

**Part 1            General**

**1.1               MEASUREMENT AND PAYMENT**

- .1       Asphalt pavement crack routing and sealing will be measured in linear metres. The unit price includes survey, layout, material, equipment, tools, transporting, preparation, routing and/or saw cutting, cleaning, sealing, curing, protecting and all work incidental thereto.

**1.2               REFERENCES**

- .1       Department of Justice Canada (Jus)
  - .1       Canadian Environmental Protection Act, 1999 (CEPA).
- .2       Transport Canada (TC)
  - .1       Transportation of Dangerous Goods Act, 1992 (TDGA).
- .3       ASTM D6690, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

**1.3               SUBMITTALS**

- .1       Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2       Submit to Departmental Representative one 4 L container of sealant proposed for use at least 2 weeks prior to beginning Work.
- .3       Submit certificates in accordance with Section 01 33 00 - Submittal Procedures.
- .4       Submit manufacturer's test data and certification that the following materials meet ASTM D6690 requirements for Type IV (Cold Climates) to Departmental Representative at least 2 weeks prior to beginning Work.
- .5       Submit the following documentation to the Departmental Representative prior to the placement of sealant compound:
  - .1       Sealant compound information from the Manufacturer for every batch of sealant compound which is to be used in the Work:
    - .1       The batch numbers or designation;
    - .2       The size of the batch;
    - .3       Application recommendations;
    - .4       Recommended heating time and temperature;
    - .5       Allowable storage time and temperature after initial heating;
    - .6       Allowable reheating criteria;
    - .7       Recommendations for continuous overnight heating, if the Manufacturer allows such heating;
    - .8       Application temperature range.

- .2 One copy of at least one set of test results that have been conducted for each batch of hot-poured rubberized asphalt joint/crack sealant compound used on the Work. The testing shall be carried out according to ASTM D6690 by a certified Canadian Council of Independent Laboratories (CCIL) laboratory that is independent of both the Manufacturer and the Contractor.

#### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .5 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .6 Dispose of unused sealant material at official hazardous material collections site or recycling facility.
- .7 Fold up metal banding, flatten and place in designated area for recycling.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Sealant:
  - .1 Hot-pour rubberized joint sealant shall comply with ASTM D6690 Type IV requirements. The following low modulus hot-poured, single component sealants will be acceptable subject to submission of current test results confirming compliance with ASTM D6690 Type IV requirements:
    - .1 Crafcro Roadsaver 522;
    - .2 Deery 101 ELT; or
    - .3 MACSEAL 6690-4 Mod.
    - .4 Nuvo 6690 Type IV.

*See Section 32 01 18 Appendix 32 01 18A for Commentary on Approved Products for Routing and Sealing of Pavement Cracks.*
- .2 Limestone Screenings:
  - .1 Limestone screenings used for dusting sealant shall have 100 percent passing the 1.18 mm sieve and not greater than 25 percent passing the 0.075 sieve.

## 2.2 EQUIPMENT

- .1 Machines, tools, and equipment used in the performance of the Work required by this section shall be approved before the work is started and shall be maintained in satisfactory condition at all times.
- .2 Compressed air unit
  - .1 The compressed air unit shall be equipped with water and oil traps and must produce sufficient air volume and pressure to remove all debris from the cracks. It shall be capable of delivering a continuous stream of clean, dry air at a minimum pressure of 700 kPa and a minimum air volume of 4.25 m<sup>3</sup>/min.
- .3 Hot compressed air lance
  - .1 Capable of providing a continuous hot, high pressure air stream (500°C at an exit velocity of at least 1000 m/sec) with no flame at the exit nozzle.
- .4 Heating equipment for melting sealant
  - .1 Mobile unit equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer and equipped with calibrated thermometers to measure the temperature of both the heat transfer oil and the sealant compound.
  - .2 Motor driven agitator.
  - .3 Totally automatic temperature control system controlling both heat transfer oil temperature and sealing compound temperature that prevent overheating of the sealant compound.
  - .4 The heating kettle shall be equipped with a spigot.
- .5 Pressure applicator capable of applying sealant at 100 kPa by means of hose and wand fitted with size of tip suitable for cracks.
  - .1 Capable of maintaining temperature of sealant as per manufacturer's recommendation during application.
  - .2 Allow the sealant to circulate through the delivery hose and return to the inner kettle when not in use.
- .6 All equipment used for routing or cutting grooves shall consist of well-maintained mechanical routers or random crack saws capable of continually creating well-defined right-angled grooves with centrelines which are approximately coincident with the centrelines of their associated cracks to the tolerances stated within this specification. Such capability shall be successfully demonstrated to the Departmental Representative's satisfaction prior to its use.

**NOTE: Rotary impact routers that are equipped with vertical sided, carbide tipped bits have been used successfully to rout cracks in pavements. Impact routers that are not equipped with carbide tipped bits can chip and damage the surrounding pavement and are not permitted.**

*See Section 32 01 18 Appendix 32 01 18B for Commentary on Use of Rotary Impact Routers For Routing of Pavement Cracks.*

- .1 Routing Equipment and Random Crack Saws
  - .1 Provide mechanical routing equipment which is self-powered and operating a power-driven carbide tipped cutting wheel or bit specifically designed for routing or sawing pavement cracks. The cutter or bit shall rotate at sufficient speed to cut a smooth vertical-walled reservoir in the pavement surface and shall maintain accurate cutting without damaging the sides or top edges of the reservoir. Provide a router or random crack saw capable of following the trace of the crack without deviation.
  - .2 Demonstrate that the router or random crack saw is capable of following the trace of the crack and keeping the crack centered within  $\pm 6$  mm of the center of the rout/groove.
  - .3 Replace all the carbide bits or cutters in the router's cutting head at a minimum frequency of completion of every 2500 linear meters of routed grooves and the Contractor shall notify the Departmental Representative prior to doing this. In addition, at any other time when the Contractor cannot demonstrate to the satisfaction of the Departmental Representative that the routing equipment is able to maintain the specified dimensions and shape of the routed groove due to excessive wear of the carbide bits or cutters or excessive wear of diamond saw blades if a random crack saw is used, then the Contractor shall respectively adjust and/or replace, as many bits, cutters in the router's cutting head, or diamond saw blades as necessary until the Contract is completed.

### **Part 3 Execution**

#### **3.1 PREPARATION**

- .1 Crack Selection
  - .1 Unless otherwise indicated, all cracks shall be sealed.
    - .1 All cracks that are greater than 6 mm wide shall be routed to a nominal width of 20 mm and to a depth not less than 20 mm.
- .2 Routing
  - .1 Rout all cracks to fix width of 20 mechanical routers or random crack saws..
  - .2 Rout all cracks to a minimum depth of 20 mm.
  - .3 Routs must be square or rectangular at bottom. Rounded bottoms and V-shaped are not permitted.
  - .4 Centre of rout cut to deviate not more than  $\pm 6$  mm from centreline of crack.
    - .1 Perform routing of the cracks using a mechanical router with a cutter or bit that is at least 3 mm wider than the nominal width of the crack to remove all residual old sealant (resealing), oxidized pavement and any loose aggregate in the crack wall. Where a random crack saw is used, the blade shall be at least 3 mm wider than the nominal crack width.

- .5 Limit the stages of crack preparation, which include routing/sawing and air pressure cleaning to only that length that can be sealed during the same day.

*See Section 32 01 18 Appendix 32 01 18C for Commentary on Selection of Appropriate Rout Geometry.*

.3 Cleaning

- .1 Immediately before the installation of the crack sealant, thoroughly clean the cracks to remove oxidized pavement, loose aggregate and foreign debris.
- .2 Clean and dry routed or sawn cracks using lance with oil-free hot compressed air, applied at minimum pressure of 700 kPa and minimum volume of 4.25 m<sup>3</sup>/sec.
- .3 Dispose of material removed from cracks.

### 3.2 APPLICATION OF SEALANT

- .1 Departmental Representative to review of preparation of cracks before application of sealant.
- .2 Do not use sealant material that has been frozen.
- .3 Heat crack sealant slowly to application temperature in accordance with manufacturer's recommendations.
  - .1 Withdraw and waste sealant that has been overheated above 205 °C or subjected to application temperatures for over 4 hours or that has remained in the applicator at the end of the day's operation.
- .4 Ensure cracks are clean and dry immediately before applying sealant. There shall be a maximum time period of 2 minutes between cleaning and drying the routed cracks and the application of the crack sealant.
  - .1 Do not apply sealant if moisture is observed in the crack.
  - .2 When rain interrupts sealing operations, crack reservoirs shall be re-cleaned and allowed to dry prior to installing the sealant.
- .5 Maintain tip of cone or wand close to bottom of routed groove during filling.
- .6 Fill cracks only when the pavement temperature is a minimum of 10 °C and rising, the daily low ambient air temperature does not fall below 5 °C, and no rain is forecast. Do not fill cracks when the pavement temperature exceeds 50 °C.
  - .1 Pavement temperature shall be measured using a non-contact infrared thermometer. See *Section 32 01 18 Appendix 32 01 18D for Commentary on Alternative Methods of Measuring Surface Temperature.*
- .7 Pour sealant in crack so that cooled sealant fills crack from bottom up to level 2 mm below pavement surface.
- .8 Over-banding of routed crack is not permitted. Do not fill spalled crack areas with sealant.
- .9 Keep traffic off newly sealed cracks for 8 hours. Where traffic must be maintained during or shortly after crack sealing has been completed, the surface of the sealant compound shall be dusted with limestone screenings, meeting the requirements specified in Section

2.1.2, in order to eliminate any tackiness, prior to allowing any traffic, including the Contractor's own construction control vehicles, on the sealed routs or cracks.

