

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 RESERVATION OF MATERIAL

- .1 Whenever gravel, sand topsoil, or any other material suitable for special use is encountered, it shall be deemed to be the property of the Contractor and shall be disposed of properly outside of Waterton National Park.
- .2 Where layers of gravel or gravelly mixtures are encountered, they shall be excavated separately from other excavation and shall be stockpiled or incorporated into the work as base or sub-base material, or otherwise disposed of by the Contractor outside of Waterton National Park.

3.2 DISPOSAL OF MATERIAL

- .1 Excavated materials shall be utilized as fill if required on any portion of the work being carried out under this Contract. Where excavated material is specifically directed to be used as fill or for any other purpose, the Contractor will be required to haul the material as part of the unit of excavation.
- .2 Sufficient material will be kept on site for backfill of curbs and boulevard areas. Overhaul will not be paid to haul back to an area which contained a surplus of excavated soil suitable for this purpose.
- .3 The excavated material shall be hauled and dumped at the fill area as part of the unit of excavation. Any materials required to be used in boulevard areas or for rounding at the base of cuts or fills shall be placed, spread in lifts not exceeding 150 mm, and fine graded as part of the unit of excavation. No special compaction will be required.
- .4 All materials deemed to be in excess of requirements or unsuitable shall be disposed of appropriately by the Contractor outside of Waterton National Park.

3.3 FINISHING AND COMPACTING SUBGRADE

- .1 The excavated sections shall be ploughed to a depth of at least 150 mm below the surface of the subgrade and replaced and compacted to a minimum of ninety eight percent (98%) of Standard Proctor Density. The cut shall be left sufficiently high so that the surface after compaction can be trimmed to the final grade, and any loose material resulting from this operation removed. All depressions caused by the finishing rollers shall be removed during the final blading operation.

3.4 EXCAVATION BELOW GRADE

- .1 Unsuitable Materials: When topsoil, muskeg, or other soft areas are encountered below the finished subgrade, which in the opinion of the Departmental Representative require removal, the area shall be undercut and the unsuitable material excavated, loaded and disposed of outside of Waterton National Park. These materials shall be replaced with suitable common excavation.
- .2 Placing Fill: Fill material shall be placed in successive horizontal layers not exceeding 150 mm. Suitable spreading and leveling equipment shall be kept in continuous operation at all times.
- .3 Compaction: The compaction will be sufficient to obtain a minimum density of 98% of maximum dry density in accordance with ASTM D698 (Method C or D), unless otherwise stated in the specifications. Where it is necessary to add or remove moisture from the soil to obtain the compaction, it shall be done as part of the requirements of this section.
- .4 Finishing: The fill section shall be compacted to a level slightly above the finished grade, and cut back to the final elevation. All loose material shall be removed from the surface of the subgrade.

3.5 THE FOLLOWING TESTS SHAL BE EMPLOYED TO ESTABLISH COMPACTION PROCEDURES:

- .1 The maximum dry density of the soil shall be determined by ASTM procedure D-698 (Moisture Density Relationships of soils), to be determined for each soil type. The optimum moisture content of the soil shall be determined from the laboratory compaction curve established.
- .2 The field density of soils shall be determined by ASTM D-2922 – Determining density of soil and soil aggregate in place by nuclear methods (shallow depth).

3.6 NORMAL COMPACTED THICKNESSES OF LIFTS

Equipment Type	Cohesive Soils	Non-Cohesive Soils
Vibratory Sheepsfoot Packer	300 mm	300 mm
Sheepsfoot Packer	200 mm	--
Pneumatic Tire	200 mm	200 mm
Vibratory Roller	150 mm	300 mm
Pneumatic Tamper (contact area < 130 sq cm)	100 mm	100 mm
Pneumatic Tamper (contact area > 130 sq cm)	100 mm	100 mm
Mechanical Tamper (diesel or gas – jumping jack)	100 mm	200 mm

- .1 Thickness of lifts for other equipment shall be determined by laboratory testing procedures during the construction process. The Departmental Representative may grant approval in writing to alter lift thicknesses upon evidence of satisfactory compaction at other lift thicknesses.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 SAMPLES

- .1 At least two (2) weeks prior to commencing work, inform the Departmental Representative of proposed source of aggregates and provide access for sampling.

2.2 MATERIALS CERTIFICATION

- .1 Aggregates: At least two (2) weeks prior to commencing work provide:
- .1 Test data reports representing granular base and/or granular sub-base processed into stockpile. Submit one (1) complete aggregate gradation analysis report for every 1,000 tonnes of each material required for the project or one complete analysis for each production day when production is less than 1,000 tonnes. Include percentage of crushed coarse aggregate particles in granular base reports.
 - .2 Certification that the physical properties of the aggregates meet the requirements of this section.
 - .3 Reports and certification shall be provided by an independent testing consultant under the signature and professional seal of a qualified materials engineer.
- .2 At least two (2) weeks prior to contemplated change in source of aggregates, provide written notification to the Departmental Representative and provide new materials certification in accordance with the requirements of this section.

2.3 GRANULAR BASE

- .1 Crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
- .2 Physical properties of Aggregates:
- | | |
|---|---------|
| % Fracture, by weight (2 faces) | 60 min. |
| Los Angeles Abrasion, loss, % | 45 max. |
| Liquid Limit, % | 25 max. |
| Plasticity Index, % | 6 max. |
| Lightweight Particles, % | 5 max. |
| California Bearing Ratio, when compacted to 100% of ASTM D698 | 80 min. |
- .3 Gradation to be within the following limits when tested to ASTM C-117 with sieve sizes to CAN/CGSBD 8-GP-2M rather than ASTM E11, and to have a smooth curve without sharp breaks when plotted on a semi-log grading chart.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
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25 000	100
16 000	73-94
10 000	56-80
5 000	40-66
1 250	24-45
315	13-27
160	9-19
80	4-10

2.4 GRANULAR SUB BASE

- .1 Crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

- .2 Physical properties of Aggregates:

Los Angeles Abrasion, loss, %	50 max.
Liquid Limit, %	25 max.
Plasticity Index, %	6 max.
Lightweight Particles, %	5 max.
California Bearing Ratio, when compacted to 100% of ASTM D698	20 min.
Crushed particles (1 face plus 5 000 sieve fraction), %	25 min.

- .3 Gradation to be within the following limits when tested to ASTM C-136 and ASTM C-117 with sieve sizes to CAN/CGSBD 8-GP-2M rather than ASTM E11, and to have a smooth curve without sharp breaks when plotted on a semi-log grading chart.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
75 000	100
25 000	65-100
10 000	40-100
5 000	30-90
2 500	25-65
630	15-35
160	5-15
80	3-10

2.5 SCREENED GRANULAR BASE

- .1 Screened stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

- .2 Physical properties of Aggregates:

Los Angeles Abrasion, loss, %	50 max.
Liquid Limit, %	25 max.
Plasticity Index, %	6 max.
Lightweight Particles, %	5 max.
California Bearing Ratio, when compacted to 100% of ASTM D698	20 min.

- .3 Gradation to be within the following limits when tested to ASTM C-136 and ASTM C-117 with sieve sizes to CAN/CGSBD 8-GP-2M rather than ASTM E11, and to have a smooth curve without sharp breaks when plotted on a semi-log grading chart.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
75 000	100
25 000	65-100
10 000	40-100
5 000	30-90
2 500	25-65
630	15-35
160	5-15
80	3-10

2.6 SCREENED GRANULAR SUB-BASE

- .1 Screened stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

- .2 Physical properties of Aggregates:

Los Angeles Abrasion, loss, %	50 max.
Liquid Limit, %	25 max.
Plasticity Index, %	6 max.
Lightweight Particles, %	5 max.
California Bearing Ratio, when compacted to 100% of ASTM D698	20 min.

- .3 Gradation to be within the following limits when tested to ASTM C-136 and ASTM C-117 with sieve sizes to CAN/CGSBD 8-GP-2M rather than ASTM E11, and to have a smooth curve without sharp breaks when plotted on a semi-log grading chart.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
75 000	100
25 000	60-100
10 000	40-80
5 000	25-65
630	10-35
160	5-15
80	3-10

Part 3 Execution

3.1 PREPARATION

- .1 The Contractor shall maintain the subgrade to the specified section, free from ruts, waves and undulations until granular sub-base material is placed. The subgrade shall be in a firm dry condition and must be approved by the Departmental Representative before gravel is placed. The depositing of granular base or sub-base on a soft, muddy or rutted subgrade will not be permitted.

3.2 PLACING

- .1 Place material on a clean unfrozen surface, properly shaped and compacted and free from snow and ice.
- .2 Place using methods which do not lead to segregation or degradation of aggregate. Use approved methods to create uniform windrow of material along a crown line or high side of a one-way slope.
- .3 Place material to full width in layers not exceeding 150 mm in compacted thickness.
- .4 Shape each layer to a smooth contour and compact to the specified density before succeeding layer is placed.
- .5 Remove and replace any portion of a layer in which material becomes segregated during compaction.

3.3 COMPACTING

- .1 Moisture condition of granular sub-base and base course materials to be within plus or minus 3 percent of the optimum moisture content of the material.
- .2 Compact to density not less than 98% of maximum dry density in accordance with ASTM D698 (Method C or D).
- .3 Shape and compact alternately to obtain a smooth, even and uniformly compacted base.
- .4 In areas not accessible to rolling equipment, compact to specified density with approved mechanical tampers.

3.4 FINISH TOLERANCES

- .1 Finished sub-base and base surfaces shall be within plus or minus 10 mm of established grade, but not uniformly high or low.
- .2 Correct surface irregularities by loosening and adding or removing materials until surface is within the specified tolerances.

3.5 MAINTENANCE

- .1 Maintain finished base in a condition conforming to this section until succeeding material is applied or until acceptance.

3.6 TESTING

- .1 The Departmental Representative shall perform all quality assurance tests for acceptance in accordance with the requirements of this section. Test data provided shall be final and binding on both the Department and the Contractor.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.2 DEFINITIONS

- .1 End Product Specification (EPS) – A specification whereby the methods of construction are not defined. Under EPS the Departmental Representative will monitor the Contractor's control of the process that produces the items of construction and will accept or reject the end product according to a specified acceptance plan. The Contractor is responsible for quality control. End product acceptance, including quality acceptance is responsibility of the Departmental Representative.
- .2 Project Category – For the purposes of this specification, projects are to be identified as Category A or Category B. Generally, Category A projects have asphalt concrete quantities greater than 2,000 tonnes of any one mix type; and Category B projects have quantities of any one mix type less than 2,000 tonnes.
- .3 Lot – A lot is a portion of the Work being considered for acceptance, and is defined as the following:
 - .1 Category A projects – One day of plant production, per mix type, when the day's quantity is greater than 1,000 tonnes. When a day's production is less than 1,000 tonnes, the material may be added to the previous or subsequent day(s) of production, at the Departmental Representative's discretion. The maximum Category A lot size shall be 2,000 tonnes.
 - .2 Category B projects – The entire project quantity for each mix type.
 - .3 At the Departmental Representative's discretion, any portion of the Work may be deemed a lot.

