



CONSTRUCTION SPECIFICATION FOR HOT MIX ASPHALT

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310.01	SCOPE
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This specification covers the requirements for the placement and compaction of hot mix asphalt for Marshall and Superpave mixes.

310.01.01 Significance and Use of Appendices

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

Appendix 310-A is a commentary appendix to provide designers with information on the use of the specification in a Contract.

310.02

REFERENCES

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

Ontario Provincial Standard Specifications, Material

OPSS 1003	Aggregates - Hot Mix Asphalt
OPSS 1101	Performance Graded Asphalt Cement
OPSS 1103	Emulsified Asphalt
OPSS 1150	Hot Mix Asphalt
OPSS 1151	Superpave and Stone Mastic Asphalt Mixtures

Ministry of Transportation, Ontario, Publications

MTO Laboratory Testing Manual:

LS-261	Preparation of Marshall Specimens
LS-262	Bulk Relative Density of Compacted Bituminous Mixtures
LS-263	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
LS-264	Theoretical Maximum Relative Density of Bituminous Paving Mixtures
LS-265	Percent Air Voids in Compacted Dense Bituminous Pavement Mixtures
LS-282	Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-287	The Determination of Percent Compaction of Compacted Bituminous Paving Mixture (MRD Method)
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

American Association of State Highway and Transportation Officials (AASHTO)

M 320-03	Standard Specification for Performance Graded Asphalt Binder
MP 2-03	Specifications for Superpave Volumetric Mix Design
T 166-00	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
T 209-99	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
T 275-00	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens

ASTM International

D 6752-03	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
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310.03

DEFINITIONS

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

AMRL means the AASHTO Materials Reference Laboratory.

Attribute means one of the following: Designated Large Sieve (DLS), 4.75 mm sieve, 600 μ m sieve, 75 μ m sieve, asphalt cement content, air voids, or compaction.

Binder Course means a hot mix asphalt (HMA) course between a surface course and either a base course or stabilized base course, an existing pavement, or another HMA binder course.

CCIL means the Canadian Council of Independent Laboratories.

Designated Large Sieve (DLS) means the sieve size specifically designated for each mix type for gradation testing according to Table 1.

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

Hot Mix Asphalt (HMA) means hot mixed, hot laid asphaltic concrete, including Marshall, Superpave, and Stone Mastic Asphalt (SMA) mixes. 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 an 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 an HMA surface course placed over localized areas of distressed pavement, generally for the purpose of improving strength, rideability, or safety.

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

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

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

Lot means a specific quantity of material or a specific amount of construction normally from a single source and produced by the same process.

Mix Properties means the percent passing the DLS, 4.75 mm sieve, 600 μ m sieve, and 75 μ m sieve; the asphalt cement content; and the air voids.

Paving in Echelon means two or more pavers are used to pave multiple adjacent lanes simultaneously, within 60 m of each other.

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

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 specified requirements.

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 specified requirements.

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 subplot 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.

Referee Testing means testing by an independent laboratory selected by the Owner and acceptable to the Contractor, the results of which are used for resolving differences between QC and QA testing.

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.

Southern Ontario means that area of Ontario south of a line joining Waubauskene, Severn Bridge, Bancroft, and Ottawa.

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

Sublot means approximately equal divisions or portions of a lot.

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

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

Vertical Surface means all edges of concrete curbs, catch basins and other appurtenances, longitudinal joints, and transverse joints for application of tack coat.

310.05 MATERIALS

310.05.01 Hot Mix Asphalt

The materials used in the production of the HMA shall be according to OPSS 1150 for Marshall mixes and OPSS 1151 for Superpave and SMA mixes.

310.05.02 Tack Coat Material

Tack coat shall consist of SS-1 emulsified asphalt diluted with an equal volume of water. The undiluted material shall be according to OPSS 1103.

The use of an alternate product may be permitted at the Contractor's request provided that such a request is submitted in writing to the Contract Administrator a minimum of 14 Days prior to the intended use of the alternate product. The Contractor's proposal shall include, but not be limited to, the following:

- a) The reasons for the use of the alternate material.
- b) Material Safety Data Sheets and any other information for the safe handling, transportation, and storage of the product.
- c) Testing protocols to be used in confirming the properties of the material.
- d) Typical test results.
- e) Required application rates.
- f) Cost implications for the use of the alternate product.

The Contract Administrator shall review this proposal and respond in writing within 7 Days of receiving it, either accepting the use of the alternate product or not accepting its use with reasons. The alternate product shall not be used until permission has been granted in writing by the Contract Administrator.