### **3.3 CRACK SEALANT INSTALLATION TEST SECTION**

- .1 Prior to the cleaning and sealing of the cracks for the entire project, construct a test section at least 60 m long using the specified materials and approved equipment, to demonstrate the proposed sealing of all cracks on the project.
- .2 Following the completion of the test section and before any other crack is sealed, inspect the test section to determine that the materials and installation meet the requirements specified.
  - .1 If materials or installation do not meet requirements, remove the materials and re-clean and reseal the cracks at no cost to the project.
  - .2 When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear metre for routing and sealing. Route and seal all other cracks in the manner approved for sealing the test section.

### **3.4 QUALITY CONTROL**

- .1 Conduct quality control inspection during the crack cleaning process and make necessary adjustments in methods and equipment used to correct improper equipment and cleaning techniques that damage the pavement in any manner. Cleaned cracks shall be approved prior to installation of the crack sealant.
- .2 Inspect the application equipment to ensure conformance to temperature requirements and proper installation. Evidences of bumbling, improper installing, and failing to cure or set will cause to suspend operations until causes of the deficiencies are determined and corrected.
- .3 Inspect the crack sealant for proper cure and set rating, bonding to the bituminous pavement, cohesive separation within the sealant, reversion to liquid, and entrapped air and voids. Sealants exhibiting any of these deficiencies, at any time prior to the final acceptance of the project, shall be removed from the crack, wasted, and replaced as specified herein at no additional cost to the project.

### **3.5 QUALITY ASSURANCE**

- .1 Sampling and Testing Sealant Compound
  - .1 Unheated (as Delivered) Sealant Compound  
When requested by the Departmental Representative, the Contractor shall provide samples of batches of sealant compound used on the Contract. Each sample shall be approximately 4 liters in volume and placed in a suitable box, provided by the Contractor, which is clearly marked with the sampling identification information, along with the following additional information:
    - a) The designated trade name and designation # of the compound;
    - b) The manufacturer;
    - c) The manufacturer's batch number; and
    - d) The size of the applicable batch.

.2 Samples During Sealant Placement

- .1 The Contractor shall take samples of hot-poured rubberized asphalt joint/crack sealant compound directly from the heating kettle, while the sealant compound is being placed, at the direction of and in the presence of the Departmental Representative. A minimum of either three samples at points when approximately 1/4, 1/2, and 3/4 of the proposed number of linear meters has been placed on the Contract or a minimum of one sample for each 25,000 linear meters has been placed on the Contract, whichever is greater, shall be taken. The Contractor shall also take additional samples when requested by the Departmental Representative.
- .2 Each sample shall be placed in a triple-tight single metal container (e.g. paint can) with a wire handle and with a minimum volume of 4 liters. The side and top of each metal container shall be clearly marked with the following information:
  - .1 Contract number;
  - .2 Designated trade name and designation # of the compound;
  - .3 Manufacturer;
  - .4 Manufacturer's batch number; and
  - .5 The point in the Contract at which the sample was taken, e.g., the percentage of the work completed.
- .3 An accompanying tag shall also be firmly affixed to the wire handle of the metal container showing all of the sampling identification information mentioned above, all other sampling information specified elsewhere in the Contract as well as the following additional information:
  - .1 The location on the project where the sample was taken;
  - .2 The temperature of the sealant compound when the sample was taken; and
  - .3 The weather conditions (ambient temperature and precipitation).

.2 Deficiencies During Construction

- .1 If during construction: a routed groove is found to have:
  - .1 two intersecting sides deviating by more than 10° from a right-angle; or
  - .2 its centerline more than 4 mm from the centerline of its associated crack; or
  - .3 a width less than 20 mm or more than 33 mm; or
  - .4 a depth less than 15 mm or more than 20 mm, or

the sealant in a routed and sealed groove has:

- .1 has, upon complete cooling, subsided to the point that, the sealant compound has subsided by more than 3 mm below the adjacent pavement surface; or

the sealant compound itself:

- .1 does not meet the material quality requirements, stated elsewhere in the Contract; or
- .2 contains imbedded foreign material (other than limestone screenings to eliminate tackiness); or
- .3 contains entrained bubbles, indicating excessive moisture; or
- .4 has debonded or pulled away from the routed groove; or
- .5 has been excessively heated.

then, the sealed crack or routed and sealed groove shall, be repaired by the Contractor, or the Contractor will be given a payment adjustment in lieu of repairs per Section 3.6 Payment.

### **3.6 TOLERANCES FOR COMPLIANCE**

- .1 For the purposes of evaluating rout width, depth and centering accuracy, tolerances for compliance shall be used to determine non-compliant work as follows:
  - .1 Rout Cross-Section Dimensions: Width: 20 mm; Depth 20 mm; Acceptable Width: Depth Ratio: 1.0 to 1.3.1 Non-Compliance: A lot with a compliance percentage of less than 90% for width: depth ratio shall be subject to corrective action and remedial work.
- .2 Rout Centering on Crack: Centre of crack shall not be more than 4 mm from the center of the rout.
  - .1 Non- Compliance: A lot with a compliance percentage of less than 80% shall be subject to corrective action and remedial work.
- .3 Rejected Work
  - .1 Sealed cracks shall be rejected if there is evidence of poor workmanship or obvious defects, including:
    - .1 Routed crack not completely filled;
    - .2 Lack of bond to sides of route;
    - .3 Excessive debris or moisture in the route;
    - .4 Excessive entrapped air and voids in the sealant.
    - .5 Contamination of the sealant;
    - .6 Routed crack, upon cooling, not filled flush within  $\pm 2$ mm.
    - .7 Tracking of uncured sealant.
    - .8 Excessive rounding or spalling of the routed edges.
- .4 Repair of rejected sealed cracks by removing the sealant and resealing the cracks will be completed at no cost to the project.

**3.7 FINAL CLEAN-UP**

- .1 Upon completion of the project, remove unused materials from the site and leave the pavement in a clean condition.

**END OF SECTION**

**Section 32 01 18 APPENDIX 32 01 18A, March 2018**

**APPROVED PRODUCTS FOR ROUTING AND SEALING OF PAVEMENT CRACKS**

**Note: This Commentary Appendix is intended to provide information to a designer, during the design stage of a Contract, on the selection and approval of hot-poured, rubberized crack sealants suitable for use at Canadian DND airfields. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede the Owner's design decisions and methodology.**

**Designer Actions/Considerations**

Section 2.1 Materials of this Specification provides a list of four hot-poured rubberized crack sealants currently approved for use at Canadian DND airfields. Their continued approval is contingent upon them confirming that they meet the requirements of ASTM D6690 for Type IV and as such are capable of maintaining an effective seal in climates experiencing very cold temperatures. ASTM D6690 Type IV requires that the material is tested for low temperature performance at -29°C using 200% extension.

Some provincial agencies maintain similar lists of Approved or Recognized Products for use in their respective jurisdictions. The Ontario Ministry of Transportation currently lists MACSEAL 6690-4 MOD, Ultraseal 3407 LM and Ultraseal 3405 approved for use for sealing concrete pavements (DSM 3.20.45) in All Districts. These same three products are also approved for use in bituminous pavements (DSM 3.05.40). Alberta Infrastructure & Transportation's Recognized Products List for crack routing and sealing (hot poured, rubberized crack sealant) lists the same four products currently listed in 32 01 18.

Newfoundland & Labrador Department of Transportation & Works Section 350 specifies crack sealing products meet ASTM D6690 Type IV requirements. Saskatchewan Department of Highways requires rubberized crack sealant to meet ASTM D3405 and ASTM D3407 requirements; note that ASTM D3405 was withdrawn by ASTM in 2002 and replaced with ASTM D6690; similarly, ASTM D3407 was withdrawn in 1996 and replaced with ASTM D5329. BC MOT's Recognized Products List has 14 products currently listed for use in the entire province, and an additional 10 products recognized for use in the Lower Mainland and Vancouver Island; only some of these products will meet ASTM D6690 Type IV requirements and could be potentially suitable for use at Canadian DND airfields.

Notwithstanding the above, only products meeting ASTM D6690 requirements for Type IV will be considered for use at Canadian DND airfields.

