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PART 1 - GENERAL

This specification covers the preparation of hot-mixed and hot laid asphalt concrete utilised during HRM construction, HRM maintenance activities and development projects relating to pavement works.

The hot mix asphalt concrete shall comprise a mixture of mineral aggregate, filler and asphaltic binder combined and placed in accordance with this specification.

This standard does not address any safety concerns related to the use of its contents. It is the responsibility of the user of this specification to establish appropriate safe work practices applicable to the work detailed within.

Conversion of in-place pay volume (pay area time thickness) to unit tonnage for asphalt shall be at the rate of 2.3 tonnes per cubic metre.

1.1 Work Included

This section specifies requirements for constructing asphalt concrete pavement. Work includes fine grading, supply and placing of tack coat, hot mix asphalt concrete, and pavement markings.

1.2 Related Sections

.1	Concrete	Section 03 30 00
.2	Earthwork	Section 31 20 00
.3	Walks, Curbs and Gutters	Section 32 16 00
.4	Reinstatement	Section 32 98 00
.5	Precast Manholes, Catch-Basins and Structures	Section 33 39 00
.6	Standard Details	Section 39 00 00
.7	Specification for Performance Graded Asphalt Binder	S-2
.8	Pavement Markings	S-4

1.3 Reference Standards

74M	.1	Canadian General Standards Board (CGSB) 1-GP- Paint, Traffic, Alkyd
	.2	Nova Scotia Transportation and Infrastructure Renewal Standard Specification - Highway Construction and Maintenance
	.3	Transportation Association of Canada; Manual of Uniform Traffic Control Devices for Canada
	.4	AASHTO T 283, Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage
	.5	AASHTO T 304(A), Standard Method of Test for Uncompacted Void Content of Fine Aggregate

- .6 ASTM C 88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- .7 ASTM C 117, Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- .8 ASTM C 127, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
- .9 ASTM C 128, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate
- .10 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- .11 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- .12 ASTM D 242, Standard Specification for Mineral Filler for Bituminous Paving Mixtures
- .13 ASTM D 546, Standard Test Method for Sieve Analysis of Mineral Filler for Asphalt Paving Mixtures
- .14 ASTM D 2041, Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
- .15 ASTM D 2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
- .16 ASTM D 3203, Standard Test Method for Percent Air Voids in Compacted Asphalt Mixtures
- .17 ASTM D 4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
- .18 ASTM D 6927, Standard Test Method for Marshall Stability and Flow of Asphalt Mixtures
- .19 ASTM D 6928, Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
- .20 ASTM D 7428-15, Standard Test Method for Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

PART 2 - EXECUTION

<u>2.1 Fine Grading</u>	.1	Fine grade gravel surface to within 10 mm of elevations and cross sections indicated immediately prior to placement of asphalt materials. Add or remove gravel as required. Compact to 100% Standard Proctor Density or as directed by the Engineer.
<u>2.2 Adjusting Tops of Castings</u>		Prior to placing asphalt surface course:
	.1	Adjust manhole covers and catch basin frames to match asphalt surface, using manufactured grade rings or cast in place concrete.
	.2	Adjust valve boxes to finished asphalt surface. Raise or lower top sections of the valve boxes.
	.3	Upon manhole adjustment, removal of catchment device and all works associated with restoration around the manhole, the contractor shall provide all testing equipment, labour, incidentals, traffic control, etc. required to undertake an inspection of the system to verify its cleanliness. This inspection must be done in the presence of the Engineer.
<u>2.3 Water Main Leakage prior Testing</u>	.1	After placement of the asphaltic concrete base course and to the placement of the asphaltic concrete surface course, contractor to provide 24 hours notice to Halifax Water for leakage testing. Allow access to and coordinate with Halifax Water for leakage testing.
<u>2.4 Pavement Markings</u>	.1	Arterials shall have the pre-markings (tabs on milled surface, temporary tape on micro and pavement) applied immediately after the placement of each lift of asphaltic concrete and permanent markings shall be applied within 48 hours. All other streets shall have the permanent markings applied within one week after the placement of the final lift of asphaltic concrete.
	.2	Surface to be dry and clean prior to the application of pavement markings. Apply paint at application rate indicated with spray gun to lines and at locations indicated. Dimensions and colour to HRM's Pavement Markings, Section S-4 specification.
<u>2.5 Quality Management Plan – Cold Weather</u>	.1	The cut-off date for asphalt construction is October 31. Beyond these dates the proposed asphalt work shall be reviewed on a case-by-case situation and must be approved by HRM. If approved by HRM the QMP shall be adhered to. The length of time beyond the traditional cut-off dates the

QMP can be considered will be at the discretion of the Engineer. HRM reserves the right to terminate the QMP program at any point in time. A Professional Engineer in good standing with Engineers Nova Scotia shall certify to HRM that the asphalt work meets the requirements under the QMP and HRM Specifications.

- .2 Prior to the placement of any hot mix asphalt a geotechnical engineering consultant shall test and confirm that the minimum compaction requirements have been achieved in the granular base material. Where the minimum specified compaction is not achieved prior to the granular base material freezing, the contractor shall remove the frozen granular material and underlying soils and shall replace it with non-frozen material. All compaction results shall meet the minimum requirements as described in the HRM standard specifications. HRM may independently perform compaction tests for both the granular and asphalt layers to verify the results. A Professional Engineer in good standing with Engineers Nova Scotia shall certify to HRM that the granular base layers meet the requirements under the QMP and HRM Specifications.
- .3 Asphalt concrete shall not be placed during rain or snow or on asphalt surfaces, which are wet and/or unclean. Asphalt concrete shall not be placed on any surface, which has ponded water. Placing of conventional hot mix asphalt concrete shall not be permitted when the ambient air temperature is below 5 degrees Celsius. The wind chill temperature (if any) must also be included in the final decision. If paving operations are to take place between 0 - 5 degrees Celsius, the contractor shall use a Warm Mix Asphalt Technology in place of conventional Hot Mix Asphalt, and the contractor shall advise of the technology and receive approval from HRM prior to construction. However, all paving operations shall cease when the ambient air temperature is below 0 degrees Celsius. A joint heater or echelon paving shall be used in cold weather paving. As well, the asphalt temperature testing frequency at the job site shall be increased to ensure the asphalt meets the HRM Specification. A Professional Engineer in good standing with Engineers Nova Scotia shall certify to HRM that the asphalt work meets the requirements under the QMP and HRM Specifications.
- .4 Regardless of the technology used, the contractor shall obtain the minimum compaction requirements as outlined in the HRM specifications. The testing results for the granulars and the asphalt shall be submitted to HRM, and the testing frequency and requirements shall adhere to HRM Specifications. The contractor shall also ensure that all

employees are trained and made aware of the importance of quality workmanship.

