1.0 GENERAL

1.1 Scope

1.1.1 The asphaltic concrete shall consist of a homogeneous mixture of mineral aggregate, filler and asphaltic binder, combined in accordance with these Specifications.

1.1.2 Where a standard, specification or test method is referenced in this specification, the current version shall apply.

1.2 Related Sections

1.2.1 Section 2550 – Placement of Asphalt Pavement

2.0 PRODUCTS

2.1 Aggregate

2.1.1 Shall consist of hard, durable, uniformly graded, crushed gravel or steel slag and shall not contain organic or soft materials nor materials that break down when alternately frozen and thawed or wetted and dried, nor other deleterious materials.

2.1.2 The proposed aggregate gradations are shown in the following table. Suppliers may propose alternate aggregate gradations provided the mix properties meet the requirements indicated in Clause 2.5 and Clause 2.6. Any deviations in the aggregates must be approved by the Engineer.

2.1.3 The fine and coarse graded mixes for are shown in the Table 2.1:

Table 2.1 - Blended Aggregate Gradation Control Points

	* Nominal Maximum Aggregate Size Percent Passing							
Sieve size (mm)	Special Mixes for New Pavements with Asphalt Layer ≥ 200mm thick				Standard Mixes			
	25 mm		20 mm		12.5 mm		10 mm	
	Coarse Graded	Fine Graded	Coarse Graded	Fine Graded	Coarse Graded	Fine Graded	Coarse Graded	Fine Graded
37.5	100	100						
25	90-100	90-100	100	100				
20	90 Max	90 Max	90-100	90-100	100	100		
12.5			90 Max	90 Max	90-100	90-100	100	100
10					90 Max	90 Max	90-100	90-100
5	21-39	41-50	23-47	49-60			90 Max	90 Max
2	18-26	28-43	20-31	33-47	26-35	37-56	29-43	45-64
0.08	1-7	1-7	2-7	2-8	3-7	3-8	3-7	3-8

* *Nominal Maximum Aggregate Size (NMAS) is one size larger than the sieve retaining more than 10% of material.*

2.1.4 Unless otherwise specified or directed by the Engineer, only 10 mm and 12.5 mm NMAS aggregate shall be used. If the size and type of the aggregate is not specified, either 10 mm or 12.5 mm may be used, and the type of aggregate shall be as per the following table:

Table 2.2 – Aggregate Type

Road Class	Lift	Fine Mix	Coarse Mix
Locals, Collectors, Bus Routes outside Core Area	Top	X	
	Bottom	X	X
Arterials, Industrials & Bus Routes in Core Area	Top	X	X
	Bottom		X

2.1.5 The recommended lift thickness for nominal maximum aggregate size and mix type shall be in accordance with the following table:

Table 2.3 – Recommended Lift Thickness Range

Mix Type	NMAS (mm)	Mix Type	Recommended Lift Thickness Range (mm)		
			Base	Intermediate	Surface
Standard Mixes	10	Fine	NA	NA	30-40
		Coarse	40-50	NA	40-50
	12.5	Fine	40-50	NA	40-50
		Coarse	50-70	NA	50-70
Special Mixes for New Pavements with Asphalt Layer ≥ 200mm thick	20	Fine	60-80	60-80	60-80
		Coarse	80-100	80-100	80-100
	25	Fine	75-100	75-100	NA
		Coarse	100-125	NA	NA

Note to Specifiers: *NMAS 20 mm and 25 mm aggregates are not typically produced therefore asphalt suppliers may require additional lead time to source and produce these aggregates. Confirm availability with local suppliers before specifying NMAS 20 mm or 25 mm aggregates.*

2.1.6 The minimum sand equivalent value shall be 45 when tested in accordance with ASTM D2419, Test Method for Sand Equivalent Value of Soils and Fine Aggregates.

2.1.7 When tested according to A.S.T.M. D4791 method of testing, the maximum allowable flat and elongated particles, measured using 1:5 pivot, should be 10% & measuring using 1:3 pivot should be 20%. When tested according to A.S.T.M. D6928 (Micro-Deval) the maximum allowable degradation loss should be 20%.

2.1.8 When tested according to A.S.T.M. C 1252 method of testing, the minimum allowable un-compacted material voids content should be 45%. When tested according to A.S.T.M. D7428 (Micro-Deval) the maximum allowable degradation loss should be 25%.

2.1.9 The aggregate must exhibit an affinity for asphalt cement, and meet the Saskatchewan method for Aggregate Stripping Potential, and ASTM D4867. If the material has greater than 25% stripping potential, then a suitable anti-strip agent shall be utilized upon approval by the Engineer. If an anti-strip agent is required it shall be at the Contractor's expense.

2.1.10 When tested according to ASTM D5821, the minimum amount of aggregate having at least two (2) fractured faces shall be 90%.

2.2 Mineral Filler

2.2.1 When the aggregate is deficient in mineral filler, the Contractor shall add in the weigh hopper of the asphalt plant, mineral filler in such quantities as will be required to meet the gradation of aggregate as specified above. Mineral filler shall consist of Portland Cement, pozzolan, commercially ground stone dust, or other mineral dust approved by the Engineer. Mineral filler shall have a plasticity index of zero.

