

1.0 GENERAL

- .1 The Contractor shall read and be governed by the General Provisions, Special Provisions, General Requirements, Instructions to Bidders, Addenda, Bid Form, Agreement, and the complete Specification for this project.
- .2 The complete work under this trade shall be governed by the dictates of good practice in all details of materials and methods even if not minutely specified. The work shall be properly coordinated with the requirements of other units of work specified in other sections.

1.2 Work Included

- .1 The work to be done under this item of the specification includes the supply and placing of hot mix asphalt concrete.

1.3 Submissions

- .1 The Contractor shall provide weigh scale receipts for each load to the Engineer at the time of load delivery. The Contractor shall quote using his own certified scale only with the approval of the Engineer or where indicated within the tendering documents.

1.4 Measurement for Payment

- .1 Hot mix Bituminous Surface Course pavement will be paid for at the unit price bid per tonnes for the thickness specified which shall be compensation in full for the furnishing, mixing, transporting, placing and rolling, and for all other labour and materials required to complete the work in accordance with these specifications. Tonnage will be verified by measurement made of the finished top width and length, and calculated on a unit area basis for the designated thickness specified and subject to adjustment as outlined in Clause 3.13 of this section.

A manhole or catch basin handwork is defined as the additional work for placement of asphalt adjacent to manhole and catch basins and shall be paid by the unit count in addition to the payment for asphalt surface.

2.0 PRODUCTS

2.1 Approvals

- .1 The Contractor shall submit asphalt concrete mix design based on the Marshall Method and trial mix test results to the Engineer for review at least two (2) weeks prior to commencing work and before any asphalt is used in the work. The Contractor shall provide a sieve analysis of the aggregate material for the Engineer's review. The Contractor shall pay for all costs of performing these tests.

.2 The Contractor shall supply a five point, 50 blow, Marshall method mix design on the approved aggregate for the asphaltic mix to meet the following characteristics.

.1	Marshall Stability at 60°	not less than 8,000 N
.2	Marshall Flow Index	2.0 mm to 4.0 mm
.3	Percentage Voids of Total Mix	3.5% to 5.5%
.4	Percentage Aggregate Voids Filled with Asphalt	75% to 90%
.5	Voids in Mineral Aggregate (VMA)	14.0% minimum
.6	Permissible Variation of Asphalt Cement from Job Mix	0.25%
.7	Asphalt Film Thickness (µm)	7.5 minimum
.8	The Asphalt Cement Content	5.7% minimum
.9	Anti-Stripping Agent or Lime	Stripping Potential <5%

The Marshall Stability value and Flow Index shall be tested by ASTM Designation D-1559 for Resistance to Plastic Flow of Bituminous Mixtures.

The Percentage Voids and Percentage Aggregate Voids filled with Asphalt shall be determined according to the Marshall Method of Mix Design for Hot Mix Asphalt Paving.

2.2 Gradation for Asphalt Mix

- .1 Aggregate shall consist of hard, durable, uniformly graded crushed gravel and shall not contain organic or soft materials that break up when alternately frozen and thawed or wetted and dried, nor other deleterious materials.
- .2 Aggregate shall meet the following gradation when tested to ASTM C136 and ASTM C117, and give a smooth curve without sharp breaks when plotted on semi-log grading chart.

ASPHALT AGGREGATE		
Sieve Designations (mm)	Per Cent by Dry Mass Residential Class II	
	Lower Limit	Upper Limit
16.0	100	100
12.5	78	97
9.0	66	90
5.0	50	72
2.0	32	51
0.900	21	37
0.400	16	27
0.160	7	15
0.071	4	10
Sand Equivalent	50 minimum	
% Fractured Face	60.0 minimum	
% Light Weight Pieces	1.5 maximum	

- .1 The Liquid Limit shall not exceed 25 and the Plasticity Index shall not exceed 6 for the portion of material passing the 400 sieve.
- .2 Los Angeles Abrasion: Maximum % loss by weight: 40%
- .3 Crushed Fragments: At least 60% of fragments within following size ranges to have at least 2 freshly fractured faces:
- | Passing | Retained On |
|---------|-------------|
| 20.0 mm | to 5.0 mm |
- .4 Maximum of 3.0% total deleterious matter by total mass of combined aggregate.
- .3 Should the grading of the mineral aggregates supplied to the plant not meet the gradation above, mineral filler shall be added in the weight hopper of the asphalt plant in such quantities as will be required to meet the specifications.

