PART 1 - GENERAL

1.1 Related Work

.1 Refer to other Specification Sections for related information.

.2 Refer to **Section 01 33 00** for Shop Drawing/Submission requirements.

1.2 Description

.1 This Section covers the removal or processing of existing asphaltic concrete within the project limits, as follows:

.1 Partial depth removal means to remove a portion of existing asphaltic concrete thickness with minimal disturbance to the remaining asphaltic concrete.

.2 Full depth removal means to remove the full depth of existing asphaltic concrete with minimal disturbance to the underlying granular base material.

.3 Full depth reclamation means to process the existing asphaltic concrete and upper granular base material in-place.

1.3 Measurement for Payment

.1 Removal or Processing Of Existing Asphalt (Milling & Pulverization) will be measured in accordance with **Section 01 29 00.**

PART 2 – PRODUCTS NOT APPLICABLE

PART 3 – EXECUTION

3.1 Preparation

.1 Prior to commencing removal operation, inspect and verify with Department Representative areas, depths and lines of asphalt concrete pavement to be removed and appropriate removal technique(s).

.2 Prior to commencing removal operation, all debris, deleterious material, and existing windrows shall be removed from the roadway surface, including material beyond the

theoretical roadway width, to provide positive drainage.

.3 Prior to full depth removal or full depth reclamation operation, cut existing pavement vertically to full depth of asphalt surface along any lines where existing adjacent pavement will remain intact.

3.2 Equipment

.1 For partial depth removal, use cold milling equipment capable of removing a portion of the existing asphaltic concrete pavement surface to depths or grades indicated. The equipment used for partial depth removal shall be automatically controlled for grade and slope during removal.

.2 For full depth removal, use milling equipment and/or hydraulic excavator capable of removing the full thickness of asphaltic concrete to depths or grades indicated.

.3 For full depth reclamation, use road reclamation equipment capable of pulverizing the full thickness of existing asphaltic concrete and a portion of the upper granular base material to sufficient depth such that the resulting blend of Reclaimed Asphalt Pavement (RAP) and granular material is approximately 50:50.

3.3 Removal

.1 For partial depth removal:
- .1 Remove the full width of the existing asphaltic concrete by milling to the depths and grades indicated.
- .2 The surface remaining after removal shall have a constant and continuous crossfall matching the intended surface course crossfall.
- .3 The surface remaining after removal shall have an even texture and be free of significantly different grooves and ridges in all directions.

.2 For full depth removal:
.1 Remove the full width of the existing asphaltic concrete by milling or excavation to the depths and grades indicated, with minimal disturbance to the underlying granular surface.
.2 The granular surface remaining after removal shall be graded and compacted to have a constant and continuous crossfall matching the intended base and/or surface course crossfall.

.3 For full depth reclamation:
.1 Pulverize the full thickness of existing asphaltic concrete and a portion of the upper granular base material to depth(s) indicated.
.2 The resulting blend of Reclaimed Asphalt Pavement (RAP) and granular material shall be graded and compacted to have a constant and continuous crossfall matching the intended base and/or surface course crossfall.

.4 Temporary transverse ramping for any process shall be as specified in the Contract Documents. If due to unforeseen circumstances, removal cannot be done full width prior to shut down at the end of the day, then temporary, longitudinal ramping shall also be provided as specified in the Contract Documents. All ramping shall be removed prior to placing adjacent hot mix asphalt pavement.

.5 Removed asphalt pavement material shall not remain on the marshalling yard after completion of the day's operation unless authorized by the Department Representative. Placing of the material on grade other than a bituminous surface prior to hauling to a stockpile shall not be permitted.

3.4 Tolerance

.1 Compacted surface shall be within plus or minus 5 mm of elevations specified, but not uniformly high or uniformly low.

3.5 Traffic Control

.1 Maintain operation of the marshalling yard to the satisfaction of the Department Representative at all times.

PART 1 - GENERAL

1.1 Related Work

.1 Refer to other Specification Sections for related information.

1.2 Reference Standards

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C117, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C127, Test Method for Specific Gravity and Absorption of Coarse Aggregate.

.3 ASTM C131/C131M, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.4 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.5 ASTM C535, Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.6 ASTM D422-63, Standard Test Method for Particle-Size Analysis of Soils.

.7 ASTM D5821, Standard Test for Determining the Percentage of Fractured Particles in Coarse Aggregate.

.8 ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft3) (600kN-m/m3).

.9 ASTM D1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

.10 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

.2 Canadian Standards Association (CSA)

.1 CSA A23.2-23A, Method of Test for the Resistance of Fine Aggregate to

Degradation by Abrasion in the Micro-Deval Apparatus.

.3 Canadian General Standards Board (CGSB)
.1 CGSB 8.1-88, Sieves, Testing, Woven Wire, Inch Series.
.2 CGSB 8.1-88, Sieves, Testing, Woven Wire, Metric Series.

.4 Nova Scotia Department of Transportation and Infrastructure Renewal
.1 TPW TM-1, Test Method for the Resistance of Coarse Aggregate to Degradation in the Micro-Deval Apparatus.
.2 TPW TM-2, Modified Petrographic Number.
.3 TPW TM-3, Test Method for the Determination of Percent Fractured Particles in Processed Coarse Aggregate.

1.3 Measurement for Payment

.1 Granular base will be measured in accordance with **Section 01 29 00.**

1.4 Delivery, Storage, and Handling

.1 Deliver and stockpile aggregates in accordance with Section 31 05 17 - Aggregate Materials.

PART 2 - PRODUCTS

2.1 Materials

.1 Granular Base: Type 1 Gravel to Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) Standard Specification, Highway Construction & Maintenance (current edition).
.1 Crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
.2 Type 1 granular fill gradation will be within following limits when

tested in accordance with ASTM C117 and ASTM C136:

| ASTM SIEVE SIZE | % PASSING BY MASS |
|---|---|
| 20 mm | 100 |
| 14 mm | 50 - 85 |
| 5 mm | 20 - 50 |
| 0.16 mm | 5 - 12 |
| 0.080 mm | 3 - 8(1) |

(1) For gravel sources not classified as quarries the allowable percentage passing the 0.080 mm sieve shall be 3 to 5%.

.3 Granular material shall conform to the physical properties requirements listed in the following table:

| Property | Test Method | Limit |
|---|---|---|
| Absorption (% Maximum) | ASTM C127 | 1.75 |
| Los Angeles Abrasion (loss % Maximum) | ASTM C131 | 40 |
| Fractured Particles, one face (% Minimum) | TPW TM-3 | 80 |
| Plasticity Index | ASTM D4318 | 3 |
| Micro-Deval (% Maximum) | TPW TM-1 | 20 |

PART 3 - EXECUTION

3.1 Placing

.1 Do not place granular base until finished sub-base surface is inspected and approved by *Departmental Representative*.

.2 Place material only on a clean unfrozen surface, properly shaped and compacted and free from snow and ice.

.3 Ensure no frozen material is placed.

.4 Construct aggregate base to depth and grade in areas indicated.

.5 Place using methods which do not lead to segregation or degradation of aggregates.

.6 Begin spreading aggregate base material on crown line or high-side of one way slope.

.7 Place material to full width in a uniform layer to 150 mm compacted thickness. *Departmental Representative* may authorize thicker lifts (layers) if specified compaction can be achieved.

