

DIVISION 400 - BITUMINOUS PAVEMENTS**SECTION 401 - HOT MIX ASPHALT (HMA) - GENERAL**

401.01--Description. These specifications include general requirements that are applicable to all types of HMA along with the specific requirements for each particular mixture when deviations from the general requirements are necessary.

This work consists of the construction of one or more lifts of HMA in accordance with these specifications and the specific requirements for the mixture to be produced and in reasonably close conformity with the lines, grades, thicknesses and typical sections shown on the plans or established by the Engineer.

401.01.1--Definitions.

Maximum Sieve Size - Maximum sieve size is the smallest sieve size at which 100 percent of the aggregate passes.

Nominal Maximum Sieve Size - The nominal maximum sieve size is one sieve size larger than the first sieve to retain more than 10 percent of the aggregate.

Maximum Density Line - The maximum density line is a straight line plot on the FHWA 0.45 power gradation chart which extends from the zero origin point of the chart through the plotted point of the combined aggregate gradation curve on the nominal maximum sieve size.

Mechanically Fractured Face - An angular, rough, or broken surface of an aggregate particle created by crushing as determined by ASTM Designation: D 5821.

401.02--Materials.**401.02.1--Component Materials.**

401.02.1.1--General. Component materials will be conditionally accepted at the plant subject to later rejection if incorporated in a mixture or in work which fails to meet contract requirements.

401.02.1.2--Aggregates. The source of aggregates shall meet the applicable requirements of Section 703.

401.02.1.2.1--Coarse Aggregate Blend. Mechanically fractured faces by weight of the combined mineral aggregate coarser than the No. 4 sieve:

<u>Mixture</u>	<u>Percent Fractured Faces, minimum</u>
25 mm	70, one-face
19 mm*	80, one-face
12.5 mm	90, two-face
9.5 mm	90, two-face
4.75 mm	90, two-face

* When used on routes requiring polymer modified asphalt, the top intermediate lift (19 mm mixture), including travel lane and adjacent lane, shall have at least 90 percent two fractured faces minimum. When placed on an existing Portland Cement Concrete surface, all intermediate lifts (19 mm mixture) shall have at least 90 percent fractured two faces minimum.

The maximum percentage by weight of flat and elongated particles, for all mixes other than 4.75 mm, maximum to minimum dimension greater than 5, shall not exceed 10% for all mixtures. This shall be determined in accordance with ASTM Designation: D 4791, Section 8.4, on the combined mineral aggregate retained on the 3/8” sieve.

401.02.1.2.2--Fine Aggregate Blend. Of all the material passing the No. 8 sieve and retained on the No. 200 sieve, not more than 60 percent shall pass the No. 30 sieve.

Uncrushed natural sand shall pass the 3/8” sieve and may be used, excluding the content in RAP, in the percentages of the total mineral aggregate by weight set out in the following table:

Mixture	Maximum Percentage of Natural Sand by Total Weight of Mineral Aggregate		
	HT	MT	ST
25 mm	10	10	20
19 mm	10	10	20
12.5 mm	10	10	20
9.5 mm	10	10	10
4.75 mm	25	30	35

401.02.1.2.3--Combined Aggregate Blend.

Design Master Range

Mixture:	25 mm	19 mm	12.5 mm	9.5 mm	4.75 mm
Nominal Maximum Sieve Size:	1 inch	3/4 inch	1/2 inch	3/8 inch	1/4 inch
Sieve Size	Percent Passing				
1-1/2 inch	100				
1 inch	90-100	100			
3/4 inch	89 max.	90-100	100		
1/2 inch	-	89 max.	90-100	100	100
3/8 inch	-	-	89 max.	90-100	95-100
No. 4	-	-	-	89 max.	90-100
No. 8	16-50	18-55	20-60	22-70	-
No. 16	-	-	-	-	30-60
No. 200	4.0-9.0	4.0-9.0	4.0-9.0	4.0-9.0	6.0-12.0

For MT and HT mixtures, the combined aggregate gradation of the job mix formula, when plotted on FHWA 0.45 power chart paper, shall fall entirely below the Maximum Density Line on all sieve sizes smaller than the No. 4 sieve. However, MT and HT mixtures having a minimum fine aggregate angularity index of 44.0, per ASTM Designation: C1252, Method A, may be designed above the maximum density line.

The 9.5 mm mixtures shall have a minimum fine aggregate angularity of 44.0 for HT and MT mixtures and 40.0 for ST mixtures when tested on combined aggregate in accordance with ASTM Designation: C1252 Method A. The 4.75 mm mixtures shall have a minimum fine aggregate angularity of 45.0 for all design levels when tested on combined aggregate in accordance with ASTM Designation: C 1252, Method A.

The minus No. 40 fraction of the combined aggregate shall be non-plastic when tested according to AASHTO Designation: T 90. The clay content for the combined aggregate for underlying layers shall not exceed 1.0 percent, and for the top layer shall not exceed 0.5 percent by weight of the total mineral aggregate when tested according to AASHTO Designation: T 88.

401.02.1.3--Bituminous Materials. Bituminous materials shall meet the applicable requirements of Section 702 for the grade specified.

Tack coat shall be the same neat grade asphalt cement used in the mixture being placed or those materials specified for tack coat in Table 410-A on the last page of Section 410. Emulsified asphalt shall not be diluted without approval of the Engineer.

401.02.1.4--Blank.

401.02.1.5--Hydrated Lime. Hydrated lime shall meet the requirements of Subsection 714.03.2 for lime used in soil stabilization.

401.02.1.6--Asphalt Admixtures. Additives for liquid asphalt, when required or permitted, shall meet the requirements of Subsection 702.08.

401.02.1.7--Polymers. Polymers for use in polymer modified HMA pavements shall meet the requirements of Subsection 702.08.3.

401.02.2--Blank.

401.02.3--Composition of Mixtures.

401.02.3.1--General. Unless otherwise specified or permitted, the HMA shall consist of a uniform mixture of asphalt, aggregate, hydrated lime and, when required or necessary to obtain desired properties, antistripping agent and/or other materials.

The total amount of crushed limestone aggregate for mixtures, excluding 4.75 mm mixtures, when used in the top lift, shall not exceed 50 percent of the total combined aggregate by weight.

Hydrated lime shall be used in all HMA at the rate of one percent (1%) by weight of the total dry aggregate including aggregate in RAP, if used. The aggregate, prior to the addition of the hydrated lime, shall contain sufficient surface moisture. If necessary, the Contractor shall add moisture to the aggregate according to the procedures set out in Subsection 401.03.2.1.2.

The Contractor shall obtain a shipping ticket for each shipment of hydrated lime. The Contractor shall provide the District Materials Engineer with a copy of each shipping ticket from the supplier, including the date, time and weight of hydrated lime shipped and used in hot mix asphalt production. An amount equal to twenty-five percent (25%) of the total value of HMA items performed during the initial estimate period in which the Contractor fails to submit the hydrated lime shipping tickets to the District Materials Engineer will be withheld from the Contractor's earned work. Non-conformance with this specification for successive estimate period(s) will result in the total value (100%) of HMA items performed during this period(s) being withheld from the Contractor's earned work. Monies withheld for this non-conformance will be released for payment on the next monthly estimate following the date the submittal of hydrated lime shipping tickets to the District Materials Engineer is brought back into compliance with this specification.

Mixtures will require the addition of an antistripping agent when the Tensile Strength Ratio (MT-63) and/or the Boiling Water Test (MT-59) fail to meet the following criteria.

Tensile Strength Ratio (TSR - MT-63)

Wet Strength / Dry Strength	85 percent minimum
Interior Face Coating	95 percent minimum
Boiling Water Test (MT-59)	
Particle Coating	95 percent minimum

Reclaimed asphalt pavement (RAP) materials may be used in the production of HMA in the percentages of the total mix by weight set out in the following table:

HMA Mixture	Maximum percent RAP by total weight of mix
4.75 mm	0
9.5 mm	15
12.5 mm Top Lift	15
12.5 mm Underlying Lift	30
19 mm	30
25 mm	30

During HMA production, the RAP shall pass through a maximum 2-inch square sieve located in the HMA plant after the RAP cold feed bin and prior to the RAP weighing system.

Crushed reclaimed concrete pavement may be used as an aggregate component of all HMA pavements. When crushed reclaimed concrete pavement is used as an aggregate component, controls shall be implemented to prevent segregation. Crushed reclaimed concrete pavement aggregate shall be separated into coarse and fine aggregate stockpiles using the 3/8-in or 1/2-in sieve as a break-point unless otherwise approved by the Engineer in writing.

401.02.3.1.1--Mixture Properties.

<u>ALL MIXTURES</u>	<u>Percent of Maximum Specific Gravity (Gmm)</u>
N _{Design}	96.0
N _{Initial}	Less than 90.0
N _{Maximum}	Less than 98.0
 <u>VMA CRITERIA</u>	 <u>Minimum percent</u>
25-mm mixture	12.0
19-mm mixture	13.0
12.5-mm mixture	14.0
9.5-mm mixture	15.0
4.75 mm mixture	16.0

Mixtures with VMA more than two percent higher than the minimum may be susceptible to flushing and rutting; therefore, unless satisfactory experience with

high VMA mixtures is available, mixtures with VMA greater than two percent above the minimum should be avoided.

The specified VFA range for 4.75 mm nominal maximum size mixtures for design traffic levels >3 million ESAL's (HT Mixtures) shall be 75 to 78 percent, for design traffic levels of 1.0 to 3 million ESAL's (MT mixtures) 65 to 78 percent, and for design traffic levels of <1.0 million ESAL's (ST mixtures) 65 to 78 percent.

DUST/BINDER RATIO for 4.75 mm mixtures

Percent Passing No.200 / Effective Binder Percent 0.9 to 2.0

DUST/BINDER RATIO for 9.5 mm, 12.5 mm, 19 mm & 25mm mixtures

Percent Passing No.200 / Effective Binder Percent 0.8 to 1.6

401.02.3.2--Job Mix Formula. The job mix formula shall be established in accordance with Mississippi Test Method: MT-78, where N represents the number of revolutions of the gyratory compactor.

Compaction Requirements:	$N_{Initial}$	N_{Design}	$N_{Maximum}$
High Type (HT) Mixtures			
19 mm, 12.5 mm, 9.5 mm & 4.75 mm	7	85	130
Medium Type (MT) Mixtures			
19 mm, 12.5 mm, 9.5 mm & 4.75 mm	7	65	100
All Standard Type (ST) Mixtures;			
25 mm HT & MT Mixtures	6	50	75

At least 10 working days prior to the proposed use of each mixture, the Contractor shall submit in writing to the Engineer a proposed job-mix formula or request the transfer of a verified job-mix formula as set forth in the latest edition of MDOT's Field Manual for HMA and SOP TMD-11-78-00-000. The job-mix formula shall be signed by a Certified Mixture Design Technician (CMDT).

The Department will perform the tests necessary for review of a proposed job-mix formula for each required mixture free of charge one time only. A charge will be made for additional job-mix formulas submitted by the Contractor for review.

Review of the proposed job-mix formula will be based on percent maximum specific gravity at $N_{Initial}$, N_{Design} , and $N_{Maximum}$, VMA @ N_{Design} , resistance to stripping, and other criteria specified for the mixture.

The mixture shall conform thereto within the range of tolerances specified for the particular mixture. No change in properties or proportion of any component of

the job-mix formula shall be made without permission of the Engineer. The job-mix formula for each mixture shall be in effect until revised in writing by the Engineer.

A job-mix formula may be transferred to other contracts in accordance with conditions set forth in the Department's Field Manual for HMA.

The Contractor shall not place any HMA prior to receiving "tentative" approval and a MDOT design number from the Central Laboratory.

When a change in source of materials, unsatisfactory mixture production results (such as segregation, bleeding, shoving, rutting over $\frac{1}{8}$ "", raveling & cracking) or changed conditions make it necessary, a new job-mix formula will be required. The conditions set out herein for the original job-mix formula are applicable to the new job-mix formula.

401.02.4--Substitution of Mixture. The substitution of a one (1) size finer mixture for an underlying lift shall require written permission of the State Construction Engineer, except no substitution of a 4.75 mm mixture will be allowed. A 9.5 mm mixture may be substituted for the 12.5 mm mixture designated on the plans as the top lift or pre-leveling. The 19 mm mixture may be substituted for the 25 mm mixture in trench widening work. Any substitution of mixtures shall be of the same type. No other substitutions will be allowed. The quantity of substituted mixture shall be measured and paid for at the contract unit price for the mixture designated on the plans. The substitution of any mixture will be contingent on meeting the required total structure thickness and maintaining the minimum and/or maximum laying thickness for the particular substituted mixture as set out in the following table.

Mixture	Single Lift Laying Thickness Inches	
	Minimum	Maximum
25 mm	3	4
19 mm	2 $\frac{1}{4}$	3
12.5 mm	1 $\frac{1}{2}$	2
9.5 mm	1	1 $\frac{1}{2}$
4.75 mm	$\frac{1}{2}$	$\frac{3}{4}$

401.02.5--Contractor's Quality Management Program.

401.02.5.1--General. The Contractor shall have full responsibility for quality management and maintain a quality control system that will furnish reasonable assurance that the mixtures and all component materials incorporated in the work conform to contract requirements. The Contractor shall have responsibility for the initial determination and all subsequent adjustments in proportioning

materials used to produce the specified mixture. Adjustments to plant operation and spreading and compaction procedures shall be made immediately when results indicate that they are necessary. Mixture produced by the Contractor without the required testing or personnel on the project shall be subject to removal and replacement by the Contractor at no additional cost to the State.

401.02.5.2--Personnel Requirements. The Contractor shall provide at least one Certified Asphalt Technician-I (CAT-I) full-time during HMA production at each plant site used to furnish material to the project. Sampling shall be conducted by a certified technician or by plant personnel under the direct observation of a certified technician. All testing, data analysis and data posting will be performed by the CAT-I or by an assistant under the direct supervision of the CAT-I. The Contractor shall have a Certified Asphalt Technician-II (CAT-II) available to make any necessary process adjustments. Technician certification shall be in accordance with MDOT SOP TMD-22-10-00-000, MDOT HMA Technician Certification Program. An organizational chart, including names, telephone numbers and current certification, of all those responsible for the quality control program shall be posted in the Contractor's laboratory while the asphaltic paving work is in progress.

401.02.5.3--Testing Requirements. As a minimum, the Contractor's quality management program shall include the following:

- (a) Bituminous Material. Provide Engineer with samples in a sealed one quart metal container at the frequency given in MDOT SOP TMD-20-04-00-000.
- (b) Mechanically Fractured Face. Determine mechanically fractured face content of aggregates retained on the No. 4 sieve, at a minimum of one test per day of production.
- (c) Mixture Gradation. Conduct extraction tests for gradation determination on the mixture. Sample according to the frequency in paragraph (i) and test according to Mississippi Test Method MT-31.
- (d) Total Voids and VMA. Determine total voids and voids in mineral aggregate (VMA), at N_{Design} , from the results of bulk specific gravity tests on laboratory compacted specimens. Sample according to the sampling frequency in paragraph (i) and test according to the latest edition of MDOT's Field Manual for HMA.
- (e) Asphalt Content. Sample according to the sampling frequency in paragraph (i). Determine the asphalt content using one of the following procedures.
 - (1) Nuclear gauge per Mississippi Test Method MT-6.
 - (2) Incinerator oven per AASHTO Designation: T 308, Method A.

