

PART 1 - GENERAL

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| <u>1.1 Measurement Procedures</u> | .1 | Crack routing, cleaning and filling with sand-asphalt slurry seal emulsion or sand-asphalt mix using liquid asphalt, or crack sealant will be measured in lineal metres not withstanding the numbers of applications necessary to completely seal the cracks. |
| <u>1.2 References</u> | .1 | American Society for Testing and Materials International, (ASTM)
.1 ASTM C 117-95, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
.2 ASTM C 136-96a, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
.3 ASTM D 2419-95, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate. |
| | .2 | Canadian General Standards Board (CGSB)
.1 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.
.2 CAN/CGSB-16.1-M89, Cutback Asphalts for Road Purposes.
.3 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.
.4 CAN/CGSB-16.4-M89, Emulsified Asphalts, Cationic Type, for Road Purposes. |
| <u>1.3 Certificates</u> | .1 | Submit manufacturer's test data and certification that the materials meet requirements of this Section. |
| <u>1.4 Waste Management And Disposal</u> | .1 | Remove from site and dispose of all packaging materials at appropriate recycling facilities. |
| | .2 | Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan. |
| | .3 | Place materials defined as hazardous or toxic in designated containers. |

1.4 Waste Management And Disposal
(Cont'd)

- .4 Divert unused aggregate materials from landfill to quarry or facility for reuse as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.
- .6 Divert unused asphalt from landfill to facility capable of recycling materials.
- .7 Dispose of unused sealing at official hazardous material collections site or recycling facility approved by Departmental Representative.
- .8 Do not dispose of unused sealing mix into the sewer system, into streams, lakes, on to ground or in other location where it will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 Materials

- .1 Anionic Emulsified asphalt: to CAN/CGSB-16.2, grade SS-1h.
- .2 Cutback asphalt: to CAN/CGSB-16.1, grade RC-250.
- .3 Aggregate for crack filling: material to following requirements:
 - .1 Clean sand or crushed screenings consisting of hard, durable particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
 - .2 Gradations to be within limits specified when tested to ASTM C 136-96a and ASTM C 117-95 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart.
 - .3 Table

Sieve Designation	% Passing	
	Sand-asphalt slurry using emulsion	Sand-asphalt mix using cutback asphalt
12.5 mm	-	-
9.5 mm	-	-

2.1 Materials (Cont'd)

- .3 Aggregate for crack filling: (Cont'd)
.3 (Cont'd)

Sieve Designation	% Passing	
4.75 mm	-	-
2.00 mm	100	100
0.425 mm	30-55	-
0.180 mm	12-30	-
0.075 mm	3-12	0-8

.4 Sand equivalent: to ASTM D 2419, not less than 45%.

.5 Mixing water: potable.

- .4 Or use Crafco RS 221 or equivalent sealant in accordance with manufacturer's instructions.

2.2 Equipment

- .1 Pressure applicator capable of applying slurry mix at 100 kPa from one or two nozzle arrangement.
- .2 Manual pouring cones.
- .3 Hand tools.
- .4 Small diameter diamond bladed pavement saws
Mechanical rotary routers specifically designed for following random irregular cracks without tearing, chipping or spalling edge and capable of producing clean, vertical side walls. Open "V" type grooves not permitted.

2.3 Mixes

- .1 Determine exact proportions for preparing filling mixes by site conditions and subject to approval of Departmental Representative.
- .2 Prepare sand asphalt slurry mix with following proportions:
.1 50 kg of aggregates.
.2 10 to 16L of asphalt material as determined by Departmental Representative.
.3 Water to produce uniform mix of consistency to achieve full penetration into cracks.
- .3 Heat cutback asphalt to temperature suitable for mixing and pumping to CAN/CGSB-16.1.

PART 3 - EXECUTION

3.1 Preparation

- .1 Clean cracks designated by Departmental Representative and as shown on drawings.
- .2 Remove existing sealer and loose materials
 - .1 From spalled edges and pavement surface.
 - .2 To minimum depth of 50 mm.
- .3 Saw or Rout designated cracks to width of 38 mm maximum using rotary routers pavement saws approved by Departmental Representative.
- .4 Saw or Rout designated cracks to depth of 50 mm.
- .5 Clean loose material from cracks with oil free compressed air applied at pressure not less than 600 kPa.
- .6 Dispose of material removed from cracks as directed by Departmental Representative.

3.2 Crackfilling

- .1 Ensure cracks are clean and dry immediately before filling.
- .2 Fill cracks designated and approved by Departmental Representative .
- .3 Do not use frozen aggregate.
- .4 Fill cracks when air temperature is above 10° C, when daily low temperature does not fall below 5° C, and when no rain is forecast.
- .5 Fill and tamp cracks with sufficient applications to ensure cured fill material is level with pavement surface.
- .6 Cracks wider than 50 mm may be filled with hot mix asphalt concrete and tamped, immediately prior to placement of asphalt concrete overlay, where approved by Departmental Representative.
- .7 Remove and dispose of excess filling material as directed by Departmental Representative.

- 3.3 Finishing .1 After final application and settlement sealant to be 3 to 6 mm below pavement surface.
- .2 Remove excess sealant from pavement surface and sprinkle area lightly with fine sand if required.

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| <u>1.1 Measurement Procedures</u> | .1 | Measure granular base in tonnes of material incorporated into Work and accepted by Departmental Representative. |
| <u>1.2 References</u> | .1 | American Society for Testing and Materials (ASTM)
.1 ASTM C 117-95, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
.2 ASTM C 131-96, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
.3 ASTM C 136-96a, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
.4 ASTM D 698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft ³) (600kN-m/m ³).
.5 ASTM D 1557-00, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft ³) (2,700kN-m/m ³).
.6 ASTM D 1883-99, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
.7 ASTM D 4318-00, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils. |
| | .2 | Canadian General Standards Board (CGSB)
.1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric. |
| <u>1.3 Delivery, Storage, and Handling</u> | .1 | Deliver and stockpile aggregates in accordance with Section 31 05 16 - Aggregate Materials. Stockpile minimum 100% of total aggregate required prior to beginning operation. |
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- 1.4 Waste Management and Disposal .1 Divert unused granular material from landfill to local quarry or facility as approved by Departmental Representative.

PART 2 - PRODUCTS

- 2.1 Materials .1 Granular base: material in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
- .1 Crushed stone or gravel.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart. Sieve sizes to CAN/CGSB-8.2. British Columbia Highway or other local Base material grade close to this specification can be accepted with the approval of Departmental Representative. 25 mm size base can be used as bedding material and Surround material also.

.1 Gradation Method # 1 to:

Sieve Designation	% Passing Base Course	
	25mm size	Bedding Surround
25mm	- 100	100
19 mm	70-100	
12.5 mm	-	
4.75 mm	35-60	25-85
2.00 mm	22-45	
0.425 mm	10-25	5-30
0.075 mm	4-8	0-10

.2 Liquid limit: to ASTM D4318, maximum 25

.3 Plasticity index: to ASTM D4318, maximum 6

.4 Los Angeles degradation: to ASTM C 131. Max. % loss by weight: 45

.5 Coarse Aggregate is Aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to ASTM C136

.6 Flat and elongated particles: to ASTM D4791, (with length to thickness ratio greater than 5): Max by mass:15

.7 Crushed particles: at least 60% of particles by mass within each of following sieve designation ranges to have at least 1 freshly fractured face. Material to be divided into ranges using methods of ASTM C 136.

2.1 Materials (Cont'd)	.1 Granular base: (Cont'd) .2 (Cont'd)
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Passing		Retained on
25 mm	to	19.0 mm
19.0 mm	to	4.75 mm

PART 3 - EXECUTION

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| 3.1 Sequence of
Operation | .1 Place granular base after existing surface is inspected and approved by Departmental Representative. |
| | .2 Placing <ul style="list-style-type: none"> .1 Construct granular base to depth and grade in areas indicated. .2 Ensure no frozen material is placed. .3 Place material only on clean unfrozen surface, free from snow and ice. .4 Begin spreading base material on crown line or on high side of one-way slope. .5 Place material using methods which do not lead to segregation or degradation of aggregate. .6 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved. .7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed. .8 Remove and replace that portion of layer in which material becomes segregated during spreading. |
| | .3 Compaction Equipment <ul style="list-style-type: none"> .1 Compaction equipment to be capable of obtaining required material densities. Equipment to be of weight and size so that it does not damage existing pavement structure or subgrade. |
| | .4 Compacting <ul style="list-style-type: none"> .1 Compact to density not less than 100% corrected maximum dry density .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base. .3 Apply water as necessary during compacting to obtain specified density. .4 In areas not accessible to rolling equipment, compact to specified density with |

3.1 Sequence of .4 (Cont'd)
Operation
 (Cont'd) .4 (Cont'd)
 mechanical tampers approved by Departmental
 Representative.
 .5 Correct surface irregularities by
 loosening and adding or removing material
 until surface is within specified tolerance.

3.2 Site Tolerances .1 Finished base surface to be within plus or
 minus 10 mm of established grade and cross
 section but not uniformly high or low. Finished
 surface not to have irregularities exceeding
 10 mm when checked with a 4.5 m straight edge
 placed in any direction.

3.3 Protection .1 Maintain finished base in condition
 conforming to this Section until succeeding
 material is applied or until acceptance by
 Departmental Representative.

PART 1 - GENERAL

- 1.1 Summary .1 This method covers measurement of loss of Marshall Stability resulting from action of water on compacted asphalt paving mixtures containing penetration grade asphalt cement.
- .2 Numerical index of retained stability is obtained by comparing stability of specimens determined in accordance with usual Marshall procedures with stability of specimens that have been immersed in water for prescribed period.
- 1.2 References .1 American Association of State Highway and Transportation Officials (AASHTO)
- .1 AASHTO T245-97, Standard Method of Test for Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.

PART 2 - PRODUCTS

- 2.1 Materials .1 Representative samples of each asphalt paving mixture proposed for use on Project.
- 2.2 Equipment .1 One or more water baths with automatic controls for immersing specimens. Baths normally used for Marshall test are suitable for test.
- .2 Scale and water bath with suitable accessory equipment for weighing test specimens in air and in water to determine their densities.
- .3 Flat transfer plates of glass or metal. Keep one plate under each specimen during immersion period and during subsequent handling, except when weighing and testing, to prevent breakage or distortion of specimens.
- .4 Apparatus required to conduct Marshall test.
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PART 3 - EXECUTION

3.1 Preparation of Test Specimens .1 Prepare at least 8 specimens for each test with hand-operated hammer, in accordance with AASHTO T245, except where specified otherwise.

3.2 Test Procedure .1 Do Marshall testing in accordance with AASHTO T245, except where specified otherwise.

.2 Weigh each specimen in air and in water. Weigh in water as rapidly as possible to minimize absorption.

.3 Calculate specific gravity of each specimen as follows:

.1 Specific Gravity = $A / (A - B)$

.2 Where A = weight of specimen in air in grams

.3 B = weight of specimen in water in grams

.4 Sort each set of 8 specimens into 2 groups of 4 specimens each so that average specific gravity of specimens in group 1 is essentially same as that of group 2.

.5 Test group 1 specimens for Marshall stability. Calculate S1 = Marshall stability of group 1 (average).

.6 Immerse group 2 specimens in water for 24 h at 60 °C, then test immediately for Marshall stability. Calculate S2 = Marshall stability of group 2 (average).

3.3 Test Report .1 Report test results to Departmental Representative.

.2 Report numerical index of retained stability as resistance of asphaltic paving mixtures to detrimental effect of water, expressed as percentage of original stability retained after immersion period.

.3 Calculate index as follows:

.1 Index of Retained Stability = $S2 / S1 \times 100$

PART 1 - GENERAL

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| <u>1.1 Section Includes</u> | .1 | Materials and application of asphalt tack coat to an existing asphalt or concrete surface prior to asphalt paving. |
| <u>1.2 Measurement Procedures</u> | .1 | Asphalt tack coat will not be measured separately, include cost of asphaltic tack coat in HMAC unit cost in section 32 12 16. |
| <u>1.3 References</u> | .1 | American Society for Testing and Materials International, (ASTM)
.1 ASTM D140-01, Standard Practice for Sampling Bituminous Materials. |
| | .2 | Canadian General Standards Board (CGSB)
.1 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes. |
| <u>1.4 Submittals</u> | .1 | Submit two - 4 L samples of asphalt tack coat material proposed for use in new, clean, airtight, sealed, wide mouth jars or bottles made with plastic or plastic lined cans to Departmental Representative, at least 2 weeks prior to beginning Work. |
| | .2 | Sample asphalt tack coat material to: ASTM D140. |
| | .3 | Provide access on tank truck for Departmental Representative to sample asphalt material to be incorporated into Work, in accordance with ASTM D140. |
| <u>1.5 Quality Assurance</u> | .1 | Upon request by Departmental Representative, submit manufacturer's test data and certification that asphalt tack coat material meets requirements of this section. |
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- 1.6 Delivery, Storage And Handling
- .1 Deliver, store and handle materials in accordance with ASTM D 140.
 - .2 Provide, maintain and restore asphalt storage area.

