additive, accompanied by an approved statement of calibration for the metering device and a continuous record of the process prior to placement of mix containing liquid anti-stripping additive for each batch of asphalt cement with the liquid anti-stripping agent added.

1151.07.01.02 Hydrated Lime

When hydrated lime is added to the mix, it shall be added to all aggregates requiring an anti-stripping additive by any of the following methods:

a) Lime Slurry Method:

Hydrated lime shall be homogeneously mixed with aggregate prior to entering the dryer at the HMA plant. The hydrated lime slurry shall consist of approximately one part hydrated lime and three parts water, by mass. The HMA plant shall be equipped with suitable pumps or mixers to maintain the suspension of hydrated lime in the slurry and shall have adequate spray bars for introducing the required quantity of slurry into the aggregates. Mixing shall be accomplished with a pugmill or drum-type mixer, which has a mixing chamber and the capability of retaining material during the mixing process until a uniform and homogeneous mixture of slurry and aggregate has been obtained.

b) Wetted Aggregate Method:

Dry hydrated lime shall be homogeneously mixed with wetted aggregate prior to entering the dryer at the HMA plant. The wetted coarse and fine aggregate shall be sufficiently wet to ensure uniform and complete adhesion of lime to the aggregate. Mixing shall be accomplished with a pugmill, a drum-type mixer, or other mixing device approved by the Owner, which has a continuous or batch mixing chamber that retains material during the mixing process until a uniform and homogeneous coating of lime on the aggregate has been obtained. The Contractor shall submit a written request to the Contract Administrator asking for approval of a mixing device at least 15 Days prior to the start of mix production. Processes or mixing devices that do not provide retention time of materials in a mixing chamber shall not be used.
c) Blending During Aggregate Production:

Hydrated lime shall be mixed with wetted aggregate at the pit or quarry prior to delivery of the aggregate to the HMA plant, by a method approved by the Owner prior to the start of any mix production. The blending process shall produce aggregates that are uniformly and homogeneously coated with the quantity of hydrated lime specified in the Contract Documents. The Contractor or the aggregate supplier or both shall implement and maintain a quality control system and records that demonstrate compliance with the Contract. The Owner may reject Materials if they fail to meet the quality control or blending requirements or both.

Regardless of the method or mixing equipment used, the Contractor shall ensure through regular quality control sampling and inspection that the specified quantity of lime is being incorporated into the mixture and that the aggregates possess a uniform and homogeneous coating of hydrated lime free of clumps and balls prior to entering the dryer at the HMA plant.

Aggregate which was treated and stored from a previous season may be used only after the Contract Administrator agrees to a written proposal from the Contractor that verifies the effectiveness of the stored aggregate, including the sampling protocol used, and test results from those samples that indicate that the aggregates meet the moisture sensitivity requirements specified in this specification.

1151.07.02 Preparation of the Mixture

Proportioning and mixing of materials shall be of sufficient accuracy and duration to produce a uniform homogeneous mixture in which all particles of the aggregate are thoroughly and uniformly coated.

The temperature of the mixture as it is discharged from the mixing chamber shall be controlled within the temperature range that corresponds to a viscosity range of $170 \text{ mm}^2/\text{sec} \pm 20 \text{ mm}^2/\text{sec}$ for the incorporated asphalt cement, except for modified asphalt cement the maximum discharge temperature shall be according to the asphalt cement supplier’s recommendations.
### TABLE 1
Aggregate Gradation

<table>
<thead>
<tr>
<th>Hot Mix Asphalt Type</th>
<th>Percentage Passing by Dry Mass of Aggregates</th>
<th>Sieve Size mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50.0</td>
<td>37.5</td>
</tr>
<tr>
<td>Superpave 4.75</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Superpave 9.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Superpave 12.5, 12.5FC 1, and 12.5FC 2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Superpave 19.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Superpave 25.0</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Superpave 37.5</td>
<td>100</td>
<td>90-100</td>
</tr>
<tr>
<td>SMA 9.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SMA 12.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SMA 19.0</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:

1. Requirements for the 4.75 mm sieve are in addition to those normally used for Superpave.

2. For the SMA 9.5 mm the maximum percentage passing the 1.18 mm, 0.600 mm, and 0.300 mm sieves is 21, 18, and 15 respectively.