310.06 EQUIPMENT

310.06.01 Paving Equipment

Asphalt pavers shall be self-propelled and capable of laying a consistent satisfactory mat that is true to the crossfall, profile, cross-section, and alignment specified in the Contract Documents. Pavers shall be equipped with hoppers and distributing augers capable of placing the HMA evenly in front of the screeds. Screeds shall be capable of being heated and being adjustable as to level and crown. Pavers shall be capable of simultaneously placing the shoulder pavement and roadway pavement whether the shoulder pavement is at the same or different crossfall from the roadway pavement.

In all cases, pavers shall be equipped with automatic longitudinal and transverse grade and slope controls capable of being operated from either side of the paver. The longitudinal grade control shall be adjustable for mat thickness in small increments, without the necessity of stopping the paver. The paver shall be equipped to operate from either a 12 m ski or floating beam, a 3 m ski, or a joint matching shoe. Where the ski is a flexible unit, it shall be equipped with a spring-tensioned wire extending between brackets fitted on and slightly above each end of the ski. The sensing grid shall ride on the wire, not on the ski.

Plows or other edge ramping devices that are attached to or towed by the screed portion of the paver shall not be permitted.

A 3 m straight edge shall be provided on each paver. This straight edge shall be made of metal with a level recessed in its upper surface parallel to the lower edge.

310.06.02 Rollers

310.06.02.01 Classification of Rollers

Rollers shall be classified into categories as follows:

- Class S Self-propelled steel-drum, tandem, or three-wheel rollers according to Table 2.
- Class R Self-propelled pneumatic-tired rollers according to Table 3.
- Class V 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 according to Table 4.

310.06.02.02 Requirements for Rollers

310.06.02.02.01 General

All rollers shall be capable of reversing without backlash.

The Contract Administrator shall be provided with the mass of the rollers. The Contract Administrator may require the weighing of the rollers in his presence.

The rolls or drums shall be kept moist with water or non-petroleum based release agents to prevent adhesion of HMA to them. Excess water or release agents shall not be permitted.

310.06.02.02.02 Steel-Drum Rollers

The drums of tandem steel-drum rollers shall not be less than 1.20 m in width.

310.06.02.02.03 Pneumatic-Tired Rollers

Pneumatic-tired rollers shall be constructed such that the wheels on either the front or back oscillate either independently or in pairs. The wheels shall be mounted with smooth rubber tires. Tire inflation pressure shall be a minimum of 350 kPa when the tires are cold. All tires shall have equal pressure. Skirts or windbreaks shall be provided at all times to protect all tires from the cooling effects of atmospheric conditions. Each roller shall be equipped with a suitable tire pressure gauge for checking tire inflation pressure.

For SMA mixes, pneumatic-tired rollers are not permitted.

310.06.02.02.04 Vibratory Rollers

Vibratory rollers shall be according to the following requirements:

- a) Frequency of vibrations of the vibratory roller shall be 2,200 vibrations per minute or greater.
- b) Rollers shall be equipped with provision for automatic shutoff of vibrations before coming to a stop.

310.07 CONSTRUCTION

310.07.01 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 test results 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. QC documentation shall be made available to the Contract Administrator upon request. Sampling and testing methods shall be included in the QC documentation.

A laboratory that has current CCIL Type B Certification or AMRL equivalent certification or other equivalent certified laboratory acceptable to the Contract Administrator shall be used. Testing of the samples shall be conducted under the direction and constant supervision of technicians certified to perform the QC tests according to CCIL or equivalent certification.

310.07.02 Preparation of Foundation and Existing Pavement

310.07.02.01 Granular Grade

Prior to placing any course of HMA on a granular grade, a Class S roller of a minimum of 7 tonnes 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, and float-free surface.

Paving shall not be carried out if the roadbed is frozen.

The granular grade shall be free of standing water at the time of HMA placement.

310.07.02.02 Existing Pavement

Prior to placing any HMA, all HMA and concrete surfaces shall be clean of all loose, broken, and foreign materials. Milled surfaces shall be swept with a power broom. The surface of a pavement upon which HMA is to be placed shall be dry at the time of HMA placement. An HMA course shall not be placed on 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.

310.07.03 Tack Coat

Tack coat shall be applied to all surfaces and at the application rate specified in the Contract Documents prior to placing HMA.

310.07.04 Transportation of Hot Mix Asphalt

The HMA shall be transported from the asphalt plant to the work in leak proof truck boxes that have been previously cleaned of all foreign materials. If required, truck boxes shall be 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 can adversely affect the quality or performance of the HMA. Release agents shall be used according to the proprietary requirements.

Delivery of hot mix to the site shall be scheduled such that spreading and compacting of the hot mix is completed by one-half hour after sunset.

