

ITEM 461.1
ITEM 461.2

POROUS ASPHALT – BASE COURSE
POROUS ASPHALT – SURFACE COURSE

TON
TON

GENERAL

Work under this Section shall consist of providing porous asphalt paving, as indicated on the Plans and as specified herein including:

1. Furnishing porous asphalt pavement composed of mineral aggregate, asphalt binder material, stabilizing additives and anti-strip additive (if required), mixed in a central mixing plant and placed on a prepared drainage course in accordance with these Specifications and in conformance to the lines, grades, thicknesses and specified cross sections as shown on the Plans or as directed by the Engineer and recorded in a daily field report.
2. Saw cutting and removal of existing/adjacent pavements.
3. Installation of porous asphalt pavement, including surface preparation.
4. Protection of the permeable pavement system installation during and after construction (including protection from vehicular loading and sediment and/or debris deposition).

SUBMITTALS

No porous asphalt pavement shall be produced until a Job Mix Formula (JMF) has been submitted by the Contractor in writing at least 30 days prior to the start of paving operations. Paving shall not begin until the JMF has been reviewed and approved by the Engineer.

The JMF shall provide the minimum criteria listed below:

1. Percent of aggregate passing each sieve size; percentage to be used of each portion of aggregate.
2. Percent of the Performance Graded Asphalt Binder (PGAB) in the porous asphalt.
3. PGAB certified test results and a material certificate for compliance with AASHTO M 320.
4. Penetration Grade (PG), including source, location and any type of modification, if applicable.
5. Mixing temperature (290°F to 350°F or as per PGAB supplier). Required compaction temperature.
6. Percent anti-stripping additive if required by Tensile Strength Ratio (TSR) testing.

7. Percent polymer additive (Styrene Butadiene Rubber (SBR) or Styrene Butadiene Styrene (SBS)).
8. Percent and size of fibers added.
9. At the time of JMF submittal, the Contractor shall identify and make available the stockpiles of all proposed aggregates at the plant site. A minimum stockpile size of 150 tons for stone stockpiles and 75 tons for sand stockpiles will be required in order for the Engineer to obtain a representative sample.

Material Submissions:

Submit a list of materials proposed for work under this Section including the name and address of the material producers and the locations from which the materials are to be obtained.

Submit certificates, signed by the material producers and the relevant subcontractors, stating that materials meet or exceed the specified requirements for review and approval by the Engineer. See Table 1 below.

Submit samples of materials for review and approval if requested by the Engineer.

Table 1 - Material Submittal Requirements

<u>Material</u>	<u>Properties on Certificate</u>
PGAB	AASHTO M 320 PGAB Certification
Coarse Aggregate	Gradation (AASHTO T 11 / ASTM C117), Los Angeles Wear (AASHTO T 96 / ASTM C131), Micro-Deval (AASHTO T 327), Coarse Aggregate Angularity (AASHTO TP 61 / ASTM D5821)
Fine Aggregate	Flat and Elongated Particles (ASTM D4791 5:1), Gradation (AASHTO T 11 / ASTM C117), Fine Aggregate Angularity (AASHTO T 304 / ASTM C1252-A), Sand Equivalent (AASHTO T 176 / ASTM D2419), Plasticity Index (AASHTO T 90)
Mineral Filler (optional)	Manufacturer's Cert.
Hydrated Lime (required)	Manufacturer's Cert.
Fibers (required)	Manufacturer's Cert.
SBS/SBR	Manufacturer's Cert.

Additive

Anti-stripping Additive Manufacturer's Cert.

Coordination

The Contractor shall coordinate paving with all other work, with specific focus on underground utility protection/re-location/construction, to prevent damage or covering up unfinished or uninspected work and loss of time or labor by improper scheduling. Any rework required due to insufficient coordination shall be done at no cost to the City.

Pavement within public right-of-way

The construction of all pavements within public rights-of-way shall be in accordance with the rules, regulations, and requirements of the City of Boston.

MATERIALS

Porous Asphalt Pavement

Porous Asphalt for porous paving shall be placed in two lifts with one (1) base course and one (1) surface course, with an asphalt binder content of 6.0% to 6.5% by weight of dry aggregate. If more absorptive aggregates are used in the mix, then the amount of binder is to be based on the testing procedures outlined in the National Asphalt Pavement Association's Information Series 131 – "Porous Asphalt Pavements" (2003). Draindown of the binder shall be no greater than 0.3% in accordance with ASTM D6390.