- 1.7 Waste Management And Disposal
- .1 Separate waste materials for reuse and recycling.
 - .2 Divert unused asphalt from landfill to facility capable of recycling materials.

PART 2 - PRODUCTS

- 2.1 Materials
- .1 Anionic emulsified asphalt: to CAN/CGSB-16.2, grade: SS-1h.
 - .2 Water: clean, potable, free from foreign matter.

- 2.2 Equipment
- .1 Pressure distributor to be:
 - .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 an 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 metres of travel 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 an easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
 - .5 Equipped with accurate volume measuring device or calibrated tank.
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- 2.2 Equipment (Cont'd) .1 (Cont'd)
- .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.
 - .8 Cleaned if previously used with incompatible asphalt material.

PART 3 - EXECUTION

- 3.1 Application .1 Obtain Departmental Representative's approval of surface before applying asphalt tack coat.
- .2 Apply asphalt tack coat only on clean and dry surface.
- .3 Dilute asphalt emulsion with water at 1:1 ratio for application.
- .1 Mix thoroughly by pumping or other method approved by Departmental Representative.
- .4 Apply asphalt tack coat evenly to pavement surface at rate of 0.5 L/m². Adjust application rate if so directed by Departmental Representative .
- .5 Paint contact surfaces with thin, uniform coat of asphalt tack coat material.
- .6 Do not apply asphalt tack coat when air temperature is less than 10 degrees C or when rain is forecast within 2 hours of application.
- .7 Apply asphalt tack coat only on unfrozen surface.
- .8 Apply tack coat only to surfaces that are planned to be overlayed on same day.
- .9 Evenly distribute localized excessive deposits of tack coat by brooming as directed by Departmental Representative.
- .10 Where traffic is to be maintained, treat no more than one half of width of surface in one application.
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- 3.1 Application
(Cont'd)
- .11 Keep traffic off tacked areas until asphalt tack coat has set.
 - .12 Re-tack contaminated or disturbed areas as directed by Departmental Representative.
 - .13 Permit asphalt tack coat to set before placing asphalt pavement.

PART 1 - GENERAL

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| <u>1.1 Section Includes</u> | .1 | Materials and application of asphalt prime to granular base surface prior to asphalt paving. |
| <u>1.2 Measurement Procedures</u> | .1 | Asphalt prime coat will not be measured separately, include cost of asphaltic prime coat in HMA unit cost in section 32 12 16. |
| <u>1.3 References</u> | .1 | American Society for Testing and Materials International, (ASTM)
.1 ASTM D 140-01, Standard Practice for Sampling Bituminous Materials. |
| | .2 | Canadian General Standards Board (CGSB)
.1 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes. |
| <u>1.4 Submittals</u> | .1 | Submit samples in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Submit two - 4 L samples of asphalt prime proposed for use in new, clean, air tight sealed, wide mouth, jars or bottles made with plastic lined cans, to Departmental Representative, at least 2 weeks prior to commencing work. |
| | .3 | Sample asphalt prime coat materials in accordance with ASTM D140. |
| | .4 | Provide access on tank truck for Departmental Representative to sample asphalt material to be incorporated into Work, in accordance with ASTM D140. |
| <u>1.5 Quality Assurance</u> | .1 | Upon request from Departmental Representative, submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section. |
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- 1.6 Delivery, Storage And Handling
- .1 Deliver, store and handle materials to ASTM D 140.
 - .2 Provide, maintain and restore asphalt storage area.

- 1.7 Waste Management And Disposal
- .1 Separate waste materials for reuse and recycling..
 - .2 Divert unused asphalt materials from landfill to local quarry facility approved by Departmental Representative.

PART 2 - PRODUCTS

- 2.1 Material
- .1 Asphalt material: to. CAN/CGSB-16.2 grade: SS-1h.
 - .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 to be :
 - .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 metres of travel 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.
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2.2 Equipment
(Cont'd)

- .1 (Cont'd)
 - .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
 - .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.
 - .8 Cleaned if previously used with incompatible asphalt material.

PART 3 - EXECUTION

3.1 Application

- .1 Obtain Departmental Representative's approval of granular base surface before applying asphalt prime.
- .2 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 3.0 L/m². Adjust application rate if so directed by Departmental Representative.
 - .4 Apply diluted asphalt emulsion on damp surface unless otherwise directed by Departmental Representative.
- .3 Apply asphalt prime only on unfrozen surface.
- .4 Do not apply prime when air temperature is less than 10 degrees C or when rain is forecast within 2 hours.
- .5 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt prime material.
- .6 Where traffic is to be maintained, treat no more than one-half width of surface in one application.
- .7 Prevent overlap at junction of applications.
- .8 Do not prime surfaces that will be visible when paving is complete.

- 3.1 Application
(Cont'd)
- .9 Apply additional material to areas not sufficiently covered as directed by Departmental Representative.
 - .10 Keep traffic off primed areas until asphalt prime has cured.
 - .11 Permit prime to cure before placing asphalt paving.

1.1 Section Includes

- .1 Materials and installation for asphalt concrete paving for roads and airport airside runways, taxiways and aprons.

- .1 Measure asphalt concrete paving in tonnes of asphalt concrete actually incorporated into Work.Surface course, and Lower Course(binder course), will be measured separately. Include in unit prices full compensation for all labour, equipment, and materials for the production, transportation, placing and compaction of the hot-mix asphalt concrete paving. This unit cost includes cost to supply and apply asphalt prime coat and asphalt tack coat in accordance with Sections 32 12 13.16 and 32 12 13.23 as specified and shown on the Contract Drawings.
- .2 The work items required for repair of major cracks will measured in linear meters, including all labour, equipment, and materials.

- .1 This Section covers the materials and construction requirements for hot-mix asphalt concrete paving for airport runways, taxiways, apron, and roads and groundside parking areas. The objective of hot-mix asphalt concrete paving is to provide high quality, durable and smooth pavements for airport operations of aircraft, particularly high speed operations of roughness-sensitive light, medium, and heavy aircraft.
- .2 The Contractor's sequence of operations for the construction of hot-mix asphalt concrete pavements shall be the production, transportation, placement and compaction of each hot-mix asphalt course in accordance with this Specification, and conforming to the lines, grades, and thickness indicated on the Contract Drawings.
- .3 Each hot-mix asphalt course will be subject to testing by the Departmental Representative before the placement of the next course.

1.4 References

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO M320-02, Standard Specification for Performance Graded Asphalt Binder.
 - .2 AASHTO R29-02, Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
 - .3 AASHTO T245-97(2001), Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
 - .4 AASHTO TP5, Test Method for Determining Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR).
 - .5 AASHTO T40, Sampling Bituminous Materials.
 - .2 Asphalt Institute (AI)
 - .1 AI MS2-1994 Sixth Edition, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
 - .3 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C88-99a, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
 - .2 ASTM C117-95, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C123-98, Standard Test Method for Lightweight Particles in Aggregate.
 - .4 ASTM C127-01, Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - .5 ASTM C128-01, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
 - .6 ASTM C131-01, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .7 ASTM C136-01, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .8 ASTM D 5, Test Method for Penetration of Bituminous Material
 - .9 ASTM D 341, Viscosity-Temperature Charts for Liquid Petroleum Products.
 - .10 ASTM D 995--95b(2002), Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
 - .11 ASTM D 1559, Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
 - .12 ASTM D 1856, Test Method for Recovery of Asphalt from Solution by Abson Method.
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1.4 References
(Cont'd)

- .3 (Cont'd)
- .13 ASTM D 2041, Test Method for Theoretical Maximum Specific Gravity Test and Density of Bituminous Paving Mixtures
 - .14 ASTM D 2170, Test Method for Kinematic Viscosity of Asphalts (Bitumens)
 - .15 ASTM D 2172, Test Method for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
 - .16 ASTM D 2419-02, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - .17 ASTM D 2726, Test Method for Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens.
 - .18 ASTM D 2950, Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.
 - .19 ASTM D 3203-94(2000), Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
 - .20 ASTM D 4791-99, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
 - .21 ASTM D 4867, Test Method for Effect of Moisture in Asphalt Concrete Paving Mixtures.
- .4 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-16.3-M90, Asphalt Cements for Road Purposes.
- .5 Canadian Standards Association (CSA):
- .1 CAN/CSA-A23.2-23A, Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus.
 - .2 CAN/CSA-A23.2-29A, Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus.
- .6 Ontario Ministry of Transportation Laboratory Testing Manual (MTO):
- .1 LS-609, Procedure for Petrographic Analysis of Coarse Aggregate.

1.5 Definitions

- .1 For the purpose of this Specification, the following definitions apply:
- .1 Antistripping Additive: means hydrated lime, incorporated in a hot mix in order to

1.5 Definitions
(Cont'd)

- .1 (Cont'd)
- .1 Antistripping Additive: (Cont'd)
alleviate its stripping potential (physical separation of the asphalt cement and aggregate, primarily due to the action of moisture). Note since The British Columbia Ministry of Transportation and Infrastructure allows the use of redi-cote as an anti-stripping agent, it will be acceptable.
- .2 Lower Course (Binder Course): means an asphalt course between a surface course and either a base course, an existing pavement or another asphalt binder course. Sometimes called lower course.
- .3 Crack Repair: means the repair of cracks which are wider than 35 mm measured at the surface of the existing pavement. The Departmental Representative shall determine which cracks are to be repaired.
- .4 Fat Spots: mean areas of pavement substantially blacker than the surrounding acceptable pavement due to high asphalt cement content and/or fines content.
- .5 Hot Mix, Mixture, Mix: means hot-mix asphalt concrete (HMAC).
- .6 Hot Mix Levelling Course: means a hot-mix asphalt layer used for correcting geometric deficiencies in an existing pavement. Surface course hot-mix asphalt shall be used as levelling course.
- .7 Mix Types: means the hot-mix asphalt concrete mixes given in Table 2.
- .8 Paving in Echelon: means the situation when the trailing paver is not more than 30 metres behind the lead paver and uses a joint matching shoe to match the undisturbed mat laid by the lead paver when placing the hot mix in the adjacent mat (lane).
- .9 PGAC: means performance graded asphalt cement.
- .10 Quality Assurance (QA): means inspection, sampling, testing and reporting activities by the Departmental Representative to determine the acceptability of the work.
- .11 Quality Control (QC): means inspection, sampling, testing and reporting activities by the Contractor to control the quality of the work.
- .12 Repair: means repair of pavement areas with localized distress, such as settlements, base failure, cracks and deterioration, that require repair prior to paving.
- .13 Segregation: means a lack of surface uniformity where areas of pavement are either too coarse or too fine in relation to the

1.5 Definitions
(Cont'd)

- .1 (Cont'd)
- .13 Segregation: (Cont'd)
surrounding acceptable pavement. Segregation is visually classified as:
- .1 slight - area where the matrix is in place between the coarse aggregate, however there is slightly more coarse aggregate in comparison with the surrounding acceptable pavement;
 - .2 medium - area which has significantly more coarse aggregate than the surrounding acceptable pavement and usually exhibits some lack of matrix; and
 - .3 severe - area which appears very coarse, with coarse aggregate against coarse aggregate and little or no matrix.
- .14 Special Mixes: mean those mixes sometimes used for special purposes such as patching, padding, levelling and the paving of small areas, that may not fall within the normal gradation and mix design requirements. Special mixes, if any, will be designated in the Contract and specified through a special provision.
- .15 Surface Course: means the top course of an asphalt pavement, sometimes called asphalt wearing course.
- .16 Work: means the total construction and related services required by the Contract.

1.6 Product Data

- .1 Submit viscosity-temperature chart for asphalt cement to be supplied showing either Saybolt Furol viscosity in seconds or Kinematic Viscosity in centistokes, temperature range 105 to 175 degrees C at least 4 weeks prior to beginning Work.
- .2 Submit manufacturer's test data and certification that asphalt cement meets requirements of this Section.
- .3 Submit manufacturer's test data and certification that hydrated lime meets requirements of this Section.
- .4 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for review and approval at least 4 weeks prior to beginning Work.

1.7 Submission
and Design
Requirements

- .1 All required submissions shall be submitted to the Departmental Representative in writing.
- .2 The Contractor shall be responsible for all sampling, testing, analysis and reporting for the selection of materials and the preparation of mix designs for the required submissions. The Contractor shall use qualified technicians and appropriately certified laboratories for any testing involved. The Contractor will make the work site available to the Departmental Representative to inspect the site and to take quality assurance samples.
- .3 Any testing information provided to the Contractor by the Departmental Representative is for general guidance only and shall not be relied upon by the Contractor for the required submissions. The approval of submissions by the Departmental Representative shall not alleviate the Contractor of responsibility for conformance with Contract requirements.

