

DIVISION 4 - ASPHALTIC MATERIALS		
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04000-1 DESCRIPTION

This section specifies requirements for labour, machinery, equipment and material required to rout cracked asphaltic pavement and supply and place hot-poured rubberized asphalt sealant in transverse and longitudinal cracks.

City forces will, at no cost to the Contractor, sweep the debris from the gutter and remove the "No Parking" signs after the street has been opened to traffic.

1.1 Traffic Accommodation

The City shall set up, maintain, and dismantle all detours\lane restrictions on Expressways. The Contractor is required to set up, maintain and dismantle all detours on all other road classes in accordance with City of Saskatoon standards. Details of the detouring along with a list of the streets to be treated are included in Section 01005 Specific Conditions.

04000-2 MATERIALS

2.1 Selection of Materials

The crack sealant shall be a high quality rubberized asphalt sealing compound. This material shall adhere to all bituminous and concrete surfaces and have the flexibility and resiliency to withstand pavement temperatures encountered in Saskatoon.

All products must meet or exceed ASTM Specification D6690. The City has approved Crafc0 Road Saver 522. This is the only crack seal product approved at this time. Other crack sealing products must be evaluated and approved by the City of Saskatoon prior to use.

04000-3 EQUIPMENT

The following list of equipment is required but not limited to complete the work.

(a) Melting Kettle

The rubberized asphalt sealant shall be heated in a portable, rubber tired, double boiler type unit capable of indirect heating of the sealant. The kettle shall be equipped with:

- automatic heat controlling device to control product temperature.
- a horizontally mounted built-in paddle agitator capable of automatic operation to keep the sealant under vigorous continuous movement during heating.
- monitoring thermometers for the sealant temperature and heat transfer oil if present.
- a positive displacement pump to discharge the sealant via a connecting wand such that proper temperatures are maintained.

(b) Pavement Crack Router

A vertical router capable of cutting grooves with vertical sides in asphaltic concrete pavements to specified widths and depths. Routers must be able to achieve consistent and accurate routing depths. The router must be capable of following meandering cracks with routing restricted to the crack without any unnecessary pavement cutting. The router shall be equipped with suitable screens to prevent flying particles that may be hazardous to personnel or may

damage vehicles or property.

(c) **Hot Compressed Air Lance (HCA Lance)**

The HCA Lance shall be capable of providing a combined jet of compressed air and a propane flame capable of clearing, heating, drying and darkening a routed or unrouted crack.

(d) **Crack Filling Devices and Strike-off Tools**

This equipment must be capable of flattening a head of sealant over the prepared crack if it has been overfilled.

04000-4 CONSTRUCTION

4.1 Crack Preparation

All areas to be routed and or cleaned shall be inspected by the Engineer prior to the work starting. Cracks less than 19 mm in width must be routed to a width of 19 mm or greater. Both sides of the crack shall be routed. All cracks routed shall be routed to a minimum depth of 20 mm. Cracks greater than 30 mm shall not be routed or sealed.

Wedged chips or other non-compressible material shall be removed prior to sealing. The routed and non-routed crack must be cleaned and heated using a HCA lance to remove debris, dust and moisture. The hot rubberized asphalt sealant must be placed within 30 seconds of hot lancing. Pavement surfaces adjacent to the cleaned cracks shall be blown and cleared of all debris that might otherwise contaminate the cleaned crack prior to sealing.

4.2 Preparation of the Crack Sealant

During the melting operation, all foreign material shall be prevented from entering the melter. All sealant protection wrapping is to be removed prior to melting the compound if required by the manufacturer. The compound shall be melted slowly with constant agitation. The manufacturer's maximum safe heating temperature and minimum pour temperatures shall be adhered to at all times. The Engineer may allow temperature lower than the minimum pour temperature when the ambient temperature is high or on steep gradients where the sealant might otherwise flow after placement. The maximum crack seal batch size shall be as much crack filling sealant as can be placed in a given day, or 400 litres, whichever is less.

Reheating unused sealant shall not be permitted. All overheated, diluted or contaminated material shall be removed from the site and disposed of at the Contractor's expense.

4.3 Crack Sealing

At the time of crack filling the ambient temperature shall be a minimum of 5° C and rising. All areas of crack to be sealed shall be inspected by the Engineer prior to placement of the sealant. Crack sealing shall not be performed on alligator cracking or block cracking or cracks wider than 30 mm.

Care is to be taken when filling routed or cleaned cracks. The tip of the wand shall be placed at the bottom of the routed crack or as far into the unrouted crack as possible to ensure uniform application and that no sealant bridges entrapped air pockets. A second application of sealant may be required where excess subsidence occurs. Sealant should be placed so as to fill the route or crack such that both edges of the route or crack are covered.

After placement of the sealant, excess material should be struck off with a strike-off device to leave a flush surface over the crack as shown in Figure 1. The methods of application must be approved by the Engineer in the field prior to commencement of the work.

Where pedestrian or vehicular traffic may cause tracking of the sealant (crosswalks or intersections), the sealed cracks shall be dusted with silica sand or cement powder. Supply and placement of this material shall be a subsidiary obligation of the Contractor and as such there will be no direct payment.

The Contractor shall ensure traffic is not allowed on the newly sealed surface for a period of 1 hour from completion of the crack sealing in order to prevent tracking.

Damage such as embedded stones, excessive debris or moisture in the sealant or obvious contamination shall be rejected. The defective work shall be repaired, removed, replaced or remedied at the Contractor's cost.

All debris from the cleaning and routing operation shall be swept or blown from the surface of the roadway into the gutter for removal by City Forces. All refuse such as wrappings, containers or any other debris resulting from this operation shall be gathered and removed from the site on a daily basis by the Contractor.

The sealed cracks shall be guaranteed for a period of two years from the date of completion of the sealing operation. If, during the warranty period, the sealant pops out or there is obvious evidence of water or material ingress through the crack, the sealant shall be removed, the crack cleaned and resealed.

4.4 Concrete Roadway and Sidewalk Joint Sealing

Only the deep tooled longitudinal joint located at the top of the rolled curb section of the sidewalk is intended to be sealed. Weeds shall be removed from this joint prior to sealing by handpicking or by use of such tools as a rotary edger. The joint shall then be thoroughly cleaned of debris and remaining organic material by hydro blasting or sand blasting. Any other cleaning method requires the Engineer's approval.

The concrete faces on either side of the joint shall be dried with compressed air prior to sealing with hot rubberized sealant. Prior to leaving the worksite, the Contractor shall sweep up from both the sidewalk and the gutter all loose debris left as a result of cleaning and shall properly dispose of this debris off-site.

The Contractor shall fill these longitudinal joints with rubberized sealant to a minimum depth of 20 mm measured from the top of the concrete surface. To ensure proper shape factor and to mitigate waste of the sealant product the Contractor shall employ one of the following methods:

- i) Insert heat resistant backer rod in the prepared joint. The depth of the backer rod will be set to accommodate the minimum required depth of Hot Rubberized Sealant.
- ii) Fill the void at the bottom of the prepared joint with fine dry sand. The depth of the sand filler will be set to accommodate the minimum required depth of Hot Rubberized Sealant. After the sand filler has been placed, the exposed sides of the joint between the top of the sand and the top of the concrete shall be wire brushed clean of any sand particles.
- iii) If the Contractor deems the width of the prepared joint to be sufficiently narrow, he may apply full depth sealant. There will be no additional payment for the extra Sealant used.

Transverse joints at 1.5 metre typical spacing extend from back of sidewalk to lip of gutter. The Contractor shall place temporary filler in the transverse joints on both sides of the longitudinal joint. The purpose of this temporary filler is to prevent spillage of hot sealant from the longitudinal joint. This temporary filler shall match the colour of the hot sealant if it is to be left in place to disintegrate over time or shall be removed after the sealant has set up, with the method of removal such that no holes are left in the sealant afterwards. The Contractor's temporary filler method must be approved by the Engineer prior to the start of the sidewalk crack sealing.

Any spillage of sealant on the surface of the concrete sidewalk or curb shall be cleaned up immediately by the Contractor.

For aesthetic reasons, the completed longitudinal joint shall be lightly dusted with a fine sand, talcum powder, or cementitious powder at those locations, such as driveway crossings, where there is a risk of traffic driving over newly completed joints.

04000-5 MEASUREMENT AND PAYMENT

Measurement and payment for rubberized asphalt crack sealing will be on a lineal metre basis and shall be full compensation for the supply of all labour, equipment and material required to rout and clean cracks, supply and apply sealant, supply and place blotting sand where required, provide proper traffic accommodation and clean up all cuttings, debris, and blotting sand before leaving the site.

END OF SPECIFICATION 04000

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04005-1 GENERAL

1.1 Description

These Specifications apply to the manufacture of asphalt binders to be used for the construction of asphalt pavements and ancillary work. The types and grades of asphalt to which this Specification will apply shall be those indicated under execution.

1.2 Definitions

1.2.1 Bitumen - A class of black or dark coloured (solid, semisolid, or viscous) cementitious substance, natural or manufactured, composed principally of high molecular weight hydrocarbons, of which asphalts, tars, pitches, and asphaltites are typical.

1.2.2 Asphalt - A dark brown to black cementitious material in which the predominating constituents are bitumens which occur in nature or are obtained in petroleum processing.

1.2.3 Asphalt Cement - A fluxed or unfluxed asphalt specifically prepared as to quality and consistency for direct use in the manufacture of bituminous pavements, and having a penetration at 25°C (77°F) of between 5 and 300, under a load of 100 g applied for 5 seconds.

1.2.4 Cut-Back Products - Petroleum or tar residuums which have been blended with distillates. Also referred to as liquid asphalts.

1.2.5 Bituminous Emulsion

- (a) a suspension of minute globules of bituminous material in water or in an aqueous solution.
- (b) a suspension of minute globules of water or of an aqueous solution in a liquid bituminous material.

1.2.6 Performance Graded Asphalt Binders

Asphalt binder grade designation used in Superpave. It is based on the binder's mechanical performance at critical temperatures and aging conditions.

1.2.7 Polymer Modified Asphalt

Conventional asphalt cement to which one or more polymer compounds have been added to improve resistance to deformation at high pavement temperatures and often cracking resistance at low temperatures.

04005-2 MATERIALS

All asphalt binders shall be prepared from petroleum oils. They shall be free from water and other impurities and shall not foam when heated to 175°C. Solvents used in the manufacture of cut-back asphalts shall be derived from petroleum oils. Emulsifiers used to stabilize asphalt emulsions shall not be harmful to the performance of the asphalt in service.

04005-3 EXECUTION

3.1 General

The refining process shall be selected by the supplier provided that the resulting product conforms to all applicable requirements of this Specification when tested in accordance with methods shown.