.8 Shape each layer to a smooth contour and compact to specified density before succeeding layer is placed.

.9 Remove and replace portion of layer in which material has become segregated during spreading.

3.2 Compacting

.1 Compact to density not less than 98% maximum dry density in accordance with ASTM D698.

.2 Shape and roll alternately to obtain a smooth, even and uniformly compacted base.

.3 Apply water as necessary during compacting to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.

.4 In areas not accessible to rolling equipment, compact to specified density with approved mechanical tampers.

3.3 Finish Tolerances

.1 Finished base surface shall be within plus or minus 10 mm of established grade but not uniformly high or low.

.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.4 Maintenance

.1 Maintain finished base in a condition conforming to this section until succeeding material is applied or until acceptance by *Departmental Representative*.

PART 1 - GENERAL

1.1 Related Work

.1 Refer to other Specification Sections for related information.

1.2 Reference Standards

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C117, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C127, Test Method for Specific Gravity and Absorption of Coarse Aggregate.

.3 ASTM C131/C131M, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.4 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.5 ASTM C535, Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.6 ASTM D422-63, Standard Test Method for Particle-Size Analysis of Soils.

.7 ASTM D5821, Standard Test for Determining the Percentage of Fractured Particles in Coarse Aggregate.

.8 ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft3) (600kN-m/m3).

.9 ASTM D1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

.10 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

.2 Canadian Standards Association (CSA)

.1 CSA A23.2-23A, Method of Test for the Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus.

.3 Canadian General Standards Board (CGSB)
.1 CGSB 8.1-88, Sieves, Testing, Woven Wire, Inch Series.
.2 CGSB 8.1-88, Sieves, Testing, Woven Wire, Metric Series.

.4 Nova Scotia Department of Transportation and Infrastructure Renewal
.1 TPW TM-1, Test Method for the Resistance of Coarse Aggregate to Degradation in the Micro-Deval Apparatus.
.2 TPW TM-2, Modified Petrographic Number.
.3 TPW TM-3, Test Method for the Determination of Percent Fractured Particles in Processed Coarse Aggregate.

1.3 Measurement for Payment

.1 Granular sub-base will be measured in accordance with **Section 01 29 00**.

1.4 Delivery, Storage, and Handling

.1 Deliver and stockpile aggregates in accordance with Section 31 05 17 - Aggregate Materials.

PART 2 - PRODUCTS

2.1 Materials

.1 Granular Sub-Base: Type 2 Gravel to Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) Standard Specification, Highway Construction & Maintenance (current edition).
.1 Crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
.2 Type 2 granular fill gradation will be within following limits when tested in accordance with ASTM C117 and ASTM C136:

| ASTM SIEVE SIZE | % PASSING BY MASS |
|---|---|
| 80 mm | 100 |
| 56 mm | 70 - 100 |
| 28 mm | 50 - 80 |
| 14 mm | 35 - 65 |
| 5 mm | 20 – 50 |
| 0.160 mm | 3 – 10 |
| 0.080 mm | 0 - 7(1) |

(1) For gravel sources not classified as quarries the allowable percentage passing the 0.080 mm sieve shall be 3 to 5%.

.3 Granular material shall conform to the physical properties requirements listed in the following table:

| Property | Test Method | Limit |
|---|---|---|
| Absorption (% Maximum) | ASTM C127 | 1.75 |
| Los Angeles Abrasion (loss % Maximum) | ASTM C131 | 40 |
| Fractured Particles, one face (% Minimum) | TPW TM-3 | 50 |
| Plasticity Index | ASTM D4318 | 3 |
| Micro-Deval (% Maximum) | TPW TM-1 | 20 |

PART 3 - EXECUTION

3.1 Placing .1 Do not place new granular sub-base until underlying backfill material is compacted, inspected and approved by the *Departmental Representative*.

.2 Place material only on a clean unfrozen surface, properly shaped and compacted and free from snow and ice.

.3 Ensure no frozen material is placed.

.4 Construct aggregate base to depth and grade in areas indicated.

.5 Place using methods which do not lead to segregation or degradation of aggregates.

.6 Begin spreading aggregate base material on crown line or high-side of one way slope.

.7 Place material to full width in a uniform layer to 150 mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.

.8 Shape each layer to a smooth contour and compact to specified density before succeeding layer is placed.

.9 Remove and replace portion of layer in which material has become segregated during spreading.

3.2 Compacting

.1 Compact to density not less than 98% maximum dry density in accordance with ASTM D698.

.2 Shape and roll alternately to obtain a smooth, even and uniformly compacted base.

.3 Apply water as necessary during compacting to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.

.4 In areas not accessible to rolling equipment, compact to specified density with approved mechanical tampers.

3.3 Finish Tolerances

.1 Finished base surface shall be within plus or minus 10 mm of established grade but not uniformly high or low.

.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.4 Maintenance

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

PART 1 - GENERAL

1.1 Related Work

.1 Refer to other Specification Sections for related information.

.2 Refer to **Section 01 33 00** for Shop Drawing/Submission requirements.

1.2 Submissions

.1 Product Data/Samples:
.1 Provide samples of materials proposed for the work.

.2 Methodology:
.1 Provide methodology for carrying out the work.

.3 Provide submissions in accordance with **Section 01 33 00**.

1.3 Measurement for Payment

.1 All classes of Nominal Clear Stone will be measured in accordance with **Section 01 29 00.**

PART 2 - PRODUCTS

2.1 Materials

.1 Nominal Clear Stone

.1 Material to **Section 31 05 17** and to be a stone consisting of hard, durable particles, free from clay lumps, silt, cementation, organic material, frozen material and other deleterious foreign materials. Clear stone to be free from splits, seams or defects likely to impair its soundness during handling or under action of water.

.2 Specific gravity of not less than 2.65 when tested to ASTM C127 (AASHTO T85).

.3 25 mm Clear Stone gradation will be within the following limits:

| ASTM SIEVE SIZE | % PASSING BY MASS |
|---|---|
| 38 mm | 100 |
| 25 mm | 90 - 100 |
| 12.5 mm | 0 - 10 |

PART 3 - EXECUTION

3.1 Placement

.1 Clear stone can be end dumped provided that no breakage of stone occurs. Any broken rock shall be removed at the contractor's expense.

.2 Place clear stone at maximum density.

3.3 Protection

.1 Take into account anticipated weather conditions and degree of exposure of site in setting requirements for protection.

.2 Schedule and carry out construction so that each phase of work is not left exposed longer than necessary.

.3 The Contractor should note that the work site is subject to water level variations due to tidal action.

.4 The Contractor will be responsible to replace any mattress lost due to storms, tidal erosion or by his own activities.

PART 1 - GENERAL

1.1 Related Work
.1 Refer to other Specification Sections for related information.

1.2 Reference Standards
.1 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.

.2 ASTM D140, Practice for Sampling Bituminous Materials.

1.3 Submissions
.1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.

.2 Upon request by *Departmental Representative*, submit manufacturer's test data and certification that asphalt tack coat material meets requirements of this section.

1.4 Source Sampling
.1 Submit, in plastic containers to Department Representative, two - 4L samples of asphalt tack coat material proposed for use at least 2 weeks prior to commencing work.