- .5 The contractor shall implement a Quality Paving Plan to ensure the quantity and quality of equipment and personnel are adequate to achieve a quality end product as outlined in the specifications. There will be a point in time where all concrete and paving operations will cease altogether for the remainder of the year, and the QMP will not be permitted. A notice will be provided at that time. Under these circumstances, temporary asphalt shall be required as per the HRM Specifications.

PART 3 - MATERIALS

3.1 General

The Contractor shall be responsible for the supply, storage and handling of all material utilised to produce the hot mix asphalt concrete described in this specification.

3.2 Aggregates

Aggregates shall be crushed pit run or quarried stone or sand conforming to the quality requirements of this specification. All aggregates shall be free from coatings of clay, silt or other deleterious organic matter.

The Contractor shall submit to the Halifax Regional Municipality the location of all proposed aggregate sources at the commencement of each construction season. Any subsequent aggregate source changes must be requested in writing to HRM prior to material acceptance.

.1 Fine Aggregates

Fine Aggregate shall consist of clean, tough, rough-surfaced grains, free from clay, loam and other foreign matter. The portion of the material passing the 5 mm sieve shall be known as fine aggregate.

Fine aggregate shall conform to the physical requirements as stipulated in Table 1.

Table 1 - Fine Aggregate Physical Requirements ⁽¹⁾		
Material Property	Test Method ⁽²⁾	Specified Value
Absorption	ASTM C 128	< 2.000
Angularity ⁽³⁾	AASHTO T 304(A)	≥45.0
Sand Equivalent	ASTM D 2419	≥50
Soundness ⁽⁴⁾	ASTM C 88	<10
Micro Deval	ASTM D7428-15	<20

(1) Applies to each individual aggregate component in the asphalt mixture

(2) Latest Addition

(3) Does not apply to Natural Blend Sand Component

(4) Test to be conducted utilizing Sodium Sulphate (NaSO₄)

.2 Coarse Aggregates

Coarse Aggregate shall consist of hard, durable crushed stone or crushed gravel particles, reasonably uniform in quality and free from soft or disintegrated pieces. The portion of material retained on the 5 mm sieve shall be known as coarse aggregate.

Coarse Aggregates shall conform to the physical requirements as stipulated in Table 2.

Table 2 - Coarse Aggregate Physical Requirements		
Material Property	Test Method	Specified Value
Absorption	ASTM C 127	< 1.750
Petrographic Number ⁽⁵⁾	NSTIR TM2	≤ 135
Los Angeles Abrasion	ASTM C 131	< 30
% Fractured Particles	NSTIR TM3	> 95
Flat or Elongated Particles	ASTM D 4791	< 10
Micro Deval	ASTM D 6928	< 20
Aggregate Soundness ⁽⁶⁾	ASTM C 88	< 15

(5) Coarse Aggregate Sources may be blended to meet Petrographic Number

(6) Test to be conducted utilizing Sodium Sulphate (NaSO₄)

.3 Gradation of Combined Aggregate

The gradation of the combined processed aggregate for the asphalt concrete shall conform to the values shown in Table 3 when tested by washed sieve analysis according to ASTM C 117, C 136 and D 546.

Table 3 - Combined Processed Aggregate Gradations for Each Mix Type⁽⁷⁾				
Sieve Size (µm)	Cumulative Percent Passing			
	B-HF	C-HF	Special C	D-HF
28000	100			
20000	95-100	100	100	
14000	80-90	95-100	95-100	100
10000	68-80	75-90	80-95	95-100
5000	47-63	52-68	58-76	60-80
2500	30-46	30-50	35-56	35-58
1250	18-35	18-35	22-40	20-40
630	12-24	10-25	15-28	14-28
315	8-16	7-15	10-20	8-18
160	5-10	4-10	6-12	6-12
80	3-6.5	3-6.5	4-7.5	4-7.5

(7) A maximum of 15% natural sand will be permitted to achieve required gradation

.4 Mineral Filler

Mineral filler, when required, shall comprise finely divided mineral matter such as rock dust, hydrated lime, hydraulic cement, pozzolanic material, fly ash or other suitable mineral matter. All mineral fillers must conform to the requirements of ASTM D 242, Standard Specification for Mineral Filler for Bituminous Paving Mixtures. All mineral fillers utilised must have a plasticity of zero.

.5 Performance Graded Asphalt Binder (PGAB)

The asphalt cement shall be prepared by the refining of petroleum. The Contractor will be responsible for the supply and transportation of the PGAB. Material storage, transportation and material properties will comply with HRM's Performance Graded Asphalt Binder Specification, Section S-2.

.6 Reclaimed Asphalt Pavement (RAP)

The Contractor will be permitted to use Reclaimed Asphalt Pavement (RAP) in the base course HMA and surface course HMA. The RAP content in the pavement mixture will be limited to 20% in each lift. HMA mixes inclusive of RAP will be subject to the following conditions:

Preparation and submission of a Marshall Asphalt Design Mix Formula and Lottman (including all supporting documentation) for the asphalt mixture containing RAP, for HRM's approval, is the responsibility of the Contractor. The Contractor shall use professional engineering services and a qualified testing laboratory to assess the aggregate materials, asphalt binders, blending sands, mineral fillers, anti-stripping agents and asphalt cement rejuvenation agents proposed for use and to carry out the design of the asphalt concrete mix. No compensation will be provided to the contractor for the production of the asphalt design mix formula for the HMA containing RAP.

The asphalt mixture containing RAP shall be designed in accordance with the Ontario Ministry of Transportation Design Procedure for Recycled Hot Mix Asphalt, latest edition, except that all test methods referred to shall be replaced with the appropriate ASTM Standards.