3.2.1 Asphalt Cements - Neat

All grades of this type of asphalt shall conform to requirements listed in Table 1, Table 2 and Figure 1, and shall be homogenous and uniform in character throughout.

3.2.2 Asphalt Cements – Modified

The polymer modified asphalt cement shall be performance graded as determined by the current edition of AASHTO M320. Polymer modified asphalt cement shall meet or exceed the performance grade PG64-37, unless otherwise specified.

ASPHALT CEMENT GRADE		150- 200(A)	200- 300(A)	300- 400(A)	400- 500(A)	200- 300(B)	300- 400(B)
Requirements	ASTM Test Method						
Visc. @60°C, Pa.s	S2171	(1)	(1)	(1)	(1)	(1)	(1)
Penetration @ 25°C, 100g 5s	D5	(1)	(1)	(1)	(1)	(1)	(1)
Ductility @15°C, 5cm/ min, minimum cm	D113	-	100	100	-	100	-
Ductility @25°C(3)	D113	100	-	-	-	-	-
Flashpoint (COC), °C	D92	205	175	175	175	175	175
Solubility in Trichloroethylene min %	D2042	99.5	99.5	99.5	99.5	99.5	99.5
Thin Film Oven Test Weight Loss, Maximum %	D1754	1.0	1.5	2.0	2.5	1.5	2.0
Penetration at 25°C of minimum % or original	D5	50	45	-	-	45	-
Viscosity @60°C of residue Maximum % of original	D2171	-	-	300	400	-	300

Note (1) Viscosity @60°C and Penetration @25°C shall fall within the area described in Figure 1.

TABLE 1

Grade of Asphalt Cement	150-200A			200-300A			300-400A			400-500A			200-300B			300-400B		
	Point	Abs Visc	Pen	Point	Abs Visc	Pen	Point	Abs Visc	Pen	Point	Abs Visc	Pen	Point	Abs Visc	Pen	Point	Abs Visc	Pen
Viscosity & Penetration Shall be within graphic regions described by the lettered coordinates	A	155	150	C	50	200	E	45	300	H	27	400	C	50	200	F	26.5	300
	B	78	150	D	92	200	F	26.5	300	G	17	400	J	30	200	K	17.5	300
	C	50	200	E	45	300	G	17	400	M	12.5	500	K	17.5	300	L	12	400
	D	92	200	F	26.5	300	H	27	400	I	19	500	F	26.5	300	G	17	400

TABLE 2

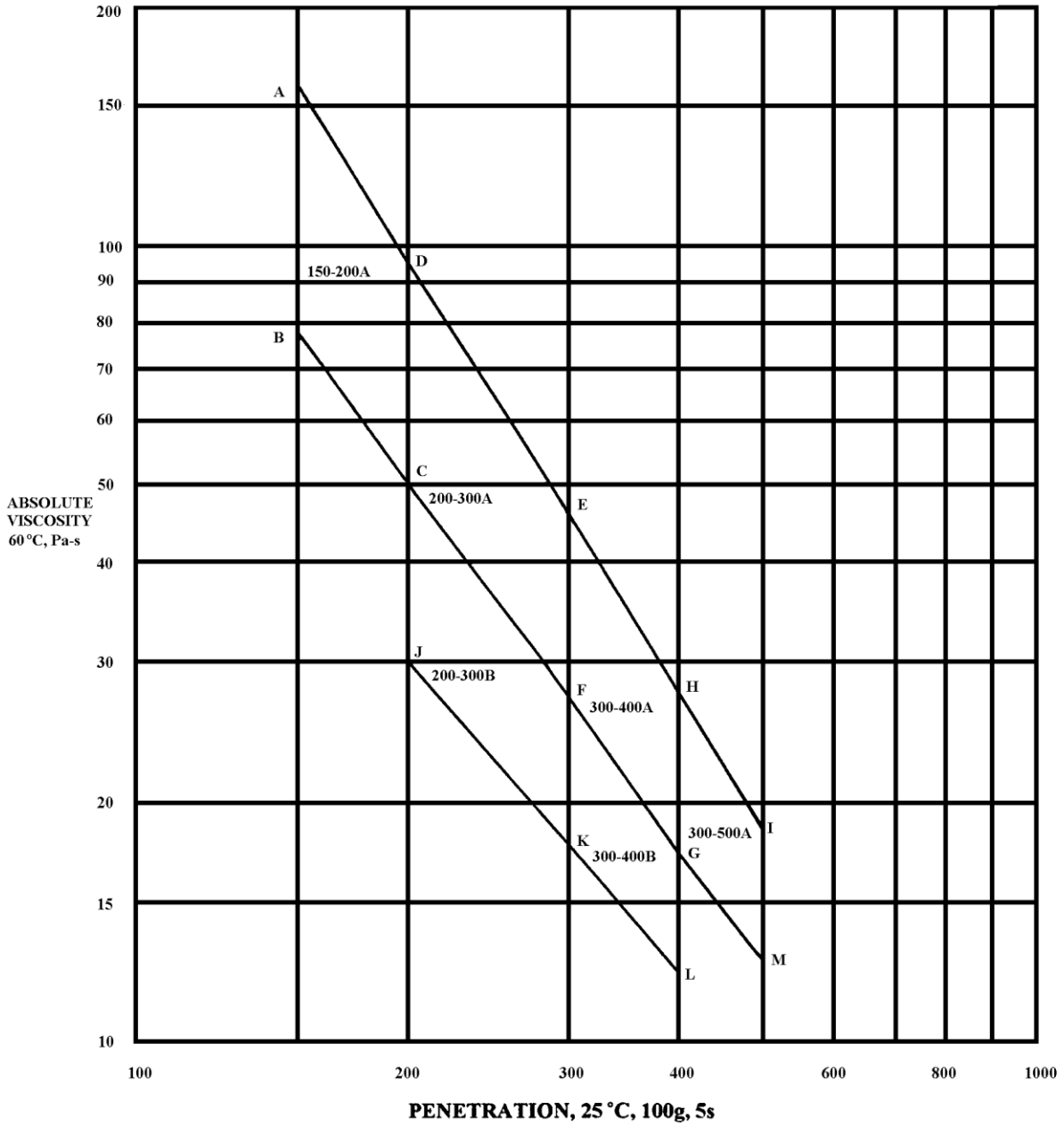


FIGURE 1

3.3 Slow Curing Liquid Asphalt Binder

All grades of this type of asphalt shall conform to the requirements listed in Table 3 and shall be homogenous and uniform in character throughout.

Asphalt Grade Requirements	ASTM Test Method	SC-70		SC-250		SC-800		SC-3000	
		Min	Max	Min	Max	Min	Max	Min	Max
Flash Point (C.O.C), °C	D92	65	-	80	-	90	-	105	-
Kinematic Viscosity at 60°C mm ² /s	D2170	70	140	250	500	800	1600	3000	6000
Distillation Test Total Distillate to 360°C % by Volume	D402	10	30	4	20	2	12	-	5
Distillation Residue Kinematic Viscosity at 60°C mm ² /s	D2170	400	7000	800	10000	2000	16000	4000	35000
Asphalt Residue of 100% Penetration % by mass	D243	50	-	60	-	70	-	80	-
Ductility of 100 Penetration Residue at 25°C cm	D113*	100	-	100	-	100	-	100	-
Solubility of Distillation Residue to 360°C cm % by Mass	D2042**	99.0	-	99.0	-	99.0	-	99.0	-
Water, % by Mass or Volume	D95	-	0.5	-	0.5	-	0.5	-	0.5

* If the ductility at 25°C is less than 100, the material will be acceptable if its ductility at 15°C is more than 100.

** Using trichloroethylene as solvent or use of ignition burn furnace.

TABLE 3

3.4 Medium Curing Liquid Asphalt Binder

All grades of this type of asphalt shall conform to the requirements listed in Table 4 and shall be homogenous and uniform in character throughout.

Asphalt Grade Requirements	ASTM Test Method	MC-30		MC-70		MC-250		MC-800		MC-3000	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Flash Point (Open Tag), °C	D92	38	-	38	-	65	-	65	-	65	-
Kinematic Viscosity at 60°C mm ² /s	D2170	30	60	70	140	250	500	800	1600	3000	6000
Distillation Test % of total distillate to 360°C	D402										
- 225°C		-	25	-	20	-	10	-	-	-	-
- 260°C		40	70	20	60	15	55	-	35	-	15
- 315°C	75	93	65	90	60	87	45	80	15	75	
Residue from Distillation to 360°C Volume % by difference		50	-	55	-	67	-	75	-	80	-
Tests on Residue from Distillation											
a) Penetration at 25°C 100g 5s 0.1mm	D5	120	250	120	250	120	250	120	250	120	250
b) Ductility at 25°C cm*	D113	100	-	100	-	100	-	100	-	100	-
c) Solubility % by Mass	D2042**	99.0	-	99.0	-	99.0	-	99.0	-	99.0	-
Water, % by Mass or Volume	D95	-	0.2	-	0.2	-	0.2	-	0.2	-	0.2

* If the ductility at 25°C is less than 100, the material will be acceptable if its ductility at 15°C is more than 100.

** Using trichloroethylene as solvent or use of ignition burn furnace.

TABLE 4

3.5 Anionic Emulsified Binder

All grades of this type of asphalt shall conform to the requirements listed in Table 5 and shall be homogenous and uniform in character throughout.

Grade Requirements	ASTM Test Method	Rapid Setting				Medium Setting				Slow Setting					
		RS-1		RS-2		MS-1		MS-2		SS-1		SS-1C		SS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Tests on Emulsion															
Saybolt Viscosity Furol Seconds at 25°C	D244	20	100	-	-	20	60	-	-	20	60	20	100	20	60
50°C	D244	-	-	50	300	-	-	35	400	-	-	-	-	-	-
Residue by Distillation, %	D244	55	-	60	-	55	-	59	-	55	-	55	-	55	-
Storage Stability 24 hr, %	D244	-	1	-	1	-	1	-	1	-	1	-	1	-	1
Sieve Test, % retained on a 1000 µm Sieve, % by weight	D244	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Demulsibility 35 mL of 0.02 NCaCl ₂ , %	D244	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Demulsibility 50 mL of 0.01 NCaCl ₂ , %	D244	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coating Test	D244	-	-	-	-	No appreciable separation uniform coating of the stone									
Cement Mixing Test, %	D244	-	-	-	-	-	-	-	-	-	2.00	-	-	-	2.00
Dilution Test	Note (1)	-	-	-	-	-	-	-	-	-	-	Must Pass		-	-
Particle Charge	Note (2)	Negative													
Test on Residue															
Penetration at 25°C, 100g, 5s	D244	100	200	100	200	100	200	100	200	100	200	150	275	40	100
Ductility at 25°C, cm	D244	60	-	60	-	60	-	60	-	60	-	60	-	60	-
Solubility in Trichloroethylene, %	D2042	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-

Note (1) Method for Dilution Test

- Mix together 50 g SS-1C emulsified asphalt and 450 g soft or demineralized water until homogenous.
- Pour into 500 mL graduated cylinder.
- After 2 hours observe cylinder to determine if a line of separation of asphalt from water has appeared. If separation is apparent in 2 hours, emulsion is not acceptable.
- After 24 hours, if asphalt has visually separated from water, re-mix contents of cylinder. Material is acceptable if homogenous liquid is re-established.