Hydrated lime shall be added at a dosage rate of 1.0% by weight of dry aggregate to mixes containing granite. Hydrated lime shall meet the requirements of ASTM C977 – "Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization". The hydrated lime must be able to prevent the separation of the asphalt binder from the aggregate and achieve a required tensile strength ratio (TSR) of at least 80% when tested in accordance with AASHTO T 283 – "Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture- Induced Damage". The mix shall also be tested for its resistance to stripping by water in accordance with ASTM D1664 – "Test Method for Coating and Stripping of Bitumen- Aggregate Mixtures". If the estimated coating area is not above 95 percent or the TSR falls below 80%, additional anti-stripping additives will be required.

Asphalt Binder:

The performance graded asphalt binder (PGAB) shall be in accordance with State or Municipal standards (i.e., PG 64-22 or PG 64-28 depending upon location within the northeast - PG 64-28 northerly and PG 64-22 southerly.) Blending of PGAB from different suppliers is strictly prohibited.

A test report from the batch plant representing the first hour of production shall be submitted to the Engineer.

Coarse Aggregate:

Coarse aggregate shall be that part of the aggregate retained on the No. 4 sieve; it shall consist of clean, tough, durable fragments of crushed stone, or crushed gravel of uniform quality throughout. Coarse aggregate shall have a percentage of wear as determined by Los Angeles Wear (AASHTO T 96) of not more than 40 percent or by Micro-Deval (AASHTO T 327) not more than 18 percent. In the mixture, at least 75 percent, by weight of the material coarser than the No. 4 sieve, shall have at least two fractured faces, and 90 percent shall have one or more fractured faces (ASTM D5821). Coarse aggregate shall be free from clay balls, organic matter, deleterious substances, and not more than 8.0% of flat or elongated pieces (>3:1) as specified in ASTM D4791.

Fine Aggregate:

Fine Aggregate shall be that part of the aggregate mixture passing the No. 4 sieve and shall consist of sand, screenings, or a combination thereof with uniform quality. Fine aggregate shall consist of durable particles, free from injurious foreign matter. Screenings shall be of the same or similar materials as specified for coarse aggregate. The plasticity index (AASHTO T 90) of that part of the fine aggregate passing the No. 40 sieve shall be not more than 6. The angularity of the fine aggregate shall be measured with the fine aggregate angularity test (AASHTO TP 56, Method A) and shall be 45 or higher. The Sand Equivalent (AASHTO T 176) shall be a minimum of 50.

Tack Coat (Vertical Surfaces Only):

Emulsified asphalt: AASHTO M 140/ASTM D977 or AASHTO M 208/ASTM D2397, RS-1 or CRS-1; CSS-1, CSS-1h, SS-1, SS-1h.

No tack coat shall be applied on any part of the permeable pavement horizontal surface. Tack coat will be paid for under Item 463.5, Bituminous Tack Coat.

Anti-stripping Additive:

The mix shall be tested for moisture susceptibility and asphalt stripping from the aggregate by AASHTO T 283. If the retained tensile strength ratio (TSR) is less than 80% upon testing, a heat-stable additive shall be furnished to improve the anti-stripping properties of the asphalt binder. Test with one freeze-thaw cycle (rather than five recommended in NAPA IS 115). The amount and type of additive (e.g., fatty amines or additional hydrated lime) to be used shall be based on the manufacturer's recommendations, the mix design test results, and shall be approved by the Engineer.

Fibers:

Fibers are required, either mineral or cellulose. The dosage rate for mineral fibers shall be approximately 0.4 percent by total mixture weight and sufficient to prevent draindown. The dosage rate for cellulose fibers shall be approximately 0.3 percent by total mixture weight and sufficient to prevent draindown. Cellulose fibers shall conform to AASHTO MP 8-02.

Additional fibers may be necessary consistent with NAPA IS 115 recommendations if the draindown requirement cannot be met (<0.3% via ASTM D6390 – “Standard Test Method for Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures”) provided that the air void content requirement is met (>18%).