- (f) Stripping Tests. Conduct a minimum of one stripping test at the beginning of each job-mix production and thereafter, at least once per each two weeks of production according to Mississippi Test Method: MT-63 and one stripping test per day of production according to Mississippi Test Method: MT-59. Should either the TSR (MT-63) or the boiling water (MT-59) stripping tests fail, a new antistripping additive or rate shall be established or other changes made immediately that will result in a mixture which conforms to the specifications; otherwise, production shall be suspended until corrections are made.
- (g) Density Tests. For 25 mm, 19.5 mm, 12.5 mm & 9.5 mm mixtures, conduct density tests as necessary to control and maintain required compaction according to Mississippi Test Method: MT-16, Method C (nuclear gauge), or AASHTO Designation: T 166. Note - The nuclear gauge may be correlated, at the Contractor's option, with the average of a minimum of five pavement sample densities. For 4.75 mm mixtures, conduct density tests as necessary to control and maintain required compaction according to AASHTO Designation: T 166.
- (h) Quality Control Charts. Plot the individual test data, the average of the last four tests and the control limits for the following items as a minimum:

Mixture Gradation (Percent Passing) Sieves:

1/2-in, 3/8-in, No. 8, No. 16, No. 30 and No. 200.

Asphalt Content, Percent

Maximum Specific Gravity, G_{mm}

Total Voids @ N_{Design} , Percent

VMA @ N_{Design} , Percent

NOTE: For 4.75 mm mixtures, Quality Control Charts for mixture gradation are not required on the No. 8 and No. 30 sieves. For 4.75 mm mixtures, as a minimum, Quality Control Charts for mixture gradation shall be kept on the 3/8-in, No. 16 and No. 200 sieves. For all mixtures other than 4.75 mm, Quality Control Charts for mixture gradation are not required on the No. 16 sieve.

Keep charts up-to-date and posted in a readily observable location. Charts may be kept on a computer, however, the charts shall be printed out a minimum of once each production day and displayed in the laboratory. Note any process changes or adjustments on the Air Voids chart.

- (i) Sampling Frequency. Conduct those tests as required above at the following frequency for each mixture produced based on the estimated

plant tonnage at the beginning of the day.

<u>Total Estimated Production, tons</u>	<u>Number of Tests</u>
50-800	1
801-1700	2
1701-2700	3
2701+	4

NOTE: Material placed in a storage silo from a previous day's production shall be randomly sampled and tested when removed for placement on the roadway. Such sample(s) shall be independent of the day's production sampling frequency and shall be used in calculating the four (4) sample running average.

- (j) **Sample Requirements.** Obtain the asphalt mixture samples from trucks at the plant. Obtain aggregate samples from cold feed bins or aggregate stockpile. Save a split portion of all mixture samples at the laboratory site in a dry and protected location for 14 calendar days. At the completion of the project, the remaining samples may be disposed of with the approval of the Engineer.

The above testing frequencies are for the estimated plant production for the day. If production is discontinued or interrupted, the tests will be conducted at the previously established sample tonnage points for the materials that are actually produced. If the production exceeds the estimated tonnage, sampling and testing will continue at the testing increments previously established for the day. A testing increment is defined as the estimated daily tonnage divided by the required number of tests from the table in Subsection 401.02.5.3 paragraph (i).

In addition to the above program, the following tests shall be conducted on the first day of production and once for every eight production samples thereafter, with a minimum of one test per production week.

Aggregate Stockpile Gradations per AASHTO Designations: T-11 and T-27.

Reclaimed Asphalt Pavement (RAP) Gradation per Mississippi Test Method MT-31.

Fine Aggregate Angularity for all 4.75 mm and 9.5 mm mixtures and all MT and HT mixtures designed above the maximum density line per ASTM Designation: C 1252, Method A.

Testing of the aggregate and RAP stockpiles during production will be waived provided the Contractor provides the Engineer with gradation test results for the materials in the stockpile determined during the building of the stockpiles. The test results provided shall represent a minimum frequency of one per one

thousand tons of material in the stockpile. If the Contractor continues to add materials to the stockpile during HMA production, the requirements for gradation testing during production are not waived.

401.02.5.4--Documentation. The Contractor shall document all observations, records of inspection, adjustments to the mixture, and test results on a daily basis. All tests conducted by the Contractor in accordance with Subsection 401.02.5.3(h) shall be included in the running average calculations. If single tests are performed as a check on individual HMA properties, between regular samples, without performing all tests required in Subsection 401.02.5.3(h), the results of those individual tests shall not be included in the running average calculations for that particular property. The Contractor shall record the results of observations and records of inspection as they occur in a permanent field record. The Contractor shall record all process adjustments and job mix formula (JMF) changes on the air void charts. The Contractor shall provide copies of all test data sheets and the daily summary reports on the appropriate Mississippi DOT forms to the Engineer on a daily basis. The Contractor shall provide a written description of any process change, including blend proportions, to the Engineer as they occur. Information provided to the Engineer must be received in the Engineer's office by no later than 9:00 AM the day after the HMA is produced. Fourteen days after the completion of the placement of the HMA, the Contractor shall provide the Engineer with the original testing records and control charts in a neat and orderly manner.

401.02.5.5--Control Limits. The following control limits for the job mix formula (JMF) and warning limits are based on a running average of the last four data points.

<u>Item</u>	<u>JMF Limits</u>	<u>Warning Limits</u>
Sieve - % Passing		
1/2-in	± 5.5	± 4.0
3/8-in	± 5.5	± 4.0
No. 8	± 5.0	± 4.0
No. 16, for 4.75 mm mixtures ONLY	± 4.0	± 3.0
No. 30	± 4.0	± 3.0
No. 200	± 1.5	± 1.0
Asphalt Content, %	-0.3 to +0.5	-0.2 to + 0.4
Total Voids @ N _{Design} , %	± 1.3	± 1.0
VMA @ N _{Design} , %	- 1.5	- 1.0

401.02.5.6--Warning Bands. Warning bands are defined as the area between the JMF limits and the warning limits.

401.02.5.7--Job Mix Formula Adjustments. A request for a JMF adjustment signed by a CAT-II may be made to the Engineer by the Contractor. Submit sufficient testing data with the request to justify the change. The requested

change will be reviewed by the State Materials Engineer for the Department. If current production values meet the mixture design requirements, a revised JMF will be issued. Adjustments to the JMF shall conform to the latest edition of MDOT's Field Manual for HMA. Adjustments to the JMF to conform to actual production shall not exceed the tolerances specified for the JMF limits. Regardless of such tolerances, any adjusted JMF gradation shall be within the design master range for the mixture specified. The JMF asphalt content may only be reduced if the production VMA meets or exceeds the minimum design VMA requirements for the mixture being produced.

401.02.5.8--Actions and Adjustments. Based on the process control test results for any property in question, the following actions shall be taken or adjustments made when appropriate:

- (a) When the running average trends toward the warning limits, the Contractor shall consider taking corrective action. The corrective action, if any, shall be documented. All tests shall be part of the contract files and shall be included in the running average calculations.
- (b) The Contractor shall notify the Engineer whenever the running average exceeds the warning limits.
- (c) If two consecutive running averages exceed the warning limit, the Contractor shall stop production and make adjustments. Production shall only be restarted after notifying the Engineer of the adjustments made.
- (d) If the adjustment made under (c) improves the process such that the running average after four additional tests is within the warning limits, the Contractor may continue production with no reduction in payment.
- (e) If the adjustment made under (c) does not improve the process and the running average after four additional tests stays in the warning band, the mixture will be considered unsatisfactory. Reduced payment for unsatisfactory mixtures will be applied starting from the stop point to the point when the running average is back within the warning limits in accordance with Subsection 401.02.6.3.
- (f) Failure to stop production and make adjustments when required shall subject all mixture produced from the stop point to the point when the running average is back within the warning limits to be considered unsatisfactory. Reduced payment for unsatisfactory mixtures will be applied in accordance with Subsection 401.02.6.3.
- (g) If the running average exceeds the JMF limits, the Contractor shall stop production and make adjustments. Production shall only be restarted after notifying the Engineer of the adjustments made.
- (h) All materials for which the running average exceeds the JMF limits will be considered unacceptable and shall be removed and replaced by the Contractor at no additional cost to the State. The Engineer will determine the quantity of material to be replaced based on a review of the individual testing data which make up the running average in question and an inspection of the completed pavement. If the Engineer decides to

leave the mixture in place because of special circumstances, the quantity of mixture, as defined above, will be paid for in accordance with Subsection 401.02.6.3.

- (i) Single test results shall be compared to 1.7 times the warning and JMF limits. If the test results verified by QA testing (within allowable differences in Subsection 401.02.6.2) exceed these limits, the pay factor provided in Subsection 401.02.6.3 will apply for the quantity of material represented by the test(s). Single test limits will be used for the acceptance of projects when insufficient tonnage is produced to require four (4) Contractor's tests.
- (j) The above corrective action will also apply for a mixture when the Contractor's testing data has been proven incorrect. The Contractor's data will be considered incorrect when; 1) the Contractor's tests and the Engineer's tests do not agree within the allowable differences given in Subsection 401.02.6.2 and the difference can not be resolved, or 2) the Engineer's tests indicates that production is outside the JMF limits and the results have been verified by the Materials Division. The Engineer's data will be used in place of the Contractor's data to determine the appropriate pay factor.

401.02.6--Standards of Acceptance.

401.02.6.1--General. Acceptance for mixture quality (VMA and total voids @ N_{Design} , gradation, and asphalt content) will be based on random samples tested in accordance with the latest edition of MDOT's Field Manual for HMA. Pavement densities and smoothness will be accepted by lots as set out in Subsections 401.02.6.4 and 401.02.6.5.

401.02.6.2--Assurance Program for Mixture Quality. The rounding of test results will be in accordance with Subsection 700.04.

The Engineer will conduct assurance tests on split samples taken by the Contractor. These samples may be the regular quality management samples or a sample chosen by the Engineer anytime during production. The frequency will be equal to or greater than ten percent of the tests required for the Contractor quality control and the data will be provided to the Contractor within two asphalt mixture production days after the sample has been obtained by the Engineer. At least one sample shall be tested from the first two days of production. The Engineer may select any or all of the Contractor retained samples for assurance testing. All testing and data analysis shall be performed by a Certified Asphalt Technician-I (CAT-I) or by an assistant under the direct supervision of the CAT-I. Certification shall be in accordance with MDOT SOP TMD-22-10-00-000, MDOT HMA Technician Certification Program. The Department shall post a chart giving the names and telephone numbers for the personnel responsible for the assurance program.

The Engineer shall be allowed to inspect measuring and testing devices to confirm

both calibration and condition. The Contractor shall calibrate and correlate all testing equipment in accordance with the latest version of the Department's Test Methods.

Random differences between the Contractor's and Engineer's split sample test results will be considered acceptable if within the following limits:

Item	Allowable Differences
Sieve - % Passing	
3/8-in and above	6.0
No. 4	5.0
No. 8	4.0
No. 16, for 4.75 mm mixtures ONLY	3.5
No. 30	3.5
No. 200	2.0
AC Content	0.4
Specimen Bulk SG, Gmb @ N _{Design}	0.030
Maximum SG, Gmm	0.020

In the event that; 1) the comparison of the Contractor's and Engineer's test results are outside the allowable differences in the above table, or 2) if a bias exists between the results, such that one of the results is predominately higher or lower than the other, and the Engineer's results fail to meet the JMF control limits, the Engineer will investigate the reason immediately. The Engineer's investigation may include testing of the remaining split samples, review and observation of the Contractor's testing procedures and equipment, and a comparison of split sample test results by the Contractor quality control laboratory, Department quality assurance laboratory and the Materials Division. The procedures outlined in the latest edition of MDOT's Field Manual for HMA may be used as a guide for the investigation. In the event that the Contractor's results are determined to be incorrect, the Engineer's results will be used for the quality control data and the appropriate payment for the mixture will be based on the procedures specified in Subsection 401.02.5.8(j).

The Engineer will periodically witness the sampling and testing being performed by the Contractor. The Engineer, both verbally and in writing, will promptly notify the Contractor of any observed deficiencies. When differences exist between the Contractor and the Engineer which cannot be resolved, a decision will be made by the State Materials Engineer, acting as the referee, and will in writing promptly notify the Contractor. If the deficiencies are not corrected, the Engineer will stop production until corrective action is taken.

401.02.6.3--Acceptance Procedure for Mixture Quality. All obviously defective material or mixture will be subject to rejection by the Engineer. Such defective material or mixture shall not be incorporated into the finished work. If the defective material has already been placed in the work, the material shall be removed and replaced at no additional cost to the State.

The Engineer will base final acceptance of the asphalt mixture production on the results of the Contractor's testing for total voids and VMA @ N_{Design} , gradation, and asphalt content as verified by the Engineer in the manner hereinbefore described and the uniformity and condition of the completed pavement. Areas of pavement that exhibit non-uniformity or failures, materials or construction related, such as but not limited to segregation, bleeding, shoving, rutting over $\frac{1}{8}$ "", raveling, slippage, or cracking will not be accepted. Such areas will be removed and replaced at no additional cost to the State.

Bituminous mixture placed prior to correction for deficiencies in VMA and total voids @ N_{Design} , gradation, or asphalt content, as required in Subsection 401.02.5.8 and determined by the Engineer satisfactory to remain in place will be paid for in accordance with the following pay factors times the contract unit price per ton.

Pay Factor for Mixture Quality *

Item	Produced in Warning Bands	Produced Outside JMF Limits, Allowed to Remain in Place
Gradation	0.90	0.75
Asphalt Content	0.85	0.75
Total Voids @ N_{Design}	0.70	0.50
VMA @ N_{Design}	0.90	0.75

* The minimum single payment will apply.

401.02.6.4--Acceptance Procedure for Density. Each completed lift will be accepted with respect to compaction on a lot to lot basis from density tests performed by the Department. For normal production days, divide the production into approximately equal lots as shown in the following table. When cores are being used for the compaction evaluation, randomly obtain one core from each lot. When the nuclear density gauge is being used for compaction evaluation, obtain two random readings from each lot and average the results. See Chapter 7 of the latest edition of MDOT's Field Manual for HMA for more details. Additional tests may be required by the Engineer to determine acceptance of work appearing deficient. The Contractor shall furnish and maintain traffic control for all compaction evaluations, including coring, required in satisfying specified density requirements.

Lot Determination

<u>Daily Production - Tons</u>	<u>Number of Lots</u>
0-300	1
301-600	2
601-1000	3
1001-1500	4
1501-2100	5
2101-2800	6
2801+	7

401.02.6.4.1--Roadway Density. The density requirement for each completed lift on a lot to lot basis from density tests performed by the Department shall be as follows:

1. For all single lift overlays, with or without leveling and/or milling, the required lot density shall be 92.0 percent of maximum density.
2. For all multiple lift overlays of two (2) or more lifts excluding leveling lifts, the required lot density of the bottom lift shall be 92.0 percent of maximum density. The required lot density for all subsequent lifts shall be 93.0 percent of maximum density.
3. For all pavements on new construction, the required lot density for all lifts shall be 93.0 percent of maximum density.

When it is determined that the density for a lot is below the required density (93.0 percent or 92.0 percent) but not lower than 91.0 or 90.0 percent of maximum density, respectively, the Contractor will have the right to remove and replace the lot(s) not meeting the specified density requirements in lieu of accepting reduced payment for the lot(s).

When it is determined that the density for a lot is above 96.0 percent, the Engineer shall notify the Contractor who will make plant adjustments to resolve the problem.

