



**ONTARIO  
PROVINCIAL  
STANDARD  
SPECIFICATION**

**METRIC  
OPSS 1151  
NOVEMBER 2006**

**MATERIAL SPECIFICATION FOR  
SUPERPAVE AND STONE MASTIC ASPHALT MIXTURES**

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**1151.01 SCOPE**

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

**1151.01.01 Significance and Use of Appendices**

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 the specification in a Contract.

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

#### **Ontario Provincial Standard Specifications, Material**

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

#### **Ministry of Transportation Publications**

MTO Laboratory Testing Manual:

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-306	Bulk Relative Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
LS-603	Resistance to Degradation of Coarse Aggregate by Abrasion and Impact in the Los Angeles Abrasion Machine
LS-604	Relative Density and Absorption of Coarse Aggregate
LS-605	Relative Density and Absorption of Fine Aggregate
LS-629	Uncompacted Void Content of Fine Aggregate

#### **American Association of State Highway and Transportation Officials**

M 320-05	Standard Specification for Performance Graded Asphalt Binder
MP 8-05	Standard Specification for Designing Stone Matrix Asphalt (SMA)
PP 28-03	Practice for Designing Superpave Volumetric Design for HMA
PP 41-02(2004)	Standard Practice for Designing Stone Matrix Asphalt (SMA)
R 35-04	Standard Practice for Superpave Volumetric Design for Hot Mix Asphalt (HMA)
T 84-00(2004)	Specific Gravity and Absorption of Fine Aggregate
T 85-91(2004)	Specific Gravity and Absorption of Coarse Aggregate
T 166-05	Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
T 209-05	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
T 275-91(2000)	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
T 283-03	Resistance of Compacted Bituminous Mixtures to Moisture Induced Damage
T 304-96(2004)	Uncompacted Void Content of Fine Aggregate
T 305-97(2001)	Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures
T 312-04	Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyrotory Compactor

#### **ASTM International**

C 612-04	Standard Specification for Mineral Fiber Block and Board Thermal Insulation
D 6752-03	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method

#### **Asphalt Institute Publications**

Superpave Series:

SP-2	Superpave Mix Design Method
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## National Cooperative Highway Research Program

NCHRP Report 452      Recommended Use of Reclaimed Asphalt Pavement in the Superpave Mix Design Method, Technician's Manual

### 1151.03                      DEFINITIONS

For the purpose of this specification, the following definitions apply:

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

**Binder Course** means an HMA course between a surface course and either a granular base course or stabilized base course, an existing pavement, or another HMA binder course.

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

**Chip** means an aggregate product, predominantly containing material passing the 6.7 mm sieve and retained on the 4.75 mm, 2.36 mm, and 1.18 mm sieves.

**Draindown** means that portion of SMA mix, fines, and asphalt cement that separates and flows downwards through the mix.

**Equivalent Single Axle Load (ESAL)** means equating the damage to a pavement structure caused by the passage of a non-standard load to a standard 80 kN axle load.

**Field Adjustment to the JMF** means adjustments to the target gradation or asphalt cement content or both of a mix without a redesign of the HMA, resulting in a revised job-mix formula (JMF).

**Hot Mix Asphalt (HMA) Types** means Superpave and SMA mixes, including Superpave 4.75, 9.5, 12.5, 12.5 FC1, 12.5 FC2, 19.0, 25.0, and 37.5 and SMA 9.5, 12.5, and 19.0.

**Job-Mix Formula (JMF)** means the percentage passing on each designated sieve of the total mass of aggregate and the amount of asphalt cement as a percentage by mass of the mix that are based on specified mix design procedures that when mixed result in a paving mix that is according to this specification.

**Levelling Course** means an HMA course of variable thickness used to eliminate transverse and longitudinal irregularities on an existing surface prior to placing an HMA binder or surface course.

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

**Mixes for Miscellaneous Work** means HMA used for miscellaneous work such as the paving of shoulders, boulevards, and sidewalks and the construction of curb and gutter and spillways. These mixes do not meet normal HMA gradation and mix design requirements.

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

**Performance Graded Asphalt Cement (PGAC)** means an asphalt binder that is an asphalt-based cement produced from petroleum residue, either with or without the addition of non-particulate modifiers according to AASHTO M 320.

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

**Reclaimed Asphalt Pavement (RAP)** means the processed HMA material that is recovered by partial or full depth removal.