### TABLE 2
Superpave Gradation Primary Control Sieve Points

<table>
<thead>
<tr>
<th>Hot Mix Asphalt Type</th>
<th>Primary Control Sieve mm</th>
<th>PCS Control Point At % Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superpave 4.75</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Superpave 9.5</td>
<td>2.36</td>
<td>47</td>
</tr>
<tr>
<td>Superpave 12.5, 12.5FC 1, and 12.5FC 2</td>
<td>2.36</td>
<td>39</td>
</tr>
<tr>
<td>Superpave 19.0</td>
<td>4.75</td>
<td>47</td>
</tr>
<tr>
<td>Superpave 25.0</td>
<td>4.75</td>
<td>40</td>
</tr>
<tr>
<td>Superpave 37.5</td>
<td>9.5</td>
<td>47</td>
</tr>
</tbody>
</table>
### TABLE 3
Superpave Hot Mix Asphalt Properties

<table>
<thead>
<tr>
<th>Traffic Category (Note 1)</th>
<th>% of Theoretical Maximum Specific Gravity</th>
<th>Voids in Mineral Aggregate (VMA) % minimum</th>
<th>Voids Filled with Asphalt (VFA) (Note 2) %</th>
<th>Dust to Binder Ratio (Note 3)</th>
<th>Minimum Tensile Strength Ratio %</th>
</tr>
</thead>
<tbody>
<tr>
<td>N&lt;sub&gt;initial&lt;/sub&gt;</td>
<td>N&lt;sub&gt;design&lt;/sub&gt;</td>
<td>N&lt;sub&gt;max&lt;/sub&gt;</td>
<td>Nominal Maximum Aggregate Size mm 37.5</td>
<td>25.0</td>
<td>19.0</td>
</tr>
<tr>
<td>A</td>
<td>≤ 91.5</td>
<td>96.0</td>
<td>≤ 98.0</td>
<td>11.0</td>
<td>12.0</td>
</tr>
<tr>
<td>B</td>
<td>≤ 90.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>≤ 89.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

2. For Traffic Categories C, D, and E Superpave 9.5 mixes shall have a VFA range of 73 to 76%, while Superpave 4.75 mixes shall have a VFA range of 75 to 78%.
3. For Superpave 4.75 mixes, the dust-to-binder ratio shall be 0.9 to 2.0. Superpave mixes with gradations that pass beneath the PCS Control Point in Table 4, the dust-to-binder ratio shall be 0.8-1.6.
4. For Traffic Category A, Superpave 25.0 mixes shall have a VFA range of 67 to 80%.
5. Superpave 37.5 mixes shall have a VFA range of 64 to 75%.
### Table 4
#### Stone Mastic Asphalt Properties

<table>
<thead>
<tr>
<th>% Air Voids (Note 1)</th>
<th>Minimum Voids in Mineral Aggregate (VMA) %</th>
<th>Voids in Coarse Aggregate (VCA) of the Compacted Mixture %</th>
<th>Maximum Draindown at Production Temperature (Note 2) %</th>
<th>Minimum Tensile Strength Ratio %</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>17</td>
<td>Less than the VCA in the dry rodded condition.</td>
<td>0.3</td>
<td>70</td>
</tr>
</tbody>
</table>

**Notes:**

1. SMA mixes shall be designed with 100 gyrations, unless the mix aggregates has an L.A. Abrasion value according to LS-603 of greater than 30%, then the SMA mix shall be designed with 75 gyrations.

2. Tested according to AASHTO T 305.

### Table 5
#### Stone Mastic Asphalt Minimum Asphalt Content for Aggregates With Varying Bulk Specific Gravities

<table>
<thead>
<tr>
<th>Combined Aggregate Bulk Relative Density</th>
<th>Minimum Asphalt Content Based on Mass, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.40</td>
<td>6.8</td>
</tr>
<tr>
<td>2.45</td>
<td>6.7</td>
</tr>
<tr>
<td>2.50</td>
<td>6.6</td>
</tr>
<tr>
<td>2.55</td>
<td>6.5</td>
</tr>
<tr>
<td>2.60</td>
<td>6.3</td>
</tr>
<tr>
<td>2.65</td>
<td>6.2</td>
</tr>
<tr>
<td>2.70</td>
<td>6.1</td>
</tr>
<tr>
<td>2.75</td>
<td>6.0</td>
</tr>
<tr>
<td>2.80</td>
<td>5.9</td>
</tr>
<tr>
<td>2.85</td>
<td>5.8</td>
</tr>
<tr>
<td>2.90</td>
<td>5.7</td>
</tr>
<tr>
<td>2.95</td>
<td>5.6</td>
</tr>
<tr>
<td>3.00</td>
<td>5.5</td>
</tr>
</tbody>
</table>
### TABLE 6
Maximum Reclaimed Asphalt Pavement Proportions by Mass