The asphalt plant must be equipped with a metering system that allows the RAP to be added in a controlled manner acceptable to the Engineer.

.7 Tack Coat

.1 Local Roads Tack Requirements

Non-Tracking Emulsion Requirements (Prior to Dilute)

Table 4 - Local Roads Tack Requirements Non-Tracking Emulsion Requirements (Prior to Dilute)		
Test Type	Specification Range	
	Minimum	Maximum
Test on Emulsion		
SF Viscosity, 25°C, SFs	20	
Sieve Test		0.1
Dist. Residue	55	
Oil Portion of Dist., %		Trace
Particle Charge	(-) or (+)	
Test on Residue		
Penetration, 25°C, dmm	20	55
Ash Content, %		1.0

*Non-tracking tack can be used on all other road classifications

.2 Minor/Major Collectors and Arterials Tack Requirements

Rapid Setting Emulsified Asphalt (RS-1) Requirements

Table 5 - Minor/Major Collectors and Arterials Tack Requirements Rapid Setting Emulsified Asphalt (RS-1) Requirements		
Test Type	Specification Range	
	Minimum	Maximum
SF Viscosity, 25°C, SFs	20	100
Dist. Residue	55	
Storage Stability, %		1.5
Sieve Test, %		0.1
Demulsibility, %	60	
Particle Charge	Negative	
Penetration, 0.2mm	100	200
Ductility, cm	60	
Solubility, %	97.5	

PART 4 - MIX DESIGN REQUIREMENTS

The Contractor shall undertake a laboratory-based mix design based on current aggregate stockpiles. The mix design, in all instances, must be current and reflective of the aggregate that is to be utilised in the hot mix asphalt. The Contractor shall submit the design mix formula (DMF) to HRM at least 14 days prior to the initial start of production and for each subsequent change in supplier or source of materials. The DMF shall follow the Marshall method and achieve the properties listed in Table 6.

Table 6 - Mix Properties Requirements⁽⁸⁾			
Property	Test Method	Specified Value	Mix Type
Marshall Stability @ 60°C (kN)	ASTM D6927	> 12	All Mixes
Marshall Flow (mm)	ASTM D6927	2.0 - 4.0	All Mixes
Voids in Mineral Aggregate (%) ⁽⁹⁾		> 13.0	B-HF
		> 14.0	C-HF, Special C
		> 15.0	D-HF
Air Voids (%)	ASTM D 2041	3.0 - 5.0	B-HF, C-HF and D-HF
		2.5 - 4.0	Special C
Modified Lottman Test, TSR (%)	AASHTO T 283	> 75.0	All Mixes

(8) Marshall compactive effort shall be 75 blows

(9) Shall be calculated utilizing oven dry specific gravity for combined aggregate

The final DMF will be implemented as the initial trial for plant mix start up with any necessary adjustments immediately being made by the Contractor. These adjustments will be documents as the Job Mix Formula (JMF). Any additional adjustments will result in an additional documented JMF. Copies of all JMF reports will be provided to HRM.

All JMF's shall meet the requirements of Tables 3 & 6, and Subsection 4.1 of this specification. All quality control tests will be measured against the documented JMF.

4.1 Field Mix Tolerance

Changes to the JMF shall be submitted in advance of paving. The maximum mean of the deviations of the lot from the Job Mix Formula for gradation and PGAB content in percent by mass shall be:

B-HF

Passing the 5000 µm sieve	± 6.0	
Passing the 80 µm sieve		± 0.8
PGAB	± 0.4	

C-HF, Special C, D-HF

Passing the 5000 µm sieve	± 5.0	
Passing the 80 µm sieve		± 0.5
PGAB	± 0.3	

A lot is defined as one day of production per street, with 2 samples per lot, per mix type. Where planned daily production is greater than 1000 tonne, an additional sample will be taken and the lot will be based on three (3) samples. Price adjustments will be made as detailed in the tables below:

Table 7 – Price Adjustments for Gradation

Sieve Designation	Mean of the Deviations of the Gradation from the JMF	B-HF Price Adjustment for Gradation (\$ per Tonne)	C-HF, Special C, D-HF Price Adjustment for Gradation (\$ per Tonne)
5000	0.00 to 5.00	0	0
	5.01 to 5.20	0	-0.25
	5.21 to 5.40	0	-0.50
	5.41 to 5.60	0	-0.75
	5.61 to 5.80	0	-1.00
	5.81 to 6.00	0	-1.25
	6.01 to 6.20	-0.25	-1.50
	6.21 to 6.40	-0.50	-1.75
	6.41 to 6.60	-0.75	-2.00
	6.61 to 6.80	-1.00	-2.25
	6.81 to 7.00	-1.25	-2.50
	7.01 to 7.20	-1.50	-5.00
	7.21 to 7.40	-1.75	-5.00
	7.41 to 7.60	-2.00	-5.00
	7.61 to 7.80	-2.25	-5.00
	7.81 to 8.00	-2.50	-5.00
	8.01 to 9.00	-5.00	-7.50
	9.01 to 10.00	-7.50	Rejection*
	>10.00	Rejection*	Rejection*

80	0.0 to 0.50	0	0
	0.51 to 0.60	0	-0.50
	0.61 to 0.70	0	-1.00
	0.71 to 0.80	0	-1.50
	0.81 to 0.90	-0.50	-2.50
	0.91 to 1.00	-1.00	-3.75
	1.01 to 1.10	-1.50	-6.00
	1.11 to 1.20	-2.50	-6.00
	1.21 to 1.30	-3.75	Rejection*
	1.31 to 1.50	-6.00	Rejection*
	>1.50	Rejection*	Rejection*

* The Engineer reserves the right to reject the work or assess double the maximum penalty outlined in the table above.