**Surface Course** means the HMA wearing course of any flexible or composite pavement.

**Stone Mastic Asphalt (SMA) Hot Mix Types** means SMA 9.5, 12.5, and 19.0 mixes.

**Stone Mastic Asphalt or Stone Matrix Asphalt (SMA)** means HMA consisting of two parts of a coarse aggregate skeleton and an asphalt binder rich mortar. The mix has a gap graded aggregate skeleton with coarse aggregate stone-on-stone contact.

**Stone Mastic Asphalt (SMA) Mortar** means a mix of asphalt cement and any additives; filler, including all material passing the 75 µm sieve from the dry sieving of all aggregate components, including any commercial filler; and fibres blended by volume to the proportions required by the JMF.

**Superpave** means an acronym for Superior Performing Asphalt Pavements. It is an alternative system to the Marshall method for specifying material components and asphalt mix design using the Superpave gyratory compactor.

**Voids in the Coarse Aggregate (VCA)** means the volume in-between the coarse aggregate particles which includes filler, fine aggregate, air voids, asphalt binder, and fibres. For SMA, the coarse aggregate particles refer to that portion retained on the 4.75 mm sieve.

## **1151.04 SUBMISSION AND DESIGN REQUIREMENTS**

### **1151.04.01 Mix Requirements for Design Purposes**

The Superpave mix designs shall be according to the requirements specified in Tables 1, 2, 4, 5, and 9.

The SMA mix designs shall be according to the requirements specified in Tables 1, 3, 6, 7, and 8.

The JMF for Superpave mixes shall be according to the requirements specified in Tables 2, 4, and 5.

The JMF for SMA mixes shall be according to the requirements specified in AASHTO MP 8 and Tables 3 and 6.

#### **1151.04.01.01 RAP Proportions**

The use of RAP is allowed, as follows:

- a) Up to 15% by mass of RAP is permitted for Superpave 4.75, 9.5, and 12.5 surface course mixes.
- b) Up to 30% by mass of RAP is permitted for Superpave 19, 25, and 37.5 binder mixes.
- c) When 31% to 50% by mass of RAP is proposed for Superpave 19, 25, and 37.5 binder mixes, written approval by the Contract Administrator must be obtained for the mix design, including PGAC modification.
- d) Over 50% by mass of RAP is not permitted for any mix.
- e) RAP is not permitted in SMA, 12.5 FC1, and 12.5 FC2 mixes.

**1151.04.02                    Mix Design**

**1151.04.02.01                General**

The mix design shall be the responsibility of the Contractor. The JMFs selected for use by the Contractor shall produce HMA that is in accordance to the requirements of this specification.

**1151.04.02.02                Mix Design Method**

**1151.04.02.02.01            General**

The Contractor shall use a laboratory that has current CCIL Type A Certification with CCIL Superpave Certified Technicians or AMRL equivalent certification or other equivalent certified laboratory acceptable to the Contract Administrator to conduct all mix designs, designate the mix proportions, and prepare the JMFs.

The aggregate gradations used for the mix design may be provided by the Contractor or may be from 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 mix or the aggregate gradations change during production due to aggregate breakdown, appropriate adjustments shall be made to the mix design gradations.

When a mix contains additives and the source of asphalt cement changes from that used in the mix design, tests shall be re-done to verify the dosage of such additives.

**1151.04.02.02.02            Superpave Mix Design Method**

Superpave mixes shall be designed using procedures specifying in AASHTO R 35 with the exception that all references to AASHTO T 84 and T 85 will be replaced by LS-604 and LS-605 respectively. Reference to AASHTO T 304 will be replaced by LS-629. The density of each coarse and fine aggregate of any single-sized chip fraction if warranted, shall be determined using the procedures in this LS test methods. However, the mix design shall also include the determination of the density of the blended coarse and blended fine aggregate.

The calculation of Voids in Mineral Aggregated (VMA) shall be based on the densities of the blended coarse and blended fine aggregate.

RAP as processed and ready for use in an 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 reclaimed asphalt pavement aggregates.

**1151.04.02.02.03            Stone Mastic Asphalt Mix Design Method**

SMA mixes shall be designed in accordance with AASHTO MP 8 and PP 41.

