04015 Asphalt Paving

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***Bold text denotes a change in this version (February 2022)**

Tables and Equations

***Bold text denotes a change in this version (February 2022)**

04015-1 General

1.1 Description

This section specifies requirements for all labour, machinery, plant, equipment and materials required to construct asphalt concrete.

Asphalt concrete shall consist of a homogenous mixture of crushed aggregate, Reclaimed Asphalt Pavement (RAP) and asphalt cement mixed in an approved central plant, hauled and spread at or above the minimum workable temperature upon a suitable base and compacted by immediate and intensive rolling so as to construct a smooth surface.

This asphalt concrete is to be constructed within the limits of the Contract Documents. The work shall be completed to the lines, grades, dimensions and typical cross-sections shown on the plans or as designated by the Engineer.

1.2 Related Sections

Specification 04010 Asphalt Mix

1.3 Definitions

1.3.1 Asphalt Cement

The bituminous material that is used to bind the asphalt mix aggregate.

1.3.2 Asphalt Aggregate

The crushed aggregate.

1.3.3 Asphalt Mix Aggregate

The mix after combining the asphalt aggregate fractions including filler or blending sand to produce the specified mix gradation.

1.3.4 Asphalt Mix

The mix produced by combining the asphalt cement with the asphalt mix aggregate.

1.3.5 Asphalt Concrete

The asphalt mix, placed and compacted on the roadway.

1.3.6 Reclaimed Asphalt Pavement (RAP)

Asphalt millings or processed asphalt removals, handled and characterized for RAP to be incorporated into asphalt mix.

04015-2 Materials

2.1 Hot Mix Asphalt

The materials used in the production of the HMA shall be according to the requirements of Section 04010 Asphalt Mix **for conventional and polymer modified HMA.**

2.2 Tack Coat Material

Tack coat materials used during paving operations shall be according to the requirements of Section 04025 Asphalt Prime and Tack Coats.

04015-3 Equipment

3.1 General

All tools, machinery, plant and equipment used in handling materials and executing any part of the work, shall be subject to the approval of the Engineer. All such equipment shall be maintained in efficient working order and where any of the machinery, plant or equipment is found to be unsatisfactory, it shall be improved or replaced by the Contractor to the satisfaction of the Engineer.

3.2 Asphalt Plant

To requirements stated in Specifications Section 04010 Asphalt Mix:

3.3 Scale

The Contractor shall supply a suitable scale of approved design. Before any weighing of material, the Contractor shall provide to the Engineer a Certificate from the Department of Trade and Commerce to the effect that the scale has been certified.

3.4 Haul Trucks

The asphalt mix shall be transported in trucks from the asphalt plant to the paving machine in vehicles with tight metal boxes.

The inside surface of all vehicles used for hauling asphalt mix shall be sprayed with diesel fuel or soap solution prior to loading, but excess lubrication will not be permitted. The use of gasoline, kerosene or similar products will not be permitted.

Haul trucks shall be of sufficient size, speed, condition and number to ensure orderly and continuous operation and be compatible with the size and capacity of the paving machine.

Haul trucks shall have covers of sufficient size to protect the asphalt mix from weather conditions and prevent a crust from forming on the asphalt mix.

3.5 Paving Machine

The paving machine shall be a self-propelled spreader capable of spreading the asphalt mix true to line, grade and crown as required.

The paving machine shall be equipped with a hopper and distributing screw of the reversing type to place the asphalt mix evenly in front of adjusting vibrating screeds.

The paving machine shall be equipped with automatic screed controls for controlling longitudinal and transverse slope and joint matching, as recommended or supplied by the manufacturer of the paving machine.

3.6 Rollers

Provide sufficient number of rollers of type and weight to obtain the specified density of compacted asphalt concrete.

Steel and pneumatic tire rollers used for compaction shall be kept slightly moistened by water. Steel rollers shall be equipped with scrapers. Pneumatic roller shall be equipped with coco mats. Excessive use of water will not be permitted.

3.6.1 Asphalt Release Agent

The contractor shall add asphalt release agent on the equipment water system to protect from asphalt pickup by pneumatic tire rollers during compaction. The contractor shall determine the amount and supplied dosage required to prevent from asphalt pickup. The contractor will submit the product name and technical specifications of the asphalt release agent that must conform to **AASHTO** TP102.

3.7 Hand Tools

Lutes or rakes with covered teeth shall be provided during the spreading and finishing operations.