Note (2) N.S.C. CAN 2-16.2, par.6.2.1.

TABLE 5

3.6 Cationic Emulsified Asphalt Binder

All grades of this type of asphalt shall conform to the requirements in Table 6 and shall be uniform in character throughout.

Grade		RS-1K		RS-2K	
REQUIREMENTS	ASTM Test Method	Min	Max	Min	Max
Saybolt Viscosity, Furol seconds at 50°C		35	150	150	400
Residue by distillation, %	D244	62	(1)	67	(1)
Settlement in 5 days, %		-	5	-	5
Oil portion of distillate, %		-	3	-	3
Sieve test, % retained on 1000 µm sieve, by weight	D2397 -71	-	0.10	-	0.10
Particle charge	(2)	Positive			
Tests on Residue					
Penetration at 25°C, 100g, 5s	D244	100	250	100	250
Ductility at 25°C, cm	D244	60	-	60	-
Solubility in trichloroethylene, %	D244	97.5	-	97.5	-

Note (1) Upper limit on % residue is governed by the viscosity limits.

Note (2) N.S.C. CAN 2-16.2, par.6.2.1.

TABLE 6

3.7 High Float Emulsified Asphalt Binder

All grades of this type of asphalt shall conform to the requirements listed in Table 7, Table 8 and Figure 2 and shall be homogenous and uniform in character throughout.

Grade		HF-100S		HF-150S		HF-250S		HF-350S		HF-500M		HF-1000M	
Requirements	ASTM Test Method	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Tests on Emulsion													
Percent Asphalt Residue by Distillation	(1)	62	-	62	-	62	-	65	-	65	-	65	-
Oil Distillate % by Volume (7)	D244 and (2)	1	4	1	4	1	6	1.5	6	1	6	1	7
Saybolt Viscosity Furol Seconds at 50°C	D244	30	150	30	150	35	150	75	400	50	-	50	-
Sieve Test % Retained on 1000 µm Sieve	D244	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Coating Test	D244	(8)		(8)		(8)		(9)		(9)		(9)	
Settlement, 1 day %	D244	-	1.5	-	1.5	-	1.5	1.5	-	-	1.5	-	1.5
Demulsibility 50 mL 0.1 N CaCl ₂ , %	D244	60	-	60	-	-	-	-	-	-	-	-	-
Workability @ -10°C	(3)	-	-	-	-	-	-	-	-	-	-	Pass	-
Tests on Residue													
Penetration at 25°C 100g, 5s	(4)	(10)		(10)		(10)		(10)		-	-	-	-
Viscosity at 60°C, Pa-s	(5)	(10)		(10)		(10)		(10)		8	20	2	8
Float Test at 60°C, s	(6)	1200	-	1200	-	1200	-	1200	-	1200	-	1200	-
Solubility in Trichloroethylene, %	D2042	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-

See following for Note (1) to (10) inclusive.

TABLE 7

Notes for Table 7 as follows:

- | | |
|-----------|--|
| Note (1) | CAN 2-16.5 par.6.2.1 |
| Note (2) | CAN 2-16.5 par.6.2.1.3 |
| Note (3) | CAN 2-16.5 par.6.2.3 |
| Note (4) | CAN 2-16.5 par.6.2.4 |
| Note (5) | CAN 2-16.5 par.6.2.5 |
| Note (6) | CAN 2-16.5 par.6.25 |
| Note (7) | Percent Oil in the emulsified asphalt is more accurately determined using ASTM Test Method D-2461, Section 6. |
| Note (8) | Coating Test: ASTM Method D-244 except that the mixture of limestone and emulsified asphalt shall be capable of being mixed vigorously for 5 minutes, at the end of which period the stone shall be thoroughly and uniformly coated. The mixture shall then be completely immersed in tap water and the water poured off. The stone shall not be less than 90% coated. |
| Note (9) | Coating Test: ASTM Method D-244 except that the mixture of limestone and emulsified asphalt shall be mixed vigorously for 5 minutes, then allowed to stand for 3 hours, after which the mixture shall be capable of being mixed an additional 5 minutes. The mixture shall then be rinsed twice with approximately its own volume of tap water without showing appreciable loss of bituminous film. After the second coating the aggregate shall be at least 90 percent coated. Note (1) viscosity at 60°C and penetration at 25°C shall fall within the area described in Figure 2. |
| Note (10) | Viscosity at 60°C and penetration at 25°C shall fall within the area described in Figure 2. |

Viscosity shall be within the graphic regions above the line designated by specified letters, and between penetration limits contained in vertical lines extending upwards from those points.

Viscosity value shall be reported as 0.5 s^{-1} for grades HF-100S and HF-150S and at 1.0 s^{-1} for grades HF-250S and HF-350S.

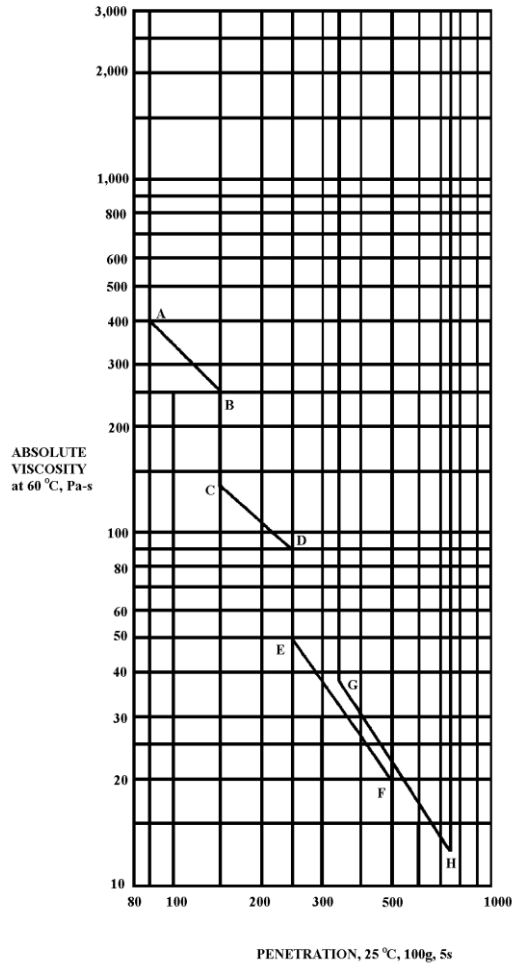


FIGURE 2

Grade of HF Emulsified Asphalt	HF-100S	HF-150S	HF-250S	HF-350S
	A,B	C,D	E,F	G,H

TABLE 8

04005-4 TESTING

The supplier shall, prior to initial delivery, undertake standard control tests and provide test results to prove compliance with the requirements for the desired type and grade of bituminous binder stated in the Specification (04005-3 Execution).

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

Material	Frequency	Test Required
Asphalt Cement - Neat	Every 300 tonnes Every 150 tonnes	- Viscosity at 60°C, Pas. - Penetration at 25°C, 100g, 5 sec.
Asphalt Cement - Modified	Every 500 tonnes	- AASHTO M320
Liquid Asphalt	Every 100 tonnes	- All standard control tests
Emulsions	Every 100 tonnes	- All standard control tests

If requested by the City, the supplier shall supply a representative 5 litre sample of the desired type and grade of bituminous binder prior to delivery of any order. The City shall also have the right to obtain samples of not more than 5 litres from each shipment during the course of delivery of any order.

All tests conducted by the City shall be in accordance with the procedures and methods of the American Society for Testing and Materials (ASTM) except where the Canadian Government Specification Board (C.G.S.B.) and the National Standard Council (N.S.C.) of Canada is indicated.

The Contractor, at their sole discretion, will secure samples of polymer modified asphalt cement from each 40-80 tonne shipment. These samples will

be stored for a minimum period of six months and the contractor may test as many samples as they wish at their cost. The City will only accept test data from a certified testing lab. If it is discovered that a particular load of asphalt cement does not meet the PG grade the City will pay for the cost of the test and waive the mix adjustments that occur as a result of the lower grade of polymer modified asphalt cement.

04005-5 **MEASUREMENT**

All asphalt binders will be measured in litres corrected to 15°C, or tonnes.

END OF SPECIFICATION 04005

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04010-1 GENERAL

1.1 Description

This section specifies requirements for labour, machinery, plant, equipment and materials required to produce hot mix asphalt concrete.

1.2 Related Work

Specification: Section 04005 Bituminous Binder.

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 individual crushed and processed aggregate fractions before combining to produce the asphalt mix 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 asphalt cement with the asphalt mix aggregate.

04010-2 MATERIALS

2.1 Specific Requirements

2.1.1 Asphalt Cement 150/200 A and polymer modified asphalt cement to the requirements of Section 04005 Bituminous Binder.

2.1.2 Asphalt Mix Aggregate

- .1 Asphalt mix aggregate, retained on the 5.0 mm plus sieves, shall be composed of fragments of durable rock and shall not contain more than 2% by weight of deleterious materials such as shale, ironstone, and coal. The maximum permissible organic content of the material passing the 5.0 mm sieve is 1.0%.

- .2 Physical properties for aggregate shall meet the following requirements:

Requirement	Test Designation	Asphalt mix type		
		A2, A9 & T9	1, 2 & M2	M1 & 3
Sand Equivalence	ASTM D2419	45 min.	45 min.	45 min.
Los Angeles Abrasion (% loss)	ASTM C131	30 max.	35 max.	35 max.
Organic Content (% Passing 5.0 mm)		1.0 max.	1.0 max.	1.0 max.
Crush Count (1) (% Retained 5.0 mm Sieve)		80 min. 2 faces	70 min. 1 face	70 min. 1 face
Manufactured Fines (2) (% Passing 5.0 mm Sieve)		70 min.	-	-

Notes:

1. Crush Count is the percentage of the crushed aggregate retained on the 5.0 mm plus sieves having either 1 or more fractured faces or 2 or more fractured faces, created by the crushing operation.
2. Manufactured fines are the percentage by mass of crusher run manufactured sand passing the 5mm sieve.
3. Asphalt mix aggregate shall meet the gradation requirements stated in Table 1 Gradation for Asphalt Mix Aggregate, when tested to ASTM designations C-136 and C-117.

