This end result specification covers the requirements for the placement, compaction, and acceptance of hot mix asphalt.

313.01.01 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.
313.01.02 Appendices Significance and Use

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

Appendix 313-A is a commentary appendix to provide designers with information on the use of this specification in a Contract.

313.02 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 308 Tack Coat

**Ontario Provincial Standard Specifications, Material**

OPSS 1101 Performance Graded Asphalt Cement
OPSS 1151 Superpave and Stone Mastic Asphalt Mixes

**Ministry of Transportation Publications**

MTO Laboratory Testing Manual:
LS-100 Rounding - off of Test Data and Other Numbers
LS-101 Calculation of Per Cent Within Limits
LS-264 Theoretical Maximum Relative Density of Bituminous Paving Mixtures
LS-282 Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-291 Quantitative Extraction of Asphalt Cement and Mechanical Analysis of Extracted Aggregate from Bituminous Paving Mixtures - Ontario Procedure
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-604 Relative Density And Absorption Of Coarse Aggregate
LS-605 Relative Density And Absorption Of Fine Aggregate

**ASTM International**

E 178-02 Standard Practice for Dealing With Outlying Observations
American Association of State Highway and Transportation Officials (AASHTO)

M 320-02 Standard Specification for Performance Graded Asphalt Binder
R 28-06 Practice for Accelerated Aging of Asphalt Binder Using Pressurized Aging Vessel (PAV)
R 35-04 Superpave Volumetric Design for Hot - Mix Asphalt
T 166-05 Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
T 240-06 Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)
T 312-04 Standard Method of Test for Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
T 313-05 Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
T 315-06 Rheological Properties of Asphalt Binder Using Dynamic Shear Rheometer (DSR)

National Asphalt Paving Association

NAPA IS-127 Evaluation of Baghouse Fines for Hot Mix Asphalt

National Center for Asphalt Technologies


313.03 DEFINITIONS

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

**Ambient Air Temperature** means the air temperature measured in the shade and away from the paving operations.

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

**Attribute** means one of the following: designated large sieve (DLS), 4.75 mm sieve, 600 µm sieve, 75 µm sieve, asphalt cement content, air voids, VMA, draindown, or compaction.

**Binder Course** means a 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.

**Class R Roller** means self-propelled pneumatic-tired rollers.

**Class S Roller** means self-propelled steel-drum, tandem, or three-wheel rollers.

**Class V Roller** means self-propelled vibratory rollers specifically designed for HMA compaction having either dual vibratory rolls or a combination of vibratory roll and pneumatic tires with a contact area equal to or greater than 70% of the roll width.

**Designated Large Sieve (DLS)** means a sieve size specifically designated for each mix type for gradation testing. The designated sieve for the following mix types is as follows:
25.0 mm for Superpave 37.5
19.0 mm for Superpave 25.0
12.5 mm for SMA 19.0, Superpave 19.0
9.5 mm for SMA 12.5, Superpave 12.5, 12.5FC 1 and 12.5FC 2
4.75 mm for SMA 9.5, Superpave 9.5

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

**Fat Spot** means an area of pavement substantially blacker than the surrounding pavement.

**Field Adjustment to the JMF** means a change in the target gradation, asphalt cement content, or both of a mix, within limits specified without a redesign of the HMA, resulting in a revised JMF.

**Hot Mix Asphalt (HMA)** means hot mixed, hot laid asphaltic concrete. The terms are used interchangeably. HMA may include recycled or specialty mixes.

**Hot Mix Asphalt Miscellaneous** means HMA that is placed in areas other than the roadway, as specified in the Contract Documents.

**Hot Mix Asphalt Padding** means a HMA layer used for correcting crossfall and profile deficiencies in the existing pavement before placing the levelling, binder, or surface course.

**Hot Mix Asphalt Patching** means a HMA surface course placed over localized areas of distressed pavement, generally for the purpose of improving strength, rideability, or safety.

**Independent Laboratory** means a third party laboratory that is not owned or corporately affiliated with the laboratory that prepared the mix design or with the Contractor.

**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 mixture that are based on specified mix design procedures.

**Joint** means a vertical contact between a HMA pavement course and any HMA pavement or any rigid object that exists at the time the HMA is laid.

**Levelling Course** means a 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.

**Loose Mix** means a sample of HMA obtained using plates or other approved means for testing mix properties.

**Lot** means a specific quantity of HMA obtained using plates or other approved means for testing mix properties.

**Mean** means the arithmetic average of the test results within a lot.

**Medium Segregation** means the pavement has significantly more coarse aggregate particles than the surrounding acceptable mat and usually exhibits some lack of surface matrix.

**Micromilling** means the use of a milling machine to restore the riding characteristics of a HMA pavement.

**Mid-Lane Segregation** means a continuous or discontinuous longitudinal “streak”, typically no greater than 300 mm in width located anywhere across the width of the lane.
Mix Properties means the percent passing the DLS, 4.75 mm sieve, 600 µm sieve, and 75 µm sieve; the asphalt cement content; and the voids.

Other Segregation means discrete areas or patches of regular, irregular or chevron shape.

Outlier means a test result that for a specific significance level is determined by statistical analysis not to be part of the test result population.

Paving in Echelon means two or more pavers are used to pave multiple adjacent lanes simultaneously.

Payment AdjustmentSieves means the DLS, 4.75 mm, 600 µm, and 75 µm aggregate gradation sieves.

Per Cent Within Limits (PWL) means an estimate of the percentage of the lot that is within specification limits, determined by using the mean and standard deviation of the lot.

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

Quality Assurance (QA) means a system or series of activities carried out by the Owner to ensure that Materials received from the Contractor meet the requirements specified in the Contract Documents.

Quality Control (QC) means a system or series of activities carried out by the Contractor to ensure that Materials supplied to the Owner meet the requirements specified in the Contract Documents.

Random Sample means a sample from a location chosen by the Contract Administrator based on random numbers such that any portion of a lot or sublot has an equal probability of being selected.

Range means the numerical difference between the maximum and minimum test results within a lot.

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

Recycled Hot Mix Asphalt (RHM) means an HMA that contains RAP or RST or both.

Roof Shingle Tabs (RST) means ground roof shingle scrap generated when new shingles are trimmed during production.

Screed means the unit of the paver that strikes off and imparts initial compaction to the HMA.

Segregation means a condition of the pavement characterized by areas with comparatively coarser or finer texture than that of the surrounding pavement.

Severe Segregation means the pavement appears very coarse, with coarse aggregate particle against coarse aggregate particle and the pavement has little or no matrix.

Slight Segregation means the pavement matrix is in place between the coarse aggregate particles; however, there are slightly more coarse aggregate particles in comparison with the surrounding acceptable mix.

Standard Deviation means the square root of the value determined by summing the squares of the difference between each test result and the mean of the test results divided by the number of test results minus one.

Stone Mastic Asphalt (SMA) means HMA consisting of a gap graded, stone-on-stone coarse aggregate skeleton with an asphalt cement-rich mortar.

SMA Mixes means SMA 9.5, SMA 12.5, and SMA 19.0.
Stone Mastic Asphalt (SMA) Mortar means a mixture of asphalt cement and any additives; filler, including all material passing the 0.075 mm 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.

Straight Edge means a straight edge made of metal with a level recessed in its upper surface parallel to the lower edge.

Superpave means the method for specifying material components and asphalt mixture design using the Superpave gyratory compactor (SGC).

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

Through Lane means a traffic lane not intended for entering or exiting the roadway and does not include shoulders. Where there is more than one roadway, through lane refers to the traffic lane for the higher-class roadway.

Vertical Surface means all edges of concrete curbs, catch basins, appurtenances, longitudinal joints, and transverse joints for application of joint painting material.

Voids means air voids and voids in mineral aggregate (VMA).

Voids in Mineral Aggregate (VMA) means the intergranular void space between the aggregate particles in a compacted paving mixture that includes the air voids and the effective asphalt cement content, expressed as a percent of the total volume.

313.04 DESIGN AND SUBMISSION REQUIREMENTS

313.04.01 Submission Requirements

Prior to hot mix asphalt production, the Contractor shall inform the Contract Administrator whether LS-291, LS-282, or LS-292 shall be used for QC testing in writing and shall not change the method without providing written notification to the Contract Administrator in advance.

Prior to the start of paving, the Contractor shall submit to the Contract Administrator the purchase price of the asphalt cement in the form of a purchase order or other document signed by the Contractor’s senior financial officer.

Prior to the start of paving on bridge desks, the Contractor shall provide to the Contract Administrator the mass of the rollers, except for Class V rollers, used on bridge decks in writing.

313.05 MATERIALS

313.05.01 Hot Mix Asphalt

The Materials used in the production of HMA shall be according to OPSS 1151.

313.05.02 Tack Coat

The Materials shall be according to OPSS 308.
313.06 EQUIPMENT

313.06.01 General

A 3 m straight edge that has been approved by the Contract Administrator shall be provided on each paver.

313.06.02 Rollers

The Contract Administrator may require that rollers used on bridge decks be weighed in his presence.

Petroleum based release agents, excess water, or excess release agents shall not be permitted.

313.06.03 Smoothness Measuring Device

Only measuring devices with current approval by the Owner shall be used.

313.06.04 Diamond Grinder

A diamond grinder shall be power-driven, self-propelled, and designed for grinding HMA. It shall be equipped with a grinding head with at least 50 diamond blades per 300 mm of shaft. The grinding head shall be at least 0.9 m wide. The grinder shall be equipped with the capability to adjust the depth, slope and crossfall to ensure that the HMA is removed to the desired dimensions and shall also include a slurry pick-up system.

313.06.05 Milling Machine

A milling machine shall be equipped with a specialized milling drum fitted with 450 to 500 carbide bits spaced approximately 5 mm apart.

313.07 CONSTRUCTION

313.07.01 Quality Control

QC procedures shall be conducted to ensure HMA meets the requirements of the Contract Documents. The Contractor shall be responsible for the interpretation of the QC inspections, test results, and measurements and the determination of any action to be taken to ensure that all Materials and Work are according to the requirements of the Contract Documents.

All QC testing shall be performed in a laboratory that has current CCIL Type B Certification for Superpave mixes, or is an AMRL accredited or equivalent laboratory. In addition, the laboratory carrying out the testing shall participate in the Ministry’s correlation programs for gyratory compactors, which occur just prior to and during the paving operations. All QC testing shall be done by and under the direct and constant supervision of a Superpave certified technician, certified by CCIL or an equivalent organization.

RAP shall be considered as an aggregate for the purposes of process control.

313.07.02 Laboratory Correlations

At the Contractor’s request, the Contract Administrator shall provide the Contractor with the opportunity to conduct a correlation of aggregate densities, mix properties, VMA, and compaction between the QA and QC laboratories prior to placement of HMA, once for each mix type.

The Contractor shall provide the Contract Administrator with all of the test results obtained by the QC laboratory. The Contract Administrator shall provide the QA correlation test results to the Contractor after receiving QC correlation test results and on completion of the correlation testing.
313.07.03 Preparation of Foundation and Existing Pavement

Prior to placing any course of HMA on:

a) a granular grade, a Class S roller with a minimum mass of 7 tonnes and minimum mass of 3.5 kg per mm total roll width or an equivalent Class V roller with a drum width of at least 1.2 m shall be used to finish roll the grade ahead of the paver to ensure a compacted, smooth, float-free surface free from contamination of foreign materials. This roller shall operate within 300 m of the paver.

b) HMA or concrete surfaces, the HMA and concrete surfaces shall be cleaned of all loose, broken, and foreign materials.

c) milled surfaces, the milled surface shall be cleaned of all loose, broken, and foreign materials and shall be swept with a power broom.

