

SECTION 2741

POROUS BITUMINOUS PAVEMENT

PART 1-GENERAL

1.01 APPLICABLE DOCUMENTS

- A. Bidding Requirements, Conditions of the Contract and pertinent portions of Sections in Division 00 and 01 of these Specifications apply to the Work of this Section.

1.02 SUMMARY

- A. This work shall consist of the following
1. Constructing a stabilized aggregate base on the prepared subgrade in accordance with MN/DOT 2211.
 2. Construction of porous pavement section including drain tile

1.03 REFERENCES

- A. Reference Standards:
1. State Highway Department Standards: Mn/DOT Spec shall mean the Minnesota Department of Transportation "Standard Specification for Highway Construction," 2005 edition.
 - a. Spec 2350/2360, Plant Mixed Asphalt Pavement.
 - b. Spec 2357, Bituminous Tack Coat.
 - c. Spec 3138, Aggregates for Surface and Base Courses.
 - d. Spec 3139, Grade Aggregate for Bituminous Mixtures.

1.04 SUBMITTALS

- A. Certification of Materials: Bituminous mix plant shall have, on file, a report by MnDOT certifying that materials are in accordance with Specification requirements.
- B. Job-Mix Design: Bituminous mix plant shall have, on file, a report by an approved testing laboratory (MnDOT or independent laboratory) that indicates the proportions of materials used in each type of bituminous course being provided and temperature of mix.
- C. Samples: Provide samples of materials for laboratory testing and job-mix design.
- D. During paving, Contractor and Engineer shall obtain mix samples for determination of the actual bituminous mixture properties during production. Each paired intersection shall be considered as a separate lot.
- E. Certificates: Provide certificates, signed by the hot mix asphalt producer and Contractor, certifying that materials comply with Specification requirements.

1.05 QUALITY ASSURANCE

- A. Subcontractor's Qualifications: Construction of bituminous paving, including stabilized aggregate base, shall be done by a responsible Paving Subcontractor having necessary equipment, plant, and not less than 5 years experience in performing Work similar to that included under this Contract.
- B. Governing Codes: Work of this section occurring on public property shall be constructed in accordance with laws, ordinances, rules, regulations, and orders of any public authority having jurisdiction. Where such work is required to be constructed in a manner differing from the Contract Documents, Contractor shall notify Engineer before proceeding with Work.
- C. Qualifications of Hot Mix Asphalt Producer: Use only materials which are furnished by a bulk asphalt concrete producer regularly engaged in production of hot-mix, hot-laid asphalt concrete. The plant shall be a Mn/DOT certified plant.
- D. In addition to other specified conditions, comply with the following minimum requirements:
1. The Owner will employ and pay for the services of a testing and inspection service (Engineer) for quality control testing.
 2. The Engineer will obtain hot-mix asphalt samples (from the truck box) prior to compaction for purposes of determining maximum specific gravity, bulk density, and in-place voids.
 3. The Engineer will test in-place asphalt concrete courses for compliance with requirements for density, thickness and surface smoothness.
 4. Provide final surfaces of uniform texture, conforming to required grades and cross-sections.
 5. Take not less than two (2) - 4" diameter pavement specimens for each completed course, from locations as directed by Engineer. Provide specimens to the Engineer.
 6. Repair holes from test specimens as specified with porous mix.
- E. Density Requirements;
1. Engineer will determine mixture voids and in-place voids after compaction.
- F. Thickness: In-place compacted thicknesses will not be acceptable if exceeding following allowable variation from thickness shown on Drawings.
1. **THE TOTAL THICKNESS OF ANY BITUMINOUS PAVEMENT SHALL NOT BE LESS THAN THE AGGREGATE DIMENSION OF THE BITUMINOUS COURSES SHOWN ON THE DRAWINGS.** The Contractor is responsible to complete yield checks and monitor thickness determinations so that the constructed dimensions correspond with required plan dimensions throughout the sections.

G. Surface Smoothness:

1. Test finished surface of each asphalt concrete course for smoothness, using a 10' straight edge applied parallel to and at right angles in Centerline of paved areas.
2. Check surfaced areas at intervals directed by Engineer.
3. Surfaces will not be acceptable if exceeding the following:
 - a. 3/16" in 10'.
4. Thickness and surface smoothness requirement is for occasional variations and not for continuous over-running or under-running, unless ordered or authorized by the Engineer.