**1151.04.02.03                Mix Design Submission**

The proposed mix design and JMF shall be submitted in writing to the Contract Administrator a minimum of 10 Business Days prior to the start of the paving operation. The mix shall not be placed until the Contract Administrator provides permission to construct hot mix using the submitted JMF. The Contract Administrator shall provide in writing the above permission or the reason why the permission is being withheld within 10 Business Days, which commence when all of the required samples and documents have been submitted.

**1151.04.02.04                Changes to the Job-Mix Formula and the Mix Design**

Changes to the JMF shall be permitted when it has been determined that the mix properties specified in the Contract Documents are not being met. All changes are subject to the conditions specified below.

Changes to the material proportions based on process control test results shall be permitted without a new mix design, but further hot mix production shall be subject to conditions imposed by the Contract Administrator. In this situation, when the Contractor changes the JMF, the revised JMF shall be submitted to the Contract Administrator. The Contract Administrator shall review the revised JMF for conformance to the mix properties with the Contract requirements. Within 1 Business Day of the modified JMF being received in full by the Contract Administrator, the Contract Administrator shall provide in writing conditional permission to construct HMA or the reason why permission is being withheld.

When the Contractor submits a new mix design it must be accompanied by samples for monitoring purposes, if required; a Mix Design Report; and the supporting documents as detailed in the Documents subsection. New mix design and mix designation documents and a new JMF shall be completed when:

- a) A material is eliminated.
- b) A new material is added.
- c) Changes to the material proportions have not resulted in correction of the problems with the mix.
- d) The net impact of all adjustments to the original JMF exceed any of the maximum field adjustments specified in Table 10.

New mix design, new JMF documents, and new samples for monitoring purposes shall be delivered to the Contract Administrator. The new mix design shall be accepted or rejected within 5 Business Days, which commence when all of the required samples and documents have been submitted.

#### **1151.04.03                    Samples for Monitoring Purposes**

Representative samples of the materials to be used in the work shall be provided to the Contract Administrator at the same time that the mix design and JMF documents are submitted.

The samples shall be labelled with the Contract number, material type, material source, and date of sampling. The samples of coarse aggregate and fine aggregate shall be identified.

Each material sample shall be packaged separately and the samples shall be in clean, closed containers that shall not rupture when lifted or handled. Each filled sample container shall have a maximum mass of 25 kg.

The minimum sample quantities shall be as specified in Table 11.

#### **1151.04.04                    Density of Hot Mix Aggregates**

Density testing of the coarse and fine aggregates shall be carried out in accordance with LS-604 and LS-605 respectively using the procedure for blended aggregates.

#### **1151.04.05                    Documents**

The Contract Administrator shall be provided with a copy of the mix design and JMF documents that shall be signed, dated, and certified correct by the person accountable for the engineering and management responsibility for the laboratory that conducted the work. When the Owner has a Bituminous Mix Design Report form, the Contract Administrator shall provide it to the Contractor for submission along with other supporting documents. Information shall be provided in a legible manner. For Superpave mixes, the documentation required with the mix design submission is covered by AASHTO PP 28. The documents shall include, but are not limited to, the following information:

- a) Contract number, item number, and mix type for which the mix design and JMF were completed and a description of the usage of the mix on the Contract.

- b) All test results, mix design work sheets, and graphs.
- c) Material proportions and sources, including the Owner's Mineral Aggregate Inventory for the aggregate sources, when such information is available. The amount of RAP in percent by mass and volumetric data shall also be included.
- d) Designation of the fine aggregate and the coarse aggregate.
- e) PGAC and source and percent by mass of the required new asphalt cement.
- f) A graph of the temperature-viscosity relationship for the PGAC that is to be used in the mix.
- g) Information on additives, including source, type, percent by mass of asphalt cement, and test results according to AASHTO T 283, with specimens prepared according to AASHTO T 312.
- h) Information regarding fines that are returned to the mix, aggregate breakdown during production, and the resultant change in the aggregate gradations.
- i) Complete gradations for all coarse and fine aggregates.
- j) For Superpave mixes, excluding SMA, the volumetric properties for the mix selected in accordance with Table 5. Graphs shall be submitted for the air voids, voids in mineral aggregate, voids filled with asphalt, dust-to-asphalt ratio, bulk relative density, maximum relative density, and the gyratory curves of the mix plotted against asphalt cement content.
- k) For SMA mixes, the volumetric properties for the mix selected in accordance with Table 6. Graphs shall be reported for the air voids, voids in mineral aggregate, bulk relative density, and maximum relative density plotted against asphalt cement content.
- l) Aggregate absorptions.
- m) Bulk specific gravity and saturated surface dry density for each aggregate.
- n) Mix bulk specific gravity by AASHTO T 166. If the percent water absorbed by the specimen is found to exceed 2% by volume as described in AASHTO T 166, then the bulk specific gravity is according to AASHTO T 275, LS-306, or ASTM D 6752.
- o) Theoretical maximum specific gravity by AASHTO T 209.
- p) When RAP is permitted for use, extracted bulk relative density, percentage asphalt cement, and gradation for the RAP used in the mix.
- q) All visual observations made during the design process with particular attention and comments regarding stripping and coating for both the coarse and fine aggregates.
- r) The mixing and compaction temperature used in the mix design and the compaction temperature of the reheated mix to be employed in the testing of the production mix.
- s) The typical mix weight to produce a gyratory specimen with a height of 115 mm  $\pm$  5 mm.
- t) For SMA mixes, the draindown test results according to AASHTO T 305.