Mineral fibers shall conform to the following properties:

Sieve Analysis:

- Fiber Length (determined according to the Bauer McNett fractionation): 0.25 inches and reported as the maximum mean test value.
- Thickness (determined by measuring >200 fibers in a phase contrast microscope): 0.0002 inches and reported as the maximum mean test value.
- Shot Content (determined as a measure of non-fibrous material on vibrating sieves) (Two sieves, No. 60 and the No. 230 are typically utilized. ASTM C612):
No. 60 Sieve: 90 +/- % Passing
No. 230 Sieve: 70 +/- % Passing

Mineral Filler:

Mineral filler shall consist of finely divided mineral matter such as rock or limestone dust or other suitable material. At the time of use it shall be sufficiently dry to flow freely and essentially free from agglomerations. Filler shall be free from organic impurities and have a plastic index not greater than 4 as determined using AASHTO T 90. Filler material for the mix shall meet AASHTO M 17, except that the gradation requirements of AASHTO M 17 shall not apply.

Porous Asphalt Mix

Porous Asphalt Mix Composition and Design: The Contractor shall submit a mix design at least 30 days prior to the beginning of production. The Contractor shall make available samples of coarse aggregate, fine aggregate, mineral filler, fibers, and a sample of the PGAB that will be used in the design of the mixture. A certified test report of the PGAB will be submitted with the mix design. The test results shall be certified by a laboratory meeting the requirements of AASHTO R 18. The Laboratory will be certified by the state DOT, a regional equivalent agency (e.g., NorthEast Transportation Technician Certification Program (NETTCP)), and/or be qualified under ASTM D3666. Technicians will be certified/qualified by the regional equivalent agency (e.g., NETTCP) in the discipline of HMA Plant Technician.

Selection of the design gradation should entail blending selected aggregate stockpiles to produce three trial blends. For each trial gradation, compact specimens between 6.0% and 6.5% asphalt binder using 50 gyrations of a Superpave gyratory compactor. Subsequently, determine air void contents from the bulk specific gravity of the compacted specimens and the theoretical maximum specific gravity of the loose mixture. Bulk specific gravity shall be calculated using ASTM D6752 (automatic vacuum sealing, e.g., Corelok).

Conduct the Cantabro Abrasion Test on unaged and aged compacted samples. (ASTM

C131).

The optimum asphalt binder content is selected when the mixture meets the criteria for Air Voids, Abrasion Loss on Unaged Specimens, Abrasion Loss on Aged Specimens and Draindown. See Table 2 below.

Table 2 – Porous Asphalt Mix Design Criteria

<u>Sieve Size (Inch/mm)</u>	<u>Percent Passing</u>
0.75/19.0	100
0.50/12.5	85-100
0.37/9.5	55-75
No. 4/4.75	10-25
No. 8/2.36	5-10
No. 200/0.075	2-4

<u>Test Criteria</u>	<u>Specification</u>
PGAB, Percent	6.0-6.5%
Temperature of Mix (°F)	265 – 325°F
Mixture Coating (AASHTO T 195)	Min. 95%
Fiber Content by total mix weight	0.3% cellulose
Rubber Solids by weight of binder	1.5% to 3% or TBD
Air Void Content	18% – 22%
Draindown (ASTM D6390)	< 0.3%
Retained Tensile Strength*	> 80%
Cantabro Abrasion Test on unaged samples	< 20%
Cantabro Abrasion Test on 7-day aged samples	< 30%

**Note: if the RTS value falls below 80% when tested by AASHTO T 283 as modified by NAPA IS 131 (with a single freeze thaw cycle rather than 5), then the Contractor shall employ an anti-strip additive in the mixture design process to raise the RTS value above 80%.*

Changes to the Mix: No change in the job-mix formula (JMF) may be made without written approval of the Engineer. The JMF must fall within the master range specified in the mix design criteria. Should there be a change in the sources of materials, a new JMF must be developed and approved before the new material is used.

The Engineer may order a change in any part of the job-mix formula if placement, finishing, or compaction characteristics are determined by the Engineer to be unsatisfactory.

EXECUTION

General:

The Contractor shall install subbase, base and porous pavement system components including associated drainage appurtenances in conformance with the Plans and Specifications.

Equipment shall be in good operating condition and breakdowns shall be corrected immediately so as not to delay paving operations.

