420.50130108 - TOP COURSE POROUS ASPHALT PAVEMENT F3
420.50190108 - TOP COURSE POROUS ASPHALT PAVEMENT F9
420.70190108 - BINDER COURSE POROUS ASPHALT PAVEMENT F9

DESCRIPTION:

Furnish and place Porous Asphalt Pavement courses in accordance with the contract documents and/or as directed by the Engineer-in-Charge. The construction of a Test Panel will be required as outlined in this specification.

MATERIALS:

The materials and composition for the Porous Asphalt Pavement mixtures shall meet the requirements specified in §401-2 Materials, except as noted herein.

Formulate a job mix formula (JMF) that satisfies the design limits listed below and submit it to the Regional Materials Engineer (RME), at least one week prior to placement of the test section.

Porous Asphalt Pavement Mixtures Gradation Requirements		
Screen Sizes	Top Course	Binder Course
	General Limits % Passing	General Limits % Passing
50mm, 2 inch	---	100
37.5mm, 1 1/2 inch	---	75-100
25mm, 1 inch	---	55-80
19mm, 3/4 inch	100	---
12.5mm, 1/2 inch	85-100	23-42
9.5mm, 3/8 inch	55-75	---
6.3mm, 1/4 inch	---	5-20
4.75mm, No. 4	10-25	---
3.2mm, 1/8 inch	---	2-15
2.36mm, No. 8	5-10	---
1.18mm, No. 16	---	---
600µm, No. 30	---	---
75µm, No. 200	2-4	---

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Porous Asphalt Pavement Mixtures Design Criteria						
Mix	N_{design}	Air Voids @ N_{design}	PG Binder Content	VCA_{mix} [2]	Draindown of Uncompacted Asphalt Mixtures, AASHTO T305, maximum	Mixing and Compaction Temperature Range [4] °C
Top Course	50	20.0	5.5 % minimum	Less than VCA_{drc} [3]	0.3 %	140°C - 163°C
Binder Course [1]	35	---	2.5 % – 4.5 %	---	0.3 %	140°C - 163°C

Notes:

1. Sufficient PG Binder shall be used in the mixture such that at least 95 percent of the aggregate particles are completely coated with binder as determined by AASHTO T195. In addition, when compacted in a gyratory compactor to 35 gyrations, the resulting specimen shall be stable and must not fall apart under its own weight.
2. VCA_{mix} = The voids in the coarse aggregate fraction of the mix based on specimens compacted to N_{design}. The coarse aggregate fraction of the aggregate is that portion of the JMF aggregate skeleton not passing the No. 4 (4.75mm) sieve.

$$VCA_{mix} = 100 - \frac{P_{ca} * G_{mb}}{G_{ca}}$$

Where: P_{ca} = The percent of the coarse aggregate fraction by weight of total mix.
G_{mb} = The bulk specific gravity of the mix at the design PG Binder content as determined by AASHTO T275 or T331.
G_{ca} = The bulk specific gravity of the coarse aggregate fraction as determined by AASHTO T85.

3. VCA_{drc} = The voids in the coarse aggregate fraction of the JMF aggregate skeleton, determined using the dry rodding technique according to AASHTO T19.

$$VCA_{drc} = \frac{100\ (G_{sbca}\Upsilon_w - \Upsilon_{ca})}{G_{sbca}\Upsilon_w}$$

Where: G_{sbca} = The bulk specific gravity of the coarse aggregate fraction as determined by AASHTO T85.
Υ_{ca}= The unit weight of the coarse aggregate fraction (as determined by AASHTO T19.
Υ_w= The unit weight of water.

4. Or as specified by the PG Binder Supplier.

Coarse Aggregate Type F3 Conditions. Use one of the following types of coarse aggregate.

1. Limestone or a blend of limestone and dolomite having an acid-insoluble residue content of not less than 20.0%.
2. Dolomite.

3. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.
4. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, where the noncarbonate plus 1/8 inch (3.2mm) particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus 3/8 inch (9.5mm) particles must be noncarbonate.