313.07.04 Tack Coat

Tack coat shall be applied to surfaces according to OPSS 308 prior to placing HMA.

313.07.05 Transportation of Hot Mix Asphalt

Truck boxes used to transport HMA shall be clean and, if required, lightly coated with a uniform application of a non-petroleum based release agent. Truck boxes must be drained after each application and before loading. No release agents shall be used that may adversely affect the quality or performance of the HMA. Release agents shall be used according to the proprietary requirements.

313.07.06 Placing Hot Mix Asphalt

313.07.06.01 Operational Constraints

Paving shall not be carried out if the roadbed is frozen. When placing the mixture on a granular grade, the granular grade shall not be saturated and shall be free of standing water. The surface of a pavement upon which HMA is to be placed shall be clean and dry at the time of HMA placement.

An HMA course shall not be placed upon a previously laid course until a minimum 4 hours have elapsed, following final compaction of the previous course and the temperature of the previous course is 50 °C or less. HMA binder courses shall be not placed unless the ambient air temperature is at least 2 °C. For surface course, the ambient air temperature shall be at least 7 °C except for SMA and Superpave 12.5FC 2 the ambient air temperature shall be at least 12 °C.

The Contractor shall not allow traffic to travel between pavers operating within 300 m of each other.

313.07.06.02 Paving

Levelling, binder, and surface courses shall be laid by means of mechanical self-propelled pavers. Prior to roller compaction, obvious defects in the HMA Material placed shall be corrected. Irregularities in the alignment and grade along the outside edges shall be corrected.

After final compaction of each course the surface shall be smooth and true to the established crown and grade, uniform in texture and shall be free of any defects including segregation, fat spots, oil spills, and roller marks.

All through lane paving courses shall be completed prior to the placement of adjacent sideroads, speed change lanes, and other paved areas.
At the end of each completed portion of the lanes and prior to opening them to traffic, the ends of completed sections of HMA course shall be temporarily ramped down to the existing pavement at a slope of 120H:1V transversely. Longitudinal ramp downs shall only be permitted if specified in the Contract Documents. Transverse and longitudinal ramps downs shall not form part of the permanent pavement and shall be removed prior to paving of the adjacent section.

If paving is being carried out under lane closures, paving shall be completed to the same station for the full pavement width, including paved shoulders, prior to the roadway being reopened to traffic. If, due to unforeseen circumstances such as equipment breakdown occurring during paving, the Contractor can not complete paving to the same station across the full pavement width, the Contractor shall construct a temporary longitudinal ramp down at 10H: 1V. The temporary ramp down shall be removed and the adjacent lane paved within 1 Day or as agreed to by the Contract Administrator in the event of weather or access restrictions.

313.07.07 Paving in Echelon

Paving in echelon shall be as specified in the Contract Documents.

The pavers shall be operated at the same time within 60 m of the next paver so that a hot joint is obtained between the lanes of HMA being placed. Should one paver break down while placing levelling, binder, or surface course, the Contract Administrator may permit the day's work to be completed with the remaining paver only.

313.07.08 Widenings and Irregular Sections

The HMA shall be placed in widenings such that the top of the compacted HMA is flush with the top of the existing pavement. When stepped joints are specified, the layers placed in the widening shall be placed to the top of each step in separate operations. HMA shall be placed in the widening using equipment specially designed for this purpose.

In turnouts, driveways, and other irregular sections, the Contractor may use other methods to spread and finish the HMA.

313.07.09 Longitudinal and Transverse Joints

313.07.09.01 General

All joints shall be made to ensure a complete bond is obtained between the two pavement edges and that the riding surface is smooth. Longitudinal and transverse joints between the new HMA pavement and the existing pavement shall be butt or stepped joints as specified in the Contract Documents. The existing or previously placed pavement edge shall be a straight clean vertical surface for the full depth of the course. Where ramping or damage has occurred, trimming shall be required.

All dirt or other foreign material and all loose Material shall be removed from all vertical surfaces.

When matching a compacted joint, the depth of the uncompacted mat shall be set to allow for compaction. The paver screed shall overlap the adjoining mat by at least 50 mm.

313.07.09.02 Longitudinal Joints

Longitudinal joints shall be properly set up, with the back of a rake or lute, at proper height and grade prior to rolling. Excess Material shall not be cast onto the surface of the freshly laid mat.

The width of subsequent courses shall be staggered to an offset of 150 to 300 mm so that longitudinal joints do not coincide. The longitudinal joints in the surface course shall correspond to the demarcation between the lanes specified in the Contract Documents.
When resurfacing against a rigid object, a butt joint shall be constructed by milling the existing pavement to provide an exposed vertical surface of at least 25 mm at the face of the rigid object. The milling shall be feathered out to zero over a minimum length of 1.25 m from and parallel to the exposed face of the rigid object, providing a minimum of 40 mm of resurfacing material over the area of removal.

**313.07.09.03 Transverse Joints at Limits of Paving**

Joints between HMA pavement laid under this Contract and existing HMA courses not laid under the Contract shall be constructed as follows:

a) Where a binder course is placed flush against an existing HMA pavement and a butt joint is to be made, the existing pavement shall be trimmed back to form a straight vertical surface.

b) Where a surface course is placed flush against an existing HMA pavement, a butt joint shall be prepared by removing the existing pavement to the full depth of the existing surface course, to form a straight vertical face, and for a longitudinal distance not less than 5.0 m so that the surface course placed has a thickness equal to the full depth of the existing surface course over the 5 m section.

c) Where a binder course and surface course are not placed flush against an existing HMA pavement, the binder course shall be feathered out removing the existing surface course to a minimum depth of not less than 40 mm, to form a straight vertical face, and for a longitudinal distance not less than 5 m so that the surface course placed has a minimum thickness of 40 mm over the 5 m section.

**313.07.10 Paving on Bridge Decks**

The temperature of the HMA immediately after spreading shall not be less than 115 °C. The temperature of the HMA mat ahead of initial rolling shall be measured and recorded. Compaction shall be accomplished using, as a minimum,

a) a Class S roller with a minimum mass of 9 tonnes and minimum mass of 4.5 kg per mm total roll width, and

b) a Class R roller with a minimum mass of 18 tonnes and minimum mass of 2,500 kg per tire.

The operating speed of Class S rollers shall not exceed 5 km/h and shall be operated in a manner to avoid undue displacement of the HMA. If Class V rollers are used, they shall be used in static mode. Rollers shall operate with the drive wheel forward in the direction of paving.

The mixture shall be uniformly compacted as soon after placing as it can support the rollers without checking or undue displacement. Rolling shall start longitudinally at the lower edge and proceed towards the higher edge of the course, overlapping on successive passes. Alternate passes of the roller shall be staggered.

Passes by the Class R roller shall overlap previous passes. The roller shall be operated to prevent pick-up of the HMA on the tires.

**313.07.11 Compaction**

Compaction of the HMA shall be conducted using appropriate methods and equipment to provide a uniformly compacted mat according to the requirements of this Contract. Class R rollers shall not be used to compact SMA.

At all places not accessible to rollers, the HMA shall be compacted by mechanical self-powered gas-, electric-, or air-powered equipment.
313.07.12 Review of Work

313.07.12.01 Surface Tolerances

The Contractor shall carry out surface tolerance measurements for QC using a 3 m straight edge. The Contractor may be required at any time to take additional surface tolerance measurements in the presence of the Contract Administrator or his representative at their request.

313.07.12.02 Surface Appearance

The Contractor shall review each course after final compaction and identify any visual deficiencies.

If the Contractor’s actions fail to prevent continued medium or severe segregation regardless of cause, the Contract Administrator may instruct the Contractor to cease paving until the problem has been corrected.

From the time that the Contractor receives notification of midlane segregation, the Contractor shall be allowed a maximum of 500 tonnes of mix to be placed on the Contract, in order to demonstrate the effectiveness of any repairs and adjustments that have been made to a defective paver. The Contractor shall demonstrate his repairs or adjustments or both to the Contract Administrator. If the Contractor is unable to eliminate midlane segregation to the satisfaction of the Contract Administrator by making repairs or adjustments to the paver within the allowable 500 tonnes of HMA, then the Contractor shall discontinue the use of that paver.

313.07.13 Field Adjustments to the Job Mix Formula

All field adjustments to the JMF are subject to the conditions specified herein.

The revised JMF shall be supplied in writing on a form supplied by the Contract Administrator together with supporting test results. Within 1 Business Day of receiving the new JMF documentation, the Contract Administrator shall give a written confirmation of receipt of the revised JMF to the Contractor confirming conformance to the contract requirements or advising of any non-conformance. The revised JMF may be applied to the lot being placed at the time the confirmation of receipt of the revised JMF is issued and the previous lot, if requested by the Contractor as part of the written submission for a JMF change. If this request is not made, the revised JMF shall only apply to mix placed subsequent to the acceptance of the revised JMF.

A field adjustment to the JMF shall be permitted under three situations:

a) To more closely reflect the actual mix being produced, when test results for the last lot produced to the submitted JMF accrued a payment reduction for asphalt cement content or aggregate gradation or both but met all other specified mix requirements. The test results (lot mean) shall show that the design requirements for VMA, percent G_mn at N_{max}, VFA, and dust proportion were met, and that there was no payment reduction for air voids.

b) To permit minor changes in the constituent proportions, when test results for the last lot produced to the submitted JMF indicated no negative price adjustments for asphalt cement or gradation, but changes are designed to improve either the air voids or the VMA or both. For this situation, the air voids PWL shall be at least 50 and the lot mean VMA shall be no more than 0.50% below the design minimum.

c) To permit minor changes in the submitted JMF before production starts.

In all cases, the Contractor shall submit test results to support the application for the change to the JMF. For situation a), this shall be for a minimum of one lot with all its sublots. For situation b), the mean of test results for a minimum of four samples of mix produced in support of this application shall be submitted which shall confirm that the proposed JMF shall produce mix that shall conform to the contract requirements for air voids and VMA, and that the proposed mix shall continue to conform to the percent G_mn at the initial and maximum
number of gyrations, VFA, and dust proportion. For situation b) or c), in lieu of plant check data, results of tests carried out on laboratory mixed samples are acceptable. A minimum of six gyratory-compacted specimens, four compacted to the design number of gyrations and two compacted to the maximum number of gyrations, is required. A minimum of two determinations for maximum theoretical density shall be performed.

The number of field adjustments to the JMF shall be limited to two for each mix design submitted for a given tender item. Field adjustments to the JMF shall be limited in scope such that the net impact of all field adjustments to the JMF does not exceed any of the maximum field adjustments to the JMF in Table 1 in comparison to the original JMF submitted under the current mix design.