Protection of Existing Infrastructure:

1. Protect adjacent infrastructure/work from splashing of paving materials. Remove stains from adjacent exposed surfaces including paving, structures, and grounds. Remove waste and spillage completely.
2. Do not damage or disturb existing infrastructure, property, or vegetation. Provide suitable protection where required before starting work and maintain protection throughout the course of the work.
3. Restore damaged infrastructure, property, improvements, including existing paving on or adjacent to the site that has been damaged as a result of construction work.

The City and Engineer shall be notified at least 48 hours prior to porous paving work.

Check frames, covers, grates, water valve boxes and other miscellaneous castings that are located in the proposed pavement areas to ensure that they have been correctly positioned and set to the proper slope and elevation a minimum of 24 hours prior to paving.

Preparation:

Subgrade Preparation:

1. Existing subgrade under porous pavement areas shall NOT be compacted or subject to excessive construction equipment traffic prior to subbase placement. The infiltration rate of the uncompacted subgrade material shall be no less than 5-30 ft/day or 50% of the hydraulic conductivity (per ASTM D2434) at 95% standard proctor compaction.
2. If accumulation of fine materials and/or surface ponding occurs, this material shall be removed in a manner that does not cause further compaction to the underlying soils. The soils must subsequently be scarified to a minimum depth of 6 inches (or as directed by the Engineer) with the appropriate scarification equipment.
3. Bring subgrade to line, grade, and elevations indicated in Plans and Specifications. Fill and lightly re-grade any areas damaged by erosion or ponding before the placing of stone. Subgrade should be generally level unless otherwise indicated.

Subbase and Base Installation:

1. The completed subgrade work shall be inspected by the Engineer prior to Contractor proceeding with subbase and base installation.

2. Geotextiles and geomembranes as required shall be placed according to Specifications and Plans.
3. Subbase and base aggregate shall be placed immediately after approval of subgrade preparation. Install Reservoir Course in 6-inch maximum lifts. Compact each layer with a 60 kN plate compactor machine (or other approved equipment) with a compaction indicator until no visible movement of the stone, keeping equipment movement on Reservoir Course to a minimum. Install Reservoir Course as indicated on Plans and Specifications.
4. Install Choker Course in 6-inch maximum lifts over the surface of Reservoir Course. Notify Engineer for inspection prior to porous asphalt paving. Compact each layer with a 60 kN plate compactor machine (or other approved equipment) with a compaction indicator until no visible movement of the stone, keeping equipment movement on Choker Course to a minimum. Install Choker Course as indicated on Plans and Specifications.

Application:

Tack Coat: No tack coat or other asphalt sealant shall be applied between layers of the porous asphalt pavement system. An emulsified asphalt tack coat shall be applied to vertical contact surfaces of all cement concrete and other surfaces abutting or projecting into the permeable pavement system.

All vertical surfaces of structures and existing concrete surfaces in contact with new the porous asphalt pavement system shall be painted with a uniform coating of an approved tack coat material. Take extreme care in the application of this material to prevent splattering or staining of surfaces that will be exposed after the paving is completed. Surfaces that are stained as a result of the Contractor's operation shall be repaired or replaced by the Contractor at no additional cost to the City.

The vertical applications of tack coat shall be allowed adequate time to cure prior to receiving paving.

Weather Limitations: Construct pavement when atmospheric temperature is above 55°F, the ground temperature is above 55°F and there is not any film of water (free standing water) on the base to be paved. The pavement shall not be installed on wet aggregate or treated bases when atmospheric temperature is less than 55°F. The atmospheric and base temperature requirements may only be modified at the discretion of the Engineer. The Contractor shall not pave on days when rain is forecast for the day, unless change in the weather results in favorable conditions as determined by the Engineer.

Porous Asphalt Pavement Production and Placement:

Production:

1. Asphalt Binder Material: The Contractor shall maintain documentation in the form of a Materials Certificate of each shipment. Material shall conform to the specification requirements for the applicable performance grade as specified

herein.

2. **Mixing Plants:** Mixing plants shall be in conformance with NAPA IS 131 and applicable sections of the Massachusetts Department of Transportation Specifications and Boston Public Works Department (PWD) Special Provisions (latest edition) for the Plant requirements in regard to asphalt mixtures. The use of surge bins shall not be permitted.
3. **Silo/Truck Storage:** The plant produced porous mixture shall be retained in a silo or truck bed for no more than ± 2 hours unless otherwise approved by the Engineer. Any excessive draindown observed due to the extended storage will be rejected by the Engineer and all costs associated will be the responsibility of the Contractor.
4. **Contractor Quality Control (QC) During Production:** The Contractor shall provide at the Contractor's expense a Quality Control Plan meeting the approval of the Engineer. The QC Plan shall include material inspection, staking and layout control, testing and inspection of site grading and pavement work, documentation, communication to the Engineer, and all test reports signed by the Quality Control Plan Administrator. This material should be provided sequentially as accepted and maintained in a QC binder at the plant.