Part 2 Products

2.1 MATERIALS

- .1 Aggregates:
 - .1 Coarse aggregate is aggregate retained of the 5 000 µm sieve; fine aggregate is aggregate passing the 5 000 µm sieve.
 - .2 Aggregate material shall be crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
 - .3 Gradation to be within limits specified, when tested to ASTM C-136 and ASTM C-117 with sieve sizes to CAN/CGSB 8-GP-2M rather than ASTM E11.
 - .4 Aggregate shall be processed to meet the following requirements:
 - .1 Natural fines shall be pre-screened and stockpiled with not more than 10% of material retained in the 5 000 µm sieve and 100% passing the 10 000 µm sieve.

- .2 Fine fraction or manufactured sand to contain not more than 20% of material retained on the 5 000 µm sieve.
- .5 Physical properties of aggregates to meet the requirements in Table 2.1.1.5

Table 2.1.1.5
Aggregate Physical Property Requirements

REQUIREMENT	TEST STANDARD	MIX TYPES I, II AND III
Los Angeles Abrasion, Grading B (% loss)	C131	32.0 max.
Magnesium Sulphate Soundness (% loss)	C88	
Coarse Aggregate:		12.0 max.
Fine Aggregate:		12.0 max.
Lightweight Particles (%)	C123	1.5 max.

- .6 Blend sand:
 - .1 To consist of natural or manufactured sand passing the 5 000 µm sieve.
 - .2 Stockpile volumes shall be maintained to ensure a minimum of 5 000 tonne of plant mix production at all times.
- .7 Blended Aggregate Requirements:
 - .1 Aggregate Gradation Requirements, including RAP, to meet the requirements of Table 2.1.1.7.1.

Table 2.1.1.7.1
Blended Aggregate Gradation Requirements

SIEVE SIZE (µm)	Percent Passing					
	Type I		Type II		Type III	
	Max.	Min.	Max.	Min.	Max.	Min.
25 000	-	-	100	100	-	-
20 000	-	100	95	85	-	-
16 000	100	97	88	77	-	100
12 500	95	85	80	65	100	90
10 000	85	70	72	57	90	75
5 000	65	50	55	40	75	60
2 500	50	40	42	30	60	45
1 250	40	30	33	23	45	30
630	30	20	27	17	36	22
315	23	15	22	12	27	15
160	16	6	15	6	18	6
80	8.0	4.0	8.0	4.0	10.0	4.0

- .2 Coarse Aggregate Fracture: Of coarse fraction (retained on 5 000 µm sieve size) the percentage of particles with two (2) or more fractured faces shall be by mass:
 - .1 Mix Type I – 80% minimum
 - .2 Mix Type II – 60% minimum
 - .3 Mix Type III – 80% minimum
- .3 Flat and Elongated Particles: Of coarse fraction (retained on the 5 000 µm sieve size) the percentage of flat and elongated particles greater than a 5:1 ratio shall be by mass less than 10%.
- .4 Manufactured Sand: Of total fine fraction (passing 5 000 µm sieve size), manufactured sand shall be by mass:
 - .1 Mix Type I – 70% minimum
 - .2 Mix Type II – 50% minimum
 - .3 Mix Type III – 50 % minimum
- .5 For mixes incorporating RAP, 50% of the RAP sand portion shall be considered manufactured sand.
- .6 The sand equivalent value (ASTM D2419, mechanical method) determined for the fine aggregate portion shall be:
 - .1 Mix Types I and III – 45% minimum
 - .2 Mix Type II – 40% minimum
- .7 Of total aggregate, the maximum RAP portion shall be by mass:
 - .1 Mix Type I – 15% maximum
 - .2 Mix Type II – 15% maximum
 - .3 Mix Type III – 20% maximum
- .8 Delivery and Storage
 - .1 Aggregates: Stockpile minimum of 50% of total amount of aggregate required before commencing trial mix designs.
 - .2 Reclaimed Asphalt Pavement (RAP): Stockpile minimum of 100% of total amount of RAP required before commencing trial mix designs.

2.2 MIX DESIGN

- .1 An asphalt mix design must be prepared and submitted to the Departmental Representative for review and approval at least one week prior to the work. The Contractor shall use qualified engineering and testing services licensed to practice in the Province of Alberta.
- .2 The mix design shall follow the Marshall method of mix design as outlined in the latest edition of the Asphalt Institute Manual Series No. 2 (MS-2), and shall include five separate trial values of asphalt content.
- .3 Design of mix:
 - .1 Mix Types I and II – 75 blows on each face of test specimens.
 - .2 Mix Type III – 50 blows on each face of test specimens.

- .4 Include the following data with mix design submission:
 - .1 Aggregate specific gravity and asphalt absorption.
 - .2 Sand equivalent, coarse aggregate fracture, flat and elongated particles, and percent manufactured sand values.
 - .3 Asphalt cement supplier/refinery, specific gravity and mixing and compaction temperatures, based on temperature-viscosity properties of asphalt cement.
 - .4 Job mix formula including aggregate gradation and blending proportions, and design asphalt content.
 - .5 Maximum relative density at each trial asphalt content.
 - .6 Where reclaimed asphalt pavement (RAP) is to be incorporated into the mix supply, RAP gradation, RAP asphalt cement content and design recycle percentage.
 - .7 Data to satisfy the requirements of the following:

Table 2.2.4.7
Mixture Physical Property Requirements

PROPERTY	REQUIREMENTS		
	Mix Type		
	I	II	III
Marshall Stability (kN)	10.0 min.	10.0 min.	5.4 min.
Marshall Flow (0.25 mm units)	8 - 14	8 – 15	8 – 14
Air Voids (%)	3.8 – 4.2	4.3 – 4.7	2.8 – 3.2
Voids in Mineral Aggregate (VMA) (%)	13.5 – 15.0	12.5 – 14.0	14.0 – 16.0
Voids Filled With Asphalt (VFA) (%)	65 – 75	60 – 70	70 – 80
Film Thickness (µm)	7.0 – 8.5	6.0 – 8.0	7.0 min.

2.3 JOB MIX FORMULA

- .1 Subject to approval by the Departmental Representative, the aggregate proportioning (including RAP), target gradation, asphalt content and air void content from the Mix Design will become the Job Mix Formula for the supply of hot mix asphalt.
- .2 Once established, no alterations to the Job Mix Formula will be permitted unless the Contractor submits a new Job Mix Formula and approved by the Departmental Representative.
- .3 If the sum of any alterations to the Job Mix Formula is in excess of any one of the following limits, a new Mix Design is required.
 - ± 5% passing the 5 000 µm sieve size
 - ± 1% passing the 80µm sieve size
 - ± 0.30% asphalt content

- .4 Any alteration to the Job Mix Formula shall not result in properties which do not meet the requirements of this Specification.

2.4 PRODUCTION TOLERANCES

- .1 All mixtures shall be supplied to the Job Mix Formula within the range of tolerances specified.
- .2 Asphalt cement content: $\pm 0.30\%$ of JMF value.
- .3 Temperature: Mix temperature at point of plant discharge shall not vary from that specified in the JMF by more than $\pm 10^{\circ}\text{C}$.
- .4 Aggregate Gradation:

AGGREGATE PASSING SIEVE SIZE (μm)	TOLERANCE (% BY MASS)
Max. Size to 5 000	± 5.0
2 500 & 1 250	± 4.0
630 & 315	± 3.0
160	± 2.0
80	± 1.0

- .5 Air Voids: $\pm 1.0\%$ of the JMF value.
- .6 Mixture Properties: Marshall Stability, Marshall Flow, Voids Filled with Asphalt, Voids in Mineral Aggregate, and Film Thickness as per requirements identified in Table 2.2.4.7.
- .7 Moisture in Mix: Maximum permissible moisture, at point of plant discharge, is 0.2% by mass of mix.
- .8 Asphalt cement recovered from freshly produced hot mix by the Abson Method, ASTM D1856 and subsequently tested in accordance with ASTM D5, shall retain a minimum value of 50% of its original penetration value.

Part 3 Sampling and Testing

3.1 GENERAL

- .1 The Departmental Representative shall have access to all production processes and materials used for the work to monitor material quantity as often as deemed necessary. Such inspection and testing shall not relieve the Contractor of the responsibility for meeting the requirements of this specification.
- .2 At least three (3) weeks prior to commencing work, inform the Departmental Representative of the proposed source of aggregates and provide access for sampling, and provide samples of asphalt cement.

3.2 QUALITY CONTROL

- .1 Quality control is the responsibility of the Contractor throughout every stage of the work from aggregate processing to the final accepted product. Tests performed by the Departmental Representative will not be considered as quality control tests.
- .2 The Contractor shall be totally responsible for production of materials and construction that meets all specified requirements.
- .3 All quality control shall be conducted by qualified personnel. The Contractor shall bear the cost of all quality control testing and consulting services.
- .4 Pre-Production testing and sampling and minimum frequencies are described in Table 3.2.4, Pre-Production Quality Control Requirements.

Table 3.2.4
Pre-Production Quality Control Requirements

Quality Control Requirement	Test Standard	Minimum Frequency
Asphalt Cement Certification	-	Once per year or for change in supplier.
Aggregate Physical Properties Table 2.1.1.5	Table 2.1.1.5	Once per year, or for change in source.
Crushed Coarse Aggregate Gradation Analysis and Fracture Content	ASTM C 136 ASTM D 5821	One for every 1,000 tonnes of each class of material processed into stockpile, or one analysis for each material, every production day when production rate is less than 1,000 tonnes.
Manufactured Sand Aggregate Gradation	ASTM C 117 ASTM C 126	
Natural Fine Aggregate Gradation	ASTM C 117 ASTM C 126	
Blend Sand Aggregate Gradation	ASTM C 117 ASTM C 126	
Reclaimed Asphalt Pavement (RAP) Asphalt Content and Extracted Aggregate Gradation	ASTM D 2172 ASTM C117 ASTM C 136	One for each 500 tonnes delivered to stockpile, or one for each location when delivery rate is less than 500 tonnes.
Penetration of Asphalt Cement Recovered from RAP by Abson Method	ASTM D 1856 ASTM D 5	One for each 2,000 tonnes delivered to stockpile.
Trial Mix Design by Marshall Method Section 2.2	Asphalt Institute MS-2	One per mix type every 3 years, or as required for a change in asphalt cement supply, aggregate gradation or aggregate source. See Note 1.