TABLE 1: GRADATION FOR ASPHALT MIX AGGREGATE

Sieve Designation	Asphalt mix type							
	A2	1	M1	2	M2	3	9 & A9	4
20.0 mm	100	100	-	-	-	-	-	-
16.0 mm	98-100	98-100	100	-	-	-	-	-
12.5 mm	82-89	82-89	83-94	100	100	100	100	-
9.0 mm	67-78	69-80	69-87	76-89	78-89	80-89	98-100	-
5.0 mm	49-59	49-59	50-75	50-60	52-62	59-69	85-95	100
2.0 mm	32-54	29-48	29-48	30-48	30-48	36-56	49-59	45-65
900 µm	22-42	18-38	24-41	19-38	19-38	24-41	32-42	22-44
400 µm	12-24	10-26	11-29	10-26	10-26	11-29	15-26	12-28
160 µm	3-10	3-10	3-12	3-10	3-10	3-12	6-15	6-15
71 µm	2-5	2-5	2-6	2-5	2-5	2-6	3-7	4-10

Percent Passing by Weight

2.1.3 Asphalt Concrete Mix

- .1 Asphalt mix shall consist of a homogeneous mixture of asphalt mix aggregate and asphalt cement mixed in a central plant.
- .2 Marshall Mix designs are to be completed in accordance with the latest edition of the Asphalt Institute Manual Series No. 2 (MS-2), ASTM D1559 and ASSHTO T-245 unless otherwise modified by City of Saskatoon requirements.

The Contractor shall provide the Project Engineer a Job Mix Formal (JMF) for each type of hot mix to be supplied. The Contractor will only supply hot mix for which the Project Engineer has approved the JMF.

The JMF is developed through a multi stage process based on

the Contractor's quality control testing of aggregate fractions, laboratory preparation of a mix design, and the setting of the JMF after evaluating the mix properties of the different plant trials.

The Contractor shall arrange for a laboratory to evaluate the proposed aggregate fractions to be used in the hot mix so a theoretical blend of the asphalt mix aggregate can be determined. Using the theoretical blend of the asphalt mix aggregate the laboratory prepare briquettes at various asphalt contents (minimum three briquettes prepared at five different asphalt contents) to determine design curves for the mix.

The design curves are analyzed to determine the "design asphalt content" that will provide mix properties meeting specifications. The Contractor shall submit the proposed mix design and supporting test documentation to the Engineer for review, and upon approval shall undertake plant trials.

The aggregate gradation for the plant trials shall be within ± 2 percent of the mix design target gradation for material above the 2 mm sieve and within ± 1.5 percent for material on or below the 2 mm sieve. The plant will produce runs of HMA at the design asphalt content, one plant run at both 3 tenths above and below the proposed design asphalt content.

From these plant trial production runs the Contractor will set the JMF. The JMF and supporting test results from the plants trials are to be submitted to the Engineer for approval.

- .3 Anti stripping agent, if required, shall be added to achieve a stripping potential of less than five percent (5%) as determined

by the Saskatchewan Ministry of Highways and Infrastructure Stripping Potential Test. The Contractor shall provide test results identifying the type and amount of anti-stripping agent required to meet this requirement. The contractor shall provide the brand name and technical literature of the product to be used. The cost of the anti-stripping agent, if required shall be included in the unit prices under the contract.

- .4 Physical properties for the mix shall meet the following requirements at the design asphalt content and gradation:

Property	Notes	Asphalt mix type					
		A2	A2	A2	A2	2	1 & 2
Asphalt Grade		PG76-28	PG70-28	PG64-37	150/200A	PG64-37	150/200A
Marshall (blows per face)		75	75	75	75	50	50
Marshall Stability (KN) at 60°C min	(1)	16	15	14	11	11	8
Retained Stability (%) (minimum)		75	75	75	75	75	75
Marshall Flow Index (mm)	(1)	2-5	2-5	2-5	2-4	2-5	2-4
Air Voids in Mixture	(2)	3.5-5.5	3.5-5.5	3.5-5.5	3.5-5.5	3-5	3-5
Voids filled with Asphalt (%)	(2)	67-75	67-75	67-75	67-75	70-80	70-80
Min. Film Thickness (µm)	(3)	7.5	7.5	7.5	7.5	8.0	8.0

Property	Notes	Asphalt mix type				
		M1	M2	3 & 4	A9	9
Asphalt Grade		150/200A	150/200A	150/200A	PG64-37	150/200A
Marshall (blows per face)		50	50	50	75	50
Marshall Stability (KN) at 60°C min	(1)	7	8	6	11	8
Retained Stability (%) (minimum)		75	75	75	75	75
Marshall Flow Index (mm)	(1)	2-4	2-4	2-4	2-5	2-4
Air Voids in Mixture	(2)	2-4	2-4	2-4	3-5	3-5
Voids filled with Asphalt (%)	(2)	75-85	75-85	75-85	75-85	75-85
Min. Film Thickness (µm)	(3)	8.5	8.5	8.5	8.0	8.0

- Notes:**
1. Marshall Stability and Flow Index shall be determined according to ASTM Designation D1559 with the exception that briquettes shall be fan cooled as per Note 5 of D1559. A mechanical compactor, calibrated by a certified hand hammer, shall be used to prepare briquettes.
 2. The percentage of air voids and percentage of voids filled with asphalt shall be determined in accordance with ASTM D3203 with ASTM C127 and C128.
 3. The minimum asphalt content by dry mass of aggregate are:
 - 5.0% for A2 mixes
 - 5.3% for Type 1 and Type 2 mixes
 - 5.7% for M1, M2 and Type 3 mixes
 - 6.5% for Type 9 and Type 4 mixes
 - 6.3% for Type A9 mix
 4. Temperature: Mix temperature at point of plant discharge shall not vary from that specified in the job mix formula by more than 10°C.
 5. Moisture in mix: Maximum permissible moisture at point of plant discharge is 0.2 % by weight of mix.

2.1.4 Tolerances

1. All asphalt mix shall be supplied to the approved job mix formula within the range of tolerances specified. Where tolerances are not specified, the values stated under this section shall be considered

absolute, minimums, maximums or allowable ranges. Unless otherwise stated specification limits are based on single tests and include sampling, testing, and process variance.

2. Tolerances stated in this section shall apply to all asphalt concrete mix types unless otherwise specified.
3. The job mix formula, as originally established, shall remain in effect until modified in writing. Should a change of aggregate(s) be made, or when unsatisfactory results or other conditions make it necessary, the Contractor shall submit a new mix design for approval.

2.2 Compliance With Specifications

2.2.1 General

For contract administration and enforcement, testing for quality control of the mix to determine compliance with specification during production (process control), and quality assurance to determine acceptance and payment adjustments to material supplied and placed will be carried out by the City. This is not intended to relieve the contractor of the responsibility of maintaining their own quality control testing programs for the mix, or preventing them from initiating shutdown of production for material that will be out of specification as determined from their own testing program.

2.2.2 Quality Control

After the job mix formula gradation and proportioning of various aggregate sizes have been established and approved, no alteration will

be permitted. The working ranges outlined in Tables 1, 2, 3 and 4 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 or,
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.

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.

TABLE 1
 MAXIMUM PERMISSIBLE VARIATION* **TYPE A2**

PROPERTY OR CHARACTERISTIC	ACCEPTABLE ZONE	BORDERLINE ZONE	PLANT SHUTDOWN ZONE	ASPHALT TYPE
ASPHALT CEMENT (%)	(+/-) 0.2	(+/-) 0.3 TO 0.4	> (+/-) 0.4	All A2 Types
AIR VOIDS (%)				
LOWER LIMIT	3.5	3.0 TO 3.4	< 3.0	All A2 Types
UPPER LIMIT	5.5	5.6 TO 6.0	> 6.0	
MARSHALL STABILITY (KN)	(>=) 11.0	10.5 TO 10.9	< 10.5	A2 w/ 150/200A
	(>=) 14.0	13.5 TO 13.9	< 13.5	A2 w/ PG 64-37
	(>=) 15.0	14.5 TO 14.9	< 14.5	A2 w/ PG 70-28
	(>=) 16.0	15.0 TO 15.9	< 15.0	A2 w/ PG 76-28
FLOW INDEX (mm)				
LOWER LIMIT	2.0	1.5 TO 1.9	< 1.5	All A2 Types
UPPER LIMIT	4.0	4.1 TO 4.2	> 4.2	A2 w/ 150/200A
UPPER LIMIT	5.0	5.1 TO 5.3	> 5.3	A2 w/ Polymer
FILM THICKNESS (µm)				
LOWER LIMIT	7.5	7.0 TO 7.4	< 7.0	All A2 Types
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	All A2 Types
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	
75 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 2
 MAXIMUM PERMISSIBLE VARIATION* **TYPES 1, 2, T1 & T2**

PROPERTY OR CHARACTERISTIC	ACCEPTABLE ZONE	BORDERLINE ZONE	PLANT SHUTDOWN ZONE	ASPHALT TYPE
ASPHALT CEMENT (%)	(+/-) 0.2	(+/-) 0.3 TO 0.4	> (+/-) 0.4	All Types 1 & 2
AIR VOIDS (%)				
LOWER LIMIT	3.0	2.5 TO 2.9	< 2.5	All Types 1 & 2
UPPER LIMIT	5.0	5.1 TO 5.5	> 5.5	
MARSHALL STABILITY (KN)	(>=) 8.0 (>=) 11.0	7.0 TO 7.9 10 TO 10.9	< 7.0 <10.0	T1 & T2 T2 w/ PG 64-37
FLOW INDEX (mm)				
LOWER LIMIT	2.0	1.5 TO 1.9	< 1.5	All Types 1 & 2
UPPER LIMIT	4.0	4.1 TO 4.2	> 4.2	T1 & T2
UPPER LIMIT	5.0	5.1 TO 5.3	> 5.3	T2 w/ PG 64-37
FILM THICKNESS (µm)				
LOWER LIMIT	8.0	7.5 TO 7.9	< 7.5	All Types 1 & 2
UPPER LIMIT	10.0	10.1 TO 10.5	> 10.5	
GRADATION	MAXIMUM PERMISSIBLE VARIATION % BY WEIGHT PASSING			
20.0 mm				
16.0 mm	(+/-) 1.0	(+/-) 1.1 TO 2.0	> (+/-) 2.0	Type 1 only
12.5 mm	(+/-) 3.0	(+/-) 3.1 TO 5.0	> (+/-) 5.0	All Types 1 & 2
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 3
 MAXIMUM PERMISSIBLE VARIATION* **TYPES 3, M1 & M2**