1.06 SITE CONDITIONS

A. Weather Limitations:

1. Construct hot mix asphalt courses only when atmospheric temperature is above 50° F, when dry, and when weather is not inclement.
2. Paving shall not take place when, in the opinion of the Engineer, the weather or surface conditions are considered unfavorable.

B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

C. Protection: Protect grass, vegetation, concrete work, building and other work adjacent to paving, with building paper or other suitable material, so that stains of bitumen shall not reach these surfaces.

D. Traffic Control:

1. Maintain vehicular and pedestrian traffic during paving operations as required for other construction activities.
2. Provide flagmen, barricades, warning signs, and warning lights for movement of traffic and safety and to cause the least interruption of work.

E. Coordination and Responsibility

1. Coordinate pavement construction with casting adjustments.
2. Coordinate installation of subgrade, drain tile, reservoir layer and geotextile fabric with Contract and any subcontractor.
3. Coordinate street construction with Electrical contractor for installation of conduits, light pole bases and other electrical items.
4. Prime Contractor shall present for approval a program for sequencing activities.
5. Coordinate pavement construction with monitoring equipment and sensor installation with the Engineer.

1.07 REQUIREMENTS

A. Job-Mix Criteria:

1. Provide job-mix formulas for each required asphalt-aggregate mixture.

2. Establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt cement to be added to aggregate, and a temperature range at which hot mix asphalt is to be produced.
3. Comply with the mix requirements of the Minnesota Department of Transportation (Mn/DOT) special provisions 2350/2360.
4. Maintain material quantities within allowable tolerances of the governing standards.

PART 2—PRODUCTS

2.01 MATERIALS

A. POROUS PAVEMENT SUB-LAYERS

1. Aggregates consist of a Choker Layer and a Reservoir Layer. These aggregates shall meet the following common requirements:
 - a. Maximum Wash Loss of 1.5 %.
 - b. The Los Angeles Rattler (LAR) loss on the coarse aggregate fraction (material retained on the 4.75 mm [No. 4] sieve) shall not exceed 35% for any individual source used within the mix.
 - c. Material shall be 80% crushed (one fractured face).
 - d. Use washed, Class A, Aggregate.
 - e. The use of recycled materials will not be permitted. Recycled materials shall include, but are not limited to: glass, recycled asphaltic pavement, crushed concrete, and roofing shingles.
2. Choker Layer. Aggregate for the choker layer shall be uniformly graded meeting modified AASHTO #57:

Modified AASHTO size number 57

U.S. Standard Sieve Size	Percent Passing
1 ½ " (37.5mm)	100
1" (25 mm)	95-100
½ " (12.5 mm)	25-60
4 (4.75 mm)	0-10
8 (2.36 mm)	0-5

Note: Estimate a nominal 1” thickness in place

3. Reservoir Layer. Coarse aggregate for the reservoir layer shall be uniformly graded meeting modified AASHTO #3:

Modified AASHTO size number 3*

U.S. Standard Sieve Size	Percent Passing
2 1/2 " (63mm)	100
2" (50mm)	70-100
1 1/2" (37.5mm)	35-70
1/2 " (12.5mm)	0-5

*As a substitution, a uniformly graded gradation with a minimum void space of 40% is allowed according to AASHTO T19.

4. Geotextile Fabric: Type V, woven geotextile, or approved equal.

B. Porous Pavement: Mn/DOT Spec 2360 with the following modifications:

1. Replace 2360.1 DESCRIPTION with:
This work consists of the construction of a Porous Hot Mix Asphalt Wearing Course Mixture (Porous HMA). The work shall be in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans or established by the Engineer.
2. 2360.2A2a. Use Class A aggregate in Porous HMA. Limestone aggregate will be accepted for smaller aggregate and to ensure minimum 5% passing the #8 sieve. Limestone will not exceed 35% of the total aggregate. Hardness must be met regardless of aggregate material mix.
3. Modify 2360.2E Gradation Requirement as follows:

Table 2360.2-E
Aggregate Gradation Broad Bands
(% passing of total washed gradation)

Sieve Size, mm (inch)	Porous HMA
19.0 (3/4")	100
12.5 (1/2")	85-100
9.5 (3/8")	55-75
4.75 (#4)	10-25
2.36 (#8)	5-10
0.075 (#200)	2-4

Note: It is estimated that the mixture unit weight will be approximately 95 to 100 lbs./sq/yd-inch

4. Replace 2360.2C1 (Los Angeles Rattler [LAR] Test) with:
The Los Angeles Rattler loss on the coarse aggregate fraction (material retained on the 4.75mm [#4] sieve) shall not exceed 35 percent for any individual source used within the mix.