The QC Plan shall detail the process control and documentation of mix production and placement by certified/qualified (e.g., NETTCP or equal) technicians/inspectors. All mix testing results during production shall be submitted to the Engineer within 24 hours. The QC Plan may be altered at the discretion of the Engineer and based on feasible testing as suggested in the Plan. Certain QC test requirements during production may not be feasible for small projects in which limited mix is generated. This feasibility should be assessed with the Engineer and the producer. The Contractor shall sample, test, inspect and evaluate the mix in accordance with the methods and minimum frequencies shown in Table 3 and the maintain mixture production with the allowable Production and Suspension Limits shown in Table 4.

Table 3 – QC Testing Frequencies

<u>Test</u>	<u>Min. Frequency</u>	<u>Test Method</u>
Temp. of Mix in Truck at Plant	6 times per day	Stem Style Thermometer
Gradation	Greater of either: a. 1 per 500 tons b. 2 per day c. 3 per job	AASHTO T 30
Binder Content	Greater of either: a. 1 per 500 tons b. 2 per day c. 3 per job	AASHTO T 164 AASHTO T 308
Air Void Content	Greater of either: a. 1 per 500 tons b. 2 per day c. 3 per job	ASTM D6752
Binder Draindown	Greater of either: a. 1 per 500 tons b. 1 per day c. 1 per job	ASTM D6390

Table 4 – QC Production and Suspension Limits

<u>Sieve Size (inch/mm)</u>	<u>Production Limits</u>	<u>Suspension Limits</u>
0.75/19.0	+/- 0%	+/- 0%
0.50/12.5	+/- 6%	+/- 9%
0.375/9.5	+/- 6%	+/- 9%
No.4/4.75	+/- 6%	+/- 9%
No.8/2.36	+/- 5%	+/- 7%
No.200/0.075	+/- 1.0%	+/- 1.5%
<u>Test Criteria</u>		
PGAB, Percent	+/- 0.4%	+/- 0.7%
Temperature of Mix (F)	+/- 10°F	+/- 20°F
Air Void Content	-2 / +4%	-3 / +6%
Draindown (ASTM D6390)	+0.05	+0.10

5. Hot Mix Asphalt Production Corrective Action: The Contractor's QC system shall include an appropriate action to be taken when the process is believed to be out of tolerance. The Contractor should review production on a continuous basis making adjustments to the process when necessary to keep the product consistent. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:
 - a. Design Air Voids fall outside the Suspension Limits for an individual measurement; or

- b. Design Air Voids and two or more criteria fall outside the Production Limits for individual measurements; or
- c. Design Air Voids fall outside the Production Limit and one point falls outside the Suspension Limit for individual measurements; or
- d. Three tests in a row fall outside the Production Limits for individual measurements; or
- e. Three nonconsecutive tests fall outside the Production Limits for individual measurements in five successive samples.

Placement:

1. **Hauling Equipment:** The Porous mixture shall be transported in clean vehicles with tight, smooth dump beds that have been sprayed with a sufficient coating of non-petroleum release agent to prevent the mixture from adhering to the dump bodies. Mineral, fine aggregate, slag dust, etc. shall not be used to dust truck beds. The porous mixture shall be covered at all times with a suitable material of such size sufficient to protect the mix from the weather and to minimize mix cooling and the prevention of mixture conglomeration. When necessary, to ensure the delivery of material at the specified temperature, truck bodies shall be insulated, and covers pinned securely at the sides. Long hauls, particularly those in excess of 35 miles, may result in undesired mixture thermal segregation. Avoid haul distances greater than 50 miles.
2. **Placing Equipment:** The paver shall be a self-propelled unit with an activated screed capable of being heated and capable of spreading the mixture uniformly without segregation for the widths and thicknesses required. In general, track pavers have proved superior for Porous Asphalt placement. The screed shall be adjustable to provide the desired cross-sectional shape. The finished surface shall be of uniform texture and evenness and shall not show any indication of tearing, shoving, or pulling of the mixture. The machine shall, at all times, be in good mechanical condition and shall be operated by competent personnel.