**Part 4 Section 32 01 18 APPENDIX 32 01 18B, March 2018**

**USE OF ROTARY IMPACT ROUTERS FOR ROUTING OF PAVEMENT CRACKS**

**Note: This Commentary Appendix is intended to provide information to a designer, during the design stage of a Contract, on the suitability and use of impact routing equipment for the routing of cracks, joints and grooves at Canadian DND airfields. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede the Owner's design decisions and methodology.**

**Designer Actions/Considerations**

The use of rotary impact routers for routing pavement cracks, joints and grooves is not permitted in some jurisdictions. Rotary impact routers have been determined in some locations to damage asphalt pavements where hard, brittle aggregates are present in the asphalt pavement, due to micro fracturing of the aggregate particles and subsequent infiltration and expansion of water into these micro-cracks. The use of random crack saws or vertical spindle routers are technically preferred and present less risk of damage to the adjacent pavements; however, these methods are comparatively much slower and therefore much more costly. Rotary impact routers are accepted in some jurisdictions and by some provincial agencies. The Ministry of Transportation of Ontario, permits the use of rotary impact routers that are equipped with carbide-tipped cutting wheel bits that are required to be replaced with new bits at regular 2500 lineal meter intervals.

**Part 5                      Section 32 01 18 APPENDIX 32 01 18C, March 2018**

**SELECTION OF APPROPRIATE ROUT GEOMETRY**

**Note: This Commentary Appendix is intended to provide information to a designer, during the design stage of a Contract, on the selection of the optimal geometry for routing of cracks in pavements. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede the Owner's design decisions and methodology.**

**Designer Actions/Considerations**

The 2003 National Guide to Sustainable Municipal Infrastructure (InfraGuide) Best Practice (Guidelines for Sealing and Filling Cracks in Asphalt Concrete Pavement) states that the rout width should not exceed 30 mm, and good performance is obtained with routs with Width (W) to Depth (D) ratio greater than or equal to 1 (30 mm by 15 mm, 25 mm by 12 mm, or 12 mm by 12 mm). This is somewhat consistent with National Research Council (NRC) findings and recommendations that a 20 mm by 10 mm rout configuration provides an appropriate compromise between the theoretical 'optimum' 40 mm by 10 mm configuration and the observed 'optimum' 12 mm by 12 mm or 19 mm by 19 mm configurations. The US Federal Highway Administration (FHWA) Best Practices Manual indicates that a shape factor of 1 (width to depth) is best for rubberized asphalt crack sealant materials.

While this specification requires that cracks be routed to 30 mm wide by 15 mm deep geometry, there is a relatively broad range of geometries currently specified and in use by provincial and other airport authorities in Canada. For instance:

- Greater Toronto Airports Authority: 19 mm x 19 mm.
- Ottawa Airport Authority: 40 mm x 12 mm.
- Aeroports de Montreal: 12 mm x 12 mm.
- Unified Facilities Guide Specification (USACE/NAVFAC/AFCEC /NASA): Only requires the minimum depth to be 20 mm.
- Alberta Transportation and Infrastructure: 19 mm x 19 mm.
- Newfoundland & Labrador Department of Transportation and Works: 20 mm x 20 mm.
- Saskatchewan Highways and Transportation: 30 mm x 15 mm.

If the materials and construction are consistently adopted and achieved as stipulated in this Specification, then the 20 x 20 mm configuration should be maintained. Specifically for working cracks, the performance of the 20 mm x 20 mm configuration is somewhat a function of the pavement surface temperature conditions at the time of crack sealing - it is therefore important that crack sealing not be

completed when the pavement surface temperature is less than 10°C (as thermal expansion or the pavement during warmer temperatures can cause the sealant to compress and potentially extrude above the pavement surface where it then becomes more susceptible to damage from traffic or maintenance equipment such as snow plows or wire brooms), or greater than 50°C (as thermal contraction of the pavement during cooler temperatures can over stress the pavement/sealant bond, causing bond failures).

**Part 6                      Section 32 01 18 APPENDIX 32 01 18D, March 2018**

**MEASUREMENT OF PAVEMENT SURFACE TEMPERATURE**

**Note: This Commentary Appendix is intended to provide information to a designer and/or Departmental Representative, during the construction stage of a Contract, on the alternate methods of measuring the surface temperature of the pavement in conjunction with Section 2.4.6 of this Specification. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede the Owner's design decisions and methodology.**

**Designer Actions/Considerations**

The use of non-contact infrared thermometers has been specified for the determination of the pavement surface temperature in conjunction with Section 3.2.6 of this Specification. Suitable non-contact infrared thermometers (also known as "temperature guns") are produced by a number of manufacturers (Fluke, FLIR, Milwaukee, Ryobi for instance) and are commercially available from a wide variety of retailers carrying power tools, electronics or kitchen supplies.

In the absence of a non-contact infrared thermometer, the pavement surface temperature can be determined by drilling holes to shallow (<25 mm depth) below the pavement surface and filling the bottom of these holes with 10 to 15 mm of a fluid that has a low evaporation rate (to prevent cooling), such as a glycerin or oil-based product (such as mineral oil), and recording the temperature as soon as the temperature of the fluid has stabilized.

**Part 1 General**

**1.1 MEASUREMENT AND PAYMENT**

- .1 Granular base aggregate processing and stockpiling required for granular material replacement on the unpaved runway will be measured in tonnes. The unit price shall include materials aggregate source preparation, processing, stockpiling, loading, hauling, QC testing and all work incidental thereto.
- .2 No measurement will be made for: unnecessary aggregate produced beyond quantities established.

**1.2 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM C117, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - .3 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .4 ASTM D1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
  - .5 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
  - .1 Stockpile aggregate in designated stockpile location as shown on the drawings. Replace defective or damaged materials with new.

**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 C117 and ASTM C136. Sieve sizes to CAN/CGSB-8.2.

- .1 Gradation to:

Granular Base Material Replacement for Unpaved Runway Maintenance	
Sieve Designation	% Passing
(1)	
25 mm	100
19 mm	70-100
12.5 mm	-
9.5 mm	-
4.75 mm	-
2.00 mm	40-70
0.425 mm	20-45
0.180 mm	-
0.075 mm	10-20

- .2 Liquid limit: to ASTM D4318, maximum 25
    - .3 Plasticity index: to ASTM D4318, maximum 6.
    - .4 Micro-Deval Abrasion: To CSA A23.2.29A, Max % loss by mass: 25%.
    - .5 Los Angeles degradation: to ASTM C131. Max. % loss by weight: 45  
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 C136.
    - .6 Soaked CBR: to ASTM D1883, minimum 80, when compacted to 100% of ASTM D1557.

### **Part 3 Execution**

#### **3.1 PLACEMENT AND INSTALLATION**

- .1 Place granular base into designated stockpile location as shown on the Drawings.

#### **3.2 PROTECTION**

- .1 Maintain granular base materials in condition conforming to this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

**1.2 MEASUREMENT AND PAYMENT**

- .1 Asphalt concrete pavement will be measured in tonnes in place of asphalt concrete actually incorporated and accepted into the Work. The unit price shall include materials including aggregate handling and processing from stockpile, anti-stripping agent (hydrated lime), fibre reinforcement additive (Nilex aramid), production, mixing, loading, hauling, surface preparation, placing, compacting, surface application of hydrated lime following compaction, QC testing and all work incidental thereto.
- .2 Payment will be made for all asphalt placed during the project including asphalt repairs, overlay, patching and transition ramps.
- .3 No measurement will be made for: unnecessary asphalt concrete pavement beyond lines established; surplus asphalt concrete pavement not incorporated into the work; asphalt cement materials not incorporated into the work; longitudinal and transverse joints including saw cutting or repair of damaged areas resulting from the Contractors equipment and operations; labour and equipment costs for temporary transition ramps required at end of work shift including saw cutting, milling and miscellaneous handwork.
- .4 Aggregate required for asphalt paving mix will be measured in tonnes of asphalt aggregate delivered to the designated stockpile location. The unit price shall include materials, aggregate crushing, processing, handling, delivery to designated stockpile location, QC testing and all work incidental thereto.