5. B 1 Mineral Filler AASHTO M17

B1a Composition

Mineral filler shall consist of carbonate dust, Portland cement, hydrated lime, crushed rock screening, or rotary limekiln dust.

Crushed rock screenings to be used as mineral filler shall be of such composition and quality that the bituminous mixture containing the rock screenings will have stability and durability equivalent to those of the comparable mixture containing one of the other acceptable filler materials. The rock screenings shall be free from clay and shale.

Mineral filler prepared from rock dust, slag dust, and similar materials shall be free from organic impurities and have a plasticity index not greater than 4 (AASHTO T 90).

B1a1 Hydrated Lime

Hydrated lime used in asphalt mixtures shall meet the requirements of ASTM C977 and have a maximum of eight percent unhydrated oxides (as received basis).

B1b Gradation

Mineral filler shall be graded within the following limits:

Percent finer than 0.600mm (#30)	100
Percent finer than 0.300mm (#50)	95-100
Percent finer than 0.075mm (#200)	70-100

B1c Condition

Mineral filler that is to be added directly to the dried aggregate for the bituminous mixture shall be thoroughly dry and free from lumps consisting of aggregations of fine particles.

Crushed rock screenings used as mineral filler shall be of uniform gradation and shall be processed and handled in such a manner as will prevent segregation. The rock screenings shall be dried by passing through the dryer.

B1d Sampling and Testing

- 1) Sampling Mn/DOT Bituminous Manual
- 2) Fineness
 - Sieve Analysis AASHTO T 27
 - Hydrometer Analysis AASHTO T 88
 - a) This procedure is modified to permit the use of Gum Arabic as a dispersing agent if flocculation occurs.
- 3) Plasticity Index AASHTO T 89 & 90
- 4) Specific Gravity..... AASHTO T100

6. Insert:2360 FS

FS Porous HMA Asphalt Stabilizer AASHTO MP8-02

An asphalt stabilizer additive may be used to control drain-down. The stabilizer additive shall be a cellulose fiber conforming to AASHTO MP8-02.

Stabilizer dosage rate shall be within 0.2-0.4 percent by weight of the total mix.

7. Insert 2360.2G

G Asphalt Binder Material AASHTO M 320

The asphalt binder material shall be PG 64-22. Confirm binder performance grade with Engineer.

8. 2360.3 Mixture Design General

Include:

- a) No paving will be allowed without a Contractor or consultant laboratory job mix formula design using Gyrotory (50 gyrations) mix design. The Contractor shall provide all data necessary (aggregate and mixture) and pay all costs.
- b) All mixture shall be designated as wearing course.
- c) Additional information can be found in Appendix A of NAPA's Porous Asphalt Pavements, Quality Improvement Series 131, however these specs shall take precedence.

9. Insert B1a Desired Aggregate Blend

Prior to the start of asphalt production, the Contractor shall provide:

1. Dry-rodded voids in coarse aggregate of the coarse aggregate fraction (VCA_{DRC}).
2. Voids in the coarse aggregate of the mix (VCA_{MIX}) according to the following steps.
 - a. For each trial gradation prepare three batches at between 6.0 and 6.5 percent asphalt binder. Include fibers.
 - b. Compact two specimens from each trial gradation using 50 gyrations of the Superpave gyrotory compactor.
 - c. Use the remaining sample from each trial gradation to determine the theoretical maximum specific gravity (G_{mm}) of each trial.
 - d. To select design gradation, choose the trial gradation with the $VCA_{MIX} < VCA_{DRC}$ with high air voids.