Each truck shall use a canvas tarpaulin of sufficient size to completely cover the load at all times.

310.07.05 Sampling

310.07.05.01 Asphalt Cement

310.07.05.01.01 General

Sampling and testing of asphalt cement shall be completed by the Contractor according to OPSS 1101.

310.07.05.01.02 Frequency and Location

The asphalt cement sampling frequencies and locations shall be as specified in the Contract Documents. A minimum of one sample shall be randomly chosen for each asphalt cement used on the Contract.

310.07.05.01.03 Labelling

Samples shall be appropriately labelled with the Contract number, date and time of sampling, performance grade of the asphalt cement, supplier, refinery, waybill number, tanker number, whether the sample was taken from a delivery tanker or from a storage tank at the plant, and name and proportions of additives in the asphalt cement.

310.07.05.01.04 Delivery

Samples for the Owner shall be delivered within 4 hours of sampling to a location designated in the Contract Documents.

310.07.05.02 Hot Mix Asphalt

310.07.05.02.01 General

The Contractor is responsible for obtaining QC and QA HMA samples. For QC samples, the Contractor shall determine the method of sampling. QA samples shall be taken in accordance with the Contract Documents in the presence of the Contract Administrator. QA samples shall be placed in an appropriate container. The Contract Administrator may apply security seals to the samples prior to transportation.

310.07.05.02.02 Frequency and Location

The minimum frequency for sampling and testing is the responsibility of the Contractor, but shall be no less than the requirements specified in Table 6.

310.07.05.02.03 Labelling

All samples shall have required sample identification of location, date and time of sampling; asphalt type; and asphalt lift.

310.07.05.02.04 Cores

One 150 mm diameter core of the HMA shall be extracted adjacent to each HMA plate sample location. Cores shall be taken no later than the next Business Day on which a lane closure is permitted. All core locations must be accurately identified with the field location and corresponding HMA plate sample. The frequency of cores shall be a minimum of one per 500 tonnes of HMA type. The Contract Administrator may reduce the frequency of core extractions to a minimum of one core per 1,000 tonnes of HMA type, if results indicate compactive effort is consistently meeting the specification.

310.07.05.02.05 Delivery

All samples for the Owner shall be delivered within 24 hours of sampling to a location designated in the Contract Documents.

310.07.05.03 Repair of Sampling Locations

HMA and compaction requirements for filling all sample holes shall be the same as the adjacent undisturbed pavement. All 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.

310.07.06 Placing Hot Mix Asphalt

310.07.06.01 General

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.

A through lane paving course shall be completed prior to the placement of adjacent side roads, speed change lanes, and other paved areas. For all courses, each adjacent lane shall be completed to approximately the same location at the end of each day's paving.

At the end of each completed portion and prior to opening the lanes to traffic, the completed sections of HMA course shall be ramped transversely to the existing pavement for a minimum distance of 1.5 m. If at the end of a day's production two adjacent lanes are not completed to the same location, the longitudinal edges must be ramped down in a safe manner to the adjacent existing pavement. In all cases, the ramps shall not form part of the permanent asphalt pavement and shall be removed prior to continuing paving operations.

The temperature of the HMA immediately after spreading and prior to initial rolling shall not be less than 120°C.

310.07.06.02 Binder Course

Binder courses shall not be placed, unless the air temperature at the surface of the road is a minimum of 2°C and rising.

310.07.06.03 Surface Course

Surface courses shall not be placed, unless the air temperature at the surface of the road is at least 7°C and rising, except as follows:

- a) When single course pavement is laid on granular grade or HL 2, Superpave 4.75, or Superpave 9.5 that was laid on a granular grade, the minimum air temperature shall be at least 2°C and rising.

- b) For DFC, Superpave 12.5 FC2, and SMA surface course, the minimum air temperature shall be at least 12°C.

310.07.07 Use of Paving Equipment

Levelling, binder, and surface courses shall be laid by means of mechanical self-propelled pavers.

Pavers working in echelon shall maintain a distance of less than 60 m between them.

The longitudinal alignment of the spreader shall be controlled by the use of a string line placed at each outer edge of the pavement. The spreader is to be directed at all times by the string line and not by the edge of the preceding course, except for the trailing paver when paving in echelon.

The automatic screed controls and all compaction aids on the paver shall be operational while the HMA is being placed, except that the automatic controls shall not be used when placing HL 2, Superpave 4.75, Superpave 9.5, or a single course of HMA on granular grade.

Single pavers or the lead paver when paving in echelon shall be controlled as to longitudinal grade by a 12 m ski or floating beam.