.2 Provide access on tank truck for Department Representative to sample asphalt material to be incorporated into work, in accordance with ASTM D140.

1.5 Measurement for Payment
.1 Granular base will be measured in accordance with **Section 01 29 00.**

PART 2 - PRODUCTS

2.1 Materials
.1 Anionic emulsified asphalt: to CAN/CGSB-16.2, grade SS-1.

PART 3 - EXECUTION

3.1 Equipment
.1 Pressure distributor to be designed, equipped, maintained and operated so that asphalt material:

.1 Is maintained at even temperature. May be applied uniformly on variable widths of surface up to 5 metres.

.2 May be applied at readily determined and controlled rate of 0.14 L/m2 with uniform pressure, and with an allowable variation from any specified rate not exceeding 0.04 L/m2.

.2 Capable of distributing asphalt material in uniform spray without atomization at temperature required.

.3 Equipped with meter registering metres of travel per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.

.4 Equipped with pump having flow meter graduated in units of 5L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.

.5 Equipped with an easily read, accurate and sensitive device which registers temperature of liquid in reservoir.

.6 Equipped with accurate volume measuring device or calibrated tank.

.7 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.

3.2 Application

.1 Apply tack coat only on clean and dry surface. Obtain Department Representative's approval of surface before applying asphalt tack coat.

.2 Dilute asphalt emulsion with water at 1:1 ratio for application. Mix thoroughly by pumping or other method approved by Department Representative.

.3 Apply tack coat evenly to pavement surface at rate as directed by Department Representative but do not exceed 0.7 L/m2.

.4 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt tack coat material.

.5 Do not apply asphalt tack coat when air temperature is less than 5°C or when rain is forecast within 2 hours of application.

.6 Apply tack coat only to base coarse surfaces that are expected to be overlaid on same day.

.7 Evenly distribute localized excessive deposits of tack coat by brooming as directed by Department Representative.

.8 Where traffic is to be maintained, treat no more than one half of width of surface in one application.

.9 Keep traffic off tacked areas until tack coat has set as directed by Department Representative.

.10 Re-tack contaminated or disturbed areas as directed by Department Representative.

.11 Permit tack coat to set before placing asphalt paving.

PART 1 - GENERAL

1.1 Description

.1 This section specifies requirements for supplying, hauling, placing, shaping and compacting of hot-mix asphalt concrete.

1.2 Reference Standards

.1 ASTM C88-18, Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.

.2 ASTM C117-17, Test Method for Material Finer than 0.075 mm Sieve in Mineral Aggregates by Washing.

.3 ASTM C123-14, Test Method for Lightweight Pieces in Aggregate.

.4 ASTM C127-15, Test Method for Specific Gravity and Absorption of Coarse Aggregate.

.5 ASTM C128-15, Test Method for Specific Gravity and Absorption of Fine Aggregate.

.6 ASTM C131-14, Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.7 ASTM C136-14, Method for Sieve Analysis of Fine and Coarse Aggregates.

.8 AASHTO M156, Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

.9 ASTM D2419-14, Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

.10 ASTM D2041-11, Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

.11 ASTM D2950-14, Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.

.12 ASTM D3203-17, Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

.13 ASTM D3515-01, Standard Specifications for Hot Mixed, Hot Laid Bituminous Paving Mixtures.

.14 ASTM D4469-17, Standard Method for Calculating Percent Asphalt Absorption by

the Aggregate in an Asphalt Pavement Mixture.

.16 CAN/CGSB-8.2-M88 (R10/3 Series), Sieves Testing, Woven Wire, Metric.

.17 CAN/CGSB-16.3-M90, Asphalt Cements for Road Purposes.

.18 AASHTO T-283 with Lottman Conditioning.

1.3 Related Work

.1 Refer to other Specification Sections for related information.

1.4 Samples

.1 Submit samples in accordance with the Section 01 33 00 – Submittal Procedures.

.2 At least 4 weeks prior to commencing work submit samples of following materials proposed for use:

.1 One 4L container of asphalt cement.

1.5 Material Certification

.1 At least 4 weeks prior to commencing work submit viscosity-temperature chart for asphalt cement to be supplied showing kinematic viscosity in mm2/s versus temperature range from 105° to 175°.

.2 At least 4 weeks before commencing work, submit refinery's test data and certification that asphalt cement meets requirements of this section which also includes the specific gravity of the asphalt cement.

1.6 Submission of Mix Design

.1 Samples of aggregate for mix design shall be derived from stockpiles not less than 1000 tonnes of each of fine and course aggregate.

.2 The Contractor will submit, in writing, asphalt concrete mix design and trial mix test results to Department Representative for review at least 4 weeks prior to commencing work. The mix design shall contain the job mix formula which shall include the following:

- asphalt cement content
- specific gravity and absorption of each aggregate, including natural blend sand, lime, and RAP (if used)
- Percentage of each aggregate
- Gradation of Job Mix Formula
- Bulk Specific Gravity, kg/m3
- Maximum theoretical density, kg/m3
- percentage voids in mineral aggregate
- percentage air voids
- percentage voids filled
- percentage of absorbed asphalt cement
- long term TSR (AASHTO T283)
- All superpave mix design characteristics, including graphs used in arriving at the final mix design, the bulk relative density of the combined aggregates, and the asphalt absorbtion of the combined aggregates.

1.7 Delivery and Storage

.1 Deliver and stockpile aggregates. Stockpile outside of park boundaries, a minimum 50% of total amount of aggregate required before commencing asphalt concrete operations.

.2 Coarse aggregate stockpile shall contain no more than 15% passing 4750 sieve.

.3 Fine aggregate stockpile shall contain no more than 15% retained on 4750 sieve.

.4 When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.

.5 If applicable, The Contractor shall be responsible for the incorporation of RAP in to the asphalt concrete mix. The Contractor shall be responsible for collecting 6 RAP samples during milling operations over the portion of the milling operations over the portion of the milling area needed to

produce the recycle mix. Only RAP obtained from the project site may be incorporated into the recycle mixes.

.6 When dryer drum mixing plant is used, stockpile fine aggregate separately from coarse aggregate.

.7 Provide approved storage, heating tanks and pumping facilities for asphalt cement.

1.8 Measurement For Payment

.1 Hot mix asphalt paving will be measured in accordance with **Section 01 29 00.**

PART 2 – PRODUCTS

2.1 Materials

.1 Asphalt Cement: to M320 Table 1 for PG 64-28.

.2 Aggregates:

.1 Coarse aggregate to be supplied for the manufacture of asphaltic concrete shall consist of crushed stone, composed of clean, sound, hard and durable particles free from a coating of silt, and/or clay and shall not contain other deleterious materials. Coarse aggregate shall conform to the physical requirements for coarse aggregate shown in Table 2.1-1 and 2.1-2.

.2 Irrespective of compliance with the physical requirements of Table 2.1-1 and 2.1-2, a coarse aggregate may be rejected on the basis of past field performance.

.3 Fine aggregate to be supplied for the manufacture of asphaltic concrete shall consist of manufactured material processed by crushing quarried rock or natural sand and gravel, the particles of which shall be clean, hard, durable and free from coatings of silt, clay or other deleterious material. Fine aggregate shall conform to the physical

and gradation requirements shown in Table 2.1-3 and the fraction between any two of the following consecutive sieves (4.75 mm, 2.36 mm, 1.18 mm, 600 µm, 150 µm) shall be a minimum of 7%. A minimum of 25% fine aggregate, processed by crushing quarried rock, shall be incorporated into all asphaltic mixes.