**1.3 REFERENCE STANDARDS**

- .1 American Association of State Highway and Transportation Officials (AASHTO)
  - .1 AASHTO M156, Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
  - .2 AASHTO M303, Standard Specification for Lime for Asphalt Mixes.
  - .3 AASHTO M320, Standard Specification for Performance Graded Asphalt Binder.
  - .4 AASHTO R29, Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
  - .5 AASHTO T245, Standard Method of Test for Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
  - .6 AASHTO T324, Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures
  - .7 AASHTO T340, Standard Method of Test for Determining Rutting Susceptibility of Hot Mix Asphalt (HMA) Using the Asphalt Pavement Analyzer (APA)

- .2 Asphalt Institute (AI)
  - .1 AI MS-2, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
- .3 ASTM International
  - .1 ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
  - .2 ASTM C117, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
  - .3 ASTM C123, Standard Test Method for Lightweight Particles in Aggregate.
  - .4 ASTM C127, Standard Test Method for Relative Density, Specific Gravity and Absorption of Coarse Aggregate.
  - .5 ASTM C128, Standard Test Method for Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
  - .6 ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - .7 ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .8 ASTM C207, Standard Specification for Hydrated Lime for Masonry Purposes.
  - .9 ASTM D242, Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
  - .10 ASTM D6979 Standard Practice for Sampling Bituminous Paving Mixtures
  - .11 ASTM D995, Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
  - .12 ASTM D1074 Standard Test Method for Compressive Strength of Bituminous Mixtures
  - .13 ASTM D1274 Standard Test Methods for Chemical Analysis of Pentachlorophenol
  - .14 ASTM D2041 Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
  - .15 ASTM D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
  - .16 ASTM D2726 Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
  - .17 ASTM D2950, Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
  - .18 ASTM D3203, Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
  - .19 ASTM D4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
  - .20 ASTM D4867, Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
  - .21 ASTM D5821, Standard Test Method for Determining the Percentage of Particles in Coarse Aggregate

- .22 ASTM D6926 Standard Practice for Preparation of Asphalt Mixture Specimens Using Marshall Apparatus
- .23 ASTM D6927 Standard Test Method for Marshall Stability and Flow of Asphalt Mixtures
- .24 ASTM D6373, Standard Specification for Performance Graded Asphalt Binder
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.2, Sieves Testing, Woven Wire, Metric.
- .5 Canadian Standards Association (CSA)
  - .1 CSA A23.2-29A, Method of Test for the Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Asphalt Mix Design
    - .1 Mix design by Marshall method (75 blows), as outlined in the latest edition of the Asphalt Institute Manual Series No. 2 (MS-2), including all laboratory testing results. Mix formulas only are not acceptable.
    - .2 Mix design submittal shall also include, or be followed by submission of, the results of Tensile Strength Ratio testing, the amount and type (dosage) of hydrated lime or liquid anti-stripping additive required.
  - .2 Asphalt Cement
    - .1 A complete series of certified PG Graded Binder test results will be required.
    - .2 AASHTO M320, Standard Specification for Performance Graded Asphalt Binder.
    - .3 AASHTO R29, Standard Specification for Grading or Verifying the Performance Grade of an Asphalt Binder.
    - .4 Viscosity - temperature chart for asphalt cement to be supplied showing Kinematic Viscosity in centistokes (mm<sup>2</sup>/s), temperature range 105o C to 175o C including manufacturer's recommended asphalt pumping, mixing, and compaction temperature ranges.
    - .5 Submit manufacturer's test data and certification that asphalt cement meets requirements of this Section.
    - .6 Proposed source of asphalt cement.
  - .3 Anti-stripping additive
    - .1 Proposed source of anti-stripping additive and related technical data sheets.
  - .4 Aggregates
    - .1 Contractor QC test results to confirm aggregates supplied by Owner comply with the specified requirements as follows:
      - .1 Aggregate pre-qualification test results (representing actual Job Mix Formula aggregates).

- .2 Quality Control test results.
- .5 Paving Plan
  - .1 Submit a paving plan detailing the following:
    - .1 A plan illustrating sequence of pavement lane construction including grade and final elevation control methodology, offset, mat edge offset, locations of transverse joints, joint construction and other information.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for asphalt mixes and aggregate and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 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 4 weeks prior to beginning Work.
- .3 Samples:
  - .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling 4 weeks prior to beginning Work.
  - .2 Submit samples of following materials proposed for use 4 weeks prior to beginning Work.
    - .1 One 5 L container of asphalt cement.
    - .2 10 kg of hydrated lime or liquid antistripping additive.
- .4 Test and Evaluation Reports:
- .5 Certificates:
  - .1 Certification to be marked on pipe.
- .6 Test and Evaluation Reports:
  - .1 Submit manufacturer's test data and certification that asphalt cement meets specification requirements.
  - .2 Submit manufacturer's test data and certification that hydrated lime meets specified requirements.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .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.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Performance graded asphalt cement: to AASHTO M320,
  - .1 Grade PGAC 52-46 when tested to AASHTO R29.
  - .2 Asphalt cement binder prepared from petroleum oils, free from impurities.
  - .3 Asphalt cement binder shall be straight run, non-chemically modified.
  - .4 Re refined Engine Oil Bottoms (REOD) also known as Vacuum Tower Asphalt Extenders (VTAE) not permitted in asphalt cement.
- .2 Aggregates: in accordance with Section 31 05 16 - Aggregate Materials: General and following requirements:
  - .1 Crushed stone or gravel consisting of hard, durable angular particles, free from clay lumps, cementation, organic material and other deleterious materials.
  - .2 Reclaimed asphalt pavement (RAP) and/or reclaimed asphalt shingles (RAS) not permitted in asphalt aggregate.
  - .3 Gradations: within limits specified when tested to ASTM C136 and ASTM C117 and to provide a smooth well graded curve without sharp breaks when plotted on semi-log chart. Sieve sizes to CAN/CGSB 8.2.

Sieve Designation	% Passing Surface or Levelling Course
20 mm	100
12.5 mm	78-98
9.5 mm	70-90
4.75 mm	55-70
2.0 mm	35-55
0.630 mm	18-38
0.425 mm	17-32
0.180 mm	4-12
0.075 mm	3-7

- .4 Coarse aggregate: aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to ASTM C136.
- .5 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.
- .6 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .7 Sand equivalent: ASTM D2419. Min: 50.
- .8 Magnesium Sulphate soundness: to ASTM C88. Max % loss by mass:
  - .1 Coarse aggregate surface course: 12%.
  - .2 Fine aggregate, surface course: 16%.
- .9 Los Angeles degradation: Grading B, to ASTM C131. Max % loss by mass:
  - .1 Coarse aggregate, surface course: 25%.
- .10 Micro-Deval Abrasion: to CSA A23.2-29A. Max % loss by mass.
  - .1 Coarse aggregate surface course: 15%.

- .11 Absorption: to ASTM C127. Max % by mass:
  - .1 Coarse aggregate, surface course: 1.75%.
- .12 Loss by washing: to ASTM C117. Max % passing 0.075 mm sieve:
  - .1 Coarse aggregate, surface course: 1.5%.
- .13 Lightweight particles: to ASTM C123. Max % by mass less than 1.95 relative density:
  - .1 Surface course: 1.5%.
- .14 Flat and elongated particles: to ASTM D4791, (with length to thickness ratio greater than 5): Max % by mass:
  - .1 Coarse aggregate, surface course: 15%.
- .15 Crushed fragments: at least 100% of particles by mass within each of following sieve designation ranges, to have 2 minimum freshly fractured face. Material to be divided into ranges, using methods of ASTM C136.

Passing		Retained on
25 mm	to	12.5 mm
12.5 mm	to	4.75 mm

- .16 Ironstone: Max % by mass:
    - .1 Surface or Base course: 2.0%.
  - .17 Shale: Max % by mass:
    - .1 Surface or Base course: 2.0%.
  - .18 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
  - .19 Natural Sand (Uncrushed Material): quantity of natural sand shall not be more than 10% of total aggregate.
- .3 Mineral filler:
- .1 Ensure finely ground particles of limestone, hydrated lime, Portland cement or non-plastic mineral matter are thoroughly dry and free from lumps.
  - .2 Add mineral filler when necessary to meet job mix aggregate gradation to improve mix properties.
  - .3 Ensure mineral filler is dry and free flowing when added to aggregate.
- .4 Add asphalt cement at rate of minimum 5.5% by dry weight of aggregate.
- .5 Anti-stripping agent: hydrated lime (calcium hydroxide – CaOH<sub>2</sub>) to AASHTO M303 and ASTM C207 type N. High calcium hydrated lime shall contain no less than 90% calcium hydroxide. Add lime at rate required to comply with the Tensile Strength Ratio, however, not less than minimum of 1.25% of dry weight of aggregate fibre reinforcement: synthetic polymer fibres to AASHTO MP8, Nilex aramid fibres or equivalent. Fibre length shall be 38 mm. Add aramid fibres at minimum dosage rate 65 g per tonne (residual) or 130 g per tonne (including wax coating).
- .6 Water: as reviewed by Departmental Representative.

## 2.2 EQUIPMENT

- .1 Pavers: mechanical grade controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: sufficient number of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers:
  - .1 Drum diameter: 1200 mm minimum.
  - .2 Amplitude of vibration (machine setting): 0.5 mm maximum for lifts less than 40 mm thick.
- .4 Haul trucks: sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
  - .1 Boxes with tight metal bottoms.
  - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
  - .3 In cool weather or for long hauls, insulate entire contact area of each truck box.
  - .4 Use only trucks which can be weighed in single operation on scales supplied.
- .5 Hand tools:
  - .1 Lutes or rakes with covered teeth for spreading and finishing operations.
  - .2 Tamping irons having mass 12 kg minimum and bearing area not exceeding 310 cm<sup>2</sup> for compacting material around structures inaccessible to roller. Mechanical compaction equipment may be used instead of tamping irons.
  - .3 Straight edges, 4.5 m in length, to test finished surface.
- .6 Plant testing facility: provide laboratory space at plant site for exclusive use of Departmental Representative, for performing tests, keeping records and making reports.