313.07.14 Revision to Submitted Mix Design

Submission of a revised mix design is permitted prior to placing any HMA for a tender item when the Contractor determines that aggregate densities in the original mix design have changed but the material sources and proportions are unchanged. A written request shall be made that shall be accompanied by the revised mix design submission clearly showing the more recently determined aggregate density test results and the mix properties obtained with the newly established aggregate density, and with replicate referee and QA aggregate samples. The mix design laboratory shall carry out testing using the protocol for a mix check specified above, except that the mix design laboratory shall use its own density results to determine volumetric properties, and the Mix Check Requirements according to OPSS 1151, does not apply to the mix design laboratory’s results. The mix design laboratory results for the revised mix design shall meet all mix design requirements, except that the percent air voids at the design number of gyrations shall be 4.0 ± 0.3.

The independent laboratory shall conduct a mix check and provide a completed certification MTO Form PH-CC-822IMC, Certificate of Independent Check of Mix Design, for the revised mix design as specified in the Contract Documents. Results of testing carried out by the mix design laboratory in support of the revision and the certification form for the revised mix design shall be submitted with the revised mix design. Within 4 Business Days commencing after the day of delivery of all required documents and all samples, the Contract Administrator shall provide, in writing, the above confirmation or advise the Contractor of any Contract requirements that have not been met. Production shall not begin until the Contract Administrator has issued written confirmation that the revised submission meets Contract requirements.

313.07.15 Sampling

313.07.15.01 Asphalt Cement

Samples of the asphalt cement shall be taken according to OPSS 1101.

313.07.15.02 Hot Mix Asphalt Aggregates for Density Testing

The Contractor shall procure samples for RAP, RST, and the aggregates identified in the mix design for each mix type using methods specified in the Contract Documents. The first set of samples shall be taken no later than 10 Days prior to the start of production of the first lot of HMA. Subsequent samples shall be taken immediately following the completion of 15,000 tonnes ± 1,000 tonnes of mix production, and thereafter at further intervals of 20,000 tonnes as required. The aggregate, RAP, and RST sampling program shall be established in consultation with the Contract Administrator prior to paving. If the Contractor determines that a sampling interval needs to be reduced to reflect changes in the aggregate properties, the Contract Administrator shall be notified and samples shall be taken as warranted.

Each sample shall be clearly identified as to the date of sampling, the lot number, and the item hot mix tonnage being produced when the sample was taken.
313.07.15.03 Hot Mix Asphalt Mix Properties

Samples shall be appropriately labelled with the Contract number, highway number, Region, lot number, sublot number, mix type, lift number, station, offset from the centreline of the highway, and date and time of sampling.

The Contract Administrator shall advise the Contractor of each random sample location or the tonnage from which the sample is to be taken. A set of three samples shall be taken as per Table 2. One of these samples shall be for the Contractor’s QC testing and the other two shall be designated for QA and referee testing.

Samples shall be obtained on site from the same truckload and at the same transverse offset. When the mass of the sample does not meet the requirements of Table 2, the sample shall be discarded and a new one taken immediately. The transverse location of the new sample shall be the same as that of the discarded one.

The SMA sample for draindown testing shall coincide with one of the other sublot samples as designated by the Contract Administrator. The samples shall be transferred to a clean stainless steel bowl or pan of suitable size, immediately after splitting, for delivery to the testing laboratory.

313.07.15.04 Compaction

Upon completion of each sublot, the Contract Administrator shall inform the Contractor of each random sample location in writing. The Contractor shall obtain pavement core samples in triplicate, from each sublot no later than the next Working Day after the completion of the sublot. Each core shall have a minimum nominal diameter of 150 mm and a maximum nominal diameter of 200 mm and shall consist of the full layer being sampled and at least one underlying layer, if one is present. Cores shall not be taken within 250 mm of a longitudinal or transverse joint or the edge of pavement.

Each set of samples shall be taken from the same lane, same transverse offset, and at a spacing of 1.0 m ± 0.1 m between each individual core edge.

Care shall be taken to ensure that cores are not damaged during coring operations or in transit. If a core is damaged, a replacement core shall be extracted at a location adjacent to the original core.

When the lift thickness of the pavement core is less than 35 mm, the core shall be submitted to the Contract Administrator and a replacement core shall be extracted at a location within the same sublot selected by the Contract Administrator. If the thickness of the replacement core is also less than 35 mm, the Contractor shall submit the core to the Contract Administrator and review the situation with the Contract Administrator prior to any further coring of the sublot.

Core samples shall also include design lift thickness on the label and the lot and sublot numbers shall be clearly marked with a permanent marker on all compaction cores.

HMA and compaction requirements for filling the sample holes shall be the same as the adjacent undisturbed pavement. Sample holes shall be cleaned, dried, and filled and then compacted using a mechanical self-powered gas-, electric-, or air-powered compactor immediately after sampling.

313.07.15.05 Stone Mastic Asphalt

Once each week during production of SMA, the Contractor shall provide a summary and appropriate supporting documentation, including bills of lading, that reconciles the daily usage of fibres and mineral filler in the mix with the quantity of SMA produced.
The Contractor shall obtain a set of three samples of mineral filler and fines returned to the mix according to Table 2. One of these samples shall be for the Contractor’s QC SMA Mortar testing and for the Contractor to test for Rigden Voids and the other two samples shall be designated for QA and referee testing. Lots shall consist of mineral filler and returned fines incorporated in 10,000 tonnes of SMA produced. Each lot shall consist of one sublot.

313.07.16 Testing

313.07.16.01 Submission of Test Results

The Contractor shall submit all test results to the Contract Administrator not later than 2 Business Days after sampling each sublot for HMA mix properties and compaction and 5 Business Days for density testing of the HMA aggregates.

313.07.16.02 HMA Aggregates for Density Testing

The Contractor shall conduct density tests for RAP, RST, and aggregates identified in the mix design for each mix type using methods specified in the Contract Documents and also report the resulting combined aggregate density for the purpose of determining the VMA of the mix.

Density testing of the coarse and fine aggregates shall be carried out according to LS-604 and LS-605 respectively using the procedures for blended aggregates. The resulting combined aggregate density for each set of samples shall represent the aggregates incorporated in up to 20,000 tonnes of HMA or all the full lots of mix within this tonnage, as established in the sampling program. All test results shall be provided to the Contract Administrator within 5 Business Days of sampling the aggregates, RAP, and RST.

313.07.16.03 Hot Mix Asphalt Properties and Compaction

The Contractor shall conduct tests, carry out calculation and provide values according to Table 3.

313.07.16.04 Surface Smoothness

The Contractor shall measure all through lane pavement surfaces using an approved smoothness-measuring device as specified in the Contract Documents, with the following exceptions:

a) Where the posted speed is 60 km/hour or less.

b) Where a single lift is placed on an existing surface.

c) Within 10 m of the end of a placement where the paving Contractor is not responsible for the adjoining surface.

d) Bridge decks and within 10 m of bridge deck expansion joints.

e) Detours and other temporary pavement that shall be removed or overlaid under this Contract.

f) The first adjacent lane consisting of one or more lifts of hot mix where the Contractor must match to an existing surface that is not being resurfaced under this Contract.

g) Within 10 m of any access holes, water valves, or similar structures which are located within the lane or within 1.5 m of the outside edge of the lane.

313.07.17 Management of Excess Material

Management of excess material shall be according to the Contract Documents.
313.08 QUALITY ASSURANCE

313.08.01 Acceptance Criteria

Acceptance of hot mix shall be based on the following criteria:

a) Asphalt cement physical requirements

b) Mix properties, VMA and compaction

c) Surface tolerance

d) Surface appearance

e) Surface smoothness

313.08.01.01 Asphalt Cement Physical Requirements

The Contract Administrator shall determine the acceptability of the performance graded asphalt cement according to OPSS 1101.

313.08.01.02 Mix Properties, Voids in Mineral Aggregate, and Compaction

313.08.01.02.01 Lot Size

The Contract Administrator shall determine the size and location of the lots and sublots, including the optional trial, after discussion with the Contractor and before HMA production for the tender item starts. Guidelines for the breakdown of the tender item quantity into lots are as listed in Table 4.

When the tender item quantity is 1,000 tonnes or less, the sublot sizes shall be based on individual circumstances. When the tender item quantity is between 1,000 tonnes and 5,000 tonnes of hot mix, the quantity shall normally be considered as a single lot. The number or size of the sublots may be adjusted to suit the quantity. When the tender item quantity is 5,000 tonnes or more, the lot size shall normally be 5,000 tonnes with ten sublots of equal size. The lot and sublot sizes may be reduced, at the discretion of the Contract Administrator and after discussion with the Contractor, prior to placing the lot.

When the hot mix tender item is 5,000 tonnes or more, an optional trial of one lot, not exceeding 500 tonnes, with one sublot shall be permitted for the tender item. If the Contractor elects to plan this optional trial, he shall advise the Contract Administrator in writing prior to placing the trial lot. The optional trial shall be placed in a binder course and shall not be placed in a critical location such as bridge decks. Before placing any SMA as surface course, an optional trial consisting of a quantity of up to 1,000 tonnes is permitted. The optional trial may be divided into two to three sections in the upper binder, with each section being considered as a separate lot for sampling and testing, as specified in the Contract Documents.

When only one or two sublots are completed at the end of paving for the tender item due to a change in the JMF or when a delay of more than 20 Business Days occurs in placing the complete lot, the test results obtained shall be considered as part of the previous lot and the previous lot shall then have 11 or 12 sublots. When the optional trial is the previous lot and only one or two sublots are completed as described above, they shall be evaluated for acceptance in the same manner as for the optional trial. When only 3 to 9 sublots are completed due to the above circumstances, then the 3 to 9 sublots shall be considered as a lot.

When a delay of more than 20 Business Days occurs in placing the complete lot and this lot shall be completed during the same calendar year, the Contractor may, prior to the end of the 20 Business Days, request in writing to the Contract Administrator that the lot be continued upon the resumption of paving for that tender item. If the request is not made or is not accepted by the Contract Administrator, the lot shall be terminated and evaluated for acceptance.
313.08.01.02.02 Comparison of Test Results and Impacts

The QA and referee laboratories shall use the same test method as the Contractor except that when the Contractor chooses LS-292, the QA and referee laboratories shall use that method provided the calibration requirements are met. If they are not met, the affected laboratory shall use LS-282.

QA testing shall be for comparison purposes only except as allowed for in Use of QA Results for Payment clause, and shall be based on a minimum frequency of one test result generated by the QA laboratory for every two results generated by the QC laboratory. The Contract Administrator shall provide the Contractor with a copy of the test results.

On receiving the QC test results for the lot, the compaction payment factor and the mix properties payment factor for the lot, shall be calculated by the Contract Administrator. If no QA testing is carried out, the QC results shall be used for acceptance of HMA, unless either party requests referee testing. If QA testing is carried out, the QC and QA results shall be compared by the Contract Administrator on a lot-by-lot basis, and the following shall apply:

a) The QC and QA results shall be deemed to agree, if the difference in the compaction payment factor and the mix properties payment factor calculated using the QA and QC test results are both less than 0.025. When the QC and QA results agree, the payment factor obtained using the QC results shall apply unless either party requests referee testing.

b) If the above comparison criterion is not met, the QC and QA results shall be deemed to disagree, and either party may request referee testing.

The Contract Administrator shall compare SMA air void test results. If a QA sublot or a QA lot are rejectable for air voids and the corresponding QC sublot or QC lot was not rejectable, the Owner may request referee testing.