Table 8 – Price Adjustment for Asphalt Binder Content		
Mean of the Deviation of the Asphalt Binder Content from the JMF	B-HF Price Adjustment for Asphalt Binder Content (\$ per Tonne)	C-HF, Special C, D-HF Price Adjustment for Asphalt Binder Content (\$ per Tonne)
0.00 to 0.30	0	0
0.31 to 0.35	0	-0.50
0.36 to 0.40	0	-1.00
0.41 to 0.45	-0.50	-1.50
0.46 to 0.50	-1.00	-2.50
0.51 to 0.55	-1.50	-3.00
0.56 to 0.60	-2.00	Rejection*
0.61 to 0.65	-2.50	Rejection*
0.66 to 0.70	-3.00	Rejection*
>0.70	Rejection*	Rejection*

* The engineer reserves the right to reject the work or assess double the maximum penalty outlined in the table above.

HRM's testing company will take duplicate samples in the event of an appeal. Appeals shall be sent in writing to HRM within five (5) business days of receiving test results. Should the price adjustment remain the same or increase, based on the new results, the Contractor will be responsible for the new price adjustment plus the cost of the additional sampling and testing. Should the price adjustment be eliminated or reduced based on the new results, the cost of the sampling and testing will be borne by HRM. Loose mix samples shall not be taken from the first or last loads of the day. On

projects where less than 300 tonne of asphalt is placed, price adjustments for gradation and asphalt cement shall not apply. For projects with tonnage greater than 1200 t per mix type, the contractor may elect to complete up to a 300 t trial prior to submitting the job mix formula.

4.2 Anti-Stripping Agents

An anti-stripping additive may be required in the Hot Mix Asphalt Concrete. Resistance of Compacted Hot Mix Asphalt to Moisture-Induced Damage tests in accordance with AASHTO T283 shall be completed following the mix design procedure, to determine the need for and the required amount of anti-stripping additive. An anti-stripping agent will be required if the tensile strength ratio of the asphalt concrete is less than 75%, as determined by AASHTO T 283. Additionally, the tested specimens are to be inspected by the firm conducting the mix design for any visual evidence of moisture damage as evidence by the loss of asphalt coating on the aggregate matrix. If coating loss is evident, the test procedure is to be repeated incorporating an approved anti-stripping agent. The testing procedure is repeated at increments of 0.2% LAS, or 0.5% lime until such time that the moisture damage is not evident. An asphalt mixture will also require the addition of an approved anti-stripping agent if based on past knowledge that the aggregate source is susceptible to moisture damage.

Either hydrated lime ($\text{Ca}(\text{OH})_2$) or approved liquid anti-strip additives can be utilised.

Where stripping tests are deemed necessary, the Contractor must submit a report to the Engineer summarizing the test results. The report must contain, as a minimum, the following:

- The source and percentage of aggregates used within the proposed asphalt concrete;
- The type and percentage of asphalt binder used;
- The percentage of air voids for both the untreated and treated mix;
- The average tensile strength of both the treated and untreated mix;
- The Tensile Strength Ratio (TSR); and
- Visual inspections of any moisture damage.

Where liquid anti-stripping agents are required as an additive to the PGAB, the dosage added will be the minimum dosage required to satisfy the above criteria.

Contractors electing to utilize liquid anti-stripping agents in their PGAB are required to ensure all appropriate safety precautions are taken in the handling, use and blending of this material. All workers are to be formally trained with respect to working with PGAB containing liquid anti-stripping additives.

Where hydrated lime is used as an anti-stripping agent, the dosage requirement shall be the greater of one half ($\frac{1}{2}$) percent by mass of total dry aggregate, or the recommended percentage as determined from AASHTO T283 test results.

Where hydrated lime is utilised, the hydrated lime shall be added to the aggregates by the dry method or the wet method.

For the dry method, lime shall be taken from the lime storage facility and combined with aggregate with an appropriate mixing device. Prior to the addition of the hydrated lime, the aggregate source must be dampened to improve aggregate coating.

For the wet method, a slurry containing one part hydrated lime to three parts water by mass shall be used. The slurry shall be prepared in a central mixing tank. When the wet method of lime addition is utilised, no addition of water to the aggregate prior to the mixing of the slurry mix and aggregate will be required.

Both the coarse and fine aggregate components must be treated if an anti-stripping agent is required.

PART 5 - TRANSPORTATION, PLACEMENT AND CONSTRUCTION

5.1 Transportation of Hot

Mix Asphalt

The Hot Mix Asphalt shall be transported from the mixing plant to the work site in tight vehicles with the bottoms cleaned of all foreign materials. Vehicles shall be equipped with tarpaulins of water-repellent material with a maximum mesh size of 0.5 mm when stretched, a minimum melting point of 200°C and of sufficient size to completely cover truck bodies from edge of box to edge of box and about the tailgate.

Tarps shall be in good condition and shall have no holes or tears. The tarps shall be securely tied down so there is no visible opening between the truck box and tarp. Vehicles shall also be equipped with wind deflectors at the front of the truck box. Tarpaulins must always be used during the transportation of hot mix asphalt to the respective job site unless otherwise stated by the Engineer.

The use of hydrocarbon-based fuels or solvents to lubricate the truck bodies or to clean tools or equipment will not be permitted. A biodegradable release agent shall be supplied by the Contractor to clean or lubricate tools, equipment and truck bodies.

In no case shall the temperature of the Hot Mix Asphalt/Warm Mix Asphalt exceed 165°C. Hot Mix Asphalt shall have temperatures of at least 125°C immediately prior to loading into the spreader hopper. Warm Mix Asphalt shall have temperatures of 105°C immediately prior to loading into the spreader hopper.

5.2 Placing of Hot Mix Asphalt

The mixing and compaction temperature ranges for the Marshall Mixtures shall be determined from the supplier temperature-viscosity charts current for the calendar year. Laboratory asphalt mixing shall occur within temperature ranges such that the viscosity of the PGAB is 170 ± 20 centistokes. Asphalt compaction shall occur within temperature ranges such that the viscosity of the PGAB is 280 ± 30 centistokes.

Asphalt concrete shall be placed upon a prepared gravel surface, which is free from standing water, and cleaned of all loose or foreign material including fine dust. Hand sweeping, power sweeping, power blowers, vacuum sweepers and/or pressure washers may be required between successive lifts of asphalt or on milled surfaces when deemed necessary by the Engineer.