## 2.3 MIX DESIGN

- .1 Mix design to be reviewed by Departmental Representative.
- .2 Mix design to be developed by testing laboratory reviewed by Departmental Representative.
- .3 Design of mix: by Marshall method to requirements below.
  - .1 Compaction blows on each face of test specimens: 75.
  - .2 Mix physical requirements:

Property	Airfield Pavements
Marshall Stability at 60 degrees C kN min	12.5
Flow Value mm	2-4
Air Voids in Mixture, %	2-4
Voids in Mineral Aggregate, % min	14 surface course
Index of Retained Stability % minimum	75
Tensile Strength Ratio, %, (TSAR)	85 min.

Property	Airfield Pavements
Asphalt Pavement Analyzer (APA - 52°C, 8000 cycles – AASHTO T340) and/or Hamburg Wheel Track Testing (HWTT – AASHTO T324)	5.0 mm max.

- .3 Measure physical requirements as follows:
  - .1 Marshall load and flow value: to AASHTO T245.
  - .2 Compute void properties on basis of bulk specific gravity of aggregate to ASTM C127 and ASTM C128. Make allowance for volume of asphalt absorbed into pores of aggregate.
  - .3 Air voids: to ASTM D3203.
  - .4 Voids in mineral aggregates: to AI MS2.
  - .5 Index of Retained Stability: measure in accordance with Section 32 12 10 - Marshall Immersion Test for Bitumen.
  - .6 Tensile Strength Ratio testing is to include vacuum saturation and five freeze thaw cycles in accordance with ASTM D4867.
- .4 Asphalt Cement
  - .1 A complete series of PG Graded Binder test results will be required.
  - .2 AASHTO M320, Standard Specification for Performance Graded Asphalt Binder.
  - .3 AASHTO R29, Standard Specification for Grading or Verifying the Performance Grade of an Asphalt Binder.
  - .4 Viscosity - temperature chart for asphalt cement to be supplied showing Kinematic Viscosity in centistokes ( $\text{mm}^2/\text{s}$ ), temperature range 105° C to 175° C including manufacturer's recommended asphalt pumping, mixing, and compaction temperature ranges.
  - .5 Proposed source of asphalt cement.
  - .6 Proposed source of anti-stripping additive and related technical data sheets.
- .5 Aggregates
  - .1 Proposed source of aggregates.
  - .2 Aggregate pre-qualification test results (representing actual Job Mix Formula aggregates).
  - .3 Submit 50 kg samples of coarse and fine aggregates.
  - .4 Submit aggregate processing Quality Control test results.
- .6 Anti-Strip Dosage
  - .1 Anti-strip (hydrated lime) additive dosage to be determined based on the Tensile Strength Ratio test carried out in accordance with ASTM D4867 Standard Test Method for Effective of Moisture on Asphalt Concrete Paving Mixture.
  - .2 Proposed source of hydrated lime, test results and technical data sheets.
- .7 Fibre Reinforcement Dosage
  - .1 Fibre dosage as stabilizing agent shall be minimum 65 g per tonne (residual) and 65 g per tonne (including the wax coating).

- .2 Proposed source of fibres, test results and technical data sheets.

### **Part 3 Execution**

#### **3.1 PLANT AND MIXING REQUIREMENTS**

- .1 Batch and continuous mixing plants:
  - .1 To ASTM D995 and AASHTO M156.
  - .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 0.5% by mass or to lesser moisture content if required to meet mix design requirements.
  - .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.
  - .8 Heat asphalt cement and aggregate to mixing temperature. Do not heat asphalt cement above 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 review temperature of completed mix at plant and at paver after considering hauling and placing conditions.
  - .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 reviewed 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 reviewed by Departmental Representative but not less than 45s.
    - .3 Mixing time reviewed by Departmental Representative.
- .2 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 Meter total flow of aggregate using electronic weigh belt system with indicator that can be monitored by plant operator and which is interlocked with asphalt

- pump to ensure proportions of aggregate and asphalt entering mixer remain constant.
- .5 Allow for easy calibration of weighing systems for aggregates without having material enter mixer.
- .6 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
- .1 Calibrate weigh bridge on charging conveyor by weighing amount of aggregate passing over weigh bridge in set amount of time.
- .2 Difference between this value and amount shown by plant computer system to differ by not more than plus or minus 1%.
- .7 Make provision for conveniently sampling full flow of materials from cold feed.
- .8 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate from cold feed prior to entering drum.
- .9 Provide system interlock stop on feed components if either asphalt or aggregate from bin stops flowing.
- .10 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.
- .1 Control heating to prevent fracture of aggregate or excessive oxidation of asphalt.
- .2 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.
- .3 Submit printed record of mix temperatures at end of each day.
- .11 Ensure mixing period and temperature to produce uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer is 1% maximum.
- .3 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 hours.
- .4 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.
- .5 Mixing tolerances:
- .1 Permissible variation in aggregate gradation from job mix (percent of total mass).

4.75 mm sieve and larger	4.5
2.0 mm sieve	4.0
1.25 mm sieve	4.0
0.630 mm sieve	3.0
0.425 mm sieve	3.0
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.
- .6 Addition of anti stripping agent:
  - .1 Hydrated lime to be added to all aggregates by one of the following methods:
    - .1 Hydrated lime slurry to be homogeneously mixed with the aggregate in a pugmill or tumble mixer prior to entering the asphalt plant.
    - .2 Hydrated lime to be homogeneously mixed with wetted aggregate in a pugmill or tumble mixer prior to entering the asphalt plant. The wetted coarse and fine aggregate shall have sufficient moisture content to ensure uniform and complete adhesion of lime to the aggregate.
    - .3 Hydrated lime shall be homogeneously mixed with the aggregate at the pit or quarry in a pugmill or tumble mixer prior to delivery of the limed aggregate to the hot mix plant.
  - .2 Aggregate to be coated with a uniform and homogeneous coating of hydrated lime regardless of the mixing equipment or procedure used to add the hydrated lime.
  - .3 Plant to be equipped with suitable conveyor systems capable of supplying aggregates and lime at constant rate to produce a uniform homogeneous mixture in which all particles of the aggregate are thoroughly and uniformly coated.
  - .4 Plant and equipment used for addition of lime to be equipped with covers to control loss of lime.
  - .5 Plant to be equipped to control rate of lime incorporation to within 0.25%.
  - .6 Add water to aggregate prior to entering pug mill.
  - .7 Add water to lime sufficiently in advance to permit time to slake prior to entering pug mill.
- .7 Addition of fibre reinforcement:
  - .1 Store treated aramid product in a dry environment. Do not permit contact with moisture.
  - .2 For batch plant, feed treated aramid manually, or with machine operated equipment on RAP or aggregate belts, or directly into the pug mill or weigh hopper at constant rate to produce uniform homogeneous mixture during the heated aggregate mixing batch time.
  - .3 For continuous dryer drum plant, feed treated aramid manually, or with machine operated equipment, onto the RAP belt or directly into the mixing drum through the RAP collar at constant rate to produce uniform homogeneous mixture with heated aggregates.
  - .4 Plant to be equipment to control rate of fibre reinforcement incorporation to within 5 g per tonne of asphalt mix produced.

### 3.2 PREPARATION

- .1 When paving over existing asphalt surface, clean pavement surface.

- .1 When levelling course is not required, patch and correct depressions and other irregularities with prior review of Departmental Representative before beginning paving operations.
- .2 Apply tack coat in accordance with Section 32 12 13.16 - Asphalt Tack Coats prior to paving.
- .3 Prior to laying mix, clean surfaces of loose and foreign material.

### **3.3 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. Raise truck bed and thoroughly drain, and ensure no excess solution remains in truck bed.
- .3 Schedule delivery of material for placing in daylight
- .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, but not less than 135 degrees C.

### **3.4 PLACING**

- .1 Obtain Departmental Representative's review of tack coat prior to placing asphalt.
- .2 Place asphalt concrete to thicknesses, grades and lines as indicated on the drawings.
- .3 Placing conditions:
  - .1 Place asphalt mixtures only when air temperature is 5 degrees C minimum.
  - .2 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.
  - .3 Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .4 Place asphalt concrete in compacted lifts of thickness as follows and as indicated on the drawings.
  - .1 Surface course in layers of maximum 80 mm.
  - .2 Apply a tack coat between the lifts, as specified in Section 32 12 13.
- .5 Place individual strips no longer than 200 m.
- .6 Spread and strike off mixture with self propelled mechanical finisher.
  - .1 Construct longitudinal joints and edges true to line markings.
    - .1 Contractor to establish lines for paver to follow parallel to centerline of proposed pavement. Position and operate paver to follow established line closely.

- .2 Maintain constant head of mix in auger chamber of paver during placing.
- .3 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
- .4 Correct irregularities in alignment left by paver by trimming directly behind machine.
- .5 Correct irregularities in surface of pavement course directly behind paver.
  - .1 Remove excess material forming high spots using shovel or lute.
    - .1 Fill and smooth indented areas with hot mix.
    - .2 Do not broadcast material over such areas.
- .6 Do not throw surplus material on freshly screeded surfaces.
- .7 When hand spreading is used:
  - .1 Use approved wood or steel forms, rigidly supported to assure correct grade and cross section.
    - .1 Use measuring blocks and intermediate strips to aid in obtaining required cross-section.
  - .2 Distribute material uniformly without broad casting material.
  - .3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes.
    - .1 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.
    - .1 Control temperature to avoid burning material.
    - .2 Do not use tools at higher temperature than temperature of mix being placed.