Tamping irons or mechanical compaction equipment shall be provided for compacting material along curbs and gutters and other structures not accessible to rollers.

04015-4 Execution

4.1 Spreading

The asphalt mix shall be spread with a paving machine where at all possible.

The asphalt mix shall be laid on recently cured, primed, granular base or tacked asphalt concrete. The compacted base shall be free from all loose material and have a uniform, planar surface prior to applying the prime coat.

Asphalt mix shall only be spread **at the corresponding minimum air temperature and mat thickness listed in Table 1, unless waived by the Engineer.**

Table 1: Minimum Air Temperature Based on Asphalt Mat Thickness

Mat Thickness	Air Temperature
< 30mm	**10°C**
30mm	**6°C**
50mm	**4°C**
65mm	**3°C**
75mm+	**2°C**

Asphalt mix shall be spread on surfaces that are dry. Asphalt mix shall not be spread on surfaces that have pools of standing water or generally damp.

The minimum temperature of the asphalt mix in the paving machine shall not be less than 120°C.

If required, the contact edges of the mat shall be coated with a thin layer of liquid asphalt before the asphalt mix is placed against them.

Contact faces of curbs, gutters, manholes, and sidewalks shall be coated with liquid asphalt before placing the asphalt mix.

The surface of the mat behind the paving machine shall not be torn and shall be smooth, true to cross section, and uniform in density and texture.

The finished surface shall have a minimum of longitudinal and transverse joints. Where the asphalt mix is placed in two layers, the longitudinal joints shall be staggered by a minimum of 150 mm. Transverse joints shall be staggered a minimum of 3 m when the asphalt is placed in two lifts.

Longitudinal joints shall not be placed under proposed wheel paths.

Where a lift thickness of 80 mm or less is specified, it shall be placed in one lift, if all other specifications are met. Lift thickness greater than 80 mm shall be placed in two or more

lifts. Asphalt lifts shall never be placed at a thickness of less than two times the maximum aggregate size for Types 9 and **9P** and three times the maximum aggregate size for all other asphalt types except Type 4 which has no restriction.

Surplus asphalt mix shall not be spread over the freshly screed surface. The length of individual paving mats after each day shall be limited, such that the width of road can be covered with any given lift resulting in all transverse joints being kept within 100 m of each other.

4.2 Compacting

Rolling shall start as soon as the pavement will bear the weight of the roller without checking, cracking or undue displacement.

Each lift of asphalt shall be compacted to the density specified in this Section using the Marshall method specified under Section 04010 Asphalt Mix.

The finished surface of the mat shall be well-knit and free from waves, hairline cracks, roller marks, and other unevenness. The finished surface shall be free from depressions exceeding 5 mm as measured in any direction with a 3 m straight edge.

The rollers shall not be left stationary on the fresh asphalt until it has cooled down to ambient temperature as not to leave any obvious dips or marks which would allow water to pond.

The asphalt concrete surface shall be within 5 mm of design elevation but not uniformly high or low. At the lip of gutter the asphalt concrete surface shall be 5 to 10 mm above the lip of gutter.

All areas not accessible by the roller shall be compacted by hand tampers.

Care shall be used to ensure adequate compaction along the face of concrete curb or gutter without damaging the finished concrete. Damaged concrete work shall be replaced by the Contractor.

4.3 Quality Control

4.3.1 Process Control and Charting

The Contractor shall maintain the following charts:

- **IBar control charts for Process Control**
- **Moving average charts for Specification Compliance**

These charts shall be maintained for the following parameters:

1. **Mix Parameters**
    a. **Asphalt Cement Content**
    b. **Air Voids**
    c. **Marshall Stability**
    d. **All sieve designation**
2. **Aggregate during crushing and production:**
    a. **All sieve designations for each aggregate fraction processed into separate stockpiles**

A current copy (continuously updated to the most recent test results to next page specification compliance) of the Asphalt Control charts for mix parameters shall be kept at the asphalt plant control centre and be made available for inspection at the engineer's request.

4.3.1.1 Process Control Charting

Process Control Charting shall consist of the following:

1. **IBar Control Chart complete with:**
    a. **Upper and Lower Warning Limits: 95% confidence limit (+2 sigma)**
    b. **Upper and Lower Control Limits (CUL/LL): 99% confidence limit (+3 sigma)**
    c. **Centreline**
    d. **All limits re-calculated following data shifts or N=10, N=20, N=30,… as appropriate chart maintenance.**

e. All lines are to be labelled with their numerical values.