Asphalt concrete shall be placed upon a milled and/or existing asphalt surface, which is dry, and cleaned of all loose or foreign material including fine dust. Hand sweeping, power sweeping, power blowers, vacuum sweepers, and/or pressure washers may be required between successive lifts of asphalt or on milled surfaces when deemed necessary by the Engineer, prior to placement of tack coat.

Placement shall not take place during rain, after October 31, or when the ambient temperature is below 5°C , unless otherwise directed by the Engineer.

Where a Hot Mix Asphalt is to be placed as an overlay to an existing asphalt wearing or milled surface, a tack coat must be applied to the surface prior to the placement of the Hot Mix Asphalt. Tack coat as per NSTIR specification Division 4, Section 1 for Rapid Setting Emulsified Asphalt RS-1. The method of application, shall be as recommended by the manufacturer and shall be subject to the approval of the Engineer. The tack coat utilised must be appropriate for the prevailing weather conditions.

New pavement may be applied directly over a freshly placed mat without applying a tack coat when multiple lifts are being placed and the fresh mat is free of any type of contamination or debris. However, a tack coat must be applied if more than 24 hours expires between consecutive lifts.

Where tack coat is required by the Engineer, an application rate of 0.25 L/m^2 for non-tracking and 0.15 L/m^2 for RS-1 shall be utilized. On milled surfaces the application rate shall be increased to 0.30 L/m^2 for non-tracking and 0.20 L/m^2 for RS-1.

The placing of asphalt concrete shall be at a constant and even rate of speed compatible with the rate of compaction rolling and plant output.

5.3 Thickness Requirements The maximum thickness allowed for any one lift of hot mix asphalt shall be 75 mm unless otherwise approved by the Engineer.

For new construction as well as paving atop a milled surface, the average compacted thickness of the hot mix asphalt mat shall be within 5 mm with all core results within 10 mm of the thickness as specified by the contract documents or by the Engineer. Based on the thickness test results determined by the Engineer's testing agency, the following unit price adjustment table will be applied:

Table 9 - Thickness Price Unit Price Adjustments⁽¹⁰⁾⁽¹¹⁾	
Scenario of Core Results	Price Adjustment / square metre
1) Average Core Results greater than total specified thickness	+\$0.30 / mm ⁽¹²⁾
2) Average Core Results deficient more than 5 mm relative to the total specified thickness	-\$0.30 / mm ⁽¹³⁾
3) For each individual Core Result deficient more than 10 mm relative to the total specified thickness	(-\$0.50 / mm ⁽¹⁴⁾) / (total # of core samples taken on project)

⁽¹⁰⁾ Items 1 & 2 will not apply on projects in which hot mix asphalt payment is on a per mass (metric tonne) basis.

⁽¹¹⁾ Table will be applied in numerical order. When item 2 applies, item 3 will not be applied on the same project. Items 1 and 3 will each be applied on a project if applicable.

⁽¹²⁾ Applied to a maximum of 5 mm or \$1.50 / m² unit price adjustment. No price adjustment will be applied if any compaction penalty applies.

⁽¹³⁾ Thickness deviation will be difference between average and specified thickness.

⁽¹⁴⁾ Thickness deviation on individual core results is as follows:

[(Specified Thickness - 10 mm tolerance) - Actual Thickness]

.1 Dispute Resolution

Should the Contractor wish to appeal the original thickness results obtained the following option is available. Within five business days of receiving the quality assurance test results from the Engineer's testing agency the Contractor may request in writing to the HRM Construction Supervisor appeal sampling for thickness determination. The specific core sample locations to be appealed shall be identified by the Contractor and will be sampled by the Engineer within one metre of the original sample location. The original thickness result will be discarded from the data set and replaced with the new result determined during the appeal testing.

.2 Appeal Testing Process

The Engineer will coordinate the additional testing with their testing agency and the Contractor. The Contractor may have a representative present during the time of the appeal sampling and testing to verify the accuracy of the test method. Should the Contractor's representative take issue with the test procedures utilized in the appeal testing, they must provide the issue in writing prior to leaving the QA testing laboratory. Any concerns identified will be reviewed by the Engineer to determine the appropriate action. Concerns identified in writing or otherwise raised by the Contractor after leaving the QA laboratory will not be considered by the Engineer.

.3 Cost of Appeal Testing

Should the thickness price adjustment remain the same or increase, based on the new results, the Contractor will be responsible for the new price adjustment plus the cost of the additional sampling and testing. Should the price adjustment be eliminated or reduced based on the new results, the cost of the sampling and testing will be borne by HRM.

5.4 Placement by Hand

Where areas are not accessible by equipment, hand placement will be permitted. Care must be taken during hand placement to avoid segregation of the coarse and fine aggregate. Lutes and rakes must be utilised during hand placement to thoroughly loosen and uniformly distribute the mix. Any lumps that do not readily break down must be removed.

All hand tools must be heated prior to hand placement operations to keep them free from sticking asphalt. Care must be taken when heating the tools to ensure the mix is not overheated.

Prior to rolling, the surface must be checked with a straightedge for level, and any irregularities must be corrected.

5.5 Compaction

Compaction of the asphalt concrete shall be with any combination of rollers that can achieve the specified smoothness and density. However, the Contractor is encouraged to utilise a fully functional pneumatic tire roller on all paving projects. A 'paving' project shall be defined as a contract which involves full-width replacement or overlay of new HMA.

Trench reinstatement or partial-width road paving will be considered 'patching' projects.

The Contractor shall demonstrate a rolling pattern for achieving compaction at the start of paving operations, and the degree of compaction will be verified by the Engineer.

Rollers shall be in good condition, capable of reversing direction without backlash, and they shall be operated by competent and trained operators. The speed of steel-wheeled rollers and pneumatic rollers shall not exceed 5 km/h. The speed shall be slow enough to avoid displacement of the asphalt concrete. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected.

Rolling shall proceed continuously until all roller marks are removed and the specified compaction is achieved.

Water or a biodegradable release agent shall be used on the roller wheels or tires to prevent adhesion of asphalt concrete. Hydrocarbon fuels or solvents shall not be permitted.

Breakdown rolling shall take place as closely behind the laying machine as the temperature and condition of the mat will allow.

Secondary rolling shall follow the breakdown rolling as closely as possible while the asphalt concrete is still viscous enough to achieve the specified compaction.

