

PART V—ASPHALT PAVEMENTS

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Section 501

Thin Asphalt Concrete Applications

501.01 DESCRIPTION.

501.01.1 General: Furnish and construct one or more courses of asphalt concrete mixture in conformance with these specifications and in conformity with the lines, grades, thicknesses, and typical sections shown on the plans or established.

Comply with Section 503, Equipment and Processes and the Application of Quality Assurance Specifications for Asphalt Concrete Mixtures (QA Manual).

These specifications apply to all asphalt concrete mixtures with plan thicknesses less than 1½ inches. The following mixtures are further described herein and as shown on the plans:

1. Dense Mix – allowed for traffic volumes < 3,500 ADT.
2. Coarse Mix – allowed for all traffic volumes. Can be substituted for Dense Mix without change order.
3. Open Graded Friction Course (OGFC) – allowed for all levels of traffic volume, and required when used on Interstate Highway System. The OGFC can be substituted for any Thin Asphalt Concrete application without change order. Use the same mixture type throughout the project length unless approved otherwise by the engineer.

501.01.2 Quality Assurance: It is the intent of these specifications that the mixtures produced and placed meet the requirements for 100 percent payment. Work shall meet the requirements of this section and be subject to acceptance by the Department.

Exercise quality control as defined in 101.03. When these specifications are not being met and satisfactory control adjustments are not being made, discontinue operations and notify the project engineer immediately until proper adjustments and uniform operations are established. Accomplish control by a program independent of the Department's testing and ensure that the requirements of the job mix formula (JMF) are being achieved and that necessary adjustments provide the specified results.

Do not begin daily plant operations unless the contractors' Certified Asphalt Concrete Plant Technician (Level 2 or Level 3) is at the plant. When the plant is in operation, have a Certified Asphalt Concrete Plant Technician at the plant or jobsite.

501.02 MATERIALS. Sample and test in accordance with the Material Sampling Manual and the test procedures described in Table 502-1

Keep accurate records including proof of deliveries of materials for use in these processes. Ensure that materials comply with the following Sections and Subsections and as specified in this section:

Asphalt	1002
Anti-Strip Additives	1002.02.1
Aggregates	1003.01 & 1003.06
Hydrated Lime	1018.02
Crumb Rubber	1002.02.2
Mix Release Agent	1018.10
Fibers	1002.02.5

501.02.1 Tack Coat: Ensure that tack coat meets the requirements of Section 1002. Apply tack coat as described in 501.08.1. Application rates are defined in Table 501-1. Use emulsions listed in the Approved Materials List.

For dense mixtures, apply a NTSS-1HM, SS-1H, CSS-1H, CSS-1HP, or a hot applied non-tracking tack (NTHAP).

For coarse and OGFC mixtures, apply a Polymer Emulsion Tack (PET) or SS-1L using the spray paver as described in Section 503.

On all non-interstate roadways, if not using a spray paver, use a hot applied non-tracking (NTHAP).

501.02.2 Asphalt Cement: Use asphalt cement grades as specified in Table 501-1. If the asphalt cement does not comply with the requirements of Section 1002, notify the project engineer and cease mix production until proper asphalt material is supplied. Allow grade substitution as specified in Section 502. PG82-22rm may be substituted for PG76-22m or PG70-22m.

501.02.3 Additives: Use anti-stripping additives from a source listed on the Approved Materials List. Add anti-strip at a minimum rate of 0.6 percent. Hydrated lime additive may be incorporated into all asphalt concrete mixtures at the rate specified in the approved JMF. Add hydrated lime and thoroughly mix with aggregates in conformance with 503.05.5. Hydrated lime may be added as mineral filler in accordance with 503.05.4 and 1003.06.6

501.02.4 Aggregates: Use an aggregate from Approved Material List with a maximum water absorption of 2 percent as reported on the Approved Material List. For Dense Mix, use aggregate from Approved

Materials List. Use aggregate that meets requirements of 1003.06. Submit a Certificate of Analysis with the JMF to the District Laboratory Engineer indicating conformance to Table 501-2.

501.02.5 Mineral Filler: If used, meet the requirements of 1003.06.6

501.02.6 Grit: When required to prevent draindown, use cellulose or mineral fiber, meeting the requirements of 1002.02.5. When used, add fibers at a rate sufficient to prevent draindown.

501.03 DESIGN OF THIN ASPHALT CONCRETE MIXTURES.

Submit an aggregate gradation that conforms to Table 501-3 along with the Certificates of Analysis required in 501.02.4. Aggregate friction rating for coarse mix and OGFC will be in accordance with Table 502-3.