The paver shall be equipped with the necessary attachments, designed to operate electronically, for controlling grade of the finished surface.

3. **Compacting Equipment:** Rollers shall be in good mechanical condition, operated by competent personnel, capable of reversing without backlash, and operated at speeds slow enough to avoid displacement of the asphalt mixture. The weight of the rollers shall be sufficient to compact the mixture to the required density without crushing of the aggregate. Rollers shall be equipped with tanks and sprinkling bars for wetting the rolls. Rollers shall be two-axle tandem rollers with a gross weight of not less than 7.5 tons and not more than 10 tons and shall be capable of providing a minimum compactive effort of 250 pounds per inch of width of the drive roll. All rollers shall be at least 42 inches in diameter.
4. **Existing Surface Conditions:** Contact surfaces such as curbing, gutters, and manholes shall be painted with a thin, uniform coat of Type RS-1 emulsified

asphalt immediately before the porous pavement mixture is placed against them.

5. **Temperature Requirements:** The temperature of the Porous Asphalt mixture, at the time of discharge from the haul vehicle and at the paver, shall be between 265°F to 325°F, or within 20°F of the approved job mix formula for compaction.
6. **Spreading and Finishing:** Porous Asphalt for porous paving shall be placed in two lifts with (1) base and (1) surface course. Take care between lifts to ensure that the porous asphalt layers bond completely. Keep time between layer placements to a minimum. Keep the first layer clear from dust and moisture and minimize traffic on the underlying layer. The Contractor shall protect exposed surfaces that are not to be treated from damage during all phases of the paving operation. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture shall be spread, raked, and luted by hand tools. No material shall be produced so late in the day as to prohibit the completion of spreading and compaction of the mixture during daylight hours unless night paving has been approved for the project. No construction equipment will be permitted on material placed until the material has been thoroughly compacted and has been permitted to cool to below 100°F for subsequent pavement lifts. The use of water to cool the pavement is permitted. No construction equipment will be allowed on the pavement after surface course placement for a recommended minimum of 48 hours.

The Engineer reserves the right to require that all work adjacent to the pavement, such as guardrail, cleanup, and turf establishment, is completed prior to placing the surface course when this work could cause damage to the pavement.

7. **Compaction:** Immediately after the asphalt mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The compaction objective is 18% - 20% in place void content.

The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking, or shoving.

Rollers or oscillating rollers, ranging from 7.5-10 tons, shall be used for compaction. The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. Generally, one breakdown roller will be needed for each paver used in the spreading operation.

To prevent adhesion of the mixture to the drums, drums shall be kept moist with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.

Along forms, curbs, headers, walls, and other places not accessible to the

rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons or with mechanical tampers.

Other combinations of rollers and/or methods of compacting may be used, provided the compaction requirements are met. Break down rolling shall be performed with 1-2 passes of a 7.5-10 ton static tandem steel wheel roller when the mix temperature is between 275 to 325°F. Do not use the roller in vibratory mode. Finished rolling with 1 pass shall be performed with a double-drum finish roller operated in static mode when the mix temperature is between 150 to 200°F. More rolling could cause a reduction in the porosity of the pavement.

Unless otherwise specified, the longitudinal joints shall be rolled first. Next, the Contractor shall begin rolling at the low side of the pavement and shall proceed towards the center or high side with lapped passes parallel to the centerline. The speed of the roller shall be slow and uniform to avoid displacement of the mixture, and the roller should be kept in as continuous operation as practical. Rolling shall continue until all roller marks and ridges have been eliminated.

Rollers will not be permitted to stop or be parked on any porous pavement. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture. The mixture shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of bitumen shall be removed and replaced. These replacements shall be at the Contractor's expense.

The Contractor assumes full responsibility for the cost of repairing damages that may occur to roadway or parking lot components and adjacent property if vibratory compaction equipment is used. After final rolling, no vehicular traffic shall be permitted on the surface until cooling and hardening has taken place and not less than the recommended 48 hours. Provide barriers as necessary at no cost to the City to prevent vehicular use.