1.8 Hot Mix
Asphalt Materials
and Mix Design

- .1 Prior to starting the Work, the Contractor shall supply the Departmental Representative with Material Safety Data Sheets (MSDS) for all materials to be incorporated in the Work.
- .2 The Contractor shall design each hot-mix type in accordance with the Marshall method of mix design contained in the Asphalt Institute Manual Series No. 2, and the requirements given in item 2.3 Aggregates and item 2.2 Hot Mix Asphalt of this section.
- .3 The job mix formula (JMF) for each hot-mix asphalt mix type shall be submitted to the Departmental Representative at least 14 calendar days prior to the start of operations with the mix type, and shall include as a minimum for each mix type:
 - .1 source of each aggregate and properties of each aggregate for specified requirements
 - .2 material proportions
 - .3 plot of combined gradation of the aggregates
 - .4 source and supplier of asphalt cement.
 - .5 properties of asphalt cement for specified requirements
 - .6 temperature-viscosity relationship of the asphalt cement
 - .7 mixing temperature
 - .8 compaction temperature

1.8 Hot Mix
Asphalt Materials
and Mix Design
(Cont'd)

- .3 (Cont'd)
- .9 amount of fines (minus 0.075 mm) added during mix design to simulate plant fines generation
 - .10 plots of air voids, bulk relative density, maximum relative density, stability, flow and voids mineral aggregate versus asphalt cement content by total mix
 - .11 tensile strength ratio
 - .12 percent passing each sieve size for job mix formula
 - .13 source, type, properties, and amount of hydrated lime antistripping additive incorporated.
 - .14 percent of asphalt cement for job mix formula by total mix
 - .15 75 kg of each aggregate.
 - .16 5 kg of fines (minus 0.075 mm), if any added
 - .17 4 litres of the asphalt cement
 - .18 0.5 kg of hydrated lime antistripping additive, if required.
- .4 No hot-mix asphalt of a mix type shall be produced for pavement until the Contractor's job mix formula for the mix type has been approved by the Departmental Representative. The Departmental Representative will complete the job mix formula review for a mix type within 7 calendar days.
- .5 The approved job mix formula for a hot-mix asphalt mixture shall be in effect until a Contractor technically supported request for minor adjustments, if any, is approved by the Departmental Representative. Should a change in source or properties of materials be required, a new job mix formula submission for the mix type must be approved by the Departmental Representative before the change is made.

1.9 Trial Batches .1

- The Contractor shall make a pre-operation plant trial batch for each hot-mix asphalt mix type, from which samples will be taken by the Departmental Representative to check that the hot-mix asphalt meets the Contract requirements. The trial batch affords the Contractor and the Departmental Representative an opportunity to determine the quality of each mix type and performance of the plant. Each trial batch shall be representative of consistent mix production and shall be a

- 1.9 Trial Batches .1 (Cont'd)
- (Cont'd)
- minimum of two pugmill batches of the size that will be used for mix production for a batch plant, or a minimum of 5 tonnes for a drum mixing plant. The remainder of the trial batch shall be disposed of by the Contractor. Such trial batches shall be produced until complete mix compliance check indicates conformance with the design mix proportions and properties for the hot-mix asphalt mix type.
- .1 A maximum of 30 tonnes shall be paid for in each trial batch.
- .2 Trial batches shall be made prior to the start of paving in each phase.
- .2 The Contractor will be permitted to make small adjustments to the job mix formula for the mix type at this time with the approval of the Departmental Representative. Up to two trial batches for each mix type will be paid for as shown for each hot-mix asphalt mix type in the Contract Tender Form. Should more than two trial batches be required for a mix type, the Contractor shall bear both the cost of the trial batches and the cost of the Departmental Representative's mix compliance checks for such additional trial batches. The Departmental Representative will complete the compliance check on a trial batch within 6 working hours.
- 1.10 Surface Course .1
- Trial Section
- The Contractor shall complete a surface course trial section, prior to placing any surface course hot-mix asphalt for payment, at the location identified by Departmental Representative. Each trial section shall be a minimum of 100 metres long, 7 metres wide, placed in two lanes, with a longitudinal joint and at least one transverse joint being a minimum of 4.5 m in length. The trial section affords the Contractor and the Departmental Representative an opportunity to check the overall quality of the surface course hot-mix asphalt in place, as well as the overall performance of the paving and compaction equipment.
- .2 If the trial section should prove to be in non-conformance with the Contract requirements, the Contractor shall make adjustments to materials and/or procedures. Additional trial sections, as required, shall
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- 1.11 Quality Control (QC)
(Cont'd)
- .2 (Cont'd)
.2 (Cont'd)
gradation, quality of materials, stockpile management, proportioning, mixing and transportation, mixture volumetrics, moisture content of mixtures, placing and finishing, joints, compaction, and surface smoothness.
- .3 The HMAC QCP is to contain a comprehensive account of the Contractor's QC procedures to be applied throughout the Contract. Include the following:
- .1 Organization chart clearly delineating the flow of responsibility from ground up to top management. Chart shall identify by name the Quality Control Manager (QCM), project engineer, Contractor's designated testing agent(s), technicians/inspectors, and other key project personnel. Identify duties, levels of authority and responsibility of each individual. The Contractor's QCM shall be a full-time employee of the Contractor, shall have a minimum of 5 years' experience in construction materials testing and shall have authority to stop all work associated with the incorporation of non-conforming materials into the project.
- .2 Description of the proposed methods and techniques to:
- .1 Prevent segregation and contamination of aggregate stockpiles.
- .2 Mix, transport, place, and compact the HMAC.
- .3 Ensure smoothness and grade control during HMAC placement.
- .3 Detailed plan of inspection and test procedures necessary to ensure that the HMAC materials, mix and paving are in conformance with the Contract requirements.
- .1 List all applicable tests stipulated by the Contract Documents as well as supplementary tests that the Contractor will require. Identify individuals who will perform them and the frequency at which they will be performed. Reference appropriate acceptance criteria.
- .2 Should there be a conflict between the accepted Quality Control Plan and the Specifications, the Specifications shall govern.
- .3 Procedures to be in accordance with all relevant codes, laws, ordinances, and the Specification and referenced standards.
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- 1.11 Quality Control (QC)
(Cont'd)
- .3 (Cont'd)
- .4 Description of procedures to be used to report and then correct deficiencies. Procedures shall indicate when action (increased testing or work stoppage) is required and what steps will be taken to bring the process into control.
- .4 The responsibilities and roles of the key individuals are defined as follows:
- .1 Contractor's QCM is responsible for developing and implementing an effective quality management system. The QCM is responsible to ensure that adequate inspection and testing measures are identified and executed to assure conformance of the materials and workmanship to the specified requirements prior to inspection and testing by the Departmental Representative's designated testing agent for QA testing.
- .5 The Contractor shall conduct such process control inspection, sampling and testing as is necessary to ensure that any hot-mix asphalt aggregates and hot-mix asphalt are in conformance with the Contract requirements. The extent of quality control sampling and testing by the Contractor and/or Contractor's suppliers shall be sufficient to meet all testing and submission requirements of this Specification, but shall not be less than:
- .1 hot-mix asphalt aggregates
- .1 one sample of each aggregate per day and at least one per 2000 tonnes of hot-mix production for moisture content and gradation
- .2 hot-mix asphalt
- .1 one sample per 500 tonnes of hot-mix production for asphalt cement content and gradation
- .2 one sample per 500 tonnes of hot-mix production for air voids and Marshall stability
- .3 one test for moisture content of the mixture per 2000 tonnes of hot-mix production.
- .3 placing and compaction of hot-mix asphalt
- .1 one test each 500 tonne, compaction (nuclear density gauge, ASTM D 2950)
- .2 one measurement each 100 m², grade and smoothness (straight edge).
- .6 A file of all quality control test results shall be maintained by the Contractor and be
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1.11 Quality Control (QC) <u>(Cont'd)</u>	.6	(Cont'd) made available daily for review by the Departmental Representative. Protect records from damage, deterioration, or loss. Upon request, the Contractor shall provide split samples to the Departmental Representative for quality assurance testing.
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1.12 Grade and Slope Control of Pavers <u></u>	.1	At least seven (7) calendar days prior to the commencement of any paving operations, the Contractor shall advise the Departmental Representative as to the number of pavers, type of grade and transverse slope control, and all pertinent information with respect to setting grades and controlling the pavers to follow these grades. This information will be reviewed jointly by the Contractor and Departmental Representative so that they are all familiar with the methods to be used for the work. Paving in echelon is preferred since it provides superior joints
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1.13 Delivery, Storage And Handling <u></u>	.1	Deliver and stockpile aggregates in accordance with Section 31 05 16 - Aggregate Materials. Stockpile minimum 50 % of total amount of aggregate required before beginning asphalt mixing operation.
	.2	When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.
	.3	Stockpile fine aggregate separately from coarse aggregate, although separate stockpiles for more than two mix components are permitted.
	.4	Provide approved storage, heating tanks and pumping facilities for asphalt cement.

1.14 Waste Management And Disposal <u></u>	.1	Separate waste materials for reuse and recycling.
	.2	Remove from site and dispose of all packaging materials at appropriate recycling facilities.
	.3	Collect and separate, for disposal, paper plastic, polystyrene, and corrugated cardboard packaging material in appropriate on-site bins

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| 1.14 Waste Management And Disposal
(Cont'd) | .3 | (Cont'd)
for recycling in accordance with Waste Management Plan. |
| | .4 | Divert unused aggregate materials from landfill to quarry facility for reuse. |
| | .5 | Divert unused asphalt from landfill to facility capable of recycling materials. |
| | .6 | Fold up metal banding, flatten and place in designated area for recycling. |

PART 2 - PRODUCTS

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| <u>2.1 Materials</u> | .1 | Unless otherwise specified in the Contract, the Contractor shall supply all materials necessary for the execution and completion of the Work. |
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|---------------------------|----|--|
| <u>2.2 Asphalt Cement</u> | .1 | Asphalt cement: to CAN/CGSB-16.3, grade: 80-100A, high viscosity penetration grade.
.1 The asphalt cement shall be homogeneous, free of water and any contamination and shall not foam when heated to the temperatures specified by the manufacturer for safe handling and use of the product. It shall be shipped, used and handled at all times in accordance with the manufacturer's specifications.
.2 For each grade of asphaltic cement specified in the Contract, the Contractor shall supply to the Departmental Representative, test results and two 1 litre samples for the products proposed for use to demonstrate compliance to the requirements at least 14 calendar days prior to the first use of the product.
.3 The Contractor shall also concurrently provide the applicable mixing and compaction temperatures for each product, and documentation of construction, storage and handling requirements, including material safety data sheet, recompact temperature, mix discharge temperature and recommended extraction procedure.
.4 The Contractor shall provide the Departmental Representative with the asphalt cement supplier's certified test report for |
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2.2 Asphalt Cement <u>(Cont'd)</u>	.1	Asphalt cement: (Cont'd) .4 (Cont'd) each lot of asphalt cement shipped to the work site.
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2.3 Aggregates <u> </u>	.1	Aggregates shall be sound, hard, durable crushed stone or gravel free from soft, thin, elongated or laminated particles, and films of matter that would prevent thorough coating and bonding with asphalt cement. The portion of material retained on the 4.75 mm sieve (CAN/CGSB-8.1) is coarse aggregate. The portion passing the 4.75 mm sieve and retained on the 0.075 mm sieve is fine aggregate, and the portion passing the 0.075 mm sieve is mineral filler.
	.2	The blend of coarse and fine aggregates for each hot-mix asphalt mix type shall meet the gradation and physical requirements given in Table 1 below.
	.3	Aggregates having known poor polishing characteristics shall not be used in surface course hot-mix asphalt.
	.4	Regardless of conforming with the physical requirements in Table 1, aggregates may be rejected by the Departmental Representative on the basis of past field performance.
	.5	Surface course and binder course hot-mix asphalt gradation shall be as indicated in Table 1. Hot-mix levelling course shall meet the same requirements as surface course mix.
	.6	Aggregates: in accordance with Section 31 05 16 - Aggregate Materials: General and following requirements: .1 Gradations: within limits specified when tested to ASTM C136 and ASTM C117 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart. Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2. .2 Table 1, Gradation requirement.

Sieve Designation	% Passing
Lower Course	Surface Course

2.3 Aggregates (Cont'd)

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.6  Aggregates: (Cont'd)
    .2      (Cont'd)
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Sieve Designation	% Passing	
25 mm	100	-
12.5 mm	70-85	100
4.75 mm	40-65	55-75
2.00 mm	30-50	35-55
0.425 mm	15-30	15-30
0.180 mm	5-20	5-20
0.075 mm	3-8	3-8

.3 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75 mm sieve and stockpile separately from coarse aggregate.