The pavers shall operate continuously at a uniform speed necessary to match the output of the HMA plant. However, in no case shall the speed of the paver exceed 18 m/min.

If the HMA for surface course paving comes from more than one mixing plant, the HMA from each plant shall be placed by a separate paver.

310.07.08 Widening and Irregular Sections

When it is necessary to hand-spread the HMA in sections adjacent to machine-laid areas, such hand-spreading shall be carried out concurrently with machine-laying operations.

a) Widening

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 in the Contract Documents, 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.

b) Irregular Sections

In turn-outs, driveways, and other irregular sections where it is impractical to use machine methods to spread and finish the binder, levelling, or surface courses, the Contractor shall use other spreading equipment or shall spread the HMA by hand.

310.07.09 Hot Mix Asphalt Padding

HMA padding shall be carried out as specified in the Contract Documents.

310.07.10 Hot Mix Asphalt Patching

Prior to HMA patching, temporary patching material shall be removed from the locations designated for such removal in the Contract Documents. The resulting areas shall be filled and compacted with HMA, as specified in the Contract Documents.

The HMA patching material shall be machine laid to the required thickness, grade, and crossfall.

Transverse and longitudinal joints between the existing pavement and the patch shall be perpendicular butt joints formed by a milling process or keyed in, as specified in the Contract Documents.

310.07.11 Longitudinal and Transverse Joints

310.07.11.01 General

All joints shall be made to ensure a full face bond and a smooth riding surface.

Longitudinal and transverse butt or stepped joints between the new HMA pavement and the existing pavement shall be constructed by trimming the existing pavement edge to a straight clean vertical surface of at least 40 mm.

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 no more than 50 mm.

310.07.11.02 Tack Coating of Joints

Vertical surfaces at which joints are made shall be tack coated with a thin uniform and continuous coating of tack coat material, except for longitudinal joints between lanes paved in echelon.

310.07.11.03 Longitudinal Joints

Longitudinal joints shall be properly set up, with the back of a rake or lute, at the proper height and grade prior to rolling, unless the Contractor has demonstrated acceptable joint construction.

For multiple lifts of HMA, the width of subsequent courses shall be staggered to an offset of 150 to 300 mm so that longitudinal joints do not coincide. This shall also apply to the joint between through lanes and speed change lanes and other similar longitudinal joints. The longitudinal joints in the surface course shall correspond to the demarcation between the driving lanes, speed change lanes, and tapers specified in the Contract Documents.

During surface course paving, excess material shall not be cast onto the surface of the freshly laid mat.

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.

310.07.11.04 Transverse Joints

The paver shall not move more than 15 m from any transverse joint until that joint has been rolled and checked with a straight edge. If the joint is not satisfactory, it shall be corrected immediately before the paver is allowed to proceed.

Joints between HMA pavement laid under this Contract and existing HMA courses not laid under this 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 stepped joint shall be prepared by removing the existing surface course to its full depth for a minimum length of 0.5 m and the remaining face shall be trimmed to form a straight vertical surface.

- c) Where a binder course and surface course are not placed flush against an existing HMA pavement, the binder course shall be feathered out and the surface course shall be butt jointed by removing the existing surface course to a minimum depth of 40 mm and for a longitudinal distance not less than 3 m.

310.07.12 Compaction

310.07.12.01 Rolling

310.07.12.01.01 Static Rolling

Compaction shall be accomplished using the minimum combination number of rollers specified in Table 5.

The Contractor shall determine the correct sequence of rollers used for compacting in order to achieve compaction requirements.

The operating speed of steel drum rollers shall not exceed 5 km/h and shall be operated in a manner to avoid undue displacement of the mix. Rollers shall operate with the drive wheel forward in the direction of paving.

Rolling procedures shall be as follows:

a) Breakdown Rolling

The mix shall be uniformly compacted as soon after placing as it can support the roller 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.

b) Intermediate Rolling

The intermediate roller shall follow the breakdown roller as closely as possible. Passes shall overlap previous passes. The roller shall be operated to prevent pick-up of the HMA on the tires.

c) Finish Rolling

Finish rolling shall start longitudinally at the higher edge and proceed towards the lower edge.

310.07.12.01.02 Vibratory Rolling

For all HMA being compacted on bridge decks, vibratory rollers shall be operated in static mode.

310.07.12.02 Compaction of Irregular Sections and Inaccessible Areas

At all places not accessible to rollers, the mix shall be compacted by mechanical, self-powered gas, electric, or air powered equipment.

310.07.13 Tolerances

After final compaction, each course shall be smooth and true to the established crown and grade. HMA binder and surface courses shall be free from deviations exceeding 6 mm and 3 mm, respectively, as measured in any direction with a 3 m straight edge.