#### **1151.04.06                      Anti-Stripping Additives**

The Contractor shall determine the need for and the amount of anti-stripping additive required using AASHTO T 283.

The need for and the amount of anti-stripping additive required shall not be affected by any previous determination made with respect to the same or any other aggregate source.

Regardless of the hot mix type, the amount of anti-stripping additive either specified in the Contract Documents or determined through mix design procedure shall be a percentage of the total asphalt cement required.

The amount of anti-stripping additive required shall be as follows:

- a) For Superpave mixes, excluding SMA, amount required to provide a minimum of 80% Tensile Strength Ratio as determined by AASHTO T 283.
- b) For SMA mixes, amount required to provide a minimum of 70% Tensile Strength Ratio as determined by AASHTO T 283.
- c) Minimum dosage requirements specified in the Contract Documents.

Whenever an anti-stripping additive is required, the following applies:

- a) For all Superpave 12.5 FC2 and SMA mixes, or other mixes consisting of more than 75% dolomitic sandstone or meta-arkose aggregates, the anti-stripping additive shall be hydrated lime ( $\text{Ca}(\text{OH})_2$ ) with a minimum dosage requirement of 1% by mass of the total dry aggregate.
- b) For all other aggregates, the anti-stripping additive may be hydrated lime or a chemical agent.

Anti-stripping additive shall be used according to supplier information. The following information on the hydrated lime anti-stripping additive shall be provided to the Contract Administrator:

- a) Documentation that the hot mix shall be produced in accordance to the Contract Documents.
- b) Amount of hydrated lime to be used as determined in the mix design procedures expressed as a percentage of the specified aggregate.
- c) Complete information on how the hydrated lime is to be used and how the hydrated lime is to be incorporated into the mix.

## **1151.05 MATERIALS**

### **1151.05.01 Asphalt Cement**

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

The supply and use of performance graded asphalt cement shall be as specified in the Contract Documents.

### **1151.05.02 Aggregates**

Aggregates shall be according to OPSS 1003.

Both the coarse and fine aggregates used for SMA shall be crushed from the same source of traprock, diabase, dolomitic sandstone, or meta-arkose. The aggregate source used shall be as specified in the Contract Documents.



**1151.05.02.01 Reclaimed Asphalt Pavement**

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

RAP that is contaminated with deleterious material shall not be used and shall be removed from the Work. RAP shall be stockpiled conforming to the stockpiling requirements for coarse aggregates according to OPSS 1001.

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

**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.

**1151.05.05 Fibres**

Cellulose or mineral fibres shall be used as a stabilizing additive in dosage rates of 0.3% or 0.5% by mass of the total mix respectively. Cellulose and mineral fibres shall meet the properties shown in Tables 7 and 8 respectively.

**1151.06 EQUIPMENT**

**1151.06.01 Requirements for All Mixing Plants**

The equipment shall be such that the HMA produced shall meet this specification and shall demonstrate adequate control and documentation of the HMA materials, mixing temperature, and storage for monitoring and production purposes.

When required by the Contract Administrator, all equipment shall be on the site and available for inspection before operations are commenced and during production operations.

**1151.06.02 Truck Scales**

Truck scales shall be as specified in the Contract Documents.