Plant Calibration	-	As required.
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Note 1: A laboratory/plant JMF verification is required each year when a trial mix design is not conducted.

- .5 Post-Production testing and sampling at minimum frequencies are described in Table 3.2.5, Recommended Post-Production Quality Control Requirements.

Table 3.2.5
Recommended Post-Production Quality Control Requirements

Quality Control Requirement	Test Standard	Minimum Frequency
Hot Mix Asphalt Analysis (including Asphalt Content, Aggregate Gradation, Marshall Density and Void Properties)	ASTM D 6307 ASTM C117 ASTM C 136 ASTM D 3203	One for every 500 tonnes of each mix type supplied under this specification. See note 1.
Quality Control Charts (including 3 test running average for Binder Content, Aggregate Gradation, Marshall Density and Void Properties)	-	For each hot mix analysis. Test results and updated 3 test running average to be submitted to the Departmental Representative as they become available.
Hot Mix Asphalt Temperature	-	Minimum frequency not specified.
Cold Feed Aggregate Analysis	ASTM C 117 ASTM C 1236	Minimum frequency not specified.
Maximum Relative Density of Hot Mix Asphalt	ASTM D 2041	Minimum frequency not specified.
Compaction Monitoring (Core or Nuclear Density)	ASTM D 2726 ASTM D 2950	Minimum frequency not specified. See note 2.

Note 1: Where an individual test indicates non-compliance, another test shall be initiated immediately.

Note 2: Coring is subject to approval by the Departmental Representative.

- .6 Pre-Production Quality Control test data as specified in Table 3.2.4 shall be reported to the Departmental Representative one week prior to commencing the project, or as requested.
- .7 Post-Production Quality Control test data as specified in Table 3.2.5 shall be reported to the Departmental Representative daily as the work proceeds.

3.3 QUALITY CONTROL COMPLIANCE WITH SPECIFIED TOLERANCES

- .1 Asphalt Content, Aggregate Gradation and Mixture Properties
- .1 The test data derived by Post-Production Quality Control mix testing, described in Section 3.2, shall be compared to the tolerances set forth in Section 2.4 of this specification. The Contractor shall document, and make available to the

Departmental Representative, any adjustments made to correct non-compliance with the specified tolerances.

- .2 The Contractor shall suspend mix production when the 3 test running average for any property is outside of the specified tolerance limits for three consecutive tests. Supply shall not commence again until it is demonstrated that corrective action has been taken.

- .2 Hot Mix Asphalt Temperature

- .1 Plant mix that does not meet temperature requirements of Section 2.4.3, at the point of plant discharge shall be subject to rejection at the discretion of the Departmental Representative.

3.4 ACCEPTANCE SAMPLING AND TESTING

- .1 Within this specification, certain requirements, limits and tolerances are specified regarding supplied materials and workmanship. Compliance with these requirements shall be determined from acceptance testing as described in this section.
- .2 Acceptance testing is the responsibility of the Departmental Representative.
- .3 Initial acceptance testing will be undertaken free of cost to the Contractor.
- .4 Sampling and acceptance testing is described in Table 3.4.4, Acceptance Testing Requirements – Category A & B Projects.

Table 3.4.4
Acceptance Testing Requirements – Category A & B Projects

Acceptance Testing	Test Standard	Minimum Frequency
Hot Mix Asphalt Analysis (including Binder Content, Aggregate Gradation, Marshall Density, Maximum Relative Density, Void Properties, Marshall Stability and Flow)	ASTM D 6307 ASTM C 117 ASTM C 136 ASTM D 2041 ASTM D 3203	For each mix type, one test for each 3,500 sq.m. of placement, or three tests per lot, whichever is greater. See note 1.
Compaction Testing (Core Density) and Thickness Determination	ASTM D 2726 ASTM D 3549	For each mix type, one test for each 2,000 sq.m. of placement, or three tests per lot, whichever is greater.
Hot Mix Asphalt Temperature	-	No minimum frequency.

Note 1: For Category B projects, the Departmental Representative may, at their discretion, acquire the minimum number of mix samples, but reduce the number of tests to a minimum of one (1). Should non-compliance be indicated by the sample(s) tested, the Departmental Representative reserves the option to test the remaining samples.

- .5 Acceptance Sampling Procedures:

- .1 Loose mix samples shall be acquired from the Work site in accordance with Albert Transportation Test (ATT) procedure ATT-37. Auger samples may be used if approved by both the Departmental Representative and the Contractor.
- .2 The timing of mix sampling shall be stratified, with each sample representing a similar production quantity.
- .3 Core locations will be selected using stratified random sampling procedures. The lot will be divided into segments meeting or exceeding the minimum frequency in Table 3.4.4 and of approximately equal area. In each segment a test site will be located using random numbers to determine the longitudinal and transverse coordinates.
- .4 Areas within 3 metres of transverse joints or 0.3 metres of a mat edge are excluded from compaction acceptance sampling and testing.
- .6 Reporting Protocols
 - .1 Test reporting accuracy shall be as stipulated in the referenced test procedures, including:
 - .1 Gradation to the nearest whole number, except the percent passing the 80 μ m sieve, which shall be reported to the nearest 0.1%.
 - .2 Binder content to the nearest 0.01%.
 - .3 Air voids and compaction to the nearest 0.1%.
 - .4 Thickness to the nearest whole millimeter (mm).
 - .2 Lot averages shall be reported to the same accuracy as test results.

3.5 APPEAL OF ACCEPTANCE TESTING RESULTS

- .1 General
 - .1 The Contractor may appeal the results of acceptance testing for Compaction Standard, Asphalt Content or Air Voids for any lot subject to rejection or unit price reduction. The notice of appeal shall be in writing and submitted to the Departmental Representative within 48 hours of receipt of the acceptance testing results.
 - .2 Appeals will only be considered if cause can be shown and the requirements of Table 3.2.5 have been satisfied.
 - .3 Quality Control tests initiated after the Contractor's receipt of the acceptance testing results will not be considered when evaluating cause for appeal.
 - .4 For Category A projects, only Quality Control testing during production for the subject project will be considered when evaluating cause for appeal. For Category B projects, Quality Control test results from production prior to the subject project may be considered when evaluating cause for appeal.
- .2 Asphalt Content Appeal
 - .1 A stratified random sampling plan shall be developed by the Departmental Representative with the same number of segments as the original number of samples for the subject lot. Sufficient core samples will be acquired from each segment to enable asphalt content determinations.

- .2 For asphalt content appeal testing, the Contractor will have the option for the testing to be done by the Departmental Representative or an independent testing laboratory selected by the Departmental Representative.
 - .3 The average of the appeal test results will be used for acceptance and unit price adjustment, and shall be binding on both the Departmental Representative and the Contractor.
 - .4 If the average appeal test result verifies that any unit price reduction of rejection applies for that Lot, the costs of the appeal sampling and testing will be borne by the Contractor. If the results show that a penalty or rejection no longer applies, the sampling and appeal costs will be the responsibility of the Departmental Representative.
- .3 Compaction Standard or Air Void Appeals
- .1 The testing laboratory conducting the project acceptance sampling and testing will routinely retain companion samples sufficient for the determination of maximum relative density and/or Marshall density.
 - .2 For compaction standard or air void (Marshall density) appeal testing, the Contractor will have the option for the testing to be done by the Departmental Representative or an independent testing laboratory selected by the Departmental Representative.
 - .3 The average of the appeal test results will be used for acceptance and unit price adjustment, and shall be binding on both the Departmental Representative and the Contractor.
 - .4 If the new compaction standard verifies that any unit price reduction of rejection applies for that Lot, the costs of the appeal sampling and testing will be borne by the Contractor. If the results show that a penalty or rejection no longer applies, the appeal costs will be the responsibility of the Departmental Representative.

Part 4

4.1 CONTINUITY OF PRODUCTION

- .1 During the time period that work is in progress on any project for which this specification is in effect, and at the Departmental Representative's discretion, the plant may be limited to producing only the mix type required for that project.

4.2 MIX PRODUCTION

- .1 Preparation of Mineral Aggregate
 - .1 The Mineral aggregates shall be at as low a temperature as is consistent with proper mixing and lay down and in no case to exceed 165°C.
- .2 Composition of Mixture
 - .1 The mineral aggregate, reclaimed asphalt pavement (where applicable) and asphalt cement shall be mixed in a manner to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated.
 - .2 Incorporate RAP such that it does not come in direct contact with the burner flame.

- .3 Plant emissions shall not exceed the limits set by Alberta Environment.

4.3 PREPARATION FOR PAVING

- .1 The Contractor shall provide the Departmental Representative a minimum of six hours notice of the intention to commence paving over any previously approved primed or tacked surface.
- .2 The hot asphalt mixture shall be laid upon a dry firm surface, true to grade and cross-section and free from all loose or foreign material. No hot mix shall be placed when the surface is wet or when other conditions prevent proper spreading, finishing or compaction.
- .3 If undercutting, and subsequent backfill with asphalt concrete is done, the backfill operation shall be performed sufficiently far ahead of the paving operation to allow the asphalt concrete time to cool down enough to support equipment.

4.4 HOT MIX ASPHALT PLACING TEMPERATURE

- .1 No hot mix asphalt shall be dispatched to the field unless the temperature, as issued by Environment Canada, is rising and meets the following minimum temperature requirements.
 - .1 Thickness less than 50 mm: 7°C
 - .2 Thickness greater than 50 mm: 2°C
- .2 A tolerance will be permitted for plant start-up.
- .3 No surface lift asphalt shall be placed regardless of temperature until the road surface is 5°C or higher.

4.5 HOURS OF OPERATION

- .1 No loads of hot mix asphalt shall be dispatched from the plant after sunset or during hours of darkness unless loads can be placed and compacted in accordance with these specifications, and suitable artificial illumination is provided, all subject to the Departmental Representative's approval.

4.6 TRANSPORTATION OF HOT MIX ASPHALT

- .1 Trucks shall be equipped with tarpaulins of sufficient weights and size to cover the entire open area of the truck box. Regardless of weather conditions, tarpaulins shall be used.
- .2 Vehicles used for the transportation of hot mix asphalt from the plant to the site of work shall have tight metal boxes previously cleaned of all foreign matter. The inside surface may be lightly lubricated with a soap solution just before loading. Excess lubrication will not be permitted.
- .3 For purposes of checking asphalt mixture temperatures, trucks shall have an accessible 13 mm diameter hole drilled into the driver's side of the truck box, at a distance of 0.3 metres from the bottom of the box and 150 mm clear of the reinforcing ribs.
- .4 The speed and weight of hauling trucks shall be regulated so that, in the opinion of the Departmental Representative, no damage will occur to any portion of the work underway. The Contractor at their own expense shall repair any damage to the tack coat, prime coat or the existing surface caused by the Contractor's equipment.