310.07.14 Surface Appearance

Each course after final compaction shall be of uniform texture and shall be free of defects such as segregation, fat spots, oil spills, and roller marks. Defective areas shall be removed and replaced with HMA of the same type and compacted to the satisfaction of the Contract Administrator.

310.07.15 Operational Constraints

Traffic shall be kept off the SMA surface pavement until it has cooled below 50°C.

310.07.16 Management of Excess Material

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

310.08 QUALITY ASSURANCE

310.08.01 General

The Contract Administrator is responsible for conducting QA procedures for all HMA aggregates, asphalt cement, and compaction to meet the requirements of the Contract. QA HMA testing shall be conducted at a frequency specified in Table 6 or as specified in the Contract Documents.

The HMA samples shall be randomly taken in the field by the Contractor using sample plates or other methods approved by the Contract Administrator.

The QA HMA samples and, if required, pavement cores, shall be delivered to a designated location within 4 hours of the sampling time. All samples require identification of the location, date, and time of sampling; HMA type; and HMA lift.

Acceptance of hot mix aggregates and asphalt cement shall be according to OPSS 1003 and OPSS 1101, respectively.

All QA testing shall be completed in a certified laboratory that is CCIL Type B and C, or AMRL accredited, or equivalent. Testing of the samples shall be conducted under the direction and constant supervision of technicians certified to perform the QA tests.

The Contract Administrator may reject visually defective HMA areas based on, but not limited to a condition survey of the following defects: flushing, bleeding, segregation, fat spot, surface damage, and surface contamination. Such defective HMA or areas shall be removed from the work and replaced with acceptable HMA.

Where the HMA supplier fails to consistently produce HMA that meets the specifications, the Contract Administrator may refuse further material from the supplier until the mix properties are verified for compliance by one of the following methods:

- a) For Marshall mixes, samples shall be used to determine compliance to asphalt cement content, aggregate gradation, air voids, flow, voids in mineral aggregate, and stability requirements.
- b) For Superpave mixes, samples shall be used to determine compliance to asphalt cement content, aggregate gradation, and Superpave mix properties in accordance to AASHTO MP 2.

310.08.02 Aggregate Gradation Requirements

Aggregate gradation test results for HMA samples based on LS-282 and LS-292 shall meet the JMF tolerance requirements as specified in Table 7.

310.08.03 Asphalt Cement Content Requirements

Asphalt cement content test results for HMA samples based on LS-282 and LS-292 shall meet the JMF tolerance requirements specified in Table 7.

310.08.03.01 Aggregate Gradation and Asphalt Cement Content Acceptance

If the HMA is borderline for aggregate gradation or asphalt cement content specified in Table 7, the Contractor shall be notified in writing by the Contract Administrator and shall take immediate corrective action through process control at the HMA plant. A total of three borderline test results for the same attributes representing up to 5,000 tonnes of HMA production shall result in the work being deemed rejectable. Alternately, the Contract Administrator may accept a guaranteed maintenance bond or a negotiated price adjustment.

Rejected HMA due to aggregate gradation, such as non-compliance on the DLS 4.75 mm, 600 μ m, or 75 μ m sieve sizes, or non-compliance due to the asphalt cement content specified in Table 7, shall be removed and replaced with acceptable HMA.

310.08.04 Hot Mix Asphalt Properties

310.08.04.01 General

Marshall test results for hot mix samples based on LS test procedures shall meet the requirements specified in Table 8.

The production air voids for all Superpave and SMA mixes is in the range of 3% to 5%.

310.08.04.02 Acceptance Criteria

310.08.04.02.01 Marshall Hot Mix Asphalt

If the HMA properties do not meet the requirements specified in Table 8 and the air voids are within $\pm 1.0\%$ of the range as shown in Table 8, except for DFC, which requires the air voids to be within $\pm 0.5\%$, the Contractor will be notified in writing by the Contract Administrator and shall take immediate corrective action.

If the air voids are outside $\pm 1.0\%$ of the range as shown in Table 8, except for DFC, which requires the air voids to be within $\pm 0.5\%$, the HMA represented by the test shall be removed and replaced by the Contractor with acceptable HMA of the same type and compacted to the satisfaction of the Contract Administrator.

310.08.04.02.02 Superpave Hot Mix Asphalt

If the Superpave mix does not meet AASHTO MP 2 and the air voids are within $\pm 1.0\%$ of the production range, the Contractor will be notified in writing by the Contract Administrator and shall take immediate corrective action.

If the air voids are outside $\pm 1.0\%$ of the production range the HMA represented by the test shall be removed and replaced by the Contractor with acceptable HMA of the same type and compacted to the satisfaction of the Contract Administrator.

