

CITY OF WHITEHORSE SERVICING STANDARDS MANUAL
PART 3 - SPECIFICATIONS
SECTION 3.17 - HOT MIX ASPHALT

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SECTION 3.17 – HOT MIX ASPHALT

3.17.1 SCOPE

The work described in this section is that required for construction of a hot-mix asphaltic concrete surface course.

3.17.2 MATERIALS

3.17.2.1 AGGREGATES

3.17.2.1.1 APPROVAL

The Developer is to submit to the Engineer at least ten workdays before start of paving, a mix design using the Marshall Method and performed by an independent testing laboratory acceptable to the Engineer. The Developer is to submit a separate mix design for each change in the supplier or source of materials. No mixing of asphaltic concrete is to proceed until the Engineer approves the job mix formula or any subsequent changes.

Preliminary approval of the aggregate, as represented by the samples, is not to constitute general acceptance of all material in the deposits or source of supply; acceptance is to be subject to field tests taken at the discretion of the Consultant. Materials may be considered unsuitable even though particle sizes are within the limits of the gradation sizes required if particle shapes are thin or elongated or any other characteristic precludes satisfactory compaction, or if the material fails to provide a pavement suitable for traffic. The Engineer will determine the acceptability of the final material.

Aggregate is to consist of hard, durable, uniformly graded, crushed gravel, and is not to contain organic or soft materials that break up when alternately frozen and thawed, or wetted and dried, or other deleterious materials.

3.17.2.1.2 GRADATION

Coarse aggregate is aggregate retained on the 5.000 mm sieve. Fine aggregate is aggregate passing the 5.000 mm sieve. Fine aggregate is to contain manufactured or crushed fines at a percentage by mass of fine aggregate of minimum 70%. Aggregate is to be hard, clean and durable, free from coatings of silt, clay or other deleterious materials, and is to contain no organic matter.

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The combined aggregates are to meet the following gradation requirements when tested to ASTM C136 and C117.

| SIEVE SIZE (mm) | PASSING BY MASS (%) |
|-----------------|---------------------|
| 12.500 | 100 |
| 5.000 | 55-75 |
| 2.000 | 35-55 |
| 0.400 | 15-30 |
| 0.160 | 5-16 |
| 0.080 | 3- 8 |

Additional properties that are to be met are as follows:

| | |
|--|---|
| Liquid Limit | Maximum 25, ASTM D423-66 |
| Plasticity Index | Maximum 6, ASTM D424-59 |
| Los Angeles Abrasion Gradation "B" | 35% maximum loss by mass, ASTM C131- 76 |
| Sand Equivalent | Minimum of 35% ASTM D2419-74 |
| Magnesium Sulphate Soundness - Coarse Aggregate | Maximum 12% |
| - Fine Aggregate | Maximum 16%, ASTM C88-77 |
| Absorption of Coarse Aggregate | Maximum 1.75%, ASTM C127-77 |
| Lightweight Particles(Specific gravity less than 1.95) | Maximum 3% by mass, ASTM C123-69 (1975) |
| Flat Particles | Length to thickness ratio greater than 5, maximum of 15% by mass |
| Loss by Washing | 1.5% maximum passing the 0.08 sieve, ASTM C117-80 |
| Crushed Fragments | 60% minimum material retained on the 5.000 mm with 1 crushed face |

A minimum of 70% of material retained on the 5.000 mm sieve are to have at least two crushed faces.

Aggregate is to be hard, clean, durable, and free from clay and coatings of silt, clay, or other deleterious materials, and is to contain no organic matter.

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When coarse aggregate grading is such that the material will tend to segregate in stockpiling or handling, such aggregate is to be supplied in two or more sizes. Each size of coarse aggregate required to produce the combined gradation specified above is to be placed in individual stockpiles satisfactory to the Consultant. When it is necessary to blend two or more coarse aggregates before placing them in the cold bins, the blending is to be done through separate bins at the cold elevator feeders, and not in the stockpile.

When it is necessary to blend fine aggregates from one or more sources to produce the combined gradation specified, each source or size of fine aggregate is to be placed in individual stockpiles at the plant site, and separated by bulkheads or other means satisfactory to the Consultant. The blending is to be done through separate bins at the cold elevator feeders and not in the stockpile.