Note: Upper and Lower warning and control limits and the centreline are statistically calculated from individual tests, given our current sampling methodology.

4.3.1.2 Moving Average Charting

Moving Average Chart complete with:

a. Line showing specification warning zone
b. Line showing specification shutdown zone
c. Centreline
d. Numerical values entered on all lines

4.3.2 Alternate Charting

The contractor can make an alternate charting proposal complete with the following:

1. Charted parameters
2. Testing method summary
3. Minimum one month correlation to Marshall Properties

The Engineer can then decide to substitute the alternate charting in place of one, or all of the contracted requirements with the following stipulations:

If the Contractor fails to maintain a weekly update of his chart, he will revert back to all contract defaults.

4.3.3 Operating Tolerances

The working ranges outlined in Table 4, Table 4, Table 5, Table 6 and Table 7 will be used to assess compliance with specification.

The Contractor shall cease operations when:

1. two consecutive three point moving average points for any property or characteristic fall in the borderline zone
2. two or more tests in four consecutive tests are in the borderline zone or,

3. **any individual test for any property or characteristic fall in the plant shutdown zone or,**
4. **The Contractor's process is out of control based on the IBar control chart. The process shall be defined as out of control if it meets one or more of the following criteria:**
    a. **Test result is on or outside the upper or lower control limit.**
    b. **There are seven consecutive points above or below the centreline.**
    c. **Upward or downward trend.**
    d. **An obvious repetitive or cyclical pattern.**
    e. **The average of any seven consecutive tests runs at 0.3, or less, above the lower specification limit.**

When the asphalt falls in the shutdown zone, the Contractor shall assume the responsibility of ceasing operations on his own even in the absence of City personnel on site. When asphalt meets the four consecutive or two three point moving average criteria for shutdown, shutdown will be initiated at the instruction of the Engineer. Production shall not commence again until two consecutive tests are within specification limits or it has been demonstrated to the satisfaction of the Engineer that corrective action has been taken.

The aforementioned procedure shall not prevent the City from rejecting specific batches or production runs of asphalt concrete mix that from visual inspection or associated testing do not meet the requirements of this Section.

4.3.3.1 Mix Temperature

Mix temperature at point of plant discharge shall not vary from that specified in the job mix formula my more than10°C.

4.3.3.2 Moisture in mix

Maximum permissible moisture at point of plant discharge is 0.2 % by weight of mix.

4.3.4 Asphalt Cement Quality Control

On subsequent deliveries the suppliers shall provide the following test data:

Table 2: Asphalt Cement Quality Control Tests

Material	Frequency	Test Required
150-200A	**Every 300 tonnes** **Every 150 tonnes**	**Viscosity at 60°C, Pas.** **Penetration at 25°C, 100g, 5 sec.**
PG 64-37	**Every 500 tonnes**	**AASHTO M320**

Table 3: Type 1 and 1P - Maximum Permissible Variation

Property or Characteristic	Acceptable Zone	Borderline Zone	Plant Shutdown Zone	Asphalt Type
Asphalt Cement (%)	(+/-) 0.2	(+/-) 0.2 to 0.4	> (+/-) 0.4	Type 1 & 1P
Air Voids (%)				
Lower Limit	3.5	3.0 to 3.4	< 3.0	Type 1 & 1P
Upper Limit	5.5	5.6 to 6.0	> 6.0	
Marshall Stability (kN)	(>/=) 11.0	10.5 to 10.9	< 10.5	Type 1
	(>/=) 14.0	13.5 to 13.9	< 13.5	Type 1P
Flow Index (mm)				
Lower Limit	2.0	1.5 to 1.9	< 1.5	Type 1 & 1P
Upper Limit	4.0	4.1 to 4.2	> 4.2	Type 1
Upper Limit	5.0	5.1 to 5.3	> 5.3	Type 1P
Film Thickness (μm)				
Lower Limit	7.5	7.0 to 7.4	< 7.0	Type 1 & 1P
Upper Limit	9.5	9.6 to 10.0	> 10.0	
Gradation	Maximum Permissible Variation % by Weight Passing			
20.0 mm				
16.0 mm	(+/-) 1.0	(+/-) 1.1 to 2.0	> (+/-) 2.0	Type 1 & 1P
12.5 mm	(+/-) 3.0	(+/-) 3.1 to 5.0	> (+/-) 5.0	
9.0 mm	(+/-) 4.0	(+/-) 4.1 to 6.5	> (+/-) 6.5	
5.0 mm	(+/-) 4.0	(+/-) 4.1 to 6.5	> (+/-) 6.5	
2.0 mm	(+/-) 4.0	(+/-) 4.1 to 6.0	> (+/-) 6.0	
900 μm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
400 μm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
160 μm	(+/-) 2.0	(+/-) 2.1 to 3.0	> (+/-) 3.0	
71 μm	(+/-) 1.5	(+/-) 1.6 to 2.0	> (+/-) 2.0	

Note: The % asphalt cement and gradation are listed as variation from the job mix formula rather than an upper or lower limit.