310.08.05 Compaction Requirements

310.08.05.01 General

Acceptance for compaction based upon core testing shall be conducted by the Contract Administrator.

Compaction testing of the placed HMA shall meet the requirements specified in Table 9.

If specified in the Contract Documents, the Contract Administrator may use the nuclear density test gauge results for acceptance of compaction.

310.08.05.02 Compaction Determined by Core Density Testing

310.08.05.02.01 Marshall Hot Mix Asphalt

Density testing of the cores shall be in accordance with LS-287. Percent compaction shall be determined by comparing the core Bulk Relative Density (BRD) according to LS-262 to the average Maximum Relative Density (MRD) according to LS-264 of the plant produced HMA.

310.08.05.02.02 Superpave Hot Mix Asphalt

Density testing of the cores shall be in accordance with AASHTO T 166. If the percent water absorbed by the specimen is found to exceed 2% by volume as described in AASHTO T 166, then the bulk specific gravity shall be according to AASHTO T 275, LS-306, or ASTM D 6752. Percent compaction shall be determined by comparing the core BRD to the average MRD both according to AASHTO T 209 of the plant produced HMA.

310.08.05.03 Compaction Determined by Nuclear Density Gauge

Compaction testing shall be conducted randomly at a minimum frequency of every 100 m per lane or 150 m² area.

310.08.05.03.01 Marshall Hot Mix Asphalt

Percent compaction shall be determined by comparing the nuclear density in situ BRD according to LS-262 to the average plant produced HMA MRD according to LS-264.

310.08.05.03.02 Superpave Hot Mix Asphalt

Percent compaction shall be determined by comparing the nuclear density in situ BRD to the average plant produced HMA MRD both according to AASHTO T 209.

310.08.05.04 Acceptance

If the average percent compaction for the completed course of HMA pavement does not meet the acceptable minimum percent compaction, the Contractor will be notified in writing and shall take immediate corrective action. If the average percent compaction is rejectable, then the HMA pavement shall be removed and replaced.

310.08.06 Dispute Resolution

In the case of dispute, the Contractor may request in writing stating the technical reasons for the Contract Administrator to undertake a coring and testing program to verify the mix using a mutually agreed upon third party referee laboratory. If the mix is confirmed to be rejectable, the Contractor shall be responsible for all associated costs of the coring and testing program, otherwise the Contract Administrator will be responsible for the costs. Referee cores may be used to verify compliance, if cores were previously extracted. Results of the referee testing shall be used to assess the degree of remedial action required, if applicable. Referee testing of samples shall be under the same requirements as the QA laboratory.

Both the Contractor and the Contract Administrator may have representatives present during referee testing. During the referee testing, each representative shall immediately comment on any aspect of the testing which the representative does not consider valid, and the referee laboratory representative will respond to the comments. Prior to leaving the laboratory, any unresolved comments regarding testing procedures are to be given to the referee laboratory's representative in writing.

310.09 MEASUREMENT FOR PAYMENT

310.09.01 Actual Measurement

310.09.01.01 Hot Mix Asphalt

The unit of measurement for HMA shall be by mass in tonnes or by area in square metres. The unit of measurement for each HMA type shall be specified in the Contract Documents.

310.09.01.01.01 By Mass

When payment is in tonnes:

All HMA that is delivered to the Work site shall be accompanied by a truck weigh ticket showing the truck number, type of hot mix, Contract number, truck time in and out of the hot mix plant, tare mass to the nearest 50 kg, gross mass to the nearest 50 kg, net mass in kg, and the driver's signature.

The truck weigh ticket shall be printed by an electronic printer interfaced with the truck scale readout and capable of recording the tare mass, gross mass, and net mass. The tare mass for the truck shall include the vehicle, operator, fuel, spare tire, etc. The tare mass of the truck shall be taken at least once per shift.

The Contractor shall be responsible for ensuring that the truck weigh ticket or delivery ticket for each load is handed to the Contract Administrator inspecting the HMA paving operation at the time the delivery truck unloads at the paving site. The Contract Administrator may not accept delivery tickets that are not submitted at the proper time or are submitted in groups after the delivery trucks have left the paving site.

The Contractor shall permit the Contract Administrator to make random checks of the gross mass and tare mass of trucks hauling HMA by requiring them to be driven over an independent certified scale.

310.09.01.01.02 By Area

When payment is in square metres:

Random pavement cores, maximum 100 mm in diameter, shall be taken to verify the actual thickness approximately every 100 m along the length of the roadway or 300 m² of pavement surface area. The average thickness for a core shall be based on the measurement from each quadrant of the core. The average thickness for the area shall be determined by averaging the core thicknesses.