2.3 Asphaltic Binder

2.3.1 The asphaltic binder shall be uniform in character, free of water and shall not foam when heated to 175^{o}C. It shall meet the specifications shown in Table 2.4

2.3.2 All performance graded asphalt binder (PG) should meet specification as per AASHTO MP1 and MP1a.

2.3.3 Recycled mixes may be used upon approval of the Engineer. The mixed binder shall fall within the conditions outlined above.

2.3.4 Unless specified otherwise, the asphalt binder grades shown in Table 2.5 shall be used for each roadway type.

Table 2.4 - Asphalt Binder Specifications

ASTM CHARACTERISTICS	ASTM TEST METHOD	SPECIFICATIONS		
		150-200(A)		
Absolute Viscosity, 60^{o}C, MPa-s	D2171	The viscosity and penetration values must fell within the area bounded by A-B-C-D-A plotted as straight lines on a full logarithmic plot (log-log), with the coordinates of the points as follows:		
Penetration, @ 25^{o}c, 100 g, 5 sec, dmm	D5	Pt.	Abs Visc.	Pen.
		A	155	150
		B	70	150
		C	50	200
		D	92	200
Kinematic Viscosity, 135^{o}C, sq.mm/s	D2170	The viscosity and penetration values must fell within the area bounded by A-B-C-D-A plotted as straight lines on a full logarithmic plot (log-log), with the coordinates of the points as follows:		
Penetration, @ 25^{o}C, 100 g, 5 sec, dmm	D5	Pt.	Abs Visc.	Pen.
		A	155	150
		B	70	150
		C	50	200
		D	92	200
Flash Point (Cleveland Open Cup), ^{o}C	D92	205		
Solubility in Trichlorethelene, % minimum	D2042	99.5		
Test of Residue from Thin Film Oven Test Ratio of Absolute Viscosity of Residue from Thin-Film Oven Test to Original Absolute viscosity, maximum Thin Film Oven Test Weight Loss, max. %	D1754 D2171	4		
Ductility: @ 25 ^{o}C, cm, Minimum		100		

Table 2.5 – Asphalt Binder Grades

Type of Road	Standard Grades	Optional Grades
Local/Residential	AC 150-200 (A) or PG 58-28	PG 58-31 or PG 58-34
Collector/Bus Routes outside Core Area	AC 150-200 (A) or PG 58-28	PG 58-34 or PG 64-28 or PG 64-34
Arterial/Industrial & Bus Routes in Core Area	PG 58-28	PG 58-34 or PG 64-28 or PG 64-34

2.4 Mix Design Procedure

2.4.1 Prior to the commencement of any work, the contractor shall employ a testing laboratory to produce a laboratory mix design and make recommendations concerning blending of mineral aggregates.

The asphalt cement and mineral aggregates shall be uniformly combined in such proportions as to produce a suitable mixture that produces the properties called for in this specification.

No asphalt concrete shall be supplied or placed until the Engineer has received copies of the mix design and has given written approval of its use.

2.4.2 The laboratory mix design is to comply with the requirements for Section 2325 for Supply of Asphaltic Concrete, clauses 2.1, 2.2, 2.3 and 2.4 and follow the Marshall Method of mix design.

2.4.3 The Marshall Method of mix design shall be used in accordance with AASHTO T245, Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus. Marshall specimens shall be compacted with 50 blows for fine mixes and 75 blows for coarse mixes. The mix, for Minimum Marshall Stability, shall conform to the following criteria, unless otherwise specified or directed by the Engineer:

Table 2.6 – Mix Design Parameters

.1	Local Residential	5,700 Newtons
.2	Collector/ Bus Route (Residential)	7,000 Newtons
.3	Arterial/Industrial/ Bus Route (Core)	10,000 Newtons
.4	Minimum Retained Stability	70% of Initial Stability
The retained stability test is to ensure that the asphalt mix has reasonably good durability. One of the Marshall specimens is soaked in a water bath at 60°C for twenty-four hours. A Marshall stability performed on this specimen shall retain a minimum of		

<table>
<tr><td colspan="5">70% of the initial stability.</td></tr>
<tr><td colspan="5">.5 Meet ASTM D4867 upon request of the Engineer.</td></tr>
<tr><td colspan="2" rowspan="2">.6 % Voids of Total Mix</td><td colspan="2">Residential</td><td>3% +/- 1%</td></tr>
<tr><td colspan="2">Collectors, Arterials, Industrials & All Bus Routes</td><td>4% +/- 1%</td></tr>
<tr><td colspan="2" rowspan="5">.7 Minimum V.M.A.</td><td>NMAS (mm)</td><td>VMA for Fine-graded</td><td>VMA for Coarse-graded</td></tr>
<tr><td>10</td><td>15.0</td><td>14.5</td></tr>
<tr><td>12.5</td><td>14.0</td><td>13.5</td></tr>
<tr><td>20</td><td>13.0</td><td>12.5</td></tr>
<tr><td>25</td><td>12.5</td><td>12.0</td></tr>
<tr><td colspan="2">.8 Maximum Flow</td><td colspan="3">5 mm</td></tr>
<tr><td colspan="2">.9 Minimum Flow</td><td colspan="3">2 mm</td></tr>
<tr><td colspan="2" rowspan="2">.10 Minimum Film Thickness
(Film thickness shall be determined in accordance with Saskatchewan Highways and Transportation Standard Test Procedure STP 204-19)</td><td colspan="2">Residential</td><td colspan="2">7.5 µm</td></tr>
<tr><td colspan="2">Collectors, Arterials, Industrials & All Bus Routes</td><td colspan="2">7.0 µm</td></tr>
</table>