***Adjustments can occur in the acceptable zone for mix designs that are at minimum levels.**

Table 4: Types 2 and 2P - Maximum Permissible Variation

Property or Characteristic	Acceptable Zone	Borderline Zone	Plant Shutdown Zone	Asphalt Type
Asphalt Cement (%)	(+/-) 0.3	(+/-) 0.3 to 0.4	> (+/-) 0.4	Type 2 & 2P
Air Voids (%)				
Lower Limit	3.0	2.5 to 2.9	< 2.5	Type 2 & 2P
Upper Limit	5.0	5.1 to 5.5	> 5.5	
Marshall Stability (kN)	(>/=) 8.0	7.0 to 7.9	< 7.0	Type 2
	(>/=) 11.0	10 to 10.9	<10.0	Type 2P
Flow Index (mm)				
Lower Limit	2.0	1.5 to 1.9	< 1.5	Type 2 & 2P
Upper Limit	4.0	4.1 to 4.2	> 4.2	Type 2
Upper Limit	5.0	5.1 to 5.3	> 5.3	Type 2P
Film Thickness (μm)				
Lower Limit	8.0	7.5 to 7.9	< 7.5	Type 2 & 2P
Gradation	Maximum Permissible Variation % by Weight Passing			
20.0 mm				
16.0 mm				
12.5 mm	(+/-) 3.0	(+/-) 3.1 to 5.0	> (+/-) 5.0	Type 2 & 2P
9.0 mm	(+/-) 4.0	(+/-) 4.1 to 6.5	> (+/-) 6.5	
5.0 mm	(+/-) 4.0	(+/-) 4.1 to 6.5	> (+/-) 6.5	
2.0 mm	(+/-) 4.0	(+/-) 4.1 to 6.0	> (+/-) 6.0	
900 μm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
400 μm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
160 μm	(+/-) 2.0	(+/-) 2.1 to 3.0	> (+/-) 3.0	
71 μm	(+/-) 1.5	(+/-) 1.6 to 2.0	> (+/-) 2.0	

Note: The % asphalt cement and gradation are listed as variation from the job mix formula rather than an upper or lower limit.
***Adjustments can occur in the acceptable zone for mix designs that are at minimum levels.**

Table 5: Type 3 - Maximum Permissible Variation

Property or Characteristic	Acceptable Zone	Borderline Zone	Plant Shutdown Zone	Asphalt Type
Asphalt Cement (%)	(+/-) 0.3	(+/-) 0.3 to 0.4	> (+/-) 0.4	Type 3
Air Voids (%) Lower Limit Upper Limit	 2.0 4.0	 1.5 to 1.9 4.1 to 4.5	 < 1.5 > 4.5	Type 3
Marshall Stability (kN)	(>/=) 6.0	5.0 to 5.9	< 5.0	Type 3
Flow Index (mm) Lower Limit Upper Limit	 2.0 4.0	 1.5 to 1.9 4.1 to 4.2	 < 1.5 > 4.2	Type 3
Film Thickness (μm) Lower Limit Upper Limit	 8.5 10.5	 8.0 to 8.4 10.6 to 11.5	 < 8.0 > 11.5	Type 3
Gradation	Maximum Permissible Variation % by Weight Passing			
20.0 mm				
16.0 mm				
12.5 mm	(+/-) 2.0	(+/-) 2.1 to 3.0	> (+/-) 3.0	Type 3
9.0 mm	(+/-) 3.0	(+/-) 3.1 to 5.0	> (+/-) 5.0	
5.0 mm	(+/-) 4.0	(+/-) 4.1 to 6.5	> (+/-) 6.5	
2.0 mm	(+/-) 4.0	(+/-) 4.1 to 6.0	> (+/-) 6.0	
900 μm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
400 μm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
160 μm	(+/-) 2.0	(+/-) 2.1 to 3.0	> (+/-) 3.0	
71 μm	(+/-) 1.5	(+/-) 1.6 to 2.0	> (+/-) 2.0	

Note: The % asphalt cement and gradation are listed as variation from the job mix formula rather than an upper or lower limit.