For aggregate density testing, when the difference in the combined aggregate densities determined through QA and QC testing is less than or equal to 0.010, the QC value shall be used for the purposes of calculating the VMA of the HMA. If this difference is between 0.011 and 0.020, the value used for calculating the VMA shall be the mean of the QC and QA densities. When the QC and QA combined aggregate densities are different by more than 0.020, the result shall be deemed to be in disagreement and referee testing shall be invoked by the Owner to determine the combined aggregate density. The value determined by the referee laboratory shall be used to calculate the VMA of the mix.

313.08.01.02.03 Basis of Acceptance

Acceptance for all mixes for mix properties and compaction is based on the lot PWL for each attribute, excluding VMA and except that for SMA the air voids PWL is determined for information purposes only. The PWL of the lot for each criteria shall be used to determine the payment adjustment factor from Table 5, based on PWL. If the PWL is less than 50% for asphalt cement content, air voids or compaction, or less than 25% for any payment adjustment sieve, the lot is rejectable and shall be subject to repair or payment adjustment. VMA shall meet the minimum mix design requirements according to OPSS 1151 for each lot and payment shall be based on the lot mean as specified in the Payment Factor for Voids clause. If the VMA payment factor is less than 0.500, the lot shall be considered rejectable. SMA lots shall be considered rejectable if the draindown is more than 0.3%.

When the tendered item quantity is less than 1,000 tonnes, the HMA may be accepted by the Contract Administrator based upon such testing as is deemed necessary by the Contract Administrator to determine substantial conformance with the Contract. When three or more tests have been completed for a lot the Material shall be accepted at the full Contract price, subjected to a payment adjustment or rejected as detailed herein.
The optional trial shall not be subject to payment adjustment unless the mix is rejectable. To determine if the mix is rejectable for the optional trial, the asphalt cement content, aggregate gradation, air voids, and compaction shall comply with the limits specified in Table 6.

The Contract Administrator shall determine if a rejectable lot may remain in the work without repairs. When the Contract Administrator has determined that a rejectable lot may remain in the work without repair, the lot shall be subjected to a payment adjustment. If the Contractor elects to repair the lot in lieu of a payment adjustment or if the Contract Administrator determines that a rejectable lot requires repair, the lot shall be repaired and re-evaluated as detailed under repairing and re-evaluating.

313.08.01.02.03.01 Interim Procedure for Administration of Air Voids Requirements for Stone Mastic Asphalt

A lot shall be considered acceptable for air voids, if the mean of the test results within that lot is greater than or equal to 2.5 percent and less than or equal to 5.5 percent and no sublot has a test result less than 2.0 percent or greater than 6.0 percent air voids.

A lot shall be considered rejectable, if the mean of all of the test results within that lot is either less than 2.5 percent or greater than 5.5 percent air voids.

A sublot shall be considered rejectable, if its test result is less than 2.0 percent or greater than 6.0 percent air voids.

For lots or sublots that are rejectable with respect to air voids and that the Contract Administrator requires repaired, the Contractor shall provide a written proposal to the Contract Administrator with the details of how the repairs shall be carried out.

313.08.01.02.03.02 Stone Mastic Asphalt Mortar Properties

SMA mortar shall be considered acceptable on a lot-by-lot basis, if the SMA mortar meets the following requirements as determined according to Table 3:

- Unaged Dynamic Shear Rheometer, G*/Sinδ - 5 kPa minimum
- RTFO Aged Dynamic Shear Rheometer, G*/Sinδ - 11 kPa minimum
- PAV Aged Bending Beam Rheometer - 1,500 MPa maximum

The SMA mortar shall be blended by volume using a portion of the lot asphalt cement and mineral filler and baghouse fines samples to the proportions used in the mix design.

313.08.01.02.04 Referee Testing

313.08.01.02.04.01 General

The Contractor or the Contract Administrator may request testing by an independent third party referee laboratory for the entire lot for any completed lot, regardless of the difference in QC and QA payment factors. All referee testing shall meet the conditions associated with one of the categories identified in Table 8.

Either party may request referee testing for determining the draindown of a SMA sample.

Referee testing for a given lot can only be invoked by the Contractor within 5 Business Days of the Contractor receiving the Contract Administrator’s calculated payment factors for that lot. The Owner may invoke referee testing for a given lot not more than 15 Business Days after all the QA samples for the lot are received at the QA laboratory, or not more than 15 Days after a lot is terminated due to a delay of more than 20 Business Days in placing the complete lot, whichever is the latest date.
The results generated by the referee laboratory shall be used to re-evaluate the lot to determine the payment factors for the acceptance of the disputed properties for the disputed lots of HMA.

313.08.01.02.04.02   Referee Voids in Mineral Aggregate

When the QA combined aggregate density is within 0.020 of the QC combined aggregate density, the aggregate densities shall be deemed to be in agreement and the referee laboratory shall use the QC combined aggregate density in calculating the VMA. If the mean QC and QA combined densities are not in agreement, the referee laboratory shall conduct aggregate density testing on samples supplied to it for this purpose. These samples shall be the last samples taken prior to the start of the lot being subjected to referee testing. The combined aggregate density result shall be compared to the QC and QA combined aggregate density results, and the referee calculation of VMA shall be based on the result that is closer to the referee result. The referee result shall only be used if it is exactly in between the QC and QA combined aggregate density test result.

313.08.01.02.05   Outliers

313.08.01.02.05.01   Determination of Outliers in Test Results

The Contractor or the Contract Administrator may question an individual value for any attribute of a sublot’s test result, excluding VMA. The request shall be made within 3 Business Days of the Contractor and Contract Administrator receiving all of the test results for the lot and only when the payment factor for the attribute with an outlier is less than 1.0. The validity of the questioned attribute shall be ascertained in accordance with ASTM E 178 using a T test at a 10% significance level.

If the T test procedure shows that the questioned value of the attribute is not an outlier, then the test result shall be used in the calculations. If the T test procedure shows that the questioned value of the attribute is an outlier, then the test result for the sublot shall be checked for mathematical errors.

For QC and QA test results, if there are no mathematical errors, the test result for the sublot is also considered an outlier and shall be discarded and replaced. For referee test results, if there are no mathematical errors, the sublot with the outlier is treated as a lot with one sublot and the remaining sublots shall form a separate lot as detailed in Outlier in Referee Results clause.

313.08.01.02.05.02   Quality Control and Quality Assurance Outlier Replacement Testing

When requested by the applicable party as specified in the Outlier in Quality Control Results and the Outlier in Quality Assurance Results clauses, a laboratory designated by the Owner from the Owner’s roster of referee laboratories shall perform outlier replacement testing for QC and QA test results to replace the discarded test result using the referee sample. Outlier replacement testing shall be performed for a sublot for all mix properties or compaction or both (i.e., if one mix attribute is an outlier, all mix property results for that sublot shall be replaced, not just the attribute identified as an outlier). Regardless of the presence of outliers in the replacement test result for the sublot and remaining original results, the replacement test result shall be binding on both the Contractor and the Owner and further outlier replacement testing shall not be performed on the lot.

313.08.01.02.05.03   Outlier in Quality Control Results

For an outlier in the QC results, one of the following actions shall be taken:

a) The Contractor may replace the outlier result with the Owner’s QA result, either mix properties or compaction, for the affected sublot, if the Owner tested that sample.

b) The Contractor may request that the Contract Administrator arrange for the Owner’s laboratory to test the corresponding QA sample for that sublot.
c) The Contractor may request that a replacement result for the outlier be obtained by testing of the referee sample for the subject sublot. If the Contractor or Owner were to subsequently request referee testing on the full lot, the same lab that performed the outlier replacement testing would be assigned as the referee lab, and the results of the replacement testing already completed for the subject sublot shall also become the referee results for that sublot.

313.08.01.02.05.04 Outlier in Quality Assurance Results

For an outlier in the QA results, the Contractor or the Contract Administrator may request that a replacement result for the outlier be obtained by testing of the referee sample for the subject sublot. If the Contractor or Owner subsequently requested referee testing on the full lot, the same laboratory that performed the outlier replacement testing shall be assigned as the referee laboratory, and the results of the replacement testing already completed for the subject sublot shall also become the referee results for that sublot. The cost of the outlier replacement testing shall be borne by the party requesting the outlier replacement testing, unless the entire lot subsequently undergoes referee testing, in which case, the referee testing for the entire lot shall be paid according to the referee testing procedure specified in the Contract Documents.

313.08.01.02.05.05 Outlier in Referee Results

When an outlier in the referee results is identified, the sublot with the outlier shall be treated as a lot with one sublot for both mix properties and compaction or air voids, when only air voids was subject to referee testing, and compaction for SMA.

When the sublot with the outlier is treated as a lot with one sublot, the remaining sublots shall form a separate lot.

The lot with one sublot shall be evaluated as follows:

A single test result for each attribute shall be used to evaluate the lot.

If the outlier value and the other attributes for the sublot are within the specification limits listed in Table 6, then the payment factor shall be 1.00 for the lot.

If the outlier value or any of the attributes used to evaluate the lot is rejectable (i.e., outside the specification limits listed in Table 6) or the outlier value and any of the attributes used to evaluate the lot is rejectable, then the lot is rejectable. The Contract Administrator may assess a payment reduction or require that the lot be repaired at the Contractor’s expense as specified in the Repairing and Re-evaluating clause. If a rejectable lot is allowed to remain in the work, a payment factor of 1.00 shall be given to each attribute that is not rejectable, and the payment factor for \( PWL = 50\% \), 25\% for each sieve analysed for gradation, from Table 5 based on PWL, shall be given to each attribute that is rejectable. The total payment factor for the lot shall be calculated using the formulae detailed in the Calculations clause.

The lot formed by the remaining sublots shall:

a) be accepted, subjected to a payment adjustment or rejected as detailed elsewhere in the Contract Documents for lots with 3 or more sublots, and

b) not be checked for further outliers.

If only two sublots remain, the two sublots shall be treated as two separate lots each with one sublot.
Use of Quality Assurance Results for Payment

At the Contractor’s request, made in writing to the Contract Administrator within 2 Business Days of receiving the initial set of QA test results for the lot from the Contract Administrator, the use of the Owner’s QA results for payment purposes shall be permitted on a lot-by-lot basis. When the Contract Administrator grants the Contractor’s request in writing, all of the following actions shall apply:

a) All the remaining untested QA samples in the lot shall be tested by the QA laboratory and used with the initial set of QA test results to determine the payment factors.

b) The QA test results in the lot and the calculated payment factors shall be binding on both the Owner and the Contractor.

c) Referee testing cannot be invoked by either the Owner or the Contractor for the subject lot.

Repairing and Re-Evaluating

The Contract Administrator may require any rejectable lot to be repaired. When the Contract Administrator has determined that a rejectable lot may remain in the work without repair, the lot shall be subjected to a payment adjustment.

The Contractor may elect to carry out repairs in lieu of accepting a payment adjustment, if the lot is not rejectable and the total payment factor for the lot is less than 0.940. When the Contract Administrator requires a rejectable lot to be repaired or the Contractor elects to carry out repairs in lieu of accepting a payment adjustment, the Contractor shall determine what areas of hot mix in a lot are to be repaired subject to the minimum lengths and widths specified herein. Each repair area shall include at least one of the loose mix or core sample locations or both representing that sublot.