2.3 Mineral Filler

- .1 Mineral filler shall consist of Portland Cement, Pozzolan, commercially ground stone dust or other mineral dust approved by the Engineer. Mineral filler shall have a Plasticity Index of Zero and, when tested by means of laboratory sieves, it shall meet the following gradation.

Sieve Size (mm)	Percent Passing (by weight)
0.400	100
0.160	not less than 90
0.063	not less than 70
0.045	not less than 62

- .2 Mineral filler to be dry and free flowing when added to aggregate.

2.4 Asphaltic Binder

- .1 The asphaltic binder shall be uniform in character, shall not foam when heated to 175° C, and shall meet the following requirements:
- | | | |
|----|--|-------------|
| .1 | Designation | A/C 150/200 |
| .2 | Penetration (ASTM D5) under 100 g for 5 sec. at 25° C | 170 to 240 |
| .3 | Flash Point (ASTM D92) filled or unfilled greater than | 232° C |
| .4 | Ductility (ASTM D113) 25° C greater than 100(+) cm strain rate of cm/sec. at | |
| .5 | Solubility in CC1 ₄ (unfilled) | 99.0(+)% |
| .6 | Kinematic Viscosity in Centistokes at 135° C | 150(+) |

- .7 Thin Film Oven Test Penetration under 100 g for 5 sec. at 25° C 45(+)%

2.5 Storage of Materials

- .1 The aggregate shall be stockpiled at the mixing plant. Stockpiles shall be constructed by placing the aggregate in uniform layers over a pre-determined stockpile area in such a manner that no segregation of the various particle sizes results. The asphalt binder shall be stored in suitable tanks at a temperature not exceeding 150°C.

2.6 Mixing Plant

- .1 The mixing plant and auxiliary equipment shall be such as to combine, dry, and heat the mineral aggregate, heat the asphalt and accurately proportion the asphalt and aggregate to produce a uniform mixture. The mixing plant shall meet the requirements of A.S.T.M. Designation D995 for Bituminous Mixing Plant Requirements.

3.0 EXECUTION

3.1 Preparation of Site

- .1 Patch and correct depressions and other irregularities to approval of the Engineer before beginning paving operations. Prior to laying mix, clean surfaces of loose and foreign material and apply prime coat or tack coat in accordance with Section 02745.

3.2 Preparation of Mixture

- .1 The mineral aggregate, and mineral filler when required, shall be combined by means of hoppers and conveyors at the cold feed plant. The aggregate shall be dried and delivered at a temperature of 120°C to 160°C to the mixer. The temperature between these limits shall be regulated according to the penetration grade of the asphalt, temperature of the atmosphere and workability of the mixture. The aggregate shall be dry mixed in the mixer for not less than 15 seconds.
- .2 The asphalt cement shall be brought to temperature of 120° to 160°C before mixing with aggregate. The temperature between these limits shall be regulated to the penetration grade of the asphalt used.
- .3 The aggregate and asphalt cement shall then be mixed in the proportions as determined by the design mix. The temperature of both the aggregate and asphalt cement shall be maintained between 120°C and 150°C until mixing is completed. The time of mixing shall be not less than 30 seconds, and shall be such that a homogenous mixture is produced in which all particles of the aggregate are uniformly coated with asphalt.

.4 The bituminous mix temperature at mixer discharge shall be controlled between low temperature of 130°C and a maximum high temperature of 150°C.

.5 Mix Tolerances

.1 All mixture furnished shall conform to the job mix formula within the range of tolerance specified.

<u>Aggregate Material Passing</u>	<u>Percent by Weight</u>
5.0 mm Sieve	± 5
0.90 mm Sieve	± 3
0.071 mm Sieve	± 1.5

.2 The amount of bituminous material designated for the job mix shall be maintained within the tolerance of 0.25 percentage points.

.3 The temperature for mixing asphaltic mixtures shall not vary from those specified in the job mix formula by more than 5° C.

3.3 Transportation of Mix

.1 The mixture shall be transported from the mixing plant to the work in vehicles with tight metal boxes previously cleaned of all foreign materials. The vehicles shall be suitably insulated and each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions. The inside surface of all vehicles may be lightly lubricated with a thin oil or soap solution prior to loading, but excess lubricating will not be permitted.

.2 Any accumulation of asphaltic material which was collected in the box shall be thoroughly cleaned before loading with hot mix.

.3 Trucks shall be maintained perfectly clean of mud or any substance which could contaminate the working area.