If the Developer elects to use an approved drier-drum asphalt mixing process, the designated aggregates are to be split on the 5.000 mm sieve, and each material is to be stockpiled separately so that intermixing of each size and type does not occur.

The coarse aggregate stockpile is to contain no more than 20% passing the 5.000 mm sieve, and the fine aggregate stockpile is to contain no more than 20% retained on the 5.000 mm sieve. At least 2,000 tonnes of aggregate is to be placed in each stockpile prior to the start of mixing operations.

The Developer, during the crushing and splitting process, is to provide a convenient means for accurately and representatively:

- Sampling the individual coarse and fine aggregate streams, and the combined aggregate stream in its proper proportion;
- Sampling the individual coarse and fine aggregate streams and weighing the total amounts of both coarse and fine materials being produced.

3.17.2.1.3 MINERAL FILLER

Mineral filler is to be added in the mixing plant if the aggregate gradation is such that its addition is necessary to meet the above specifications. Mineral filler is to consist of Portland Cement, pozzolan, commercially ground stone dust or other mineral dust approved by the Consultant. Mineral filler is to have a plasticity index of zero and is to meet the following gradation requirements:

| SIEVE NO. (mm) | PASSING BY MASS (%) |
|-----------------------|----------------------------|
| 0.400 | 100 |
| 0.160 | 90 - 100 |
| 0.080 | 70-100 |
| 0.045 | 62 - 100 |

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3.17.2.2 ASPHALT CEMENT

The asphalt cement is to be uniform in character, free of water and is to not foam when heated to 175 degrees Celsius. It is to meet the following specifications:

| | |
|----------------------------------|--|
| Viscosity | 500+ poises, 60 degrees Celsius at 30 cm vacuum, ASTM D2171 |
| Penetration | 150A-200A, 100g in 5.0 sec. At 25 degrees Celsius, ASTM D5 |
| Flash point | 205+ degrees Celsius, ASTM D92 |
| Thin film over test | ASTM D1754 |
| Penetration | 40+% of original, 100 g in 5 sec. At 25 degrees Celsius, ASTM D5 |
| Ductility | 100+ at 25 degrees Celsius, ASTM D113 |
| Solubility in trichloro-ethylene | 99.5% ASTM D2042 |

3.17.2.3 STORAGE

No stacking conveyor is to be used to stockpile aggregate for a continuous mix or drum plant. Reference to continuous mix plant in Section 3.17.4.0 is also to include drum plant.

The aggregate is to be stockpiled at the mixing plant in such a manner that no segregation of the various particle sizes is produced. The asphalt binder is to be stored in suitable tanks at a temperature not exceeding 150°C.

3.17.3 DESIGN MIX

A qualified testing laboratory is to be employed to prepare a mix design and job mix formula for the aggregate on which the tender is based. The mix design and job mix formula is to be submitted to the Engineer for approval a minimum of ten days prior to paving. No paving is to commence before the Engineer's approval is given for the mix design or job mix formula.

The laboratory mix design is to be based on the Marshall Method. Absorption of asphalt into the aggregate is to be taken into account using the ASTM bulk specific gravity of the aggregate in calculating optimum asphalt content.

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The mix design is to meet the following specifications:

| | RANGE |
|---|---------------|
| Max size of aggregate (mm) | 12.5 |
| Number of compaction blow each end of specimen | 50 |
| Stability (kN) at 60 degrees Celsius | 4.5 |
| Minimum Retained Stability (%) | 75 |
| Flow (0.254 mm unit) | 8-16 |
| % Voids total mix | 4.0 ± 1.0 |
| % Aggregate voids filled with asphalt | 73-85 |
| Minimum film thickness ² (μm) | 7.0 |

The job mix formula is to be posted in a conspicuous place within sight of the plant operator. The Engineer must approve any subsequent changes in writing. The job mix formula is to list the following information:

1. Batch Plants:

- The sieve analysis of the combined aggregate in the mix
- The aggregate size range in each bin separation to be used
- The weight of the material to be used from each bin for 1 batch of mix
- The weight of asphalt to be used in each batch
- The mixing from the temperature
- Viscosity relationship for the asphalt

2. Continuous Mix Plants:

- The weight of asphalt per tonne of mix
- The mixing temperature of the asphalt mix as determined from the temperature-viscosity relationship for the asphalt
- The setting of the feed systems

Proportions for a continuous-feed mixing plant is to be determined based on a field trial, which is to be carried out at least 48 hours prior to placing the mix on the job site.