**Table 2.1-1**
**Gradation Requirements for Coarse Aggregate – ASTM C136**

| **Material Size Sieve Size** | **9.5 mm Passing (%)** | **12.5 mm Passing (%)** | **19.0 mm Passing (%)** |
|---|---|---|---|
| 25.0 mm | - | - | 100 |
| 19.0 mm | - | 100 | 90-100 |
| 12.5 mm | 100 | 90-100 | 50-75 |
| 9.5 mm | 80-100 | 45-75 | 20-55 |
| 6.3 mm | 15-50 | - | - |
| 4.75 mm | 0-15 | 0-15 | 0-15 |

**Table 2.1-2**
**Physical Requirements for Coarse Aggregate**

| **Test** | **B-HF** | **C-HF** | **ASTM** |
|---|---|---|---|
| Los Angeles Abrasion, Max % Loss | 30 | 30 | C131 |
| Magnesium Sulphate Soundness, Max % Loss | 15 | 15 | C88 |
| Absorption, Mass % | 1.75 | 1.75 | C127 |
| Crushed, Min % | 95 | 95 | D5821(1) |
| Flat and Elongated, Max % | 10 | 10 | D4791 |
| Petrographic Number, Max. | 135 | 135 | TPW TM-2 |
| Micro Deval, 1% Max | 18 | 15 | D6928 |

(1) Crushed percentage is the fraction of particles by mass retained on the 4.75 mm sieve having two or more freshly fractured faces.
(2) Petrographic number to be determined using current NSTIR test procedures.

**Table 2.1-3**

**Physical and Gradation Requirements for Fine Aggregate**

| Test | B-HF | C-HF | ASTM |
|---|---|---|---|
| Magnesium Sulphate Soundness, Max % Loss | 10 | 10 | C88 |
| Micro Deval, Max % | 20 | 17 | D7428 |
| Absorption, Max % | 2 | 2 | C128 |
| Fine Aggregate Angularity, % Min | 45 | 45 | AASHTO T304 |
| Sand Equivalent, % min | 50 | 50 | D2419 |

.3 Blending Sand:

.1 Blending sand supplied for the manufacture of asphaltic concrete shall consist of clean, tough, durable particles, free from silt clay and other deleterious material.

.2 The gradation of the blending sand shall be such that when incorporated into the asphaltic concrete mix, the resultant mix shall meet the requirements of Tables 2.2-4, 2.2-5 and 2.2-6.

.3 The blending sand shall have 100% passing the 9.5.

.4 The physical requirements of the blending sand shall be as specified in Table 2.1-3 with the exception of the limitation on the maximum percent passing the 75 µm Sieve, fine aggregate angularity and microdeval.

.5 RAP:

1. If incorporated, the amount of RAP in the hot mixed recycled asphalt concrete base mix shall be not more than 20% of the total weight of the combined aggregates.
2. If incorporated, the amount of RAP in the hot mixed recycled asphalt concrete surface mix shall be not more than 20% of the total weight of the combined aggregates.

.6 The maximum mass of blending sand to be used in the total mix shall not exceed 15% for all mixes except "D" mix.

2.2 Mix Design and Job Mix Formula

.1 Contractor Mix Design: The contractor shall use professional engineering services and a qualified testing laboratory to assess the performance grade asphalt cement and aggregate materials proposed for use and to carry out the design of the asphalt mix.

.2 Requirement for Asphalt Mix Design: the asphalt mix design shall follow the Superpave method of mix design based on 100 gyrations and be in accordance with the latest edition of the Asphalt Institute Publication, Mix Design Methods for Asphalt Concrete Manual Series No.2 (MS-2).

.1 The asphalt cement grades shall be PG 64-28, unless otherwise specified. The optimum percent of asphalt cement shall be that percent which yields design air voids of 4% +/- 1%.

.2 The approved asphalt mix design specifying the aggregate blend proportions and the design asphalt cement content shall be considered as the job mix formula.

.3 Contracts with SADT (Summer Average Daily Traffic) less that 1,000 shall have a job mix formula asphalt content yielding air voids of 3.5% +/- 1%.

.4 If desired, contractor may use up to 20% RAP in the Mix Design (actual percentage to be determined in the mix design).

.5 The asphalt mix design data and the proposed job mix formula is to be submitted by the Contractor for review and shall include for each blend the following:

.1 The name of the testing firm responsible for the mix design.

.2 The specific location(s) of the source of mineral aggregate.

.3 The source and type of mineral admixture and the percentage to be used.

.4 The percentage of aggregate passing each of the specified sieves for each aggregate to be incorporated into the mixture.

.5 The proportion of each material (in percent of aggregate) including hydrated lime, if required, as an anti-stripping agent.

.6 The composite gradation based on (4) and (5) above.

.7 The composite gradation plotted on a 0.45 power graph paper.

.8 The results of all aggregate testing, determinations, etc., as defined in Tables 2.1-1, 2.1-2 and 2.1-3, including bulk specific gravity and apparent specific gravity. In addition, aggregates shall be tested to determine if they are prone to stripping (tensile strength ratio <0.8) as well as no visual evidence of stripping. If an anti-stripping additive is required, hydrated lime or an effective liquid anti-stripping agent shall be used.

.9 The mix design with a minimum of five (5) different asphalt contents (minimum 0.5 % between each point) with at least one point above and one point below the optimum asphalt percentage that reports the following:

.1 The percentage (in units of one tenth of 1%) of asphalt cement to beaded, based on the total weight of the mixture.

.2 The Superpave test results for the individual and average bulk specific gravity of at least three specimens at each asphalt content.

.3 The maximum theoretical specific gravity at each asphalt content.
.4 The percent of air voids in the mixture for each asphalt content.
.5 The percent voids in mineral aggregate (VMA) at each asphalt content.
.6 The percent voids filled with asphalt (VFA) at each asphalt content.
.7 The design asphalt content as a percent of total mix.
.8 The percent of Theoretical maximum specific gravity for Ninitial, Ndesign, and Nmax at the design asphalt content.
9. The Superpave mix design number of gyrations at Ndesign.
10 The bulk specific gravity briquette weight and height on mm at the design optimum asphalt content.

.10 All Superpave mix design characteristics, including graphs used in arriving at the final mix design, the bulk relative density of the combined aggregates and the asphalt absorption of the combined aggregates. The Contractor shall submit the following with the asphalt mix design for verification purposes:
.1 One - 50 kg sample of each representative virgin aggregate.
.2 Thirty-two 1.2 kg samples of representative virgin aggregate blended to the design mix gradation of the asphalt mix aggregate.
.3 Four Litres of the type of performance grade asphalt cement to be used.

.3 Design Mix Approval: Design mix approval will be based on the design mix tests and the corresponding requirements detailed in Tables 2.2-4 and 2.2-5. The Departmental Representative shall require five (5) working days from the time of receipt of Contractor submitted asphalt mix design and samples to evaluate the asphalt mix design. As part of the asphalt mix design evaluation, the Departmental Representative shall determine the following properties:

.1 Combined aggregate gradation;

.2 Bulk specific gravity for the asphalt mix aggregate;

.3 Superpave density;

.4 Theoretical maximum specific gravity of the asphalt mix at the design asphalt content and at each asphalt content considered by the Contractor above and below the design asphalt content.

