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PART 1 – GENERAL

1.1 Work Included

This specification covers the supply and transportation of various grades of Performance Graded Asphalt Binder (PGAB) to the Contractor's plant for use in the manufacture of hot mix asphaltic concrete.

PGAB shall be comprised of asphaltic-based cement that is produced from petroleum residue either with or without the addition of non-particulate organic modifiers.

Quality Control (QC) and Quality Assurance (QA) procedures are described herein. The Contractor shall be responsible to submit the QC test results and to ensure that all materials meet specification.

Initial acceptance of PGAB shall be based on samples taken and tested by the supplier's designated laboratory, subject to the conditions detailed in this specification.

To determine final acceptance of the product, the Engineer will conduct QA testing to confirm test results supplied by the Contractor. QA testing will be conducted on a random basis from samples recovered from the Contractor's asphalt storage tank(s) located at the hot mix plant.

1.2 Related Sections

.1 Specification for Hot-Mix Asphalt Section S1

1.3 Reference Standards

.1 AASHTO M 320, Standard Specification for Performance Graded Asphalt Binder
.2 ASTM D 140, Standard Practice for Sampling Asphalt Materials
.3 ASTM D 4402, Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer

PART 2 - SUBMISSIONS AND DESIGN REQUIREMENTS

2.1 Contracts Completed in Calendar Year

In the event that the Contractor wishes to change the source of supply during the progress of the contract, the Contractor shall apply for approval, in writing, to the Halifax Regional Municipality (HRM). Approval in writing must be given by HRM before the source of supply is changed.

Asphalt escalation/de-escalation shall be as per S-1 - Specification for Hot Mix Asphalt Concrete.

PART 3 - MATERIALS

3.1 Physical Requirements The PGAB as outlined in Table 2 shall conform (**with or without liquid anti-stripping additive**, or other approved additives) to the requirements of AASHTO M 320; Standard Specification for Performance Graded Asphalt Binder.

3.2 General Requirements The PGAB shall be homogeneous, free of water and any contamination and shall not foam when heated to the temperatures specified by the manufacturer for the safe handling and use of the product.

Recycled engine oil binders (REOB) are not accepted in any PGAB to be used on HRM streets and roads. All suppliers of PGAB shall provide the Engineer with certification that the PGAB supplied does not contain REOBs

PART 4 - CONSTRUCTION METHODS

4.1 Tankers, Storage Tanks Tankers used to transport PGAB and PGAB storage tanks located at asphalt concrete mixing plants shall meet the following requirements:

- Be free from hydrocarbon fuels or solvents, such as gasoline, diesel, varsol, etc.;
- Have a sampling spigot as outlined in ASTM D 140; and
- Be equipped with thermometers, accurate and capable of reading to the nearest 2°C.

PART 5 - QUALITY CONTROL / QUALITY ASSURANCE

5.1 PGAB Documentation For each grade of PGAB specified in the Contract, the Contractor shall supply a copy of current test data to the Engineer prior to the use of the product(s). The PGAB shall have been graded by conducting the required testing specified in AASHTO Designation M 320 (Standard Specification for Performance Graded Asphalt Binder)

5.2 Laboratory Testing Qualifications The laboratory conducting the QC testing shall have participated in the most recent AASHTO proficiency sample correlation program for PGAB, and shall have obtained proficiency ratings in the program satisfactory to the Engineer. Alternatively, the laboratory shall have satisfactorily participated in any equivalent correlation program acceptable to the

Engineer. Documentation of the laboratory's participation and proficiency shall be provided to the Engineer upon request.

5.3 Anti-Stripping Additive

When a liquid anti-stripping agent is to be incorporated into the mix, samples of PGAB for QC or QA are to be taken after the anti-stripping agent has been added to the PGAB.

5.4 Samples for Testing

All QA samples shall be a minimum size of one litre and shall be taken from the Contractor's storage tank in accordance with ASTM D 140. Sampling will be conducted by the contractor and witnessed by the Engineer. An additional set-aside sample shall be taken by the Contractor in the event an appeal test is required. PGAB sampling will be based on a random basis with sample time supplied by the Engineer.

The Engineer will verify the sampling, package and transport all samples (including set-aside samples) for QA testing.