When it is determined that the density for a lot is below 91.0 or 90.0 percent, respectively, the lot(s), or portions thereof shall be removed and replaced in accordance with Chapter 7 of the latest edition of MDOT's Field Manual for HMA at no additional cost to the State. A corrected lot will be retested for approval. No resampling will be performed when pavement samples are used for determining density.

At any time the average daily compaction (the total of the percent compaction for the lots produced in one day divided by the total number of lots for the day) does not meet the required percent compaction or more for two consecutive days, the

Contractor shall notify the Engineer of proposed changes to the compactive effort. If the average daily compaction does not meet the required percent compaction or more for a third consecutive day, the Contractor shall stop production until compaction procedures are established to meet the specified density requirements.

Each lot of work found not to meet the density requirement of 92.0% or 93% of maximum density, respectively, may remain in place with a reduction in payment as set out in the following tables:

**PAYMENT SCHEDULE FOR COMPACTION
OF 92.0 PERCENT OF MAXIMUM DENSITY**

<u>Pay Factor</u>	<u>Lot Density ** % of Maximum Density</u>
1.00	92.0 and above
0.90	91.0 - 91.9
0.70	90.0 - 90.9

** Any lot or portion thereof with a density of less than 90.0 percent of maximum density shall be removed and replaced at no additional cost to the State.

**PAYMENT SCHEDULE FOR COMPACTION
OF 93.0 PERCENT OF MAXIMUM DENSITY**

<u>Pay Factor</u>	<u>Lot Density *** % of Maximum Density</u>
1.00	93.0 and above
0.90	92.0 - 92.9
0.70	91.0 - 91.9

*** Any lot or portion thereof with a density of less than 91.0 percent of maximum density shall be removed and replaced at no additional cost to the State.

The compaction pay factors and mixture quality pay factor, as described in Subsection 401.02.6.3, will each apply separately. However, the combined pay factor shall not be less than 0.50 for any mixture allowed to remain in place.

401.02.6.4.2--Trench Widening Density. The density for trench widening on a lot to lot basis shall be determined from density tests performed by the Department using pavement samples (cores).

When it is determined that the density for a trench widening lot is below 89.0 percent but not lower than 88.0 percent of maximum density, the Contractor will

have the right to remove and replace the lot(s) not meeting the specified density requirements in lieu of accepting reduced payment for the lot(s).

When it is determined that the density for a trench widening lot is above 95.0 percent, the Engineer shall notify the Contractor who will make plant adjustments to resolve the problem.

When it is determined that the density for a trench widening lot is below 88.0 percent, the lot(s), or portions thereof shall be removed and replaced in accordance with Chapter 7 of the latest edition of MDOT’s Field Manual for HMA at no additional cost to the State. A corrected lot will be retested for approval. No resampling will be performed when pavement samples are used for determining density.

At any time the daily compaction (the total of the percent compaction for the lots produced in one day divided by the total number of lots for the day) does not meet 89.0 percent compaction or more for two consecutive days, the Contractor shall notify the Engineer of proposed changes to the compactive effort. If the average daily compaction does not meet 89.0 percent compaction or more for a third consecutive day, the Contractor shall stop production until compaction procedures are established to meet the specified density requirement.

Each lot of trench widening work found not to meet the density requirement of 91.0 percent of maximum density may remain in place with a reduction in payment as set out in the following table:

**PAYMENT SCHEDULE FOR COMPACTION
TRENCH WIDENING WORK**

<u>Pay Factor</u>	<u>Lot Density *** % of Maximum Density</u>
1.00	89.0 and above
0.50	88.0 - 88.9

*** Any lot or portion thereof with a density of less than 88.0 percent of maximum density shall be removed and replaced at no additional cost to the State.

The compaction pay factors and mixture quality pay factor, as described in Subsection 401.02.6.3, will each apply separately. However, the combined pay factor shall not be less than 0.50 for any mixture allowed to remain in place.

401.02.6.5--Acceptance Procedure for Pavement Smoothness. When compaction is completed, the lift shall have a uniform surface and be in reasonably close conformity with the line, grade and cross section shown on the plans.

The smoothness of each applicable lift will be determined by using a California Profilograph to produce a profilogram (profile trace) at each designated location. The surface shall be tested and corrected to a smoothness index as described herein with the exception of those locations or specific projects that are excluded from a smoothness test with the profilograph.

The profilograph, furnished and operated by the Contractor under supervision of the Engineer, shall consist of a frame at least 25 feet in length supported upon multiple wheels having no common axle. The wheels shall be arranged in a staggered pattern so that no two wheels will simultaneously cross the same bump. A profile is to be recorded from the vertical movement of a sensing mechanism. This profile is in reference to the mean elevation of the contact points established by the support wheels. The sensing mechanism, located at the mid-frame, may consist of a single bicycle-type wheel or a dual-wheel assembly consisting of either a bicycle-type (pneumatic tire) or solid rubber tire vertical sensing wheel and a separate bicycle-type (pneumatic tire) longitudinal sensing wheel. The wheel(s) shall be of such circumference(s) to produce a profilogram recorded on a scale of one (1) inch equal to 25 feet longitudinally and one (1) inch equal to one (1) inch (full scale) vertically. Motive power may be provided manually or by the use of a propulsion unit attached to the center assembly. In operation, the profilograph shall be moved longitudinally along the pavement at a speed no greater than 3 MPH so as to reduce bounce as much as possible. The testing equipment and procedure shall comply with the requirements of Department SOP.

The Contractor may elect to use a computerized version of the profilograph in lieu of the standard profilograph. If the computerized version of the profilograph is used, it shall meet the requirements of Subsection 401.02.6.6.

The smoothness of each applicable lift will be determined for traffic lanes, auxiliary lanes, climbing lane and two-way turn lanes. Areas excluded from a smoothness test with the profilograph are acceleration and deceleration lanes, tapered sections, transition sections for width, shoulders, crossovers, ramps, side street returns, etc. The roadway pavement on bridge replacement projects having 1,000 feet or less of pavement on each side of the structure will be excluded from a test with the profilograph. Pavement on horizontal curves having a radius of less than 1,000 feet at the centerline and pavement within the superelevation transition of such curves are excluded from a test with the profilograph. The profilogram shall terminate 15 feet from each transverse joint that separates the pavement from a bridge deck, bridge approach slab or existing pavement not constructed under the contract.

A profilogram will be made for each applicable lift. The measurements will be made in the outside wheel path of exterior lanes and either wheel path of interior lanes. The wheel path is designated as being located three feet from the edge of pavement or longitudinal joint. The testing will be limited to a single

profilogram for each lift of a lane except that a new profilogram will be made on segments that have been surface corrected. When surface corrections are required and/or made, a new profilogram will be made. The new profilogram shall meet the requirements of Subsection 403.03.2.

Each applicable lift will be accepted on a segment to segment basis for pavement smoothness. Where the profile index requirement of the lift is 30.0 inches per mile, no segment of the lift with a profile index greater than 30.0 inches per mile shall be allowed to remain in place without correction. For the purpose of determining pavement smoothness and contract price adjustment for rideability as described in Subsection 403.03.2, each day's production will be sub-divided into sections which terminate at bridges, transverse joints or other interruptions. Each section will be sub-divided into segments of 528 feet. Where a segment less than 528 feet occurs at the end of a section, it will be combined with the preceding 528-foot segment for calculation of the profile index. The last 15 feet of a day's lift may not be obtainable until the lift is continued and for this reason may be included in the subsequent segment.

A profile index will be determined for each segment as inches per mile in excess of the "Zero" blanking band which is simply referred to as the "Profile Index". From the profilogram of each segment, the scallops above and below the "Zero" blanking band are totaled in tenths of an inch. The totaled count of tenths is converted to inches per mile to establish a smoothness profile index for that segment.

Individual bumps and/or dips that are identified on the profilogram by locating vertical deviations that exceed four tenths of an inch when measured from a chord length of 25 feet or less shall be corrected regardless of the profile index value of the segment. Surface correction by grinding shall be in accordance with Subsection 401.02.6.7. The Contractor shall also make other necessary surface corrections to ensure that the final profile index of the segment meets the requirements of Subsection 403.03.2.

Segment(s) exceeding the accepted profile index value shall be corrected as specified in Subsection 403.03.4. All such corrections shall be at the expense of the Contractor.

Scheduling will be the responsibility of the Contractor with approval of the Engineer, and the tests shall be conducted within 72 hours after each day's production unless authorized otherwise by the Engineer. The Contractor will be responsible for traffic control associated with this testing operation.

401.02.6.6--Computerized Profilograph.

401.02.6.6.1--General The computerized profilograph, furnished and operated by the Contractor under the supervision of the Engineer, shall be equipped with an on-board computer capable of meeting the following conditions.

Vertical displacement shall be sampled every three (3) inches or less along the roadway. The profile data shall be bandpass filtered in the computer to remove all spatial wavelengths shorter than two (2) feet. This shall be accomplished by a third order, low pass Butterworth filter. The resulting band limited profile will then be computer analyzed according to the California Profilograph reduction process to produce the required inches per mile index. This shall be accomplished by fitting a linear regression line to each 528 feet of continuous pavement section. This corresponds to the perfect placement of the blanking band bar by a human trace reducer. Scallops above and below the blanking band are then detected and totaled according to the California protocol. Bump/Dip analysis shall take place according to the California Profilograph reduction process.

The computerized profilograph shall be capable of producing a plot of the profile and a printout which will give the following data: Stations every twenty five (25) feet, bump/dip height and bump/dip length of specification (4/10 of an inch and 25 feet respectively), the blanking band width, date of measurement, total profile index in inches per mile for the measurement, total length of the measurement, and the raw inches for each tenth mile segment.

401.02.6.6.2--Mechanical Requirements. The profilograph shall consists of a frame twenty five (25) feet long supported at each end by multiple wheels. The frame shall be constructed to be easily dismantled for transporting. The profilograph shall be constructed from aluminum, stainless steel and chromed parts. The end support wheels shall be arranged in a staggered pattern such that no two wheels cross a transverse joint at the same time. The relative smoothness shall be measured by the vertical movement of an eight (8) inch or larger diameter sensing wheel at the midpoint of the 25-foot frame. The horizontal distance shall be measured by a twenty (20) inch or larger diameter pneumatic wheel. This profile shall be the mean elevation referenced to the twelve points of contact with the pavement established by the support wheels. Recorded graphical trace of the profile shall be on a scale of one inch equals one inch (full scale) vertical motion of the sensing wheel and one inch equals 25 feet horizontal motion of the profilograph.

401.02.6.6.3--Computer Requirements. The computer shall have the ability to produce output on sight for verification. The computerized output shall indicate the profile index for each specified section of roadway. Variable low and high pass third-order Butterworth filtering options shall be available. The printout shall be capable of showing station marks automatically on the output. Blanking band positioning for each specified section of the roadway shall be placed according to the least squares fit line of the collected data. Variable bump and dip tests shall be available to show "must correct" locations on the printout. The computer must have the ability to display on screen "must correct" conditions and alert the user with an audible warning when a "must correct" location has been located. The computer must have the ability to store profile data for later

reanalysis. The measurement program must be menu driven and IBM compatible. User selected options, identification, calibration factors, and time and date stamps shall be printed at the top of each printed report for verification. The control software must be upgradeable. A power source shall be included for each profilograph and be capable of supplying all power needs for a full days testing.

401.02.6.7--Surface Correction. Corrective work to bumps shall consist of diamond grinding in accordance with these specifications or methods approved by the Engineer. All surface areas corrected by grinding shall be sealed with a sealant approved by the Engineer.

401.02.6.7.1--Diamond Grinding. Grinding of asphalt surfaces shall consist of diamond grinding the existing asphalt pavement surface to remove surface distortions to achieve the specified surface smoothness requirements.

401.02.6.7.2--Equipment. The grinding equipment shall be a power driven, self-propelled machine that is specifically designed to smooth and texture pavement surfaces with diamond blades. The effective wheel base of the machine shall not be less than 12.0 feet. It shall have a set of pivoting tandem bogey wheels at the front of the machine and the rear wheels shall be arranged to travel in the track of the fresh cut pavement. The center of the grinding head shall be no further than 3.0 feet forward from the center of the back wheels.

The equipment shall be of a size that will cut or plane at least 2.0 feet wide. It shall also be of a shape and dimension that does not encroach on traffic movement outside of the work area. The equipment shall be capable of grinding the surface without causing spalls at joints, or other locations.

401.02.6.7.3--Construction. The construction operation shall be scheduled and proceed in a manner that produces a uniform finish surface. Grinding will be accomplished in a manner to provide positive lateral drainage by maintaining a constant cross-slope between grinding extremities in each lane.

The operation shall result in pavement that conforms to the typical cross-section and the requirements specified in Subsection 401.02.6.7.4. It is the intent of this specification that the surface smoothness characteristics be within the limits specified.

The Contractor shall establish positive means for removal of grinding residue. Solid residue shall be removed from pavement surfaces before it is blown by traffic action or wind. Residue shall not be permitted to flow across lanes used by public traffic or into gutters or drainage facilities, but may be allowed to flow into adjacent ditches.

401.02.6.7.4--Finished Pavement Surface. The grinding process shall produce

a pavement surface that is smooth and uniform in appearance with a longitudinal line type texture. The line type texture shall contain parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. The peaks of the ridges shall not be more than 1/16 inch higher than the bottoms of the grooves.

The finished pavement surface will be measured for riding quality. The grinding shall produce a riding surface which does not exceed either the specified profile index or the specified bump and dip limit.

401.02.7--Nuclear Gauges.

401.02.7.1--Nuclear Moisture-Density Gauge. The nuclear gauge unit used to monitor density shall contain a full data processor which holds all calibration constants necessary to compute and directly display wet density, moisture, and dry density in pounds per cubic foot. The data processor shall compute and display the percent moisture and percent density based on dry weight.

401.02.7.2--Nuclear Asphalt Content Gauge. The Contractor shall furnish and calibrate, unless designated otherwise in the contract, a Troxler Nuclear Asphalt Content Gauge Model 3241 or updated model, or a Campbell Nuclear Asphalt Content Gauge Model AC-2 or an approved equal.

401.03--Construction Requirements. Mississippi DOT has adopted the “Hot-Mix Asphalt Paving Handbook” as the guideline for acceptable HMA construction practices.

401.03.1--Specific Requirements.

401.03.1.1--Weather Limitations. The mixture shall not be placed when weather conditions prevent the proper handling and finishing or the surface on which it is to be placed is wet or frozen. At the time of placement, the air and pavement surface temperature limitations shall be equal to or exceed that specified in the following table:

TEMPERATURE LIMITATIONS

Compacted Thickness	Temperature
Less than 1½ inches	55°F
1½ inches to 2 inches	50°F
2¼ inches to 3 inches	45°F
Greater than 3 inches	40°F

When paving operations are discontinued because of rain, the mixture in transit shall be protected until the rain ceases. The surface on which the mixture is to be placed shall be swept to remove as much moisture as possible and the mixture

may then be placed subject to removal and replacement at no additional cost to the State if contract requirements are not met.

401.03.1.2--Tack Coat. Tack coat shall be applied to previously placed HMA and between lifts, unless otherwise directed by the Engineer. The tack coat shall be applied as a spray coating, fog coating, or "spider webbing". Construction requirements shall be in accordance with Subsection 407.03.

401.03.1.3--Blank.