Design dense and coarse mixtures to midpoint of voids using the gyratory requirements of Table 501-1. For design of OGFC mixtures, the full range of void requirements is allowed. Report the corresponding asphalt content on the JMF. For all mixtures, submit to the District Laboratory Engineer a JMF proposal for approval which is representative of the mixture that will be produced and meets the design requirements prior to validation or production. Prior to JMF approval, present a Certificate of Analysis showing aggregate physical properties conforming to Table 501-2.

Design and report mix temperatures between 300°F and 350°F on the JMF.

A change in the asphalt cement source will require testing for Moisture Susceptibility in accordance with DOTD TR 317 and either AASHTO T324 or DOTD TR 322.

501.04 LOT SIZES. A lot is a segment of continuous production of asphalt concrete mixture from the same JMF produced for the Department at a specific plant, delivered to a specific DOTD project. A lot is defined as 2400 tons of mixture production, a subplot is 800 tons. The final lot may be increased up to 50 percent of an original lot size with the mutual agreement of the contractor and Project Engineer.

501.05 JOB MIX FORMULA (JMF) VALIDATION. Validate the JMF on the first lot (1200 ton, 3-400 ton sublots) of production for a project by meeting the requirements of Table 501-1 and 501-3. The District Laboratory and Contractor shall jointly test three sublots for theoretical maximum specific gravity (G_{mm}), percent air voids, percent asphalt cement content, and extracted aggregate gradation. Each individual test result shall meet specifications. The average values will be used for verification tolerances in

Table 501-4. Validate the mixture using AASHTO T324 loaded wheel and Gyratory AASHTO T312 through testing of gyratory mix or roadway core on the second day of production. If failure occurs, adjust mix and revalidate. If second failure occurs, redesign the mix. All JMF's shall be re-validated a minimum of every 2 years. Re-validation may consist of reviewing ongoing production plant data and plant verification data.

501.06 PLANT QUALITY CONTROL. Ensure that the plant equipment and processes conform to Section 503. Produce mixtures at temperatures not to exceed 350°F. Sample and test according to the Materials Sampling Manual. Prepare Gyratory specimen in accordance with AASHTO T312. Any change in material will require a new approved JMF.

Keep accurate records, including proof of deliveries of all materials used in this process.

Sample and test the mixture for extracted aggregate gradation, asphalt cement content, and theoretical maximum specific gravity (G_{mm}) testing at the frequency listed in the Materials Sampling Manual. Ensure that the average individual deviations from JMF target values of each test result meet the requirements of Table 501-4. For each lot, report all quality control data to the Department's Certified Plant Inspector. Apply the extracted gradation tolerances listed in Table 501-3 to the JMF design target gradation. Ensure that JMF target is within the range of extracted aggregate gradation listed in 501-3. The District Laboratory Engineer may require re-validation of the mix when the average of the Quality Control data indicates non-compliance with the specified limits or tolerances. Control charts may be requested by the engineer if mixture problems develop.

501.06.1 Acceptance and Verification: Meet the verification requirements of Table 501-03 and Table 501-04 tolerances.

The Department will:

1. Perform all acceptance and verification testing using the stratified random sampling approach in accordance with S605 of the Materials Sampling Manual.
2. Sample and test the mixture for Water Susceptibility and LWT testing at the frequency listed in the Material Sampling Manual.

501.07 ROADWAY OPERATIONS. Meet the requirements of 502.07 except as modified herein.

501.07.1 Weather Limitations: Ensure that Thin Asphalt Concrete complies with the weather limitations of 502.07.1 except that both the surface and ambient temperatures shall be a minimum of 60°F.

Do not place OGFC when ambient temperatures are predicted to drop below freezing, 32°F, within a 3 day forecast period by the U.S. National Weather Service (NWS).

501.07.2 Surface Preparation: Protect and cover manhole covers, drains, grates, catch basins and other such utility structures. Cut back all vegetation at the road edge. Sweep the surface clean of dust, dirt, caked clay, and loose foreign material. Remove and discard raised pavement markers prior to placement.

501.08 HAULING, PAVING AND FINISHING. Meet the requirements of 502.08 except as modified herein. Use fully sealed tarps on all loads. Load haul trucks to minimize segregation.

501.08.1 Application of Tack Coat: Before constructing the thin lift, apply an approved asphalt tack coat in accordance with Section 504. Spray the tack coat with a power asphalt distributor meeting the requirements of 503.13.1 or a spray paver meeting the requirements of 503.15.1. Spray tack coat uniformly and accurately across the paving width and monitor the rate of spray. Determine the tack coat application rate by road conditions and mix type. Meet the undiluted asphalt emulsion application rate in Table 501-1. Tack coat application rates above the minimum specified in Table 501.1 must be approved by the Engineer.