3.4 Paver

.1 The mixture shall be laid with a mechanical self-powered spreader capable of spreading the mixture true to line, grade and crown as required. The paver shall be equipped with hopper and distributing screw of the reversing type to place the mixture evenly in front of adjustable screeds.

.2 Mechanical self-powered pavers shall be equipped with electronic screed control system capable of automatically maintaining screed elevations on each side of the paver through any combination of stringline, 9.1 m long ski-type device or joint matching shoe.

3.5 Placing

- .1 The Contractor shall remove all loose and foreign material and water prior to placing the asphaltic concrete mixture. The mixture shall be delivered at a minimum temperature of 130°C or maximum temperature of 150°C and laid in dry conditions and only when the ambient air temperature is 2°C and rising.
- .2 The mixture shall be laid and rolled to the widths and thickness shown on the drawings. The finished surface shall have the minimum number of longitudinal and horizontal joints as practicable.
- .3 The asphalt pavement shall be laid in two lifts, the second lift shall not be placed over the bottom layer within 24 hours. Before rolling is started, the surface shall be checked, inequalities in depth adjusted and fat spots or sandy accumulations replaced and irregularities in alignment or grade along the outside edge shall be corrected.
- .4 The maximum thickness of any lift shall not exceed 50 mm compacted thickness.
- .5 The Contractor will only be allowed to place bituminous mix during daylight hours. Daylight hours are from sunrise to one-half hour before sunset.
- .6 When temperature of surface on which material is to be placed falls below 10° C, provide extra rollers as necessary to obtain required compaction before cooling.
- .7 Do not place hot mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .8 In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand, if so directed by the Engineer. The material shall be distributed uniformly to avoid segregation of coarse and fine aggregates. Broadcasting of material shall not be permitted. During the spreading operation, all material shall be thoroughly loosened and uniformly distributed by lutes or rakes. Material that has formed into lumps and does not break down readily shall be rejected.

3.6 Joints

- .1 A continuous well-sealed bond is required between old and new surfaces. The contract surface of all longitudinal joints shall be painted with a thin and uniform coat of hot asphalt primer before placing the new mix, and the same treatment shall be given to contact joints with curbs, gutters, manholes and other appurtenances.
- .2 When the work is resumed after a lapse of several hours, one end shall be cut back approximately 150 mm to a new and clean surface before paving is started and heat shall be used as necessary to ensure a proper bond.

- .3 Where the asphaltic concrete material is placed in two layers; longitudinal joints in the two layers shall be staggered by a minimum of 150 mm.
- .4 Where the proposed pavement meets the existing pavement, the Contractor shall cut to a neat square edge to ensure a good seam. The cost of this cutting shall be included in the unit price bid for hot mix asphaltic concrete.

3.7 Rollers

- .1 The rollers used for compaction shall be self-propelled steel-wheeled and rubber tired rollers, weighing at least 3.6 kilograms per millimeter width of tread.
- .2 The rollers shall be in good condition without backlash when reversed and shall be operated by competent rollerman.
- .3 The wheels shall be kept properly moistened, but excess water or lubricant will not be permitted.
- .4 The rollers must be kept in continuous operation as nearly as practicable and all parts of the pavement shall receive substantially the same compaction.
- .5 The number of rollers used on the project shall be compatible with the rate the asphalt is being laid.

3.8 Rolling and Compaction

- .1 Before rolling is started, the surface shall be checked, inequalities in depth adjusted and fat spots or sandy accumulations replaced, and irregularities in alignment or grades along the outside edge shall be corrected.
- .2 At least one steel wheeled and one rubber tire roller shall be used for every 40 tonnes of asphaltic concrete laid per hour.
- .3 Rolling shall start as soon as the pavement will bear the roller without checking or undue displacement, working from the lower part or edge to the high part or edge continuously until no roller marks are left in the finished surface and no further compaction is possible.
- .4 The rollers must be kept in continuous operation as nearly as practicable and all parts of the pavement shall receive substantially the same compaction. Rolling shall be done at a maximum speed of 5 km per hour.
- .5 At all curbs, manholes and other appurtenances, and at all locations not accessible to the roller, hand tampers shall be used to produce the same density as provided by the roller.

- .6 The completed pavement shall not have a density of less than 98% of the laboratory compacted density as determined by methods described in ASTM D1559, using a compaction of 50 blows for each face.