4.7 HOT MIX ASPHALT SPREADERS

- .1 The spreading machine shall be self-propelled and capable of placing a uniform layer of asphalt mix to the depth and grades as shown on the plans or as indicated by the Departmental Representative.
- .2 The screed shall include a tamping bar or vibratory strike-off device for use when required. The screed shall strike-off the mix to the depth and cross-section specified and produces a finished surface of uniform texture.
- .3 Control of the screed shall be by automatic sensing devices. Longitudinal control shall be accomplished by a sensor, which follows a string line, ski, or other reference. The grade sensor shall be movable and mounts provided so that grade control can be established on either side of the paver. A slope control sensor shall also be provided to maintain the proper transverse slope of the screed. Use automatic grade control for paving operations.

4.8 HAND TOOLS

- .1 Only lutes shall be used during the spreading operation and when the asphalt is worked by hand in areas in which the paver cannot reach.
- .2 Tamping irons may be used to consolidate the material along structures inaccessible to the rollers. Mechanical compaction equipment, satisfactory to the Departmental Representative, may be used instead of tamping irons.
- .3 For purposes of checking the finished surface, the Contractor must provide and carry on each paving machine a 3 metre straight edge and slope measuring level.

4.9 PRE-LEVELLING FOR ASPHALT CONCRETE

- .1 Pre-levelling of uneven surfaces over which asphalt concrete is to be placed shall be accomplished by the use of asphalt concrete placed with a grader, paver, hand or by a combination of these methods as directed by the Departmental Representative.
- .2 After placement, the asphalt concrete used for pre-levelling shall be compacted thoroughly with pneumatic tired rollers.

4.10 PAVING OPERATIONS

- .1 The asphalt concrete shall be placed to the design thickness as shown on the contract drawings. On new construction where an established reference is lacking, a string-line reference will be required. Adjacent mats on the same lift are to be controlled by use of the grade sensor. No relaxation of the above procedure will be permitted without written approval of the Departmental Representative.
- .2 The spreader shall be operated in such a manner as to distribute the asphalt concrete mix to proper cross section, width and thickness without causing segregation of the mix. Segregated areas, which may occur, shall be corrected immediately. The forward motion of the spreader shall be controlled so that no irregularities in the pavement surface are caused by excessive speed. The rate of placement of the mixture shall be uniform, and shall be co-ordinated with the production rate of the asphalt plant without intermittent operation of the spreader.

- .3 Any failure of the machine or operation to produce a smooth, uniformly dense mat, free from irregularities, shall be corrected immediately to the satisfaction of the Departmental Representative.

4.11 AREAS INACCESSIBLE TO THE PAVING MACHINE

- .1 Areas that are inaccessible to the paving machine may be paved by other methods, as approved by the Departmental Representative.
- .2 In small areas or where the use of mechanical equipment is not practical, the mix may be spread and finished by hand. The asphalt mixture shall be dumped on the area and immediately thereafter distributed into place by shovels and spread with lutes in a loose uniform layer uniform density and correct depth. Material must be handled so as to avoid segregation.

4.12 COMPACTION

- .1 The Contractor shall supply sufficient compaction equipment to:
 - .1 Provide a compaction rate that will equal or exceed the placing rate of the spreader.
 - .2 Ensure the specified compaction is attained before the temperature of the mat falls below 80°C.

4.13 LONGITUDINAL AND TRANSVERSE JOINTS

- .1 Longitudinal and transverse joints shall be made in a manner consistent with industry standards. Coarse aggregate removed from the hot mix during joint preparation shall not be broadcast onto the mat.
- .2 Paving joints shall not be placed in the same vertical plane. Longitudinal joints shall be offset at least 150 mm and transverse joints shall be offset at least 2 metres.
- .3 Longitudinal joints shall not be located within travel lanes, unless approved by the Departmental Representative.
- .4 Edges where additional pavement is to be placed shall be vertically formed to true line. A lute shall be used immediately behind the paver when required to obtain a true line and vertical edge.
- .5 The exposed edges of all cold asphalt joints and the face of concrete curb and gutter shall be cleaned and painted with a thin coat of asphalt tack.
- .6 At the end of each day's paving of the surface course and upper lift of the base course mix, the uncompleted paving mats shall be provided with vertically cut transverse joints. Joints between old and new pavements or between successive days' work shall be carefully made in such a manner as to ensure a thorough and continuous bond between the old and new surfaces.

4.14 OPENING TO TRAFFIC

- .1 Prior to any application of traffic, paving mats shall be sufficiently cool to resist and deformation or surface scuffing.
- .2 The Departmental Representative may, at their discretion, require means of cooling (e.g. application of water) completed pavements prior to opening to traffic.

- .3 At their discretion, the Departmental Representative may prohibit traffic from travelling on newly paved surfaces for any length of time deemed necessary.

Part 5

5.1 GENERAL

- .1 The Contractor shall provide an end product conforming to the quantity and tolerance requirements of this specification. Where no tolerances are specified, the standard of workmanship shall be in accordance with accepted industry standards.
- .2 Acceptance of any Lot at full or increased payment will occur if there are no obvious defects and the Lot mean results for asphalt content, pavement density, air voids and thickness meet or exceed the specified tolerances.
- .3 Unit price reductions will only be applied on the basis of full acceptance testing in accordance with Table 3.4.4.

5.2 ASPHALT CONTENT

- .1 For full payment, the Lot Mean Asphalt Content must be within $\pm 0.30\%$ of the approved JMF value, as specified in Section 2.4.
- .2 Payment adjustment for asphalt content is as follows:

Asphalt Content Deviation from JMF Value (%)	Payment Adjustment Factor
± 0.30 or less	1.00
± 0.31 to ± 0.50	As per Chart A
Greater than ± 0.50	Reject (Note 1)

Note 1: Subject to removal and replacement at the discretion of the Departmental Representative.

5.3 PAVEMENT COMPACTION

- .1 For full or increased payment, the Lot Mean Pavement Compaction must be equal to or greater than 93% of the Lot Mean Maximum Relative Density.
- .2 Payment adjustment for pavement compaction is as follows:

Pavement Compaction % of Maximum Relative Density	Payment Adjustment Factor
94.6 to 95.5 (Note 1)	1.03
93.5 to 94.5 (Note 1)	1.02
93.0 to 93.4	1.00

90.0 to 92.9	As per Chart B
Less than 90.0	Reject (Note 2)

Note 1: Where no individual test result is less than 93% otherwise the payment adjustment factor 1.00.

Note 2: Subject to removal and replacement at the discretion of the Departmental Representative.

5.4 AIR VOID CONTENT

- .1 For full payment, the Lot Mean Air Voids must be within $\pm 1.0\%$ of the JMF value, as specified in Section 2.4.
- .2 Payment adjustment for air void content is as follows:

Air Void Content % Deviation from JMF Value	Payment Adjustment Factor
Less than 1.0	1.00
1.0 to 2.0	As per Chart C
Greater than 2.0 (Lower Lifts)	0.80
Greater than 2.0 (Upper Lifts)	0.60

5.5 THICKNESS (NEW CONSTRUCTION AND TOP LIFT ONLY)

- .1 Pavement of any type found to be deficient in thickness by more than 13.0 mm shall be removed and replaced by pavement of specified thickness, at the Contractor's expense.
- .2 The Lot Mean Thickness for any Lot will be determined on the basis of the acceptance cores described in Table 3.4.4. Core thickness shall be determined in accordance with ASTM D 3549.
- .3 If the deficiency of any individual core exceeds 13 mm, additional cores may be extracted in the proximity to the location of the core of excessive deficiency, to identify the extremities of the pavement area subject to be removed and replaced. The Contractor shall pay for such additional coring.
- .4 For full payment, the Lot Mean Thickness must be equal to, or greater than, the specified thickness.
- .5 Payment adjustment for the thickness is as follows:

Average Thickness Compared to Specified Thickness	Payment Adjustment Factor (Note 1)	
	Total Thickness (Single or Multiple Lifts)	Top Lift Thickness (Multiple Lifts)
Compliant or Greater	1.00	1.00

1 mm to 13 mm Deficient	As Per Chart D	As Per Chart D
More than 13 mm Deficient	Reject (Note 2)	Reject (Note 2)

Note 1: As single Thickness Payment Adjustment Factor shall be applied. Total Thickness of Top Lift Thickness, whichever results in the greatest adjustment.

Note 2: Subject to removal and replacement at the discretion of the Departmental Representative.

5.6 SMOOTHNESS

- .1 The completed asphalt concrete surface shall be true to the dimensional and tolerance requirements of the specifications and drawings. Unless detailed otherwise in the contract documents, the tolerances in both profile and crown are:
 - .1 Base course: 10 mm in 3 m
 - .2 Surface Course: 5 mm in 3 m
- .2 When deviations in excess of the above tolerances are found, the pavement surface shall be corrected by methods satisfactory to the Departmental Representative. Correction of defects shall be carried out until there are no deviations anywhere greater than the allowable tolerances.

5.7 SEGREGATION

- .1 The finished surface shall have a uniform texture and be free of segregated areas. A segregated area is defined as an area of the pavement where the texture differs visually from the texture of the surrounding pavement.
- .2 All segregation will be evaluated by the Departmental Representative to determine repair requirements.
- .3 The severity of segregation will be rated as follows:
 - .1 Slight: The matrix of asphalt cement and fine aggregates is in place between the coarse aggregate particles, however there is more stone in comparison to the surrounding acceptable mix.
 - .2 Moderate: Significantly more stone than the surrounding mix, and exhibit a lack of surrounding matrix.
 - .3 Severe: Appears as an area of very stony mix, stone against stone, with very little or no matrix.
- .4 Segregated areas shall be repaired by the Contractor as directed by the Departmental Representative. The following methods of repair are identified.
 - .1 Slight: Squeegee asphalt to completely fill the surface voids.
 - .2 Moderate: Slurry seal for full mat width.
 - .3 Severe: Removal and replacement or overlay.
- .5 All repairs shall be regular in shape and finished using good workmanship practices to provide and appearance suitable to the Departmental Representative.

- .6 Any other methods of repair proposed by the Contractor will be subject to the approval of the Departmental Representative.
- .7 Repairs will be carried out by the Contractor at their expense.