4 Coarse Aggregate is Aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to ASTM C136

.5 Do not use aggregates having known polishing characteristics in mixes for surface courses.

.6 Sand equivalent: ASTM D2419. Min: 50.

.7 Magnesium Sulphate soundness: to ASTM C

88. Max% loss by mass:

.1 Coarse aggregate surface course: 12
%

.2 Coarse aggregate lower course: 12

.3 Fine aggregate, surface course: 16
%

.4 Fine aggregate, lower course: 16 %.

Los Angeles degradation: Grading B, to ASTM C 131. Max % loss by mass:

.1 Coarse aggregate, surface course:
25.

.2 Coarse aggregate, lower course: 30

.9 Absorption: to ASTM C 127. Max % by mass:

.1 Coarse aggregate, surface course:
1.75 %.

.2 Coarse aggregate, lower course:
2.00 %.

.10 Loss by washing: to ASTM C 117. Max %
passing 0.075 mm sieve:

.1 Coarse aggregate, surface course:
1.5.

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2.0. Coarse aggregate, lower course:
2.0.

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.11 Lightweight particles: to ASTM C 123.

Max % by mass less than 1.95 relative density:

.1 Surface course: 1.5 %.

.2 Lower course: 3.0 %.

2.3 Aggregates
(Cont'd)

- .6 Aggregates: (Cont'd)
- .12 Flat and elongated particles: to ASTM D 4791, (with length to thickness ratio greater than 5): Max% by mass:
- .1 Coarse aggregate, surface course: 15 %.
- .2 Coarse aggregate, lower course: 15 %..
- .13 Crushed fragments: at least 60 % of particles by mass within each of following sieve designation ranges, to have at least 1 freshly fractured face. Material to be divided into ranges, using methods of ASTM C 136.
- | Passing | | Retained on |
|---------|----|-------------|
| 25 mm | to | 12.5 mm |
| 12.5 mm | to | 4.75mm |
- .14 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .15 Deleterious Particles, Percent Maximum, MTO LS-609 or equivalent, 1.5 for Lower and Surface Course.
- .16 Petrographic Analysis of Coarse Aggregate, Petrographic Number, Maximum, 160 for Lower Course and 135 for Surface Course.
- .7 Mineral filler:
- .1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic mineral matter, thoroughly dry and free from lumps.
- .2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed to improve mix properties.
- .3 Mineral filler to be dry and free flowing when added to aggregate.
- .8 Test aggregates to applicable ASTM standard to determine if antistripping agent is required or not. Past aggregate performance on other pavement structures indicating that there is no stripping will be accepted, if contractor provides certificate.
- .9 If required, Anti-stripping agent: hydrated lime to ASTM C 207 type N. Add lime at rate of approximately 2-3% of dry weight of aggregate.
- .10 Water: to approval of Departmental Representative.

2.4 Equipment
General
Requirements

- .1 All Equipment shall be available for inspection by the Departmental Representative before operations commence.
- .2 The Departmental Representative shall have access, at all working times, to all parts of the equipment for purposes pertaining to the Contract such as: checking adequacy of equipment; inspecting operations; verifying weights, proportions and material properties; and checking temperatures.

2.5 Requirements
for Hot-Mix Plants

- .1 Hot-mix plants used for the production of the hot-mix asphalt mix types shall conform to the requirements of ASTM D 995 with the following changes:
 - .1 Truck Scales. The hot-mix asphalt shall be weighed on suitable certified scales provided by the Contractor or on certified public scales at the Contractor's expense. Scales shall be inspected, certified and sealed as often as the Departmental Representative deems necessary to assure their accuracy.
- .2 Minimum Plant capacity to be 1800 tonne each day for 12 hour shift.

2.6 Hauling
Equipment

- .1 Trucks used for hauling hot-mix asphalt shall have tight, clean and smooth metal boxes. Truck boxes shall be lightly coated with a uniform application of a non-solvent release agent, such as soap/detergent solution, just before loading. Each truck shall have a suitable tarpaulin of sufficient size to completely cover the load as necessary to maintain mix temperature.
 - .1 In cool weather or for long hauls, insulate entire contact area of each truck box.
 - .2 Use only trucks which can be weighed in single operation on scales supplied.
- .2 Storage Bins and Surge Bins. Use of surge bins or storage bins for temporary storage of hot-mix asphalt will be permitted as follows:
 - .1 the mix may be stored in surge bins for a period of time not to exceed 3 hours; or
 - .2 the mix may be stored in insulated storage bins for a period of time not to exceed 20 hours.

- 2.6 Hauling Equipment
(Cont'd)
- .3 The bins shall be such that mix drawn from them meets the same requirements as mix loaded directly into trucks.
- .4 If the Departmental Representative determines that there is unacceptable heat loss or oxidation of the mixture due to prolonged storage, prolonged storage will not be permitted.
- .5 The moisture content of the mix, as discharged from the hot-mix plant, shall be less than 0.2 percent.

- 2.7 Hot-Mix Pavers
- .1 Hot-mix pavers shall be self-propelled, with a vibrating screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface. The paver should have sufficient capacity to pave all of the mix produced by the plants.
- .2 The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.
- .3 The paver shall be equipped with an automatic grade control system. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices in order to maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within ± 0.1 percent.
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- 2.7 Hot-Mix Pavers .4 The controls shall be capable of working in conjunction with any of the following attachments:
- .1 Ski-type device of not less than 9 metres length.
 - .2 Taut stringline (wire) set to grade.
 - .3 Laser control.

- 2.8 Rollers .1 Rollers of the vibratory, steel wheel, and pneumatic-tired type shall be used. They shall be in good condition and capable of operating at slow speeds to avoid displacement of the hot mix. The number, type, and weight of rollers shall be sufficient to compact the mix to the required density while it is still in a workable condition. Combination rollers (rollers that have both steel wheels and pneumatic tires) are not permitted.
- .2 The use of equipment which causes excessive crushing of the aggregate will not be permitted.
- .3 Rollers: sufficient number minimum of three per paver of type and weight to obtain specified density of compacted mix.
- .4 Vibratory rollers:
- .1 Minimum drum diameter: 1200 mm.
 - .2 Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.

- 2.9 Other Equipment .1 Hand Tools
- .1 Lutes or rakes with covered teeth for spreading and finishing operations.
 - .2 Tamping irons having mass not less than 12 kg and bearing area not exceeding 310 cm² for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by, may be used instead of tamping irons.
 - .3 Straight edges, 4.5 m in length, to test finished surface.
- .2 Plant testing facility: provide laboratory space at plant site for exclusive use of Departmental Representative, for performing tests, keeping records and making reports.
-

- 2.10 Mix Design
- .1 Mix design to be approved by Departmental Representative.
 - .2 Binder course and surface course hot-mix asphalt shall conform with the gradation requirements given in Table 1 and the physical requirements given in Table 2. Levelling course shall conform to the requirements of hot-mix asphalt surface course.
 - .3 Moisture Sensitivity
 - .1 The Contractor shall determine the Tensile Strength Ratio (TSR) in accordance with ASTM D 4867.
 - .2 If the TSR is less than the minimum required value, the Contractor shall select other aggregate(s) or incorporate hydrated lime as antistripping additive. The amount of hydrated lime added to the mix type shall be sufficient to produce required TSR.
 - .3 Blending of the materials is to be accomplished by adding dry hydrated lime to pre-dampened aggregate a minimum of 4 hours prior to the aggregate entering the asphalt plant.
 - .4 TSR value shall be confirmed by Quality control testing.
 - .4 Design of mix: by Marshall method to requirements below.
 - .1 Compaction blows on each face of test specimens: airfield pavements 50, Roads and groundside parking 75.
 - .2 Table 2, Mix physical requirements:

Property	Airfield Pavements	Roads/Groundside Parking
Marshall Stability at 60°C kN min	8.0	5.5
Flow Value mm	2-4	2-4
Air Voids in Mixture, %	3-5	3-5
Voids in Mineral Aggregate, % min	15 surface course/13 lower course	15 surface course/13 lower course
Index of Retained Stability % minimum	50	75

- .3 Measure physical requirements as follows:
 - .1 Marshall load and flow value: to AASHTO T245.

- 2.10 Mix Design (Cont'd) .4 Design of mix: (Cont'd)
- .3 (Cont'd)
- .2 Compute void properties on basis of bulk specific gravity of aggregate to ASTM C 127 and ASTM C128. Make allowance for volume of asphalt absorbed into pores of aggregate.
- .3 Index of Retained Stability: measure in accordance with Section 32 12 10 - Marshall Immersion Test for Bitumen.
- .4 Voids filled with Asphalt, VFA, 65-75% Lower Course and Surface Course.
- .5 Tensile Strength Ratio, Percent Minimum, based on the average of 3 tests, to ASTM D 4867, Lower and Surface Course 75.
- .6 Do not change job-mix without prior approval of Departmental Representative. When change in material source proposed, new job-mix formula will be provided to be approved to be reviewed by Departmental Representative.
- .7 Return plant dust collected during processing to mix in quantities acceptable to Departmental Representative.

PART 3 - EXECUTION

- 3.1 Plant And Mixing Requirements .1 Production Rate
- .1 Minimum Plant capacity to be 1800 tonne each day for 12 hour shift. The plant production rate shall be high enough to provide continuous operation compatible with the rate of placing of the mix.
- .2 Aggregate Stockpile Requirements
- .1 Before any production of a hot-mix asphalt mix type is started, stockpiles of each size and gradation of aggregate involved shall be provided at the asphalt plant site, each sufficient for two full days' production, or the total amount for the mix type involved, whichever is the lesser. After paving operations have commenced, there shall be sufficient aggregates in stockpiles before each day's paving begins for all of that day's production. The stockpiles shall be free draining and developed so as to prevent the mixing of the various aggregates.
- .3 Feeding and Drying of Aggregates
- .1 Feeding of material directly from any aggregate processing plant to the hot-mix
-

3.1 Plant And
Mixing Requirements
(Cont'd)

- .3 (Cont'd)
- .1 (Cont'd)
- plant cold storage bins shall not be permitted. Aggregates and hydrated lime/aggregate blend, if any, shall be loaded into cold feed bins so as to prevent the mixing of separated sizes of materials.
- .2 Surfaces of dry aggregate shall be free of combustion products. The aggregate shall be sufficiently dry as evidenced by the lack of noticeable steaming, slumping, bubbling, or foaming of the hot mix, and the absence of any visible free water on the tail-gate of truck boxes.
- .3 The hot-mix shall meet the maximum allowable moisture content requirement specified.
- .4 Proportioning, Mixing and Temperature
- .1 The proportioning and mixing of aggregates and asphalt cement shall be of a sufficient accuracy and time to produce a uniform homogeneous hot-mix asphalt in which all aggregate particles are thoroughly and uniformly coated.
- .2 The temperature of the mix as it is discharged from the hot-mix plant shall be controlled within $\pm 10^{\circ}\text{C}$ of the temperature corresponding to a viscosity of $225 \text{ mm}^2/\text{s}$ for the incorporated asphalt cement.
- .5 Batch and continuous mixing plants:
- .1 To ASTM D 995.
- .2 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders. Do not load frozen materials into bins.
- .3 Feed cold aggregates to plant in proportions to ensure continuous operations.
- .4 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
- .5 Before mixing, dry aggregates to moisture content not greater than 1 % by mass or to lesser moisture content if required to meet mix design requirements. Heat to temperature required to meet mixing temperature as directed by Departmental Representative. .
- .6 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.
- .7 Store hot screened aggregates in manner to minimize segregation and temperature loss.