The minimum length of a single-repair to one lane shall be 250 m. The minimum length of a single-repair that extends over more than one lane shall be 250 lane-metres and no portion of the single-repair in a lane shall be less than 125 m in length.

The minimum limits of each repair shall be at least 125 lane-metres from the location of the loose mix or compaction core or both that represents the sublot; otherwise, a repair limit shall coincide with one end of the sublot when the sample location is less than 125 lane-metres from it. If the proposed limit of a single-repair falls within the proposed limit of another single-repair, the overlap shall count towards the 250 lane-metre minimum for both repairs. Repair areas within a single lane shall be separated by at least 100 m. If the delineation of repair areas results in patches less than 100 metres apart, these repair areas shall be re-established to form a continuous repair.

The Contractor shall submit a list and sketch identifying the proposed locations of the repairs to the Contract Administrator for review at least 5 Business Days prior to the intended start of the repair work. Each sublot and single-repair shall be uniquely labelled. Overlapping repair areas and discontinuous portions of a single-repair shall be labelled so that they are readily identified with their single-repair. The Contractor shall not start repairs unless the Contract Administrator has given written permission. If permission is denied, then the Contract Administrator shall provide the Contractor with the reason in writing.

Prior to the repair, the Contractor shall take slab samples or cores for testing of AC Content, Gradation, Air Voids, and VMA or Compaction or all in the unrepaired area within 1 m of the limits of each end of the repair area. The Contractor shall not be permitted to take additional samples or cores beyond these locations until after QC, QA, or referee testing demonstrates that the remaining Material in the sublot proposed for repair is deemed to be rejectable. If the proposed repair limit coincides with the beginning of a sublot that is being left unrepaired, samples are not required at this location. Sufficient material shall be obtained for testing by the QC laboratory, the Owner’s QA laboratory, and for possible referee testing.
Testing shall demonstrate that the remaining Material in the sublot proposed for repair is not rejectable. To determine if the mix is rejectable, the asphalt cement content, aggregate gradation, air voids, and compaction shall comply with the limits specified in Table 6. If the Material is deemed to be rejectable, the proposed limit of the repair shall be extended by a minimum of 25 m, and the sampling and testing repeated. The repair area selected by the Contractor shall incorporate the location used for obtaining samples that shall be used to confirm that the remaining mix is not rejectable. If the contractor’s repair proposal results in the removal of at least half the sublot tonnage, the Contract Administrator may waive testing demonstrating the suitability of the remainder of that sublot.

Repair shall consist of the removal and replacement of the full thickness of the hot mix lift or the placement of an overlay when permitted by the Contract Administrator. The minimum width of repair shall be the width of the lane or shoulder or both being repaired. A paver shall be used in carrying out the repair.

When repairs are made to all or part of a lot, the lot shall be re-evaluated. The unrepaired sublots combined with the remainder of any repaired sublots shall comprise one lot and shall be assessed on the basis of the loose mix or core or both samples representing the unrepaired sublots. If there are only one or two sublots in a lot that are not repaired, the Contract Administrator shall include those sublots as part of the previous or next lot. When the referee laboratory has tested the lot, the referee test results shall be used to determine the payment factors instead of the original test results.

The mix used for the repair shall comprise a separate lot or the Contract Administrator in conjunction with the Contractor may decide to include it as part of the current lot being produced. The repaired area shall be tested for all criteria.

The 2 reconfigured lots shall be accepted at the full Contract price, subjected to a payment adjustment or rejected according to the Payment Adjustment for Mix Properties and Compaction clause.

313.08.01.02.07 Specification Limits

PWL shall be determined using lot test results, LS-101, and lower and upper limits specified in Table 6 and Table 7.

313.08.01.03 Surface Tolerance

The surface tolerances of any pavement surface shall be such that when tested with a 3 m straight edge placed anywhere, including the edge of the pavement, in any direction on the surface, except across the crown or drainage gutters, there shall not be a gap between the bottom of the straightedge and the surface of the pavement:

a) greater than 6 mm for all binder courses and padding, or

b) greater than 3 mm for all surface courses.

All areas not meeting the surface tolerance requirements shall be repaired by diamond grinding or removed and replaced. Slurry produced from diamond grinding shall be removed from the site by the Contractor and managed as specified in the Contract Documents.

313.08.01.04 Surface Appearance

HMA deemed by visual appearance to have flushing, bleeding, segregation, fat spot, surface damage, and surface contamination but not limited to these, shall all be considered deficient Material or work. Deficient material, mixture, and work shall be removed and replaced or repaired or assessed a payment reduction as directed by the Contract Administrator.
313.08.01.04.01 Segregation

The Contractor shall provide traffic control, for all segregation assessments and to resolve all segregation challenges, regardless of the type, location, causes, or severity.

313.08.01.04.02 Disposition of Segregated Mix

HMA exhibiting medium or severe midlane segregation shall be assessed a payment reduction or shall be repaired at the discretion of the Contract Administrator.

Other segregation shall be addressed in accordance with the following:

a) Slightly segregated mix shall be accepted into the work with no payment reduction.

b) Medium segregation in binder, levelling, and padding courses with a thickness no less than 40 mm, shall normally be left in place with no payment reduction. However, any areas of medium segregation that deteriorate prior to being overlaid by another pavement course shall be repaired at no cost to the Owner. Medium segregation in surface courses shall be assessed a payment reduction, or repaired at the direction of the Contract Administrator.

c) All severely segregated mix shall be repaired by removal and replacement.

Levelling or padding courses with a total thickness that is less than 40 mm, bullnoses, and tapers that were not machine-laid and any areas of handwork shall not be assessed on the basis of segregation but on the basis of other workmanship-related problems. However, if they deteriorate prior to being overlaid by another pavement course, the Contract Administrator shall assess the causes of the deterioration before determining responsibility for the cost of repairs.

313.08.01.04.03 Challenging Severity of Segregation

The Contractor may challenge, in writing, the severity of any segregated area assessed as either medium or severe, within 5 Business Days of receiving the Owner's first visual assessment. The written challenge shall list the dimensions and the Contractor's assessment of the severity of each disputed area.

For contracts with up to 30,000 tonnes of HMA, the Contractor shall be allowed a maximum of two separate written challenges for each tender item. However, for contracts with more than 30,000 tonnes of HMA, the Contractor shall be allowed a maximum of four separate written challenges for each tender item. Each written challenge may involve more than one disputed segregated area.

A representative of the Owner who is qualified in segregation assessment, who did not carry out the original assessment and who is not the Contract Administrator shall make a second visual assessment of the disputed areas. This second visual assessment shall be carried out within 5 Business Days after the Contract Administrator has received the Contractor's written challenge and the results of that second visual assessment shall be binding on both the Owner and Contractor.

313.08.01.04.04 Repairs for Segregation

All repairs shall be subject to the approval of the Contract Administrator. Repairs shall consist of removal and replacement with new HMA that meets the contract requirements for the tender item. All repaired areas shall be tack-coated and all transverse joints in surface course repairs shall butt up to a vertical face. A paver shall be used for all repairs except those where localized repairs are allowed. Repairs for segregated HMA shall be full lane or full shoulder width. Where the Contract Administrator permits localized repairs for mid-lane segregation in binder courses, these repairs shall be:
a) less than or equal to 300 mm in width;
b) to the full depth of the subject lift; and
c) tack-coated.

313.08.01.05 Acceptance Criteria for Smoothness

The acceptability of smoothness shall be as specified in the Contract Documents.

313.09 MEASUREMENT FOR PAYMENT

313.09.01 Actual Measurement

313.09.01.01 SMA 19.0
SMA 12.5
SMA 9.5
Superpave 4.75
Superpave 9.5
Superpave 12.5
Superpave 12.5FC 1
Superpave 12.5FC 2
Superpave 19.0
Superpave 25.0
Superpave 37.5

313.09.01.01.01 By Area

Measurement of HMA shall be the horizontal area in square metres in place.

313.09.01.01.02 By Mass

Measurement of HMA shall be by mass in tonnes according to the requirements of the Contract Documents.

Measurement of HMA used for temporary ramping specified in the Contract Documents shall be measured in tonnes. Removal of temporary ramping specified in the Contract Documents shall not be measured for payment.

313.09.01.02 Hot Mix Asphalt Miscellaneous

Measurement of HMA Miscellaneous shall be by area in square metres, regardless of the number of lifts placed.

313.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement is based on the units shown in the clauses under Actual Measurement.
313.10 BASIS OF PAYMENT

313.10.01 Hot Mix

313.10.01.01 SMA 19.0 - Item
SMA 12.5 - Item
SMA 9.5 - Item
Superpave 4.75 - Item
Superpave 9.5 - Item
Superpave 12.5 - Item
Superpave 12.5FC 1 - Item
Superpave 12.5FC 2 - Item
Superpave 19.0 - Item
Superpave 25.0 - Item
Superpave 37.5 - Item

Payment at the Contract price for the above tender items, including the applicable payment adjustments, shall be full compensation for all labour, Equipment, and Materials to do the work.

When repairing HMA, the Contractor shall be responsible for and shall carry out all associated work and replace or restore all associated damage and removals at no cost to the Owner.

When the Contract Administrator instructs the Contractor to cease paving due to continued medium or severe segregation regardless of cause, the Owner shall not be held responsible for any additional costs that the Contractor may incur.

313.10.01.02 Payment Adjustment for Mix Properties and Compaction

For all mixes, when the Contractor is not required to or does not elect to repair a lot, the payment adjustment for that lot due to mix properties and compaction requirements shall be:

\[ PA_{MC} = \text{lot quantity} \times \text{price} \times [PF_{MC} - 1.000] \]  
(Formula 1)

For all mixes, when the \( PF_{MC} \) is:

a) less than 1.000, there shall be a reduction in payment;  
b) equal to 1.000 there shall be no adjustment; and  
c) greater than 1.000 there shall be an increase in payment for the lot.

Where:

**Lot Quantity** shall be the quantity of the mix in the lot. For SMA 19.0, SMA 12.5, SMA 9.5, Superpave 12.5FC 1, and Superpave 12.5FC 2 the lot quantity is the quantity of the mix in the lot multiplied by the applicable mass multiplier factor (MF) in the Payment Adjustment for Aggregate Density clause.

**Price** for the purposes of payment adjustment due to mix properties and compaction, means the contract price of the hot mix tender item. In the case where surface mix is placed as an optional trial in the binder course, the term price means the contract price for the surface course tender item. If asphalt cement content is specified for bidding purposes, the term price means the adjusted contract price after adjusting for the change in asphalt cement content.
313.10.01.02.01 Optional Trial

If the Contractor has elected to place an optional trial as detailed in the Lot Size clause, the lot shall be assigned a PF_{MC} of 1.000 if the lot is not rejectable. If the lot is determined to be rejectable, it shall be administered as described in this specification. If a rejectable lot is allowed to remain in the work, a payment factor of 1.000 shall be given to each attribute that is not rejectable, and the payment factor for PWL = 50%, 25% for each sieve analysed for gradation, from Table 5 shall be given to each attribute that is rejectable. The PF_{MC} for the lot shall be calculated using the formulae detailed in the Calculations clause.