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The volumetric settings of the aggregate and asphalt are to be determined by the Contractor and approved by the Consultant. These settings are to be interlocked, so that a change in the volume of aggregate automatically results in a corresponding change in the volume of asphalt.

The mix produced is to conform to the job mix formula approved by the Engineer and to the following tolerances:

- The weight of aggregate from any bin, as well as the total weight of aggregate for each bin, is not to vary from the job mix formula by more than:

| SIEVE SIZE (mm) | VARIATION BY MASS (%) |
|------------------------|------------------------------|
| 10.000 and larger | +/-7 |
| 5.000 to 10.000 | +/-5 |
| 2.000 to 0.160 | +/-4 |
| 0.063 | +/-2 |

- The percent of asphalt in the mix is not to vary by more than 0.3% from the percentage indicated in the approved mix design.
- The mixing temperature for asphaltic materials is not to vary from those specified in the job mix formula by more than nine degree Celsius. In no case is the mixing temperature to exceed the maximum mix temperature indicated from the asphalt temperature-viscosity curve data.

The Engineer is to have the ability to request that a trial batch be produced and be tested the first time the asphalt mix design is being used for the season or at any time it is found that the actual asphalt mix is deviating from the mix design.

3.17.3.1 ASPHALTIC BINDER DATA

Temperature-viscosity data or curves, as obtained from the refineries, for the various grades and types of asphaltic material are to be used is to be made available to the Engineer.

3.17.3.2 TEST DATA

The Developer is to submit all test data performed by the accredited testing company to the Engineer within 72 hours of receiving results.

3.17.3.3 CHANGES

The Developer is to notify the Consultant of all proposed changes in the mix proportions. No changes are to be made until a representative of the Consultant is there to witness the change.

3.17.4 MIXING PLANT

The paving plant is to be of a type capable of consistently meeting or exceeding all of the requirements of these specifications.

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3.17.5 TRANSPORTATION

The mixture is to be transported from the mixing plant to the work in vehicles with tight metal bottoms previously cleaned of all foreign materials. The vehicle is to be suitably insulated, and each load is to be covered with canvas or other suitable material of sufficient size to protect it from weather conditions.

The inside surface of the box may be lubricated with a light coating of soap or detergent solution; petroleum derivatives are to not be permitted. Any accumulation of asphaltic material, which has collected in the box, is to be thoroughly cleaned before loading with hot mix. Trucks are to be clean of mud or any substance, which could contaminate the working area.

3.17.6 PLACING

Unless otherwise permitted by the Engineer, a mechanical self-powered paver is to spread the mixture. The paver is to have an automatic levelling device and automatic grade control capable of spreading the mix without segregation or tearing, in thickness varying from 12 mm to 150 mm and in widths greater than 3.0 m and to true line, grade and cross-section as shown on the plans.

The mixture is to be laid at a temperature not lower than 120 degrees Celsius or higher than 140 degrees Celsius. The atmospheric air temperature is not to be less than 2 degrees Celsius and rising, no frost is to be present and the road surface is to be dry.

Where the asphaltic surface course is to be placed in two lifts, the first lift is to be placed, finished and compacted for the full width as shown on the drawings, prior to commencing on the second lift. The maximum lift thickness is 75 mm.

In placing the second lift, the individual mixture spreads are to be aligned in a manner such that the longitudinal joints in each layer will not coincide.

In narrow areas, deep or irregular sections, intersections, turnouts, or driveways, where it is impractical to spread with a paver, the Developer may use hand methods as directed by the Consultant.

3.17.6.1 WEATHER LIMITATIONS

The mixture is not to be placed:

- when there is water present on the surface;
- during periods of rain or when there is an imminent danger of rain;
- during excessive winds;
- when there is frost present on the surface; or
- when air temperature is 2 degrees Celsius or cooler.