PROPERTY OR CHARACTERISTIC	ACCEPTABLE ZONE	BORDERLINE ZONE	PLANT SHUTDOWN ZONE	ASPHALT TYPE
ASPHALT CEMENT (%)	(+/-) 0.2	(+/-) 0.3 TO 0.4	> (+/-) 0.4	Types 3, M1, M2
AIR VOIDS (%)				
LOWER LIMIT	2.0	1.5 TO 1.9	< 1.5	Types 3, M1, M2
UPPER LIMIT	4.0	4.1 TO 4.5	> 4.5	
MARSHALL STABILITY (KN)				
Type 3	(>=) 6.0	5.0 TO 5.9	< 5.0	
Type M1	(>=) 7.0	6.0 TO 6.9	< 6.0	
Type M2	(>=) 8.0	7.0 TO 7.9	< 7.0	
FLOW INDEX (mm)				
LOWER LIMIT	2.0	1.5 TO 1.9	< 1.5	Types 3, M1, M2
UPPER LIMIT	4.0	4.1 TO 4.2	> 4.2	
FILM THICKNESS (µm)				
LOWER LIMIT	8.5	8.0 TO 8.4	< 8.0	Types 3, M1, M2
UPPER LIMIT	10.5	10.6 TO 11.5	> 11.5	
GRADATION	MAXIMUM PERMISSIBLE VARIATION % BY WEIGHT PASSING			
20.0 mm				
16.0 mm	(+/-) 1.0	(+/-) 1.1 TO 2.0	> (+/-) 2.0	Type M1
12.5 mm	(+/-) 2.0	(+/-) 2.1 TO 3.0	> (+/-) 3.0	Types 3, M1, M2
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 4
 MAXIMUM PERMISSIBLE VARIATION* **TYPES 9 & A9**

PROPERTY OR CHARACTERISTIC	ACCEPTABLE ZONE	BORDERLINE ZONE	PLANT SHUTDOWN ZONE	ASPHALT TYPE
ASPHALT CEMENT (%)	(+/-) 0.2	(+/-) 0.3 TO 0.4	> (+/-) 0.4	All Type 9 & A9
AIR VOIDS (%)				
LOWER LIMIT	3.0	2.5 TO 2.9	< 2.5	All Type 9 & A9
UPPER LIMIT	5.0	5.1 TO 5.5	>5.5	
MARSHALL STABILITY (KN)	(>=) 8.0 (>=) 11.0	7.0 TO 7.9 10.0 TO 10.9	< 7.0 < 10.0	Type 9 Type A9
FLOW INDEX (mm)				
LOWER LIMIT	2.0	1.5 TO 1.9	< 1.5	All Type 9 & A9
UPPER LIMIT	4.0	4.1 TO 4.2	> 4.2	Type 9
UPPER LIMIT	5.0	5.1 TO 5.3	> 5.3	Type A9
FILM THICKNESS (µm)				
LOWER LIMIT	8.0	7.5 TO 7.9	< 7.5	All Type 9 & A9
UPPER LIMIT	10.0	10.1 TO 10.5	> 10.5	
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 & A9
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.

2.2.2.1 Process Control and Charting

The Contractor shall maintain the following charts:

- A) IBar control charts for Process Control
- B) Moving average charts for Specification Compliance

These charts shall be maintained for the following parameters:

- 1) Mix parameters:
 - Asphalt Cement Content
 - Air Voids
 - Marshall Stability
 - All sieve designations
- 2) Aggregate during crushing and production:
 - 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.

Process Control Charting

Charting shall consist of the following:

- A) IBar Control Chart complete with:
 - Upper and Lower Warning Limits: 95% confidence limit (± 2 sigma)

- Upper and Lower Control Limits (CUL/LL): 99% confidence limit (± 3 sigma)
- Centreline
- All limits re-calculated following data shifts or N=10, N=20, N=30as appropriate chart maintenance.
- 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.

Specification Compliance

- B) Moving Average Chart complete with:
- Line showing specification warning Zone
 - Line showing specification shutdown zone
 - Centreline
 - Numerical values entered on all lines

2.2.2.2 *Alternate Charting*

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

- Charted parameters
- Testing method summary
- 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.

2.2.2.3 *Plant Shutdown*

The Contractor shall terminate asphalt production when:

- 1) The asphalt does not comply with the specifications as outlined in Division 4, Section 04010-2.2.2 Quality Control, and/or,
- 2) 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:
 - i) Test result is on or outside the upper or lower control limit.
 - ii) There are seven consecutive points above or below the centreline.
 - iii) Upward or downward trend.
 - iv) An obvious repetitive or cyclical pattern.
 - v) The average of any seven consecutive tests runs at 0.3, or less, above the lower specification limit.

2.2.3 Quality Assurance

1. Payment adjustment factors will be used to adjust the contract unit price for material not complying with specification limits. 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.
2. Reduced payment for more than one deficiency on any one test sample will be based on the reduced payment, and not the original price.
3. Adjustment to the unit bid price for non-compliance equals the unit bid price times the payment adjustment factor.
4. Air Voids Payment Adjustment Factors (by individual sample tests) are presented in Table 4.

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.

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

Adjustment Factor (%)	TYPE A2				TYPE 2	
	PG 76-28	PG 70-28	PG 64-37	150/200A	PG 64-37	150/200A
100	>15.6	>14.7	>13.7	> 10.7	> 10.7	>7.9
98	15.5-15.6	14.6-14.7	13.6-13.7	10.6-10.7	10.6-10.7	7.8 - 7.9
95	15.2-15.4	14.3-14.5	13.3-13.5	10.3-10.5	10.3-10.5	7.6 - 7.7
90	14.9-15.1	14.0-14.2	13.0-13.2	10.0-10.2	10.0-10.2	7.3 - 7.5
80	14.6-14.8	13.7-13.9	12.7-12.9	9.8 - 9.9	9.8 - 9.9	7.1 - 7.2
65	14.4-14.5	13.4-13.6	12.4-12.6	9.6 - 9.7	9.6 - 9.7	6.8 - 7.0
50	14.1-14.3	13.1-13.3	12.1-12.3	9.3 - 9.5	9.3 - 9.5	6.5 - 6.9
0*	<14	<13	<12	< 9.3	< 9.3	<6.5

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

Adjustment Factor (%)	TYPE 1,M2	TYPE M1	TYPE A9	TYPE 9	TYPE 3
	150/200A	150/200A	PG 64-37	150/200A	150/200A
100	>7.9	>6.9	> 10.8	>7.9	>5.9
98	7.8 - 7.9	6.8 - 6.9	10.6 - 10.7	7.8 - 7.9	5.8 - 5.9
95	7.6 - 7.7	6.6 - 6.7	10.3 - 10.5	7.6 - 7.7	5.6 - 5.7
90	7.3 - 7.5	6.3 - 6.5	10.0 - 10.2	7.3 - 7.5	5.3 - 5.5
80	7.0 - 7.2	6.0 - 6.2	9.9 - 9.8	7.1 - 7.2	5.1 - 5.2
65	6.8 - 6.9	5.8 - 5.9	9.6 - 9.7	6.8 - 7.0	4.8 - 5.1
50	6.5 - 6.7	5.5 - 5.7	9.3 - 9.5	6.5 - 6.7	4.5 - 4.7
0*	<6.5	<5.5	<9.3	<6.5	<4.5

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

6. 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 Section 2.1.3.4(Note 3) of these specifications. The adjustment will be:

% asphalt below Specified minimum	Type A2	Types 1, 2, 9 & A9	Types M1, M2 & Type 3
- 0.1%	1.0	1.0	1.0
-0.2%	0.90	1.0	1.0
-0.3%	0.75	0.90	0.95
- 0.4%	0.50	0.70	0.80
-0.5%	Reject	0.50	0.65
-0.6%		Reject	0.50
-0.7%			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.

2.3 Certification

2.3.1 General

1. Material certification outlines the material testing and mix design test data submission requirements that the Contractor is responsible to carry out as part of the production of asphalt concrete.
2. The Contractor shall retain and pay an independent testing consultant approved by the Engineer to perform all materials certification tests and mix designs.
3. Submission of test data reports shall be made to the Engineer.
4. At least 1 week prior to contemplated changes in source of asphalt cements or aggregates provide written notification to the Engineer and provide new material certification in accordance with requirements of this section.

TABLE 4

AIR VOID PAYMENT ADJUSTMENT FACTORS				
DEVIATION	H.M.A. TYPE			
(NOTE 1)	9	A2 & A9	1, 2 & M2	3 & M1
+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.

2.3.2 Asphalt Cement

1. Submit test data reports for the asphalt cement for the said properties and frequency in accordance with Section 04005 Bituminous Binder during the course of asphalt concrete production and with the submission of the asphalt mix design.
2. Submit temperature viscosity charts for the asphalt cement over a temperature range of 105°C to 175°C.

2.3.3 Aggregates

1. Submit one complete sieve analysis report (including crush count) for every 750 tonnes for each aggregate fraction processed into separate stockpiles or one complete analysis per material for each production day when production rate is less than 750 tonnes. For Type 9, one complete sieve report is required for every 300 tonnes of aggregate processed.
2. Submit test data reports that the physical properties of the aggregate meet the requirements of this section.

2.3.4 Asphalt Concrete Mix

1. Submit job mix formula and corresponding plant trial results to the Engineer for review and approval at least 1 week prior to the first production day.
2. Submit new mix designs at least 1 week prior to contemplated changes in source of asphalt cement or aggregate.

3. The following data shall be included in the mix design submission:
 - a) Aggregate gradation for each aggregate fraction processed and stockpiled separately and their blend proportions.
 - b) Aggregate bulk specific gravity and bitumen absorption.
 - c) Air voids as determined by ASTM designation D3203 and ASTM C127 and C128.
 - d) Maximum theoretical density of trial mixes.
 - e) Marshall characteristics and design curves.
 - f) Stripping potential without agents and, stripping potential with agents if the requirements for stripping under this section cannot be met without an agent.
 - g) Film thickness.
 - h) Retained stability.
 - i) Asphalt cement properties including mixing and compaction temperatures based on temperature viscosity properties of the asphalt cement.

04010-3 EQUIPMENT

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.

04010-4 EXECUTION

4.1 Aggregates

- 4.1.1 Deliver and stockpile aggregates in accordance with the requirements of this section.
- 4.1.2 Segregate aggregate stockpiles by each aggregate fraction processed using substantial dividers or stockpile far enough apart to prevent intermixing.
- 4.1.3 Stockpile minimum of 50% of total aggregate fractions contracted before commencing trial mix designs. This quantity shall include aggregate stockpiled at both the processing site and asphalt plant site.
- 4.1.4 Stockpile at the plant site during production at least 15% of the total contracted amount for each size fraction processed.
- 4.1.5 When hauling into stockpiles after plant mixing has commenced do not deposit material against working face of stockpile.
- 4.1.6 Construct stockpiles in uniform lifts avoiding segregation by spillage of materials over the ends of previously placed lifts. Do not use stationary conveyors in stockpile construction.
- 4.1.7 Provide a previously stabilized stockpile base not less than 300 mm in depth to prevent contamination.

- 4.1.8** Aggregates from intermixed or contaminated stockpiles will be rejected and must be removed or disposed of as directed by the Engineer within 24 hours of rejection.