Part 6

6.1 PAYMENT ADJUSTMENTS

- .1 The Unit Price applicable to each Lot quantity as asphalt concrete will be calculated as follows:

$$\text{LOT UNIT PRICE} = \text{CONTRACT UNIT PRICE} \times \text{PA}_{\text{AC}} \times \text{PA}_{\text{COM}} \times \text{PA}_{\text{AV}} \times \text{PA}_{\text{T}}$$

Where:

PA_{AC} = Asphalt Content Payment Adjustment

PA_{COM} = Compaction Payment Adjustment

PA_{AV} = Air Void Payment Adjustment

PA_{T} = Thickness Payment Adjustment

CHART A
ASPHALT CONTENT
PAYMENT ADJUSTMENT FACTOR

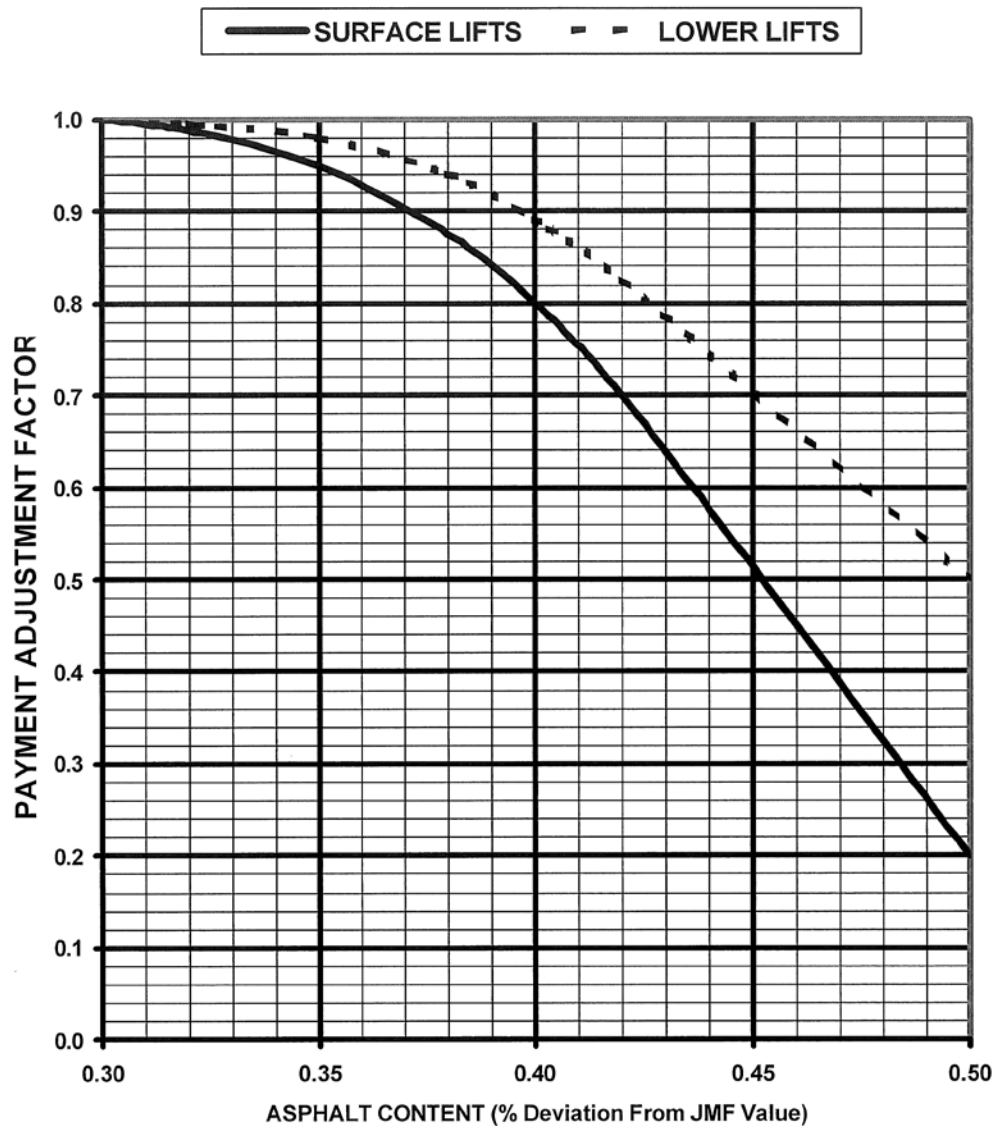


CHART B
COMPACTION
PAYMENT ADJUSTMENT FACTOR

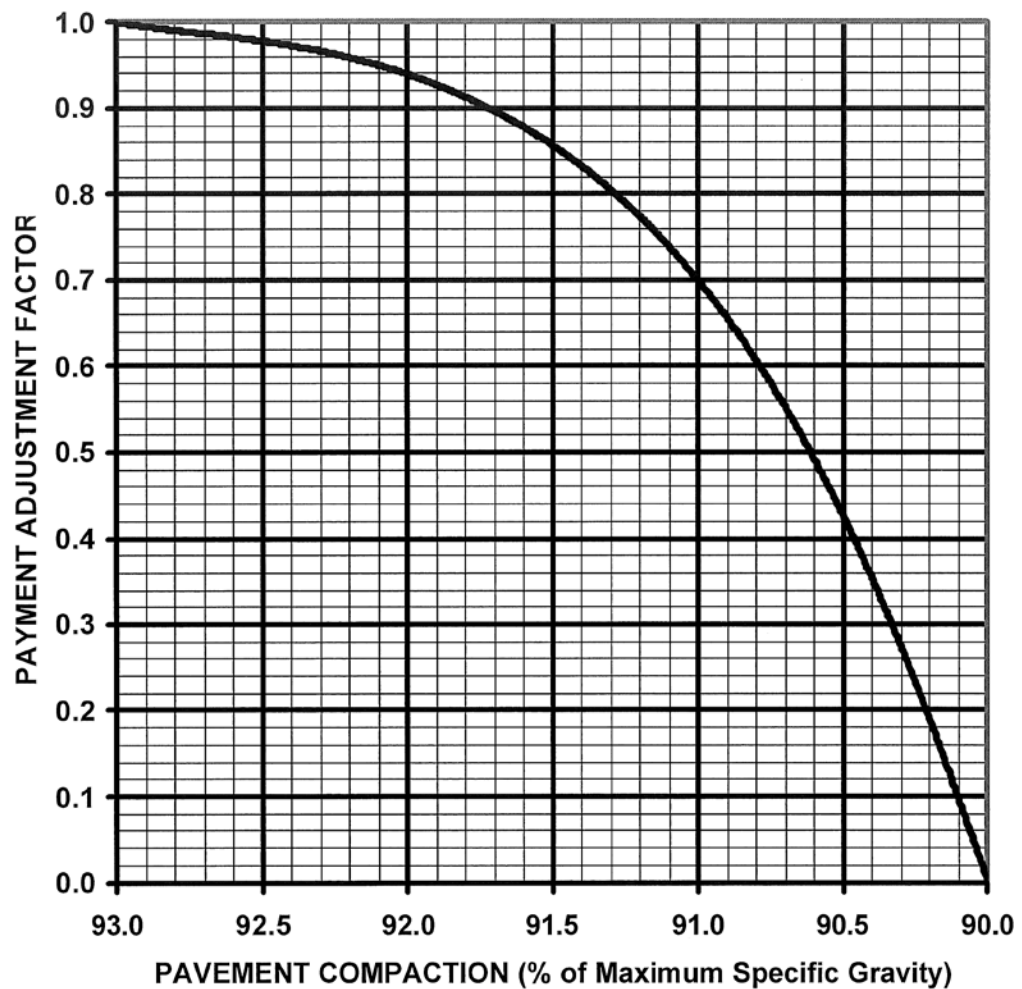
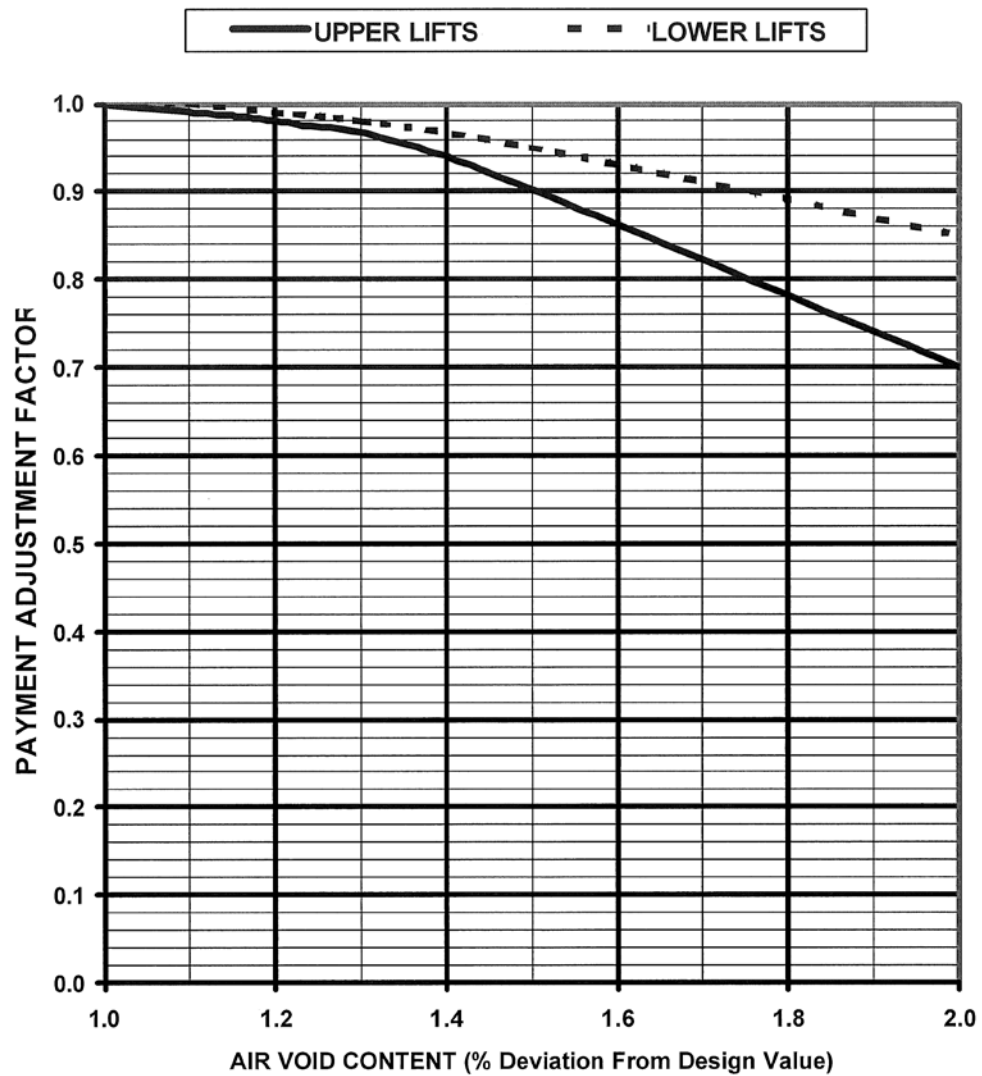
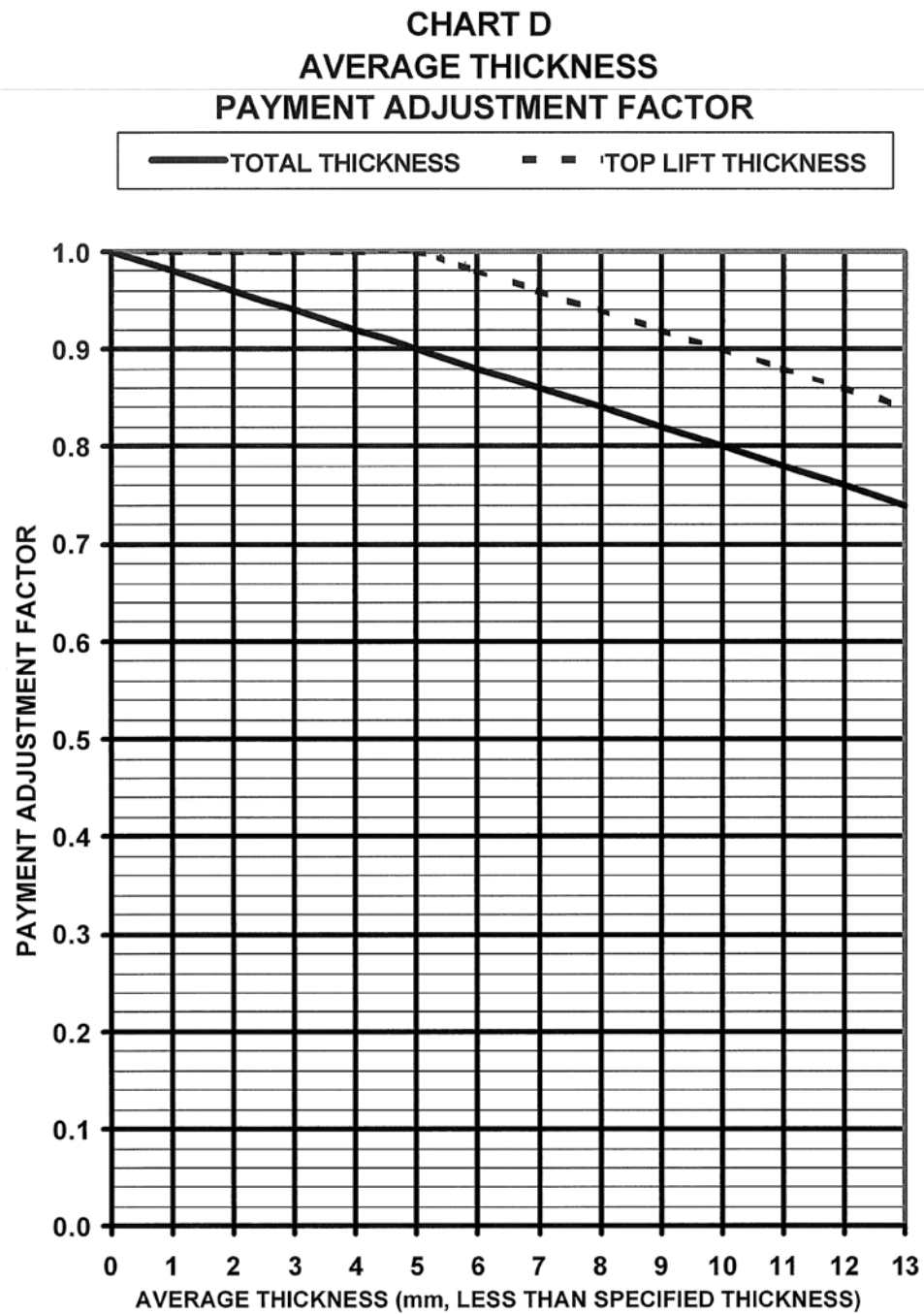