Coarse Aggregate Type F9 Conditions. Use coarse aggregate meeting the requirements of §703-02, *Coarse Aggregate*.

Performance-Grade (PG) Binder. Use a polymer or terminal blend Crumb Rubber Modified (CRM) PG 64E-22 Binder, in the production of both the Top Course Porous Asphalt mixture and the Binder Course Porous Asphalt mixture.

The PG Binder shall meet the requirements of AASHTO M 332, *Standard Specification for Performance Graded Asphalt Binder using Multiple Stress Creep Recovery (MSCR),* for the production of the Porous Asphalt Pavement mixtures. In addition, the binder grade must also meet the **elastomeric** properties as indicated by one of the following equations for $\%R_{3.2}$:

1. **For $J_{nr3.2} \geq 0.1$, $\%R_{3.2} > 29.371 * J_{nr3.2}^{-0.2633}$**
2. **For $J_{nr3.2} < 0.1$, $\%R_{3.2} > 55$**

Where
$R_{3.2}$ is % recovery at 3.2 kPa (0.5 psi)
$J_{nr\ 3.2}$ is the average non-recoverable creep compliance at 3.2 kPa (0.5 psi)

When terminal blend CRM PG binder is used, the following shall apply:

- Crumb rubber particles shall be finer than #30 (600µm) sieve size.
- The terminal blend CRM PG binder shall be storage-stable and homogeneous.
- The Dynamic Shear Rheometer (DSR) shall be set at 2-mm gap.
- The terminal blend CRM PG binder shall be 99% free of particles retained on the 600 µm sieve as tested in accordance with Section 5.4 of M 332.

In addition, the PG Binder must meet the following requirements:

- Downstate (Orange, Putnam, Rockland, Westchester, Nassau, Suffolk counties and City of New York), use of Polyphosphoric Acid (PPA) to modify the PG binder properties is prohibited for mixtures containing limestone, limestone as an aggregate blend component, or limestone as a constituent in crushed gravel aggregate. This prohibition also applies to the use of PPA as a cross-linking agent for polymer modification.

- Upstate (all other counties not listed under Downstate), use of PPA to modify PG binder properties is prohibited. This prohibition also applies to the use of PPA as a cross-linking agent for polymer modification.

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Reclaimed Asphalt Pavement (RAP). The use of RAP will not be allowed.

Fiber. A mineral or cellulose fiber stabilizing additive may be used in the production of these mixtures.

- If a Mineral fiber is utilized in the production of the porous asphalt, then the dosage rate for the Mineral fiber shall be approximately 0.4% by total mixture mass and sufficient to prevent draindown. The mineral fibers must meet the properties in the table below.

Mineral Fiber Properties[1]	
Property	**Specification**
Size Analysis Fiber Length [2] Thickness [3]	 6.3mm maximum mean test value 0.005mm maximum mean test value
Shot Content [4] Passing No. 60 (250µm) sieve Passing No.230 (63µm) sieve	 90 ± 5% 70 ± 10%

Notes:
1. The European experience and development of the above criteria are based on the use of basalt mineral fibers.
2. The fiber length is determined according to the Bauer McNett fractionation.
3. The fiber thickness, or diameter, is determined by measuring at least 200 fibers in a phase-contrast microscope.
4. Shot content is a measure of non-fibrous material. The shot content is determined on vibrating sieves. Two sieves, the 0.250 mm and the 0.063 mm, are typically utilized. For additional information, see AASHTO C612.

- If a Cellulose fiber utilized in production of the porous asphalt mixture, then the dosage rate for the Cellulose fiber shall be approximately 0.3% by total mixture mass and sufficient to prevent draindown. The Cellular fibers must meet the properties in the table below.