3.1 Plant And
Mixing Requirements
(Cont'd)

- .5 Batch and continuous mixing plants: (Cont'd)
 - .8 Heat asphalt cement and aggregate to mixing temperature directed by Departmental Representative. Do not heat asphalt cement above 160 degrees C maximum temperature indicated on temperature-viscosity chart.
 - .9 Make available current asphalt cement viscosity data at plant. With information relative to viscosity of asphalt being used, Departmental Representative to approve temperature of completed mix at plant and at paver after considering hauling and placing conditions. The temperature of the mix as it is discharged from the hot-mix plant shall be controlled within $\pm 10^{\circ}\text{C}$ of the temperature corresponding to a viscosity of 225 mm²/s for the incorporated asphalt cement.
 - .10 Maintain temperature of materials within 5 degrees C of specified mix temperature during mixing.
 - .11 Mixing time:
 - .1 In batch plants, both dry and wet mixing times as directed by Departmental Representative. Continue wet mixing as long as necessary to obtain thoroughly blended mix but not less than 30s or more than 75s.
 - .2 In continuous mixing plants, mixing time as directed by Departmental Representative but not less than 45s.
 - .3 Do not alter mixing time unless directed by Departmental Representative.
- .6 Dryer drum mixing plant:
 - .1 To ASTM D995.
 - .2 Load aggregates from individual stockpiles to separate cold feed bins. Do not load frozen materials into bins.
 - .3 Feed aggregates to burner end of dryer drum by means of multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.
 - .4 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved. Calibrate weigh bridge on charging conveyor by weighing amount of aggregate passing over weigh bridge in set amount of time. Difference between this value and amount shown by plant computer system to differ by not more than plus or minus 2 %.
 - .5 Make provision for conveniently sampling full flow of materials from cold feed.
 - .6 Provide screens or other suitable devices to reject oversize particles or lumps

3.1 Plant And
Mixing Requirements
(Cont'd)

- .6 Dryer drum mixing plant: (Cont'd)
- .6 (Cont'd)
- of aggregate from cold feed prior to entering drum.
- .7 Provide system interlock stop on feed components if either asphalt or aggregate from bin stops flowing.
- .8 Accomplish heating and mixing of asphalt mix in approved parallel flow dryer-mixer in which aggregate enters drum at burner end and travels parallel to flame and exhaust gas stream. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with printing recorder that can be monitored by plant operator. Submit printed record of mix temperatures at end of each week day.
- .9 Mixing period and temperature to produce uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer to be less than 2 %.
- .7 Temporary storage of hot mix:
- .1 Provide mix storage of sufficient capacity to permit continuous operation and designed to prevent segregation.
- .2 Do not store asphalt mix in storage bins in excess of 3 hour.
- .8 While producing asphalt mix for this Project, do not produce mix for other users unless separate storage and pumping facilities are provided for materials supplied to this project.
- .9 Mixing tolerances:
- .1 Permissible variation in aggregate gradation from job mix (percent of total mass).
- | | |
|-------------------|-----|
| 4.75 mm sieve and | |
| larger | 2.0 |
| 2.00 mm sieve | 2.0 |
| 0.425 mm sieve | 2.0 |
| 0.180 mm sieve | 2.0 |
| 0.075 mm sieve | 2.0 |
- .2 Permissible variation of asphalt cement from job mix: 0.25%.
- .3 Permissible variation of mix temperature at discharge from plant: 5 degrees C.

3.1 Plant And
Mixing Requirements
(Cont'd)

- .10 Addition of anti-stripping agent:
- .1 Plant to be equipped with pug mill to thoroughly mix aggregates and lime prior to entering the plant.
 - .2 Plant to be equipped with suitable conveyor systems capable of supplying aggregates and lime at constant rate.
 - .3 Plant and equipment used for addition of lime to be equipped with covers to control loss of lime.
 - .4 Plant to be equipped to control rate of lime incorporation to within 0.25%.
 - .5 Add water to aggregate prior to entering pug mill.
 - .6 Add water to lime sufficiently in advance to permit time to slake prior to entering pug mill.

3.2 Preparation

- .1 Granular Base
- .1 Following granular base construction in accordance with Section 32 11 23, and prior to placing any course of hot-mix asphalt on a granular base, a conventional steel wheel roller having a minimum mass of 7 tonnes, or an equivalent vibratory roller in terms of compactive effort with a drum width of at least 1.2 metres, shall be used to finish roll the granular base grade ahead of the paver to ensure a compacted smooth surface.
 - .2 The Contractor shall check granular base grades, cross fall, surface tolerance, compaction and moisture content, and correct any deficiencies to the satisfaction of the Departmental Representative.
- .2 Existing Pavement Full-Depth Crack Repairs
- .1 Longitudinal and transverse full depth crack repairs of the milled HMA areas shall be completed as instructed by the Departmental Representative following his assessment of the exposed surface. The assessment shall be completed immediately following the completion of the milling activity. The crack repair procedure shall be in accordance with the Contract Drawings and shall consist of:
 - .1 Grinding out the asphalt concrete along the crack upto 150mm depth of the existing asphalt and to a width of at least 1000 mm. The milled out material shall be removed and all surfaces tack coated with SS1h emulsion in accordance with Section 32 12 13.16. Binder course hot-mix asphalt shall then be placed in

3.2 Preparation (Cont'd)	.2 (Cont'd) .1 (Cont'd)
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50 mm thick lifts, or as directed by the Departmental Representative or indicated on the Contract Drawings, and compacted in the milled out portion. After each binder course lift is placed and compacted, the exposed binder course surface and edges of the crack repair shall be coated with SS1h emulsion.

.2 Transverse crack repair shall be performed first in its entirety. Longitudinal crack repair shall be performed last. Where longitudinal crack repairs cross transverse crack repairs, the longitudinal crack repair work shall cut through the transverse crack repair.

.3 Immediately prior to paving, the existing pavement shall be cleaned of all loose, broken, and foreign material. The Contractor shall carry out such brooming and flushing as necessary to comply with this requirement. All costs associated with this preparation work will be deemed to be included in the unit prices for the hot-mix asphalt types in the Contract Tender Form.

.4 Any excessive crack sealant shall be removed.

.5 Existing Pavement Rutting Repairs

.1 Repair of pavement areas exhibiting rutting shall be performed as instructed by the Departmental Representative and in accordance with the Contract Drawings. Rutted asphalt concrete shall be neatly milled out to a depth of 50 mm or more if required, the area shall be cleaned out and tack coated (including vertical faces) with SS-1h asphalt emulsion, diluted with an equal volume of water, at a rate of 0.5 L/m². Lifts of binder course shall then be placed in accordance with this Specification matching the adjacent pavement. All lifts shall be compacted to at least 98 percent of Marshall density.

3.3 Application Of Prime Coat	.1 When and where specified in the Contract, apply prime coat to granular base in accordance with Section 32 12 13.23.
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3.4 Application Of Tack Coat .1 When and where specified in the Contract, apply tack coat in accordance with Section 32 12 13.16.

3.5 Transportation Of Mix .1 Transport mix to job site in vehicles cleaned of foreign material.

.2 Paint or spray truck beds with limewater, soap or detergent solution, or non petroleum based commercial product, at least daily or as required. Elevate truck bed and thoroughly drain. No excess solution to remain in truck bed.

.3 Schedule delivery of material for placing in daylight, unless Departmental Representative approves artificial light.

.4 Deposit mix from surge or storage silo to trucks in multiple drops to reduce segregation. Do not dribble mix into trucks.

.5 Deliver material to paver at uniform rate and in an amount within capacity of paving and compacting equipment.

.6 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within range as directed by Departmental Representative , but not less than 135 degrees C.

3.6 Transportation Of Hot-Mix Asphalt .1 The mix shall be transported from the asphalt plant to the paver(s) in trucks meeting the requirement of paragraph 2.6 of this Specification.

3.7 Communication Between Paving Operation and Hot-Mix Plant .1 Communication between the paving operation and the hot-mix plant shall be the responsibility of the Contractor, and inability to control the delivery of hot-mix asphalt, or to make changes in the composition of the mix, shall not be cause for acceptance of work which does not meet the requirements of the Contract, nor shall it relieve the Contractor of any responsibility for rejected loads.

3.7 Communication .2 The delivery of hot-mix asphalt from the
Between Paving plant shall be scheduled for placing in
Operation and daylight, unless night paving and artificial
Hot-Mix Plant lighting suitable for night work has been
(Cont'd) approved by the Departmental Representative.

3.8 Hot-Mix .1 When and where specified in the Contract or
Levelling Course as instructed by the Departmental
Representative , hot-mix levelling course
using surface course mix shall be used to
correct geometric deficiencies on the surface
of the existing pavement. All costs associated
with hot-mix levelling course will be deemed
to be included in the unit price for levelling
course hot-mix in the Contract Tender Form.

3.9 Placing .1 Obtain Departmental Representative's approval
of base and existing surface and tack coat and
prime coat prior to placing asphalt.

.2 Place asphalt concrete to thicknesses, grades
and lines as indicated as directed by
Departmental Representative.

.3 Paving shall not be carried out if, in the
opinion of the Departmental Representative,
the surface is frozen. In case of
disagreement, the Contractor has the option of
demonstrating, at the Contractor's own expense
and to the satisfaction of the Departmental
Representative, that the surface is
frost-free.

.4 Surface course hot-mix asphalt shall be
placed only when the air temperature at the
surface is at least 7°C.

.5 All other courses shall be placed only when
the air temperature at the surface is at least
5°C.

.1 When temperature of surface on which
material is to be placed falls below 10
degrees C, provide extra rollers as necessary
to obtain required compaction before cooling.

.2 Do not place hot-mix asphalt when pools
of standing water exist on surface to be
paved, during rain, or when surface is damp.

3.9 Placing
(Cont'd)

- .6 Place asphalt concrete in compacted lifts of thickness as follows:
 - .1 Levelling courses to thicknesses required but not exceeding 50 mm.
 - .2 Lower course in layers of maximum 65mm each.
 - .3 Surface course in layers of maximum 50 mm each.
- .7 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 300 mm.
- .8 Place individual strips no longer than 500 m.
- .9 The mixture shall be laid only upon a surface which is dry. Not less than 30 metres of prepared surface shall be maintained ahead of the paver laying the subsequent course. This requirement shall be waived at the end of the paving lane, or at the end of the paving operation for that day.
- .10 Each course shall be placed to the lines, grades, thicknesses and typical cross sections indicated in the Contract Drawings. Where possible, any required tapering and levelling shall be done in the binder course.
- .11 A course shall not be placed upon a previously laid course within the twelve hours following final compaction of the latter, or until the temperature of the previous course is 40°C or less, whichever ever occurs first. For small pavement areas, the Departmental Representative will issue instructions if any modification to this requirement is to be made.
- .12 Paving sequencing.
 - .1 The surface course shall only be placed following completion of all binder course paving.
 - .2 Construct temporary HMAC ramping between milled and unmilled pavement sections as directed by Departmental Representative.
- .13 Immediately after each course is laid and before compaction is started, any deficiencies in surface geometry or hot-mix texture shall be corrected. Irregularities in alignment and grade along outside edges shall also be corrected.

3.9 Placing
(Cont'd)

- .14 For all courses, each adjacent mat (lane) shall be completed to approximately the same location at the end of each day's paving.
- .15 The Contractor shall take care during transportation, placement and compaction of hot-mix asphalt to avoid spilling any petroleum products (gasoline, hydraulic oil, oil, diesel, etc.) on to existing pavement and new pavement. Any spill areas will be considered to be defective areas and dealt with in accordance with paragraph 4.9 of this Specification.
- .16 On airport runways and taxiways, aprons and and groundside parking lots and roads commence spreading at high side of pavement or at crown and span crowned centerlines with initial strip.
- .17 Spread and strike off mixture with self propelled mechanical finisher.
 - .1 Construct longitudinal joints and edges true to line markings. Establish lines for paver to follow parallel to centerline of proposed pavement. Position and operate paver to follow established line closely.
 - .2 When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver. Work pavers as close together as possible and in no case permit them to be more than 30 m apart. The longitudinal alignment of the paver shall be controlled by following a stringline except for the trailing paver(s) when pavers are operated in echelon.
 - .3 Maintain constant head of mix in auger chamber of paver during placing.
 - .4 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
 - .5 Correct irregularities in alignment left by paver by trimming directly behind machine.
 - .6 Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess material forming high spots. Fill and smooth indented areas with hot mix. Do not broadcast material over such areas.
 - .7 Do not throw surplus material on freshly screeded surfaces.
- .18 When hand spreading is used:
 - .1 Use approved wood or steel forms, rigidly supported to assure correct grade and

3.9 Placing
(Cont'd)

- .18 When hand spreading is used: (Cont'd)
- .1 (Cont'd)
cross section. Use measuring blocks and intermediate strips to aid in obtaining required cross-section.
 - .2 Distribute material uniformly. Do not broadcast material.
 - .3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes. Reject material that has formed into lumps and does not break down readily.
 - .4 After placing and before rolling, check surface with templates and straightedges and correct irregularities.
 - .5 Provide heating equipment to keep hand tools free from asphalt. Control temperature to avoid burning material. Do not use tools at higher temperature than temperature of mix being placed.