8. Joints: Joints between old and new pavements, and between successive days work, shall be made to ensure continuous bond between adjoining work. Construction joints shall have the same texture, density, and smoothness as other sections of paving. Whenever the spreading process is interrupted long enough for the mixture to attain its initial stability, the paver shall be removed from the mat and a joint constructed.

Butt joints shall be formed by cutting the pavement in a vertical plane at right angles to the centerline and not extend into the underlying pavement layer. The butt joint shall be thoroughly coated with Type RS-1 emulsified asphalt just prior to depositing the paving mixture when paving resumes.

9. Surface Tolerances: The surface will be tested by the Engineer using a straightedge at least 10 feet in length at selected locations. Any variations of the surface course exceeding 1/4 inches between any two contact points shall be deemed unsatisfactory. Allowances will be calculated for vertical curve areas.

10. Surface Protection: Work shall be done expertly throughout, without staining or injury to other work. Transition to adjacent impervious asphalt paving shall be merged neatly with flush, clean line. Finished paving shall be even, without pockets, and graded to elevations and grades shown on the Plans.

Porous pavement aggregate beds or finished areas shall not be used for equipment or materials storage during construction, and under no circumstances shall vehicles be allowed to deposit soil on paved porous surfaces.

11. Repair of Damaged Paving: Any existing pavement on or adjacent to the site that has been damaged as a result of construction work shall be repaired to the satisfaction of the Engineer without additional cost to the City.

12. Contractor Quality Control During Placement:

- a. Continually check for mixture temperature uniformity such that the paved mat is kept within +/- 20°F of the JMF using random temperature readings.
- b. Inspect each truckload of material for draindown, segregation and other material qualities per the QC Plan prior to offloading.
- c. Test in-place base/surface course for compliance with requirements for thickness, in-place air voids and grade. Repair or remove and replace unacceptable work as directed by the Engineer. Establish and maintain required lines and elevations. The Engineer shall be notified for review of final stake lines before construction work is to begin. Finished surfaces shall be true to grade and even, free of roller marks and free of low spots/depressions. All areas must drain.
- d. Test finished surface for smoothness using a 10-foot straightedge applied parallel with and at right angles to the centerline of the paved area. Surface will not be accepted if gaps or ridges exceed 1/4".
- e. If, in the opinion of the Engineer, based upon Contractor Quality Control Reports of the testing services and inspections, the quality of the work is below the standards which have been specified, additional work and testing will be required until satisfactory results are obtained at no additional cost to the City.

13. Contractor Quality Control After Placement:

- a. Three (3) surface infiltration tests per ASTM C1701 shall be conducted per 10,000 square feet of porous asphalt, in place. Document and record the results of each field infiltration test with a

designated test number. Include infiltration rate, date pavement was placed, date test was taken, and location on the site (via stationing or other means) where test was performed in each test record.

- b. The finish surface shall yield an infiltration rate that is consistent with the following: The average infiltration rate from three (3) infiltration tests conducted per ASTM C1701 shall be greater than 100 inches per hour with no single test less than 50 inches per hour. Water shall infiltrate rapidly and uniformly through the surface without formation of large puddles when applied at a rate of 5 gallons per minute (gpm).
- c. If minimum required field infiltration rate is not achieved at any location as defined in this Section, re-test for field infiltration rate at a new location for each failed field infiltration test. Coordinate location with Engineer.
- d. It shall be the responsibility of the Contractor to conduct acceptance testing at the Engineer's direction using cores taken by the Contractor, witnessed by the Engineer and tested in the Contractor's contracted laboratory. Agencies that perform testing on porous asphalt materials shall be accredited by the AASHTO Accreditation Program (AAP) for the scope and standard being evaluated.

MATERIAL ACCEPTANCE

Acceptance Sampling and Testing:

All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section must be performed by agencies or companies hired by the Contractor.

- A. Plant Produced Material: Plant produced material must be tested for gradation, asphalt binder content, air voids and draindown on a random basis.
- B. Field Placed Material: Material placed in the field must be tested for in-place air voids, compacted thickness, and surface tolerance on a random basis, in accordance with ASTM D3665.
- C. Infiltration Rate Testing: Perform surface infiltration tests per ASTM C1701 as described above.
 1. The average infiltration rate from three (3) infiltration tests conducted per ASTM C1701 shall be greater than 100 inches per hour with no single test less than 50 inches per hour. Water shall infiltrate rapidly and uniformly through the surface without formation of large puddles when applied at a rate of 5 gallons per minute (gpm).