313.10.01.02.02 Calculations

313.10.01.02.02.01 General

The PF_{MC} shall be based on the individual payment factors obtained from Table 5, based on PWL, determined for gradation, asphalt cement content, voids, and compaction using LS-101 and the formulae in the Payment Factor for Gradation clause, the Payment Factor for Combined Gradation and Asphalt Cement Content clause, the Payment Factor for Voids clause, the Payment Factor for Combined Mix Properties clause, and the Payment Factor for Combined Mix Properties and Compaction clause.

When there is no sampling or testing specified for an attribute or when the requirement for sampling or testing for an attribute is waived by the Owner, the payment factor for that attribute shall be equal to either:

a) the payment factor it is added to in Formulae 8, 13, or 16, if that payment factor is less than 1.0; or,

b) 1.0, if the payment factor it is added to in Formulae 8, 13 or 16 is equal to or greater than 1.0.

313.10.01.02.02.02 Payment Factor for Gradation

To obtain the gradation payment factor use the following formulae:

For Superpave 37, Superpave 25, Superpave 19, Superpave 12.5, Superpave 12.5FC 1, Superpave 12.5FC 2, SMA 19, and SMA12.5:

\[ PF_{G(SUB)} = PF_{DLS} + PF_{4.75} + PF_{600} + PF_{75} \]  \hspace{1cm} \text{(Formula 2)}

If \( PF_{G(SUB)} \) is greater than or equal to 4, the equation for \( PF_{G} \) is

\[ PF_{G} = PF_{G(SUB)} - 3 \]  \hspace{1cm} \text{(Formula 3)}

If \( PF_{G(SUB)} \) is less than 4, the equation for \( PF_{G} \) is

\[ PF_{G} = PF_{G(SUB)} / 4 \]  \hspace{1cm} \text{(Formula 4)}

For Superpave 9.5, Superpave 4.75, and SMA 9.5

\[ PF_{G(SUB)} = PF_{4.75} + PF_{600} + PF_{75} \]  \hspace{1cm} \text{(Formula 5)}

If \( PF_{G(SUB)} \) is greater than or equal to 3, the equation for \( PF_{G} \) is

\[ PF_{G} = PF_{G(SUB)} - 2 \]  \hspace{1cm} \text{(Formula 6)}

If \( PF_{G(SUB)} \) is less than 3, the equation for \( PF_{G} \) is

\[ PF_{G} = PF_{G(SUB)} / 3 \]  \hspace{1cm} \text{(Formula 7)}

Where:

- \( PF_{G} \) = payment factor for gradation
- \( PF_{DLS} \) = payment factor for designated large sieve
- \( PF_{4.75} \) = payment factor for the 4.75 mm sieve
- \( PF_{600} \) = payment factor for the 600 µm sieve
- \( PF_{75} \) = payment factor for the 75 µm sieve
313.10.01.02.02.03 Combined Gradation And Asphalt Cement Content

To obtain the combined gradation and asphalt cement content payment factor use the following formulae:

\[ P_{FAC(SUB)} = P_{FG} + P_{FAC} \]  \hspace{1cm} (Formula 8)

If \( P_{FAC(SUB)} \) is greater than or equal to 2, then \( P_{FAC} = P_{FAC(SUB)} - 1 \)  \hspace{1cm} (Formula 9)

If \( P_{FAC(SUB)} \) is less than 2, then \( P_{FAC} = P_{FAC(SUB)} / 2 \)  \hspace{1cm} (Formula 10)

Where:
- \( P_{AC} \) = payment factor for asphalt cement content
- \( P_{FAC} \) = combined payment factor for asphalt cement content and gradation

313.10.01.02.02.04 Payment Factor for Voids

For Superpave mixes, if the lot mean VMA is not more than 0.5 percent below the minimum VMA specified for mix design purposes, the payment factor for VMA is 1.000. For lot mean VMA results more than 0.5 percent lower than the minimum specified for mix design purposes, a payment factor for the subject lot shall be calculated in accordance with the following:

\[ \text{If } (V_{\text{MAmin}} - V_{\text{MAmean}}) \geq 2.5, \text{ then } P_{FVA} = 0 \]  \hspace{1cm} (Formula 11)

\[ \text{If } (V_{\text{MAmin}} - V_{\text{MAmean}}) < 2.5 \text{ then, } P_{FVA} = 0.8000 - 0.4(V_{\text{MAmin}} - 0.5 - V_{\text{MAmean}}) \]  \hspace{1cm} (Formula 12)

Where:
- \( P_{FVA} \) = payment factor for VMA
- \( V_{\text{MAmean}} \) = lot mean VMA
- \( V_{\text{MAmin}} \) = minimum VMA specified for mix design

For Superpave mixes when the payment factor for VMA is less than 1.000, it shall be compared to the payment factor for air voids and the lesser of the two is the payment factor for voids, \( P_{FVOIDS} \). When the Payment Factor for VMA is equal to 1.000, \( P_{FVOIDS} \) shall be the same as the payment factor for air voids.

For SMA, the payment factor for air voids as determined by Table 5, Payment Adjustment Factors based on PWL, shall not be used in the combined payment factor.

For SMA, although sampling and testing for air voids are required, for the purposes of payment factor calculation, air voids for SMA shall be treated as an attribute where sampling or testing or both has been waived by the Owner. However, the Owner shall be given all QC test results for air voids as well as all other attributes specified in the Contract Documents.

\[ P_{FVOIDS} = P_{FAC} \text{ if } P_{FAC} < 1.000, \text{ or } P_{FVOIDS} = 1.000 \text{ if } P_{FAC} \geq 1.000 \]

313.10.01.02.02.05 Payment Factor for Combined Mix Properties

To obtain the combined payment factor for mix properties, \( P_{FM} \) use the following formulae:

\[ P_{FM(SUB)} = P_{FAC} + P_{FVOIDS} \]  \hspace{1cm} (Formula 13)

If \( P_{FM(SUB)} \) is greater than or equal to 2 then \( P_{FM} = P_{FM(SUB)} - 1 \)  \hspace{1cm} (Formula 14)

If \( P_{FM(SUB)} \) is less than 2 then \( P_{FM} = P_{FM(SUB)} / 2 \)  \hspace{1cm} (Formula 15)
### 313.10.01.02.06 Pay Factor for Combined Mix Properties and Compaction

To obtain the combined payment factor for mix properties and compaction ($PF_{MC}$) use the following formulae:

$$ PF_{MC(SUB)} = PFC + PFM $$  \hspace{1cm} \text{(Formula 16)}

If $PF_{MC(SUB)}$ is greater than or equal to 2 then

$$ PF_{MC} = PF_{MC(SUB)} - 1 $$  \hspace{1cm} \text{(Formula 17)}

If $PF_{MC(SUB)}$ is less than 2 then

$$ PF_{MC} = PF_{MC(SUB)} / 2 $$  \hspace{1cm} \text{(Formula 18)}

Where:

- $PFC$ = Compaction Payment Factor

The $PF_{MC}$ shall be reported to four decimal places with rounding in accordance with LS-100.

For SMA, if a sublot is considered rejectable for air voids and the Contract Administrator allows the Contractor to leave the sublot unrepaired, then the lot which contains that sublot shall only be allowed to receive a maximum $PF_{MC}$ of 1.000. However, when the Contractor repairs a sublot due to rejectable air voids, then only the tonnage within that sublot shall not be allowed to receive a $PF_{MC}$ greater than 1.000.

When the Contract Administrator decides that the unrepaired area of an original lot that has been partially repaired shall not be resampled, the $PF_{MC}$ for the unrepaired area shall be 1.000.

### 313.10.01.03 Payment Adjustment for Surface Smoothness

Payment adjustment for surface smoothness shall be as specified in the Contract Documents.

### 313.10.01.04 Payment Adjustment for Segregated HMA

For each continuous lane-kilometre of mainline surface course, starting at the beginning of paving and the area at the end of the Contract that is less than one lane kilometre in length, the Contractor shall receive a payment increase of $0.50 per tonne for Superpave 12.5FC 2 and where Superpave 12.5FC 1 is used on freeways in Northeastern Region or $0.20 per tonne for any other mix types as long as these areas do not have:

a) mid-lane segregation;

b) more than one area of slight, other segregation, which is no more than 8 m$^2$ in size;

c) medium or severe other segregation; or

d) other significant visual deficiencies, as specified in the Contract Documents,

before repairs have been made for visual deficiencies. Transfer lanes on freeways and freeway-to-freeway interchange ramps, excluding any hand-laid areas at the ends, which meet the above-listed restrictions for visual deficiencies, shall also be eligible for payment increases.

The Contract Administrator shall calculate the theoretical tonnage of surface course that shall receive a payment increase. Theoretical tonnage shall be calculated using the design widths and depths for each lane-kilometre of mainline paving, including any paved shoulder up to 0.5 m in width which is being placed at the same time and using the same paver as the finished lane, and the mean lot average bulk relative density calculated from all of the values obtained from compaction acceptance testing of core samples for the applicable surface course.
For all surface courses, where payment reductions for segregation are allowed in lieu of repairs, the Contractor shall be assessed a payment reduction of:

a) $2,000 once for each applicable surface course tender item regardless of the existence of payment increases;

b) an additional payment reduction of $2.50/m for mid-lane segregation; and

c) an additional payment reduction of $5.00/m² for other segregation. The area of each patch shall be computed by multiplying the full lane width by the length of the patch and rounded to the next whole square metre.

Payment under the appropriate tender item shall include full compensation for traffic control required to conduct all segregation assessments and to resolve all challenges. However, if under a challenge, as described in the Challenging Severity of Segregation clause, the Contractor is successful, then the Owner shall pay for the cost of the traffic control for the second visual assessment, if the traffic control was not necessary for any other reason. The Owner shall not be held liable for any associated costs such as delays to the Contractor.

### 313.10.01.05 Payment Adjustment for Aggregate Density

For Superpave 12.5FC 1, Superpave 12.5FC 2, SMA 19.0, SMA 12.5, and SMA 9.5, the tender quantity is based on reference densities ($D_R$) according to Table 9. A payment adjustment for aggregate density, ($PA_{AD}$) for each lot for these tender items shall be determined by the following formulae:

\[
MF = \frac{D_R}{BRD_{mix}} \quad \text{(Formula 19)}
\]

\[
PA_{AD} = M_{mix} \times \text{Contract Price} \times [MF - 1.000] \quad \text{(Formula 20)}
\]

Where:

- $MF$ = the mass multiplier factor calculated to 3 decimal places
- $D_R$ = the reference density in t/m³, as specified in Table 9
- $BRD_{mix}$ = the lot average bulk relative density in t/m³, calculated from values obtained in the testing of bulk samples obtained during production. The values shall be the same as those used in calculating the final air voids payment factor for the lot.
- $M_{mix}$ = the weighed mass of the mix in the lot incorporated into the work
- Contract Price = the Contract price of the tender item for the mix.

For all mixes, when the mass multiplier factor is:

a) less than 1.000, there shall be a reduction in payment

b) equal to 1.000, there shall be no adjustment

c) greater than 1.000, there shall be an increase in payment for the lot
313.10.01.06  Payment Adjustment for Asphalt Cement Content

The payment adjustment shall apply to the calculated mass of HMA placed using the JMF.