3.17.6.2 BASE PREPARATION

Where tack coat or prime coat is applied, it is to be thoroughly cured prior to placing the mixture. The Developer is to remove all loose and foreign material and water. Where existing pavements are to be overlaid, a levelling course of hot mix asphaltic concrete may be required prior to placing the surface course.

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Unless otherwise approved by the Engineer, this course is to be laid with a paving spreader and is to meet all the requirements of this section.

3.17.6.3 SURFACE REQUIREMENTS

Prior to the addition of material to any mat, the surface is to be broken with the tines of a rake to ensure proper bonding. Edges against which additional pavement is to be placed are to be straight and approximately vertical. A lute rake is to be used immediately behind the paver, when required, to obtain a true line and vertical face.

3.17.6.4 HAND SPREADING

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 Consultant. The material is to be distributed uniformly to avoid segregation of the coarse and fine aggregates. Broadcasting of material is not to be permitted. During the spreading operation, all material is to be thoroughly loosened and uniformly distributed by a lute rake. Material that has formed into lumps and does not break down readily is to be rejected.

3.17.6.5 ROLLING

The rollers used for compaction are to be self-propelled steel-wheeled or rubber-tired rollers, providing at least 35 Newtons per millimeter width of tread. The roller is to be in good condition, without backlash when reversed, and is to be operated by a competent rollerman. The wheels are to be kept properly moistened, but excess water or oil will not be permitted. The rollers must be kept in continuous operation as nearly as practicable, and all parts of the pavement are to receive substantially the same compaction. Rolling is to be done at a maximum speed of 5 km per hour.

At least one self-propelled steel-wheeled roller is to be used for every 40 tonnes of asphaltic concrete laid per hour. Rolling is to start as soon as the pavement will bear the roller without checking or undue displacement, working from the low 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. Where width permits, the pavement is to be rolled diagonally in two directions. At all curbs, manholes and other appurtenances, and at all locations not accessible to the rollers, hand tampers are to be used to produce the same density as provided by the roller. Where the asphaltic concrete is laid in more than one lift, each lift is to be so compacted.

3.17.6.6 PROTECTION OF APPURTENANCES

The Developer is to protect all exposed appurtenances with a suitable cover to prevent the bonding of asphalt to the surface. This includes valve boxes, manholes, and concrete curbs. The Developer is to consider exposed valve boxes and manhole covers to protect them from roller damage while compacting the first layer of asphalt.

3.17.7 JOINTS

The mixture is to be laid so that all longitudinal joints are made while the first mat is still hot. A narrow strip along the edge of a mat, which is joined with another asphalt mat, is to be left without rolling until the

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adjoining mat has been placed against it. The joint, which is formed, is to be rolled immediately after the adjacent mat has been placed to ensure a bonding of the material while the asphalt is still hot.

Transverse joints are to be carefully constructed and thoroughly compacted to provide a smooth-riding surface. Joints are to be straight-edged to assure smoothness and true alignment and are to be offset at least one meter from joints of adjacent mats.

In order to ensure that the surface does not become cooled prior to laying the adjacent mat, the spreader not to advance beyond the limits shown in the table below unless directed by the Engineer i.e. on collector or arterial roads:

| Air Temperature Degrees Celsius | Maximum Length of Advancement (m) |
|--|--|
| Above 27 | 250 |
| 15-27 | 190 |
| 7-15 | 125 |
| Below 7 | 90 |

When the air temperature is below seven degrees Celsius, an infrared generator is to be used in front of the spreader in order to heat the abutting joint.

The Contractor is to saw cut and tack all joints that are not attached on the same paving day. Payment for this work is to be included in the applicable unit item and no additional payment will be made elsewhere.

All concrete or metal structures such as gutters, manholes, etc. are to be painted with an approved bituminous material prior to placing the asphalt.

3.17.8 CLEANUP

Locations are to be cleared of all excess material resulting from the paving operation, including if directed by the Engineer, flushing of sanitary and storm mains to remove debris. Flushed debris is to be collected in manholes and removed from the site. Any damage to the Engineer's or private property caused by the Developer is to be repaired to the Engineer's satisfaction within 3 days of the date of completion of the street or lane. Failure to clean up may result in other crews undertaking this work without notice to the Developer and at the Developer's expense.