### **3.5 COMPACTING**

- .1 Do not change rolling pattern unless mix changes or lift thickness changes
- .2 Roll asphalt continuously to density not less than 98% of 75 blow Marshall density to AASHTO T245. No individual test shall be less than 96%.
- .3 General:
  - .1 Provide at least 2 rollers and as many additional rollers as necessary to achieve specified pavement density. When more than 2 rollers are required, 1 roller must be pneumatic tired type.
  - .2 Start rolling operations as soon as placed mix can bear weight of roller without 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 course 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 half the width of the roller 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 traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side.
  - .1 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.
- .4 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.
  - .4 Use only experienced roller operators.
- .5 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.
- .6 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.
    - .1 If necessary to obtain desired surface finish, use pneumatic-tired rollers
  - .2 Conduct rolling operations in close sequence.

### 3.6 JOINTS

- .1 General:
  - .1 Remove surplus material from surface of previously laid strip.

- .1 Do not deposit on surface of freshly laid strip. Do not discard surplus material in front or beneath paver.
- .2 All cold joints on surface lifts are to be saw cut to vertical face to provide true surface and cross section against which new pavement may be laid. Remove saw-cutting slurry, loose particles and dust.
- .3 A cold joint is defined as a joint where asphalt mix is placed, compacted and left to cool below 100 degrees C prior to paving of adjacent lane.
- .4 If cold joints cannot be avoided, cut back by saw cutting previously laid lane, by at least 150 mm, to full depth vertical face, clean and dry and tack face with thin coat of undiluted asphalt emulsion prior to paving of adjacent lane. Remove and dispose of saw cut portion of mat edge and discard.
- .5 Paint contact surfaces of existing asphalt joint with tack coat material prior to placing adjacent pavement.
- .6 Before rolling, carefully remove and discard coarse aggregate in material overlapping joints with lute or rake. Do not discard excess material in front of, in or under paver.
- .7 Roll joints continuously using the pattern and methods approved during the test strip, to density not less than 98% of 75 blow Marshall density to AASHTO 1245, ASTM 2950 or ASTM D2720.
- .8 Cores (150 mm) shall be obtained from immediately over the joints in accordance with ASTM D979.
- .2 Transverse joints:
  - .1 Offset transverse joint in succeeding lifts by at least 600 mm. Transverse joints in adjacent lanes shall be offset by at least 3 m.
  - .2 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.
- .3 Longitudinal joints:
  - .1 Offset longitudinal joints in succeeding lifts by at least 150 mm.
  - .2 All cold joints to be cut back to full depth vertical face and tack face with thin coat of hot asphalt prior to continuing paving.
  - .3 Overlap previously laid strip with spreader by 75 to 100 mm.
  - .4 Roll longitudinal joints directly behind paving operation.
  - .5 When rolling with static or vibratory rollers, have most of drum width ride on newly placed lane with remaining 100 to 150 mm extending onto previously placed and compacted lane.
- .4 Construct butt joints as indicated.

### **3.7 SURFACE APPLICATION OF HYDRATED LIME FOLLOWING COMPACTION**

- .1 Apply hydrated lime to the asphalt surface using a rotary spreader (common garden fertilizer spreader) at a rate of approximately 0.25 kg per square meter immediately following completion of compaction to produce uniform, light surface color.

- .2 Roll hydrated lime into the asphalt pavement surface with multiple passes of a light, unballasted, rubber tire roller.
- .3 Repeat surface application of hydrated lime as required at the same rate to achieve a consistent, uniform off white surface colour condition.

### **3.8 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 Finished asphalt surface to provide positive drainage without ponding water.

### **3.9 AUTOMATIC GRADE CONTROL DEVICE FOR PAVERS**

- .1 The pavers shall be equipped with dual grade control systems capable of automatically maintaining the screed elevation, slope and profile to within the specified tolerances. An effective GPS, laser or ultrasonic grade control system shall be automatically actuated from either a fixed or travelling reference line (non-contact beam, fixed or travelling stringline with a ski length of at least 12 m) or surface through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface.
- .2 The controls shall be capable of working in conjunction with any of the following attachments:
  - .1 Taut stringline (wire) set to grade.
  - .2 Short ski or shoe (joint match side of paver only).
  - .3 Fixed stringline, or travelling or non-contact beam (beam length of at least 12 m).

### **3.10 DEFECTIVE WORK**

- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required.
  - .1 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.
- .4 Reject and dispose of any batch of asphalt mixture, which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate or improper mix temperature.

### **3.11 PAVEMENT SEGREGATION**

- .1 General

- .1 The finished surface of the top lift of hot mix asphalt concrete pavement shall have a uniform texture and be free of segregated areas.
- .2 Classifying pavement segregation
  - .1 A segregated area is defined as an area of the pavement where the texture differs visually from the texture of the surrounding pavement. For the purposes of classifying pavement segregation, only segregated areas greater than 0.1 m<sup>2</sup> and centre-of-paver streaks greater than 1 m long will be considered.
  - .2 Moderate or severe segregated areas which do not meet these size parameters will be considered obvious defects. Pavement segregation will be classified as follows:
    - .1 "Slight": The matrix, asphalt cement and fine aggregate are in place between the coarse aggregate. However, there is more stone in comparison to the surrounding acceptable mix.
    - .2 "Moderate": Significantly more stone than the surrounding mix; moderately segregated areas usually exhibit a lack of surrounding matrix.
    - .3 "Severe": Appears as an area of very stony mix, stone against stone, with very little or no matrix.
    - .4 "Centre-of-Paver Streak": Appears as a continuous or semi-continuous longitudinal "streak" typically located in the middle of the paver "mat".
- .3 Inspections for pavement segregation
  - .1 Inspections by the Contractor
    - .1 The Contractor shall perform a daily inspection of the paving operations on all lifts of pavement to identify any instances of pavement segregation. If segregation is evident, the Contractor shall take immediate corrective action to his operations to identify the cause and prevent any further occurrence of segregation.
  - .2 Inspections by the Departmental Representative
    - .1 Inspections during construction
      - .1 The Departmental Representative will inspect the pavement to identify any instances of pavement segregation. If segregation is evident, the Departmental Representative will immediately notify the Contractor so that corrective action can be taken to prevent further occurrence of segregation.
      - .2 Typically, each pavement Lot would be inspected as soon as possible after the Lot is placed. During the inspection(s), the Departmental Representative will identify, mark and record any areas of moderate and severe segregation and any areas of center-of-paver streak.
    - .2 Inspection following construction
      - .1 The Departmental Representative will conduct a second inspection of the top lift, normally one week after the substantial completion of paving work. During this inspection, the Departmental Representative will identify and record any areas of slight, moderate and severe segregation and any areas of centre-of-paver streak which were not identified in the

inspections during construction. The Departmental Representative will provide the Contractor with a written assessment (location and severity) of the segregated areas as soon as possible following this inspection.

- .4 Repairing pavement segregation
  - .1 Pavement segregation, obvious defects, deteriorated repairs or failures identified during the inspection performed approximately one week after Substantial Performance of paving operations will require repair.
  - .2 Pavement segregation identified in the inspections performed during construction shall be repaired at the Contractor's expense and in accordance with the following:
    - .1 Moderate and severe segregation in the top lift of pavement and on entrances and intersections shall require repair.
    - .2 For entrances and the portion of intersections outside the through travel lanes and shoulders, areas of moderate and severe segregation shall be repaired in accordance with the methods of repair listed for moderate segregation. Intersections and entrances shall also be neatly shaped, smooth and free of surface defects and depressions.
  - .3 Slight segregation on any lift of pavement will not require repair.
  - .4 Moderate segregation on lower lifts will not require repair.
  - .5 Severe segregation on lower lifts will only require repair in instances where the segregated area will affect the long-term structural integrity of the pavement structure.
  - .6 Only moderate and severely segregated centre-of-paver streak on the top lift of pavement will require repair.
  - .7 Methods of repair
    - .1 Moderate Segregation - The Contractor has the option of using a slurry patch or a hot mix asphalt concrete patch.
    - .2 Severe Segregation - The Contractor has the option of removal and replacement or overlay.
    - .3 Any other methods of repair proposed by the Contractor will be subject to prior review by the Departmental Representative.
  - .8 The Departmental Representative will mark out the area of repair. The "marked area" will extend a minimum of 0.5 m beyond the segregated area. For centre-of-paver streak, the "marked area" will extend a minimum of 100 mm laterally and 0.5 m longitudinally beyond the streak.
  - .9 Cut the pavement so that all edges are vertical, the sides are parallel to the direction of traffic and the ends are skewed between 15 and 25 degrees. Coat edges with a tack coat conforming to Section 08051 and allow to cure.
  - .10 Repairs for segregation using an overlay shall be for the entire pavement width. Repairs for segregation using removal and replacement shall be for the full lane width, full lane width and shoulder or the shoulder only as applicable, depending on the extent of the segregated area. The full depth of the asphalt lift shall be removed and replaced with new hot mix asphalt concrete pavement using an appropriate paver and cold milling equipment.