CHART C
AIR VOID CONTENT
PAYMENT ADJUSTMENT FACTOR





END OF SECTION

Part 1 General

1.1 MEASUREMENT PROCEDURES

- .1 Asphalt tack coat will be considered incidental to asphalt costs. No additional payment will be made for asphalt tack.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples:
 - .1 Submit two - 1 L samples of asphalt tack coat material proposed for use in new, clean, airtight, sealed, wide mouth jars or bottles made with plastic to Departmental Representative, at least 2 weeks prior to beginning Work.
 - .2 Sample asphalt tack coat material to: ASTM D 140.
 - .3 Provide access on tank truck for Departmental Representative to sample asphalt material to be incorporated into Work to ASTM D 140.

1.3 QUALITY ASSURANCE

- .1 Upon request from Departmental Representative, submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect asphalt tack coats from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Deliver, store and handle materials in accordance with ASTM D 140.
- .5 Provide, maintain and restore asphalt storage area.

Part 2 Products

2.1 MATERIALS

- .1 Anionic emulsified asphalt: to CAN/CGSB-16.2.
- .2 Cut-back asphalt; to AASHTO M081-92-UL, grade RC-70 or RC-250.
- .3 Water: clean, potable, free from foreign matter.

2.2 EQUIPMENT

- .1 Equipment required for Work of this Section to be in satisfactory working condition and maintained for duration of Work.
- .2 Pressure distributor:
 - .1 Designed, equipped, maintained and operated so that asphalt material can be:
 - .1 Maintained at even temperature.
 - .2 Applied uniformly on variable widths of surface up to 5 m
 - .3 Applied at readily determined and controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and with allowable variation from any specified rate not exceeding 0.1 L/m².
 - .4 Distribute in uniform spray without atomization at temperature required.
 - .2 Equipped with meter, registering travel in metres per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.
 - .3 Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.
 - .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
 - .1 Measure temperature to closest whole number.
 - .5 Equipped with accurate volume measuring device or calibrated tank.
 - .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
 - .7 Equipped with nozzle spray bar, with operational height adjustment in increments of 0.6 metres and capable of being raised or lowered.
 - .8 Cleaned if previously used with incompatible asphalt material.

Part 3 Execution

3.1 APPLICATION

- .1 Apply asphalt tack coat only on clean and dry surface.
- .2 Dilute asphalt emulsion with water at 1:1 ratio for application.
 - .1 Mix thoroughly by pumping or other method approved by Departmental Representative.
- .3 Apply asphalt tack coat evenly to pavement surface at rate as directed by Departmental Representative.
- .4 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt tack coat material.
- .5 Apply asphalt tack coat only when air temperature greater than 10 degrees C and when rain is not forecast within 2 hours minimum of application.
- .6 Apply asphalt tack coat only on unfrozen surface.

- .7 Evenly distribute localized excessive deposits of tack coat by brooming as directed by Departmental Representative.
- .8 Where traffic is to be maintained, treat no more than one half of width of surface in one application.
 - .1 Control traffic in accordance with Section 01 35 00 - Special procedures for Traffic control.
- .9 Keep traffic off tacked areas until asphalt tack coat has set.
- .10 Re-tack contaminated or disturbed areas as directed by Departmental Representative.
- .11 Permit asphalt tack coat to set before placing asphalt pavement.
- .12 Submit summary report within 7 days minimum of date of application and include information as follows:
 - .1 Total area tack coated.
 - .2 Quantity of tack coat used.
 - .3 Mean application rate.
 - .4 Actual product quantity used when using equipment on pressure distributors.
 - .5 Dipstick measurements or electronic printouts are acceptable.
- .13 Carry out measurements in presence of Departmental Representative upon request.
- .14 Inspect tack coat application to ensure uniformity.
 - .1 Re-spray areas of insufficient or non-uniform tack coat coverage as directed by Departmental Representative.
 - .2 Ensure tack coating performed using hand held devices is consistent in appearance with adjacent areas of machine applied material.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

END OF SECTION

Part 1 General

1.1 MEASUREMENT PROCEDURES

- .1 Asphalt prime will be considered incidental to asphalt costs. No additional payment will be made for asphalt prime.

1.2 Submit in accordance with Section 01 33 00 - Submittal Procedures.

- .1 Samples:
 - .1 Submit two 1 L samples of asphalt prime proposed for use in new, clean, air tight sealed, wide mouth, jars or bottles made with plastic, to Departmental Representative, 2 weeks prior to commencing Work.
 - .2 Sample asphalt prime coat materials in accordance with ASTM D 140.
 - .3 Provide access on tank truck for Departmental Representative to sample asphalt material to be incorporated into Work, in accordance with ASTM D 140.

1.3 QUALITY ASSURANCE

- .1 Upon request from Departmental Representative, submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Storage and Handling Requirements:
 - .1 Deliver, store and handle materials to ASTM D 140.
 - .2 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .3 Store and protect asphalt prime coats from nicks, scratches, and blemishes.
 - .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIAL

- .1 Asphalt material: to CAN/CGSB-16.1.
- .2 Sand blotter: clean granular material passing 4.75 mm sieve and free from organic matter or other deleterious materials.
- .3 Water: clean, potable, free from foreign matter.

2.2 EQUIPMENT

- .1 Pressure distributor:
 - .1 Designed, equipped, maintained and operated so that asphalt material can be:
 - .1 Maintained at even temperature.
 - .2 Applied uniformly on variable widths of surface up to 5 m.

- .3 Applied at controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and allowable variation from any specified rate not exceeding 0.1 L/m².
- .4 Distributed in uniform spray without atomization at temperature required.
- .2 Equipped with meter registering travel distance in metres per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.
- .3 Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator.
 - .1 Pump power unit to be independent of truck power unit.
- .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
 - .1 Temperature to be measured to nearest whole number.
- .5 Equipped with accurate volume measuring device or calibrated tank.
- .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
- .7 Equipped with nozzle spray bar, with operational height adjustment in increments of 0.6 metres and capable of being raised or lowered.
- .8 Cleaned if previously used with incompatible asphalt material.
- .2 Aggregate Spreader:
 - .1 Apply blotter sand to primed surfaces using roll type spreader, or rotating disc sander capable of applying aggregate at variable widths and at variable rates.