<table>
<thead>
<tr>
<th>Traffic Category (Note 1)</th>
<th>Binder Course 150 mm or More Below Pavement Surface</th>
<th>Binder Course Within 150 mm of Pavement Surface</th>
<th>Surface Course Excluding Superpave 12.5FC 2, Superpave 12.5FC 1 and SMA</th>
<th>Superpave 12.5FC 2, Superpave 12.5FC 1 and SMA Surface Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>40%</td>
<td>40%</td>
<td>20%</td>
<td>0%</td>
</tr>
<tr>
<td>C, D</td>
<td>40%</td>
<td>20%</td>
<td>20%</td>
<td>0%</td>
</tr>
<tr>
<td>E</td>
<td>20%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Notes:

### TABLE 7
Mix Check Requirements

<table>
<thead>
<tr>
<th>Mix and Aggregate Property</th>
<th>Requirements (Note 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation of component aggregates</td>
<td>For information only</td>
</tr>
<tr>
<td>Bulk Relative Density (BRD) of (blended) coarse aggregate and (blended) fine aggregate, and the resulting BRD of the combined aggregate</td>
<td>For information only</td>
</tr>
<tr>
<td>Bulk Relative Density and Maximum Relative Density of Mix</td>
<td>For information only</td>
</tr>
<tr>
<td>Air voids at N_{design}</td>
<td>± 0.7% from submitted design</td>
</tr>
<tr>
<td>VMA</td>
<td>± 1.0% from submitted design and not more than 0.3% below design minimum</td>
</tr>
<tr>
<td>VFA</td>
<td>Within specified mix design range</td>
</tr>
<tr>
<td>%G_{mm} at N_{initial}</td>
<td>Not more than design maximum</td>
</tr>
<tr>
<td>%G_{mm} at N_{max}</td>
<td>Not more than design maximum</td>
</tr>
<tr>
<td>Dust Proportion</td>
<td>Within specified mix design range</td>
</tr>
<tr>
<td>Tensile Strength Ratio</td>
<td>Not less than design minimum</td>
</tr>
</tbody>
</table>

Notes:
1. Design requirements specified in the Contract Documents.
### TABLE 8
Sample Quantities for Mix Design Monitoring

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt cement</td>
<td>4 litres evenly split between 2 containers</td>
</tr>
<tr>
<td>Aggregate</td>
<td>75 to 100 kg of each type</td>
</tr>
<tr>
<td>RAP</td>
<td>75 to 100 kg required when RAP contained in the mix</td>
</tr>
<tr>
<td>Fines material passing 75 µm sieve</td>
<td>5 to 10 kg when the mix is to be produced with a plant that returns fines to the mixture</td>
</tr>
<tr>
<td>Mineral Filler</td>
<td>5 to 10 kg sample for SMA mixes</td>
</tr>
<tr>
<td>RST</td>
<td>10 to 15 kg required when RST contained in the mix</td>
</tr>
<tr>
<td>Any other material samples including anti-stripping agents and fibres to be used in HMA</td>
<td>Quantity large enough to allow for a complete mix design</td>
</tr>
</tbody>
</table>

### TABLE 9
Requirements for Roof Shingle Tabs

<table>
<thead>
<tr>
<th>Contents</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Cellulose or Mineral Fibres by Mass of RST</td>
<td>15-25</td>
</tr>
<tr>
<td>Percent Asphalt Cement Content Based on Mass (Note 1)</td>
<td>20-30</td>
</tr>
<tr>
<td>Percentage Passing by Dry Mass of Aggregate (Note 2)</td>
<td></td>
</tr>
<tr>
<td>9.5 mm sieve</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm sieve</td>
<td>90-100</td>
</tr>
<tr>
<td>600 µm sieve</td>
<td>45-60</td>
</tr>
<tr>
<td>75 µm sieve</td>
<td>15-25</td>
</tr>
</tbody>
</table>

Notes:
1. Asphalt cement recovered from the RST shall have a minimum penetration of 18 dmm according to LS-200 and LS-284.
2. As determined according to LS-282 or LS-292.
# TABLE 10
## Requirements for Cellulose Fibres