- .11 Make all repairs regular in shape and finish using good workmanship practices to provide an appropriate appearance to be reviewed by Departmental Representative. Keep traffic off all repairs for a sufficient period of time to ensure that tracking does not occur.
- .12 In the event repairs cover existing roadway lines or markings, the Contractor shall reinstate the lines and markings at his expense
- .13 Repairs shall be completed during construction or shortly after construction, except when prevented by inclement weather or seasonal shutdown.

**END OF SECTION**

**Part 1 General**

**1.1 MEASUREMENT AND PAYMENT**

- .1 Temporary and permanent painted pavement markings will be measured for payment in lineal metres or square metres actually applied for various paint marking requirements. The unit price shall include pavement surface cleaning, survey, layout, materials reflective glass beads, applying, protecting and all Work incidental thereto.

**1.2 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM D476 Standard Classification for Dry Pigmentary Titanium Dioxide Products
  - .2 ASTM D968 Standard Test Methods for Abrasion Resistance of Organic Coatings by 17863 Falling Abrasive
  - .3 ASTM D1652 Standard Test Method for Epoxy Content of Epoxy Resins
  - .4 ASTM D2074 Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
  - .5 ASTM D2240 Standard Test Method for Rubber Property - Durometer Hardness
  - .6 ASTM D7585 Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
  - .7 ASTM E303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
  - .8 ASTM E1710 Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
  - .9 ASTM E2302 Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
  - .10 ASTM G154 Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Non-metallic Materials
- .2 Environment Canada (EC)
  - .1 Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations, SOR/2009-264
- .3 Canadian General Standards Board
  - .1 CGSB 1-GP-71, Method, of Testing Paints and Pigments
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS)
- .5 Federal Specifications
  - .1 Federal Specification 595, Colours used in Government Procurement
  - .2 Federal Specification TT-B-1325D, Beads (Glass Spheres) Retro-Reflective

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature and data sheets for pavement markings and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Submit to Departmental Representative following material sample quantities at least 4 weeks prior to commencing work.
    - .1 Two 1 L samples of each type of paint.
    - .2 One 1 kg sample of glass beads.
  - .2 Mark samples with name of project and its location, paint manufacturer's name and address, name of paint, MPI specification number and formulation number and batch number.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operations and Maintenance Data: submit information on materials relative to work of this Section for inclusion in operations and maintenance manual.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **1.6 SITE CONDITIONS**

- .1 Sustainable Design Provisions:
  - .1 Seasonal restriction for high VOC content traffic marking coatings.
    - .1 Traffic marking coating application between July and August subject to seasonal use restriction and have VOC concentration maximum 150 g/L.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Paint: General Services Administration Federal Specification TT-P-1952E.
  - .1 100% acrylic waterborne Traffic and Airfield Marking Paint, Type III
  - .2 All paint colours, except black, shall be formatted at the time of manufacture to inhibit algae growth (the “Biocide”). The Biocide used shall meet or exceed that of ROCIMA TM 63 Industrial Micro biocide (EPA Registration: 707-303).
- .2 Colour: to Federal Standard 595
  - .1 Yellow 33538
  - .2 Black 37038
  - .3 White 37925
  - .4 Red 31136
- .3 In accordance with Environment Canada, Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations (SOR/2009-264).
- .4 Glass beads:
  - .1 Type III Federal Standard TT-B-1325D and AASHTO M-247
  - .2 “Airport bead” Virgin Glass 1.9 10R

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates and surfaces to receive pavement markings acceptable for product installation prior to pavement markings application. Visually inspect substrate in presence of Departmental Representative.
- .2 Pavement surface: dry, free from water, frost, ice, dust, oil, grease and other deleterious materials.
- .3 New asphalt pavement surfaces:
  - .1 For temporary pavement markings, apply pavement markings prior to aircraft operations.
  - .2 For permanent pavement markings, apply pavement markings following minimum 30-day curing period.
- .4 Proceed with Work only after unacceptable conditions rectified.

### **3.2 EQUIPMENT REQUIREMENTS**

- .1 Paint applicator: approved mobile airless spray type machine paint applicator with positive shut-off distributor capable of applying airfield paint in single lines in widths of between 10 centimeters and 30 centimeters and capable of applying marking components uniformly, at rates specified, and to dimensions as indicated suitable for the application of airfield paint.
- .2 Distributor: capable of applying reflective glass beads as overlay on freshly applied paint.
- .3 All auxiliary hand equipment shall be a Graco 250 or approval equal with pressurized bead systems.

### **3.3 APPLICATION**

- .1 Lay out new pavement markings in accordance with the Drawings and repaint existing runway pavement markings.
- .2 High pressure water blasting to be done on new and existing runway surface to ensure that the bonding surface is free of all contaminants including: oils, fuels, algae, loose paint, dirt, residue and others.
- .3 Paint
  - .1 Apply paint only when air temperature is above 10°C, wind speed maximum 15 km/h and no rain is forecast within next 4 hours.
  - .2 Unless otherwise specified, apply traffic paint evenly at rate of 2.8 m<sup>2</sup>/L to achieve a wet film thickness of 15 mils.
  - .3 For temporary pavement markings unless otherwise specified, apply traffic paint evenly at rate of half the normal paint application rate.
  - .4 For permanent Runway 15-33 centreline pavement markings, apply traffic paint evenly at rate of 4.6 m<sup>2</sup>/L to achieve a wet film thickness of 25 mils.
  - .5 Primer Coat: Wherever paint is applied to an asphalt surface from which was eradicated, a damaged/repair asphalt or new concrete surface, an extra coat of paint shall be applied at half the normal paint application rate without glass beads. Dependent upon weather conditions, 24 hours shall be permitted to allow the Primer Coat to cure prior to the application of the Full Application Rate with glass beads.
  - .6 Do not thin paint
  - .7 Symbols and letters to conform to dimensions indicated.
  - .8 Paint lines to be of uniform colour and density with sharp edges.
  - .9 Thoroughly clean distributor tank before refilling with paint of different colour.
- .4 Reflective Media
  - .1 Apply glass beads over the entire surface of paint evenly at a rate of 1.2 kg per litre of paint immediately after paint application over the entire surface into a layer of paint whose thickness will yield 50-60 % embedment of beads.
  - .2 Perform, at least once a day, the bead dispense calibration test to show compliance with the application rate utilizing a Bead Flow Calibration Beaker.

The test shall be in the presence of the Airport Authority or Consultant to verify material coverage.

- .3 Beads are to be applied to all paint markings except Primer Coat and those that are black.
- .4 Beads shall be dispensed with a pneumatic pressurized dispenser (not gravity fed). Bead dispensers shall be air operated with controls to start/stop and adjust bead flow.
- .5 Glass beads shall be uniformly distributed and embedded to cured paint or all marking operations shall cease until corrections are made.
- .6 Hand application of beads will not be permitted. The one permitted exception is as necessary to fill in stencil gaps.

### **3.4 TOLERANCE**

- .1 Paint markings: within plus or minus 12 mm of dimensions indicated.

### **3.5 PROTECTION**

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

**END OF SECTION**

**Part 1 General**

**1.1 MEASUREMENT AND PAYMENT**

- .1 Asphalt tack coat will be measured for payment in square metres based on the designated areas. The unit price shall include pavement surface cleaning prior to application, materials, applying, protection while curing and all work incidental thereto.

**1.2 REFERENCE STANDARDS**

- .1 American Association of State Highway and Transportation Officials (AASHTO)
  - .1 AASHTO M081-92-UL, Standard Specification for Cutback Asphalt (Rapid-Curing Type)
- .2 ASTM International
  - .1 ASTM D140/D140M, Standard Practice for Sampling Bituminous Materials
  - .2 ASTM D633, Standard Volume Correction Table for Road Tar
  - .3 ASTM D1250, Standard Guide for Use of the Petroleum Measurement Tables
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-16.2, Emulsified Asphalts, Anionic Type, for Road Purposes
  - .2 CAN/CGSB 16.4, Emulsified Asphalts, Cationic Type, for Road Purposes

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for asphalt tack coat and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Submit one 4 L sample of asphalt tack coat material proposed for use in new, clean, airtight, sealed, wide mouth plastic container to Departmental Representative at least 2 weeks prior to beginning Work.
  - .2 Sample asphalt tack coat material to: ASTM D140.

**1.4 QUALITY ASSURANCE**

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

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.
- .4 Deliver, store and handle materials in accordance with ASTM D140.
- .5 Provide, maintain and restore asphalt storage area.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Emulsified asphalt: anionic, fast cure, non-tracking finish, to ASTM D977 and CAN/CGSB 16.2, grade SS1H.
- .2 Water: clean, potable, free from foreign matter.