Cellulose Fiber Properties	
Property	**Specification**
Sieve Analysis	
Method A - Alpine Sieve[5] Analysis	
Fiber Length	6 mm Maximum
Percent Passing 0.150 mm	70 ± 10
Method B - Mesh Screen[6] Analysis	
Fiber Length	6 mm Maximum
Percent Passing 0.850 mm	85 ± 10
0.425 mm	65 ± 10
0.106 mm	30 ± 10
Ash Content[7]	18 ± 5% Non Volatiles
pH[8]	7.5 ± 1.0
Oil Absorption[9]	5.0 ± 1.0 (times fiber mass)
Moisture Content[10]	Less than 5% (by mass)

Notes:

5. This test is performed using an Alpine Air Jet Sieve (Type 200 LS). A representative 5 gram sample of fiber is sieved for 14 minutes at a controlled vacuum of 75 kPa (11 psi) of water. The portion remaining on the screen is weighed.

6. This test is performed using standard No. 20, 40, 60, 80, 100, and 140 sieves (0.850, 0.425, 0.250, 0.180, 0.150, and 0.106 mm), nylon brushes, and a shaker. A representative 10 gram sample of the fiber sieved using a shaker and two nylon brushes on each screen. The amount retained on each sieve is weighed and the percentage passing calculated. Repeatability of this method is suspect and needs to be verified.

7. A representative 2 to 3 gram sample of fiber is placed in a tared crucible and heated to between 1100 º F and 1112 º F (595º and 600º C) for not less than two hours. The crucible and ash are cooled in a desiccator and weighed.

8. Five grams of fiber are added to 100 ml of distilled water, stirred, and allowed to sit for 30 minute. The pH is determined with a probe calibrated with a pH buffer of 7.0.

9. Five grams of fibers are accurately weighed and suspended in an excess of mineral spirits for not less than 5 minutes to ensure total saturation. They are then placed in a screen-mesh strainer (approximately 0.5 mm^2 opening size) and shaken on a wrist-action shaker for 10 minutes (approximately a 1.25 inch (32 mm) motion at 240 shakes per minute). The shaken mass is then transferred without touching to a tared container and weighed. Results are reported as the amount (number of times its own weight) the fibers are able to absorb.

10. Ten grams of fibers are weighed and placed in a 250 º F (121º C), forced air oven for two hours. The sample is then reweighed immediately upon removal from the oven.

CONSTRUCTION DETAILS:

The provisions of §401-3 and §402-3, Construction Details, shall apply except as modified herein.

Plant QC/QA. QC/QA testing of the mixture will be performed a minimum of once per day regardless of the quantity produced. The QCT/QAT shall perform all testing required in Materials Procedure 401, Table 3 Sampling and Testing Matrix, including air voids testing. However, acceptance of the mixture quality will be based on aggregate gradation and asphalt binder content only.

Plant Production. If the top course mixture is produced in a batch type plant and the mixture contains a fiber stabilizing additive, the mixing time of the dry constituents of the mixture (aggregates and fiber stabilizing additive), must be increased by a minimum of 15 seconds.

Paving. Keep the porous asphalt pavement free of contamination from the construction operations. Take precautions as necessary such as washing truck tires, installation of silt fence, tarps on heavily traveled areas, etc. Stage the placement of the porous asphalt pavement after the surrounding areas have been final graded and stabilized to minimize potential sediment laden water from reaching the pavement surface.

Do not place the porous asphalt pavement mixture on a wet surface or when the surface temperature is below 50° F (10° F)

The use of Tack Coat will be prohibited. Prior to the placement of the Top Course, the Binder Course must be cleaned to the satisfaction of the Engineer-in-charge.

Place each course of porous asphalt pavement in one lift. Use a mechanical rubber track paver to place as much of the mix as possible.

After completion of each pavement course, allow the pavement to cure for a minimum of 24 hours before placing the next course or allowing traffic of any kind on it.

Rollers. A double drum asphalt roller, with a minimum drum width of 54 inches (1.35m) and a minimum weight of 10 tons (9 metric tons), is required. The roller must be operated in static mode at all times. Operation of the roller in vibratory and/or oscillatory mode is prohibited. Pneumatic Tire rollers are prohibited. Do not stop the roller on the freshly placed mix for more than 30 seconds.