Subject to the conditions specified below for the particular mixes, the payment adjustment for asphalt cement content, PA_{AC} shall be calculated using the following formula:

\[
PA_{AC} = M_{\text{mix}} \times [\text{Adjusted Contract Price} - \text{Contract Price}]
\]

When unit of measure is tonnes:

\[
M_{\text{mix}} = \text{Weighed mass of the HMA accepted into the work}
\]

When unit of measure is square metres:

\[
M_{\text{mix}} = \text{Mass of HMA accepted into the work calculated by the Contract Administrator using the design widths and depths of pavement area and HMA density. Density used in the calculation of}
\]

\[
M_{\text{mix}} \text{ shall be } 97.5\% \text{ of the bulk relative density determined from the mix design.}
\]

There shall be an adjustment to the contract price if the percentage by mass of asphalt cement required for the work as required by the JMF differs from that specified for bidding purposes.

\[
\text{Adjusted Contract Price} = \text{Contract Price} + [\text{PRICE}_{AC} \times (\text{AC}_{\text{JMF}} - \text{AC}_{\text{BID}})/100]
\]

\[
\text{PRICE}_{AC} = \text{the purchase price per tonne of the asphalt cement used in the mix}
\]

\[
\text{AC}_{\text{JMF}} = \text{the percentage by mass of asphalt cement required for the work as required by the JMF}
\]

\[
\text{AC}_{\text{BID}} = \text{the percentage by mass of asphalt cement specified for bidding purposes}
\]

The percentage by mass of new asphalt cement, % NEWAC incorporated into the HMA shall be the difference between the percentage by mass of asphalt cement required by the JMF and the percent by mass of asphalt cement contained in the RAP incorporated into the HMA, as determined by the Contract Administrator.

Contract Price = the unit price of the tender item for the mix when the unit of measurement is tonnes. When the unit of measurement is square metres, the Contract Administrator shall convert contract price to the equivalent price per tonne.

313.10.02  Anti-Stripping Additives

Payment at Contract price for the applicable HMA tender item shall be full compensation for all Labour, Equipment, and Materials required to test, supply, and incorporate the anti-stripping additives.

313.10.03  Hot Mix Asphalt Miscellaneous - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials to do the work except that the HMA Material shall be paid for under the appropriate HMA tender item.

313.10.04  Tack Coat

Where there is no separate tender item for tack coat, payment at the Contract price for the applicable HMA tender item to be placed on the tack coat shall be full compensation for all labour, Equipment, and Materials for the tack coating.
313.10.05 Repair

No payment shall be made for the:

a) quantity of HMA that is removed and replaced, overlaid, or otherwise repaired; or

b) for additional shouldering, traffic control and other work such as zone painting or bridge deck waterproofing,

when:

a) in lieu of a reduction in payment, the Contractor repairs the lot, sublot, or visually defective HMA; or

b) the Contract Administrator has determined that a rejectable lot or sublot requires repair.

The Contractor shall be charged for all additional testing resulting from a repair to a lot at the rates established by the Owner for the year in which the testing was carried out.

313.10.06 Outlier

313.10.06.01 Outlier in Quality Control Results

When there is an outlier in the QC Results and the Contractor requests the Contract Administrator arrange for the Owner’s laboratory to test the corresponding sublot QA sample, the cost of the additional testing carried out by the QA laboratory shall be the Contractor’s responsibility. The Contractor shall be charged at the rate of $200 per sublot for mix samples and $75 per sublot for compaction samples.

When there is an outlier in the QC Results and the Contractor requests that a replacement result for the outlier be obtained by testing of the referee sample for the corresponding sublot, the cost of the outlier replacement testing shall be borne by the Contractor, unless the entire lot subsequently undergoes referee testing, in which case the referee testing for the entire lot shall be paid according to the referee testing procedure specified in the Contract Documents.

313.10.06.02 Outlier in Quality Assurance Results

The party requesting outlier replacement testing shall bare the cost of the outlier in QA results replacement testing, unless the entire lot subsequently undergoes referee testing, in which case the referee testing for the entire lot shall be paid according to the referee testing procedure specified in the Contract Documents.

313.10.07 Referee Testing for Mix Properties and Compaction

When QC and QA results do not agree, for any referee testing which is carried out without an outlier in the referee results, the cost of referee testing, including sample delivery, shall be borne by the party whose payment factor is further removed from that generated by the referee laboratory. However, if the payment factor determined by the referee results is exactly in between that determined by the QC and QA laboratories, the cost of the referee testing shall be split between the Owner and the Contractor.

If the QC and QA results agree, the cost of referee testing, including sample delivery, shall be borne by the party requesting the referee testing.

When the QC and QA results for the original lot did not agree and there is an outlier in the referee test results, the Contractor shall be charged 50% of the total cost for referee testing, including sample delivery, of all sublots in the original lot.

The cost of referee testing shall be based on the referee testing rates specified in Table 10.
<table>
<thead>
<tr>
<th>JMF PROPERTIES</th>
<th>MAXIMUM FIELD ADJUSTMENT % (Notes 1 and 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt cement content (all mixes except SMA mixes)</td>
<td>± 0.2</td>
</tr>
<tr>
<td>Asphalt cement Content - SMA mixes only</td>
<td>± 0.4</td>
</tr>
<tr>
<td>Percent RAP</td>
<td>- 5.0</td>
</tr>
<tr>
<td>Percent passing 26.5 mm, 25.0 mm, 19.0 mm, and 16.0 mm sieves</td>
<td>± 5.0</td>
</tr>
<tr>
<td>Percent passing 13.2 mm, 12.5 mm, and 9.5 mm sieves</td>
<td>± 4.0</td>
</tr>
<tr>
<td>Percent passing 4.75 mm, 2.36 mm, and 1.18 mm sieves</td>
<td>± 3.0</td>
</tr>
<tr>
<td>Percent passing 600, 300, and 150 µm sieves</td>
<td>No limits</td>
</tr>
<tr>
<td>Percent passing 75 µm sieve (all mixes except SMA mixes)</td>
<td>± 1.0</td>
</tr>
<tr>
<td>Percent passing 75 µm sieve - SMA mixes only</td>
<td>± 2.0</td>
</tr>
</tbody>
</table>

Notes:

1. The maximum field adjustment is applied against the original JMF submitted with the mix design.

2. The revised JMF shall meet the requirements of the Contract, including asphalt cement content and gradation on all sieves.
### TABLE 2
Sample Size and Frequency

<table>
<thead>
<tr>
<th>Material</th>
<th>Mass of Production Samples (Note 1) (kg)</th>
<th>Frequency of Sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA mixes, Superpave 9.5, 12.5, 12.5FC 1, 12.5FC 2, and 19.0</td>
<td>20 to 30 or 30 to 40 (Notes 2 and 3)</td>
<td>Every sublot</td>
</tr>
<tr>
<td>Superpave 25.0 and 37.5</td>
<td>25 to 35 or 35 to 45 (Notes 2 and 3)</td>
<td>Every sublot</td>
</tr>
<tr>
<td>SMA mixes for draindown testing</td>
<td>3 to 5</td>
<td>Once per lot</td>
</tr>
<tr>
<td>Mineral filler and baghouse fines used in SMA mixes</td>
<td>1 (Note 4)</td>
<td>Once every 10,000 tonnes</td>
</tr>
</tbody>
</table>

Notes:

1. Each material sample receptacle shall have a maximum mass of 30 kg.

2. The larger sample size shall be applicable when samples are designated for testing to the maximum number of gyrations. The frequency of the larger samples shall be two per lot, as designated by the Contract Administrator. For ease of handling, especially when the larger sample size is required, splitting of material at the paving site is permitted such that a sample is contained in a maximum of two receptacles whose total mass does not exceed the maximum specified above. Once delivered to testing laboratories, combining of the material from the two receptacles is only mandatory if a single receptacle contains insufficient material to carry out the full suite of tests required.

3. One set of cores, with each core a minimum thickness of 35 mm.

4. Commercial mineral filler and baghouse fines shall be combined in the same proportions used in the mix design.
### TABLE 3
Testing Requirements

<table>
<thead>
<tr>
<th>Properties and Attributes</th>
<th>Testing Method</th>
<th>Calculations, Values, and Results Required</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mix Properties</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asphalt Cement Content and Aggregate Gradation for mix samples</td>
<td>LS-291, LS-282, or LS-292</td>
<td>% AC&lt;br&gt;% passing DLS sieve&lt;br&gt;4.75 mm sieve&lt;br&gt;600 μm sieve&lt;br&gt;75 μm sieve</td>
</tr>
<tr>
<td><strong>Volumetric Properties</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory Compaction to:</td>
<td>AASHTO T 166 using the same laboratory compaction protocol as was used in mix design. (Note 1)&lt;br&gt;AASHTO T 312, LS-264&lt;br&gt;Superpave Mixes only: in addition to compacting all samples to the design number of gyrations, two samples from each lot of HMA shall be compacted to the maximum number of gyrations.</td>
<td>Bulk Relative Density for mix samples, BRD&lt;sub&gt;m&lt;/sub&gt;&lt;br&gt;BRD at N&lt;sub&gt;des&lt;/sub&gt;&lt;br&gt;BRD at N&lt;sub&gt;ini&lt;/sub&gt;&lt;br&gt;BRD at N&lt;sub&gt;max&lt;/sub&gt;&lt;br&gt;G&lt;sub&gt;mm&lt;/sub&gt;&lt;br&gt;%G&lt;sub&gt;mm&lt;/sub&gt; @ N&lt;sub&gt;ini&lt;/sub&gt;&lt;br&gt;%G&lt;sub&gt;mm&lt;/sub&gt; @ N&lt;sub&gt;des&lt;/sub&gt;&lt;br&gt;%G&lt;sub&gt;mm&lt;/sub&gt; @ N&lt;sub&gt;max&lt;/sub&gt;</td>
</tr>
<tr>
<td>i. Design number of gyrations (N&lt;sub&gt;des&lt;/sub&gt;)&lt;br&gt;ii. Maximum number of gyrations (N&lt;sub&gt;ini&lt;/sub&gt;)&lt;br&gt;Maximum Theoretical Specific Gravity (G&lt;sub&gt;mm&lt;/sub&gt;)&lt;br&gt;Voids in Mineral Aggregate, VMA</td>
<td>LS-604, LS-605, AASHTO R 35 (Note 2)</td>
<td>VMA</td>
</tr>
<tr>
<td>Voids Filled with Asphalt, VFA</td>
<td>AASHTO R 35</td>
<td>VFA</td>
</tr>
<tr>
<td>Air Voids for mix, V</td>
<td>Calculate using BRD&lt;sub&gt;m&lt;/sub&gt;, MRD&lt;sub&gt;m&lt;/sub&gt;&lt;br&gt;Where:&lt;br&gt;V = 100(1 - BRD&lt;sub&gt;m&lt;/sub&gt; / MRD&lt;sub&gt;m&lt;/sub&gt;)&lt;br&gt;MRD&lt;sub&gt;m&lt;/sub&gt; = G&lt;sub&gt;mm&lt;/sub&gt;</td>
<td>Percent air voids, V</td>
</tr>
<tr>
<td>Dust to Binder Ratio, DP for Superpave mixes</td>
<td>Calculate as the ratio of dust, % passing the 75 μm sieve by mass of aggregate, to effective asphalt cement content</td>
<td>DP</td>
</tr>
<tr>
<td><strong>Compaction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compaction and Thickness of Cores</td>
<td>BRD&lt;sub&gt;c&lt;/sub&gt; = Bulk Relative Density at N&lt;sub&gt;des&lt;/sub&gt; and N&lt;sub&gt;ini&lt;/sub&gt; for core samples (BRD&lt;sub&gt;c&lt;/sub&gt;) LS-262 (Notes 1 and 3).&lt;br&gt;MRD&lt;sub&gt;c&lt;/sub&gt; = Maximum Relative Density for core samples, LS-264.&lt;br&gt;% Compaction = (100 x BRD&lt;sub&gt;c&lt;/sub&gt;/MRD&lt;sub&gt;c&lt;/sub&gt;) + C&lt;br&gt;C = Thickness Correction factor, 0.1% for each whole millimetre that the individual pavement core thickness is less than 40 mm</td>
<td>BRD&lt;sub&gt;c&lt;/sub&gt;, MRD&lt;sub&gt;c&lt;/sub&gt;, Thickness of Core&lt;br&gt;% Compaction</td>
</tr>
<tr>
<td><strong>SMA Mix Properties</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draindown for mix</td>
<td>AASHTO T 305</td>
<td>% draindown</td>
</tr>
<tr>
<td>Rigden Voids for SMA Filler</td>
<td>NAPA IS 127</td>
<td>Rigden Voids</td>
</tr>
<tr>
<td>SMA Mortar Properties</td>
<td>The asphalt cement used shall be RTFO aged according to AASHTO T 240 and PAV aged according to AASHTO R 28 prior to blending with fillers. SMA mortar shall be blended and tested according to the draft test method, Standard Practice for Testing of HMA Mortars AASHOT Format, of NCAT Report 9-8/4. Mortar with unaged and RTFO aged PGAC shall be tested using the Dynamic Shear Rheometer according to AASHTO T 315 at the average 7-day maximum pavement design temperature of the appropriate asphalt cement grade according to AASHTO M 320. Mortar with PAV aged PGAC shall be tested using the Bending Beam Rheometer according to AASHTO T 313 at the minimum pavement design temperature of the appropriate asphalt cement grade according to AASHTO M 320.</td>
<td>Unaged Dynamic Shear Rheometer, G'/Sinδ&lt;br&gt;RTFO Aged Dynamic Shear Rheometer, G'/Sinδ&lt;br&gt;PAV Aged Bending Beam Rheometer, Stiffness</td>
</tr>
</tbody>
</table>

