

Chip Seal Surface Treatment will be measured and paid for at the Contract unit price for one or more of the items listed below as specified in the Contract Documents.

**503.04.01** No. 7 Aggregate for Single Coat Chip Seal Surface Treatment per ton.

**503.04.02** No. 8 Aggregate for Second Coat Chip Seal Surface Treatment per ton.

**503.04.03** Emulsified Asphalt for Seal Coat per gallon.

The actual number of gallons of emulsified asphalt distributed will be corrected to the corresponding volume at 60 F as determined by use of conversion tables furnished by the Administration.

## **SECTION 504 — HOT MIX ASPHALT PAVEMENT**

**504.01 DESCRIPTION.** This work shall consist of constructing hot mix asphalt (HMA) pavement as specified in the Contract Documents.

### **504.02 MATERIALS.**

Performance Graded Asphalt Binders	904.02
Tack Coat	904.03
Hot Mix Asphalt Mixes	904.04
Crack Filler	911.01
Production Plant	915

### **504.03 CONSTRUCTION.**

**Quality Control Plan.** At least 30 days prior to the placement of any HMA pavement, the Contractor shall submit in writing a plant Quality Control Plan to the Team Leader of the Asphalt Team and a field Quality Control Plan to the Engineer for approval. The Quality Control Plans shall contain a statistically based procedure of random sampling and shall show how the Contractor proposes to control the equipment, materials, production and paving operations to ensure conformance with these Specifications. A master plant Quality Control Plan may be submitted for this prior approval. If a master plant quality control plan is submitted and approved, an addendum shall be submitted for each specific Contract.

The plan shall contain production plants, location of plants with respect to the project site, personnel qualifications, inspection and record keeping methods, and minimum frequencies of sampling and testing as specified in MSMT 730, Table 3. The plan shall also detail when and how corrective action will be taken for unsatisfactory construction practices and deviations from the material Specifications. Additionally, the plan shall include a Quality Control Plan for the plant which addresses all elements necessary for quality control.

**Plan Administrator and Certified Technicians.** The Quality Control Plan shall designate a Plan Administrator. The Plan Administrator shall have full authority to institute any action necessary for the successful operation of the Plan. The Plan Administrator may supervise the Quality Control Plan on more than one project if that person can be in contact with the job site within one hour after being notified of a problem.

The Quality Control Plan shall also designate a Certified Plant Control Technician, Field Control Technician and Certified Materials Tester, if used, as specified in MSMT 731.

**Records.** The Contractor shall maintain complete records of sampling, testing, actions taken to correct problems and quality control inspection results and shall make them available to the Engineer upon request. Copies of the reports shall be provided when requested by the Engineer.

Linear control charts shall be maintained by the Contractor. Control charts shall be maintained in the Quality Control laboratory in a manner satisfactory to the Engineer and shall be current. As a minimum, the control charts shall identify the mix design number, each test result and the upper and lower specification limits applicable to each test.

**Acceptance.** The Administration will provide acceptance by:

- (a) Conducting independent verification sampling and testing separate from the Contractor/producer.
- (b) Periodically observing tests performed by the producer.
- (c) Monitoring required control charts.
- (d) Directing the producer to take additional samples at any time and location.
- (e) Monitoring the Contractor's conformance with the Quality Control Plan.

- (f) Evaluating quality control sampling and testing by an independent assurance program.

The Contractor shall protect the pavement against damage from all causes. Any part of the pavement that is damaged shall be repaired or replaced by the Contractor at no additional cost to the Administration.

**504.03.01 Equipment.** All equipment, including the production plant and paving equipment, shall be subject to approval by the Engineer. The plant shall be ready for inspection by the Engineer at least 48 hours prior to the start of construction operations.

- (a) **Hauling Units.** Refer to 915.02(f). Due regard shall be given to the safety and convenience of the public while applying and maintaining the tack coat. Provisions shall be made to minimize hauling trucks from tracking tack coat onto the adjacent pavement.
- (b) **Pavers.** Pavers will be inspected and approved by the Engineer based upon the manufacturer's specification manual (copy to be provided by the Contractor). The paver shall be a self-contained, self-propelled unit capable of spreading the mixture true to line, grade and cross slope. The paver shall be equipped with a screed or strike off assembly that will produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture. The paver shall have automatic controls for transverse slope and grade. Controls shall be capable of sensing grade from an outside reference line or ski and sensing the transverse slope of the screed to maintain the required grade and transverse slope within plus or minus 0.1 of the required slope percentage.