3.9 Finish

- .1 The finished pavement shall be true to the required profile and cross-section. The allowable tolerance for finished pavement shall be ± 5 mm, and the surface shall show no depressions or bumps exceeding 3 mm under a straight-edge 3 m long placed parallel to the road centreline.
- .2 Finished surface shall have a tightly knit texture free of visible signs of poor workmanship such as, but no limited to:
 - .1 Segregation
 - .2 Areas exhibiting excess or insufficient asphalt
 - .3 Improper matching of longitudinal and transverse joints
 - .4 Roller marks, cracking, or tearing
- .3 If surface and grade tolerances are exceeded, or if surface texture is not met, repair defective areas as required by the Engineer.

3.10 Defective Work

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

3.11 Testing and Inspection

- .1 Bituminous Mixture Samples:

Samples of the bituminous mixture shall be taken from the spreader or haul truck and forwarded to an approved laboratory for testing. One such sample shall be obtained per 2,000 square metres of area surfaced except during the initial period of construction when a greater number of samples will be necessary.
- .2 The following tests shall be performed on all samples of the bituminous mixture submitted to the laboratory.
 - .1 Bitumen Content

HOT MIX ASPHALT PAVEMENT

- .2 Aggregate Gradation
- .3 On the first four samples submitted and on every third sample thereafter, the following additional tests shall be performed.
 - .1 VMA
 - .2 Per Cent Air Voids
 - .3 Marshall Stability
 - .4 Flow
 - .5 Density
- .4 One core sample shall be obtained for each one hundred lineal metres of street paved. Core sample locations should correspond to the same locations as samples gathered for Lab testing. All core samples shall be tested for bitumen content and density and measured for thickness. Every third specimen shall also be tested for aggregate gradation.
- .5 The Contractor shall repair all test holes with fresh, hot mix asphaltic concrete mixture, and thoroughly compact it to the required density with no additional compensation.

3.12 Traffic

- .1 No traffic shall be allowed on the finished surface until it has cooled to atmospheric temperature.

3.13 Failure to Meet Compaction Density and Thickness Requirement

- .1 The Owner reserves the right to reject any Hot Mix Bituminous Surface Course whatsoever which does not meet all the specified requirements for the Hot Mix Bituminous Surface Course.
- .2 The Owner may, however, at the discretion of the Engineer, accept Hot Mix Bituminous Surface Course which does not meet the specified density and thickness requirements and, in such case, payment shall be made on the basis of a percentage scale for the Hot Mix Bituminous Surface Course product by each test as follows:

- .1 Density Specified to 98% of Marshall

Compacted Density % of Marshall	Payment
98 to 100	100%
97.6 to 97.9	98%
97.0 to 97.5	96%
96.6 to 96.9	93%
96.0 to 96.5	90%
94.0 to 95.9	75%
92.0 to 93.9	50%
Less than 92%	Replace pavement – no payment for removal or replacement

.2 Thickness

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

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

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

Variation in Thickness From Design Thickness	Payment
more than specified thickness – 5 mm thin	100%
6 mm thin – 15 mm thin	X ² (100%)
more than 15 mm thin	No Payment

.3 Where more than one lift of asphalt is placed, the thickness tolerances will apply to the total asphalt layer and not to the thickness of each lift.

When asphalt concrete is measured in square meters, excess thickness will be accepted with no claim for extra payment. When asphalt concrete is measured in tonnes, asphalt concrete in excess of over thickness limit “T” will be paid at 35% of tendered unit price for that item.

.4 If any Hot Mix Bituminous Surface Course tested in accordance with this Specification fails to meet the specified density, the Contractor may request coring of the Hot Mix Bituminous Surface Course in question. When such coring is approved by the Engineer, arrangements shall be made by the Contractor, through the Engineer, to employ an independent, qualified testing service, all at the expense of the Contractor. The cores shall be taken and tested within three days of the testing of the cores representing the Hot Mix Bituminous Surface Course in question. One core shall be taken for each strength test previously taken and there shall be no doubt that the cores taken represents the area in question. Cores shall be tested in accordance with the requirements of A.S.T.M. Designation D1559 and reported by the independent testing service shall constitute a test. When more than one core strength is taken, in one area the average of all the core strength tests shall represent the strength of the Hot Mix Bituminous Surface Course in question.

3.14 Acceptance

- .1 Locations shall be cleared of all excess material resulting from the paving operation and any damage caused by the Contractor shall be repaired to the Engineer’s satisfaction within 3 days of the date of completion of the street or lane. Failure to cleanup or repair damage may result in other crews undertaking this work without notice to the Contractor and deducting the costs from money due to the Contractor.

END OF SECTION