4.2 Asphalt Plant Operation

- 4.2.1** The asphalt plant and auxiliary equipment shall be such as to combine, dry and heat the asphalt mix aggregate, heat the asphalt cement and accurately proportion the asphalt cement and asphalt mix at a centrally located plant to the requirements of this section.
- 4.2.2** When combining aggregates during asphalt concrete mix production at no time shall two processed aggregate fractions share the same mechanical cold feed bin.
- 4.2.3** The asphalt plant shall meet the requirement of ASTM designation D995 for Bituminous Mixing Plant requirements.
- 4.2.4** The maximum planned storage time for Types 1, M1, 2, M2, 3, 4, 9 and A9 HMA shall be no more than 24 hours.
- 4.2.5** The maximum planned silo storage time for Type A2 and any polymer modified mixes shall be no more than 8 hours.

04010-5 TESTING

The City of Saskatoon shall appoint an independent testing consultant to perform all tests for quality control of the mix to determine compliance with specification during production (process control), and quality assurance to determine acceptance and payment adjustments to material supplied and placed.

Sampling for quality assurance will be done using a random sampling procedure as identified by the Engineer. Where there is continuous production uninterrupted by plant shutdown due to quality control only the predetermined random sampling frequency will be used to determine payment adjustments to the unit bid price.

The quality assurance random sampling will also be the basis for quality control for generating control charts and determining plant shutdown. In addition to the quality assurance sampling the Engineer may also initiate supplementary tests independent of the quality assurance random sampling procedure to supplement the quality control tests for determining process control. These additional tests will not be used for payment adjustment factors unless it results in plant shutdown prior to the sampling for quality assurance in that specific lot of material. The supplementary test in this case will then be used for payment adjustment on that portion of the untested lot. If the supplementary test results in termination of production the contractor will be required to pay for the test.

The Contractor shall retain and pay an independent testing consultant to perform all materials certification tests and mix designs required in this section.

END OF SPECIFICATION 04010

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- 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.

04015-2 MATERIALS

2.1 Specific Requirements

2.1.1 Asphalt Cement

150-200A and Polymer modified to the requirements of Section 04005 for Bituminous Binder.

2.1.2 Asphalt Mix

To the requirements of Section 04010 Asphalt Mix.

2.2 Compliance With Specifications

2.2.1 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.

2.2.2 Reduced payment for more than one deficiency on any one test sample will be based on the reduced payment, and not the original.

2.2.3 Adjustment to the unit bid price for non compliance equals the unit price times the payment adjustment factor(s).

2.2.4 Density

Unless otherwise specified, asphalt mix Types 1, M1, 2, M2, 3 and 4 shall meet density requirements to 97% of Marshall. The density payment adjustment factors are as follows:

Compacted Density

<u>% of Marshall</u>	<u>Payment</u>
> 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

Unless otherwise specified, asphalt mix Types A1 and A2 shall meet density requirements to 98% of Marshall. The density payment adjustment factors are as follows:

Compacted Density

<u>% of Marshall</u>	<u>Payment</u>
>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

Unless otherwise specified, asphalt mix Type 9 and Type A9 shall meet density requirements to 95% of Marshall. The density payment adjustment factors are as follows:

<u>Compacted Density % of Marshall</u>	<u>Payment</u>
>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

2.2.5 Thickness

<u>Variation in Thickness From Design Thickness</u>	<u>Payment</u>
“T” mm thick - 5 mm thin	100%
6 mm thin - 15 mm thin	X ² (100)%
more than 15 mm thin	No payment

“T” – the over thickness limit, which is the greater of:

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

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

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.

2.2.6 Applying Thickness Adjustment

On a single layer HMA paving project the core taken for determining in-situ air voids and density will 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 cores taken after final lift of paving can be used for thickness payment adjustment factors, though may not exceed the 300 tonne test lot size (combine top & bottom lift) unless otherwise specified. Additional cores may be taken for determination of the thickness adjustment factor 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.

On a multi layer paving project 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 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.

2.2.7 Stripping Potential

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 04010-2.1.3.3 unless otherwise indicated in the Specific Conditions. The quantity of material representing each test shall not exceed 300 tonnes.

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, kerosine 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.

3.7 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.

Asphalt mix shall only be spread if the atmospheric temperature is 2° C and rising or higher.

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.

Any open, course or segregated areas must have Type 4 asphalt spread and compacted over the affected area during the paving of the road. Type 4 asphalt fines must be used to construct an acceptable mat where course segregated areas exist, and when matching existing asphalt.

If segregation is repetitive, the spreading operation shall be ceased, the cause determined and corrective action taken.

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 65 mm or less is specified, it shall be placed in one lift, if all other specifications are met. Asphalt lifts shall never be placed at a thickness less than 2 times the nominal aggregate size.

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 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 Corrective Action

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.

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. For the purposes of determining air voids and density, the additional cores will be taken within 2 meters of the original core location.

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

These additional cores must be taken within one week of the original core test results being communicated to the Contractor by the Engineer. Average results from these 3 core tests must meet the specified values or tolerances. 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.

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04025-1 **DESCRIPTION**

The work shall consist of supplying and the application of asphaltic material on a prepared surface at locations shown on the plans or as designated by the Engineer.

04025-2 **MATERIAL**

The Contractor shall supply the asphaltic material.

The asphaltic material shall meet the current specifications of the Asphalt Institute. Generally SS-1C emulsified asphalt shall be used for prime, tack or flush coat. The Contractor shall be required to dilute the emulsified asphalt with water, as required.

04025-3 **EQUIPMENT**

All equipment used in executing any part of the work shall be maintained in efficient working order.

The asphaltic material shall be applied by means of a self-powered pressure distributor. The distributor shall have a capacity of not less than 4,500 litres.

The distributor shall be equipped with the following appliances and devices in proper operating condition:

- 1) Tachometer.
- 2) Pressure gauge.
- 3) Adjustable length spray bar.
- 4) Positive displacement asphalt pump with separate power unit.

- 5) Heating coils and burner capable of supplying even heat to the bituminous material.
- 6) Thermometer well and accurate thermometer.

Before applying bituminous material, the Contractor shall ensure the distributor meets the following adjustments and requirements.

- 3.1 The rear chassis springs have been blocked or chained if necessary, to prevent the height of the spray bar from changing as the tank is unloaded.
- 3.2 All spray bar nozzles are of the same manufacture, type and size.
- 3.3 Clogged nozzles have been removed and cleaned with solvent.
- 3.4 All nozzles have been set in the spray bar so that the nozzle slots make the same angle (15 to 30) with the longitudinal axis of the spray bar.
- 3.5 The spray bar has been adjusted to the correct height to ensure uniform application without streaking.
- 3.6 The spray bar has been provided with a positive shut-off to prevent dribbling.
- 3.7 The distributor is capable of maintaining a uniform speed.

The distributor may be checked for calibration by the Engineer before being used on the work.

04025-4 **CONSTRUCTION**

Asphalt prime, tack and flush coat shall be applied only after authorization has been received from the Engineer.

The Contractor shall supply an experienced operator for the equipment.

Asphalt material for prime coat and tack coat shall be applied only when the surface to be treated is dry, when the weather is not foggy or rainy and when the surface temperature is above 2° C.

Asphalt material for flush coat shall be applied only when the surface to be treated is dry, when the weather is not foggy or rainy and when the surface temperature is above 10 °C.

Before applying asphaltic material, loose dirt or other objectionable material shall be removed from the prepared surface by brooming and other methods. Where base courses become ravelled, the loose material shall be recompacted or removed.

The asphaltic material shall be applied in accordance with the following temperature limits.

<u>Type of Asphaltic Material</u>	<u>Temperature C°</u>
SS-1C	N.A.
MC-30	25 - 60

The asphalt material shall be applied in a single application at the rate per square metre specified by the Engineer.

The amount of primer to be used per square metre will be determined by the Engineer after trial runs at the start of the work. As much asphalt shall be applied as can be absorbed by the surface in a 24 hour period without any excess flushing on the surface. The rate of application shall be between 0.75 to 1.50 litres per square metre. After a period of 24 hours, if any excess primer remains on the surface, the Contractor shall apply an approved sand, where necessary to blot up the excess asphalt. The sand cover, where used, shall consist of clean, granular, mineral material approved by the Engineer, all of which shall pass a 5.0 mm (No. 4) sieve. Only sufficient sand shall be spread to blot up excess asphalt and such areas shall be broomed to remove excess sand before pavement is laid.

After the prime coat has been applied, it shall be left undisturbed and no pavement shall be laid for a period of 24 hours or as determined by the Engineer.

The Contractor shall maintain the primed surface until the surfacing course has been placed. Maintenance shall include spreading any additional sand and patching any breaks in the primed surface. Any areas of primed surface that have become fouled by traffic, or otherwise, shall be cleaned before paving.

Weak spots that show up after the surface has been primed shall be repaired.

Concrete work adjacent to the roadway and roadway appurtenances shall be protected in a manner to prevent them from being splattered or marred. In the event that any of the appurtenances become splattered or marred, the Contractor shall at his own expense remove all traces of asphaltic materials and have the appurtenances in as good condition as they were before the asphalt priming work began. The distributor spray bar shall be equipped with proper guards.

A hand spray shall be used to apply primer material to areas missed or inaccessible by the distributor.

Joints and seams shall not be overlapped more than 150 mm. The bituminous material application shall be started on a strip of building paper to prevent overlap at transverse joints.

After the hot-mix asphalt surface course is completed, an asphalt flush coat shall be applied, at a rate of 0.50 to 0.75 litres per square metre. Traffic may be permitted to run on the completed flush coat after the asphalt has cured or at a time determined by the Engineer.

04025-5 MEASUREMENT

Measurement of asphalt prime, tack and flush coat will be in square metres.

04025-6 PAYMENT

Payment for prime coat, tack coat or flush coat will be at the contract unit price per square metre. The unit price will be full compensation for cleaning and preparing the surface to be treated, supplying, delivering, heating and applying the asphalt material, supplying and applying sand for blotting; and for all labour and equipment necessary to complete the work. If emulsified asphalt is used for prime coat, tack coat or flush coat, the unit price will be full compensation for supplying, hauling, loading and mixing with water.

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04030-1 DESCRIPTION

The work covered by this specification shall consist of supplying all plant, labour, equipment and materials and in performing all operations in connection with the application of Slurry Seal Coat in accordance with this specification.

The Slurry Seal Coat shall consist of a mixture of emulsified asphalt, mineral aggregate and water, properly mixed and spread on the surface as specified and as directed by the Engineer.

04030-2 MATERIALS

2.1 Emulsified Asphalt

The emulsified asphalt shall conform to the requirements of the current specifications of the Asphalt Institute. SS-1 grade emulsified asphalt shall be used with the Penetration of Residue at 38 C shall be 40-90 and a viscosity range of 20-50.