10. Modify Table 2360.3-B2a as follows:

Table 2360.3-B2a
Mixture Aggregate Requirements

Aggregate Blend Property	Porous BMA
Coarse Aggregate Angularity ASTM D5821 (one face), %- Wear & Non-Wear	55
Coarse Aggregate Absorption, % AASHTO T85, Mn/DOT modified	≤ 2
Voids in Coarse Aggregate (VCA_{drc}) AASHTO T19	$VCA_{mix} < VCA_{drc}$
Flat and Elongated Particles, max % by weight, (ASTM D 4791)	≤ 5 (5:1 ratio) ≤ 20 (2:1 ratio)
Clay Content (AASHTO T 176)	30
Total Spall in fraction retained on the 4.75 mm (#4) sieve	2.5
Maximum Spall Content in Total Sample	2.5

11. Modify Table 2360.3-B2b as follows:

Table 2360.3-B26
Mixture Requirements

Gyratory Mixture Requirements	Porous HMA
Gyrations for N_{design}	50
Air voids, % - wear	$\geq 16\%$
Tensile Strength Ratio ⁽¹⁾ , min % at mix design	Not Applicable
Fines/Effective Asphalt	≤ 1.2
Draindown - based on a 1 hour reading at the anticipated production temperature	$\leq 0.3\%$
Stabilizer by weight of total mix, %	0.2-0.4
VCA Ratio	$VCA_{MIX} < VCA_{DRC}$

(1) See 2360.4 E9. Use 150mm (6-inch) specimens for gyratory.

12. Insert: 2360.3 B2d Minimum Asphalt Content
The guideline for minimum percent asphalt binder is approximately 6.0 percent by weight of mix.

Delete Tables 2360.3-B2c (VMA Mixture Requirements) and 2360.3-B3 (Option B Mixture Requirements).
13. Modify 2360.3C(10)(a)
Using the selected design gradation, prepare mixes at the three binder contents in increments of 0.5 percent. Conduct draindown test (AASHTO T305 or ASTM D6390) on loose mix at a temperature 15 C higher than anticipated production temperature: Compact mix using 50 gyrations of a Superpave gyratory compactor and determine air void contents.
14. Insert: 2360.3C Documentation, Additional Documentation for Gyratory Design: **(G1a)** For the trial blend(s), determine the Voids in the Coarse Aggregate-Dry Rodded Condition (VCA_{DRC}) according to AASHTO T19. The VCA ratio (VCA_{mix} / VCA_{DRC}) shall be less than 1.0,
i.e. $VCA_{mix} < VCA_{DRC}$
15. Insert: 2360.4 E13 Draindown Test AASHTO T305
Draindown that exceeds 0.3% is unacceptable. The Contractor shall take appropriate action to bring draindown values into specification. This action may include checking to determine if the stabilizer is being added, if the rate of adding stabilizer is correct and checking if the mixing temperature is excessive. The draindown test shall be performed at the production plant mixing temperature.
16. Modify 2360.5 B Restrictions as follows:
Placement of Porous HMA mixtures will be allowed only when the ambient air temperatures are at least 50 °F and rising.
17. Modify 2360.5C1a(7) with:
Storage of the mix will be allowed during production at the risk of the Contractor and not to exceed 60 minutes.
18. Modify 2360.5C2a with:
HMA shall be placed with a track paver.
19. Modify 2360.5C2b with: The HMA shall be covered.
20. Insert 2360.5D1
A uniform lower rate of application may be 0.01 - 0.02 gallons per square yard (undiluted) or 0.02 - 0.04 gallons per square yard (diluted).
21. Replace 2360.6 Pavement Density, with:

All compaction shall be by the Ordinary Compaction Method. Compaction of the hot-mix asphalt shall take place when the surface is cool enough to resist a maximum 10-ton steel-wheeled roller [vibratory mode not allowed]. One or two passes is all that is required for proper compaction. More rolling could cause a reduction in the surface porosity which is unacceptable. Vibratory rollers and/or pneumatic-tired rollers are not allowed.

22. C4 Trench Rollers

Trench rollers shall be self propelled and have a mass of not less than 2,960 pounds per foot of width.

23. CS Mixture Temperature Controls

Unless directed by the Engineer in writing, no paving is allowed under the Ordinary Compaction Method when the air temperature is below 50°F when measured away from artificial heat. The minimum laydown temperature of the bituminous mix shall be 275 degrees Fahrenheit.

24. Other Guidance on Ordinary Compaction of HMA

Transporting of mix to the site shall be in vehicles with smooth, clean dump beds that have been sprayed with a non-petroleum release agent.

The porous bituminous courses shall be laid directly over the shaped choker course to the specified finished thickness.

After final rolling, no vehicular traffic of any kind shall be permitted on the surface until cooling and hardening has taken place (less than 140°F or as directed by the Engineer).

Transition to adjacent impervious bituminous paving shall be merged neatly with flush, clean line. Finished paving shall be even, without pockets, and graded to elevations shown on drawing.