.5 The difference between the property values submitted by the Contractor and the property values as determined by the Departmental Representative shall not exceed the amounts shown as follows:

| **Property** | **Maximum Permissible Variation** |
|---|---|
| Bulk Specific Gravity of Aggregate | ± 0.015 |
| Superpave Density | ± 12 kg/m$^3$ |
| Theoretical Maximum Specific Gravity | ± 0.010 |

**Table 2.2-4**
**Blended Aggregate Gradation and Asphalt Content**
**For Asphaltic Concrete Mixes**

| **Sieve Size** | **Passing %** | |
|---|---|---|
| | **B-HF** | **C-HF** |
| 37.5 mm | | |
| 25.0 mm | 100 | - |
| 19.0 mm | 90-100 | 100 |
| 12.5 mm | 70-90 | 90-100 |

| | | |
|---|---|---|
| 9.5 mm | 60-75 | 70-90 |
| 4.75 mm | 35-58 | 48-68 |
| 2.36 mm | 25-55 | 25-55 |
| 1.18 mm | - | - |
| 300 µm | 3-20 | 6-20 |
| 75 µm | 2-6.5 | 2-6.5 |

**Table 2.2-5**
**Physical Requirements for Asphaltic Concrete Mixes**

| Test | B-HF | C-HF |
|---|---|---|
| Dust to Binder Ratio | 0.6-1.2 | 0.6-1.2 |
| Tensile Strength Ratio (% min) | 80 | 80 |
| Air Voids (%) | 3-5 | 3-5 |
| Minimum VMA (%) | 13 | 14 |
| VFA (%) | 65-78 | 65-78 |

**Table 2.2-6**
**Mix Control Tolerance from Design Mix Formula to Job Mix Formula**

| Sieve Size | Allowable Variation of % Passing (±) |
|---|---|
| 4.75 mm | 3 |
| 75 µm | 0.8 |
| Asphalt Cement | 0.3 |

.4 Physical Requirements of the Mixture:

.1 The mixture shall be uniform and shall consist of a mixture of coarse and/or fine aggregate together with any required blend sand, mineral filler or lime, and mixed with asphalt cement.

.2 The mineral constituents shall be combined in such proportions as to produce a mixture conforming to the gradation requirements of Table 2.2-4. The grading shall not show marked fluctuations from opposite extremes of the limiting sizes.

.3 Mixtures shall meet the physical requirements of the properties specified in Table 2.2-5. Current NSTIR test procedures will be used to determine these properties.

.5 Mix Control Tolerances:

.1 Once the job mix formula has been designated by the Department Representative, the Contractor shall be required produce an asphaltic concrete mixture conforming to the mix control tolerance as specified in Table 2.2-6.

.6 Stockpile Requirements:

.1 Stockpiling sites shall be level, well drained, free of all foreign materials and of adequate bearing capacity to support the mass of the stockpiled materials. Stockpiles shall be either far enough apart or separated by substantial dividers to prevent intermingling.

.2 For all aggregates except where stockpiled on Portland cement concrete, asphaltic concrete or on otherwise acceptably stabilized areas, the bottom 150 mm of the stockpile is not to be incorporated into the work.

.3 Stockpiles shall be built up in layers not exceeding 1 m in depth. Each layer shall be completed over the entire area of the stockpile before beginning the next layer. Coning of the piles or spilling of material over the edges of the pile will not be permitted. Traffic over the stockpile surface shall be limited to that required for adequate levelling or removal.

.4 The minimum size of each coarse and fine aggregate stockpile shall be 1000 tonnes. The minimum size of the stockpile(s) of blending sand shall be 150 tonnes.

.5 Before any production of asphaltic concrete mixture has commenced, aggregate stockpiles of the required size and gradation shall be provided at the asphalt plant site. Minimum stockpile requirements shall be maintained throughout the project. Aggregates brought to the site after production has commenced shall be stored in separate stockpiles.

.6 A minimum of 2 working days between the arrival of asphalt aggregate and its incorporation into the asphaltic concrete mixture will be required to facilitate complete analysis of the aggregate prior to its use.

.7 Handling, Feeding and Drying of Aggregate:

.1 Aggregate shall be loaded into the cold feed bins so as to prevent the mixing of separated sizes of aggregate. Mixing of materials on site or loading of more than one material into a single bin shall not be permitted.

.2 Where the Contractor chooses to use a batch or continuous mix operation, the aggregate shall be dried and heated in the drier and separated by screening into hot storage bins. When the aggregate is delivered to the mixer, it shall be at a temperature consistent with proper mixing and laying and shall in no case exceed 165°C. Surfaces of dried aggregate shall be free of carbon or unburnt fuel oil.

.3 The aggregate shall be sufficiently dried as evidenced by the lack of noticeable steaming, bubbling, or foaming of the asphalt mixture and the absence of visible free water on the tailgate of the truck box.

.4 If insufficient drying is evident, the Contractor shall take steps as deemed

necessary to provide properly dried aggregates.

PART 3 - EXECUTION

3.1 Plant and Mixing Requirements

.1 Location: The hot mix plant shall be located within a 95 km haul distance of the project limits.

.2 Feeder lines for loading asphalt cement to the asphalt tanks shall be elevated and drained and the use of diesel fuel to clean asphalt cement pump feeder lines is not permitted. When necessary to use diesel to flush lines and pump, all flushed material shall be collected and not permitted to enter asphalt cement tanks or dumped on the ground.

.3 Batch and Continuous Mixing Plants:
.1 To AASHTO M156.
.2 Heat asphalt cement and aggregate to mixing temperature as directed by Departmental Representative. Do not heat asphalt cement above 165°. Before mixing, dry aggregates to a moisture content not greater than 0.5% by mass or to a lesser moisture content if required to meet mix design requirements.
.3 Make available current asphalt cement viscosity and specific gravity data at plant. With information relative to viscosity of asphalt cement being used, Departmental Representative will direct temperature of completed asphalt concrete at plant and at paver after considering hauling and placing conditions.
.4 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders. Aggregate will not be fed directly to the plant from the crusher.

.5 Feed cold aggregates to plant in proportions that will ensure continuous operations.

.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 a manner to minimize segregation and temperature loss.

.8 Maintain temperature of materials within plus or minus 5°C of specified mix temperature during mixing.

.9 Mixing time:

.1 In batch plants, both dry and wet mixing times as directed by the Departmental Representative. Continue wet mixing as long as necessary to obtain a thoroughly blended asphalt concrete but not less than 30 s or more than 75 s.

.2 In continuous mixing plants, mixing time as directed by the Departmental Representative but not less than 45 s.

.3 Do not alter mixing time unless directed by the Departmental Representative.

.4 Dryer Drum Mixing Plant:

.1 Feed aggregates to burner end of dryer drum by means of a multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.

.2 Meter total flow of aggregate by an electronic weigh belt system with an indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate and asphalt cement entering mixer remain constant.

.3 Provide for easy calibration of weighing systems for aggregates without having material enter drum.