Acceptance Criteria:

Acceptance will be based on the following characteristics of the hot mix asphalt and completed pavement on a material course.

A. Material Acceptance:

1. Plant Produced Material
 - a. Adherence to the Quality Control Plan
 - b. Plant air voids
 - c. Gradation
 - d. Asphalt binder content
 - e. Mixture Temperature
 - f. Fiber content
 - g. PGAB Documentation

2. Field Placed Material
 - a. Adherence to the Quality Control Plan
 - b. In-Place Air Voids
 - c. Thickness
 - d. Inferior Material/Segregation
 - e. Draindown
 - f. Smoothness
 - g. Grade
 - h. Permeability

- B. Inferior Material: Material not conforming to specification requirements shall be subject to corrective action, production suspension, rejection, removal, or reduced payment as determined by the Engineer.

The Engineer may at any time, notwithstanding previous acceptance, notify the Contractor of inferior material and recommend the rejection of any Porous Asphalt which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, draindown, or improper mix temperature. Such recommendation may be based on only visual inspection or temperature measurements.

- C. Grade: The finished surface of the pavement shall not vary from the grade line elevations and cross sections shown on the Plans by more than 1/2 inch; however positive drainage must be achieved. The Contractor shall remove deficient areas and replace with new material. Sufficient material shall be removed to allow at least 1.5 inches (37.5mm) of porous hot mix asphalt to be placed. Milling or skin patching for correcting low areas shall not be permitted. The Contractor shall make tests for conformity with the specified crown and grade immediately after initial compaction. Any variation shall be corrected by the removal or addition of materials and by continuous rolling.
- D. Shaping Edges: Edges shall be beveled while still hot with the back of a lute or

smoothing iron and thoroughly compacted by tampers or by other satisfactory methods.

Corrective Methods:

The corrective method(s) chosen by the Contractor shall be performed at the Contractor's expense, including all necessary equipment and traffic control.

1. Areas of removal and replacement shall include the full width of the paver pass. The removal areas shall be reconstructed with a transverse butt joint, using a transverse saw cut perpendicular to the paver pass.
2. Replacement materials shall be placed in sufficient quantity, so the finished surface will conform to grade and smoothness requirements. The corrective area shall conform to all material and compaction specification requirements.
3. When the corrective work consists of an overlay, the overlay shall cover those paver passes sufficient to correct the defects. The area overlaid shall be placed with a transverse butt joint using a transverse saw cut and asphalt removal.
4. All materials shall meet Contract requirements. The overlay shall be placed so the finished surface will conform to grade and smoothness requirements. The overlay area shall be compacted to the specified density.
5. The Engineer may retest any sections where corrections were made to verify that the corrections produced a surface that conforms to the grade and smoothness requirements.

Protection:

After work in this section is complete, the Contractor shall be responsible for protecting the porous asphalt areas from damage and/or contamination with mud, dirt, grass cuttings, accumulation of foliage and debris, etc. If the Engineer deems that the porous paving has become contaminated, the Contractor shall pressure wash and vacuum the paving at their own expense.

Maintenance:

The Contractor shall perform one cleaning of the porous asphalt areas with a vacuum sweeper after 120 days and before 150 days after date of Substantial Completion/Provisional Acceptance.

METHOD OF MEASUREMENT

Porous Asphalt Surface Course will be measured for payment per ton, complete in place.

Porous Asphalt Base Course will be measured for payment per ton, complete in place.

BASIS OF PAYMENT

Porous Asphalt Surface Course will be paid for at the Contract unit price per ton, which price shall include all labor, materials, equipment, and incidental costs required to complete the work.

Porous Asphalt Base Course will be paid for at the Contract unit price per ton, which price shall include all labor, materials, equipment, and incidental costs required to complete the work.

Sawcutting and removal of existing/adjacent pavements will be paid for separately under Item 120.1, Unclassified Excavation.

Washed No. 2 Stone will be paid for separately under Item 156.02, Washed No. 2 Stone.

Washed No. 8 Stone will be paid for separately under Item 156.08, Washed No. 8 Stone.

Washed No. 57 Stone will be paid for separately under Item 156.057, Washed No. 57 Stone.

Non-Woven Geotextile Fabric will be paid for separately under Item 698.3, Non-Woven Geotextile Fabric.