Manual operation will be permitted in the construction of irregularly shaped and minor areas, or where directed by the Engineer.

Whenever a breakdown or malfunction of any automatic control occurs, the equipment may be operated manually for the remainder of the work day as directed by the Engineer.

Reference lines or other suitable markings to control the horizontal alignment shall be provided by the Contractor, subject to the approval of the Engineer.

- (c) **Rollers.** Rollers shall be self-propelled, reversible, and steel wheeled or pneumatic tired. Rollers may be vibratory or nonvibratory, and they may be operated in the vibratory mode as

long as the Engineer determines that the roller is not cracking or damaging the aggregate in the mix. Rollers shall not be used in the vibratory mode on bridge decks. Pneumatic tire rollers shall have multiple tires of equal size with smooth tread. Wheels shall be arranged to oscillate in pairs, or they may be individually sprung. Tires shall be uniformly inflated at the operating pressure approved by the Engineer. The Contractor shall furnish the Engineer a manufacturer's table showing this data. The difference in tire pressure between any two tires shall not be greater than 5 psi. The Contractor shall provide a means for checking the tire pressure on the job at all times.

**504.03.02 Weather Restrictions.** HMA material shall only be placed on roadway surfaces when the ambient air and surface temperature is at least 40 F and rising for surface mixes and at least 32 F and rising for base mixes. The pavement surfaces shall be clean and dry and approved by the Engineer before HMA paving begins. Placing HMA material on a frozen graded aggregate base is prohibited. When weather conditions differ from these limits, material en route from the plant to the job site may be used at the Contractor's risk. If placement of the material is stopped by the Engineer, all material en route shall be wasted at no additional cost to the Administration.

**504.03.03 Foundation Preparation.** Prior to placement of paving material, the foundation shall be constructed as specified in the Contract Documents and approved by the Engineer. When paving over existing pavement, all excess crack filling or patch material shall be removed and all spalls and potholes shall be cleaned, tack coated, filled and tamped with HMA before placement. Manholes, valve boxes, inlets, and other appurtenances within the area to be paved shall be adjusted to grade as directed by the Engineer.

**504.03.04 Tack Coat.** Prior to application of the tack coat, the surface shall be cleaned of all loose and foreign materials. The tack coat shall be uniformly applied to the surface by full circulation spray bars that are laterally and vertically adjustable and provide triple fanning and overlapping action so that the resulting coating shall be residual asphalt applied at a rate of 0.01 to 0.05 gal/yd<sup>2</sup> as directed by the Engineer.

**504.03.05 Hot Mix Asphalt Placement.** HMA shall be placed by the paver. Delivery of the mixture by the hauling units and placement shall be continuous. The temperature of the mixture shall be a minimum of 225 F at the time of placement. Broadcasting of loose mixture over the new surface is prohibited.

**504.03.06 Compaction.** Immediately following placement of the HMA, the mixture shall be compacted by rolling to an in place density of 92.0 to

97.0 percent of the maximum density. In place compaction shall be completed before the mixture cools below 185 F, as determined by a probe type surface thermometer, supplied by the Contractor and approved by the Engineer. Price adjustment due to noncompliance with the required density will be as specified in 504.04.02. Probe type surface thermometer shall remain the property of the Contractor at the completion of the project.

Rolling shall consist of six separate operations in the following sequence:

- (a) Transverse joint.
- (b) Longitudinal joint.
- (c) Edges.
- (d) Initial breakdown rolling.
- (e) Second or intermediate rolling.
- (f) Finish rolling.

Steel wheel rollers shall be used for the first rolling of all joints and edges, the initial breakdown rolling, and the finish rolling.

Rollers shall start at the sides and proceed longitudinally toward the center of the pavement, except on superelevated curves. The rolling shall begin at the low side and progress toward the high side. Successive trips of the roller shall overlap by at least half the width of the roller, and alternate trips shall not end at the same point. When base widening is too narrow to permit the use of conventional rollers, a power driven trench roller shall be used. When the trench must be excavated wider than the proposed width of the widening, an earth berm or shoulder shall be formed against the loose HMA as soon as it is placed. The two materials shall be rolled and compacted simultaneously. Roller marks shall not be visible after rolling operations.

After rolling is completed, no traffic of any kind will be permitted on the pavement until the pavement has cooled to less than 140 F or as directed by the Engineer.

**504.03.07 Joints.** Both longitudinal and transverse joints in successive courses shall be staggered so that one is not above the other. Transverse joints shall be staggered by the length of the paver. Longitudinal joints shall be staggered a minimum of 6 in. and shall be arranged so that the

longitudinal joint in the top course shall be within 6 in. of the line dividing the traffic lanes.