5.5 Quality Control Plan

The contractor shall provide a QC Plan to the Engineer detailing the quality control activities related to the use of PGAB. The Supplier's QC Plan may be used for this purpose, provided that specific storage/handling details, etc. are furnished by the Contractor. The QC Plan shall be submitted at least seven (7) days prior to the start of the construction season. Hot mix production shall not commence until the QC Plan is accepted by the Engineer.

As a minimum, the QC Plan shall provide the following information:

- The type of facility from which the product(s) will be supplied (refinery, terminal) and its location.
- The method and frequency for initial testing, specification compliance testing and any other testing employed to either guide the manufacturing process of the PGAB or to ensure the on-going compliance of the product(s) to Table 2.
- If specification compliance testing is carried out prior to shipping the product(s) from the Supplier's facility to the hot mix plant, the QC Plan shall provide an outline of the procedures to be followed for checking transport vehicles before loading to prevent contamination of shipments.
- The QC Plan shall provide an outline of procedures detailing how anti-strip additive products and dosage rates will be identified on shipping documentation. Tests employed to ensure compliance of the product(s)

to Table 2 after anti-strip additives are incorporated in the product(s) shall be identified.

- The QC Plan shall detail the methods to be used to identify and provide for the exclusion of materials which do not conform to specifications, prior to incorporating into the hot mix. The QC Plan shall also detail how such materials will be identified and dealt with in the event that they are inadvertently incorporated into the hot mix. The QC Plan shall detail how such occurrences will be documented, and the methods of disposition of such materials.

5.6 Basis of Initial Acceptance

Initial acceptance of PGAB will be based on QC test results submitted to the Contractor, subject to the conditions specified herein. The Contractor shall be responsible to submit the Supplier's QC test result data and to ensure that all materials meet specification. The supplied product shall meet the requirements of AASHTO Designation M 320 (Standard Specification for Performance Graded Asphalt Binder) for the specified performance grade.

For initial acceptance purposes, a minimum of one complete compliance verification test shall be performed for each Supplier batch of PGAB.

.1 Lot Sizes

Lot sizes for the recovery and testing of PGAB shall be based on the total tender quantity of asphalt concrete hot mix for each grade of PGAB specified in the tender. A Lot shall be determined when the source of the PGAB is changed.

.2 Quality Assurance

QA testing will be carried out by the Engineer for the purposes of ensuring that the materials used in the work conform to the quality requirements of Table 2.

One PGAB sample shall be recovered from the plant site for every 5 000 tonnes of mix placed for HRM, with a minimum of one sample per year from each plant providing HMA to HRM. Additional samples may be taken by the Engineer at any time for QA conformance testing. All samples shall be appropriately labeled (date, time, contract, PGAB type, anti-stripping agent type/dosage) and delivered to the Engineer within 48 hours of sampling.

If a QA test result for any sample indicates non-compliance with the specification, the Engineer will advise the Contractor of the test result and may conduct a performance-graded classification to determine the actual grade of the PG binder. The additional testing will determine the actual performance high and low temperatures of the sample, rounded to the nearest 0.5 degrees Celsius.

Test results for sub-lots which do not comply with the performance grading requirements shall be categorized based on individual deviations from the design maximum or minimum temperature defined below. Price adjustments, where applicable, will be expressed as a percentage of the Contractor's unit bid price for the hot mix within the given sub-lot.

Table 1 - Price Adjustment

Temperature Deviation	Price Adjustment (% of Mix Price)
$\leq 3^{\circ}\text{C}$	10 %
$> 3 \ \& \ \leq 6^{\circ}\text{C}$	20 %

.3 Disposition of Reduced / Rejected Lots

The Engineer will review the test results and determine the disposition of the mix using any PGAB product which does not conform to Table 2. Hot mix constructed using PGAB for which test results indicate that the product did not conform to specification will be dealt with as follows:

Price Reductions: As per the above table

Rejection: The Engineer reserves the right to reject all asphalt concrete mix produced with PGAB sub-lot temperature deviations exceeding 6°C from the specified minimum and maximum temperature range. Rejected sub-lots shall be removed and replaced at the Contractor's expense.

The full thickness of the appropriate lift of pavement shall be removed by cold milling. The asphalt concrete mix used to replace the rejected pavement shall meet the same requirements as those originally specified. Repair areas will be retested for acceptance with the cost of retesting to be borne by the Contractor.