3.10 Compacting

- .1 The minimum field density achieved for each completed course of asphalt concrete pavement shall be at least 98 percent of the Marshall density. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor.
 - .2 The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mix and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.
 - .3 Roll asphalt continuously using established rolling pattern for test strip and to density of not less than 100 % of maximum density determined for test strip.
 - .4 Do not change rolling pattern unless mix changes or lift thickness changes. Change rolling pattern only as directed by Departmental Representative.
 - .5 General:
 - .1 Provide at least two rollers and as many additional rollers as necessary to achieve specified pavement density. When more than two rollers are required, one roller must be pneumatic tired type.
 - .2 Start rolling operations as soon as placed mix can bear weight of roller without
-

3.10 Compacting
(Cont'd)

- .5 General: (Cont'd)
 - .2 (Cont'd)

excess displacement of material or cracking of surface.
 - .3 Operate roller slowly initially to avoid displacement of material. Do not exceed 5 km/h for breakdown and intermediate rolling for static steel-wheeled and pneumatic tired rollers. Do not exceed 9 km/h for finish rolling.
 - .4 Use static compaction for levelling coarse less than 25 mm thick.
 - .5 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 25 impacts per metre of travel. For lifts less than 50 mm thick, impact spacing not to exceed compacted lift thickness.
 - .6 Overlap successive passes of roller by minimum of 200 mm and vary pass lengths.
 - .7 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.
 - .8 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.
 - .9 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
 - .10 After transverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side. Ensure that all points across width of pavement receive essentially equal numbers of passes of compactors.
 - .11 When paving in echelon, leave unrolled 50 to 75 mm of edge which second paver is following and roll when joint between lanes is rolled.
 - .12 Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.
- .6 Breakdown rolling:
 - .1 Begin breakdown rolling with static steel wheeled roller or vibratory roller immediately following rolling of transverse and longitudinal joint and edges.
 - .2 Operate rollers as close to paver as necessary to obtain adequate density without causing undue displacement.
 - .3 Operate breakdown roller with drive roll or wheel nearest finishing machine. When working on steep slopes or super-elevated

3.10 Compacting
(Cont'd)

- .6 Breakdown rolling: (Cont'd)
 - .3 (Cont'd)
sections use operation approved by
Departmental Representative.
 - .4 Use only experienced roller operators.
- .7 Intermediate rolling:
 - .1 Use pneumatic-tired, steel wheel or
vibratory rollers and follow breakdown rolling
as closely as possible and while paving mix
temperature allows maximum density from this
operation.
 - .2 Rolling to be continuous after initial
rolling until mix placed has been thoroughly
compacted.
- .8 Finish rolling:
 - .1 Accomplish finish rolling with two-axle
or three-axle tandem steel wheeled rollers
while material is still warm enough for
removal of roller marks. If necessary to
obtain desired surface finish, use
pneumatic-tired rollers as directed by
Departmental Representative.
 - .2 Conduct rolling operations in close
sequence.

3.11 Joints

- .1 General:
 - .1 Remove surplus material from surface of
previously laid strip. Do not deposit on
surface of freshly laid strip.
 - .2 Construct joints between asphalt
concrete pavement and Portland cement concrete
pavement as indicated.
 - .3 Paint contact surfaces of existing
structures such as manholes, curbs or gutters
with bituminous material prior to placing
adjacent pavement.
 - .4 All joints shall be made to ensure a
thorough and continuous bond and to provide a
smooth riding surface.
 - .5 All dirt or other foreign material, and
all loose material, shall be removed from all
faces at which joints are made.
 - .6 When matching a compacted joint, the
depth of the uncompacted mat shall be set to
allow for compaction and the paver shall
overlap the adjoining mat (lane) by not more
than 25 mm.
 - .7 The method of making joints shall be
such that any excess mix is not scattered on
the surface of the freshly laid mat. Such
excess mix shall be removed.

3.11 Joints
(Cont'd)

- .1 General: (Cont'd)
 - .8 For any handwork, care shall be taken to avoid opening or segregation of the mix, and any coarse mix or excess mix from raking shall be removed.
- .2 Tacking of Joints
 - .1 All faces at which joints are made shall be sprayed with a thin, uniform and continuous coating of SS-1h tack coat material (tacked) in accordance with Section 32 12 13.16 with the exception of joints that are still hot (greater than 100°C) and the longitudinal joint between mats (lanes) laid in echelon.
- .3 Transverse joints:
 - .1 Offset transverse joint in succeeding lifts by at least 600 mm.
 - .2 Cut back to full depth vertical face and tack face with thin coat of hot asphalt prior to continuing paving.
 - .3 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.
 - .4 The paver shall not move more than 15 m from any transverse joint until that joint has been rolled and checked with a straightedge. If the joint is not satisfactory, it shall be corrected immediately before the paver is allowed to proceed.
 - .5 Transverse joints shall be constructed by trimming the end of the previously laid course back to its full depth, to expose a fresh straight, vertical surface. Tack coat vertical surface with SS1h emulsion in accordance with Section 32 12 13.16.
 - .6 Transverse joints between the new asphalt pavement and existing asphalt courses shall be constructed as follows:
 - .1 Where the binder course is placed against the existing asphalt pavement and a butt joint is to be made, the existing pavement shall be sawcut to form a straight vertical face.
 - .2 Where the surface course is placed against the existing asphalt pavement and a butt joint is to be made, the existing pavement shall be sawcut to form a straight vertical face.
- .4 Longitudinal joints:
 - .1 Offset longitudinal joints in succeeding lifts by at least 300 mm.

3.11 Joints
(Cont'd)

- .4 Longitudinal joints: (Cont'd)
 - .2 Longitudinal joints shall be properly 'set up' with the back of a rake or lute at a proper height and grade prior to rolling.
 - .3 Longitudinal joints between a new asphalt pavement and existing asphalt pavement shall be formed as follows:
 - .1 The binder course joint shall be a butt joint constructed by trimming the existing pavement edge to a straight, clean, vertical face.
 - .2 The surface course joint shall be a stepped joint constructed by trimming the existing pavement edge to a straight, clean, vertical face back to the depth and width as indicated on the Contract Drawings.
 - .4 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100 degrees C prior to paving of adjacent lane.
 - .1 For airfield runway paving, avoid cold joint construction in mid 30 m of runway.
 - .2 If cold joint can not be avoided, cut back by saw cutting previously laid lane, by at least 150 mm, to full depth vertical face, and tack face with thin coat of hot asphalt of adjacent lane.
 - .5 Overlap previously laid strip with spreader by 25 to 50 mm.
 - .6 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with lute or rake.
 - .7 Roll longitudinal joints directly behind paving operation.
 - .8 When rolling with static or vibratory rollers, have most of drum width ride on newly placed lane with remaining 150 mm extending onto previously placed and compacted lane.
- .5 Construct butt joints as indicated.

3.12 Finish
Tolerances

- .1 Finished asphalt surface to be within 5 mm of design elevation but not uniformly high or low.
 - .2 Finished asphalt surface not to have irregularities exceeding 5 mm when checked with 4.5 m straight edge placed in any direction.
-

3.12 Finish
Tolerances
(Cont'd)

- .3 Each course of asphalt pavement after final compaction shall be smooth and true to the established crown or grade and shall be free from deviations as follows:
 - .1 Tolerances determined by straightedge:
 - .1 Tolerances shall be measured using a rigid metal straightedge, 4.5 m in length, which has been approved by the Departmental Representative.
 - .2 Tolerance measurement shall be carried out by the Contractor on binder and surface course for quality control. In addition, at any time, the Contractor may be required to take additional tolerance measurements at the direction of and in the presence of the Departmental Representative.
 - .3 Surface tolerance: the tolerance of the pavement surface shall be such that when tested with a 4.50 m long straightedge placed anywhere, including the edge of pavement and across longitudinal and transverse joints, in any direction on the surface, except across the crown or drainage gutters, there shall not be a gap between the bottom of the straightedge at any point along its length and the surface of the pavement greater than 5 mm for all binder courses or greater than 5 mm for all surface courses.
- .4 The Contractor shall measure the finished pavement surface for smoothness using a rigid metal 4.5 m long straightedge approved by the Departmental Representative. The finished surface for each completed course of asphalt concrete pavement shall not vary more than 5 mm when measured along the centreline of the mat with a 4.5 metre straightedge both perpendicular and parallel to the mat centreline, at intervals not to exceed 20 metres.
- .5 The finished surface for each completed course of asphalt concrete pavement shall not vary from the gradeline elevations and cross sections shown on the Contract Drawings by more than 5 mm, and shall not be uniformly high or low.

- 3.13 Defective Work .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking, rippling, or segregation.
- .3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement. rippling and checking of pavement. rippling and checking of pavement.

PART 4 - QUALITY
ACCEPTANCE

- 4.1 Acceptance
Sampling and
Testing - General .1 All Quality control sampling and testing necessary to determine conformance with the Contract requirements will be performed by the Contractor. The Departmental Representative will determine the lot sizes. All Quality assurance testing necessary to determine conformance with the Contract requirements will be performed by the Departmental Representative. The Contractor shall assist, as necessary, in the obtaining of samples for testing.
- .2 The Contractor shall repair any holes resulting from the removal of pavement samples with hot-mix asphalt, of the same mix type, compacted to match the adjoining pavement, at no cost to the Departmental Representative.
- 4.2 Acceptance
Criteria for
Hot-Mix Asphalt .1 Each completed course of hot-mix asphalt concrete pavement will be tested for asphalt cement content, aggregate gradation, air voids, stability and penetration of recovered asphalt cement on a lot basis.
- .2 Sampling
.1 Sampling will be at the paving site (plate samples). The lot size will normally be 2000 tonnes with four sublots sampled on a

- 4.2 Acceptance Criteria for Hot-Mix Asphalt (Cont'd)
- .2 (Cont'd)
- .1 (Cont'd)
- stratified random basis in accordance with ASTM D 3665.
- .3 Testing
- .1 Asphalt cement content and aggregate gradation
- .1 The asphalt cement content and aggregate gradation of each subplot will be determined in accordance with ASTM D 2172 or ASTM D 6307 (ignition furnace) and ASTM C 136 (washed sieve).
- .2 Air Voids
- .1 One set of three compacted specimens (briquettes) will be prepared for each subplot in accordance with ASTM D 1559, using 50 or 75 blows as required per face with a manual compaction hammer or the mechanical equivalent. The compaction temperature will be based on the typical temperature-kinematic viscosity relationship for recovered asphalt cement.
- .2 The bulk specific gravity of each compacted specimen will be determined in accordance with ASTM D 2726 and used in computing air voids and pavement compaction.
- .3 The theoretical maximum specific gravity for each subplot will be determined in accordance with ASTM D 2041 and used in computing air voids.
- .3 Stability
- .1 The stability and flow of each compacted specimen from the air voids testing will be determined in accordance with ASTM D 1559.
- .4 Penetration of Recovered Asphalt Cement
- .1 One recovery of asphalt cement by the Abson method will be completed for every 10,000 tonnes of HMA produced in accordance with ASTM D 1856 and the penetration of the recovered asphalt cement determined in accordance with ASTM D 5.
- .4 Acceptance
- .1 Acceptance of Hot Mix Asphalt will be determined by the Departmental Representative.
-

4.3 Acceptance
Criteria for
Pavement Density
(Compaction)

- .1 Each completed course of hot-mix asphalt concrete pavement will be tested for density (compaction) on a lot basis.
- .2 Sampling
 - .1 Sampling will be by coring. The lot size will normally be the same size as indicated in paragraph 4.2.2, with four sublots cored on a stratified random basis in accordance with ASTM D 3665. Pavement density cores will be taken at least 300 mm away from longitudinal or transverse joints.
- .3 Testing
 - .1 The bulk specific gravity of each core will be determined in accordance with ASTM D 2726. The percent compaction of each core will be determined by dividing the bulk specific gravity of the core by the average bulk specific gravity of the laboratory compacted hot-mix asphalt representative of the lot as determined in paragraph 4.2.3.2.
- .4 Acceptance
 - .1 Acceptance of each completed course of asphalt concrete pavement for compaction will be determined by the Departmental Representative .