.4 Make provision for conveniently sampling the full flow of aggregate from the cold feed.

.5 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate from cold feed prior to entering drum.

.6 Provide a system interlock which will stop all feed components if either asphalt or aggregate from any bin stops flowing.

.7 Accomplish heating and mixing of asphalt concrete in an approved parallel flow dryer-mixer in which aggregate and asphalt cement enter drum at burner end and travel parallel to flame and exhaust gas stream. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt cement. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt concrete at discharge, with a printing recorder that can be monitored by plant operator. Submit printed record of mix temperatures at end of each week.

.8 Mixing period and temperature to produce a uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves plant to be less than 0.5 %.

.5 Temporary storage of hot asphalt concrete:

.1 Provide storage of sufficient capacity to permit continuous operation and designed to prevent segregation.

.2 Do not store in storage bins in excess of 3 h.

.6 While producing asphalt concrete for this project, do not produce it for other users unless separate storage and pumping

facilities are provided for materials supplied to this project.

.7 Mixing tolerances:

.1 Permissible variation in aggregate gradation from job mix (percent of total mass):

| Seive, µm | Allowable Variation % Passing (+/-) | |
|---|---|---|
| | Type B-HF | Type C-HF |
| 4750 | 6.00 | 5.00 |
| 75 | 0.80 | 0.50 |

.2 Permissible variation of asphalt cement from job mix, Type A-HF, B-HF: 0.40%, Type C-HF, D-HF: 0.30%

.3 Permissible variation of asphalt concrete temperature at discharge from plant, 5°.

.4 Permissible variation in VMA (%) from mix type specified valve.

| Mix Type | Allowable Variation |
|---|---|
| B-HF | 12.50 - 13.99 |
| C-HF | 13.50 – 14.99 |

3.2 Equipment

.1 General: All equipment used on this project shall be in top operating condition because the project is located on a roadway with very steep grades and sharp curves.

.2 Pavers: Mechanical grade controlled self powered pavers capable of spreading asphalt concrete within specified tolerances, true to line, grade and crown indicated.

.1 Pavers to be equipped with automatic screed controls, as recommended by manufacturer for control of longitudinal grade and transverse slope.

.2 Pavers to be equipped with joint matching shoe to operate with longitudinal grade control.

.3 Transverse slope control shall be capable of operating from either side of paver.

.4 Pavers to be equipped with an approved 12 metre ski. Where such ski is a flexible unit, it shall be equipped with a spring tensioned wire extending between brackets fitted on and slightly above each end of ski. Sensing grid shall ride on wire and not on ski.

.3 Rollers: sufficient number of rollers of type and mass to obtain specified density of compacted mix.

.4 Vibratory Rollers:
.1 Minimum drum diameter: 1200 mm.

.2 Maximum amplitude of vibration (machine setting): 500 µm for lifts less than 40 mm thick.

.5 Haul Trucks: of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
.1 Boxes with tight metal bottoms.
.2 Covers (tarps) of sufficient size and weight to completely cover and protect asphalt concrete when truck fully loaded.
.3 In cool weather or for long hauls, insulate entire contact area of each truck box.
.4 Trucks which cannot be weighed in a single operation on scales supplied will not be accepted.
.5 Truck tailgate assemblies must be such that they do not strike paver hopper when emptying into the hopper.

.6 Hand Tools:
.1 Lutes or rakes with covered teeth for spreading and finishing operations.
.2 Tamping irons having mass not less than 12 kg and a bearing area not exceeding 310 cm2 for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical

compaction equipment, when approved by the Departmental Representative, may be used instead of tamping irons.

.3 Straight edges, 3 metres in length, to test finished surface.

.7 Material Transfer Vehicle: Transfer asphalt concrete from haul units to spreader with an approved Material Transfer Vehicle, i.e. Roadtec SB 2500 C or approved equal.

3.3 Preparation

.1 Pavement sites indicated by the Departmental Representative for pulverizing will be prepared in accordance with Section 32 01 16 - Removal of Existing Asphalt.

.2 Apply tack coat in accordance with Section 32 12 15 - Asphalt Tack Coat prior to paving.

.3 Pavement sites indicated by the Departmental Representative for overlay and skin patching shall be free of loose and foreign material and tack coat shall be applied in accordance with Section 32 12 15 – Asphalt Tack Coat.

3.4 Transportation Asphalt Concrete

.1 Transport asphalt concrete to job site in vehicles cleaned of foreign material.

.2 Paint or spray truck beds with limewater, soap or detergent solution, at least once a day or as required. Elevate truck bed and thoroughly drain. No excess solution will be permitted. Diesel fuel is not permitted.

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

.4 Deliver asphalt concrete to paver at a uniform rate and in an amount within capacity of paving and compacting equipment.

.5 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place asphalt concrete at temperature within range as directed by the Departmental Representative, but not less than 135°.

.6 Tarpaulins or other coverings for trucks must be of sufficient mass to prevent rapid cooling of asphalt concrete surface.

3.5 Placing

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

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

.3 Use asphalt material transfer vehicle (MTV) when placing asphalt surface course to transfer hot asphaltic concrete from and unloading truck to the paving insert hopper and remixing the asphalt concrete before it is transferred.

.4 Placing Conditions:

.1 Place asphalt concrete only when air temperature is above 5°.

.2 When temperature of surface on which asphalt concrete is to be placed falls below 10°C, provide extra rollers as necessary to obtain required compaction before cooling.

.3 Do not place asphalt concrete when pools of standing water exist on surface to be paved, or during rain, or when surface is damp, or if ambient temperature is below 5°C .

.5 Place asphalt concrete in compacted lifts of thickness as follows:

.1 On overlay section in two compacted lifts each with a spread rate of 120

kg/m2 or as directed by the Departmental Representative.

.6 Spread and strike off asphalt concrete overlay with self-propelled mechanical finisher.

.1 Place individual strips no longer than 500 m.

.2 Construct longitudinal joints and edges true to line markings. Lines for paver to follow will be established by the Departmental Representative parallel to centreline of proposed pavement. Position and operate paver to follow established line closely.

.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. Remove by shovel or lute access asphalt concrete forming high posts. Fill and smooth dips with asphalt concrete.

.6 Do not broadcast asphalt concrete over surface.

.7 The forward speed of the paver shall be regulated by capacity of the plant and the rollers but shall not exceed a forward speed of 10 m/min.

.7 When hand spreading is used:

.1 Approved wood or steel forms, rigidly supported to assure correct grade and cross section, may be used. Use measuring blocks and intermediate strips to aid in obtaining required cross-section.

.2 Distribute material uniformly. Do not broadcast material.

.3 During spreading operation, thoroughly loosen and uniformly distribute asphalt

concrete by lutes or covered rakes. Reject asphalt concrete 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. Avoid high temperatures which may burn asphalt concrete. Do not use tools at a higher temperature than temperature of asphalt concrete being placed.

3.6 Compacting

.1 Compact asphalt concrete continuously using established rolling pattern.

.2 Do not change rolling pattern unless asphalt concrete changes or lift thickness changes. Change rolling pattern only as directed by the Departmental Representative.

.3 General:

.1 Provide at least three rollers or as many additional rollers as necessary to achieve specified pavement density.

.2 Start rolling operations as soon as asphalt concrete can bear mass of roller without undue displacement of asphalt concrete or cracking of surface.