Final rolling shall be performed while the asphalt concrete is still viscous enough to permit the removal of roller marks.

Sufficient rollers must be maintained on the job site to ensure full compaction of the asphalt mix before the temperature of the mix falls below 80°C.

The surface, after final rolling, shall be smooth and true to the established crown and grade.

All defective areas shall immediately be repaired by removing the asphalt concrete and replacing it with the same type of hot mix asphalt concrete used in that particular lift as per the specifications.

The surface shall be free from roller marks or any depressions exceeding 5 mm when measured with a 3 m straight edge held parallel to the centerline. A lower surface tolerance may be accepted with 5 m of iron works at the discretion of the Engineer.

The surface shall have a cross slope of 20 mm/m to 35 mm/m or as specified by the Engineer (in areas of normal crown).

.1 Compaction Requirements

The minimum density acceptable shall be 92.0% of the theoretical maximum density determined according to ASTM D 3203. The percent compaction shall be determined by comparing the core densities with the average theoretical maximum relative density determined from the recovered

field samples from each day's production of any given mix designation.

A bonus will be paid if the average density of all cores is above 92.0% with no individual cores below 91.0%. If any core results fall below 88.5% the Contractor shall either repair, remove and replace or recap the deficient sections at the Contractor's expense subject to the approval of the Engineer, or the Contractor shall be penalized by HRM as outlined in Table 10.1. No bonus will be applied if thickness penalty applies.

Core compaction results shall be based on 1 core sample per 1,500 m², with a minimum of 5 core samples per project or area of consideration. Connecting streets shall be considered as one project, with a minimum of 2 cores per street.

At the discretion of the Engineer rejected asphalt concrete can remain in place without payment to the contractor.

Table 10.1 - Compaction Unit Price Adjustments (per metric tonne) ⁽¹⁵⁾⁽¹⁶⁾				
Average Compaction of Cores less than 92.0% of MTD	Percentage of Cores ≥ 92.0% MTD			
	60.0 - 79.9	40.0 - 59.9	20.0 - 39.9	0.0 - 19.9
91.9	-\$0.96	-\$1.92	-\$2.88	-\$3.84
91.8	-\$1.08	-\$2.16	-\$3.24	-\$4.32
91.7	-\$1.20	-\$2.40	-\$3.60	-\$4.80
91.6	-\$1.32	-\$2.64	-\$3.96	-\$5.28
91.5	-\$1.44	-\$2.88	-\$4.32	-\$5.76
91.4	-\$1.56	-\$3.12	-\$4.68	-\$6.24
91.3	-\$1.68	-\$3.36	-\$5.04	-\$6.72
91.2	-\$1.80	-\$3.60	-\$5.40	-\$7.20
91.1	-\$1.92	-\$3.84	-\$5.76	-\$7.68
91.0	-\$2.04	-\$4.08	-\$6.12	-\$8.16
90.9	-\$2.16	-\$4.32	-\$6.48	-\$8.64
90.8	-\$2.28	-\$4.56	-\$6.84	-\$9.12
90.7	-\$2.40	-\$4.80	-\$7.20	-\$9.60
90.6	-\$2.52	-\$5.04	-\$7.56	-\$10.08
90.5	-\$2.64	-\$5.28	-\$7.92	-\$10.56
90.4	-\$2.76	-\$5.52	-\$8.28	-\$11.04
90.3	-\$2.88	-\$5.76	-\$8.64	-\$11.52
90.2	-\$3.00	-\$6.00	-\$9.00	-\$12.00
90.1	-\$3.20	-\$6.40	-\$9.60	-\$12.80
90.0	-\$3.40	-\$6.80	-\$10.20	-\$13.60
89.9	-\$3.60	-\$7.20	-\$10.80	-\$14.40
89.8	-\$3.80	-\$7.60	-\$11.40	-\$15.20
89.7	-\$4.00	-\$8.00	-\$12.00	-\$16.00
89.6	-\$4.20	-\$8.40	-\$12.60	-\$16.80
89.5	-\$4.40	-\$8.80	-\$13.20	-\$17.60
89.4	-\$4.60	-\$9.20	-\$13.80	-\$18.40
89.3	-\$4.80	-\$9.60	-\$14.40	-\$19.20
89.2	-\$5.00	-\$10.00	-\$15.00	-\$20.00
89.1	-\$5.30	-\$10.60	-\$15.90	-\$21.20

89.0	-\$5.60	-\$11.20	-\$16.80	-\$22.40
88.9	-\$5.90	-\$11.80	-\$17.70	-\$23.60
88.8	-\$6.20	-\$12.40	-\$18.60	-\$24.80
88.7	-\$6.50	-\$13.00	-\$19.50	-\$26.00
88.6	-\$6.80	-\$13.60	-\$20.40	-\$27.20
88.5	-\$7.10	-\$14.20	-\$21.30	-\$28.40
<88.5	Rejected*	Rejected*	Rejected*	Rejected*

* The engineer reserves the right to reject the work or assess double the maximum penalty outlined in the table above.

⁽¹⁵⁾ \$1.20 per metric tonne bonus will be extended should the average of all cores in the project area of consideration meet or exceed 92.0% with no individual core below 91.0%.

⁽¹⁶⁾ Additional cores will be taken by HRM to delineate poorly compacted area(s) to be removed, irrespective to percentage of cores applicable.

.2 Analysis of Rejected Asphalt Concrete Mix

The Contractor is responsible for any Asphalt Concrete Mixture with low compaction deemed 'rejected' by Table 10.1. The Engineer will sample additional cores to delineate location(s) with low density. The delineated area determined by all the core results will dictate where asphalt concrete mix is to be milled and replaced with the equivalent mix type. Replacement mixtures will be subject to testing.

.3 Dispute Resolution

Should core compaction results obtained on a project result in a unit price adjustment that is considered unfavourable by the Contractor, the Contractor may request a review of the project data. This request must be sent to HRM's Construction Supervisor in writing within five business days of receipt of the test results from the Engineer's testing agency. Following this request, the Engineer will review the 'Asphalt Concrete Pavement Inspection Checklist(s)' completed for the day(s) of HMA placement in which the core samples were retrieved.