401.03.1.4--Density. The lot density for all dense graded pavement lifts, except as provided below for preleveling, wedging [less than fifty percent (50%) of width greater than minimum lift thickness], ramp pads, irregular shoulder areas, median crossovers, turnouts, or other areas where the established rolling pattern cannot be performed, shall not be less than 92.0 percent of the maximum density based on AASHTO Designation: T 209 for the day's production. If a job-mix formula adjustment is made during the day which affects the maximum specific gravity, calculate a new average maximum density for the lot(s) placed after the change.

Pavement core samples obtained for determining density which have a thickness less than two times the maximum size aggregate permitted by the job-mix formula will not be used as a representative sample.

Preleveling, wedging [less than fifty percent (50%) of width greater than minimum lift thickness], ramp pads, irregular shoulder areas, median crossovers, turnouts, and other areas where an established rolling pattern cannot be obtained shall be compacted to refusal densification.

401.03.2--Bituminous Mixing Plants.

401.03.2.1--Plant Requirements.

401.03.2.1.1--Cold Aggregate Storage. The cold storage for hydrated lime shall be a separate bulk storage bin with a vane feeder or other approved feeder system which can readily be calibrated. The system shall provide a means for easy sampling of the hydrated lime additive and verifying the quantity of lime dispensed. The feeder system shall require a totalizer.

The hydrated lime additive equipment shall be interlocked and synchronized with the cold feed controls to operate concurrently with the cold feed operation which will automatically adjust the hydrated lime feed to variations in the cold aggregate feed. A positive signal system shall be installed which will automatically shut the plant down when malfunctions cause an improper supply of hydrated lime or water.

The plant shall not operate unless the entire hydrated lime system is functioning properly.

401.03.2.1.2--Cold Aggregate Feed. The hydrated lime shall be dispensed dry or as a slurry directly onto the composite aggregate between the cold feed and the dryer. The slurry shall consist of 1 part hydrated lime to 3 parts water.

When hydrated lime is introduced dry, a spray bar or other approved system capable of spraying all aggregate with water shall be installed in order to maintain all aggregate at the moisture condition set out in Subsection 401.02.3.1 prior to addition of the hydrated lime. An alternate system for spraying the coarse aggregate stockpiles may be allowed when approved by the Engineer. The approved equipment and methods shall consistently maintain the aggregate in a uniform, surface wet condition. The moisture content of the aggregate-hydrated lime mixture, following spraying and mixing, shall be introduced into the automatic moisture controls of the plant.

The aggregate-hydrated lime mixture shall be uniformly blended by some mechanical means such as a motorized "on the belt" mixer or pug mill located between the cold feed and the dryer. Other mixing devices may be used subject to approval by the Engineer.

A maximum of forty five (45) percent of the total aggregate blend may be fed through any single cold feed bin. If the JMF calls for more than forty five (45) percent of a specific aggregate, that aggregate must be fed through two (2) or more separate cold feed bins.

401.03.2.1.3--Dryer. The efficiency of drying aggregates shall be such that the moisture content of the top HMA mixture shall not exceed 0.50 percent by weight of the total mixture, and the moisture content of all the underlying mixtures shall not exceed 0.75 percent by weight of the total mixture being produced.

401.03.2.1.4--Blank.

401.03.2.1.5--Control of Bituminous Material and Antistripping Agent. Specified bituminous materials from different manufacturers or from different refineries of a single manufacturer shall not be mixed in the plant's asphalt cement supply system storage tank and used in the work without prior written approval of the Engineer. Approval is contingent upon the Engineer's receipt of three copies of the manufacturer's certified test report(s) from the Contractor showing that the bituminous material blend conforms to the specifications.

A satisfactory method of weighing or metering shall be provided to ensure the specified quantity of bituminous material. Provisions shall be provided for checking the quantity or rate of flow. Weighing or metering devices shall be

accurate within plus or minus one-half percent.

The antistripping agent shall be injected into the bituminous material immediately prior to the mixing operation with an approved in-line injector system capable of being calibrated so as to ensure the prescribed dosage.

An in-line spigot for sampling of asphalt shall be located between the asphalt storage tank and the antistripping agent in-line injector.

401.03.2.1.6--Thermometric Equipment. An armored thermometer of adequate range and calibrated in 5°F increments shall be fixed at a suitable location in the bituminous line near the charging valve of the mixer unit.

The plant shall be equipped with an approved dial-scale, mercury-actuated thermometer, pyrometer or other approved thermometric instrument placed at the discharge chute of the dryer to measure the temperature of the material.

When the temperature control is unsatisfactory, the Engineer may require an approved temperature-recording apparatus for better regulation of the temperature.

401.03.2.1.7--Screens. A scalping screen shall be used.

401.03.2.1.8--Dust Collector. The plant shall be equipped with a dust collector constructed to waste or return collected material. When collected material is returned, it shall be returned through a controlling device which will provide a uniform flow of material into the aggregate mixture.

401.03.2.1.9--Safety Requirements. A platform or other suitable device shall be provided so the Engineer will have access to the truck bodies for sampling and mixture temperature data.

401.03.2.1.10--Blank.

401.03.2.1.11--Truck Scales. The specifications, tolerances and regulations for commercial weighing and measuring devices as recommended by the National Bureau of Standards [National Institute of Standards and Technology (NIST) Handbook 44] shall govern truck scales used in the State of Mississippi, except weighing devices with a capacity of ten thousand (10,000) pounds or more used to weigh road construction materials (i.e. sand, gravel, asphalt, fill dirt, topsoil and concrete) shall have a tolerance of one-half of one percent (1/2 of 1%) in lieu of the requirements of Handbook 44 and shall be regulated by the Mississippi Department of Transportation.

Scales shall be checked and certified by a scale company certified in heavy truck weights by the Mississippi Department of Agriculture and Commerce. In the

case of scales used for measurement of materials on Department of Transportation projects, certification shall be performed in the presence of an authorized representative of the Department or a copy of the certification may be furnished for scales that have been checked and certified within the last six months for use on other Department of Transportation projects and are still in the position where previously tested. Scales that have not been checked and certified under NIST Handbook 44 guidelines, except for the herein modified tolerances allowed, shall be so checked and certified prior to use for measurement of materials on Department of Transportation projects. Tests shall be continued on six month intervals with the test conducted in the presence of an authorized representative of the Department.

Truck scales shall be accurate to one-half of one percent of the applied load, shall be sensitive to 20 pounds, and shall have a graduation of not more than 20 pounds.

The Contractor may use an electronic weighing system approved by the Engineer in lieu of truck scales. The system shall be equipped with an automatic print out system which will print a ticket for each load with the following information:

MDOT, Contractor's name, project number, county, ticket number, load number, pay item number, item description of the material delivered, date, time of day, haul vehicle number, gross weight, tare weight, net weight and total daily net weight.

When approved by the Engineer and materials are measured directly from a storage bin equipped with load cells, exceptions may be made to the gross and tare weight requirements.

The ticket shall also have a place for recording the temperature of HMA mixtures, if applicable, and the signatures of MDOT's plant and roadway inspectors. The load numbers for each project shall begin with load number one (1) for the first load of the day and shall be numbered consecutively without a break until the last load of the day. The Contractor shall provide MDOT with an original and one copy of each ticket. When the ticket information provided by the Contractor proves to be unsatisfactory, MDOT will use imprinter(s) and imprinter tickets to record load information. All recorded weights shall be in pounds and shall be accurate to within one-half of one percent of the true weight, and the system shall be sensitive to 20 pounds. The Engineer will require random loads to be checked on certified platform scales at no cost to the Department.

When an electronic weighing system utilizes the plant scales of a batch plant, the system may be used only in conjunction with a fully automatic batching and control system.

401.03.2.2--Additional Requirements for Batching Plants.

401.03.2.2.1--Plant Scales. The plant batch scale weight shall not exceed the platform scale weight by more than one percent (1.0%).

401.03.2.3--Additional Requirements for Drum Mixing Plants.

401.03.2.3.1--Plant Controls. The plant shall be operated with all the automatic controls as designed and provided by the plant manufacturer. If the automatic controls malfunction, brief periods of manual operations to complete the day's work or to protect the work already placed may be conducted with the approval of the Engineer. During manual operation, the Contractor must continue to produce a uniform mixture meeting all contract requirements.

401.03.2.3.2--Aggregate Handling and Proportioning. A screening unit shall be placed between the bins and the mixer to remove oversized aggregate, roots, clayballs, etc.

401.03.2.4--Surge or Storage Bins. Surge and/or storage systems may be used at the option of the Contractor provided each system is approved by the Department prior to use. Surge bins shall be emptied at the end of each day's operation. Storage silos may be used to store mixtures as follows:

19 mm & 25 mm mixtures	24 hours
9.5 mm & 12.5 mm mixtures	36 hours

The storage silos must be well sealed, completely heated and very well insulated. The mixture when removed from the storage silo shall be tested to ensure that it meets all the same specifications and requirements as the mixture delivered directly to the paving site. See Subsection 401.02.5.3, subparagraph (i) for sampling and testing requirements.

401.03.3--Hauling Equipment. The inside surfaces of each vehicle bed shall be coated with a light application of water and thin oil, soap solution, lime water solution or other approved material to prevent the mixture from sticking. Diesel fuel or gasoline shall not be used to lubricate vehicle beds. Truck beds shall be raised to drain excessive lubricants before placing mixture in the bed. An excess of lubricant will not be permitted.

401.03.4--Bituminous Pavers. The screed or strikeoff assembly shall be capable of vibrating and heating the full width of the mixture being placed and shall lay the lift with an automatic control device to the specified slope and grade without tearing, pulling or gouging the mixture surface.

401.03.5--Rollers. All rollers shall be self-propelled units capable of maintaining a smooth and uniform forward and reverse speed as required for

proper compaction. They shall be equipped with adjustable scrapers, water tanks, mats and a device for wetting the wheels or tires to prevent the mixture from sticking. Adhesion of the mixture to the rollers will not be permitted. The use of diesel fuel or gasoline for cleaning roller wheels or tires or to aid in preventing the mixture from sticking to the wheels or tires is prohibited.

All rollers shall be in good mechanical condition, free from leaking fuels and lubricants, loose link motion, faulty steering mechanism, worn king bolts and bearings. They shall be operational at slow speeds to avoid displacement of the mixture and capable of reversing direction smoothly and without backlash.

401.03.6--Preparation of Grade. The foundation upon which HMA pavement is to be placed shall be prepared in accordance with the applicable Section of the Standard Specification.

Unless otherwise directed, tack coat shall be applied to the underlying surface on which the mixture is to be placed. Emulsions, if used, must be allowed to "break" prior to placement of the bituminous mixture.

Bituminous mixture shall not be placed against the edge of pavements, curbs, gutters, manholes and other structures until sprayed with a thin uniform tack coating. The tack coat shall be protected until the mixture has been placed.

Existing HMA pavements that require preliminary leveling or patching in advance of placing the bituminous mixture shall be sprayed with a tack coat material and then brought as nearly as practicable to uniform grade and cross section. The material shall be placed by hand or machine in one or more compacted layers approximately two (2) inches or less in compacted thickness.

401.03.7--Blank.

401.03.8--Preparation of Mixture. The temperature of the mixture, when discharged from the mixer, shall not exceed 340°F.

401.03.9--Material Transfer Equipment. Except for the areas mentioned below, when placing the top intermediate lift and/or the top lift of HMA pavements, the material transferred from the hauling unit shall be remixed prior to being placed in the paver hopper or insert by using an approved Materials Transfer Device. Information on approved devices can be obtained from the State Construction Engineer. Areas excluded from this requirement include: temporary work of short duration, detours, bridge replacement projects having less than 1,000 feet of pavement on each side of the structure, acceleration and deceleration lanes less than 1,000 feet in length, tapered sections, transition sections for width, shoulders less than 10 feet in width, crossovers, ramps, side street returns and other areas designated by the Engineer.

401.03.10--Spreading and Finishing. Grade control for HMA pavements shall be established by stringline at least 500 feet ahead of spreading, unless placement is adjacent to curb and gutter, concrete pavement, or other allowed grade control. The mixture shall be spread to the depth and width that will provide the specified compacted thickness, line, grade and cross section. Placing of the mixture shall be as continuous as possible. On areas where mechanical spreading and finishing is impracticable, the mixture may be spread, raked and luted by hand tools.

Immediately after screeding and prior to compaction, the surface shall be checked by the Contractor and irregularities adjusted. When the edge is feathered as in a wedge lift, it may be sealed by rolling. Irregularities in alignment and grade along the edges shall be corrected before the edges are rolled.

Hauling, spreading and finishing equipment shall be furnished that is capable of and operated in such a manner that the rolling operation will satisfactorily correct any surface blemishes.

The longitudinal joint in the subsequent lift shall offset that in the underlying lift by approximately six (6) inches. However, the joint in the top lift shall be at the centerline or lane line.

401.03.11--Compaction. After the mixture has been spread and surface irregularities corrected, it shall be thoroughly and uniformly compacted to the required line, grade, cross section and density.

401.03.12--Joints. Joints between previously placed pavement and pavement being placed shall be so formed as to insure thorough and continuous bond.

Transverse construction joints shall be formed by cutting the previously placed mixture to expose the full depth of the lift.

The contact surface of transverse joints and longitudinal joints, except hot joints, shall be sprayed with a thin uniform tack coating before additional mixture is placed against the previously placed material.

Longitudinal joints shall be formed by overlapping the screed on the previously placed material for a width of at least one (1) inch and depositing the quantity of mixture to form a smooth, tight joint.

401.03.13--Pavement Samples. The Contractor shall cut samples from each lift of HMA at the time and locations designated by the Engineer. The samples shall be taken for the full depth of each lift and shall be of a size approved by the Engineer but not to exceed 120 square inches. Tools used for cutting or coring of samples shall be of the revolving blade type such as saw or core drill. Cores shall be taken using a 4.0 to 6.0-inch inside diameter coring bit. The sample hole

shall be filled, compacted and finished by the Contractor to conform with the surrounding area. No additional compensation will be allowed for furnishing samples and repairing the areas with new pavement.

SECTION 403 - HOT MIX ASPHALT PAVEMENT

403.01--Description. This work consists of constructing one or more lifts of HMA pavement meeting the requirements of Section 401 on a prepared surface in accordance with the requirements of this section and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer. This work shall also include applicable in-grade preparation of the underlying course in accordance with Section 321.

403.02--Material Requirements. Materials and their use shall conform to the applicable requirements of Subsection 401.02.

403.03--Construction Requirements.

403.03.1--General. Construction requirements shall be as specified in Subsection 401.03 except as otherwise indicated in this section or applicable special provisions.

403.03.2--Smoothness Tolerances. Except as noted herein, the finished smoothness of each lift shall conform to the designated grade and cross section within the following tolerances from grade stakes or other grade reference points set at 25 foot intervals:

	Lower* & Leveling Lifts	Lower* Intermediate Lift	Top Intermediate Lift	Surface Lift
Maximum deviation from grade and cross section at any point	1/2"	3/8"	1/4"	1/4"
Maximum deviation from A 10 foot straight edge.....	3/8"	1/4"	1/8"	1/8"
Profile Index (PI) inches/mile	-	-	45.0	30.0

Note: Where more than four (4) lifts of HMA are required, all lifts, excluding the top three (3) lifts, shall meet the requirements of the lower lift.

- * When tested longitudinally from a stringline located equidistant above points 50 feet apart, the distance from the stringline to the surface at any two points located 12 1/2 feet apart shall not vary one from the other more than the maximum deviation allowed above from a 10-foot straight edge.