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sieve Analysis, Method A or B</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Method A, Alpine Sieve Analysis (Note 1)</strong></td>
<td></td>
</tr>
<tr>
<td>Fibre Length</td>
<td>6 mm maximum</td>
</tr>
<tr>
<td>Passing 0.150 mm sieve</td>
<td>70 ± 10%</td>
</tr>
<tr>
<td><strong>Method B, Mesh Screen Analysis (Note 2)</strong></td>
<td></td>
</tr>
<tr>
<td>Fibre Length:</td>
<td>6 mm maximum</td>
</tr>
<tr>
<td>Passing 0.850 mm sieve</td>
<td>85 ± 10%</td>
</tr>
<tr>
<td>Passing 0.425 mm sieve</td>
<td>65 ± 10%</td>
</tr>
<tr>
<td>Passing 0.106 mm sieve</td>
<td>30 ± 10%</td>
</tr>
<tr>
<td>Ash Content (Note 3)</td>
<td>18 ± 5% non-volatiles</td>
</tr>
<tr>
<td>pH (Note 4)</td>
<td>7.5 ± 1.0</td>
</tr>
<tr>
<td>Oil Absorption (Note 5)</td>
<td>5 ± 1.0, times fibre mass</td>
</tr>
<tr>
<td>Moisture Content (Note 6)</td>
<td>Less than 5%, by mass</td>
</tr>
</tbody>
</table>

**Notes:**

1. Method A, Alpine Sieve Analysis - This test is performed using an Alpine Air Jet Sieve, Type 200 LS. A representative 5-gram sample of fibre is sieved for 14 minutes at a controlled vacuum of 75 kPa of water. The portion remaining on the screen is weighed.

2. Method B, Mesh Screen Analysis - This test is performed using standard 0.850, 0.425, 0.250, 0.180, 0.150, and 0.106 mm sieves, nylon brushes, and a shaker. A representative 10-gram sample of fibre is sieved, using a shaker and two nylon brushes on each screen. The amount retained on each sieve is weighed and the percentage passing calculated.

3. Ash Content. A representative 2-3 gram sample of fibre is placed in a tared crucible and heated between 595 and 650 °C for no less than 2 hours. The crucible and ash are cooled in a desiccator and re-weighed.

4. A pH test - Five grams of fibre is added to 100 ml of distilled water, stirred and let sit for 30 minutes. The pH is determined with a probe calibrated with pH buffer of 7.0.

5. Absorption Test - 5 grams of fibre is accurately weighed and suspended in an excess of mineral spirits for no less than 5 minutes to ensure total saturation. It is then placed in a screen mesh strainer with an approximately 0.5 mm² opening size and shaken on a wrist action shaker for 10 minutes, approximately 32 mm motion at 240 shakes per minute. The shaken mass is then transferred without touching to a tared container and weighed. Results are reported as the amount, number of times its own weight, the fibres are able to absorb.

6. Moisture Content - 10 grams of fibre are weighed to an accuracy of 0.1 g and placed in a 121 °C forced air oven for two hours. The sample is then re-weighed upon removal from the oven.
TABLE 11
Requirements for Mineral Fibres

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Analysis</td>
<td></td>
</tr>
<tr>
<td>Fibre Length (Note 1)</td>
<td>6 mm maximum mean test value</td>
</tr>
<tr>
<td>Thickness (Note 2)</td>
<td>0.005 mm maximum mean test value</td>
</tr>
<tr>
<td>Shot Content (Note 3)</td>
<td></td>
</tr>
<tr>
<td>Passing 0.250 mm sieve</td>
<td>90 ± 5%</td>
</tr>
<tr>
<td>Passing 0.063 mm sieve</td>
<td>70 ± 10%</td>
</tr>
</tbody>
</table>

Notes:
1. The fibre length is determined according to the Bauer McNett fractionation of AASHTO MP 8.
2. The fibre thickness is determined by measuring at least 200 fibres in a phase contrast microscope.
3. Shot content is a measure of non-fibrous material. The shot content is determined on vibrating sieves. Two sieves, 0.250 mm and 0.063 mm, are typically used. For additional information see ASTM C 612.
Appendix 1151-A, Commentary for OPSS.PROV 1151, April 2007

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in the Contract.

Designer Action/Considerations
No information provided here.

Related Ontario Provincial Standard Drawings
No information provided here.