Part 3 Execution

3.1 APPLICATION

- .1 Proceed with application of tack coat only after receipt of written approval of granular base surface from Departmental Representative.
- .2 Cutback asphalt:
 - .1 Heat asphalt prime for pumping and spraying.
 - .2 Apply asphalt prime to granular base at rate as directed by Departmental Representative.
 - .3 Apply on dry surface unless otherwise directed by Departmental Representative.
- .3 Anionic emulsified asphalt:
 - .1 Dilute asphalt emulsion with clean water at 1:1 ratio for application.
 - .2 Mix thoroughly by pumping or other method approved by Departmental Representative.
 - .3 Apply diluted asphalt emulsion at rate directed by Departmental Representative.
 - .4 Apply diluted asphalt emulsion on damp surface unless otherwise directed by Departmental Representative.
- .4 Apply asphalt prime only on unfrozen surface.

- .5 Apply asphalt tack coat only when air temperature is greater than 10 degrees C and when rain is not forecast within 2 hours minimum of application.
- .6 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt prime material.
- .7 Where traffic is to be maintained, treat no more than one-half width of surface in one application.
- .8 Prevent overlap at junction of applications.
- .9 Do not prime surfaces that will be visible when paving is complete.
- .10 Apply additional material to areas not sufficiently covered as directed by Departmental Representative.
- .11 Keep traffic off primed areas until asphalt prime has cured.
 - .1 Control traffic in accordance with Section 01 35 00.06 - Special Procedures for Traffic Control.
- .12 Permit prime to cure before placing asphalt paving.

3.2 USE OF SAND BLOTTER

- .1 If asphalt prime fails to penetrate within 24 hours, spread sand blotter material in amounts required to absorb excess material.
- .2 Allow sufficient time for excess prime to be absorbed as directed by Departmental Representative.
- .3 Apply second application of sand blotter as required.
- .4 Do not roll blotter sand.
- .5 Sweep and remove excess blotter material.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform Departmental Representative of proposed source of materials and provide access for sampling at least 2 weeks prior to commencing work.
- .3 If materials have been tested by accredited testing within previous 2 months and have passed tests equal to requirements of this specification, submit test certificates from testing laboratory showing suitability of materials for this project.

Part 2 Products

2.1 MATERIALS

- .1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Granular base: material to Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Type 1, 2 or 3 fill.
 - .2 Crushed stone or gravel.
 - .3 Gradations: within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.
- .3 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water-soluble soap.
- .4 Fill material: to Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Type 1, 2 or 3 fill.
 - .2 Crushed stone or gravel.
 - .3 Gradations: within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.

Part 3 Execution

3.1 GRADE PREPARATION

- .1 Do grade preparation work in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .2 Construct embankments using excavated material free from organic matter or other objectionable materials.
 - .1 Dispose of surplus and unsuitable excavated material outside of Waterton Lakes National Park.

- .3 Place fill in maximum 150 mm layers and compact to at least 95% of maximum dry density to ASTM D 698.

3.2 GRANULAR BASE

- .1 Obtain Departmental Representative's approval of subgrade before placing granular base.
- .2 Place granular base material to lines, widths, and depths as indicated.
- .3 Compact granular base in maximum 150 mm layers to at least 95% of maximum density to ASTM D 698.

3.3 CONCRETE

- .1 Obtain Departmental Representative's approval of granular base prior to placing concrete.
- .2 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .3 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.
- .4 Provide edging as indicated with 10 mm radius edging tool.
- .5 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Departmental Representative can be demonstrated. Hand finish surfaces when directed by Departmental Representative.

3.4 TOLERANCES

- .1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.

3.5 EXPANSION AND CONTRACTION JOINTS

- .1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals shown on the drawings.
- .2 Install expansion joints as directed by Departmental Representative.
- .3 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

3.6 ISOLATION JOINTS

- .1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.
- .2 Install joint filler in isolation joints in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .3 Seal isolation joints with sealant approved by Departmental Representative.

3.7 CURING

- .1 Cure concrete by adding moisture continuously in accordance with CSA-A23.1/A23.2 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound as directed by Departmental Representative.

- .2 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.
- .3 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.

3.8 BACKFILL

- .1 Allow concrete to cure for 7 days prior to backfilling.
- .2 Backfill to designated elevations with material as directed by Departmental Representative.
 - .1 Compact and shape to required contours as directed by Departmental Representative.

3.9 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 MEASUREMENT FOR PAYMENT

- .1 Pavement marking: measured in metres of solid lines or painted length of dash lines.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature and data sheets for pavement markings and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit to Departmental Representative following material sample quantities at least 2 weeks prior to commencing work.
 - .1 Two 1 L samples of each type of paint.
 - .2 One 1 kg sample of glass beads.
 - .2 Mark samples with name of project and its location, paint manufacturer's name and address, name of paint, specification number and formulation number and batch number.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Paint and Markings:
 - .1 To CGSB 1-GP-74M-79, Paint, Traffic, Alkyd.
 - .2 Colour: to CGSB 1-GP-12C-68, yellow 505-308, white 513-301.
- .2 Thinner: to CAN/CGSB-1.5.
- .3 Glass reflective beads: type suitable for application to wet paint surface for light reflectance.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates and surfaces to receive pavement markings previously installed under other Sections or Contracts are acceptable for product installation in accordance with MPI instructions prior to pavement markings installation.
 - .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Pavement surface: dry, free from water, frost, ice, dust, oil, grease and other deleterious materials.
- .3 Proceed with Work only after unacceptable conditions have been rectified.

3.2 EQUIPMENT REQUIREMENTS

- .1 Paint applicator: approved pressure type mobile with positive shut-off distributor capable of applying paint in single, double and dashed lines and capable of applying marking components uniformly, at rates specified, and to dimensions as indicated.
- .2 Distributor: capable of applying reflective glass beads as overlay on freshly applied paint.

3.3 APPLICATION

- .1 Pavement markings: laid out by Contractor.
- .2 Unless otherwise approved by Departmental Representative, apply paint only when air temperature is above 10 degrees C, wind speed is less than 60 km/h and no rain is forecast within next 4 hours.
- .3 Apply traffic paint evenly at rate of 3 m²/L.
- .4 Do not thin paint unless approved by Departmental Representative.
- .5 Symbols and letters to dimensions indicated.
- .6 Paint lines of uniform colour and density with sharp edges.
- .7 Thoroughly clean distributor tank before refilling with paint of different colour.
- .8 Apply glass beads at rate of 200 g/m² of painted area immediately after application of paint.

3.4 TOLERANCE

- .1 Paint markings: within plus or minus 12 mm of dimensions indicated.
- .2 Remove incorrect markings to the satisfaction of the Departmental Representative.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

3.6

PROTECTION

- .1 Protect pavement markings until dry.
- .2 Repair damage to adjacent materials caused by pavement marking application.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Not Used

2.1 NOT USED

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for fence and gate installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Grading:
 - .1 Level ground along fence line prior to reinstallation.

3.3 ERECTION OF FENCE

- .1 Erect fence along lines as directed by Departmental Representative.
- .2 Installation of posts:
 - .1 Space posts to match current fence as directed by Departmental Representative.
 - .2 Install posts true to line and plumb.
- .3 Fencing with wood posts:
 - .1 Backfill around posts and compact to same density as surrounding ground. Dispose of surplus material as directed by Departmental Representative.
 - .2 Erect wires and stretch to have uniform tension.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Clean and trim areas disturbed by operations. Dispose of surplus material and replace damaged turf with sod as directed by Departmental Representative.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

END OF SECTION

Part 1 General

1.1 MEASUREMENT PROCEDURES

- .1 Preparation of sub-grade for placing of topsoil will not be measured for payment.
- .2 Topsoil stripping will be measured by Departmental Representative in square metres of placed topsoil.

Part 2 Not Used

2.1 NOT USED

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 STRIPPING OF TOPSOIL

- .1 Begin topsoil stripping of areas as indicated and removed to stockpile within Waterton Lakes National Park.
- .2 Strip topsoil to depths as directed by Departmental Representative.
 - .1 Avoid mixing topsoil with subsoil where textural quality will be moved outside acceptable range of intended application.
- .3 Stockpile in locations as directed by Departmental Representative.
 - .1 Stockpile height not to exceed 2 m.
- .4 Disposal of unused topsoil is to be in an environmentally responsible manner but not used as landfill as directed by Departmental Representative.
- .5 Protect stockpiles from contamination and compaction.
- .6 Stripped sod shall be broken into 2 in or smaller pieces and mixed with the topsoil.

3.3 PREPARATION OF EXISTING GRADE

- .1 Verify that grades are correct.
 - .1 If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.

- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials.
 - .1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
 - .2 Remove debris which protrudes more than 75 mm above surface..
 - .3 Dispose of removed material off site.

3.4 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after Departmental Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For sodded areas keep topsoil 15 mm below finished grade.
- .4 Spread topsoil to following minimum depths after settlement.
 - .1 150 mm for seeded areas.
 - .2 135 mm for sodded areas.
 - .3 300 mm for flower beds.
 - .4 500 mm for shrub beds.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.5 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
 - .1 Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by Departmental Representative.
 - .1 Leave surfaces smooth, uniform and firm against deep footprinting.

3.6 ACCEPTANCE

- .1 Departmental Representative will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.7 SURPLUS MATERIAL

- .1 Dispose of materials except topsoil not required outside of Waterton Lakes National Park.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .1 Protect plant material from frost, excessive heat, wind and sun during delivery.
 - .2 Protect plant material from damage during transportation:
 - .1 Delivery distance is less than 30 km and vehicle travels at speeds under 80 km/h, tie tarpaulins around plants or over vehicle box.
 - .2 Delivery distance exceeds 30 km or vehicle travels at speeds over 80 km/h, use enclosed vehicle where practical.
 - .3 Protect foliage and root balls using anti-desiccants and tarpaulins, where use of enclosed vehicle is impractical due to size and weight of plant material.
 - .3 Storage and Handling Requirements:
 - .1 Immediately store and protect plant material which will not be installed within 1 hour in accordance with supplier's written recommendations and after arrival at site in storage location approved by Departmental Representative.
 - .2 Protect stored plant material from frost, wind and sun and as follows:
 - .1 For bare root plant material, preserve moisture around roots by heeling-in or burying roots in topsoil and watering to full depth of root zone.
 - .2 For pots and containers, maintain moisture level in containers.
 - .3 For balled and burlapped and wire basket root balls, place to protect branches from damage. Maintain moisture level in root zones.
 - .3 Store and manage hazardous materials in accordance with manufacturer's written instructions.

1.3 WARRANTY

- .1 Contractor hereby warrants that plant material will remain free of defects in accordance with General Conditions CCDC GC 12.3, but for 1 full growing season.
- .2 End-of-warranty inspection will be conducted by Departmental Representative.
- .3 Departmental Representative reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival.