**1151.07 PRODUCTION**

**1151.07.01 General**

The HMA shall be produced to meet the submitted JMF or the adjusted JMF that was accepted in writing by the Contract Administrator.

The Contractor shall be responsible for the quality and characteristics of the mix. If the hot mix produced does not meet the requirements of this specification, hot mix production shall stop and appropriate corrections shall be made to the process.

The Contractor is responsible for the process control and condition of all materials during the handling, blending, and mixing operations. The Contractor is responsible for determining and making all necessary adjustments in proportioning materials used to produce HMA to meet the Contract requirements.

**1151.07.02                    Operational Constraints**

The JMF is the target to which the HMA shall be compared to determine the acceptance of the aggregate gradation and asphalt cement content. HMA shall not be placed until the Contract Administrator provides permission in writing to proceed with a submitted JMF.

The JMF shall remain in effect until the Contract Administrator receives any requested changes in writing and approves them.

**1151.07.03                    Handling of Materials**

**1151.07.03.01                Aggregate Stockpile Requirements**

Before any production of the mix is started, stockpiles of each size and gradation of aggregate shall be provided at the asphalt plant site. Each stockpile shall contain sufficient aggregate for one full day's production of hot mix, before that day's paving begins.

**1151.07.03.02                Aggregates**

**1151.07.03.02.01            General**

Aggregates shall be loaded into the cold feed bins in a manner that prevents the mixing of separate sizes of aggregates.

**1151.07.03.02.02            Batch and Continuous Mixing Plants**

When delivered to the mixing plant, the heated and dried aggregate shall be at a temperature consistent with proper mixing and laying of the mix. Surfaces of all dried aggregates shall be free of carbon or unburnt fuel oil.

**1151.07.03.03                Anti-Stripping Additives**

**1151.07.03.03.01            Liquid Anti-Stripping Additives**

Anti-stripping additive shall be handled and mixed with the asphalt cement according to the manufacturer's recommendations.

The Contractor shall provide the Contract Administrator with the following documentation:

- a) Verification that the chemical anti-stripping additive shall remain stable in the heated asphalt cement for a minimum of 4 Days.
- b) Type and dosage of anti-stripping additive used.
- c) Time, date, and temperature when anti-stripping was added to the asphalt cement.

If the liquid anti-stripping additive is added to the asphalt cement at the refinery or asphalt cement depot, the Contractor shall provide the Contract Administrator with the above documentation in the form of a waybill or bill of lading that accompanies each tanker of asphalt cement delivered.

If liquid anti-stripping additive is added to the asphalt tank at the hot mix plant, the liquid agent may be added to the asphalt tank by an in-line metering device or by another means, provided the above documentation is given to the Contract Administrator for each batch of asphalt cement to which anti-stripping agent is added.

If a liquid anti-stripping additive is not added to the asphalt tank, a continual record of the process for adding the additive shall be provided to the Contract Administrator in addition to the above documentation each time liquid anti-stripping additive is metered into the asphalt cement.

The Contract Administrator shall be provided with an approved statement of calibration for any metering device used to add the liquid anti-stripping additive.

#### **1151.07.03.03.02          Hydrated Lime**

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

- a) Hydrated lime slurry shall be homogeneously mixed with the aggregate in a pugmill or tumble mixer, prior to entering the asphalt plant.
- b) Hydrated lime shall be homogeneously mixed with wetted aggregate in a pugmill or tumble mixer, prior to entering the asphalt plant. The wetted coarse and fine aggregate shall have a sufficient moisture content to ensure uniform and complete adhesion of lime to the aggregate.
- c) Hydrated lime shall be homogeneously mixed with the aggregate at the pit or quarry, prior to delivery of the limed aggregate to the hot mix plant.

Regardless of the mixing equipment or procedure used, the aggregate must possess a uniform and homogeneous coating of hydrated lime. Aggregate treated with hydrated lime shall be used within the same construction season it is treated. Aggregate that was treated and stored from a previous construction season may be used only if the Contract Administrator agrees to a written proposal from the Contractor. The written proposal must verify the effectiveness of the stored aggregate, indicate the sampling protocol used, and include the current test results from samples that indicate the aggregate meets the Contract requirements for retained stability.