***Adjustments can occur in the acceptable zone for mix designs that are at minimum levels.**

Table 6: Types 9 and 9P - Maximum Permissible Variation

Property or Characteristic	Acceptable Zone	Borderline Zone	Plant Shutdown Zone	Asphalt Type
Asphalt Cement (%)	(+/-) 0.3	(+/-) 0.3 to 0.4	> (+/-) 0.4	All Type 9 & 9P
Air Voids (%) Lower Limit Upper Limit	 3.0 5.0	 2.5 to 2.9 5.1 to 5.5	 < 2.5 >5.5	 All Type 9 & 9P
Marshall Stability (kN)	(>/=) 8.0 (>/=) 11.0	7.0 to 7.9 10.0 to 10.9	< 7.0 < 10.0	Type 9 Type 9P
Flow Index (mm) Lower Limit Upper Limit Upper Limit	 2.0 4.0 5.0	 1.5 to 1.9 4.1 to 4.2 5.1 to 5.3	 < 1.5 > 4.2 > 5.3	 All Type 9 & 9P Type 9 Type 9P
Film Thickness (μm) Lower Limit	 8.0	 7.5 to 7.9	 < 7.5	 Type 9 & 9P
Gradation	Maximum Permissible Variation % by Weight Passing			
20.0 mm 16.0 mm 12.5 mm				
9.0 mm	(+/-) 1.0	(+/-) 1.1 to 2.0	> (+/-) 2.0	All Type 9 & 9P
5.0 mm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
2.0 mm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
900 μm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
400 μm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
160 μm	(+/-) 2.0	(+/-) 2.1 to 3.0	> (+/-) 3.0	
71 μm	(+/-) 1.5	(+/-) 1.6 to 2.0	> (+/-) 2.0	

Note: The % asphalt cement and gradation are listed as variation from the job mix formula rather than an upper or lower limit.
***Adjustments can occur in the acceptable zone for mix designs that are at minimum levels.**

Table 7: Type 5 (SUTO) - Maximum Permissible Variation

Property or Characteristic	Acceptable Zone	Borderline Zone	Plant Shutdown Zone	Asphalt Type
Asphalt Cement (%)	(+/-) 0.3	(+/-) 0.3 to 0.4	> (+/-) 0.4	Type 5
Air Voids (%) Lower Limit Upper Limit	 2.0 5.0	 1.5 to 1.9 5.1 to 5.5	 < 1.5 >5.5	 Type 5
Marshall Stability (kN)	(>/=) 9.0	8.0 to 8.9	< 8.0	Type 5
Flow Index (mm) Lower Limit Upper Limit	 2.0 4.0	 1.5 to 1.9 4.1 to 4.2	 < 1.5 > 4.2	 Type 5 Type 5
Film Thickness (μm) Lower Limit	 8.5	 8.0 to 8.4	 < 8.0	 Type 5
Gradation	Maximum Permissible Variation % by Weight Passing			
20.0 mm 16.0 mm 12.5 mm 9.0 mm				
5.0 mm	(+/-) 1.0	(+/-) 1.1 to 2.0	> (+/-) 2.0	Type 5
2.0 mm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
900 μm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
400 μm	(+/-) 3.0	(+/-) 3.1 to 4.5	> (+/-) 4.5	
160 μm	(+/-) 2.0	(+/-) 2.1 to 3.0	> (+/-) 3.0	
71 μm	(+/-) 1.5	(+/-) 1.6 to 2.0	> (+/-) 2.0	

Note: The % asphalt cement and gradation are listed as variation from the job mix formula rather than an upper or lower limit.

***Adjustments can occur in the acceptable zone for mix designs that are at minimum levels.**

4.4 Acceptance, Rejection and Repairs

If the finished surface of the mat does not comply with the aforementioned requirements, the Contractor shall either repair, remove and replace or recap the deficient section(s) at his own expense subject to approval by the Engineer. The replacement of the mat and/or placement of a recap shall be performed with a paving machine and shall comply with the specified riding quality requirements.

4.4.1 Segregation

An area of asphalt shall be considered segregated when the texture differs visually from the texture of the surrounding pavement. For the purposes of classifying asphalt segregation, only segregated areas greater than 0.1m^2 and/or greater than 1.0m in length shall be considered. Pavement segregation shall be classified as slight, moderate, or severe segregation as described in Table 8 below.