Part 2 Products

2.1 PLANT MATERIAL

- .1 Plantings to be selected from the attached document entitled: TREES AND SHRUBS RECOMMENDED FOR WATERTON PARK TOWNSITE (Pages 6 and 7 of this Section).
- .2 Type of root preparation, sizing, grading and quality: comply to Canadian Standards for Nursery Stock.
- .3 Plant material: free of disease, insects, defects or injuries and structurally sound with strong fibrous root system.
- .4 Trees: with straight trunks, well and characteristically branched for species.
- .5 Trees larger than 200 mm in caliper: half root pruned during each of two successive growing seasons, the latter at least one growing season before arrival on site.
- .6 Bare root stock: nursery grown, in dormant stage, not balled and burlapped or container grown.
- .7 Collected stock: maximum 40 mm in caliper, with well developed crowns and characteristically branched; no more than 40% of overall height may be free of branches.
 - .1 During collection, ensure 10% maximum seed crop (or plants) are collected from healthy population of many individuals, and from several plants of same species.
 - .2 Leave remainder for natural dispersal and as food for dependent organisms.

2.2 WATER

- .1 Free of impurities that would inhibit plant growth.

2.3 STAKES

- .1 Wood, pointed one end, 38 x 38 x 2300 mm.

2.4 GUYING COLLAR

- .1 Tube: plastic, 13 mm diameter, nylon reinforced.

2.5 TRUNK PROTECTION

- .1 Wire mesh: galvanized, electrically welded 1.4 mm wire with 25 x 25 mm mesh and fastener.
- .2 Plastic: perforated spiralled strip.

2.6 FERTILIZER

- .1 Synthetic commercial type as recommended by manufacturer.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for planting installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PRE-PLANTING PREPARATION

- .1 Proceed only after receipt of written acceptability of plant material from Departmental Representative.
- .2 Remove damaged roots and branches from plant material.
- .3 Locate and protect utility lines.

3.3 EXCAVATION AND PREPARATION OF PLANTING BEDS

- .1 For individual planting holes:
 - .1 Stake out location and obtain approval from Departmental Representative prior to excavating.
 - .2 Excavate to depth and width as indicated.
 - .3 Remove subsoil, rocks, roots, debris and toxic material from excavated material that will be used as planting soil for trees and individual shrubs. Dispose of excess material.
 - .4 Scarify sides of planting hole.
 - .5 Remove water which enters excavations prior to planting. Notify Departmental Representative if water source is ground water.

3.4 PLANTING

- .1 For bare root stock, place 50 mm backfill soil in bottom of hole.
 - .1 Plant trees and shrubs with roots placed straight out in hole.
- .2 For jute burlapped root balls, cut away top one third of wrapping and wire basket without damaging root ball.
 - .1 Do not pull burlap or rope from under root ball.
- .3 For container stock or root balls in non-degradable wrapping, remove entire container or wrapping without damaging root ball.
- .4 Plant vertically in locations as indicated.
 - .1 Orient plant material to give best appearance in relation to structure, roads and walks.
- .5 For trees and shrubs:

- .1 Backfill soil in 150 mm lifts.
 - .1 Tamp each lift to eliminate air pockets.
 - .2 When two thirds of depth of planting pit has been backfilled, fill remaining space with water.
 - .3 After water has penetrated into soil, backfill to finish grade.
- .2 Form watering saucer as indicated.
- .6 For ground covers, backfill soil evenly to finish grade and tamp to eliminate air pockets.
- .7 Water plant material thoroughly.
- .8 After soil settlement has occurred, fill with soil to finish grade.

3.5 TRUNK PROTECTION

- .1 Install trunk protection on deciduous trees as indicated.
- .2 Install trunk protection before installation of tree supports.

3.6 TREE SUPPORTS

- .1 Install tree supports as indicated.
- .2 Use single stake tree support for deciduous trees less than 3 m in height and evergreens less than 2 m in height.
 - .1 Place stake on prevailing wind side and 150 mm minimum from trunk.
 - .2 Drive stake 150 mm minimum into undisturbed soil beneath roots.
 - .1 Ensure stake is secure, vertical and unsplit.
 - .3 Install 150 mm long guying collar 1500 mm above grade.
 - .4 Thread Type 1 guying wire through guying collar tube.
 - .1 Twist wire to form collar and secure firmly to stake. Cut off excess wire.
- .3 After tree supports have been installed, remove broken branches with clean, sharp tools.

3.7 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following maintenance operations from time of planting to acceptance by Departmental Representative.
 - .1 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.
 - .1 For evergreen plant material, water thoroughly in late fall prior to freeze-up to saturate soil around root system.
 - .2 Keep trunk protection and guy wires in proper repair and adjustment.
 - .3 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.

3.8 MAINTENANCE DURING WARRANTY PERIOD

- .1 From time of acceptance by Departmental Representative to end of warranty period, perform following maintenance operations.

- .1 Water to maintain soil moisture conditions for optimum growth and health of plant material without causing erosion.
- .2 Apply fertilizer in early spring as indicated by soil test.
- .3 Remove dead, broken or hazardous branches from plant material.
- .4 Keep trunk protection and tree supports in proper repair and adjustment.
- .5 Remove trunk protection, tree supports and level watering saucers at end of warranty period.
- .6 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.
- .7 Submit monthly written reports to Departmental Representative identifying:
 - .1 Maintenance work carried out.
 - .2 Development and condition of plant material.
 - .3 Preventative or corrective measures required which are outside Contractor's responsibility.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

3.10 CLOSEOUT ACTIVITIES

- .1 Submit maintenance reports for trees, shrubs, and other plantings.

TREES AND SHRUBS RECOMMENDED FOR WATERTON PARK TOWNSITE

The following is a condensed list of native tree and shrub species which are recommended for planting in the Waterton Townsite area. Species of trees and shrubs native to the Waterton area are the preferred species to be used when planting and should be sourced locally to prevent the introduction of non-native varieties. Where possible species have been selected to minimize the attraction to wildlife (bears, deer, elk) and have reduced fire risk potential. Species not found on this list must be approved by the Park Ecologist (Vegetation) or representative prior to planting.

TREES:

Coniferous:

Douglas fir (*Pseudotsuga menziesii*) – medium browse; medium fire

- Growing to 10 metres or more with a massive trunk and dense, spreading branches. Occurs at low elevations on dry exposed slopes and ridges.
- A primary species on disturbed sites, it occupies a variety of habitats from moist to very dry soils
- Adaptable to most sites; therefore good survival rate
- Good windthrow resistance; good shade tree
- Plant well away from eaves troughs (high needle cast)

White Spruce (*Picea glauca*) – Low browse; high fire

- Often somewhat bluish-green with a dense crown, up to 15 metres in height.
- Best on a moist site; needs a great deal of water, especially after transplanting
- Good shade tree; wind and shade tolerant.
- Colorado Spruce is not a desirable alternative; it's non-native

Lodgepole Pine (*Pinus contorta*) – low browse; high fire

- Occurs on a wide variety of soils, at low to middle elevations
- Young trees are intolerant of shade and grow best on dry exposed sites

Limber Pine (*Pinus flexilis*) – low browse; high fire

- Long-lived and slow growing
- A SARA listed species but plantings in town site can be used as educational material

Deciduous:

Trembling aspen (*Populus tremuloides*) – high browse; very low fire

- Rather small and more or less rounded leaves
- Mature trees form groves from root suckers.
- Require a moderately moist site
- NOTE – lots of hybrid and cultivar species available – these must not be used.

Balsam Poplar (*Populus balsamifera*) – high browse; very low fire

- Tall tree growing best along creek-beds and lakeshores (requires a moist site)
- Long, wide leaf-blades
- Sticky seed scales can be a nuisance; roots can surface

Paper Birch (*Betula papyrifera*) – low browse; very low fire

- A slender, long-branched tree – 10-25 m tall, mature bark mostly white; peeling
- Moist upland sites; shade intolerant
- Can withstand moderate drought once established

Water Birch (*Betula occidentalis*) – low browse; very low fire

- Smaller tree - <10m; dark-reddish brown bark that does not peel.
- Good early successional species in moist areas

SHRUBS:

Mountain Maple (*Acer glabrum*) – medium browse; very-low fire

- A red-stemmed shrub growing to a few metres tall. Typical "maple leaf" shaped leaf blades
- Will grow on rocky sites

Shrubby Cinquefoil (*Potentilla fruticosa*) – low browse; low fire

- A coarse shrub of grasslands and open places, decorated June to September with numerous small, yellow, rose-like flowers.
- NOTE – lots of hybrid and cultivar species available – these must not be used.

Red Osier Dogwood (*Cornus stolonifera*) - high browse; low fire

- Willow-like shrub with distinct red bark and small greenish-white flowers; 1 to 3 metres tall
- grows best in damp, somewhat sheltered places

Wolf Willow (*Elaeagnus commutata*) – medium browse; low fire

- Leaves silvery in colour; exhibits small yellow aromatic flowers in June/July
- Forms small groves in seepage areas
- NOTE – lots of hybrid and cultivar species available – these must not be used.

Snowberry (*Symphoricarpos albus*) – medium browse; low fire

- Common in a variety of habitats
- Small bell-shaped flowers June to August

Buffalo-berry (*Shepherdia canadensis*) – medium browse; low fire

- PLANT MALE BUSHES ONLY
- Spreading shrub to 3m tall

Common Wild Rose (*Rosa woodsii*) – medium browse; low fire

- Exhibits bright pink flowers in June and July
- Open woods and thickets, some tolerance to sandy areas

Prickly Rose (*Rosa accicularis*) – high browse; low fire

- Branching shrub, up to 1.5 metres high
- Open woods and moist thickets

General Tips:

- Plants should be put in the ground in spring and fenced immediately to prevent animal damage.
- Frequent watering is necessary for the weeks following transplantation, and if possible up to the first frost.
- It is advisable to screen young plants from wind over the winter
- Avoid planting dense clusters of shrubs; this helps limit cover for large animals such as cougars and reduces fire hazards.
- Even “fire resistant” vegetation will burn if the plant’s moisture content is low.
- To prevent the spread of non-native species and reduce the appeal of the townsite for animals such as deer and bear, please avoid planting the following:
 - Saskatoon (*Amelanchier alnifolia*) - berries attract bears
 - Chokecherry (*Prunus virginiana*) - cherries can attract bears
 - Pincherry (*Prunus pennsylvanica*) – cherries can attract bears
 - Common Caragana (*Caragana arborescens*) - it's non-native and can crowd out other plants.
 - Junipers – (*Juniperus communis & horizontalis*) – can be highly volatile in case of fire.

For further information please contact the Park Ecologist (Vegetation) at 859-5137.

END OF SECTION