Where only one intermediate lift is required, it shall meet the smoothness requirements for lower intermediate lifts and shall have a Profile Index of not more than 60.0 inches per mile. The surface lift shall have a Profile Index of not more than 30.0 inches per mile.

Where only a leveling lift and a surface lift are required, the surface lift shall meet the smoothness requirements for lower intermediate lifts, and shall have a Profile Index of not more than 60.0 inches per mile.

Where only a surface lift is required, the Contractor shall determine the existing surface profile index at no additional cost to the State. The finished surface lift shall have a profile index of sixty percent (60%) of the profile index of the existing surface or 60.0 inches per mile, whichever is greater.

Where milling is required to remove undesirable material and/or correction of the cross-slope and only one (1) lift is required, the lift shall have a Profile Index of not more than 45.0 inches per mile.

Where milling is required to remove undesirable material and/or correction of the cross-slope and a leveling lift and a surface lift are required, the surface lift shall have a Profile Index of not more than 45.0 inches per mile.

Where milling is required to remove undesirable material and/or correction of the cross-slope and two (2) lifts are required, the lower lift shall have a Profile Index of not more than 45.0 inches per mile and the surface lift shall have a Profile Index of not more than 30.0 inches per mile.

Grade stakes or other grade reference points set at 25-foot intervals and maximum deviation from grade and cross section will not be required provided an approved profile averaging device is furnished and properly used for the four conditions set forth herein; however, all other surface requirements are applicable.

- (a) Overlays with one overall lift.
- (b) Overlays with two or more overall lifts -- for each lift above the first overall lift provided each underlying overall lift is within the allowable tolerances.
- (c) Surface lift of new construction provided the underlying lift is within the

allowable tolerances.

- (d) Full-depth asphalt construction for lifts above the lower lift provided the lower lift is within the specified tolerances for the lower intermediate lift.

In the placement of full depth HMA pavement, where the chemically treated base is constructed, graded and/or trimmed, full lane width, to a surface tolerance of $\pm 3/8$ inches from design grade, stringline grade controls may be eliminated for the placement of the asphalt drainage course and all HMA lifts. In addition, where the base course is crushed stone or crushed concrete and is constructed to a surface tolerance of $\pm 3/8$ inches from design grade using a stringline controlled spreader, stringline grade controls may be eliminated for the placement of the asphalt drainage course and all HMA lifts.

All other tolerances as specified in Section 321 are applicable, except for bases, when tested longitudinally, the maximum deviation when measured at the 12 $\frac{1}{2}$ -foot midpoint shall be $\pm 3/8$ inches.

Acceptance and payment of HMA will be determined on a lot to lot basis by cores taken from the completed pavement as outlined in Subsection 403.03.3.

Approved contacting type profile averaging devices are those devices capable of working in conjunction with a taut string or wire set to grade, or ski-type device with extreme contact points with the surface at least 30 feet apart. Approved non-contacting type profile averaging devices are laser type ski devices with at least four referencing mobile stations at a minimum length of 24 feet, or an approved equal.

When approved by the Engineer, a short ski or shoe may be substituted for a long ski on the second paving operation working in tandem.

During the finishing and compacting of pavement lifts, it shall be the responsibility of the Contractor to check the surface and joints for progress toward conformance to surface requirements set forth herein. Variations from surface requirements exceeding the allowable tolerances shall be corrected at the Contractor's expense.

When a portland cement concrete pavement is to be placed on a HMA lift, the finished top of the HMA lift shall meet the requirements of Sections 321 and 501.

When the Profile Index for the final surface lift is less than or equal to twenty-two inches per mile (22.0 inches / mile), per segment, a unit price increase will be added. The following schedule lists the Profile Index range and the corresponding contract price adjustment:

Profile Index inches / mile / segment	Contract Price Adjustment percent of HMA unit bid price
less than 10.0	108
10.0 to 14.0	106
14.1 to 18.0	104
18.1 to 22.0	102
22.1 to 30.0	100
over 30.0	100 with correction of $PI \leq 30.0$

Contract price adjustments for rideability shall only be applicable to the surface lift and furthermore to only the segment(s) or portions of the segments(s) of the surface lift that require smoothness be determined by using a profilograph and then only when the surface tolerance requirements include a profile index of 30.0 inches / mile.

Segment(s) or portions thereof representing areas excluded from a smoothness test with the profilograph shall also be excluded from consideration for a contract price adjustment for rideability.

Any contract price adjustment for rideability will be applied on a segment to segment basis to the pay tonnage, determined in accordance with Subsections 401.02.6.5 and 403.04, for the segment(s) or portions thereof for which an adjustment is warranted.

403.03.3--Thickness Requirements. Hot mix asphalt overlay lifts shall be constructed as nearly in accordance with the thickness shown on the plans as the underlying pavement and foundation will permit. Periodic and cumulative yield tests will be made to determine practicable conformity to the thickness of each lift. The Engineer may order modifications in placement thicknesses to prevent unwarranted variations in plan quantities.

When the paver is operating off an established grade line, no thickness determination will be required for the various lifts of pavement. It is understood that the tolerances from design grade will control the thickness requirements.

When grade stakes are eliminated by Notice to Bidders or as outlined in Subsection 403.03.2(d) and where resulting in the placement of two (2) or more lifts, acceptance and payment will be determined on a lot to lot basis by cores taken from the completed pavement. Lots will be coincidental with acceptance lots for the surface lift as provided in Subsection 401.02.6.4, except that only lots resulting from the placement of mainline surface lift will be used for thickness assessment. One core will be obtained at random from each lot. Irregular areas will not be cored.

When the average thickness of all the cores from the lots representing a day's production, excluding any discarded by the Engineer for justifiable reason, is within $3/8$ of an inch of the total pavement thickness shown on the plans, excluding lift(s) placed using an established grade line, corrective action will not be required and a price adjustment will not be made for non-conformity to specified thickness.

When the average thickness of all the cores from the lots representing a day's production is deficient in thickness by more than three-eighths of an inch ($3/8''$) of the total pavement thickness shown on the plans, excluding lift(s) placed using an established grade line, the deficiency shall be corrected by overlaying the entire length of the day's production. The thickness of the overlay shall be equal to the thickness deficiency but no less than the minimum single lift laying thickness for the specified mixture.

When the thickness of all the cores from the lots representing a day's production is more than three-eighths of an inch ($3/8''$) thicker than the total thickness shown on the plans, excluding lift(s) placed using an established grade line, a price adjustment will be made in accordance with Subsection 403.05.1.

The cores shall be cut and removed by the Contractor in the presence of the Engineer's representative and turned over to the Engineer's representative for further handling. The Contractor shall fill each core hole with surface lift mixture and compact to the satisfaction of the Engineer within 24 hours after coring.

403.03.4--Lift Corrections. Pavement exceeding the allowable surface tolerances shall be corrected at the Contractor's expense by the following methods:

Lower, Leveling and Lower Intermediate Lifts:

- (a) Removal or addition of mixture by skin patching, feather edging, wedge lift construction or full depth patching where appropriate and can be completed in a satisfactory manner.
- (b) Superimposing an additional layer which shall be an approved grade raise for the full roadway width and length of the area to be corrected.

Top Intermediate Lift:

- (a) Removal and the addition of sufficient mixture to provide the specified thickness. Corrections by this method shall be square or rectangular in shape and shall completely cover the area to be corrected.
- (b) Superimposing an additional layer of minimum lift thickness for mixture

being used which shall be an approved grade raise for full roadway width of the area to be corrected. Transverse joints shall be perpendicular to the centerline of the pavement.

Surface Lift:

- (a) Removal and the addition of sufficient mixture to provide new material of at least minimum single lift laying thickness for full lane width of the area to be corrected. Transverse joints shall be perpendicular to the centerline of the lane.
- (b) Superimposing an additional layer (minimum lift thickness for mixture being used) which shall be an approved grade raise for full roadway width of the area to be corrected. Transverse joints shall be perpendicular to the centerline of the pavement.

All mixtures used in the correction of unacceptable pavement shall be approved by the Engineer prior to use.

403.03.5--Overlays or Widening and Overlays. In addition to the requirements of Subsections 403.03.1 through 403.03.4, the following requirements will be applicable when an existing pavement is to be overlaid or widened and overlaid.

403.03.5.1--Blank.

403.03.5.2--Sequence of Operations. In order to expedite the safe movement of traffic and to protect each phase of the work as it is performed, a firm sequence of operations is essential. Unless otherwise provided in the traffic control plan and/or the contract, the following appropriate items of work shall be begun and continually prosecuted in the order listed:

- (a) In sections designated by the Engineer, trim the shoulders along the pavement edges to provide drainage from the pavement.
- (b) Perform prerolling to locate areas of pavement with excessive movement per Section 511.
- (c) Perform selective undercutting and patching as directed per Subsection 403.03.5.4.
- (d) Perform pressure grouting as specified in Section 512.
- (e) Clean and seal joints per Section 413.
- (f) Complete preparation on one side of roadway to be widened and place widening materials.

- (g) Reconstruct shoulders to elevation necessary to assure traffic safety.
- (h) Open the widened section to traffic.
- (i) Complete above work for other side of roadway.
- (j) Perform preliminary leveling as directed.
- (k) Apply interlayer as specified.
- (l) Place the first overall leveling lift.
- (m) After the first overall leveling lift, reconstruct shoulders as necessary to eliminate vertical differentials which may be hazardous to traffic.
- (n) Place first intermediate lift.
- (o) Construct shoulders to the contiguous elevation of the first intermediate lift.
- (p) Place remaining intermediate lift, if required.
- (q) Place surface lift.
- (r) Complete construction of shoulders.
- (s) Apply permanent traffic marking.
- (t) Final cleanup.

The above operations shall be performed in such a manner that traffic will be maintained on a paved surface at all times. Two-lane, two-way highways should not be restricted to a single lane in excess of a 3,000 foot section.

403.03.5.3--Widening of Pavement. The foundation for widening shall be formed by trenching or excavating to the required depth and constructing a smooth, firm and compacted foundation. It shall have sufficient density and stability to withstand the placement and compaction of subsequent lifts. Soft, yielding and other unsuitable material which the Engineer determines will not compact readily shall be removed and backfilled with granular material or hot mix asphalt as directed.

Except as provided herein, excavation for widening, undercutting or other required excavation shall be spread along the edge of the shoulders, foreslopes or other adjacent areas as directed and will be an absorbed item. When the quantity is in excess of what may be used satisfactorily on adjacent areas, the Engineer

may direct that the material be loaded, hauled and spread uniformly on other designated areas. In this case, compensation for handling surplus material will be in accordance with the appropriate pay items as provided in the contract or as extra work.

If the plans require widening of the shoulders or embankment with Contractor furnished material, all suitable material obtained from widening excavation may be used and will be measured and paid for as Contractor furnished materials. No measurement for payment of haul will be made.

Removal and disposal of old stakes, forms and other debris encountered in excavating shall be in accordance with Section 201 and shall be considered as incidental to and included in the unit prices bid for other items. No separate measurement will be made therefor. Pavement edges and surfaces shall be cleaned prior to final shaping and compaction of adjacent trenching or undercut areas.

Granular material for widening shall be placed on a previously prepared, smooth, firm and unyielding foundation in accordance with the typical section. Density of the granular material shall be as specified.

Hot mix asphalt for widening, including trench widening, shall meet the applicable requirements of this section and Section 401 and shall be placed in one or more layers as shown on the plans or directed. The surface of the mixture shall be finished as a continuation of the adjacent pavement slope.

Trench rollers or other compaction equipment shall be used to compact the foundation, granular material and bituminous mixtures for widening when standard width rolling equipment cannot be used.

403.03.5.4--Patching. Existing pavement which has failed or unsatisfactorily stabilized shall be removed as directed. Removal of pavement will be measured and paid for under the appropriate pay items as provided in the contract.

Backfill shall consist of hot mix asphalt or a combination of compacted layers of granular material and hot mix asphalt. Unless otherwise specified, the Engineer will make this determination based on depth and field conditions.

Hot mix asphalt used for backfilling will be measured and paid for at the contract unit price for the mixture designated on the plans as the lowest lift. Granular material will be measured and paid for under the appropriate pay item as provided in the contract or as extra work.

403.03.5.5--Preliminary Leveling. All irregularities of the existing pavement that result in a thickness greater than approximately two and one-half inches for the first overall leveling lift shall be corrected by skin patching, feather edging or

a wedge lift and shall be approved by the Engineer in advance of placing the first overall lift.

403.03.5.6--Placement of Lifts. The leveling lift shall be placed in a layer, or layers, not exceeding approximately two and one-half inches compacted thickness.

When single lane construction is required, placement of a lift on the adjacent lane may be performed by an approved profile averaging device provided the lane previously placed is within the allowable tolerances for all surface requirements. When any of the tolerances are exceeded, the Contractor shall reestablish the control stringline for laying the adjacent lane should the Contractor elect to perform this work prior to correcting the deficiencies of the lane previously placed. In no case shall a "matching shoe" be used to control the grade of an adjacent lane.

In instances where there are only minor deviations from the allowable tolerances in the first overall lift, the Engineer may permit the Contractor to place the next higher lift by graded stringline in lieu of making the corrections.

Single lane placement of leveling, intermediate and surface lifts shall be limited to the distance covered in one and one-half days in advance of that placed in the adjacent lane.

403.03.5.7--Protection of Pavement. The pavement shall be protected and properly maintained until it has been compacted and cooled sufficiently for use by traffic.

403.04--Method of Measurement. HMA pavement, complete in place and accepted, will be measured by the ton. The weight of the composite mixture shall be determined in accordance with the provisions of Subsection 401.03.2.1.11.

Unless shown as a separate pay item, the furnishing and application of the tack coat will not be measured for payment. When payment is provided, tack coat will be measured as set out in Subsection 407.04.

The quantity of bituminous mixture required to correct the work, when made at the expense of the Contractor, will not be measured for payment.

Any trenching required for widening will not be measured for payment, such cost thereof shall be included in other items of work.

Undercut required by the Engineer will be measured for payment under the appropriate excavation item as provided in the contract or as extra work. Pavement removal and any required trenching will not be included in the

measurement for undercut.

Class "B" structural concrete base substituted for hot mix asphalt under portland cement concrete bridge end pavement, as per Subsection 502.03.1, will be paid for as hot mix asphalt calculated as follows:

Square yards of portland cement concrete bridge end pavement x concrete base thickness in inches x 0.055 = tons of hot mix asphalt.

403.05--Basis of Payment. Subject to the adjustments set out in Subsections 401.02.6.3, 401.02.6.4, 401.02.6.5 & 403.03.2, hot mix asphalt pavement, complete-in-place, accepted, and measured as prescribed above, will be paid for at the contract unit price per ton for each lift of pavement specified in the bid schedule and shall be full compensation for completing the work.

403.05.1--Price Adjustment for Thickness Requirement. When grade stakes are eliminated as provided in Subsection 403.03.3 and the average thickness of all cores from lots representing a day's production is more than 3/8 inch thicker than the total specified thickness of the pavement, excluding lift(s) placed using an established grade line, a lump sum reduction in payment for the surface lift of lots representing a day's production will be made as follows:

$$\text{Individual Day's L.S. Reduction} = (\text{Monetary Value of the Day's Surface Lift Production}) \times \frac{(\text{D} - 3/8)}{\text{ST}}$$

Where:

D = The day's average deviation from total pavement thickness shown on the plans, excluding lift(s) placed using an established grade line.

ST = Specified thickness for surface lift.

The total L.S. reduction for the project is the summation of the individual day's reductions in payment.