Porous pavement beds 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.

Establish and maintain required lines and elevations. The Engineer shall be notified for review and approval of final stake lines for the work before construction work is to begin. Finished surfaces shall be true to grade and even, free of roller marks and free of low spots to form puddles. All areas must drain.

- C. Drain tile: Shall be PVC A-2000 perforated sewer pipe conforming to ASTM specifications F949-90, D1784, D2321-83A or approved equal. Drain tile shall not be directly wrapped in geotextile fabric, unless specifically noted on the

Drawings. Pipe diameter shall be 6", unless otherwise indicated on the Drawings.

PART 3 - EXECUTION

3.01 PREPARATION PRIOR TO PAVING

- A. Surface Preparation for Porous Pavement Areas
 - 1. Subgrade within limits of porous pavement areas shall NOT be compacted or subject to excessive construction equipment traffic prior to geotextile and filter layer placement.
 - 2. Bring subgrade of porous pavement area to line, grade, and elevations indicated. Fill and lightly regrade any areas damaged by erosion, ponding, or traffic compaction before the placing of geotextile fabric.
- B. Loose and Foreign Material:
 - 1. Remove loose and foreign material from compacted sub-base surface immediately before application of paving.
 - 2. Do not displace sub-base material.
- C. Tack Coat:
 - 1. Apply to contact surfaces of previously constructed asphalt concrete or Portland cement concrete and similar surfaces.
 - 2. Apply at rate of 0.05 to 0.15 gal. per sq. yd. of surface.
 - 3. Apply tack coat by brush to contact surfaces of curbs, gutters, manholes, and other structures projecting into or abutting asphalt concrete pavement.
 - 4. Allow surfaces to dry until material is at condition of tackiness and to receive pavement.

3.02 POROUS PAVEMENT AREA PREPARATION

- A. Place geotextile in accordance with manufacturer's standards and recommendations. Adjacent strips of geotextile shall overlap a minimum of sixteen inches (16"). Secure geotextile at least four feet (4) beyond porous pavement limits and take any steps necessary to prevent any runoff or sediment from entering the porous pavement limit area.
- B. Install reservoir layer and choker base course aggregate evenly over surface of geotextile, sufficient to allow placement of pavement, and notify Engineer for approval. Choker base course shall be sufficient to allow for even placement of hot-mix asphalt (HMA) but no thicker than nominal 1-inch in depth.
- C. Compaction of the coarse aggregates shall be by ordinary compaction. One pass with vibration is allowable (low amplitude, high frequency) for aggregate interlock. Continuous vibratory passes are not allowed.

- D. Following placement of aggregates, the geotextile fabric shall be folded back along all bed edges to protect from sediment washout along bed edges. At least a four-foot edge strip shall be used to protect beds from adjacent bare soil. This edge strip shall remain in place until all bare soils contiguous to beds are stabilized and vegetated. In addition, take any other necessary steps to prevent sediment from washing into beds during site development: When the site is fully stabilized, temporary sediment control devices shall be removed.

3.03 PAVING

A. General Requirements

1. Contractor shall prepare the site to receive the subsequent improvements shown on Drawings and outlined herein.
2. Remove loose and foreign materials from compacted surfaces -immediately before application of paving.
3. Do not displace choker course material. Uniformly grade all ruts and ridges prior to installation of hot mix asphalt to provide uniform material thickness.
4. Place mixture in as continuous an operation as practicable.
5. Hand Placing:
 - a. Spread, tamp and finish mixture using hand tools in areas where machine spreading is not possible, as acceptable to Engineer.
 - b. Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperature.
6. Joints:
 - a. Gradually make joints between old and new pavements, or between successive days' work, to ensure a continuous bond between adjoining work.
 - b. Construct joints to have same texture, density and smoothness as adjacent sections of asphalt concrete course.
 - c. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat.
 - d. Cut back edge of previously placed course to expose an even, vertical surface for full course thickness.
 - e. When the edges of longitudinal joints are irregular, honeycombed, or inadequately compacted, cut back unsatisfactory section to expose an even, vertical surface for full course thickness.

3.04 CLEANING

- A. Cleaning: After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of the Engineer.

3.05 PROTECTION

- A. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened and less than 140°F or approved by the Engineer.

- B. Provide barricades and warning devices as required to protect pavement and the general public.
- C. Cover openings of structures in the area of paving until permanent coverings are placed.

END OF SECTION