When the average thickness is more than or equal to 95% of the specified thickness, the payment area shall be the total surface area of the HMA type laid for the course.

When the average thickness is less than 95% of the specified thickness, the surface area for payment purposes shall be calculated as follows:

$$\text{Payment area} = \frac{\text{actual area} \times \text{average thickness}}{\text{specified thickness}}$$

310.09.01.02 Tack Coat

Measurement for tack coat shall be of the area applied in square metres.

310.09.01.03 Hot Mix Asphalt Miscellaneous

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

310.09.02 Plan Quantity Measurement

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

310.10 BASIS OF PAYMENT

- 310.10.01 Hot Mix HL (“type”) - Item**
- Hot Mix HL (“type”) Patching - Item**
- Heavy Duty Binder Course Mix - Item**
- Medium Duty Binder Course Mix - Item**
- Dense Friction Course Mix - Item**
- Superpave (“type”) - Item**
- Superpave (“type”) Patching - Item**
- SMA - Item**

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

The Contractor shall be responsible for the cost of coring and filling all sample holes.

Removal and replacement of defective areas such as flushing, bleeding, segregation, fat spots, surface damage, and surface contamination, shall be at the Contractor’s expense.

Removal and replacement of rejected HMA due to aggregate gradation or non-compliance due to the asphalt cement content shall be at the Contractor’s expense.

Removal and replacement of HMA that does not meet the acceptance criteria for Marshall or Superpave HMA shall be at the Contractor’s expense.

Removal and replacement of HMA pavement that does not meet the average percent compaction shall be at the Contractor’s expense.

No additional payment shall be made for any delays or costs attributed to verification of the gross mass and tare mass of trucks requested by the Contract Administrator.

310.10.02 Hot Mix Asphalt Miscellaneous - Item

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

310.10.03 Tack Coat - Item

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

Tack coating in association with bridge deck waterproofing is included in the bridge deck waterproofing item.

**Table 1
Designated Large Sieve for Mix Types**

Mix Type	Designated Large Sieve mm
Superpave 37.5	25.0
Superpave 25.0	19.0
Superpave 19.0	12.5
Superpave 12.5, 12.5 FC1, and 12.5 FC2, HL 1, HL 3, HL 3A, OFC, DFC, and SMA	9.5
Superpave 9.5	4.75
Superpave 4.75	2.36
HL 8, MDBC, and HDBC	16.0
HL 4 Binder and HL 4 Surface	13.2
HL 2, HL 2 Modified, and RHM	2.36

**Table 2
Requirements for Class S Rollers**

Roller	Minimum Mass t	Minimum Mass Per mm Total Roll Width kg
S 1	7	3.5
S 2	9	4.5

**Table 3
Requirements for Class R Rollers**

Roller	Minimum Mass t	Minimum Mass Per Tire kg
R 1	8	900
R 2	18	2,500
R 3	25	3,600

**Table 4
Requirements for Class V Rollers**

Roller	Minimum Roll Diameter m	Minimum Roll Width m	Minimum Static Mass Per mm Total Roll/Tire Width kg
V1	1.00	1.40	2.0
V2	1.20	1.60	2.6
V3	1.40	1.90	2.9

**Table 5
Maximum Production Rates Per Paver
for Combinations of Rollers**

Maximum Production t/h	Minimum Roller Combinations	
	Southern Ontario	All Ontario
120	S2 + R1 + S1	S2 + R2 + S1
	V1 + R1	V1 + R2
135	V2 + R1	V1 + R3
	V1 + R2	V2 + R2
150	S2 + 2 x R1 + S1	S2 + 2 x R2 + S1
	S2 + R2 + S1	S2 + R3 + S1
	V2 + R2	
200	V3 + R2	V3 + R2
220	V3 + R3	V3 + R3

**Table 6
Sampling and Testing Frequency of Hot Mix Asphalt**

Quantity Per Day Per HMA Type	Minimum Frequency of Sampling and Testing	Minimum Marshall Sampling Size kg	Minimum Superpave Sampling Size (Note 1) kg
≤ 500 tonnes	One sample	10	20
> 500 and ≤ 1,500 tonnes	One sample per 500 tonnes or part thereof		
> 1,500 tonnes	One sample per 500 tonnes (Note 2), minimum of 3		
Notes:			
1. One additional 5 kg sample is required for SMA mixes to test for draindown.			
2. The Contract Administrator may reduce the testing frequency for HMA that is consistently being produced to meet the specification requirements.			