4.4 Acceptance
Criteria for
Longitudinal
Joint Density
(Compaction)

- .1 Binder and surface course hot-mix asphalt concrete pavement will be tested for longitudinal joint density (compaction) on a lot basis.
 - .2 Sampling
 - .1 The sampling will be by coring as in paragraph 4.3.2, with the exception that the cores will be taken along the longitudinal joint(s) within 300 mm. The lot size will normally be proportional to the total length of longitudinal joint representing the lot size in paragraph 4.2.2, with four sublots cored on a stratified random basis in accordance with ASTM D 3665.
 - .3 Testing
 - .1 As given in paragraph 4.3.3.
 - .4 Acceptance
 - .1 Acceptance of each completed course of asphalt concrete pavement for longitudinal joint compaction will be determined by the Departmental Representative.
-

4.5 Acceptance
Criteria for
Surface Tolerance
and Smoothness

- .1 Surface Tolerance
 - .1 The tolerance of the pavement surface shall be such that when tested with a 4.5 m long straightedge placed anywhere, including the edge of pavement and across longitudinal and transverse joints, in any direction on the surface, except across the crown or drainage gutters, there shall not be a gap between the bottom of the straightedge along its full length and the surface of the pavement greater than 5 mm for all binder courses or greater than 5 mm for all surface courses.
 - .2 If the results of surface tolerance testing by the Contractor or by the Departmental Representative shows that the criteria are not met, the Contractor will be warned by the Departmental Representative and shall take immediate corrective action(s). If the Contractor cannot achieve acceptable surface tolerance within 2 hours of being warned, the Contractor shall be required to complete trial section(s) in accordance with the procedure given in paragraph 1.9.
 - .2 Smoothness
 - .1 The measurement will be made with a 4.5 m straightedge, perpendicular and parallel to the mat centreline including the longitudinal joint as determined randomly. The lot size will normally be 4000 m², with 20 subplot locations determined on a stratified random basis in accordance with ASTM D 3665. This method shall be used to determine the offset and station of the centre point of the straightedge. One transverse and one longitudinal measurement shall be taken at each subplot location for a total of 40 subplot measurements per lot. The smoothness variation shall be measured as the maximum gap between the pavement surface and the bottom of the straightedge anywhere along its length. The lot value shall be the mean of all 40 subplot measurements (20 transverse and 20 longitudinal).
 - .3 Acceptance
 - .1 Acceptance of completed surface course pavement for pavement smoothness will be determined by the Departmental Representative.
-

- 4.6 Acceptance Criteria for Pavement Grade .1 The completed surface course of asphalt concrete pavement will be measured for grade on a lot basis.
- .2 Measurement
.1 The grade measurements will be made by running levels at intervals, normally of 20 m longitudinally and 10 m transversely, to determine the elevation of the completed pavement.
- .3 Acceptance
.1 Acceptance of the completed surface course asphalt concrete pavement for pavement grade will be determined by the Departmental Representative.
- 4.7 Partial Lot .1 When operational conditions cause a lot to be terminated before the specified number of tests (sublots) have been made for the lot, test results (sublot results) will normally be taken from the previous lot, in reverse order, as necessary to complete the number of tests (sublots) for the terminated lot.
- 4.8 Disputes .1 In the case of a dispute concerning any sampling, testing or measurement that results in a rejectable or unacceptable subplot or lot, the Contractor may request, in writing with technical reasons supported by quality control testing, the Departmental Representative to undertake a sampling and testing program, or measurement program, to check the subplot or lot. The Contractor will have the opportunity to observe all aspects of the program and to obtain split samples. If the rejectable or unacceptable subplot or lot is confirmed by the program, the Contractor shall be responsible for the program costs involved. If the dispute then still remains unresolved, it will be dealt with in accordance with the Contract General Conditions.
- 4.9 Surface Appearance .1 The surface of each completed course of asphalt pavement shall be of uniform texture and shall be free of segregation, fat spots, oil spills or any other defects. Areas of severe segregation in the binder course and medium or severe segregation in the surface

- 4.9 Surface Appearance (Cont'd)
- .1 (Cont'd)
course are considered to be defective areas. Defective areas identified by the Departmental Representative shall be removed to a depth of at least the thickness of the course involved and replaced with acceptable hot-mix asphalt of the same type compacted to the satisfaction of the Departmental Representative, all at the Contractor's cost.
- 4.10 Hot-Mix Asphalt Acceptance
- .1 Asphalt Cement Content
.1 Asphalt cement content test results for hot-mix asphalt, completed in accordance with paragraph 4.2, shall meet the subplot and lot requirements given in Table 3. The tolerances given in Table 3 shall be applied to the asphalt cement content of the approved Job-Mix Formula.
- .2 Aggregate Gradation
.1 Aggregate gradation test results for hot-mix asphalt, completed in accordance with paragraph 4.2, shall meet the subplot and lot requirements given in Table 4.
.2 The tolerances given in Table 4 shall be applied to the gradations of the approved Job-Mix Formula.
.3 The Lot mean gradations for surface course shall meet the acceptable tolerances given in Table 4 and be within the limits given in Table 1.
- .3 Air Voids
.1 Air voids test results for hot-mix asphalt, completed in accordance with paragraph 4.2, shall meet the subplot and lot requirements given in Table 5.
- .4 Stability
.1 Stability test results for hot-mix asphalt, completed in accordance with paragraph 4.2, shall meet the subplot and lot requirements given in Table 6.
- .5 Acceptance/Rejection of Hot-Mix Asphalt
.1 If a subplot or lot of hot-mix asphalt is borderline for asphalt cement content, aggregate gradation, air voids, or stability the Contractor will be warned by the Departmental Representative, and shall take immediate corrective action. The Contractor will be allowed 3 hours production to make the corrective action for the borderline hot-mix

4.10 Hot-Mix .5
Asphalt Acceptance
(Cont'd)

(Cont'd)

.1 (Cont'd)

asphalt. If the hot-mix asphalt remains borderline, the contractor will be allowed an additional 2 hours production to make the corrective action. If the hot-mix asphalt is still borderline, the Contractor shall be required to complete a trial batch(es) in accordance with paragraph 1.9 of this Specification. The Contractor shall bear the cost of the trial batch(es) and the evaluation by the Departmental Representative of the trial batch(es).

.2 If a subplot or lot of hot-mix asphalt is rejectable for asphalt cement content, aggregate gradation, air voids, or stability, the Contractor shall remove the subplot or lot to a depth of at least the thickness of the course involved and replace it with hot-mix asphalt meeting the Contract requirements, all at the Contractor's cost. The Contractor shall also bear the cost of the evaluation by the Departmental Representative.

4.10 Hot-Mix .5 (Cont'd)
Asphalt Acceptance .2 (Cont'd)
(Cont'd)

TABLE 3
ASPHALT CEMENT CONTENT
TOLERANCES ON THE JOB-MIX FORMULA (Nearest 0.01%)

Sublot	Lot	Action
± 0.40	± 0.30	Acceptable
± 0.41 to ± 0.50	± 0.31 to ± 0.40	Borderline
More than ± 0.50	More Than ± 0.40	Reject

TABLE 4
AGGREGATE GRADATION
TOLERANCES ON THE JOB-MIX FORMULA (NEAREST 0.01%)
BINDER COURSE MIX

SIEVE SIZE	SUBLOT	LOT	ACTION
25.0 mm	± 5.0 ± 5.1 to ± 7.5 Not applied	± 5.0 ± 5.1 to ± 6.5 Not applied	Acceptable Borderline Reject
19.0 mm	± 6.5 ± 6.6 to ± 7.5 Not Applied	± 5.0 ± 5.1 to ± 6.5 Not Applied	Acceptable Borderline Reject
16.0 mm	± 6.5 ± 6.6 to ± 7.5 Not Applied	± 5.0 ± 5.1 to ± 6.5 Not Applied	Acceptable Borderline Reject

4.10 Hot-Mix .5 (Cont'd)
Asphalt Acceptance .2 (Cont'd)
(Cont'd)

	SUBLOT	<u>SURFACE COURSE MIX</u> LOT	ACTION
16.0 mm	± 5.0 ± 5.1 to ± 7.5 Not Applied	± 5.0 ± 5.1 to ± 6.5 Not Applied	Acceptable Borderline Reject

BINDER COURSE AND SURFACE COURSE MIXES

	SUBLOT	LOT	ACTION
12.5 mm	± 6.5 ± 6.6 to ± 7.5 Not Applied	± 5.0 ± 5.1 to ± 6.5 Not Applied	Acceptable Borderline Reject
9.5 mm	± 6.5 ± 6.6 to ± 7.5 Not Applied	± 5.0 ± 5.1 to ± 6.5 Not Applied	Acceptable Borderline Reject
4.75 mm	± 6.5 ± 6.6 to ± 7.5 More than ± 7.5	± 5.0 ± 5.1 to ± 6.5 More than ± 6.5	Acceptable Borderline Reject
2.36 mm	± 6.0 ± 6.1 to ± 7.0 Not Applied	± 4.5 ± 4.6 to ± 5.5 Not Applied	Acceptable Borderline Reject
1.18 mm	± 5.5 ± 5.6 to ± 6.5 Not applied	± 4.0 ± 4.1 to ± 5.0 Not Applied	Acceptable Borderline Reject
0.600 mm	± 4.5 ± 4.6 to ± 5.5 More than ± 5.5	± 3.5 ± 3.6 to ± 4.5 More than ± 4.5	Acceptable Borderline Reject
0.300 mm	± 4.0 ± 4.1 to ± 5.0 Not Applied	± 3.0 ± 3.1 to ± 4.0 Not applied	Acceptable Borderline Reject
0.150 mm	± 3.5 ± 3.6 to ± 4.5 Not Applied	± 2.5 ± 2.6 to ± 3.5 Not Applied	Acceptable Borderline Reject
0.075 mm	± 2.0 ± 2.1 to ± 2.4 More than ± 2.5	± 1.0 ± 1.1 to ± 1.4 More than ± 1.5	Acceptable Borderline Reject

4.10 Hot-Mix .5 (Cont'd)
Asphalt Acceptance .2 (Cont'd)
(Cont'd)

TABLE 5
AIR VOIDS (Nearest 0,1%)

BINDER COURSE MIX

SUBLOT	LOT	ACTION
2.5 to 5.5	3.0 to 5.0	Acceptable
2.0 to 2.4	2.5 to 2.9	Borderline
5.6 to 6.5	5.1 to 6.0	
Less than 2.0	Less than 2.5	Reject
More than 6.5	More than 6.0	

SURFACE COURSE MIX

2.0 to 5.0	2.5 to 4.5	Acceptable
1.5 to 1.9	2.0 to 2.4	Borderline
5.1 to 6.0	4.6 to 5.5	
Less than 1.5	Less than 2.0	Reject
More than 6.0	More than 5.5	

TABLE 6
STABILITY (NEAREST 0.1 KN)

Runway, Taxiway, Apron,

SUBLOT	LOT	ACTION
More than 8.0	More than 8.0	Acceptable
7.5 to 7.7	7.7 to 7.9	Borderline
Less than 7.5	Less than 7.7	Reject

Roads and Parking lots

SUBLOT	LOT	Action
More than 5.5	More than 5.5	Acceptable
4.9 to 5.3	5.2 to 5.4	Borderline
less than 4.9	less than 5.2	Reject

4.11 Pavement	.1	Pavement compaction test results, shall meet
Compaction		the requirements in Table 7.
Acceptance		

SUBLOT	LOT	ACTION
97.0 or greater	98.0 or greater	Acceptable
96.0 to 96.9	97.0 to 97.9	Borderline
Less than 96.0	Less than 97.0	Reject

4.12 Longitudinal	.1	Longitudinal Joint Compaction Requirements
Joint Compaction		.1 Longitudinal joint compaction test
<u>Acceptance</u>		results shall meet the subplot and lot
		requirements given in Table 8.

SUBLOT	LOT	ACTION
96.0 greater	97.0 or greater	Acceptable
95.0 to 95.9	96.0 to 96.9	Borderline
Less than 95.0	Less than 96.0	Reject

4.12 Longitudinal .1 (Cont'd)
Joint Compaction
Acceptance
(Cont'd)

- .2 Acceptance of Longitudinal Joint Compaction
.1 The acceptance of longitudinal joint compaction by the Departmental Representative shall be done the same as the acceptance of pavement compaction.

4.13 Pavement .1 Pavement Smoothness Requirements
Smoothness
.1 Pavement smoothness shall meet the subplot and lot tolerance requirements given in Table 9. Lot tolerance will be evaluated as the mean of all 4 subplot measurements in the lot.

TABLE 9
TOLERANCE OF SMOOTHNESS
(4.5 meter Straightedge, Variance, nearest 0.1mm)

SUBLOT	LOT	ACTION
Up to 4.0	Up to 3.0	Acceptable
4.1 to 6.0	3.1 to 5.0	Borderline
Greater than 6.0	Greater than 5.0	Reject

- .2 Acceptance/Rejection of Pavement Smoothness
.1 If the subplot or lot variance for smoothness is borderline, the Contractor will be warned by the Departmental Representative and shall take immediate corrective action. If the Contractor cannot achieve acceptable pavement smoothness within 2 hours of being warned, the Contractor shall be required to complete a trial section(s) in accordance with the procedures given in Section 1.9. The Contractor shall bear the cost of the evaluation of the trial section(s) by the Departmental Representative.
.2 If the subplot or lot variance for smoothness is rejectable, the Contractor shall remove the subplot or lot to a depth of at least the thickness of the course involved and replace it with hot-mix asphalt meeting the Contract requirements, all at the Contractor's cost. Skin patching shall not be permitted. The Contractor shall bear the cost of the evaluation by the Departmental Representative of the removal and replacement.
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- 4.14 Pavement Grade .1 Pavement Grade Requirements
Acceptance .1 Grade measurements shall meet the lot tolerance requirements given in Table 10. Lot variance will be calculated as the mean of the absolute values of all individual grade variances measured in the lot.