SS-1 and SS-2 grade emulsified asphalt may be used if approved by the Engineer.

The Contractor shall supply the emulsified asphalt.

2.2 Mineral Aggregate

Aggregate shall consist of natural, hard, durable, angular sand. The aggregate shall be clean, free from deleterious material, lumps of dried fines or adherent coatings.

The mineral aggregate shall meet the following gradation requirements:

<u>Sieve Designation</u>	<u>Percent Passing by Weight</u>
2.0 mm	100
900 µm	40 - 65
400 µm	25 - 45
160 µm	11 - 22
75 µm	7 - 15

2.3 Filler

When required to produce a proper "slurry consistency", the addition of a correct filler shall be added as required. Commercial fillers consisting of Portland Cement, Hydrated Lime, limestone dust or crusher run dust shall be used. Natural occurring materials, namely, silt or clay, will only be permitted to be used as a filler when approved by the Engineer.

04030-3 CONSTRUCTION

Immediately prior to applying slurry seal coat, the surface shall be cleaned of all loose material, silt spots and other objectionable material.

On old pavement, a tack coat consisting of a dilution of 1 part emulsified asphalt to 3 parts water shall be applied with a conventional pressure distributor.

3.1 Equipment

All equipment, tools, and machinery used in the performance of this work shall be maintained in satisfactory working condition.

3.1.1 Mixer

The slurry seal coat mixing machine shall be a continuous flow mixing unit and be able to accurately deliver and proportion aggregate, asphalt emulsion, and water to a revolving spiralled multiblade mixer and discharge the thoroughly mixed product on a continuous basis in a minimum amount of time.

The mixing machine shall be equipped with an approved fines feeder with an accurate metering device or method to introduce a predetermined amount of mineral filler into the mixer at the same time and location where the aggregate is fed. A calibrated control for aggregate and asphalt shall be provided capable for accurately proportioning materials.

The mixing machine shall be equipped with a water pressure system and a fog type spray bar adequate for complete fogging of the surface preceding spreading equipment with a maximum application of 0.30 litres per square metre.

The machine while in operation shall have a minimum speed of 18 metres per minute and shall not be allowed to exceed 55 metres per minute. Sufficient machine storage capacity shall be provided to properly mix and apply a minimum of 5 tonnes of slurry.

3.1.2 Spreading Equipment

The mechanical type squeegee distributor shall be equipped with flexible material in contact with the surface to prevent the loss of slurry from the distributor. It shall be maintained so as to prevent loss of slurry on varying grades and crown by adjustments to assure uniform spread and depth.

There shall be a steering device and a flexible strike-off. A piece of burlap or a piece of heavy canvas shall be attached behind the spreader to provide a smooth surface. The squeegee shall be attached behind the mixer.

3.1.3 Auxiliary Equipment:

Hand squeegees, shovels and hand equipment shall be provided as necessary to perform the work.

3.2 Mix Preparation

The quantities of aggregate, emulsified asphalt and water shall be measured or weighed into each batch. When preparing slurry seal mixes, the water and emulsified asphalt shall be added first, and then the aggregate. The amount of water used shall be a minimum to provide a fluid homogeneous mixture.

The Contractor shall make trial batches, at his expense, to determine the final blend of mineral aggregate, mineral filler and asphaltic binder until approved by the Engineer. Approximately 9.5 to 11.5 litres of emulsified asphalt shall be used per 45 kilograms of dry aggregate weight.

3.3 Application of Slurry Seal Coat

The surface shall be fogged with water from pressure nozzles directly preceding the drag distributor. No puddles of free water shall remain after fogging. The slurry mix shall be of the desired consistency when deposited on surface and no additional elements added. Total time of mixing shall not exceed 4 minutes. A maximum amount of slurry shall be carried in the distributor and the maximum allowable speed shall be 55 m per minute.

The average thickness of slurry seal coat applied shall be 3 mm or approximately 1 tonne per 1,500 square metres of surface.

Slurry seal shall be protected from all traffic until the slurry has set. The minimum time period, in excellent drying weather, shall be 4 hours or the time required for the slurry colour to change from uniform brown to uniform black.

Slurry application shall be suspended when rain is imminent within 12 hours.

04030-4 **MEASUREMENT**

Slurry seal coating will be measured in square metres.

04030-5 **PAYMENT**

Payment for Slurry Seal Coating will be at the contract unit price per square metre. The unit price will be for full compensation for supplying emulsified asphalt slurry seal aggregate and filler, preparing and applying the slurry seal, applying tack coat when required and cleaning the surface to be treated.

END OF SPECIFICATION 04030

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04040-1 GENERAL

1.1 Description

1.1.1 This Section specifies requirements for supply of hot mix asphalt concrete to the City of Saskatoon for placement by its own forces or it's agents.

1.1.2 The work includes supply of aggregates and asphalt cement, asphalt plant mixing and discharging of asphalt mix to the requirements of Section 04010 into vehicles operated by the City of Saskatoon.

1.2 Related Work

1.2.1 Bituminous Binder - Section 04005.

1.2.2 Asphalt Mix - Section 04010.

04040-2 SPECIFIC REQUIREMENTS

2.1 Materials

2.1.1 Asphalt Mix

1. To the requirements of Section 04010, Asphalt Mix.

2. For specialty placement, the City may request a temperature increase above the maximum specified resulting in a decreased kinematic viscosity of approximately 50 centistokes (an approximate 20°C increase in temperature).

2.2 Supply

2.2.1 Hours of Work

Normal hours of work for the supply of asphalt mix will be 7:00 a.m. to 4:00 p.m. Exceptions to this schedule are to be mutually agreed upon by both parties 24 hours prior to the time of supply. The Owner reserves the right to extend the hours of supply beyond the normal 4:00 p.m. limit with 3 hours notice.

2.2.2 Days of Work

Normal days of work for supply of asphalt concrete shall be 5 days a week Monday through Friday. The Contractor shall be prepared to supply asphalt mix on weekends and statutory holidays with a preliminary and confirmation notice from the City for this supply of 48 hours and 12 hours respectively. Applicable premiums for weekend or statutory supply of asphalt mix shall apply. This amount per tonne would be added to the base price per tonne for any type of asphalt.

2.2.3 Rate of Supply

The Contractor shall be prepared to supply the following quantities at a uniform rate during each working day:

	<u>Normal Day</u>	<u>Maximum Day</u>
Type A1 or A2	450 tonnes	600 tonnes
Type 1 or 2	450 tonnes	600 tonnes
Type 3	300 tonnes	700 tonnes
Type 4	3 tonnes	10 tonnes

These rates shall be uniform throughout the day at no less than 40 tonnes per half hour per type.

The Contractor shall be capable of supplying each day all types of asphalt mix bid. If this condition is to be met by use of an alternate supplier, such shall be stated in the tender together with the name and plant location of the supplier.

To assist scheduling the City shall supply in writing each week, the estimated needs for the following week of each type and quantity of asphalt mix.

Changes to needs, quantities and/or temperatures will be given to the supplier on or before 2:00 p.m. the prior day.

2.2.4 Waiting Time

Trucks supplied by the Owner shall be alternated between trucks supplying to the Contractor as it applies to receiving asphalt mix at the asphalt plant.

If either the Owner or Contractor has trucks supplying to more than one site, the apportionment of asphalt mix shall be made according to the total number of projects being supplied. When this alternating method is employed, the leading truck supplied by the Owner shall not have to wait more than 5 minutes to start loading.

2.3 Plant and Yard Facilities

2.3.1 Plant Location

Asphalt mix supplied under this Contract is desired to be supplied from an asphalt plant located within the City limits. A location outside these limits will be considered on an evaluated basis wherein the cost of the City of increased haul distance is added to the bid price for purpose of comparison. The precise location of the plant must be stated in the tender.

2.3.2 Asphalt Plant Capacity and Set Up

The asphalt silos and associated equipment must have sufficient capacity to meet requirements under this section for the supply of multiple products tendered. The Contractor shall indicate plant capacity (tonnes) and number of silos in Schedule C of the Tender Form.

A sketch of the asphalt plant layout, entry and exit locations from the yards and stockpile size and capacity (tonnes) for each aggregate fraction as an attachment to the Tender Form.

2.3.3 Scales

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.

2.3.4 Truck Box Cleaning Facility

The Contractor shall provide a facility at the plant site to spray the City's truck boxes with diesel fuel in order to remove asphalt mix adhered to the interior of the box.

2.4 Compliance With Specifications

2.4.1 Materials

1. All applicable adjustment factors and provisions for non-compliant asphalt mix shall be enforced to the requirements stated in Section 04010, Asphalt Mix.
2. No segregation in the asphalt concrete shall be attributable to the production of the asphalt mix. If segregation occurring in the final mat is caused by the operation of the asphalt plant, asphalt mix

production shall be ceased, the cause determined and corrective action taken.

2.4.2 Supply

Further to General Conditions Section 00705-22, if the Seller fails to supply the specified materials or meet provisions under this section, the City may without terminating this Contract;

1. Secure other sources of supply immediately upon written notice to the Contractor, until the Contractor can demonstrate that their product meets specifications and provisions under this Section. The City shall deduct from the Contractor's payment an incremental cost to secure an alternate supply. The total contract price shall be reduced accordingly.
2. Terminate acceptance of materials immediately upon written notice to the Contractor until the Contractor can demonstrate that their product meets specifications and provisions under this Section. The City shall deduct from the payment due the Contractor damages resulting from lost production and or delay in schedule.
3. Deduct from the payment due the Contractor damages resulting from lost production and or delay in schedule for plant breakdown.

04040-3 MEASUREMENT

3.1 Asphalt Mix

3.1.1 Asphalt shall be measured in tonnes of material loaded as determined by scales at the Contractor's plant location.

3.1.2 Material is to be scaled and recorded by the Contractor on duplicate weigh slips. Weigh slips must be signed by both parties at the time of loading and a copy supplied to the City of Saskatoon. Tickets shall include a ticket number, gross, net and tare weights, truck number and cumulative total by asphalt type and project for that day. A summary of daily asphalt quantities giving ticket number, time, date, and quantity by asphalt type and subtalled by project shall be submitted to the City on a daily basis.

3.1.3 The weight of each vehicle shall be determined while the truck is on the scale prior to loading with hot mix asphalt.

3.1.4 The premium for weekend or statutory holiday supply shall be measured in tonnes of material loaded as determined by scales at the Contractor's plant location. This amount per tonne would be added to the base price per tonne for any type of asphalt.

3.2 Truck Box Cleaning

3.2.1 Truck box cleaning shall be measured per each truck box sprayed with diesel fuel.

04040-4 PAYMENT

4.1 Asphalt Mix

Payment for asphalt concrete will be at the contract unit price per tonne adjusted as per the specified adjustment factors for air voids and stability.