403.05.2--Pay Items.

Payment will be made under:

403-A: Hot Mix Asphalt, $\frac{(1)}{\text{Type}}, \frac{(2)}{\text{Mixture}}$ - per ton

403-B: Hot Mix Asphalt, $\frac{(1)}{\text{Type}}, \frac{(3)}{\text{Mixture}}$, Leveling - per ton

403-C: Hot Mix Asphalt, (1), (4), Trench Widening - per ton
Type Mixture

403-D: Hot Mix Asphalt, HT, (3), Polymer Modified - per ton
Mixture

403-E: Hot Mix Asphalt, HT, (3), Polymer Modified, Leveling - per ton
Mixture

- (1) ST, MT or HT
- (2) 4.75 mm mixture, 9.5 mm mixture, 12.5 mm mixture, 19 mm mixture or 25 mm mixture
- (3) 4.75 mm mixture, 9.5 mm mixture, 12.5 mm mixture or 19 mm mixture
- (4) 19 mm mixture or 25 mm mixture

SECTION 404 - COLD BITUMINOUS PAVEMENT

404.01--Description. This work consists of constructing one or more courses of cold bituminous pavement in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer. This work shall also include applicable in-grade preparation of the underlying course in accordance with Section 321.

The bituminous pavement shall be composed of aggregates and bituminous material, and, if specified, a top dressing of sand, gravel, stone, or slag screenings.

404.02--Materials.

404.02.1--General. Cold bituminous mixtures shall be either a preapproved commercial cold mix as listed on the Department's Approved Products List, or conform to the requirements of the Department's standard cold mixture as set out below.

404.02.2--Preapproved Commercial Cold Bituminous Mixture. Commercial cold bituminous mixture must be an approved product as listed on the Department's List of Approved Products and Suppliers. Such approval will be based on satisfactory performance of the cold bituminous mixture on a field test section, placed in accordance with the manufacture's recommendations, after from six months to one year's evaluation by the Department. The mixture shall have a minimum shelf life of six months.

404.02.3--MDOT Standard Cold Bituminous Mixtures - General. MDOT standard cold bituminous mixtures shall conform to the requirements of

Subsection 703.13 and the requirements as set out below. The mixture shall have a minimum shelf life of six months.

404.02.3.1--Mineral Filler. Mineral filler shall meet the requirements of Subsection 703.16. Mineral filler may be used as necessary to obtain desired properties of the mixture; however, excessive use will not be permitted.

404.02.3.2--Bituminous Materials. Bituminous material shall be cutback asphalt of one of the grades set out in AASHTO Designation: M 82 or, in lieu thereof, a combination of petroleum asphalt cement Grade PG 58-28, 64-22 or 67-22 conforming to Section 702 and a liquefier.

404.02.3.3--Hydrated Lime. Hydrated lime meeting the requirements of Subsection 714.03.2 may be used as a facilitator in the mixture and will be required when siliceous aggregates are used.

404.03--Construction Requirements.

404.03.1--General. Construction requirements shall be as prescribed in Subsection 401.03, except as modified in the following subsections.

404.03.2--Weather Limitations. Cold bituminous pavement courses shall be placed only when the air temperature is 40°F or above.

404.03.3--Tack Coat. Unless otherwise directed by the Engineer, tack coat shall be applied at a minimum rate of 0.05 gallon per square yard residual asphalt. The tack coat shall be applied as a complete coating, fog coating, or "spider webbing" as directed.

404.03.4--Preparation of Aggregate. When combined with cut-back asphalt, aggregates shall be dry and at a temperature of at least 60°F and not more than 225°F. If not already surface dry, aggregates shall be dried at a temperature between 150°F to 300°F and then cooled before being mixed with bituminous material.

When combined with emulsified asphalt, the aggregates shall be at a temperature of at least 60°F and not more than 175°F.

404.03.5--Mixing. The prepared aggregates shall be combined in the quantities required to meet the job-mix formula, introduced into the mixer, and mixed dry for a period sufficient to distribute the various sizes uniformly throughout the batch. The bituminous material shall then be introduced and mixed until the aggregates are thoroughly coated and the mass is a uniform color.

The mixing time for each phase of the mixing operations will be set by the Engineer, based on the nature of the aggregates, the job-mix formula, and the size

of the batch, but in no case shall the mixing time, after introduction of the bituminous material, be less than two minutes.

404.03.6--Spreading and Finishing. The material shall be spread by a motor grader or mechanical paver.

Where the compacted thickness is to be more than two inches, the mixture shall be spread and compacted in layers of no more than two inches in thickness.

When spreading with a motor grader the mixture shall be dumped along the centerline or along the outside quarter point in sufficient volume to produce the weight per square yard indicated or directed. It shall then be moved for its full depth and formed into a windrow of uniform section. The windrow shall then be spread, at the prescribed rate per square yard.

While the surface is being compacted and finished, the edges shall be shaped to a neat line.

404.03.7--Compaction. Immediately after the mixture has been spread, it shall be thoroughly and uniformly compacted. Rolling shall extend over a period of three days after the initial rolling and shall consist of a minimum of two coverages each day.

404.03.8--Top Dressing. When a top dressing of aggregate is specified, it shall be applied immediately after the rolling of the surface course. The top dressing shall be applied at the rate specified and rolled as directed.

404.03.9--Surface Tolerances. The distance at any point from a 10 foot straight edge to the surface shall not exceed three- sixteenths inch. Lumps or depressions exceeding this tolerance shall be corrected by removing defective work and replacing with new material as directed.

404.04--Method of Measurement. Cold bituminous pavement of the type specified will be measured by the square yard or ton. When measured by the ton, measurement will be as prescribed in Subsection 401.04.

404.05--Basis of Payment. Cold bituminous pavement will be paid for by the square yard or ton. Payment on a tonnage basis, will be as set out in Subsection 401.05, except no reduction in payment will be made for compaction.

Payment will be made under:

404-A: ____” Cold Bituminous Pavement, Type _____ - per square yard or ton

404-B: Aggregate Top Dressing _____ - per ton

SECTION 406 - COLD MILLING

406.01--Description. This work consists of removal of pavement materials on the roadway and shoulders by cold milling to the designated depth and, loading, hauling, and disposal of the milled materials by the Contractor in accordance with the plans and specifications, or as directed by the Engineer. The milled surface shall provide a desirable surface free from gouges, continuous grooves, ridges, oil film, and other imperfections of workmanship and shall have a uniform appearance.

406.02--Blank.

406.03--Construction Requirements.

406.03.1--Equipment. The equipment to be used for this work shall be a self-propelled milling machine capable of removing a minimum width of four feet. The equipment shall have sufficient power, traction, and stability to remove material and maintain an accurate grade and cross slope. The equipment shall be capable of accurately and automatically establishing profile grades along each edge of the machine by referencing from the existing pavement with means of an approved profile averaging device with extreme contact points with surface at least 30 feet apart, or from an independent grade line and shall have an automatic system for controlling cross slope. The machine shall be equipped with an integral loading and reclaiming means to immediately remove material being cut from the surface and discharge the cuttings into a truck or windrow, all in one operation.

Adequate back-up equipment, such as mechanical sweepers, loaders, water truck, etc., and personnel shall be provided to insure that all cuttings are removed immediately behind the milling machine.

406.03.2--Construction Methods. On the roadway, when hot mix asphalt will be required on the milled area, milling operations shall not begin until the Contractor has an approved job-mix formula and is prepared to begin paving operations. The milled roadway area opened to public traffic shall be covered by placing the first required course within 30 calendar days after milling. During the period from November 1 to March 1, the uncovered milled area shall not exceed one mile of full roadway width.

The pavement and shoulder materials shall be removed to the depth, width, grade, and cross section shown on the plans, or as directed by the Engineer. The number of passes necessary to accomplish the work required herein and on the plans shall be determined by the Contractor.

The surface of the pavement and shoulders, after milling, shall be reasonably smooth and true to the established line, grade and cross section. Areas damaged by the Contractor's operations shall be corrected and/or repaired as directed by

the Engineer at no additional costs to the State. The Contractor shall take necessary action to prevent or minimize the ponding of water on the milled roadway and shoulder.

Where traffic is required to be maintained adjacent to the milled area, no more than a 2¼-inch differential in grade between the milled area and the adjacent surface will be allowed, unless a positive separation in accordance with the plans and specifications is established between the traffic and milled area.

A longitudinal pavement edge that traffic is expected to move across should have an elevation difference of not more than 2¼ inches. If the pavement edge is more than 1½ inches and less than or equal to 2¼ inches, uneven pavement signs will be required as shown in the plans, or contract documents. If the pavement edge is less than or equal to 1½ inches, no uneven pavement signs will be required. Transverse pavement joints shall be sufficiently tapered to allow for the safe movement of traffic.

When traffic is required to be maintained adjacent to milled shoulders, traffic control devices shall be placed in accordance with the requirements of the detail sheet for shoulder closures, or as directed by the Engineer.

It is understood that the milled shoulder shall be covered with the next required course as soon as possible but in no case later than 30 calendar days after milling.

406.04--Method of Measurement. Cold milling of pavement, all depths, will be measured by the square yard, cubic yard (LVM), or ton as indicated in the contract. Loading, hauling, and disposal will not be measured for separate payment.

406.05--Basis of Payment. Cold milling of pavement, all depths, measured as prescribed above, will be paid for at the contract unit price per square yard, cubic yard (LVM) or ton, as indicated, which price shall be full compensation for completing the work.

When not shown as a separate pay item in the contract, the price for each item of cold milling shall include the cost of continuous maintenance of traffic and protective services as required by the Department's Traffic Control Plan, including all required individual traffic control devices.

Payment will be made under:

406-A: Cold Milling of Bituminous Pavement, All Depths	- per square yard, cubic yard or ton
406-B: Cold Milling of Concrete Pavement, All Depths	- per square yard, cubic yard or ton

SECTION 407 - TACK COAT

407.01--Description. This work consists of preparing and treating an existing bituminous or concrete surface with bituminous material in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the Engineer.

407.02--Materials.

407.02.1--Bituminous Material. The materials shall conform to the applicable requirements of Section 702. The particular type and grade will be specified in the contract or by the Engineer.

When emulsified asphalt is used, it shall not be diluted without approval of the Engineer.

407.03--Construction Requirements.

407.03.1--Equipment. The Contractor shall provide equipment for heating and applying bituminous material. Heating equipment and distributors shall meet the requirements of Subsection 410.03.3. Other equipment for applying tack coat shall be approved by the Engineer prior to use.

407.03.2--Preparation of Surface. The existing surface shall be prepared in accordance with Subsections 401.03.6 and 410.03.4.

407.03.3--Application of Bituminous Material. The tack coat shall be applied in such a manner as to offer the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the bituminous material. Tack coat shall not be applied during wet or cold weather, after sunset, or to a wet surface. The quantity, rate of application, temperature, and areas to be treated shall be approved prior to application. Emulsions shall be allowed to "break" prior to superimposed construction.

407.04--Method of Measurement. Unless shown as a separate pay item in the proposal, tack coat will not be measured for direct payment, but shall be considered a necessary part of the construction involved, and the cost thereof shall be included in the appropriate contract unit prices.

When shown as a separate pay item, bituminous tack coat material will be measured by the gallon as prescribed in Subsections 109.01 and 410.04.

Emulsified asphalt as delivered by the producer will be measured prior to any dilution that may be required by the Engineer.

407.05--Basis of Payment. When shown as a separate pay item in the contract,

tack coat will be paid for at the contract unit price per gallon, which price shall be full compensation for completing the work.

Payment will be made under:

407-A: Asphalt for Tack Coat, Grade - per gallon

SECTION 408 - PRIME COAT

408.01--Description. This work consists of preparing and treating an existing surface with bituminous material, and blotter material if required, in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the Engineer.

408.02--Materials.

408.02.1--Bituminous Materials. The bituminous material shall conform to the applicable requirements of Section 702. The type and grade of bituminous material will be specified in the contract. The grade may be changed one step by the Engineer at no change in unit price.

408.02.2--Blotter Material. Blotter material shall be sand clay or other friable or near friable material approved by the Engineer.

408.03--Construction Requirements.

408.03.1--Seasonal and Weather Limitations. Bituminous material shall be applied only when permitted under the seasonal and weather limitations specified in Subsection 410.03.2.

408.03.2--Equipment. The Contractor shall provide equipment for heating and applying bituminous material. Heating equipment and distributors shall meet the requirements of Subsection 410.03.3.

408.03.3--Preparation of Surface. The surface to be primed shall be prepared in accordance with Section 321 free from ruts, corrugations, segregated material, or other irregularities. It shall be conditioned as set out in Subsection 410.03.4.

408.03.4--Application of Bituminous Material. The bituminous material shall be applied in accordance with applicable requirements of Subsection 410.03.5.

408.03.5--Application of Blotter Material. The Contractor shall furnish and spread, at no additional cost to the State, the minimum necessary quantity of approved blotter material over the prime coat where necessary under the requirements of Subsection 104.04.

408.03.6--Maintenance. The Contractor shall maintain the prime coat in a satisfactory condition until covered by subsequent construction. Maintenance shall include immediate repairs of all damage that may occur. All maintenance shall be performed at the expense of the Contractor, and shall be repeated as often as necessary to properly maintain the work.

408.04--Method of Measurement. Asphalt for prime coat will be measured by the gallon as prescribed in Subsections 109.01 and 410.04. Blotter material will not be paid for separately but shall be included in the unit price per gallon for prime coat.

408.05--Basis of Payment. Asphalt for prime coat, measured as prescribed above, will be paid for at the contract unit price per gallon., which prices shall be full compensation for all incidentals necessary to complete the work.

Payment will be made under:

408-A: Asphalt for Prime Coat, Grade - per gallon

SECTION 409 - GEOTEXTILE FABRIC FOR UNDERSEAL

409.01--Description. This work consists of furnishing and placing fabric underseal in accordance with the details shown on the plans and the requirements of these specifications. An underseal shall consist of an application of asphalt cement covered with a layer of fabric.

409.02--Materials.

409.02.1--Geotextile Fabric. The fabric shall meet the specific requirements for geotextile fabric underseal contained in Subsection 714.13.4 and the applicable requirements of Subsection 714.13.

409.02.2--Bituminous Material. Unless otherwise designated, the asphalt sealant shall be asphalt cement Grade PG 64-22 meeting the applicable requirements of Section 702.

409.03--Construction Requirements.

409.03.1--Equipment. The Contractor shall provide equipment for heating and applying bituminous material and for laying the pavement fabric.

Heating equipment and distributors shall meet the requirements of Subsection 410.03.3.

The mechanical fabric laydown equipment shall be capable of handling full rolls

of fabric and shall be capable of laying the fabric smoothly without excessive wrinkles and/or folds. When manual laydown is required, a length of standard one inch pipe and suitable roll tension devices shall be used for proper roll handling.

The fabric manufacturer or distributor shall furnish a technician to supervise installation of the fabric and training of Contractor's personnel.

409.03.2--Surface Preparation. The surface to be treated, and at least one additional foot on each side, shall be cleaned by sweeping, blowing, or other methods until all dust, dirt, mud, vegetation, and foreign materials are removed entirely from the pavement before the asphalt sealant is applied. Care shall be exercised to prevent material so removed from becoming mixed with subsequent courses.