Joints shall be constructed to provide a continuous bond between the old and new surfaces.

Joints shall be coated with tack coat as directed by the Engineer. When placing a surface course, the edge of the existing pavement shall be cut back for its full depth at transverse joints to expose a fresh surface which shall be coated with tack coat material as directed by the Engineer. Before placing the mixture against curbs, gutters, headers, manholes, etc., all contact surfaces shall be coated with tack coat.

**504.03.08 Edge Dropoff.** Where HMA paving is being applied to highways carrying traffic, all pavement courses exceeding 2-1/2 in. in depth shall be matched with the abutting lane or shoulder on the same working day. Where pavement courses of 2-1/2 in. or less are placed, the Contractor shall have the option of paving the abutting lane or shoulder on alternate days. The abutting lane or shoulder shall be paved regardless of the depth of pavement course prior to weekends and temporary shutdowns. When uneven pavement joints exist, the Contractor shall provide advance warning traffic control devices in conformance with the Contract Documents.

**504.03.09 Tie-In.** Where HMA paving is being applied to the traveled way carrying traffic, the Contractor shall construct a temporary tie-in a minimum of 4 ft in length for each 1 in. of pavement depth before traffic is allowed to cross the transverse joint.

The final tie-in shall include the removal of a transverse portion of the existing pavement to a depth so the design thickness of the final surface course is maintained. The length of the final tie-in shall be equal to the posted speed per 1 in. depth of the design thickness of the final course with a minimum length of 25 ft per 1 in. depth and a maximum length of 50 ft per 1 in. depth.

**504.03.10 Sampling and Testing for Density.** Density testing shall be performed before allowing traffic or construction equipment on the in place material and before placement of the next layer.

- (a) **Compaction for Quality Control.** A lot shall not exceed 1000 tons. A subplot shall not exceed 200 tons. Five consecutive 200 ton sublots shall equal one lot. A lot may contain only one subplot that is less than 200 tons.

On any paving day when production does not end in a multiple of 1000 tons, the remaining fraction shall be considered another lot.

A paving day shall begin with a new lot and sublots. Control strips shall be divided into five equal sublots.

On Contracts requiring less than 500 tons of HMA or when HMA is used in nontraffic areas or on bridge decks, acceptance will be determined by the use of a thin layer nuclear density gauge, when tested in conformance with the manufacturer's recommendations. When the HMA courses are compacted to 1 in. or less, a control strip shall be constructed on the first day of paving. Readings shall be taken with a thin layer nuclear density gauge to determine roller patterns and the number of coverages to obtain optimum density. Optimum density is defined as when the average density does not change by more than 1.0 percent between successive coverages of a 400 to 500 ft area. This optimum density shall be used to determine HMA acceptance after approval by the Engineer. Any lot average 2.0 percent or more below optimum density shall require a new control strip be constructed and tested before paving continues.

The Contractor may use the core or the combined nuclear/core method of testing on Contracts requiring 500 tons or more.

The Contractor shall secure samples and perform tests as follows:

- (1) **Core Method.** When the core method is used, the Contractor shall take samples as specified in MSMT 451, Method B, for each subplot of material placed. Core sample locations will be randomly determined by the Engineer in conformance with MSMT 418.

Two core samples shall be taken from each subplot no later than the next day after compaction. The size diameter cores shall be 4 or 6 in. cores for 9.5 mm, 12.5 mm, and 19.0 mm mixes; and 6 in. cores for 25.0 mm and 37.5 mm mixes. These cores shall represent the day's production and shall be taken prior to placement of the next layer.

Core samples shall be tested in conformance with MSMT 452. The specific gravity of the samples shall be expressed as a percentage of the maximum specific gravity determined for each lot of material. The in place density of each mixture in each lot shall be 92.0 to 97.0 percent. The two core results from each subplot shall be averaged and compliance will be determined on the basis of all sublots tested for each material. Results shall be made available by the Contractor no later than the following work day.

- (2) **Nuclear/Core Method.** The nuclear gauge shall be calibrated in conformance with MSMT 417. A daily validation and standard count shall be performed as specified in the manufacturer's recommendations. A log of these validations and counts shall be with the gauge at all times.

Two one-minute special calibration nuclear tests shall be conducted on each subplot as specified in MSMT 418 no later than the next work day after compaction. A special calibration nuclear test is defined as an average of a minimum of two special calibration readings taken at the same location after rotating the gauge 180 degrees. Two tests per subplot; a minimum of four readings (2 tests  $\times$  2 readings/test = 4) shall be taken. Likewise, a 1000 ton lot shall have a minimum of 20 readings (5 sublots  $\times$  2 tests/sublot  $\times$  2 readings/test = 20).