2.4.4 Mix design shall also include test results from ASTM D6928 Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus.

2.4.5 Representative samples of all aggregates proposed for use shall be submitted, when requested, to the Engineer sufficiently in advance of the commencement of operations or during operations to permit the Engineer to carrying out Quality Assurance tests.

2.5 Rutting Susceptibility Testing

2.5.1 Rut Resistance testing is required for the following roadway classes only: all arterials, industrial and bus routes in the core area of the City. Locals,

collectors and bus routes in residential areas do not require rut resistance testing. *(Note: Unless otherwise specified, the "Core area" is typically considered to be bounded by College Avenue on the south, Dewdney Avenue on the north, Albert Street on the west and Broad Street on the east).*

2.5.2 The hot-mix shall be subjected to the Asphalt Pavement Analyzer (APA) procedure during the mix design process. APA testing is to be carried out by the Contractor using an independent testing laboratory as part of the Quality Control testing. The APA device must meet the requirements of AASHTO T-340-10 and must be equipped with an automatic rut measurement system. The APA device must be calibrated at least once per year according to the procedures in the test method. In addition, the load cell used for checking wheel loads shall be calibrated at least once per year. Each test shall have 6 cylindrical samples fabricated and tested with the interior temperature of the APA set at 58°C. The downward force shall be set at 45 kg and the hoses shall be pressurized to 689 kPa. Each specimen shall be compacted so that 7.0 ± 0.5 percent air voids are achieved. The APA rut test results shall be provided to the nearest 0.1mm.

2.5.3 Rutting after 8,000 cycles should be no more than 5mm.

2.5.4 The Engineer may obtain samples of asphalt and send for rut susceptibility testing as part of the Quality Assurance testing program during placement.

2.6 Job-Mix Formula

2.7.1 The job-mix formula is the target aggregate gradation and asphalt cement content for plant production.

2.7.2 The Contractor's quality control laboratory will test a trial batch of the proposed job-mix formula to verify the laboratory mix design. If the initial trial batch fails, the Contractor will submit results of further trial batch tests performed by its laboratory until successful results are obtained. The laboratory mix design and proposed job-mix formula will not be approved until successful results are obtained.

2.7.3 The approved job-mix formula shall comply with the requirements of Section 2325 for Supply of Asphaltic Concrete, clauses 2.1, 2.2, 2.3, 2.4 and 2.5.

2.7.4 Hot mix asphalt shall not be supplied until the Engineer gives permission in writing to proceed with a specific job-mix formula. The job-mix formula shall remain in effect until changes are approved in writing by the Engineer. The job mix formula must meet the gradation specifications of section 2.1.2.

2.7.5 The maximum permissible variation in the aggregate gradation of the actual hot mix produced from the job-mix formula shall be as follows:

Table 2.7 – Permissible Variation from Job –Mix Formula

25 mm sieve	± 5%
20 mm sieve	± 5%
16 mm sieve	± 5%
12.5 mm sieve	± 5%
10 mm sieve	± 5%
5 mm sieve	± 5%
2 mm sieve	± 4%
800 µm sieve	± 3%
160 µm sieve	± 2%
80 µm sieve	± 1.5%

2.7.6 The Quality Control and Quality Assurance testing shall be reported according to the job mix formula on all reports. Any changes to the job mix formula shall be reported immediately to the Engineer.

2.7.7 The three point moving average of asphaltic binder in the mix shall not vary by more than zero point three percent (0.3%) from the job-mix formula design.

2.7.8 All of the above mentioned tests, laboratory mix designs and job mix formula confirmations shall be at the expense of the Contractor.

3.0 EXECUTION

3.1 Quality Control

3.1.1 Before commencing hot mix production, the Contractor shall submit to the Engineer a quality control plan. This plan shall include: tests to be performed, by whom, and at what frequency (if not specified in the specifications, contract or by the Engineer). The job mix formula shall be provided and any changes shall be immediately provided to the Engineer.

3.1.2 Contractor shall be responsible for the final product of asphaltic concrete production meeting the requirements of these specifications including the approved job mix formula.

3.1.3 The Contractor shall provide copies of all quality control testing to the Engineer within seven days of placing material.

3.2 Acceptance

3.2.1 The Engineer may reject the asphaltic concrete if it does not meet the specifications, at no additional cost to the Owner.