5.7 Appeal Testing

The Contractor shall serve notice of appeal to the Engineer, in writing, within 48 hours of receipt of the QA test results. Appeal re-testing may be carried out on set-aside samples only if the cost of the impact of non-compliance, as determined by the Engineer, exceeds the cost of retesting.

The Contractor may have a representative present during testing at HRM's QA facility. During the period of testing, the Contractor's representative shall comment on anything concerning the testing which they do not consider to be valid, and the Engineer shall respond to all comments in order to resolve them.

The appeal testing will determine the actual performance high and low temperatures, rounded to the nearest 0.5 degrees Celsius, of the PGAB, and the outcome is binding on HRM and the Contractor.

The cost of the appeal testing, including sample delivery, shall be borne by the Contractor unless the testing confirms total conformance of the material sample to contract specifications, in which case the cost will be borne by HRM.

Table 2 – Performance Graded Asphalt Binder Specification

Performance Grade	PG-52							PG-58					PG-64					
	-10	-16	-22	-28	-34	-40	-46	-16	-22	-28	-34	-40	-10	-16	-22	-28	-34	-40
Average 7-day Maximum Pavement Design Temperature, °C ⁽¹⁾	<52							<58					<64					
Minimum Pavement Design Temperature, °C	>10	>16	>22	>28	>34	>40	>46	>16	>22	>28	>34	>40	>10	>16	>22	>28	>34	>40
Original Binder																		
Flash Point Temp., T48: Minimum °C ⁽¹⁾	230																	
Viscosity, ASTM D 4402: ⁽²⁾ Maximum, 3 Pa.s (3000cP), Test Temp., °C	135																	
Dynamic Shear, TP5 ⁽³⁾ G* $\sin\delta$ ⁽⁷⁾ , Minimum, 1.00 kPa Test temperature @ 10 rad/s, °C	52							58					64					
Rolling Thin Film Oven (T 240) or Thin Film Oven (T 179) Residue																		
Mass Loss, Maximum %	1.00																	
Dynamic shear, TP5: G*/ $\sin\delta$ ⁽⁷⁾ , Minimum, 2.20 kPa Test Temperature @ 10 rad/s, °C	52							58					64					
Pressure Aging Vessel Residue (PPI)																		
PAV Aging Temperature, °C ⁽⁴⁾	90							100					100					
Dynamic shear, TP5: G* $\sin\delta$ ⁽⁷⁾ , Maximum, 5000 kPa Test Temperature @ 10 rad/s, °C	25	22	19	16	13	10	7	25	22	19	16	13	31	28	25	22	19	16
Physical Hardening⁽⁵⁾																		
Report																		
Creep Stiffness, TP1 ⁽⁶⁾ S, Maximum, 300 Mpa m-value, Minimum, 0.300 Test Temp., @ 1.0 mm/min, °C	0	-6	-12	-18	-24	-30	-36	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30
Direct Tension, TP3: ⁽⁶⁾ Failure strain, Minimum, 1.0% Test Temp. @ 1.0 mm/min, °C	0	-6	-12	-18	-24	-30	-36	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30

- (1) Pavement temperatures are estimated from air temperatures using an algorithm contained in the LTPP Bind program and may be provided by the specifying agency, or by following the procedures as outlined in MP2 and PP28.
- (2) This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.
- (3) For quality control of unmodified PGAB production, measurement of the viscosity of the original PGAB may be used to supplement dynamic shear measurements of G*/ $\sin\delta$ at test temperatures where the asphalt is a Newtonian fluid.
- (4) The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures: 90°C, 100°C, or 110°C. The PAV aging temperature is 100°C for PG58- and above, except in desert climates, where it is 110°C.
- (5) Physical Hardening - TP1 is performed on a set of asphalt beams according to Section 13.1, except that the conditioning time is extended to 24 hrs ± 10 minutes at 10°C above the minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes only.
- (6) If the creep stiffness is below 300 MPa, the direct tension test is not required. If the creep stiffness is between 300 and 600 Mpa, the direct tension failure strain requirement can be used in lieu of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.
- (7) G*/ $\sin\delta$ = high temperature stiffness, and G* $\sin\delta$ = intermediate temperature stiffness.