Table 8: Segregation Classifications

Segregation Type	Description
Slight	**The matrix of asphalt cement and fine aggregate is in place between the coarse aggregate but there is more coarse aggregate in comparison to the surrounding acceptable mix.**
Moderate	**A lack of asphalt cement and fine aggregate and significantly more coarse aggregate than the surrounding mix.**
Severe	**Very little or no asphalt cement and fine aggregate and appears as an area of coarse aggregate against coarse aggregate.**

4.4.1.1 Repairing Asphalt Segregation

Pavement segregation shall be repaired at the Contractor's expense and in accordance with Table 9 below.

Table 9: Asphalt Segregation Repairs

Segregation Type	Required Repair on Lower Lifts	Required Repair on Top Lifts
Slight	**No Repair Required**	**Slurry Seal Patch**
Moderate	**No Repair Required**	**Slurry Seal Patch**
Severe	**Removal and Replacement**	**Removal and Replacement**

All slurry seal patching shall be performed as per the Engineer's discretion. All removal and replacement shall be a minimum width between asphalt seams and 3m on either side or as per the Engineer's discretion.

If excessive segregation continues, the City of Saskatoon may require the work to stop until the Contractor can demonstrate that they have rectified the cause of the segregation.

04015-5 Testing

The Contractor shall provide access for core testing by others.

A core test representing a maximum of 300 tonnes of asphalt mix shall be used to determine payment adjustments. Results which do not meet specification may be averaged with results from 2 additional core tests. Additional cores for determining air voids and density will be taken within 2 meters of the original core location.

Additional cores for determining asphalt thickness will be taken within 5 meters of the original core location. Additional core tests must not be located in a wheel path. The Contractor shall notify the Project Engineer of their intent to do re-cores and shall not proceed without the Project Engineers' approval.

All additional cores must be requested within one week of the original core test results being communicated to the Contractor by the Engineer. The costs of this additional testing shall be the responsibility of the Contractor. Patching of core test holes with asphalt concrete shall be a subsidiary obligation of the contract and as such, shall not be paid for directly. Bulk samples shall also be taken to determine compliance with mix requirements.

This coring and bulk sampling will not necessarily be carried out on a regular basis, therefore, any testing and subsequent penalties will only represent the quantities placed in those areas tested.

04015-6 Measurement

Asphalt concrete will be measured in tonnes or square metres as specified.

The weight of each vehicle shall be determined at the beginning of the work with the fuel tank half full, spare tire in place and the driver in the cab. This weight, called the vehicle weight will be checked and/or amended at the discretion of the Engineer.

The Engineer may place a representative at the Contractor's scales and at the delivery site if the need arises.

Payment for asphalt concrete will be reduced for work which fails to meet specified tolerances. Air voids of the asphalt mix will be measured from test cores or bulk samples.

04015-7 Payment

Payment for asphalt concrete in place will be at the contract unit price per tonne or square metre, adjusted as per the specified adjustment factor for density, air voids, stripping potential, thickness, stability and asphalt content. The unit price will be full compensation for removing overburden, excavating, crushing, screening, stockpiling, and drying the aggregate; supplying, heating and storing the asphalt cement; mixing, loading, hauling, dumping, spreading, compacting, and finishing the asphalt mix. The unit price will also be full compensation for supplying and adding filler or blender sand at the central mixing plant.

7.1 Payment Adjustment Factors

Payment adjustment factors will be used to adjust the contract unit price for materials not complying with the tolerances and values in this section or related specifications. All adjustment factors will be determined on the basis of individual test results. The quantity of material represented by a single test will not exceed 300 tonnes.

Adjustment to the unit bid price for non-compliance equals the unit price times the payment adjustment factor(s). Reduced payment for more than one deficiency on any one test sample will be based on the reduced payment, and not the original.

7.1.1 Air Void Payment Adjustment Factors

Air Voids Payment Adjustment Factors (by individual sample tests) are presented in Table 10.