#### **1151.07.04                  Preparation of the Mix**

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

### **1151.08                      QUALITY ASSURANCE**

#### **1151.08.01                  General**

The Contractor shall obtain for the Contract Administrator, within 1 Business Day of submission of request in writing, the right to enter upon the premises of any of the material manufacturers, suppliers, plants, laboratories, or equipment for purposes pertaining to the work, to carry out such inspection, sampling, and testing as specified or as requested by the Contract Administrator.

**TABLE 1**  
**Superpave and SMA Design Traffic Categories by ESALs**

<b>Ontario Traffic Category</b>	<b>20-Year Design ESALs (Note 1)</b>	<b>Typical Applications</b>
A	Less than 0.3 million	Low volume roads, parking lots, driveways, and residential roads.
B	0.3 to 3 million	Minor collector roads.
C	3 to 10 million	Major collector and minor arterial roads.
D	10 to 30 million	Major arterial roads and transit routes.
E	Greater than 30 million	Freeways, major arterial roads with heavy truck traffic, and special applications such as truck and bus climbing lanes or stopping areas.
<b>Note:</b> 1. Equivalent Single Axle Load (ESAL) for the projected traffic level expected in the design lane over a 20-year period, regardless of the actual design life of the pavement.		

**TABLE 2**  
**Superpave Aggregate Gradation Control Points**

<b>Hot Mix Asphalt Type</b>	<b>Percentage Passing by Dry Mass of Aggregates</b>									
	<b>Sieve Size mm</b>									
	<b>50.0</b>	<b>37.5</b>	<b>25</b>	<b>19.0</b>	<b>12.5</b>	<b>9.5</b>	<b>4.75</b>	<b>2.36</b>	<b>1.18</b>	<b>0.075</b>
Superpave 4.75	-	-	-	-	100	95-100	90-100	-	30-60	6-12
Superpave 9.5	-	-	-	-	100	90-100	32-90	32-67	-	2-10
Superpave 12.5	-	-	-	100	90-100	28-90	-	28-58	-	2-10
Superpave 12.5 FC1 and 12.5 FC2	-	-	-	100	90-100	45-90	45-60	28-58	-	2-10
Superpave 19.0	-	-	100	90-100	23-90	-	-	23-49	-	2-8
Superpave 25.0	-	100	90-100	19-90	-	-	-	19-45	-	1-7
Superpave 37.5	100	90-100	15-90	-	-	-	-	15-41	-	0-6

**TABLE 3  
SMA Aggregate Gradation Control Points**

Hot Mix Asphalt Type	Percentage Passing by Dry Mass of Aggregates							
	Sieve Size mm							
	37.5	25	19.0	12.5	9.5	4.75	2.36	0.075
SMA 9.5	-	-	-	100	70-95	30-50	20-30	8-12
SMA 12.5	-	-	100	90-100	50-80	20-35	16-24	8-11
SMA 19.0	-	100	90-100	50-88	25-60	20-28	16-24	8-11

Note:

A. For the SMA 9.5 mm the Upper Gradation Control Points are 21, 18, and 15 percent passing for the 1.18 mm, 0.600 mm, and 0.300 mm sieves, respectively.

**TABLE 4  
Superpave Gradation Primary Control Sieve (PCS) Points**

Hot Mix Asphalt Type	Primary Control Sieve mm	PCS Control Point At % Passing
Superpave 4.75	-	-
Superpave 9.5	2.36	47
Superpave 12.5, 12.5 FC1, and 12.5 FC2	2.36	39
Superpave 19.0	4.75	47
Superpave 25.0	4.75	40
Superpave 37.5	9.5	47

**TABLE 5  
Superpave HMA Volumetric Properties**

Ontario Traffic Category	% of Theoretical Maximum Specific Gravity			Voids in Mineral Aggregate (VMA) % minimum (Note 4)						Voids Filled With Asphalt (VFA) %	Dust to Binder Ratio (Note 1)
	N <sub>initial</sub>	N <sub>design</sub>	N <sub>max</sub>	Nominal Maximum Aggregate Size mm							
				37.5	25.0	19.0	12.5	9.5	4.75		
A	≤91.5	96.0	≤98.0	11.0	12.0	13.0	14.0	15.0	16.0	70-80 (Note 2)	0.6-1.2
B	≤90.5									65-78	
C	≤89.0									65-75 (Note 3)	
D											
E											

Notes:

- 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 specified in Table 4, the dust-to-binder ratio shall be 0.8-1.6.
- For Traffic Category A, Superpave 25.0 mixes shall have a VFA range of 67% to 80%.
- Superpave 4.75 mixes shall have a VFA range of 75% to 78%.  
Superpave 9.5 mixes shall have a VFA range of 73% to 76%.  
Superpave 37.5 mixes shall have a VFA range of 64% to 75%.
- Density testing of the coarse and fine aggregate shall be carried out in accordance with LS-604 and LS-605 respectively using the procedure for blended aggregates.