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 and loading the asphalt mix.

4.2 Truck Box Cleaning

Payment for truck box cleaning shall be at the contract unit price per each truck box cleaned. The unit price shall be full compensation for providing a pressured diesel fuel sprayer as the washing medium at the asphalt plant site.

END OF SPECIFICATION 04040

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04050-1 **DESCRIPTION**

Cold Mix Asphalt shall be used for patching potholes and utility cuts primarily during the winter months and early spring before Hot Mix Asphalt is available.

04050-2 **MATERIALS**

2.1 **Bituminous Binder**

The Bituminous Binder shall be SC 250 which conforms to the requirements listed in Table 3 under Section 04005-3.3. Percent of Binder by dry weight shall be from 5.5 - 6.5.

2.2 **Aggregate**

Shall meet the following gradation listed below:

General Specifications

Sieve Designation	% Pass by Weight
12.5 mm	100
9.0 mm	78 - 88
5.0 mm	58 - 75
2.0 mm	38 - 57
900 µm	26 - 42
400 µm	11 - 30
160 µm	3 - 12
71 µm	2 - 6

The maximum allowable mixing temperature is 80°C.

04050-3 MEASUREMENT

- 3.1 Cold Mix asphalt shall be measured in tonnes of material loaded as determined by scales at the Contractor's plant location.

- 3.2 Material is to be scaled and recorded by the Contractor on duplicate weigh slips. Weigh slips must be signed by both parties at the time of loading and a copy supplied to the City of Saskatoon. Tickets shall include a ticket number, gross, net and tare weights, truck number and cumulative total by asphalt type and project for that day.

- 3.3 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.

04050-4 PAYMENT

Payment for Cold Mix Asphalt will be at the unit price per tonne.

The unit price will be full compensation for removing overburden, excavating, crushing, screening, stockpiling, and drying the aggregate; mixing and loading the asphalt mix.

END OF SPECIFICATION 04050

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04060-1 **DESCRIPTION**

1.1 **Description**

The work shall include the supplying of all labour, plant, equipment and materials required to cut and remove existing asphalt, replace insufficient load bearing granular and patch paving to the thickness required for street class.

1.2 **Definitions**

1.2.1 Shallow Patching - An area of failed asphalt, that upon removal, shows a hard, stable granular structure that does not need to be removed. Removed area is then replaced with a predetermined asphalt type and thickness, according to Table 1.

1.2.2 Deep Patching - An area of failed asphalt, that upon removal, shows that the granular structure below the asphalt is not stable. The granular structure would be removed to a depth to accommodate a proper new structure. The structure would be replaced according to Table 1.

04060-2 MATERIALS

2.1 Granular Base Course

The Base Course shall conform to the requirements as set out in Section 03005 - “Granular Base Course” of the City of Saskatoon specifications.

2.2 Pit Run Aggregate

Pit Run aggregate shall conform to the requirements of Section 03001.

2.3 Asphaltic Material

The Asphaltic Material shall meet the current specifications of the Asphalt Institute. The material to be used for tacking saw cut joints shall be 150/200A asphalt cement.

The use of SS-1C as an emulsified prime coat or MC-30 will be permitted for application on the finished base surface as a prime coat.

All Asphaltic Material will meet specifications outlined in Section 04025 - “Asphalt Prime, Tack & Flush Coat” of the City of Saskatoon specifications.

2.4 Hot Mix Asphalt

All Hot Mix Asphalt (HMA) will meet specifications outlined in Section 04010, “Asphalt Mix” and install in accordance with Section 04015, “Asphalt Concrete” of the City of Saskatoon specifications.

2.5 Slurry Seal Coat

Slurry Seal Coat shall meet specifications outlined in Section 04030 - “Slurry Seal Coat” of the City of Saskatoon specifications.

04060-3 CONSTRUCTION

The Contractor shall supply an experienced operator for any equipment being used.

The Asphalt shall be saw cut prior to the removal of asphalt. The saw cut must extend completely through the asphalt.

3.1 Asphalt Removal

Care must be taken to ensure that the adjacent asphalt is not lifted, nor the edges of the saw cut asphalt damaged. Damaged areas shall be saw cut, removed and fully restored at the Contractor’s expense. Removed asphalt will be disposed of at the recycling yard. The removed asphalt will be disposed of separately from the excavated gravel and soil.

Once the asphalt has been removed, the existing granular layer will be proof-rolled by the Contractor. Based on the performance of the granular layer, the Contractor will be directed to either further excavate the area or prepare the existing granular structure. The depth of the excavation will extend to the depth of the pavement structure specified in Table 1. However, based on the results of an axle test or proof-roll on the sub-grade, the Contractor may be directed to further excavate to a specified depth.

3.2 Salvage Granular To Stockpile & Reinstall

Deep patches may have granular material which is suitable for salvaging and reuse. Where appropriate, the Contractor will salvage the granular to a specified depth and stockpile the material on site. During the salvage operation, care must be taken to ensure that the granular material is not contaminated with subgrade soil or other deleterious material. Once the subgrade has been adequately prepared, the salvaged granular will be installed and compacted in accordance with the specification Section 3005-4 Construction - "Granular Base Course", except that densities will not be determined using the Standard Proctor Compaction Test. Instead the salvaged granular shall be proof-rolled. If the salvaged granular is spongy or moves under a concentrated load or during proof-rolling, it shall be reworked until stable and shows no movement.

3.3 Prepare Subgrade

Once exposed, the sub-grade will be compacted to a minimum depth of 150 mm. In areas where it is deemed not reasonable to obtain a Proctor value for the sub-grade, it shall be proof-rolled. If the sub-grade is spongy or moves under a concentrated load or during proof-rolling, it shall be reworked until hard and shows no movement.

3.4 Placement of Base

For deep patches granular base course will be installed to the depth specified in Table 1 with the thickness of compacted lifts not exceeding 150 mm.

For shallow patches, granular base course will be installed to ensure that the thickness of the asphalt layer does not exceed the designed thickness. Where the lift thickness of the granular base course is less than 75mm, the existing granular shall be scarified and the new base mixed and compacted with the existing granular to provide an homogenous layer.

Special attention is to be taken along the edges of the patches to ensure that proper compaction is achieved across the entire patch surface. Densities will be determined by the Standard Proctor Compaction test, or at the discretion of the Engineer, acceptance of the installation will be subject to proof-rolling. In the case of the

later, if the base is spongy or moves under a concentrated load or during proof-rolling, it shall be reworked until hard and shows no movement.

3.5 Tack Coat

The saw cut joints will be tacked with a 150/200A asphalt cement. It will be acceptable for the asphalt cement to be reheated in a pail and applied with a broom or other applicator to ensure that the vertical edge of the joint is uniformly coated. Paving operations may commence immediately after tacking joints.

3.6 Asphalt Patching

After the base has been prepared or installed, and the existing asphalt edges tacked, hot mix asphalt shall be supplied and placed.

Patches with a width of 2 metres or greater shall be paved with a paving machine. Patches with a width of less than 2 metres shall be paved with a paving machine, skidsteer loader, motor grader, or by hand at the Contractor's discretion.

The hot mix asphalt shall be installed in accordance with Section 04015 - "Asphalt Concrete". Adjustment to the unit bid price for the supply and installation of hot mix asphalt will be made for non compliance with the specifications.

3.7 Slurry Seal Coat

A slurry seal coat may be applied to patches with a width of less than 2 metres at the Engineer's discretion. The slurry seal coat shall be applied in accordance with Section 04030 - "Slurry Seal Coat", and shall extend 100 mm beyond the edges of the patch.

Classification	Base	Asphalt	Asphalt Type
Local	300 mm	50 mm	Type 2
Industrial Local	500 mm	80 mm	Type A2
Collector	400 mm	80 mm	Type 2
Arterial	450 mm	100 mm	Type A2
Freeway/Expressway	500 mm	100 mm	Type A2

TABLE 1

04060-4 MEASUREMENT

4.1 Saw Cutting

Will be measured by linear metre of asphalt cut.

4.2 Asphalt Removal

Will be measured by square metre of asphalt removed.

4.3 Salvage Granular to Stockpile and Reinstall

Salvaging granular to stockpile and reinstalling will be based on per cubic metre and shall be measured by the area of removal times the average depth.

4.4 Excavation to Waste

Excavation to waste will be based on per cubic metre and shall be measured by the area of removal times the average depth.

4.5 Sub-grade Preparation

Sub-grade preparation will be measured by square metre.

4.6 Granular Base Course

Granular base course will be measured by the tonne.

4.7 Hot Mix Asphalt

Hot mix asphalt shall be measured by the tonne.

4.8 Slurry Seal Coat

Slurry seal coat will be measured by the square metre of new asphalt covered with slurry seal.

04060-5 PAYMENT

Negative Payment adjustments will be made according to the adjustments outlined in Section 4010, and shall include thickness, density, stability and air voids. Patches tested will be at the discretion of the Engineer.

All items will be paid for as follows:

5.1 Saw Cutting

Saw cutting shall be paid for on the unit price per linear metre, and shall include all labour and equipment required to perform the work.

5.2 Asphalt Removal

Asphalt Removal shall be paid for on the unit price per square metre, and shall include all costs associated with removing, loading, hauling and disposal of the existing asphalt pavement to the Nicholson Yards, east of the City on 8th Street.

5.3 Salvage Granular to Stockpile and Reinstall

Salvage granular shall be paid for on the unit price per cubic metre, and will be full compensation for all labour, material and equipment required to excavate to the required depth, load and stockpile on site, and load, place, spread, water, aerate, compact and proof roll the salvaged material.

5.4 Excavation to Waste

Excavation to waste will be paid for on the unit price per cubic metre and will be full compensation for all labour, material and equipment required to excavate, load, haul and dispose of the material to the City of Saskatoon's disposal site.

5.5 Prepare Subgrade

Preparing subgrade will be paid for at the contract unit price per square metre and will include all costs associated with the labour, material and equipment required to shape and compact the subgrade. For shallow patching, this item will refer to any necessary compaction or reworking of the existing granular structure.

5.6 Granular Base Course

Payment will be at the contract unit price per tonne and will include all costs for labour, material and equipment required to supply, spread, water, aerate and compact the granular base course.

5.7 Tack Coating Joints

Tack coating joints will be a subsidiary obligation of the contract.

5.8 Hot Mix Asphalt

Payment for Hot mix asphalt will be at the contract unit price per tonne and will be full compensation for all the labour, material and equipment required to supply, spread and compact the asphalt mix.

5.9 Slurry Seal Coat

Payment for slurry seal coat will be at the contract unit price per square metre of new asphalt and will be full compensation for supplying the emulsified asphalt slurry seal aggregate and filler, and preparing and applying the slurry seal coat to the finished asphalt surface.

END OF SPECIFICATION 04060