Table 10: Air Void Payment Adjustment Factors

Deviation (Note 1)	H.M.A. Type			
	9 & 5 (SUTO)	1, 1P & 9P	2 & 2P	3
+1.6				
+1.5	REJECT	REJECT	REJECT	REJECT
+1.4	0.30	0.30	0.30	0.30
+1.3	0.50	0.50	0.50	0.40
+1.2	0.60	0.60	0.60	0.50
+1.1	0.65	0.65	0.68	0.55
+1.0	0.75	0.75	0.75	0.60
+0.9	0.80	0.80	0.80	0.68
+0.8	0.85	0.85	0.85	0.77
+0.7	0.90	0.90	0.90	0.84
+0.6	0.93	0.93	0.93	0.89
+0.5	0.95	0.95	0.96	0.94
+0.4	0.98	0.98	0.98	0.98
+0.3	1.00	1.00	1.00	1.00
+0.2	1.00	1.00	1.00	1.00
+0.1	1.00	1.00	1.00	1.00
0.0	1.00	1.00	1.00	1.00
-0.1	1.00	1.00	1.00	1.00
-0.2	1.00	1.00	1.00	1.00
-0.3	1.00	1.00	1.00	1.00
-0.4	0.95	0.95	0.95	0.95
-0.5	0.90	0.90	0.90	0.925
-0.6	0.85	0.85	0.85	0.90
-0.7	0.65	0.65	0.65	0.85
-0.8	0.50	0.50	0.50	0.80
-0.9	REJECT	0.25	0.25	0.75
-1.0		REJECT	REJECT	0.65
-1.1				0.50
-1.2				REJECT
-1.3				

Note 1: Deviation in % air voids at 100% Marshall from mix specifications.

Air voids shall be determined from bulk samples or cores taken from the roadway. Where cores are used to determine air voids, field air voids shall be corrected to 100% Marshall using the following formula (Field Air voids) - (100 Field density as percentage of Marshall).

For Example: Field air voids is 5.4%, density is 98% of Marshall Density, Corrected air voids is 5.4% - (100 - 98) = 3.4%)

This calculation for correcting the air voids to 100% of Marshall Density will be used where the field density is less than 100% of Marshall Density and shall be used for the purpose of payment adjustment. Where field density is greater than 100% of Marshall Density, the air voids determined from the cores will be used for the purpose of payment adjustment.

7.1.2 Marshall Stability payment Adjustment Factors

Marshall Stability Payment Adjustment Factors (by individual sample test):

Table 11: Marshall Stability Payment Adjustment Factors

Adjustment Factor (%)	TYPE 1P	TYPE 1	TYPE 2P	TYPE 2	TYPE 9P	TYPE 9	TYPE 3	TYPE 5 (SUTO)
	PG 64-37	150/200 A	PG 64-37	150/200 A	PG 64-37	150/200 A	150/200 A	150/200 A
100	> 13.7	> 10.7	> 10.7	> 7.9	> 10.8	> 7.9	> 5.9	> 8.9
98	13.6-13.7	10.6-10.7	10.6-10.7	7.8 - 7.9	10.6 - 10.7	7.8 - 7.9	5.8 - 5.9	8.8 - 8.9
95	13.3-13.5	10.3-10.5	10.3-10.5	7.6 - 7.7	10.3 - 10.5	7.6 - 7.7	5.6 - 5.7	8.6 - 8.7
90	13.0-13.2	10.0-10.2	10.0-10.2	7.3 - 7.5	10.0 - 10.2	7.3 - 7.5	5.3 - 5.5	8.3 - 8.5
80	12.7-12.9	9.8 - 9.9	9.8 - 9.9	7.1 - 7.2	9.9 - 9.8	7.1 - 7.2	5.1 - 5.2	8.1 - 8.2
65	12.4-12.6	9.6 - 9.7	9.6 - 9.7	6.8 - 7.0	9.6 - 9.7	6.8 - 7.0	4.8 - 5.1	7.8 - 8.0
50	12.1-12.3	9.3 - 9.5	9.3 - 9.5	6.5 - 6.9	9.3 - 9.5	6.5 - 6.7	4.5 - 4.7	7.5 - 7.9
0*	< 12	< 9.3	< 9.3	< 6.5	< 9.3	< 6.5	< 4.5	< 7.5

***No Payment or Remove and Replace as directed by City of Saskatoon Engineer**

7.1.3 Asphalt Cement Content Payment Adjustment Factors

A payment adjustment factor for asphalt cement content payment will be applied to all mix represented by the test that fails to meet the minimum asphalt cement content as outlined in the Contractor's approved Job Mix Formula (JMF). The adjustment will be:

Table 12: Asphalt Cement Content Payment Adjustment Factors

Asphalt Content Deviation from JMF value	Type 1 & 1P	Types 2, 2P, 9, 9P & 5 (SUTO)	Type 3
+/- 0.1%	1.0	1.0	1.0
+/- 0.2%	1.0	1.0	1.0
+/- 0.3%	0.90	1.0	1.0
+/- 0.4%	0.75	0.90	0.95
+/- 0.5%	0.50	0.70	0.80
+/- 0.6%	Reject	0.50	0.65
+/- 0.7%		Reject	0.50
+/- 0.8%			Reject

Change in asphalt content based on dry mass of aggregate.