**TABLE 6  
SMA Hot Mix Asphalt Volumetric Properties**

% Air Voids (Note 1)	Voids in Mineral Aggregate (VMA) % minimum			Voids in Coarse Aggregate (VCA) of the Compacted Mix %	Maximum Draindown at Production Temperature (Note 2) %
	Nominal Maximum Aggregate Size mm				
	19.0	12.5	9.5		
4.0	17			Less than the VCA in the dry rodded condition.	0.3

Notes:

- SMA mixes shall be designed with 100 gyrations unless the mix aggregates have a LS-603 value greater than 30%, then the SMA mix shall be designed with 75 gyrations.
- Tested according to AASHTO T 305.

**TABLE 7**  
**Physical Requirements for Cellulose Fibres**  
**According to AASHTO MP 8**

Property	Requirement
Sieve Analysis, Method A or B: Method A, Alpine Sieve Analysis (Note 1) Fibre Length Passing 0.150 mm sieve	6 mm maximum 70% ± 10%
Method B, Mesh Screen Analysis (Note 2) Fibre Length Passing 0.850 mm sieve 0.425 mm sieve 0.106 mm sieve	6 mm maximum 85% ± 10% 65% ± 10% 30% ± 10%
Ash Content (Note 3)	18% ± 5% non-volatiles
pH (Note 4)	7.5 ± 1.0
Oil Absorption (Note 5)	5 ± 1.0, times fibre mass
Moisture Content (Note 6)	Less than 5%, by mass
Notes:	
<ol style="list-style-type: none"> <li>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.</li> <li>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 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.</li> <li>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 not less than 2 hours. The crucible and ash are cooled in a desiccator and reweighed.</li> <li>4. pH Test - 5 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.</li> <li>5. Absorption Test - 5 grams of fibre is accurately weighed and suspended in an excess of mineral spirits for not less than 5 minutes to ensure total saturation. It is then placed in a screen mesh strainer with an approximately 0.5 mm<sup>2</sup> 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 the fibres are able to absorb, i.e., the number of times its own weight.</li> <li>6. Moisture Content - 10 grams of fibre are weighed and placed in a 121 °C forced air oven for two hours. The sample is then reweighed upon removal from the oven.</li> </ol>	

**TABLE 8  
Mineral Fibre Quality Requirements  
According to AASHTO MP 8**

Property	Requirement
Sieve Analysis  Fibre Length (Note 1) Thickness (Note 2)	6 mm maximum mean test value 0.005 mm maximum mean test value
Shot Content (Note 3)  Passing 0.250 mm sieve Passing 0.063 mm sieve	90% ± 5% 70% ± 10%
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.	

**TABLE 9  
Superpave Compactive Effort**

Ontario Traffic Category (Note 1)	Number of Gyration		
	N <sub>initial</sub>	N <sub>design</sub>	N <sub>max</sub>
A	6	50	75
B and C	7	75	115
D	8	100	160
E	9	125	205
Note:  1. The traffic categories are according to Table 1.			



**TABLE 10**  
**Permitted Field Adjustment to a JMF**

<b>JMF Property</b>	<b>Maximum Field Adjustment (Note 1)</b>
Percent asphalt cement content, all mixes except SMA	± 0.2
Percent asphalt cement content, SMA only	± 0.4
Percent RAP	- 5.0
Percent passing 26.5 mm, 25.0 mm, 19.0 mm, and 16.0 mm sieves	± 5.0
Percent passing 13.2 mm, 12.5 mm, and 9.5 mm sieves	± 4.0
Percent passing 4.75 mm, 2.36 mm, and 1.18 mm sieves	± 3.0
Percent passing 600 µm, 300 µm, and 150 µm sieves	No limits
Percent passing 75 µm sieve, all mixes except SMA	± 1.0
Percent passing 75 µm sieve, SMA only	± 2.0
Note:	
1. The maximum field adjustment is applied against the actual JMF property value.	