### **2.2 EQUIPMENT**

- .1 Equipment required for Work of this Section to be in satisfactory working condition and maintained for duration of Work.
- .2 Pressure distributor:
  - .1 Designed, equipped, maintained and operated so that asphalt material can be:
    - .1 Maintained at even temperature.
    - .2 Applied uniformly on variable widths of surface up to 5 m.
    - .3 Applied at readily determined and controlled rates from 0.1 to 5.5 L/m<sup>2</sup> with uniform pressure, and with allowable variation from any specified rate not exceeding 0.1 L/m<sup>2</sup>.
    - .4 Distribute in uniform spray without atomization at temperature required.
  - .2 Equipped with meter, registering travel in metres per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.
  - .3 Equipped with pump having flow metre graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.
  - .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
    - .1 Measure temperature to closest whole number.
  - .5 Equipped with accurate volume measuring device or calibrated tank.
  - .6 Equipped with nozzles of same make and dimensions adjustable for fan width and orientation.
  - .7 Equipped with nozzle spray bar, with operational height adjustment in increments of 0.6 metres and capable of being raised or lowered.
  - .8 Cleaned if previously used with incompatible asphalt material.

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**Part 3            Execution**

**3.1                APPLICATION**

- .1      Departmental Representative to review the surface preparation 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.
- .4      Apply asphalt tack coat evenly to pavement surface at rate between 0.25 and 0.70 L/m<sup>2</sup> and at temperature recommended by the manufacturer. Apply asphalt tack coat only when air temperature greater than 10 degrees C and when rain is not forecast within 2 hours minimum of application.
- .5      Apply asphalt tack coat only on unfrozen surface.
- .6      Evenly distribute localized excessive deposits of tack coat by brooming.
- .7      Keep traffic off tacked areas until asphalt tack coat has set.
- .8      Re-tack contaminated, or disturbed areas.
- .9      Permit asphalt tack coat to reach tacky condition before placing asphalt pavement.
- .10     Submit summary report within 7 days minimum of date of application and include information as follows:
  - .1      Total area tack coated.
  - .2      Quantity of tack coat used.
  - .3      Mean application rate.
  - .4      Actual product quantity used when using equipment on pressure distributors.
  - .5      Dipstick measurements or electronic printouts are acceptable.
- .11     Inspect tack coat application to ensure uniformity.
  - .1      Re-spray areas of insufficient or non-uniform tack coat coverage.
  - .2      Ensure tack coating performed using hand held devices is consistent in appearance with adjacent areas of machine applied material.

**END OF SECTION**

**Part 1 General**

**1.1 MEASUREMENT AND PAYMENT**

- .1 Topsoil placement and seeding shall be measured in square meters of airfield ditch area actually topsoiled and seeded. The unit price shall include all materials, equipment, personnel, cleanup and all Work incidental thereto.
- .2 Departmental Representative will designate location for the supply of suitable topsoil available on-airport property.
- .3 No separate payment will be made for preparation of sub-grade prior to placing of topsoil. Costs for this work shall be included under airfield grading payment items.

**1.2 REFERENCE STANDARDS**

- .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, Guidelines for Compost Quality.

**1.3 DEFINITIONS**

- .1 Topsoil: The top layer of soil containing organic material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
- .2 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 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse.
- .2 Divert unused soil amendments from landfill to official hazardous material collections site.

- .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.

## **1.6 CLASS OF SEEDING**

- .1 Hydraulic Seeding: hydraulic seeding shall include the supply of suitable equipment and the application of a spray-pumped mixture of water, seed, fertilizer, hydro-mulch and tackifier at locations noted on the Drawings. Hydraulic seeding equipment shall have a storage tank with continuous agitation to maintain seed, fertilizer and hydro-mulch uniformly mixed until pumped from the tank. The pump pressure shall maintain a continuous non-fluctuating stream of solution that is calibrated to distribute seed into the soil at not less than specified minimum rates of application. Hydraulic seeding is warranted in areas identified by the Drawings, in which the terrain characteristics of these areas are deemed impractical to drill seed.
- .2 Drill Seeding: drill seeding shall include the supply of suitable equipment to perform the work, the supply and placement of the specified seed mixtures and fertilizer at locations indicated on the Drawings. Distribution of the seed and fertilizer shall be at a uniform rate and not less than the minimum specified rate of application. The Contractor's equipment shall be calibrated to distribute seed and fertilizer into the soil at not less than specified minimum rates of application. The equipment shall then cover the seed and fertilizer with a suitable covering of soil.

## **Part 2 Products**

### **2.1 TOPSOIL**

- .1 Topsoil for seeded areas: on-airport property location designated by Departmental Representative, mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
  - .1 Contain no toxic elements or growth inhibiting materials.
  - .2 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.
  - .3 Consistence: friable when moist.

### **2.2 SEED**

- .1 Seed shall be Canada No. 1 Grade quality seed free of impurities and disease as specified in the Canada Seeds Act. The Contractor shall provide a Certificate of Seed Analysis acceptable to the Prime Consultant before seeding. The seed mix shall not contain nuisance or noxious weeds.

- .2 Provide seed mixes in accordance with the following tables:

**Table 1 - Seed Mix A (Airside Native/Non-native Species)**

Percentage	Common Name	Species Name
20	3 variety Kentucky Blue Grass	
40	Creeping Red Fescue	
15	Low grow Perennial Ryegrass	<i>Lolium perenne</i>
25	Hard Fescue	<i>Festuca duriuscula</i>

- .3 Mulch: specially manufactured for use in hydraulic seeding equipment, nontoxic, water activated, green colouring, free of germination and growth inhibiting factors with the following properties:

- .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:

- .1 Waterborne, copolymer emulsion suitable for soil stabilization
- .2 Biodegradable, non-toxic
- .3 Capable of joining together the mulch particles to secure the mulch to the ground without preventing penetration of moisture to underlying soil.

- .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 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

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

### **3.2 STRIPPING OF TOPSOIL**

- .1 Begin topsoil stripping of areas as indicated after area has been cleared of brush and removed from site.
- .2 Strip topsoil to depths as required.
- .3 Stockpile in locations as Departmental Representative.
  - .1 Stockpile height not to exceed airport obstacle limitation heights.
- .4 Disposal of unused topsoil is to be in an environmentally responsible manner but not used as landfill and as reviewed by Departmental Representative.
- .5 Protect stockpiles from contamination and compaction.

### **3.3 PREPARATION OF EXISTING GRADE**

- .1 Verify that grades are correct.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials.
- .4 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.

### **3.4 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL**

- .1 Place topsoil after Departmental Representative has reviewed subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 Spread topsoil to following minimum depths after settlement.
  - .1 150 mm for seeded areas.
- .4 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

### **3.5 FINISH GRADING**

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
  - .1 Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil as required.
- .3 Leave surfaces smooth, uniform and firm against deep foot printing.
- .4 Finished topsoil on slopes of 4H:1V or steeper shall be cat tracked perpendicular to the slope. Tracked equipment shall be run up and down all sloped surfaces, if the time between topsoil placement and seeding exceeds sixty days, leaving track indentations that run horizontally to the slope.

### **3.6 GRASS SEED**

- .1 Slurry Application for hydraulic seeding

- .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 Slurry mixture applied per hectare:
  - .1 Seed: Grass mixture 100 kg.
  - .2 Mulch: Type I, 1700 kg.
  - .3 Tackifier:
    - .1 For mulch, as recommended by manufacturer.
    - .2 In areas impacted by jet blast, as directed by the Prime Consultant, apply four (4) times the amount as recommended by manufacturer, in 2014 only.
  - .4 Water: minimum 30,000 L.
  - .5 Fertilizer: 400 kg.
- .3 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.
- .4 Blend application 300 mm into adjacent grass areas or previous applications to form uniform surfaces.
- .5 Reapply where application is not uniform.
- .6 Remove slurry from items and areas not designated to be sprayed.
- .2 Application for drill seeding
  - .1 Apply seeds uniformly, at optimum angle of application for adherence to surfaces and germination of seed.
  - .2 Seed the area uniformly in one pass using a Brillion seeder with a minimum width of 3 m.
  - .3 For areas too small for the use of a Brillion Seeder, apply seed at the designated seeding rates per hectare with a broadcast spreader.
  - .4 Roller pack all seeded areas.
  - .5 Apply mulch.
  - .6 Blend application 300 mm into adjacent grass areas or previous applications to form uniform surfaces.
  - .7 Reapply where application is not uniform.
- .3 Application Rates
  - .1 Application Rate for Hydraulic Seeding shall be 100 kg/hectare.

- .2 Application Rate for Drill Seeding shall be 35 kg/hectare.

**3.7 ACCEPTANCE**

- .1 Departmental Representative will review topsoil, finish grading and seeding in place.
- .2 Seeded areas will be reviewed provided that:
  - .1 Plants are uniformly established. Seeded areas are free of rutted, eroded, bare or dead spots.
  - .2 Areas have been fertilized.

**3.8 SURPLUS MATERIAL**

- .1 Dispose of materials except topsoil not required

**3.9 CLEANING**

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

**END OF SECTION**