**Notes:**

1. For all gyratory-compacted specimens and cores of SMA mixes and Superpave mixes, if the percent water absorbed by the specimen is found to exceed 2% by volume, as described in AASHTO T 166, then the bulk relative density shall be determined using either LS-306 or ASTM D 6752. The method of testing cores or laboratory compacted specimens shall not be changed without the written consent of the Contract Administrator.

2. Calculate to two decimal places for each sublot using the BRD<sub>m</sub> for the sublot, and the combined aggregate densities of the blended coarse and blended fine aggregate, as specified in this specification, to provide a lot mean VMA to one decimal place.

3. The Contractor shall identify the method of test used with the results of first set of QC cores tested for a particular mix type. If the method of test is different from that used for laboratory compacted specimens, the Contractor shall provide written confirmation of this to the Contract Administrator, stating the reason for the difference.
<table>
<thead>
<tr>
<th>Number Of Tonnes In Tender Item</th>
<th>Number Of Lots</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5,000</td>
<td>1</td>
</tr>
<tr>
<td>5,000 to 10,000</td>
<td>2</td>
</tr>
<tr>
<td>10,000 to 12,000</td>
<td>2 or 3 (Note 1)</td>
</tr>
<tr>
<td>&gt; 12,000</td>
<td>3 +</td>
</tr>
</tbody>
</table>

Note:

1. As determined by the Contract Administrator in consultation with the Contractor.
### TABLE 5
Payment Factors Based on Per Cent Within Limits

<table>
<thead>
<tr>
<th>PWL</th>
<th>Designated Large Sieve</th>
<th>4.75 mm Sieve</th>
<th>600 µm Sieve</th>
<th>75 µm Sieve</th>
<th>AC Content</th>
<th>Air Voids (Note 1)</th>
<th>Compaction (Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1.0025</td>
<td>1.0025</td>
<td>1.0025</td>
<td>1.0025</td>
<td>1.010</td>
<td>1.020</td>
<td>1.030</td>
</tr>
<tr>
<td>99</td>
<td>1.002</td>
<td>1.002</td>
<td>1.002</td>
<td>1.008</td>
<td>1.013</td>
<td>1.024</td>
<td></td>
</tr>
<tr>
<td>98</td>
<td>1.0015</td>
<td>1.0015</td>
<td>1.0015</td>
<td>1.006</td>
<td>1.007</td>
<td>1.018</td>
<td></td>
</tr>
<tr>
<td>97</td>
<td>1.001</td>
<td>1.001</td>
<td>1.001</td>
<td>1.004</td>
<td>1.000</td>
<td>1.012</td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>1.0005</td>
<td>1.0005</td>
<td>1.0005</td>
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<td>0.039</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Notes:

1. For SMA, the payment factor for air voids as determined by this table shall not be used in the PFMC.

2. Superpave 12.5FC 2 compaction shall be analysed using a lower limit (LL) of 90.5%. If the PWL for Superpave 12.5FC 2 compaction using a LL of 90.5% is greater than 95, the compaction PWL shall also be calculated using a LL of 91.5%, and the payment factor shall be determined for each LL using Table 7. The highest calculated payment factor shall be used.
### TABLE 6
**Specification Limits For Hot Mix Asphalt Acceptance Attributes**

<table>
<thead>
<tr>
<th>Attributes</th>
<th>HMA Type</th>
<th>Lower Limit (LL)</th>
<th>Upper Limit (UL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Cement Content</td>
<td>All HMA types</td>
<td>JMF - 0.40</td>
<td>JMF + 0.50</td>
</tr>
<tr>
<td>Designated Large Sieve</td>
<td>All HMA types</td>
<td>JMF - 5.0</td>
<td>JMF + 5.0</td>
</tr>
<tr>
<td>4.75 mm Sieve</td>
<td>All HMA types</td>
<td>JMF - 5.0</td>
<td>JMF + 5.0</td>
</tr>
<tr>
<td>600 µm Sieve</td>
<td>All HMA types</td>
<td>JMF - 3.5</td>
<td>JMF + 3.5</td>
</tr>
<tr>
<td>75 µm Sieve</td>
<td>All HMA types</td>
<td>JMF - 2.0</td>
<td>JMF + 2.0</td>
</tr>
<tr>
<td>Air Void Mix Design Criteria 4.0%</td>
<td>Superpave Mixes, SMA</td>
<td>2.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Pavement Compaction</td>
<td>Superpave 12.5 and 12.5FC 1</td>
<td>91.5</td>
<td>97.0</td>
</tr>
<tr>
<td></td>
<td>Superpave 37.5, 25.0 and 19.0</td>
<td>90.5</td>
<td>97.0</td>
</tr>
<tr>
<td></td>
<td>Superpave 12.5FC 2</td>
<td>91.5 (Note 2)</td>
<td>98.0</td>
</tr>
<tr>
<td></td>
<td>SMA 19.0, 12.5 and 9.5</td>
<td>93.0</td>
<td>98.0</td>
</tr>
</tbody>
</table>

**Notes:**

1. When a JMF change results in a decrease in the design asphalt cement content, the lower limit (LL) shall be set at the revised JMF minus 0.3% for all lots to which the JMF change applies.

2. Superpave 12.5FC 2 compaction shall be analysed using a LL of 90.5%. If the PWL for Superpave 12.5FC 2 compaction using a LL of 90.5% is greater than 95, the compaction PWL shall also be calculated using a LL of 91.5%, and the payment factor shall be determined for each LL using Table 7. The highest calculated payment factor shall be used.

### TABLE 7
**Superpave 12.5FC 2 Pay Factors For Per Cent Within Limits > 95%**

<table>
<thead>
<tr>
<th>PWL</th>
<th>LL = 90.5%</th>
<th>LL = 91.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1.015</td>
<td>1.030</td>
</tr>
<tr>
<td>99</td>
<td>1.012</td>
<td>1.024</td>
</tr>
<tr>
<td>98</td>
<td>1.009</td>
<td>1.018</td>
</tr>
<tr>
<td>97</td>
<td>1.006</td>
<td>1.012</td>
</tr>
<tr>
<td>96</td>
<td>1.003</td>
<td>1.006</td>
</tr>
</tbody>
</table>
### TABLE 8
**Referee Testing Categories**

<table>
<thead>
<tr>
<th>Referee Categories</th>
<th>Conditions for Referee Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC content and gradation with or without air voids and VMA, with or without compaction</td>
<td>May be carried out on any mix. If air voids referee testing is not to be included, its PF shall be at least 1.00 and the mean VMA shall not be less than design minimum. If air voids are to be included, VMA shall also be tested.</td>
</tr>
<tr>
<td>Air Voids and VMA only, with or without compaction</td>
<td>May only be carried out on Superpave mixes and provided that the PF for AC, the 4.75 mm, 600 µm, and 75 µm sieves are each at least 1.000.</td>
</tr>
<tr>
<td>Compaction Only</td>
<td>None</td>
</tr>
</tbody>
</table>

### TABLE 9
**Reference Densities, D_R**

<table>
<thead>
<tr>
<th>Region</th>
<th>Reference Densities, D_R tonnes/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southwestern Region</td>
<td>2.530</td>
</tr>
<tr>
<td>Central Region</td>
<td></td>
</tr>
<tr>
<td>Northeastern Region</td>
<td>2.520</td>
</tr>
<tr>
<td>Northwestern Region</td>
<td></td>
</tr>
<tr>
<td>Eastern Region</td>
<td>2.390</td>
</tr>
</tbody>
</table>

### TABLE 10
**Referee Testing Rates**

<table>
<thead>
<tr>
<th>Testing</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determination of asphalt cement content, and aggregate gradation</td>
<td>$250 per sublot sample</td>
</tr>
<tr>
<td>Determination of percent G_m at N_{des}, including N_{ini}</td>
<td>$250 per sublot sample</td>
</tr>
<tr>
<td>Determination of percent compaction</td>
<td>$125 per sublot sample</td>
</tr>
<tr>
<td>Determination of draindown only</td>
<td>$150 per sublot sample</td>
</tr>
<tr>
<td>Determination of correction factor for use of ignition furnace</td>
<td>$1,000 per calibration</td>
</tr>
<tr>
<td>Determination of bulk relative density of both coarse and fine aggregate containing no RAP or RST aggregates</td>
<td>$650</td>
</tr>
<tr>
<td>Determination of bulk relative density of both coarse and fine aggregate that incorporate extracted RAP and/or RST aggregates</td>
<td>$950 (Note 1)</td>
</tr>
<tr>
<td>Determination of VMA</td>
<td>Sum of the rates of all additional tests required for its calculation</td>
</tr>
</tbody>
</table>

**Note:**
1. This rate includes the extraction of the RAP or RST or both.
Appendix 313-A, Commentary for OPSS.PROV 313, 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.