Should the inspection checklist detail satisfactory paving practices to achieve compaction, additional core samples will be recovered by the Engineer's representative within one metre of the original sample location in question and tested at HRM's designated laboratory. The original compaction result will be discarded from the data set and replaced with the new result determined during the appeal testing.

Should the inspection checklist detail paving practices determined by the Engineer to be unsatisfactory, no appeal of results will be permitted, and the negative unit price adjustment will stand.

The use of a full rubber tire pneumatic roller during pavement laydown is considered best practice and required for consideration of compaction appeal.

.4 Appeal Testing Process

The Engineer will coordinate the additional testing with their testing agency and the Contractor. The Contractor may have a representative present during the time of the appeal sampling and testing to verify the accuracy of the test method. Should the Contractor's representative take issue with the test procedures utilized in the appeal testing, they must provide the issue in writing prior to leaving the QA testing laboratory. Any concerns identified will be reviewed by the Engineer to determine the appropriate action. Concerns identified in writing or otherwise by the Contractor after leaving the QA laboratory will not be considered by the Engineer.

.5 Cost of Appeal Testing

Should the thickness price adjustment remain the same or increase, based on the new results, the Contractor will be responsible for the new price adjustment plus the cost of the additional sampling and testing. Should the price adjustment be eliminated or reduced based on the new results, the cost of the sampling and testing will be borne by HRM.

5.6 Joints

Joints shall be constructed in a careful and workmanlike manner by experienced and competent personnel. Joints shall be smooth, well-bonded and tightly sealed.

.1 Transverse Joints

Transverse joints shall be formed by butt joints. When forming butt joints, the edge of the previously placed asphalt concrete shall be cut back to its full depth so as to expose a fresh surface after which it shall be coated with tack coat or heated before fresh asphalt concrete is placed in contact with it. Heat shall be applied to the joint using a method approved by The Engineer, with care taken not to overheat the existing asphalt concrete. The freshly placed asphalt concrete shall be raked to the proper depth and grade and then the transverse joints shall be rolled transversely (perpendicular to the travel lanes) and the compacted joint

shall be inspected with a 3 m straightedge. If there is more than a 6 mm depression, the joint shall be reconstructed.

Should any separation of the construction joint be present on or before 2 years after 100 percent completion of the project section, the Contractor will be required to undertake the following corrective action at their own cost prior to the end of the current construction year:

Table 11 - Joint Rehabilitation under Warranty Period	
Gap in Construction Joint	Required Corrective Action
3 - 20 mm	The affected joint must be cleaned, hot-air lanced, and filled with appropriate sealant
> 20 mm	Milled, tacked and replaced with equivalent HMA at a minimum width of 300 mm

.2 Keyed Joints

When overlaying existing asphalt concrete pavement, keyed joints shall be constructed at both ends of the Project repaved area, at all intersecting roads, ramps, and at all bridge decks in the repaved area, to avoid a feather joint. Keys will only be required between the final lift of pavement and the existing pavement, unless otherwise directed by the Engineer.

The existing asphalt concrete pavement shall be removed to expose a vertical surface of a depth equal to the thickness of the final lift against which new asphalt concrete may be placed. The minimum slope measured parallel to the centerline of the milled area shall be 200 horizontal to 1 vertical (200H:1V). The angle that the joint makes with the centerline shall not exceed forty-five degrees (45°) or as otherwise directed by the Engineer.

When existing pavement has been removed in advance of paving the joint area, the Contractor shall construct a smooth asphalt taper at the joint area to a slope of at least 20 horizontal to 1 vertical (20H:1V). The taper may be placed on tar paper and shall be removed just prior to paving the keyed area or as directed by the Engineer. The transverse joint shall be straight and have a vertical face when the taper is removed.

The associated cost of providing all keys shall be included in the price per tonne of asphalt concrete.

The paver shall not move more than 20 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 immediately corrected before the paver may proceed.

.3 Longitudinal Joints

Longitudinal Joints with temperatures less than 60°C must be tacked prior to placement of the successive mat. Adjacent mats must be completed to provide for exposed joint edges of maximum length of 100 m at the end of each day. When paving is conducted on multi-lane roads, the maximum length of permissible edge mat at the end of each day will be increased should the Engineer deem it safe to do so. The Contractor will not be permitted to leave exposed joints longer than 24 hours should conditions permit paving the following working day. Multi-lane roads are defined as roads with widths requiring more than two mat widths to traverse the full width of pavement.

Where practical, pavers may be used in echelon to lay full-width pavement sections, when traffic can be diverted and when production of the mixture can be maintained. Echelon paving may require a road closure permit if traffic cannot be maintained. The pavers shall follow one behind the other close enough that cooling of the longitudinal joints between the mats is minimized and in no case is less than 125°C. Adjacent mats must be completed to provide for exposed joint edges of maximum length of 100 m at the end of each day.

Should any separation of the construction joint be present on or before 2 years after 100 percent completion of the project section, the Contractor will be required to undertake the following corrective action at their own cost prior to the end of the current construction year:

Table 12 - Joint Rehabilitation under Warranty Period	
Gap in Construction Joint	Required Corrective Action
3 - 20 mm	The affected joint must be cleaned, hot-air lanced, and filled with appropriate sealant
> 20 mm	Milled, tacked and replaced with equivalent HMA at a minimum width of 300 mm

PART 6 - QUALITY CONTROL / QUALITY ASSURANCE6.1 General

All workmanship and all materials supplied under this specification are subject to close and systematic inspection by the Engineer. The Engineer shall be afforded full access both at the Site and any production plant to determine whether the material being supplied is in accordance with this specification.

All materials supplied under this specification shall be subject to testing and approval by the Engineer.

6.2 Quality of Asphaltic Concrete Paving Mixture

The Engineer shall obtain samples of the asphaltic concrete paving material and of the constituent materials (aggregates and PGAB) for quality assurance testing purposes.

The frequency and number of quality assurance tests shall be determined by the Engineer.

The physical properties of the asphaltic concrete mixture and constituent materials must meet the requirements listed in section 3.0 of this specification.