The results of the two nuclear tests in each subplot shall be averaged and conformance will be determined on the basis of all sublots tested for each material.

Three cores for each lot of material shall be sampled; one at each of three different nuclear test locations determined by the Engineer. The average of the three core results and the average of the three corresponding nuclear tests shall be within 3.0 lb/ft<sup>3</sup>. When the difference between nuclear test results and core test results is greater than 3.0 lb/ft<sup>3</sup>, the Contractor shall use the core method of testing. The Contractor may return to the nuclear/core method of testing when all calibration criteria are met. If the Contractor's nuclear test results again fail to conform to the 3.0 lb/ft<sup>3</sup> maximum requirement, the core method of density determination shall be used for the remainder of the project.

**(b) Acceptance Testing.**

- (1) **Core Method.** Acceptance testing will be performed on a minimum of three cores per 6000 tons when the core method of control is used. If the specific gravity difference on each of the three cores is within 0.030, all the lots will be evaluated individually using the test results of quality control samples as specified in 504.04.02. If the difference is greater than 0.030, the Engineer will conduct tests on the remainder of the quality control samples since the last acceptance and all the lots will be evaluated individually using the Engineer's test results.

- (2) **Nuclear/Core Method.** When the nuclear/core method is used, the Engineer will witness the Contractor's testing and coring and will perform acceptance testing on three verification cores from any one lot since the last acceptance. If the density difference between the average of three verification cores and the average of three corresponding nuclear tests is within  $3.0 \text{ lb/ft}^3$ , all the lots will be evaluated individually using nuclear quality control test results as specified in 504.04.02.

If the difference is greater than  $3.0 \text{ lb/ft}^3$ , the Engineer will test the remainder of the verification cores since the last acceptance. All lots will be evaluated for the  $3.0 \text{ lb/ft}^3$  difference. Lots not conforming to the  $3.0 \text{ lb/ft}^3$  difference will be evaluated individually as specified in 504.04.02 using verification core test results. Lots conforming to the  $3.0 \text{ lb/ft}^3$  difference will be evaluated individually.

**504.03.11 Control Strip.** The Contractor may opt to construct a control strip for guidance in determining roller patterns to achieve optimum density. When a control strip is constructed, it shall be placed on the first workday in which HMA is placed and shall be between 400 and 500 ft in length. Based on the Contractor's evaluation of the initial control strip, paving may continue at the Contractor's risk.

The Contractor will not be assessed a density pay adjustment for the amount of material required for construction of the control strips. Should the removal of any control strip be necessary, it shall be removed by the Contractor at no additional cost to the Administration.

The Engineer may require the Contractor to construct a control strip any time during placement of HMA based on the evaluation of compaction results.

**504.03.12 Pavement Surface Checks.** The Contractor shall have available, at all times, a 10 ft straightedge approved by the Engineer. After final compaction of each course, the surface of each pavement course shall be true to the established line and grade and shall be sufficiently smooth so that when tested with a 10 ft straightedge placed upon the surface parallel with the center line, the surface shall not deviate more than  $1/8$  in. The transverse slope of the finished surface of each course when tested with a 10 ft straightedge placed perpendicular to the center line, the surface shall not deviate more than  $3/16$  in.

Transverse joints on each course shall be checked with a 10 ft straightedge immediately after the initial rolling. If the surface of each course varies more than  $1/8$  in. from true, the Contractor shall make

immediate corrections acceptable to the Engineer so that the finished joint surface shall comply.

**504.03.13 Curbs, Gutters, Etc.** Where permanent curbs, gutters, edges, and other supports are planned, they shall be constructed and backfilled prior to placing the HMA, which shall then be placed and compacted against them.

**504.03.14 Shoulders.** Shoulders abutting the HMA surface course of any two lane pavement that is being used by traffic shall be completed as soon as possible after completion of the surface course on that lane. Shoulder construction shall be as specified in the applicable portions of the Specifications and the Contact Documents.

**504.03.15 Pavement Profile.** Refer to the Pavement Surface Profile requirements specified in the Contract Documents.

**504.04 MEASUREMENT AND PAYMENT.** Hot Mix Asphalt Pavement will be measured and paid for at the Contract unit price per ton. The payment will be full compensation for furnishing, hauling, placing all materials including antistripping additive, tack coat, control strip, pot hole and spall repairs, setting of lines and grades where specified, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Placement and removal of the temporary tie-in where hot mix asphalt is being applied to the traveled way carrying traffic will not be measured but the cost will be incidental to the pertinent Hot Mix Asphalt item.