Density Gauge. Provide a density gauge operator that possesses a current Density Gauge Inspector Certification from The Associated General Contractors, New York State, or its equivalent. The density gauge operator will monitor the in-place density to ensure that the

pavement is being compacted to the Project Target Density (PTD). Perform a minimum of one density gauge reading for every 200 square feet (18.5m^2) of pavement surface placed.

Final Acceptance. Acceptance of the finished product will be based on:

1. Acceptable in-place density gauge readings at each test location will be between 95% and 105% of the PTD.
2. A visual evaluation of the pavement surface. The Engineer-in-charge shall visually compare the pavement surface of the completed section to the Test Panel.
3. Porosity Test. Allow a minimum of 24 hours after completion of the Top Course, before testing. Perform a porosity test at 3 locations chosen by the Engineer-in-charge. At each location, test the porosity for a minimum of 3 minutes. The test is accomplished by applying clean water at the rate of at least 5 gal/min (19 liter/min) over the surface, using a hose or other distribution device. Water used for the test shall be clean, free from suspended solids and deleterious materials and will be provided at no additional cost. All applied water shall infiltrate the test panel directly, without puddle formation or surface runoff, and shall be observed by the Engineer-in-charge.

Test Panel. A minimum of 2 weeks prior to routine paving, construct a 1000 sq. ft. (93m^2) test panel. The test panel will be constructed at a location designated by the Engineer-in-charge or as directed in the contract documents, and will remain in place for the duration of the project to be used as a visual reference for acceptance of the pavement surface. Produce, deliver, and construct the test panel in accordance with this specification and the thicknesses specified in the contract documents. The final in-place air voids of each pavement layer shall be 16% to 22%.

Test Panel Evaluation. The following will be performed on each Test Panel:

1. Provide a density gauge operator that possesses a current Density Gauge Inspector Certification from The Associated General Contractors, New York State, or its equivalent. The density gauge operator will monitor the in-place density of the pavement course.
2. Cut a minimum of three, 6 inch (152mm) diameter, cores from each asphalt course prior to placing any subsequent courses. These cores will be used to determine:
    a. The in-place air void of the asphalt course, a density gauge correction factor, and will be used to determine a PTD for use during the paving of the routine paving courses. The PTD will be determined as 81% of the Mixture's Maximum Theoretical Density (MMTD) for the top course and 79% for the Binder course plus or minus any gauge correction factor.
    b. Compacted thickness of the asphalt course.
3. Porosity Test. Allow a minimum of 24 hours after completion of the Top Course, before testing. Perform a porosity test at 3 locations chosen by the Engineer-in-charge. At each location, test the porosity for a minimum of 3 minutes. The test is accomplished by applying clean water at a measured rate of at least 5 gal/min (19 liter/min) over the surface, using a hose or other distribution device. Water used for the test shall be clean, free from suspended solids and deleterious materials and will be provided at no additional cost. All applied water shall infiltrate the test

panel directly, without puddle formation or surface runoff, and shall be observed by the Engineer-in-charge.

METHOD OF MEASUREMENT:

The Provisions of §401-4 and §402-4 shall apply except as noted herein.

This work will be measured as the number of tons of compacted porous asphalt pavement satisfactorily furnished and installed in accordance with the plans, specifications, and orders of the Engineer.

Production meeting the specification requirements will be paid at the bid price. Production failing to meet the specification requirements will be subject to evaluation by the Engineer-in-Charge. If left in place, it will be paid for at 0.85 times the bid price.

BASIS OF PAYMENT:

The Provisions of §401-5 and §402-5, Basis of Payment shall apply.

Payment will be made under:

ITEM NO.	ITEM	PAY UNIT
420.50130108	Top Course Porous Asphalt Pavement F3	Metric Ton
420.50190108	Top Course Porous Asphalt Pavement F9	Metric Ton
420.70190108	Binder Course Porous Asphalt Pavement F9	Metric Ton