6.3 Quality of Asphaltic Concrete Compacted Pavement

Pavement core specimens shall be taken from each compacted pavement course by the Engineer. Holes left as a result of sample removal must be filled with hot mix asphalt and thoroughly compacted by the Engineer.

The thickness and percent compaction of the as-placed asphaltic concrete mix must meet the requirements listed in Section 3.0, 4.0 & 5.0 of this specification.

Core specimens shall not be sampled within 600 mm of longitudinal joints and edge of pavements, 10 m from transverse joints, or 1.5 m from ironworks. HRM reserves the right to request cores on patching and reinstatement for hardware adjustments and curb placement. Cores with compaction results below 88.5% will be removed and replaced by the Contractor at no additional cost to the Owner.

PART 7 - PRICE ESCALATION / DE-ESCALATION - PERFORMANCE GRADED ASPHALT BINDER (PGAB)

The Contractor may be assessed a price increase or decrease for asphalt concrete mix placed under this contract (not including off road asphalt work if the tonnage is less than 200 tonne), if the Monthly Asphalt Binder Rack Price (MABRP) for the PGAB specified differs by more than \$10.00 per tonne of PGAB, from the month prior to the month in which this tender closes and the month(s) in which the asphaltic concrete placement is performed. The MABRP will be the weighted average posted rack price established for the month, based on the rack prices provided by each approved supplier. This information can be reviewed on the Nova Scotia Department of Transportation & Infrastructure Renewal website at the end of each month: www.gov.ns.ca/tran.

Participation in the price escalation / de-escalation program for performance graded asphalt binder (PGAB) used in asphaltic concrete mix is mandatory.

HRM's assessment of a price increase/decrease will be based on the difference between the posted weighted average MABRP for the month prior to the month in which the tender closes, and the weighted average MABRP for the month(s) in which the asphaltic concrete placement is performed.

Price differentials will only be applied for MABRP differences of \$10.00 or more per tonne of PGAB. Corresponding amounts will be calculated based on the number of tonnes of asphalt concrete mix placed and accepted by the Engineer multiplied by \$0.50 per tonne of hot mix for each full \$10.00 incremental difference in the posted MABRP.

Where the contract unit rate for asphaltic concrete is by the square metre, conversion to tonnes shall be calculated based on the measured surface area of asphalt placed multiplied by the average thickness determined from the cores multiplied by 2.3 tonnes per cubic metre.

Price adjustments due to the Contractor or amounts owing to HRM will be paid/recovered when all the asphaltic concrete placement is completed.

Asphaltic concrete associated with vertical deflections including, but not limited to speed humps and tables, will not be included or considered for escalation/de-escalation.

All efforts shall be taken to complete the work in a timely manner and price adjustments will not be applied for any time periods where liquidated damages are being charged.

Examples of price adjustment calculations follow:

Example #1

1. Project tender closed June 5
2. Paving work carried out in June and July (total of 5,000 tonnes of hot mix)
3. 3,000 tonnes of hot mix placed in June and 2,000 tonnes placed in July
4. MABRP for PG 58-28 posted for month of May is \$598.71
5. MABRP for PG 58-28 posted for month of June is \$593.33
6. MABRP for PG 58-28 posted for month of July is \$741.93

Weighted average price (for months in which mix was placed)
 $(3,000 \times \$593.33) + (2,000 \times \$741.93) / 5,000 = \$652.77$

Price Differential = $\$652.77 - \$598.71 = \$54.06$ or 5 full increments of \$10.00

Amount Owing to the Contractor = 5,000 tonnes x (5 x \$0.50) = \$12,500.00

Example #2

1. Project tender closed May 8
2. Paving work carried out in June and July (total of 5,000 tonnes of hot mix)
3. 3,000 tonnes of hot mix placed in June and 2,000 tonnes placed in July.
4. MABRP for PG 58-28 posted for month of April is \$500.00
5. MABRP for PG 58-28 posted for month of May is \$500.00
6. MABRP for PG 58-28 posted for month of June is \$493.33
7. MABRP for PG 58-28 posted for month of July is \$475.00

Weighted average price (for months in which mix was placed)
 $(3,000 \times \$493.33) + (2,000 \times \$475.00) / 5,000 = \$486.00$

Price Differential = $\$486.00 - \$500.00 = -\$14.00$ or 1 full increment of \$10.00

Amount Recovered from the Contractor = 5,000 tonnes x (1 x \$0.50) = \$2,500.00

PART 8 - WARM MIX ASPHALT

8.1 General

The following Warm Mix Asphalt products are approved for use on HRM projects:

- Evotherm 3G
- Sonne Warmmix
- Evotherm DAT
- Cecabase RT
- Advera
- ALmix Foaming Systems
- Gencor Ultraform GX
- Meeker Foaming Systems
- Astec Double Barrel Green Foaming
- Zycotherm

The contractor shall submit a WMA mix design to HRM for review a minimum of 14 days prior to use. The contractor shall inform HRM of when WMA is used on HRM projects. The WMA must meet the Marshall mix properties outlined in S1 and shall provide the manufactures recommended compaction temperatures for Marshall air void analysis.

HRM shall be notified of every project containing WMA prior to paving.

In no case shall the temperature of the Warm Mix Asphalt exceed 165°C. Warm Mix Asphalt shall have temperatures of at least 105°C immediately prior to loading into the spreader hopper.

PART 9 – WARRANTY

9.1 General

The 2-year warranty shall begin upon substantial completion of the project. During this period any failure to the asphaltic concrete including but not limited to segregation, cracking, surface deformation, spalling, delamination, debonding, and joint failure shall be repaired and/or reconstructed at the contractor's expense to the satisfaction of the Engineer. The cost of materials, hauling, labour and all other related work including traffic control required for repair and/or reconstruction of unacceptable areas shall be borne by the contractor.

Regarding lane width requirements for remediation, the minimum repair shall include replacement of the riding (surface) lift of asphaltic concrete to be removed by cold planing to the center joint. If echelon paving was specified or used the repair patch shall be measured to the centerline of the roadway. If the failure is beyond the centerline, then both lanes shall receive the same treatment. If the failure continues below the riding (surface) lift of asphaltic concrete, then both lifts shall be removed and reconstructed as necessary.

****** END OF SECTION S-1 ******