Removal of the existing pavement or structure for the final tie-in will be measured and paid for at the Contract unit price for the pertinent items used. The hot mix asphalt for the final tie-in will be measured and paid for at the Contract unit price for pertinent Hot Mix Asphalt item.

Adjustment of existing visible manholes, valve boxes, inlets or other structures will not be measured but the cost will be incidental to the Hot Mix Asphalt item.

Adjustment of existing manholes, valve boxes, inlets or other structures that are encountered below the existing grade will be considered for payment in conformance with GP-4.07.

Removal of existing raised pavement markers will not be measured but the cost will be incidental to the Hot Mix Asphalt item.

Removal of existing raised pavement markers that are encountered below the existing pavement will be considered for payment in conformance with GP-4.07.

**504.04.01 Price Adjustment for Asphalt Binder.** An adjustment will be made to the final Contract unit price of Hot Mix Asphalt if the price of asphalt binder fluctuates significantly from the prevailing price as quoted in the Contract Documents to the date of placement. This includes HMA patching material converted to tons. The Contract unit price will be adjusted by the amount of fluctuation above 5 percent for Contracts scheduled to be paved during more than one construction season or having an estimated mix quantity of 10 000 tons or more. For Contracts completed within one construction season and having an estimated mix quantity of less than 10 000 tons, the adjustment will be based upon the amount of fluctuation above 15 percent. Only the differential percent change beyond the above noted 5 and 15 percent will be used.

For the purpose of making these calculations, a monthly price index will be maintained by the Administration. This index will be the average F.O.B. selling price of asphalt binder at the supplier's terminal in the State of Maryland.

The adjusted Contract unit price of Hot Mix Asphalt will be computed monthly by using the following formula:

$$F = (PP - Pb) / Pb \times 100$$

where:

- F = percent price increase/decrease of asphalt binder.
- PP = index price of asphalt binder per ton at placement date, and
- Pb = prevailing index price of asphalt binder per ton as specified in the Invitation for Bids.

Adjusted Contract unit price due Contractor when price of asphalt binder increases:

$$A = B + (D \times T \times Pb)$$

Adjusted Contract unit price due Administration when price of asphalt binder decreases:

$$A = B - (D \times T \times Pb)$$

where:

- A = adjusted Contract unit price per ton of Hot Mix Asphalt.
- B = Contract unit price per ton of Hot Mix Asphalt.
- D = differential percentage expressed as a decimal (F – 5 percent or F – 15 percent as defined above).
- T = design target asphalt content expressed as a decimal, and
- Pb = prevailing index price of asphalt binder per ton as specified in the Invitation for Bids.

**504.04.02 Price Adjustment for Hot Mix Asphalt Properties and Pavement Density.** A price adjustment may be made as specified in GP-5.02, when the hot mix asphalt properties or pavement density does not conform to Specifications. The Contract unit price will be adjusted in conformance with these procedures. Acceptance and payment factors of specified mixes will be based on density, binder content and gradation. A pay factor for density and a composite pay factor for binder content and gradation will be computed using the Quality Level Analysis - Standard Deviation Method specified in MSMT 730 to determine the total estimated percent of the lot that is within Specification limits. The Lot Payment for density and the Lot Payment for binder content, and gradation shall be computed as follows:

$$\text{Lot Payment} = (\text{Contract Unit Price}) \times (\text{Pay Factor}) \times (\text{Tonnage}).$$

A lot containing material with a pay factor of less than 1.0 may be accepted at the reduced pay factor, provided the pay factor for density and the composite pay factor for binder content and grading are both at least 0.75 and there are no isolated defects identified by the Engineer. A lot containing material not conforming to the Specifications may be terminated by the Engineer, and the material in the shortened lot paid for at the reduced pay factor or the Engineer may order removal of the nonconforming material. A lot containing nonconforming material that fails to obtain at least a 0.75 pay factor for density or a 0.75 composite pay factor for binder content and gradation, will be rejected and shall be replaced at no additional cost to the Administration.

If less than three samples have been obtained at the time of the verification sampling or at the time a lot is terminated, the material in the shortened lot will be considered a part of the previous lot, or will be accepted based on the individual test data at the Engineer's discretion.

**504.04.03 Control Strip Price Adjustment.** The cost of the control strip, if constructed, will not be measured but will be incidental to the pertinent Hot Mix Asphalt item.