409.03.3--Application of the Asphalt Sealant. The application of the asphalt sealant shall conform to the applicable requirements of Section 410. The sealant shall be uniformly sprayed over the area to be covered by fabric at a rate recommended by the fabric manufacturer or distributor's technician and/or ordered by the Engineer. The rate of application is usually between 0.20 and 0.40 gallon per square yard. Varying surface conditions such as the degree of porosity of the existing pavement will cause varying application rates. The quantity applied shall be sufficient to bond and saturate the fabric, and to bond the subsequent overlay course to the fabric. Within intersections or other zones where vehicle braking is frequent, the application rate should be reduced. The sealant shall be applied to an area two to six inches wider than the width of fabric being placed, but restricted to the area of immediate fabric laydown. Application shall be by distributor spray bar with hand hose spraying allowed only where the distributor spray bar cannot be used. Asphalt leakage from the distributor and any spillage shall be cleaned from the road surface to avoid flushing and possible fabric movement at these asphalt rich areas. The asphalt cement used as a sealant shall have distributor tank temperature between 300°F and 350°F, except when applying a tack coat to the fabric, the temperature shall not exceed 320°F to avoid damaging the fabric.

409.03.4--Fabric Placement. The fabric shall be placed on the asphaltic sealant as soon as practical and before the adhesion properties of the sealant is lost. The fabric shall be placed as smoothly as possible to avoid wrinkles.

Wrinkles severe enough to cause "folds" shall be slit and laid flat. Small wrinkles which flatten under compaction are not detrimental to performance. The fabric shall be broomed or squeegeed to remove air bubbles and make complete contact with the road surface as recommended by the fabric manufacturer or distributor. The fabric shall be laid straight, however moderate curves can be negotiated by stretching the fabric on the outside of the curve.

Longitudinal and transverse joints shall be made by overlapping the fabric at least six inches. Additional sealant shall be applied to the joints as required and may be applied by hand hose spraying or with mop and bucket if extreme care is taken to not over apply. Transverse joints should be "shingled" in the direction of construction traffic and paving to prevent pick-up. In circumstances where this method is impractical, asphalt pavement or sand spread over the joint will aid in prevention of pick-up.

When recommended by the manufacturer or distributor's technician and/or ordered by the Engineer, the fabric shall be rolled with a pneumatic roller to improve bonding and reduce slippage.

409.03.5--Treatment of Fabric Prior to Overlay. Normally it is not necessary to tack coat the fabric unless there are circumstances such as delay in placement of subsequent course, dust accumulation or insufficient initial application of sealant which would make tack coating desirable. If a tack coat is required by the Engineer, emulsified asphalt shall be applied at a rate of 0.02 to 0.05 gallon of residual asphalt per square yard.

Placement of the subsequent course shall closely follow fabric laydown. In the event that the sealant bleeds through the fabric, it may be necessary to blot the sealant with sand to prevent construction equipment from picking up the fabric. Turning of the paver and other vehicles must be gradual to avoid stripping or damage to the fabric.

If traffic must be maintained on the fabric prior to placement of the subsequent course, it is advisable to spread a small quantity of sand over the fabric and roll with a pneumatic roller to prevent tires from picking up the fabric.

If rain should cause a blistered appearance and bond loss, it shall be corrected by rolling with a pneumatic roller.

409.03.6--Asphalt Pavement Overlay. The overlay shall conform to Sections 401 and 403 except that the mixture shall be delivered to the paver at a temperature of 275°F to 300°F. Temperature of the mix shall in no case exceed 325°F.

409.04--Method of Measurement. Geotextile fabric for underseal, placed in accordance with these specifications and as directed by the Engineer, will be measured by the square yard of surface area. Any overwidth of material installed and additional material required for laps will not be measured.

Asphalt cement for fabric underseal, applied in accordance with these specifications and as directed by the Engineer, will be measured by the gallon in accordance with Subsections 109.01 and 410.04.

Any blotting with sand, rolling to restore bond and application of a tack coat will not be measured for payment and is considered incidental to completion of the work.

409.05--Basis of Payment. Geotextile fabric for underseal will be paid for at the contract unit price per square yard. Asphalt cement for fabric underseal of the kind and grade specified, measured as provided above, will be paid for at the contract unit price per gallon. These prices shall be full compensation for satisfactorily completing the work.

Payment will be made under:

409-A: Geotextile Fabric for Underseal, Type * - per square yard

409-B: Asphalt Cement for Fabric Underseal - per gallon

* When not designated, see Subsection 714.13.

SECTION 410 - BITUMINOUS SURFACE TREATMENT

410.01--Description. This work consists of the construction of a single or multiple layer bituminous surface treatment in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the Engineer.

410.02--Materials.

410.02.1--Bituminous Material. The type and grade of bituminous materials will be specified in the contract and conform to the applicable requirements of Section 702.

410.02.2--Cover Material. Cover material shall meet the applicable requirements of Subsection 703.14, and the kind and type will be specified in the contract.

Only one type of aggregate or combination of aggregates shall be used on a particular project except with written permission of the Engineer.

Sites for stockpiles of materials shall be grubbed and cleaned prior to storing the aggregates, and the ground shall be firm, smooth, and well drained.

410.03--Construction Requirements.

410.03.1--Prime Coat. The prime coat, when specified, shall meet the requirements of Section 408.

During the period between the application of the prime coat and the bituminous surface treatment, the primed surface shall be kept in continuous repair. All holes, raveled areas, and areas deficient in prime shall be patched and repaired with approved materials.

410.03.2--Seasonal and Weather Limitations. Emulsified asphalt and cut-back asphalt shall be applied only when the air temperature is above 60°F. Asphalt cement shall be applied only when both the air and surface temperatures are above 75°F.

Cut-back asphalt shall not be placed during the period between October 15 and March 1. No prime shall be placed when soil and weather conditions would prevent the proper placement and retention of the materials.

Bituminous materials for surface treatment shall not be placed during the period between November 1 and March 1, nor when weather conditions otherwise prevent the proper placement and retention of the materials.

On projects where completion of seal coats after November 1 or before March 1 is determined to be in the public interest, the Engineer may permit variations from the above under the condition that all the following requirements are met:

- (a) The air temperature is 60°F or higher.
- (b) Asphalt cement used is cut back with naphtha of the type that will yield from 5-10 percent off at 680°F when tested by method AASHTO Designation: T 78 and the naphtha is added at the refinery.
- (c) As an alternate to (b), the Contractor substitutes a rapid setting cationic emulsified asphalt meeting the requirements of AASHTO Designation: M 208.
- (d) Aggregate is satisfactorily air dried in covered storage, or mechanically dried.
- (e) The sun is shining.
- (f) Aggregate is applied immediately behind the distributor.
- (g) No shot is made after mid-afternoon, and rolling is increased as directed for shots made after noon.
- (h) The Contractor retains full responsibility for the acceptable quality of the work within the intent of the contract, these conditions notwithstanding.
- (i) The work is performed under these modifications at no additional cost to

the State.

Blanket authorization will not be given for use of the above modification, but will be given only when completion of the surface treatment would make the facility available for use by public traffic, or for subsequent construction.

Prior to November 1 and after March 1, when the requirements of these specifications are being met, but conditions are less than good for the adhesion of cover aggregate to the bituminous material, the Engineer may permit or require, at no additional cost to the State that the asphalt cement be cut back with naphtha as previously indicated. Less than good placement conditions shall be understood to include, but not limited to: lower than desirable temperature; higher than desirable humidity; surface dampness; or coolness of the foundation or aggregate.

410.03.3--Equipment. The following or equivalent equipment shall be furnished:

410.03.3.1--Bituminous Heating Equipment. This equipment shall heat and maintain the bituminous material within specification requirements without damaging the material. The heating equipment shall be supplied with at least one accurate asphalt thermometer.

410.03.3.2--Distributor. The distributor shall be mounted on pneumatic tires of sufficient width to prevent breaking the surface bond when the tank is fully loaded. It shall be self-propelled and sufficiently powered to maintain the desired speeds during operation. It shall be equipped to evenly heat and maintain the material at the required temperature; have adequate pressure devices and suitable manifolds to provide constant and even distribution for the entire length of the spray bars; and have positive cutoff to prevent dripping from the nozzles. It shall be so constructed that uniform applications may be made at the specified rate on variable widths up to 26 feet. Charts and devices shall be provided by the Contractor for determining the quantity being applied.

410.03.3.3--Rotary Brooms. Rotary brooms shall be constructed to permit the revolutions of the broom to be adjusted to its progression and to permit adjustment of the broom in relation to the surface. The broom bristles shall be stiff enough to sweep clean without injury to the surface.

410.03.3.4--Power Rollers. Steel-wheel rollers shall be self-propelled, rated at 5 to 8 tons, and shall have a weight of at least 200 pounds per inch of roller width. The rollers may be the three wheel type, but the tandem type is preferred.

Pneumatic rollers shall be self-propelled with wheels mounted on two axles in such a manner that the rear tires will not follow in the tracks of the forward group. The rollers shall be capable of applying a minimum of 50 pounds per

square inch contact pressure under each tire, and shall be of a weight that will not damage the base or surface treatment.

410.03.3.5--Trucks. Trucks of sufficient number and size to adequately supply the material shall be furnished.

410.03.3.6--Aggregate Spreaders. Aggregate spreaders shall be constructed so that they can be accurately gauged and set to uniformly distribute the required quantity of aggregate at regulated speed.

410.03.3.7--Other Equipment. Drag brooms shall be furnished and used as conditions dictate.

410.03.4--Preparation of Surface. The entire surface to be treated and at least one foot on each side shall be cleaned by sweeping, blowing, or other methods until all dust, mud, clay lumps, and foreign material is removed. A primed base shall be properly cured and approved prior to application of bituminous material.

410.03.5--Application of Bituminous Material. Bituminous material shall not be applied until the prepared surface has been approved by the Engineer. Where practicable, shots shall be at least 500 feet in length, and longer shots are desirable. No shot shall be in excess of a length which can be covered with aggregate before the bitumen hardens.

The bituminous material shall be uniformly heated and maintained within the specified temperature range during application. All material damaged by heating shall be rejected, and if a section has been treated with damaged material it shall be removed and replaced by the Contractor without additional compensation.

The bituminous material shall be applied with a pressure distributor at the specified rate, and at the temperature specified by the Engineer within the range set out in Subsection 702.11. It shall be uniformly applied full width in one operation unless the Engineer permits it to be applied in narrower widths. The application rate may be varied by the Engineer within the ranges set out in Table 410-A.

The application shall be stopped before the distributor is completely empty, and the length of shots shall be computed so that the application is stopped before it begins to run light. At the beginning of the application, including joints with preceding applications, intersections, and junctions with all pavements, etc., the distributor nozzles shall be operating at full force when the application begins. Building paper or other suitable material shall be used to receive the initial application from the nozzles before the asphalt reaches the road surface at the joint. The material shall be removed immediately after use without spilling asphalt on the road surface.

Spray bar nozzles shall be kept clean at all times, and should one become blocked during application of the bituminous material, the distributor shall be stopped immediately and the nozzle cleaned before proceeding. Bare or light areas shall be immediately made uniform by use of a hand hose or pouring pot.

Due to possible spillage, the transfer of material from the delivery truck to the distributor shall be outside the limits of the roadway. Bituminous material shall not be discharged on the right-of-way when cleaning out the distributor. Any spillage shall be removed from the roadway and right-of-way.

During application of bituminous material, the Contractor shall provide adequate protection to prevent marring or discoloration of pavements, structures, curbs, trees, etc., adjacent to the area being treated.

Longitudinal joints, when permitted, shall be reasonably true to line and parallel to the centerline. The overlap in the application of the bituminous material shall be the minimum to assure complete coverage.

At construction joints, the treatment of the edges shall be blended so that there are no gaps, the elevations are the same, and the joints are free from ridges and depressions.

410.03.6--Application of Cover Coat Material.

410.03.6.1--General. The application of cover material shall immediately follow the application of bituminous material. Adhesion of the cover aggregate to the bitumen is the Contractor's responsibility. The time interval between applications of bituminous material and cover aggregate shall not exceed 20 minutes when the air temperature is below 85°F or 30 minutes when the temperature is 85°F or above.

Aggregate shall be spread directly from approved spreaders. Trucks or spreaders shall not drive on the uncovered bituminous material.

The application rate of cover aggregate will be specified by the Engineer within the ranges set out in Table 410-A. The dry aggregate shall be spread uniformly to cover the bituminous material with the quantity of mineral aggregate specified by the Engineer. All deficient areas shall be covered by additional material. All excess cover material shall be removed from the surface and stockpiled or used as directed.

If needed, approved drag brooms and hand brooms shall be used to distribute the aggregate uniformly before and while the rolling operations are in progress.

The entire application of aggregate shall be rolled as soon as possible after application. Rolling shall be continued and repeated as often as necessary to key

the cover material thoroughly into the bituminous material over the entire surface.

Pneumatic rollers and steel-wheel rollers shall be used in the sequence that will provide the rolling pattern that results in the best adhesion of the aggregate to the bituminous material and the best surface qualities.

Subsequent to the initial application of the aggregate the Contractor shall distribute, as many times as is deemed necessary, loose aggregate over the surface to absorb free bituminous material and to cover areas deficient in aggregate. Immediately following each distribution, the Contractor shall roll the entire surface treatment or seal with a pneumatic-tire roller until the maximum quantity of aggregate is embedded in the bitumen. Rolling in each case shall be at least one complete coverage and as many additional coverages as necessary to properly embed the aggregate. All rolling shall be performed while the temperature is favorable for sealing the aggregate into the bitumen.

In all cases there shall be at least five complete coverages of the entire surface of the treatment with a pneumatic-tire roller.

For double treatments or seals when the Engineer has determined that the maximum quantity of aggregate has been embedded on the first layer, the Contractor shall sweep or otherwise remove all excess material but not displace any embedded aggregate.

410.03.6.2--Interlayers. The application rates of bituminous material and cover aggregate for single surface treatment placed on an existing pavement as an interlayer below hot bituminous pavement shall be as shown on the plans or as directed. Unless otherwise specified or shown on the plans, as soon as the single surface treatment has been applied and satisfactorily rolled, the first overall hot bituminous course shall be placed immediately in order to retain all aggregate of the surface treatment. Compaction of the hot bituminous layer shall consist of a minimum of three complete coverages with the pneumatic roller. The steel-wheel roller will not be required and no formal density tests will be made. The quantity of hot bituminous mixture acceptably used in the layer will be included in measurement for leveling course. Seasonal and temperature limitations will not apply to this type of surface treatment.

410.03.7--Control of Traffic. During the construction of each layer of bituminous surface treatment, the Contractor shall regulate the speed of vehicles and other traffic in order that unnecessary damage to the course will be avoided.

410.04--Method of Measurement. Accepted asphalt for surface treatment will be measured by the gallon as prescribed in Subsection 109.01. Unless otherwise specified, distributor tank measurement will be used. The volume of material over five percent above the quantity ordered for each shot will be deducted from

measured quantities, except that 15 percent will be allowed for irregular areas where hand spraying is necessary.

Aggregate cover material will be measured by the cubic yard (LVM) at the point of delivery on the road. Measurement will be for the actual volume spread. The volume of material over five percent above the quantity ordered for each "spreading" will be deducted from measured quantities, except that 15 percent will be allowed for irregular areas where hand "spreading" is necessary.

The volume of all cover material and the volume of all bituminous material lost, wasted, damaged, or rejected, or applied outside of designated areas, or in excess of the Engineer's directions and tolerances allowed, or contrary to the specifications, will be deducted from measured quantities.