TABLE 10
TOLERANCE ON GRADE
(Lot Variance from the Gradeline Elevations and Cross Sections)

Variance, Nearest 0.1 mm	Action
Up to 8.0	Acceptable
8.1 to 14.0	Borderline
Greater than 14.0	Reject

- .2 Acceptance/Rejection of Pavement Grade
.1 If the lot variance for grade is rejectable, the Contractor shall remove the lot to a depth of at least the thickness of the course involved and replace it with hot-mix asphalt meeting the Contract requirements, all at the Contractor's cost. Skin patching for correcting low areas will not be permitted. The Contractor shall bear the cost of the evaluation by the Departmental Representative of the removal and replacement.

PART 1 - GENERAL

- 1.1 Measurement for Payment .1 No measurement will be made for reshaping granular surface. Include costs in items which require this work.
- .2 For repair of soft area, removal of any granular material will be paid as common excavation under section 31 22 14, Airfield Grading, and addition of new base material will be paid under section 32 11 23, Aggregate Base courses.

PART 2 - PRODUCTS

- 2.1 Materials .1 Granular base: material to Section 31 05 16 Aggregate Materials and Section 32 11 23- Aggregate Base Courses.

PART 3 - EXECUTION

- 3.1 Scarifying and Reshaping .1 Blade and trim material to elevation and cross section dimensions indicated or directed.
- .2 Scarify top 100 mm of existing base to maximum 50 mm size.
- .3 Add and blend in new granular base material as directed by Departmental Representative to meet new grades.
- .4 Remove and replace material which becomes segregated during reshaping.
- 3.2 Placing .1 Place material in accordance with Section 32 11 23 - Aggregate Base Courses.
- .2 Place material only on a clean unfrozen surface, properly shaped and compacted and free from snow and ice.
- .3 Begin spreading base material on a crown line or on high side of a one-way slope.
-

- 3.2 Placing
(Cont'd)
- .4 Place using methods which do not lead to segregation or degradation of aggregate.
 - .5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Departmental Representative may authorize thicker lifts if specified compaction can be achieved.
 - .6 Shape to smooth contour and compact to specified density before succeeding layer is placed.
 - .7 Remove and replace that portion of layer in which material becomes segregated during spreading.
- 3.3 Compacting
- .1 Compact to a density not less than 100% corrected maximum dry density in accordance with Section 32 11 23 - Aggregate Base Courses.
 - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted surface.
 - .3 Apply water or aerate as necessary during compaction to obtain specified density.
 - .4 In areas not accessible to rolling equipment, compact to specified density with approved mechanical means.
- 3.4 Repair of Soft Areas
- .1 Correct soft areas by removing defective material to depth and extent directed by Departmental Representative. Replace with granular base material and compact to specified density.
- 3.5 Finish Tolerances
- .1 Finish surface shall be within ± 12 mm of design grade but not uniformly high or low. Finished surface not to have irregularities exceeding 10 mm when checked with a 4.5 m straight edge placed in any direction.

3.6 Maintenance .1 Maintain finished surface in a condition conforming to this section until succeeding material is applied or until acceptance.

PART 1 - GENERAL

1.1 Measurement Procedures

- .1 No separate payment will be made for topsoil placement and grading as its considered incidental to the unit price Hydraulic Seeding - Section 32 92 19.16.

1.2 References

- .1 Agriculture and Agri-Food Canada
 - .1 The Canadian System of Soil Classification, Third Edition, 1998.
- .2 Canadian Council of Ministers of the Environment
 - .1 PN1340-2005, Guidelines for Compost Quality.
- .3 Canadian Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-December 2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System For New Construction and Major Renovations.
- .4 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 Definitions

- .1 Compost:
 - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
 - .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
 - .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below 50), and contain no toxic or growth inhibiting contaminants.
 - .4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category (A) (B).
-

- 1.4 Quality Assurance .1 Pre-installation meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirement
- 1.5 Waste Management And Disposal .1 Separate waste materials for reuse and recycling.
- .2 Divert unused soil amendments from landfill to official hazardous material collections site approved by Departmental Representative.
- .3 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

PART 2 - PRODUCTS

- 2.1 Topsoil .1 Topsoil for seeded areas: mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
- .1 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70 % sand, minimum 20 % clay, and contain 2 to 10 % organic matter by weight. Around runway, taxiway, and apron edges and shoulders, heavier Topsoil is required so that it is not blown away by aircrafts.
- .2 Contain no toxic elements or growth inhibiting materials.
- .3 Finished surface free from:
- .1 Debris and stones over 50 mm diameter.
- .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
- .4 Consistency: friable when moist.
- 2.2 Soil Amendments .1 Fertilizer:
- .1 Fertility: major soil nutrients present in following amounts:
- .2 Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
- .3 Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
-

- 2.2 Soil Amendments .1 Fertilizer:(Cont'd)
- (Cont'd)
- .4 Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
 - .5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
 - .6 Ph value: 6.5 to 8.0.
- .2 Peatmoss:
- .1 Derived from partially decomposed species of Sphagnum Mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded particle minimum size: 5 mm.
- .3 Sand: washed coarse silica sand, medium to coarse textured.

PART 3 - EXECUTION

- 3.1 Stripping Of Topsoil
- .1 Begin topsoil stripping of areas as indicated as directed by Departmental Representative after area has been cleared of brush weeds and grasses and removed from site.
 - .2 Strip topsoil to depths as indicated and 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.
-

- 3.2 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 Fine grade and loosen top soil. Eliminate rough spots and low areas to ensure positive drainage. Add topsoil as required.
 - .4 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.
 - .5 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm.
 - .1 Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.
 - .6 Roll to consolidate topsoil leaving surface smooth, uniform, and firm against deep foot printing.

- 3.3 Seeding General
- .1 Apply seed and fertilizer at rate best suited to conditions and coverage required.
 - .2 Check with local nurseries and landscape contractors as required to determine best rates for local conditions. If requested submit seed type and application rates to the Departmental Representative for approval prior to seeding and fertilizing of any areas.

- 3.4 Sowing Seed
- .1 In accordance with Section 32 92 19.16 Hydraulic Seeding.
 - .2 Use equipment and methods suitable for area involved and to approval of Departmental Representative.
-

- 3.5 Establishment .1 Perform following operations from time of seed application until final acceptance by Departmental Representative:
- .1 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
 - .2 Eliminate weeds by mechanical or chemical means.
- 3.6 Acceptance .1 Seeded areas will be accepted by Departmental Representative provided that areas are uniformly established and turf is free of rutted, eroded, bare or dead spots and free of weeds.
- .2 Areas seeded in fall will be accepted in following spring, one month after start of growing season provided acceptance conditions are fulfilled.
- 3.7 Surplus Material .1 Dispose of materials, except topsoil, not required off site.

PART 1 - GENERAL

1.1 Measurement Procedures

- .1 Supplying, placing and spreading 100mm (minimum depth) of topsoil including grading, hydraulic seeding, fertilizing, and maintenance during establishment period will be measured in square metres.

1.2 Product Data

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data for:
 - .1 Seed.
 - .2 Mulch.
 - .3 Tackifier.
 - .4 Fertilizer.
- .3 Submit in writing to Departmental Representative 7 days prior to commencing work:
 - .1 Volume capacity of hydraulic seeder in litres.
 - .2 Amount of material to be used per tank based on volume.
 - .3 Number of tankloads required per hectare to apply specified slurry mixture per hectare.

1.3 Quality Assurance

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements. Comply with Section.

1.4 Scheduling

- .1 Schedule hydraulic seeding to coincide with preparation of soil surface.
 - .2 Schedule hydraulic seeding using grass mixtures between dates recommended by the Provincial Agricultural Department.
-

PART 2 - PRODUCTS

2.1 Materials

- .1 Seed: "Canada pedigreed grade" in accordance with Government of Canada Seeds Act and Regulations.
 - .1 Grass mixture: "Certified", "Canada No. 1 Lawn Grass Mixture" in accordance with Government of Canada "Seeds Act" and "Seeds Regulations". Minimum germination of 75% and minimum purity 97%
 - .2 Seed mixture: 53% Creeping Red Fescue, 25% Perennial Rye, 15% Annual Rye Grass 5% Alsike Clover, 2% Red Top. Other seed mixture suitable for local site will be accepted if certified by local nursery.
 - .3 Mulch: specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, free of germination and growth inhibiting factors with following properties:
 - .1 Type I mulch:
 - .1 Made from wood cellulose fibre.
 - .2 Organic matter content: 95% plus or minus 0.5%.
 - .3 Value of pH: 6.0.
 - .4 Potential water absorption: 900%.
 - .4 Tackifier: water dilutable..
 - .5 Water: free of impurities that would inhibit germination and growth.
 - .6 Fertilizer:
 - .1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
 - .2 Complete synthetic, slow release with 35% of nitrogen content in water-insoluble form.
 - .7 Inoculants: inoculant containers to be tagged with expiry date.
-

PART 3 - EXECUTION

- 3.1 Workmanship
- .1 Do not spray onto structures, signs, guide rails, fences, plant material, utilities and other than surfaces intended. Wrap with suitable material if over spray unavoidable, remove after spraying is complete.
 - .2 Clean-up immediately, any material sprayed where not intended, to satisfaction of Departmental Representative.
 - .3 Do not perform work under adverse field conditions such as wind speeds over 10 km/h, frozen ground or ground covered with snow, ice or standing water.
 - .4 Protect seeded areas from trespass until plants are established.
- 3.2 Preparation Of Surfaces
- .1 Fine grade areas to be seeded free of humps and hollows. Ensure areas are free of deleterious and refuse materials.
 - .2 Cultivate areas identified as requiring cultivation to depth of 100 mm.
 - .3 Ensure areas to be seeded are moist to depth of 150 mm before seeding.
 - .4 Obtain Departmental Representative's approval of grade and topsoil depth before starting to seed.
- 3.3 Fertilizing Program
- .1 Fertilize prior to fine grading incorporating fertilizer equally distributed
- 3.4 Preparation Of Slurry
- .1 Measure quantities of materials by weight or weight-calibrated volume measurement satisfactory to Departmental Representative. Supply equipment required for this work.
 - .2 Charge required water into seeder. Add material into hydraulic seeder under agitation. Pulverize mulch and charge slowly into seeder.
-

3.4 Preparation Of Slurry (Cont'd) .3 After all materials are in the seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.

3.5 Slurry Application .1 Hydraulic seeding equipment:

- .1 Slurry tank.
- .2 Agitation system for slurry to be capable of operating during charging of tank and during seeding, consisting of recirculation of slurry and/or mechanical agitation method.
- .3 Capable of seeding by 50 m hand operated hoses and appropriate nozzles.
- .4 Tank volume to be certified by certifying authority and identified by authorities "Volume Certification Plate".

.2 Apply slurry uniformly, at optimum angle of application for adherence to surfaces and germination of seed.

- .1 Using correct nozzle for application.
- .2 Using hoses for surfaces difficult to reach and to control application.

.3 Blend application 300 mm into adjacent grass areas or sodded areas previous applications to form uniform surfaces.

.4 Re-apply where application is not uniform.

.5 Remove slurry from items and areas not designated to be sprayed.

.6 Protect seeded areas from trespass satisfactory to Departmental Representative.

.7 Remove protection devices as directed by Departmental Representative.

3.6 Maintenance During Establishment Period .1 Perform following operations from time of seed application until acceptance by Departmental Representative.

.2 Grass Mixture:

- .1 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
- .2 Mow grass to 50 mm whenever it reaches height of 70 mm. Remove clippings which will

- 3.6 Maintenance .2 Grass Mixture: (Cont'd)
- During .2 (Cont'd)
- Establishment smother grass as directed by Departmental
- Period Representative.
- (Cont'd) .3 Fertilize seeded areas after first
- cutting 10 weeks after germination provided
- plants have mature true leafs in accordance
- with fertilizing program. Spread half of
- required amount of fertilizer in one direction
- and remainder at right angles ;water in well
- .4 Eliminate weeds by mechanical or
- chemical means utilizing acceptable integrated
- pest management practices.
- .5 Water seeded area to maintain optimum
- soil moisture level for germination and
- continued growth of grass. Control watering to
- prevent washouts.
- 3.7 Acceptance .1 Seeded areas will be accepted by Departmental
- Representative provided that:
- .1 Plants are uniformly established. Seeded
- areas are free of rutted, eroded, bare or dead
- spots and Areas have been mown at least twice
- .2 Areas have been fertilized.
- .2 Areas seeded in fall will achieve final
- acceptance in following spring, one month
- after start of growing season provided
- acceptance conditions are fulfilled.
- 3.8 Cleaning .1 Upon completion of installation, remove
- surplus materials, rubbish, tools and
- equipment barriers.