

**ITEM 400HS STANDARD SPECIFICATION FOR
ASPHALT CONCRETE - HIGH STRESS
USING STONE MASTIC ASPHALT
WITH SBS POLYMER**

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This Specification has been developed by Flexible Pavements, Inc., an Association for the development, improvement and advancement of quality asphalt pavement construction in Ohio. The most current update of this document can be obtained by contacting Flexible Pavements, Inc. at 1-888-4 HOT MIX.

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400HS.01 General. This work shall consist of furnishing, placing and compacting surface or intermediate courses of hot mix asphalt, designed for high stresses, on a prepared surface in accordance with these specifications and in reasonably close conformity with the lines, grades, and typical sections shown on the plans or established by the owner representative.

Where reference is made to ODOT requirements, the requirements of The Ohio Department of Transportation, Construction and Materials Specifications, current edition shall apply.

Hot mix asphalt shall be placed by weight per unit of area as determined by the thickness shown on the plans or in the proposal and weight to volume conversion factors specified under method of measurement, ODOT, 401.17.

The requirements of ODOT, 441 and 446 shall apply; deviations from these are as shown.

Tack coat, when required, and the use of reclaimed material also shall meet ODOT requirements.

When used in this specification, the term "owner" is to be understood as the entity having ownership of the facility for which the work has been contracted.

400HS.02 Composition. The stone mastic asphalt mixture designed for high stresses shall be composed of aggregate, asphalt binder and SBS polymer. Aggregate and asphalt binder shall meet ODOT requirements and modifications provided herein. The SBS polymer shall meet the manufacturers' requirements as detailed in the mixture specifications provided herein.

The contractor shall furnish a JMF (Job Mix Formula) or ODOT Bituminous Concrete Data Sheet suitable for the purpose of pavement construction. The JMF shall be established within the composition limits for the high stress mixture. Prior to producing material for this contract, the contractor shall submit to the owner representative, for approval, a JMF or data sheet. The JMF shall include the mix type being used, aggregate type and gradation, percentage of asphalt binder by weight of mixture, grade of asphalt binder, source of the SBS polymer and unit weight of the mixture. The JMF, or data sheet, shall have previously been approved for use on ODOT work. Where no previously approved JMF is available, one shall be developed meeting all criteria established herein and shall be reviewed by an independent testing laboratory prior to submission to the owner representative. The person performing the review for the testing laboratory must be of its employ and shall have a current Level II Bituminous Concrete Certification from the Ohio Department of Transportation. The independent testing laboratory shall certify to the owner the mix design is accurate, complete, and meets the requirements of this specification. Costs for performing this review shall be included in the price per unit of mix.

For hot mix asphalt produced under the provisions of this specification, the contractor shall develop a JMF which meets the following limits:

Characteristic	Total Percent Passing
¾ inch sieve	100
½ inch sieve	85 - 98
3/8 inch sieve	55 - 75
No. 4 sieve	20 - 30
No. 8 sieve	15 - 26
No. 16 sieve	12 - 22
No. 30 sieve	11 - 20
No. 50 sieve	10 - 18
No. 100 sieve	9 - 15
No. 200 sieve	9 - 12
Bitumen (1)	5.8 - 9.0
VMA (2)	15.0%
Drainage Test (3)	0.3%

Notes:

- (1) Percent of total mix.
- (2) Based on bulk gravity
- (3) National Center for Asphalt Technology (NCAT) test method, on file at the ODOT laboratory.

The F/A Ratio and F/T Value shall not apply.

The SMA shall be designed using a 50 blow Marshall and meet the properties for medium traffic volumes, except the design air voids shall be 3.5%.

For design and quality control, the Marshall specimens shall be compacted at 149°C (300°F).

The design specification for flow is waived.

The coarse aggregate, retained on the No. 4 sieve, shall have a maximum LA Abrasion of 35, a maximum of 20% 3 to 1 flat and elongated pieces in accordance with ASTM D 4791, and a minimum of 90% mechanically crushed particles. A mechanically crushed particle is defined as a particle having rough, angular edges resulting from mechanical crushing.

All of the virgin fine aggregate shall be sand manufactured from stone, gravel or air-cooled slag. If the sand is manufactured from gravel it shall be crushed from gravel material retained on the 3/8-inch sieve.

Fines from the baghouse shall be limited to 3.0% of the total weight of aggregate in the mix design unless metered from a silo through a system having been previously approved by the ODOT laboratory. The remainder of the filler in the JMF shall have a plasticity index not greater than 4. Remaining filler shall be incorporated to achieve consistent mix properties but shall not be premixed with another aggregate or be from another aggregate used in the mixture. Cement, hydrated lime or flyash shall not be used as a filler material.

No reclaimed pavement shall be permitted.

Mixture composition shall include a bituminous material consisting of a styrene butadiene styrene polymer block copolymer (SBS polymer) blended into an asphalt cement before delivery to the asphalt plant. The SBS polymer modified asphalt cement shall be smooth, homogeneous and meet the following properties:

Property	ASTM Test Method	Specification
SBS Polymer, percent by weight of asphalt cement		Note 1
Viscosity of Original Asphalt Cement, 60C, Poise	D 2171	Note 1
Penetration, 25C, 100 grams, 5 sec.	D 5	50 - 75
Viscosity, 60C, Poise	D 2171	5000 min.
Viscosity, 135C, CST	D 2070	Note 1
Ring & Ball Softening Point, °C	D 36	60 min.
Flash Point, °C	D 92	232 min.
Solubility in Trichloroethylene, percent	D 2042	99.0 min.
Separation of Polymer, °C	Note 2	6 max.
Force Ratio, f_2/f_1	Note 3	0.35 min.
Penetration, 4C, 200 grams, 60 sec.	Note 4	10 min.
Elastic Recovery, percent	Note 4 & 5	70 min.