410.05--Basis of Payment. Asphalt for surface treatment will be paid for at the contract unit price per gallon. Aggregate cover material will be paid for at the contract unit price per cubic yard (LVM). The prices thus paid shall be full compensation for completing the work.

Payment will be made under:

- 410-A: Asphalt for Surface Treatment, Grade - per gallon
- 410-B: Coarse Aggregate Cover Material, Size ____, Kind - per cubic yard
- 410-C: Seal Aggregate Cover Material, Size ____, Kind - per cubic yard

TABLE 410-A
BITUMINOUS SURFACE TREATMENTS

Item	Bituminous Material	Gallons / Square Yard	Coarse Aggregate Cubic Feet / Square Yard	Seal Aggregate Cubic Feet / Square Yard
Prime Coat	RC-70, 250; MC-30, 70 250; EA-*; AE-P	0.15 - 0.50		
Tack Coat	RC-70,250 800; RS-1,2, SS- 1, SS-1h; AC as in Mix; CSS-1, CSS- 1h	0.05 - 0.10		
Single Surface Treatment	AC-10; RC-800; RS-1, 2; CRS-2	AC = 0.36 - 0.42; RC, RS or CRS = 0.47 - 0.52	Size 5, 56 or 6 Slag or Stone = 0.52-0.56	
Single Surface Treatment	AC-10; RC-800; RS-1, 2; CRS-2	AC = 0.34 - 0.40; RC, RS or CRS = 0.42 - 0.47	Size 5 or 6 Gravel = 0.48 - 0.54	
Single Surface Treatment	AC-10; RC-800; RS-1, 2; CRS-2	AC = 0.25 - 0.31; RC, RS or CRS = 0.39 - 0.44		Size 7, 8 or 89 Slag, Stone, Gravel or Expanded Clay = 0.25 - 0.31
Double Surface Treatment 1st Course	AC-10; RC-800; RS-1, 2; CRS-2	AC = 0.30 - 0.42; RC, RS or CRS = 0.40 - 0.49	Size 5, 56 or 6 Slag or Stone = 0.50 - 0.54	
Double Surface Treatment 1st Course	AC-10; RC-800; RS-1, 2; CRS-2	AC = 0.30 - 0.38; RC, RS or CRS = 0.42 - 0.47	Size 5 or 6 Gravel = 0.48 - 0.54	
Double Surface Treatment 2nd Course	AC-10; RC-800; RS-1, 2; CRS-2	AC = 0.27 - 0.40; RC, RS or CRS = 0.39 - 0.47		Size 7, 8 or 89 Slag, Stone, Gravel or Expanded Clay = 0.25 - 0.31

* Emulsified asphalt for prime shall meet the requirements of Subsection 702.12, Table III.

SECTION 413 - CLEANING AND SEALING JOINTS AND CRACKS

413.01--Description. This work consists of routing, sawing and/or cleaning, sealing joints and cracks in existing pavement as designated by pay items in the contract proposal and as detailed on the plans and described herein. All work shall be in reasonably close conformity with these specifications and the details shown on the plans, or as directed.

When called for on the plans, this work shall also consist of saw cutting, cleaning and sealing transverse joints in new bituminous concrete overlays. Bituminous concrete pavement joints shall be constructed over, and in line with, the existing underlying transverse portland cement concrete joints in accordance with plans, specifications, and as directed by the Engineer.

413.02--Materials. Unless otherwise designated on the plans or in the contract documents, the joint sealing material may be cold or hot poured material meeting the requirements of Subsection 707.02.1.

The joint sealing material for sealing transverse joints in new bituminous pavement shall be a hot-poured elastic type conforming to the requirements of 707.02.1.3. The bond breaker tape shall consist of regular masking tape or a suitable bond breaker tape designed for use with hot-poured sealants. The width of the tape may be equal to but not more than 1/8" narrower than the width of the saw cut.

Unless otherwise specified in the plans or in the contract documents, the aggregate materials shall be size 89. The aggregate material shall conform to the applicable requirements of Section 703.

413.03--Construction Requirements.

413.03.1--Equipment. The equipment shall be that necessary for routing, sawing, cleaning and pouring the joint material as specified. When required, heating equipment shall meet the requirements of Subsection 702.03. Pouring equipment shall be subject to the approval of the Engineer and shall be capable of pouring the joints and cracks to the required elevation while the material is at the proper temperature. Cleaning equipment shall consist of mechanical or hand operated devices capable of thoroughly cleaning the joints, cracks and adjacent surfaces to the satisfaction of the Engineer. Air compressors shall be equipped with suitable traps and/or filters capable of removing moisture and oil from the compressed air.

413.03.2--Construction Methods.

413.03.2.1--Cleaning and Sealing Joints and Cracks. Joints and cracks to be sealed shall be cleaned by routing, sawing and/or sand blasting to the minimum

dimensions specified. Other methods of cleaning joints and cracks shall be approved by the Engineer. The surface which is to receive the new joint sealing material shall be dry and free of all lubricants, tar, asphalt, discoloration and stain as well as all other forms of contamination leaving a clean newly exposed surface. The adjacent surfaces of the pavement shall be cleaned to the extent necessary to prevent foreign matter from entering the joint before pouring. If necessary, re-cleaning shall be performed immediately prior to pouring.

Before pouring, suitable baffles shall be inserted in the top portion of the open joint, or other approved methods used as necessary, to control the flow of the material into the joint.

Should a joint or crack be deeper than the required dimension, a backer rod of the appropriate size shall be inserted into the opening to prevent the material from being placed in excess of the required depth.

Cracks shall be cleaned and sealed in the same manner as for joints. The Engineer may permit small cracks to be cleaned only by compressed air and sealed with joint sealing material.

Traffic shall not be allowed to travel over the sealed joints/cracks until the joint sealing material is dry enough to prevent tracking. When approved by the Engineer, the Contractor may place concrete sand or other approved material over the joint/crack to prevent tracking.

413.03.2.2--Cleaning and Filling Joints. Joints to be filled shall be cleaned by routing, sawing and/or sand blasting to the minimum dimensions specified. Other methods of cleaning joints shall be approved by the Engineer. The surface which is to receive the new joint sealing material shall be dry and free of all lubricants, tar, asphalt, discoloration and stain as well as all other forms of contamination leaving a clean newly exposed surface. The adjacent surfaces of the pavement shall be cleaned to the extent necessary to prevent foreign matter from entering the joint before pouring. If necessary, re-cleaning shall be performed immediately prior to pouring.

Before pouring, suitable baffles shall be inserted in the top portion of the open joint, or other approved methods used as necessary, to control the flow of the material into the joint.

Should a joint or crack be deeper than the required dimension, a backer rod of the appropriate size shall be inserted into the opening to prevent the material from being placed in excess of the required depth.

After the joint is filled to the required depth with joint sealing material, add aggregate material until the joint is even with the adjacent roadway.

Traffic shall not be allowed to travel over the sealed joints/cracks until the joint sealing material is dry enough to prevent tracking. When approved by the Engineer, the Contractor may place concrete sand or other approved material over the joint/crack to prevent tracking.

413.03.3--Sawing and Sealing Transverse Joints in Asphalt Pavement.

413.03.3.1--General. The Contractor's operation shall be conducted so that sawcutting of transverse joints, cleaning, and sealing is a continuous operation. The entire sawing and sealing operation shall be completed within seven (7) days after the placement of the final wearing course, unless the approved traffic control plan or sequence of operations provide otherwise. Traffic shall not be allowed on sawed unsealed joints. When intermediate lifts must be exposed to traffic for over seven (7) days, the Contractor shall be required to make an interim 1/8-inch wide saw cut which is one third (1/3) as deep as the hot mix asphalt layer. This interim saw cut does not require sealing. Costs of this interim cut(s) is to be absorbed the pay item for sawing and sealing transverse joints in asphalt pavement.

Saw cutting shall be done only after the hot mix asphalt has cooled to ambient temperature.

413.03.3.2--Sawcutting of Transverse Joints. The Contractor shall sawcut transverse joints in the pattern and to the dimensions shown on the plans or as directed by the Engineer. The sawcut joints shall be directly over the existing portland cement concrete pavement joints and shall be accurately located by a method employing pins and stringline. The pins shall be accurately located prior to paving. Details of the Contractor's method for locating the sawcuts shall be subject to the approval of the Engineer.

The blade or blades shall be of such size and configuration that the desired dimensions of each sawcut can be made with one pass. No spacers between blades will be allowed. Either dry or wet cutting will be allowed.

The transverse sawcut joints shall normally extend the full width of the pavement unless otherwise shown on the plans or directed by the Engineer. Existing transverse joints that are offset at the longitudinal joint by more than one inch, measured between the centers of the joint cavities, shall require separate sawcuts terminating at the longitudinal joint.

413.03.3.3--Cleaning. Dry sawed joints shall be thoroughly cleaned with a stream of air sufficient to remove dirt, dust or deleterious matter adhering to the joint walls or remaining in the joint cavity. Wet sawed joints shall be thoroughly cleaned with a 50 psi minimum, water blast immediately after sawing to remove any sawing slurry, dirt or deleterious matter adhering to the joint walls or remaining in the joint cavity. Wet sawed joints shall be blown with air to

provide dry joint surfaces prior to sealing.

All sawing slurry from the wet sawing process shall be immediately flushed from the pavement surface. Dry dust and material from the dry sawing process shall be blown or brushed off the pavement surface.

The Contractor shall be required to provide protective screening, subject to the approval of the Engineer, if cleaning operations are capable of causing damage to or interference with traffic in adjacent lanes.

413.03.3.4--Sealing. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign material and the joint faces shall be clean and surface dry when the seal is applied.

After cleaning, and just prior to sealing, a bond breaker tape shall be placed in the bottom of the sawcut joint.

Sealant material shall be at the pouring temperature recommended by the manufacturer when applied to the joints. Hot applied sealant material shall be stirred during heating so that localized overheating does not occur.

The sealant shall fill the joint such that, after cooling, the sealed joint conforms to the details shown on the plans or as directed by the Engineer. The pouring shall be performed in such a manner that the material will not be spilled on the exposed surfaces of the asphalt pavement. Any excess material on the surface of the asphalt pavement shall be removed immediately and the pavement surface cleaned. The use of sand or similar material as a cover for the seal will not be permitted. Poured joint sealing material shall not be placed when the air temperature in the shade is less than 50°F., unless approved by the Engineer.

413.04--Method of Measurement. Joint sealer material will be measured by the gallon for separate payment only when the proposal has a pay item for joint material.

Accepted joints and cracks, cleaned, sealed and/or filled, will be measured by the linear foot or mile as indicated in the contract proposal.

Sawed and sealed joints in new asphalt pavement will be measured by the linear foot of joint complete in place and accepted by the Engineer. Sawing, bond breaker tape and joint sealant material will not be paid for as separate items but will be included in the unit price per linear foot for sawing and sealing transverse joints in asphalt pavement.

413.05--Basis of Payment. Joint sealer material will be paid for by the gallon when measured as prescribed above, which price shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to complete the

work.

Joints and cracks, cleaned, sealed and/or filled, will be paid for by the linear foot or mile as prescribed in above, which price shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to complete the work.

Sawing and sealing transverse joints in new asphalt pavement, accepted and measured as prescribed, will be paid for at the contract unit price per linear foot; which price shall be full compensation for locating and transferring the location of existing joints to establish new joint locations, for all required sawing, for furnishing all materials, including bond breaker tape and joint sealant materials, for all cleaning, pouring, trimming, cleanup and disposal of all excess and waste, for protective screening; for all pertinent operations necessary and incidental to the construction as indicated herein, and for all equipment, tools, labor, and incidentals necessary to complete the work.

The cost of maintenance of traffic and protective services as required by the Department's Traffic Control Plan shall be included in the cost of items bid. This shall include all required individual traffic control devices.

Payment will be made under:

- 413-A: Joint Sealer Material - per gallon
- 413-B: Cleaning and Sealing Joints - per linear foot or mile
- 413-C: Cleaning and Sealing Cracks - per linear foot or mile
- 413-D: Cleaning and Filling Joints - per linear foot or mile
- 413-E: Sawing and Sealing Transverse Joints in Asphalt Pavement - per linear foot

SECTION 423 - GROUND-IN RUMBLE STRIPS

423.01--Description. This work consists of grinding rumble strips at the locations indicated on the plan, in accordance with the details on the plans, and the requirements set out herein.

423.02--Blank.

423.03--Construction Requirements.

423.03.1--Equipment. The equipment shall consist of a rotary type cutting head

capable of cutting rumble strips to the dimensions shown on the plans. The cutting head shall have the cutting tips arranged in such pattern as to provide a relatively smooth cut of approximately 1/8 of an inch between peaks and valleys. The cutting head(s) shall be on its own independent suspension from that of the power unit to allow the tool to self align with the slope of the shoulder and/or any irregularities in the shoulder surface.

The finished rumble strips shall be cut to the dimensions as shown on the plans within the allowable tolerance and be perpendicular to the direction of travel. The rumble strips shall be placed in relation to the roadway according to the patterns shown on the plans.

Adequate back-up equipment such as mechanical sweeper/vacuum, water truck, etc. and personnel shall be provided to remove all grindings from the shoulder.

423.03.2--Construction Details. The cutting tool shall be equipped with guides to provide a consistent alignment of each cut in relation to the edge line and to provide uniformity and consistency throughout the project. The alignment of the cuts shall not deviate from the path of the edge line.

When the contract requires shoulder paving, the rumble strips shall be cut into the finished shoulder after the final course has been placed, otherwise, rumble strips shall be cut into the existing shoulder material. The debris/grindings generated from the cutting shall be picked up and removed on a daily basis by use of a sweeper/vacuum or other method approved by the Engineer. The shoulder shall be cleaned prior to opening the adjacent lane to traffic. Any other method of cleaning debris from the shoulder or roadway other than picking up shall be approved by the Engineer prior to beginning construction. The use of the material from the rumble strips as RAP in the composition of hot mix asphalt mixtures shall require approval by the State Materials Engineer.

The Contractor shall demonstrate to the Engineer the ability to achieve the desired surface inside each depression without tearing or snagging the asphalt prior to beginning the work. Areas damaged by the Contractor's operations shall be corrected and/or repaired as directed by the Engineer at no additional cost to the State.

When placed on concrete shoulders, the Contractor shall adjust the spacing of the rumble strips to ensure that the depressions are not cut across a concrete shoulder joint.

This construction operation will encroach on the lane adjacent to the shoulder receiving the rumble strips. Therefore, construction on roadways under traffic will either require a lane closure or be considered as a moving operation. Traffic control shall be handled in accordance with the appropriate standard drawings shown in the plans or contract documents.

423.04--Method of Measurement. Rumble strips, ground-in, completed in accordance with the plans and specifications, will be measured by the mile, which price shall be full compensation for all materials, equipment, tools, disposal of grinding debris, any associated traffic control, and all incidentals necessary to complete the work. Length of measurement will start at the beginning of a continuous series of rumble strips and will terminate at the end of the continuous series. The length used to measure rumble strips will be the horizontal length computed along the stationed control line. Each shoulder on which rumble strips have been ground will be measured separately with the measurements from each shoulder combined to obtain the pay length for rumble strips.

423.05--Basis of Payment. Rumble strips, measured as prescribed above, will be paid for at the contract unit price per mile, which price shall be full compensation for completing the work.

The price for rumble strips shall include the cost of any required maintenance of traffic and protective services.

Payment will be made under:

- 423-A: Rumble Strips, Ground-In - per mile
- 423-B: Rumble Strips, Ground-In, Concrete - per mile