**Table 7
Tolerances for the Job-Mix Formula Aggregate Gradation and Asphalt Cement Content**

Mix	Attribute	Tolerances on the Job-Mix Formula %		
		Acceptable	Borderline	Rejectable
Surface Course	DLS, 4.75 mm sieve size	< 5.0	5.0 to 7.5	> 7.5
	600 µm sieve size	< 3.5	3.5 to 5.0	> 5.0
	75 µm sieve size	< 2.0	2.0 to 3.0	> 3.0
Binder and Levelling Courses	DLS, 4.75 mm sieve size	< 7.0	7.0 to 10.0	> 10.0
	600 µm sieve size	< 4.5	4.5 to 6.0	> 6.0
	75 µm sieve size	< 2.0	2.0 to 3.0	> 3.0
All Mixes	Asphalt Cement Content	< 0.30	0.30 to 0.50	> 0.50

**Table 8
Marshall Properties for Hot Mix Asphalt Types**

Production Properties and Test Methods	DFC	HL 1, HL 3, HL 3HS, HL 4, HL 8, HDBC, and MDBC	HL 2, HL 3F, and HL 4F
Minimum Marshall Stability: Newtons (N) at 60°C, LS-261, and LS-263	(Note 1)	(Note 1)	(Note 1)
Marshall Flow at 3.5% Air Voids: LS-261, and LS-263	8.0 minimum	8.0 - 14.0	9.0 - 18.0
Marshall Air Voids: LS-265	2.50 to 4.50%	3.0 to 5.0%	3.0 to 5.0%
Note: 1. Stability requirements shall be according to OPSS 1150.			

**Table 9
Pavement Compaction Requirements Based on Maximum Relative Density**

Mix	Acceptable %	Borderline %	Rejectable %
HDBC, Superpave 19.0, 25.0, and 37.5	91.0 to 96.5	96.6 to 97.5	< 91.0 or > 97.5
DFC and Superpave 12.5 FC2	92.0 to 97.5	97.6 to 98.5	< 92.0 or > 98.5
All Other Mixes	92.0 to 96.5	96.6 to 97.5	< 92.0 or > 97.5

Appendix 310-A, Commentary for OPSS 310, November 2004

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

The designer should be aware that excluded from the specification is recycled ratio and Owner specified use of reclaimed asphalt pavement in hot mix asphalt (HMA).

The designer should specify the following in the Contract Documents:

- HMA crossfall, profile, cross-section, and alignment. (310.06.01)
- HMA type requirements. (310.07.01)
- Tack coat surfaces and application rate. (310.07.03)
- Sampling frequencies and locations for asphalt cement. (310.07.05.01.02)
- Asphalt cement sample delivery location. (310.07.05.01.04)
- Quality assurance (QA) sample requirements. (310.07.05.02.01)
- HMA sample delivery location. (310.07.05.02.04)
- Stepped joints when required. (310.07.08)
- HMA padding requirements. (310.07.08)
- Temporary patching material removal locations. (310.07.10)
- Existing HMA patching locations requirements. (310.07.10)
- Butt joint forming method. (310.07.10)
- Lane demarcation. (310.07.11.03)
- QA HMA testing frequency if different than OPSS 310, Table 6. (310.08.01)
- Unit of measure for each HMA type. (310.09.01.01)

The designer may specify in a special provision when quality control (QC) test results are to be used for acceptance in place of QA test results.

The designer may consider extending delivery times for samples required on Contracts in remote areas. (310.07.05.01.04)

For smaller projects, the borderline category (Table 7) may not be appropriate. The designer may consider specifying that all work represented by borderline test results shall be deemed rejectable. (310.08.03.01)

Nuclear density testing, if desired, should be specified in the Contract Documents. Nuclear density testing may not be appropriate for open textured mixes. (310.08.05.01)

The complete tender item description for HMA should include a "type" of HMA according to Table 1 of OPSS 1150 for Marshall mixes and according to Tables 1 and 2 of OPSS 1151 for Superpave mixes.

Appendix 310-A

For Superpave mixes, the designer should refer to the appropriate lift thickness guidelines according to National Asphalt Pavement Association (NAPA), Information Series 128, HMA Pavement Mix Type Selection Guide, page 10, Figure 5, Recommended Minimum Lift Thickness Ranges for Dense Graded Mixes. Fine and coarse graded mixes as defined using primary control sieves are defined in OPSS 1151.

The designer may refer to the Best Practices for Testing of Superpave Hot Mix Quality Control Samples guidelines developed by the Ontario Superpave Implementation Committee. When the designer is including bonus or penalty clauses or both in relation to OPSS 310, more stringent laboratory procedures should be considered.

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

Related Ontario Provincial Standard Drawings

None.