Notes:

- (1) Report results of test.
- (2) Absolute difference in Ring and Ball (ASTM D 36) test from top to bottom tested on material stored at 171C for 48 hours.
- (3) The Force Ratio is defined as the force at 300 mm elongation (f_2) divided by the maximum force at the initial peak (f_1) when the SBS polymer modified asphalt cement is tested in accordance with ASTM D 113 with the following conditions and modifications:
 - a) The testing temperature shall be 4C.
 - b) The rate of travel shall be 50 mm/minute [2 inches/minute].
 - c) The standard V-shaped sides for the specimen mold are replaced by straight-sided inserts of the same length, such that the specimen will contain a section of 10 mm x 10 mm x 30 mm [0.4 x 0.4 x 1.2 inches].
 - d) A calibrated force adapter is placed on one end of the specimen mold so the tensile force can be determined at any point during the elongation.
- (4) Test on residue from rolling thin film oven test.
- (5) The SBS polymer modified asphalt cement is tested in accordance with ASTM D 113. The ductilometer and specimen should be conditioned at 25C. The conditioned specimen is placed in the ductilometer and elongated to 100 mm at a rate of pull of 50 mm/minute [2 inches/minute]. Upon reaching the 100 mm (4 inch) elongation, the ductilometer is stopped. The sample is held in the elongated position for 5 minutes and then clipped approximately in half with a suitable cutting device. The sample is to remain in the ductilometer in an undisturbed condition for 1 hour. The half sample is then retracted until the 2 cut ends touch. The elongation is measured in millimeters (E). Elastic Recovery, in percent, is equal to $[(100 - E)/100] \times 100$.

When the contractor submits the proposed JMF to the owner representative, the JMF submittal shall include the manufacturer's certified test data that the SBS polymer modified asphalt cement meets the above specification requirements.

The SBS polymer modified asphalt cement shall be shipped at 177°C (350°F) and stored at 160° to 165°C (320° to 330°F).

The proposed JMF shall be a design which has been properly modified to incorporate the SBS polymer modified asphalt cement.

The asphalt concrete with SBS polymer shall be a minimum of 149°C (300°F) when delivered to the paver.

The SMA shall not be stored at the plant for more than 2 hours and shall be a minimum of 300°F when it arrives at the paver, unless otherwise approved by the owner's representative. If drain-down occurs, storage time shall be shortened.

Quality Control tests shall be performed every 2 hours of production. Tests shall determine: binder content, gradation, moisture content, air voids, voids in mineral aggregate, and maximum specific gravity.

In addition to the quality control requirements of ODOT, 441.10, a drainage test (on file at the ODOT laboratory) shall be performed once each day of production.

During the production of the SMA until such time as the owner's representative determines the manufacturing process is adequately controlled, the contractor shall have at the plant or construction site a representative having a current ODOT Level II Bituminous Concrete Certification.

Table C of 441.10 shall be modified as follows:

The 4.75 mm (No. 4) and 75 µm (No. 200) sieve design bands shall not be exceeded by the moving average of three tests.

Mix Characteristic	Specification Limits	Warning Band Limits
Bitumen	-0.4 to 0.4	-0.3 to 0.3
12.5 mm (0.5 inch) sieve	-6.0 to 6.0	-5.5 to 5.5
4.75 mm (No. 4) sieve	-5.0 to 5.0	-4.5 to 4.5
75 µm (No. 200) sieve	-2.0 to 2.0	-1.8 to 1.8
Air Voids	2.5 to 4.5	2.7 to 4.3

Compaction shall start immediately after the SMA has been placed by the paver. Compaction equipment shall be limited to steel wheel rollers. Vibratory rollers, if used in vibratory mode, shall be set at high frequency and low amplitude, and shall only be used in the breakdown position. Isolated fat spots shall be sanded as soon as practicable during compaction. Placement shall cease if continuous fat spots develop.

400HS.03 Acceptance. Acceptance of the mixture shall be in accordance with ODOT, 446.05, except that an independent testing laboratory shall test the cores in accordance with ODOT Supplement 1036 and report the data to the owner's representative for the purpose of calculating the pay factor. The person testing the cores shall have a current Level I Bituminous Concrete Certification from the Ohio Department of Transportation. Costs for the acceptance testing shall be included in the price per unit of mix.

Table A of ODOT, 446.05 shall be modified as follows:

Mean of 10 cores as percent of daily MSG

93.0% or greater	1.00
92.0% to 92.9%	0.97
91.0% to 91.9%	0.94
90.0% to 90.9%	0.88
Less than 90.0%	*

*The owner will determine whether the material will remain in place. The pay factor for such material allowed to remain in place will be 0.70.

400HS.04 Basis of Payment. Payment for accepted quantities of mix, complete in place, will be made at the contract price for:

Item	Unit	Description
400HS	Cubic Yard	Asphalt Concrete - High Stress