.3 Operate roller slowly initially to avoid displacement of asphalt concrete. For subsequent rolling do not exceed 5 km/h for static steel-wheeled rollers and 8 km/h for pneumatic-tired rollers.

.4 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 20 impacts per metre of travel.

.5 Overlap successive passes of roller by at least one half width of roller and vary pass lengths.

.6 Keep wheels of roller slightly moistened with water to prevent pick-up of asphalt concrete but do not over-water and do not use diesel fuel.

.7 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.

.8 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.

.9 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side.

.10 Where rolling causes displacement of asphalt concrete, loosen affected areas at once with lutes or shovels and restore to original grade of loose asphalt concrete before re-rolling.

.11 Do not refuel rollers on fresh asphalt concrete.

.4 Breakdown Rolling:

.1 Commence breakdown rolling with static steel wheeled roller vibratory roller immediately following rolling of transverse and longitudinal joint and edges.

.2 Operate rollers as close to paver as necessary to obtain the specified density without causing undue displacement.

.3 Operate breakdown roller with drive roll or wheel nearest finishing machine. Exceptions may be made when working on steep slopes or super-elevated sections.

.4 Use only experienced roller operators for this work.

.5 Second Rolling:

.1 Use pneumatic-tired, steel wheel or vibratory rollers and follow breakdown

rolling as closely as possible and while paving asphalt concrete temperature allows maximum density from this operation.

.2 Rolling shall be continuous after initial rolling until asphalt concrete placed has been thoroughly compacted.

.6 Dusting: If required by the Departmental Representative, dust entire area of sheet asphalt concrete with hydrated lime immediately after rolling to eliminate tendency to pick-up under traffic.

.7 All asphalt concrete shall be compacted to 93% of Theoretical Maximum Relative Density (TMRD) in accordance with ASTM D3203.

.8 The Contractor will supply additional compaction equipment if required density is not achieved.

.9 Gutters will be compacted with vibratory compactors which operate perpendicular to the direction of the gutter.

3.7 Joints

.1 General:

.1 Trim vertical face to provide true surface and cross section against which new pavement may be laid. Remove loose particles.

.2 Paint joint face with coat of tack coat emulsified asphalt cement or preheat joint face with approved heater, prior to placing of fresh asphalt concrete.

.3 Overlap previously laid strip with spreader by 100 mm.

.4 Rake fresh asphalt concrete against joint and thoroughly tamp and roll.

.5 Remove surplus material from surface of previously laid strip. Dispose of surplus material as directed by the Departmental Representative.

.6 Do not throw surplus material on freshly screened mat surface.

.2 Transverse Joints:
- .1 Carefully construct and thoroughly compact transverse joints to provide a smooth riding surface.
- .2 Hold transverse joints to a minimum. When paving single width and maintaining traffic, construct one lane no farther than one-half total paving day.
- .3 Stagger joint locations 1.5 to 3.0 metres. Schedule each day's paving operation to terminate adjacent lanes in any one area to within above specified joint location.
- .4 Offset transverse joint in succeeding course by at least 600 mm.

.3 Longitudinal Joints:
- .1 Before rolling, carefully remove with a lute or rake and discard coarse aggregate in asphalt concrete overlapping joint.
- .2 Roll longitudinal joints directly behind paving operation.
- .3 When rolling with static roller, shift roller over onto previously placed lane in order that no more than 150 mm of roll rides on edge of newly laid lane, then operate roller to pinch and press fines gradually across joint. Continue rolling until a thoroughly compacted neat joint is obtained.
- .4 When rolling with vibratory roller, have most of drum width ride on newly placed lane with remaining 100 to 150 mm extending onto previously placed and compacted lane.
- .5 When abutting lane is not placed in same day, or when joint is distorted during day's work by traffic or other means, carefully trim edge of lane to line and paint with a thin coating of asphalt before abutting lane is placed.

.6 Ensure joints are offset at least 150 to 200 mm from those in lower layers.

3.8 Finishing Tolerances

.1 Finished asphalt concrete to be within 6 mm of design elevation but not uniformly high or low.

.2 Finished asphalt concrete not to have irregularities exceeding 6 mm when checked with a 3 metre straight edge placed in any direction.

3.9 Temporary Markings

.1 The Contractor will place temporary pavement markings before sunset following each day's work. Marking material will be approved by the Departmental Representative.

3.10 Defective Work

.1 Repair areas showing checking or hairline cracking to the approval of the *Departmental Representative.*

.2 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form a true and even surface and compact immediately to specified density.

.3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

PART 1 - GENERAL

1.1 Related Work

.1 Refer to other Specification Sections for related information.

.2 Refer to **Section 01 33 00** for Shop Drawing/Submission requirements.

1.2 Reference Standards

.1 CGSB 15-GP-1M-80, Calcium Chloride.

1.3 Measurement for Payment

.1 Supply and application of water for dust control is incidental to the work, to be included in overall tendered price.

PART 2 - PRODUCTS

2.1 Materials

.1 Water: potable to *Departmental Representative's* approval.

PART 3 - EXECUTION

3.1 Placement

.1 Supply water from outside sources in quantities and at times as directed by Department Representative.

.2 Apply water with equipment approved by Department Representative at rate of 0.5 to 5.0 l/m2 as appropriate when directed by Department Representative.

.3 Apply water with distributors equipped with spray system to ensure uniform application and with means of shut-off.

PART 1 - GENERAL

1.1 General

.1 This standard applies to low temperature, water-borne, acrylic, fast-drying traffic paints suitable for spray application with specialised equipment, to asphalt surfaces. Includes are centre lines to match existing layout (double solid, solid/dash or single dash lines), as well as all intersections, arrows, delineation, special marking and temporary markings, etc. for the full length of the work area.

.2 This specification includes a compound to be used as an additive in conjunction with water-borne traffic paint and glass spheres to provide a drying agent which accelerates the no-tack time of the water-borne traffic paint. No-tack time is to be increased by approximately 40% over the same paint without the compound.

.3 All pavement markings to be in accordance with the Manual of Uniform Traffic Devices for Canada, latest edition.

1.2 Reference Standards

.1 American Society for Testing and Materials (ASTM).
- .1 ASTM D 711, Test Method for No-Pick-Up Time of Traffic Paint.
- .2 ASTM D 868, Test Method for Evaluating Degree of Bleeding of Traffic Paint.
- .3 ASTM D 869, Test Method for Evaluating Degree of Settling of Paint.
- .4 ASTM D 969, Test Method for Laboratory Determination of Degree of Bleeding of Traffic Paint.
- .5 ASTM D 1155, Test Method for Roundness of Glass Spheres.
- .6 ASTM D 1210, Test Method for Fineness of Dispersion of Pigment-Vehicle Systems.

.7 ASTM D 1214, Test Method for Sieve Analysis of Glass Spheres.
.8 ASTM D 1309, Test Methods for Settling Properties of Traffic Paints During Accelerated Storage.
.9 ASTM D 2205, Guide for Selection of Tests for Traffic Paints.
.10 ASTM D 2243, Test Method for Freeze-Thaw Resistance of Water-Borne Coatings.
.11 ASTM D 3960, Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
.12 ASTM E 97, Test Method for Directional Reflectance Factor of Opaque Specimens by Broad-Band Filter Reflectometry.