"Reject" at the discretion of the Project Engineer shall mean either zero payment or remove and replace.

7.1.4 Density Payment Adjustment Factors

7.1.4.1 Asphalt Mix Types 2, 3, and 4

Unless otherwise specified, asphalt mix Types 2, 3 and 4 shall meet density requirements to 97% of Marshall. The density payment adjustment factors are as follows:

Table 13: Compacted Density for Types 2, 3 and 4

% of Marshall	Payment
> 96.9%	100%
96.6 to 96.9	98%
96.0 to 96.5	95%
95.0 to 95.9	90%
94.0 to 94.9	80%
93.0 to 93.9	65%
91.0 to 92.9	50%
less than 91%	Replace Pavement - no payment for work removed

7.1.4.2 Asphalt Mix Type 1

Unless otherwise specified, asphalt mix Type 1 shall meet density requirements to 98% of Marshall. The density payment adjustment factors are as follows:

Table 14: Compacted Density for Type 1

% of Marshall	Payment
>97.9%	100%
97.6 to 97.9	98%
97.0 to 97.5	96%
96.6 to 96.9	93%
96.0 to 96.5	90%
95.0 to 95.9	80%
94.0 to 94.9	65%
92.0 to 93.9	50%
Less than 92%	Replace pavement - no payment for work removed

7.1.4.3 Asphalt Mix Type 9

Unless otherwise specified, asphalt mix Type 9 shall meet density requirements to 95% of Marshall. The density payment adjustment factors are as follows:

Table 15: Compacted Density for Type 9

% of Marshall	Payment
>94.9	100%
93.6 to 94.9	98%
92.6 to 93.5	90%
91.7 to 92.5	75%
91.1 to 91.6	50%
Under 91.1%	Replace pavement - no payment for work removed

7.1.5 Thickness Payment Adjustment Factors

Table 16: Variation in Thickness

Variation in Thickness From Design Thickness	Payment
"T" mm thick to 5 mm thin	100%
>5 mm thin to 15 mm thin	X^2 (100)%
>15 mm thin	No payment

where:

"T" is the over thickness limit, which is the greater of:

- **(Design Thickness) x 10%; or**
- **5mm**

and

$$X = \left(\frac{actual\ thickness}{design\ thickness}\right)$$

Equation 1: Calculating "X" for Payment Adjustments

Where more than one lift of asphalt is placed, the thickness tolerances will apply to the total asphalt layer and not to the thickness of each lift.

When asphalt concrete is measured in square meters, excess thickness will be accepted with no claim for extra payment. When asphalt concrete is measured in

tonnes, asphalt concrete in excess of over thickness limit "T" will be paid at 35% of tendered unit price for that item.

7.1.6 Applying Thickness Adjustment

On a single layer HMA paving project the core taken for determining in-situ air voids and density shall be used for calculating the thickness and any adjustment factor and will be applied to that individual test lot.

On a multi-layer HMA paving project the core taken after the final lift of paving for determining the in-situ air voids and density shall be used for calculating the thickness payment adjustment factor, though may not exceed the 300 tonne test lot size (combine all lifts) unless otherwise specified. Additional cores may be taken for determination of thickness not represented by the original core. These additional cores may not exceed the 300 tonne test lot size unless otherwise specified, and will be used for determining the asphalt thickness adjustment factor only. The average cost of the hot mix asphalt structure shall be determined after all the individual test lots have been adjusted for air voids, stability, asphalt cement content and density. The payment adjustment for thickness will be applied to this average cost of the hot mix asphalt mat and corresponding test lot size.

7.1.7 Stripping Potential Payment Adjustment Factors

Random testing of bulk samples will be tested for stripping potential. The Engineer shall apply a penalty of 10% (90% payment) for stripping potential that does not meet the requirements of Section 04010-2.4.2 unless otherwise indicated in the Specific Conditions. The quantity of material representing each test shall not exceed 300 tonnes.

End of Specification 04015