**TABLE 11**  
**Minimum Sample Quantities for Mix Design Monitoring**

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

## Appendix 1151-A, Commentary for OPSS 1151, November 2006

**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 a Contract.

### Designer Action/Considerations

The designer should refer to the Superpave and Stone Mastic Asphalt (SMA) hot mix types and typical uses are provided in the following table:

Hot Mix Asphalt Type	Typical Hot Mix Use and Properties
Superpave 4.75	Fine, surface, and levelling mixes similar to the traditional sand mixes for miscellaneous applications.
Superpave 9.5	Fine, surface, padding, and levelling mixes for Traffic Category A and B roads and driveways.
Superpave 12.5	Surface mix for Traffic Category B and C roads. Superpave 12.5 is similar to the traditional HL 3, HL 3 Fine, and HL 4 mixes according to OPSS 1150.
Superpave 12.5 FC1	Surface mix for use on Traffic Category C roads that provides superior rutting resistance and skid resistance through aggregate selection. Superpave 12.5 FC1 is similar to the traditional HL 1 mix according to OPSS 1150.
Superpave 12.5 FC2	Surface mix for use on Traffic Category D and E roads that provides superior rutting resistance and skid resistance through aggregate selection. Superpave 12.5 FC2 is similar to the traditional DFC mix according to OPSS 1150.
Superpave 19.0	Binder course mix for Traffic Category A, B, C, D, and E roads. Superpave 19.0 is similar to the traditional HL 4, HL 8, and HDBC mixes according to OPSS 1150.
Superpave 25.0 and 37.5	Large stone binder course mixes for use when thicker binder lifts are required.
SMA 9.5 and 12.5	Gap-graded premium surface course mix with high frictional resistance, enhanced rutting resistance, water spray reduction, and potential noise reduction for Traffic Category D and E roads. 100% crushed aggregates from the DSM are used for both fine and coarse fraction.
SMA 19.0	Gap-graded premium binder course mix with enhanced rutting resistance for Traffic Category D and E roads. 100% crushed aggregates are used for both fine and coarse fraction.
Note:	
A. The traffic categories are according to Table 1 of OPSS 1151.	

The designer should specify the following in the Contract Documents:

- Amount of anti-stripping additive, if required, i.e., as outlined in the Ministry's Designated Sources for Materials (DSM) manual for asphalt aggregates. (1151.04.05)
- Supply and use of performance graded asphalt cement. (1151.05.01)

## Appendix 1151-A

Coarse graded Superpave mixes generally tend to have lower asphalt cement (AC) contents. To promote adequate compaction in the field and for long-term durability, it is recommended that Superpave mixes be designed below the primary control sieve (PCS), i.e., coarse gradation should be placed with a lift thickness of 3 to 4 times the nominal maximum aggregate size (NMAS). SMA mixes are designed as coarse graded mixes, therefore, SMA should also be placed at 3 to 4 times NMAS.

The designer should specify the minimum suggested lift thickness for each HMA type as provided in the following table:

<b>Asphalt Layer</b>	<b>Hot Mix Asphalt Type</b>	<b>Minimum Suggested Compacted Layer Thickness (Note 1) mm</b>
Surface Course Mixes	Superpave 4.75	25
	Superpave 9.5	30 - 40
	Superpave 12.5, 12.5 FC1, and 12.5 FC2	40 - 50
	SMA 9.5	30 - 40
	SMA 12.5	40 - 50
Base Course Mixes	Superpave 19.0	50 - 80
	Superpave 25.0	60 - 100
	Superpave 37.5	100 - 150
	SMA 19.0	60 - 80
Note:		
1. The designer should be aware that the lower minimum value is for finer graded mixes and the upper minimum value is for coarser graded mixes.		

Mixes with VMA exceeding the minimum value specified in OPSS 1151, Table 4, by more than 2% may be prone to flushing and rutting. Unless, satisfactory experience with high VMA mixes is available, mixes with VMA greater than 2% above the minimum specified should be avoided.

For SMA mixes, the designer should refer to the appropriate guidelines according to National Asphalt Pavement Association (NAPA), QIS 122, Designing and Constructing SMA Mixes, State-of-the-Practice.

The designer should ensure that the Ontario Provincial Standards General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

### Related Ontario Provincial Standard Drawings

None.