.2 Canadian General Standards Board (CGSB)
.1 CGSB Specification 1-GP-71, Refractive Index.

.3 Transportation Association of Canada (TAC)
.1 Manual of Uniform Traffic Control Devices for Canada.

1.3 Measurement for Payment

.1 Will be measured in accordance with **Section 01 29 00.**

1.4 Source Sampling

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

.2 Mark samples with name of project, location, paint manufacturer’s name and address, name of paint, CGSB specification number and formulation number and batch number.

.3 The Departmental Representative reserves the right to test samples of paint at the point of delivery, from any of all batches of paint to be used. The samples will be tested and all paint from any batch tested that

does not meet specification, will not be permitted to be used on this project.

PART 2 - PRODUCTS

2.1 Materials .1 General Requirements:

.1 The low temperature, water-borne (acrylic), lead free, fast drying traffic pains shall be designed to be applied in environmental conditions such that operational temperatures shall be in the range of 2 degrees Celsius and rising.

.2 Paint shall be well ground to a uniform smooth consistency and shall be free from skin, dirt and other foreign particles. The paint shall be capable of being sprayed at the temperature intended for the paint. It shall flow evenly and smoothly and cover solidly when applied to pavement. The paint shall be supplied ready-mixed for use without any addition of water.

.3 The paint mixture shall include the glass bead intermix system.

.4 The paint mixture is to be able to be applied under pneumatic pressure by a standard truck mounted dispensing machine moving at speeds of 8 to 25 km/hr.

2.2 Paint .1 Paint to this standard shall comply with the following detail requirements when tested in accordance with the specified test methods:

| Property | Specification | | Test Method |
|---|---|---|---|
| | Min | Max | |
| Density | -- | -- | Method 2.1 |
| Consistency, KU (2) | 85 | 95 | Method 4.5 |
| Skinning Properties (3) | 0 | 0 | Method 10.1 |

| | | | |
|---|---|---|---|
| Contrast Ratio (5) | 0.992 | -- | |
| VOC (6) | -- | 150 g/l | ASTM D3960 |
| Volatile Matter % (mass) (including water) | -- | 24 | Method 17.1 |
| Freeze-thaw resistance | Pass | -- | ASTM D2243 |
| Pigment Content, % (mass) | 56 | 62 | Method 21.2 |
| Binder Solid, % of mass | 16.75 | -- | Method 19.1 |
| 100% Acrylic Polymer, % (mass) | 15 | -- | Method 57.1 |
| No-pick-up time, min. (4) | 1 | 5 | ASTM D711 |
| Non-tracking time, sec. (8) | -- | 60 | |
| Fineness of grind, HU | 3 | -- | ASTM D1210 |
| Coarse Particles:<br>#60 Sieve – 250 µm<br>#100 Sieve – 150 µm | <br>Nil<br>-- | <br>Nil<br>0.01 | <br>ASTM D185<br>ASTM D2205 |
| Bleeding | 4 | -- | ASTM D869 & ASTM D2205 |
| Settling Rate | 6<br>8 | --<br>-- | ASTM D1309<br>ASTM D869 |
| **White Paint:**<br>Titanium Dioxide, g/L | <br>150 | <br>-- | <br>Method 2.1, 21.1, 50.14 |
| Titanium Dioxide Pigment (7)<br>Reflectance | 80 | -- | ASTM E97 |
| Colour | -- | -- | 1-GP-12C<br>513-301 |
| **Yellow Paint:**<br>Reflectance | <br>60 | <br>-- | <br>ASTM E97 |
| Colour | -- | -- | 505-308 |

.2 All tests to be performed by methods as per Canadian General Standards Board (CGSB), 1-GP-71 or American Society of Testing and Materials (ASTM) or as noted herein.

.3 Kreb units at 25°C.

.4 Paint shall be non-skinning (See General Requirements, 2.1.1.2).

.5 Perform field tests on a 15 mil wet film thickness of hot spray (maximum 50°C). Wait one minute, drive a passenger vehicles over the film and ensure no visible (from 15 m) deposition of paint is deposited onto the adjacent pavement.

.6 Volatile organic compounds (VOC) (excluding water): max 150 g/L; method ASTM D3960.

.7 Titanium dioxide pigment shall be Rutile type and have a minimum $TiO_2$ content of 93%.

.8 Non-tracking time based upon 375 µm (15 mils) wet film thickness applied when pavement temperature is greater than 10°C and humidity conditions of 80% or less on dry pavement.

2.3 Glass Bead Intermix System

.1 The compound shall be a mixture of glass beads and drying agent materials.

.2 The compound shall meet the following gradation when tested according to ASTM D1214:

| ASTM SIEVE SIZE | % PASSING |
|---|---|
| 0.850 mm | 100 |
| 0.600 mm | 80 - 100 |
| 0.300 mm | 20 - 35 |
| 0.150 mm | 0 - 8 |
| 0.075 mm | 0 – 2 |

.3 The glass bead component of the compound shall be colourless, clean, transparent, and free from milkiness and excessive air bubbles. They shall be spherical in shape, containing no more than 25% irregularly shaped particles and be the equivalent of an ASHTO Type I glass bead. The silica content of the glass spheres shall not be less than 60% as per ASTM C169 testing. The component shall be manufactured of glass of a composition designed to be highly resistance to traffic wear, decomposition, etching under atmospheric conditions, dilute acids, alkalids, paint film constitutes, and to the effect of weathering, and should be composed of recycled glass (to the maximum extent possible).

.4 The drying agent component shall be smooth and spherically shaped, amber to white in colour, and of a type that promotes accelerated coalescence of the latex polymer and as such reduces water-borne paint dry to touch time by approximately 40% minimum.

.5 The compound shall show no tendency to absorb moisture in storage and shall remain free of clusters and hard lumps. It shall flow freely from dispensing equipment at any time when applying with pavement marking.

PART 3 - EXECUTION

3.1 Equipment

.1 Paint applicator to be an approved pressure type mobile distributor capable of applying paint in single, double and dashed lines. Applicator to be capable of applying marking components uniformly, at rates specified, and to dimensions as indicted, and to have positive shut-off.

| | | | |
|---|---|---|---|
| 3.2 | Condition of Surfaces | .1 | Surface to be dry, free from ponded water, frost, ice, dust, oil, grease and other foreign materials. |
| 3.3 | Traffic Control | .1 | Traffic control to be in accordance with Section 01 55 26 – Traffic Regulation. |
| 3.4 | Application | .1 | Unless otherwise approved by *Departmental Representative*, apply paint only when air temperature is above 10°C, wind speed is less than 60 km/hr and no rain is forecast within next 4 h. |
| | | .2 | Apply traffic paint evenly at rate of 3 m/L. |
| | | .3 | Do not thin paint unless approved by *Departmental Representative*. |
| | | .4 | Symbols to conform to dimensions indicated. |
| | | .5 | Thoroughly clean distributor tanks before refilling with paint to different colour. |
| 3.5 | Tolerance | .1 | Paint markings to be within plus or minus 12 mm of dimensions indicated. |
| | | .2 | Remove incorrect markings to approval of *Departmental Representative*. |
| 3.6 | Protection of Completed Work | .1 | Protect pavement markings until dry. |