3.17.9 TOLERANCE AND PENALTIES

3.17.9.1 THICKNESS

The pavement is to have the thickness specified on the Consultant's drawings. Areas suspected to be deficient are to be cored, as directed by the Engineer, based on one core for every 1000 square meters of pavement. At least one core is to be taken at the designated Marshall location.

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Should the asphalt be found to be deficient in thickness the Developer will be permitted to take two additional asphalt cores in an effort to limit the amount of the asphalt penalty.

The Contractor is to advise the City of their intention to re-core at the time of submission of initial test results to the Engineer. Re-coring is to take place a maximum of 4 weeks from receipt of notification to re-core after which re-core test results will not be considered in the penalty calculation.

The location of the two additional cores are to be located within the same asphalt mat as the original deficient core and are to be located no more than half way between the deficient core and the next adjacent core or contract boundary. Within these two parameters, the exact core locations are to be determined by the Developer and approved by the Engineer.

A deficiency penalty is to be assessed according to the following:

| Asphalt Thickness | Tolerance Deficiencies | Deficiency Penalty |
|--------------------------|-------------------------------|---------------------------|
| 50 mm | 47 to 35 mm | $[C - [A^2/B^2] * C] * Q$ |
| 50 mm | Under 35 mm | Replacement by Contractor |
| 75 mm | 71 to 53 mm | $[C - [A^2/B^2] * C] * Q$ |
| 75 mm | Under 53 mm | Replacement by Contractor |
| 100 mm | 95 to 70 mm | $[C - [A^2/B^2] * C] * Q$ |
| 100 mm | Under 70 mm | Replacement by Contractor |

- Where:
- A = Average core thickness
 - B = Specified core thickness
 - C = Contract unit price
 - Q = Quantity of deficient HMAC

For any cores of a thickness greater than specified, the specified thickness is to be used for the purpose of all calculations and averages.

No additional payment will be made to the Developer for thickness greater than specified.

The Developer is to fill all core holes within a maximum period of 24 hours.

3.17.9.2 DENSITIES

Densities are to be based on core samples, each of which are to represent approximately 1000 square meters per constructed lift. Asphalt densities are specified as 98% of the standard laboratory Marshall. A minimum of one Marshall per day is to be performed with one core sample taken at a designated Marshall location.

If any core fails to meet the density specified, two additional cores are to be taken within one meter of the first core sample, and the average density of the three cores are to represent the area.

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Re-coring is to take place a maximum of 4 weeks from submission of the initial test results, after which re-core test results will not be considered in the penalty calculation.

No additional rolling, to achieve a more favorable density, is to be allowed, WITHOUT the WRITTEN CONSENT OF THE ENGINEER.

If the densities are less than specified, a deficiency penalty is to be assessed according to the following:

$$\text{Deficiency Penalty} = [-0.041[X-98]^2] \text{U.P.}] * Q$$

Where : U.P. = Unit Price

 X = Actual Asphalt Density (%)

 Q = Quantity

All asphalt below 95% standard Marshall Density is to be removed and replaced at the Contractor's expense. The Developer is to fill all core holes within a maximum period of 72 hours.

3.17.9.3 SMOOTHNESS

The surface of the compacted pavement is to be true to the required grade and cross-section with a smooth riding quality acceptable to the Engineer.

In addition to the above, when checked with a 3.0-meter straightedge, held in successive positions parallel or perpendicular to the centerline and in contact with the surface, the pavement surface is not to deviate from the straightedge by more than 3 mm.

If, in the opinion of the Engineer and Consultant, an objectionable riding surface exists, the Developer is to either grind and resurface with asphalt overlay or remove and replace the asphalt surface.

3.17.9.4 TEXTURE

The completed pavement is to have a tightly knit texture and is to be free from segregation and surface cracking. The Consultant is to redesign Mixes that are excessively tender or difficult to roll. The new design is to meet all of the requirements of this section, and is to be submitted to the Engineer for approval at least three working days prior to its use.

3.17.9.5 TRAFFIC

Traffic is not to be allowed on the finished surface until it has cooled to atmospheric temperature.