501.08.2 Placement: Place mixtures in accordance with processes and equipment described in Section 503. Deliver material to the paver at a uniform rate and in an amount within the capacity of paving and compacting equipment. Adjust the paver speed and number of trucks to maintain continuous paving operations. Keep the height of material in front of the screed at a uniform height.

Ensure the pavers are designed and operated to place mixtures to required line, grade and surface tolerance without resorting to hand finishing.

501.08.3 Paving: Place and compact the mixture to plan thickness. Place a smooth uniform mat over the full lane width.

501.08.4 Compaction: Comply with 502.09 except as modified herein. Compact the mixture applying a minimum of 3 passes over a single point on the road using a double drum steel wheel roller of sufficient weight to properly seat the aggregate without crushing. Roll longitudinal joints directly behind the paving machine. Do not vibrate except at transverse joints. Accomplish final compaction with a second roller. Compact and finish before the mixture temperature falls below 180°F.

501.09 ROADWAY QUALITY ASSURANCE. The Department will perform all plant acceptance and verification testing to meet the Materials Sampling Manual. The Project Engineer will verify that the tack coat application rate and mixture yield meet the requirements of Table 501-1.

Do not place asphalt concrete exhibiting deficiencies before placement such as segregation, contamination, lumps, non-uniform coating, excessive temperature variations, alignment deviations, variations in surface temperature or other deficiencies, apparent on visual inspection.

Poor construction practices such as handwork, improper truck exchanges, improper joint construction, or other deficiencies, apparent on visual inspection, will not be accepted.

501.09.1 Opening to Traffic: Do not open the new pavement to traffic or allow any roller to sit idle on the pavement until the rolling operation is complete and the material has cooled to a temperature where the mat will not be damaged by traffic.

501.09.2 Smoothness: Measure the International Roughness Index (IRI) using a Department approved automated profiler before and after laydown operations in the presence of a Project Engineer's representative. Measure IRI in accordance with DOTD TR644, on the travel lanes for highways and the center two lanes for airports before placement and meet Table 502-5 requirements. Ensure a maximum transverse deviation of 1/8 inch due to roller marks and 1/4 inch maximum deviation for longitudinal joint differences.

Submit initial and final measurements to the engineer on a USB data storage device.

501.10 MEASUREMENT. Measure the Thin Asphalt Concrete applications by the ton. Measure the tack coat in accordance with Section 504.

501.11 PAYMENT. Payment for Thin Asphalt Concrete mixture will be made at the contract unit price per ton which includes furnishing all required materials, labor, equipment, tools and incidentals necessary for producing the mixtures, preparing the surfaces on which the mixtures are to be placed, hauling the mixtures to the work site, and placing and compacting the mixtures. Asphalt tack coat will not be a pay item and will be considered incidental to the 501 item. However, if the engineer adjusts the application rate of tack coat from that specified by the contract document, payment for the asphalt mixture will be increased or decreased based on the difference in the applied quantity of asphalt emulsion shown on paid invoices (total of

charges). The contractor shall provide copies of paid invoices for this determination. Apply 95 percent payment to the 501 item when the tack coat rates do not meet the application rate as allowed by the engineer. Payment will be subject to the payment adjustment schedules as shown in Table 501-5.

Payment adjustments will be assessed on a per lot basis. The percent payment for the roadway lot will be the lowest value of the payment adjustment parameters. Adjustment for smoothness will be per travel lane for the entire project in accordance with Table 501-6.

Payment for removal of pavement markings shall be in accordance with applicable item.

Payment will be made at the contract unit price under:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
501-01	Thin Asphalt Concrete (Dense Mix)	Ton
501-02	Thin Asphalt Concrete (Coarse Mix)	Ton
501-03	Thin Asphalt Concrete (OGFC)	Ton

**Table 501-1
Asphalt Mix Design Requirements**

Mix Type		Dense Mix	Coarse Mix	OGFC
Asphalt Cement Grade		PG 67-22	PG 70-22m	PG 76-22m
Gyratory Revolutions ¹		50	75	50
Minimum AC content, %		4.5	4.5	6.5
Air Voids, % ²		4-6	6-8 ³	18-24 ³
Sands, Max. %		15	0 ⁴	0
RAP, Max %		10	0	0
LWT rut depth, 12 mm (max) @ no. passes, AASHTO T 324 ⁴		12,000	20,000	5000
Draindown, % max ⁵		---	0.15	0.30
Water Susceptibility, Boil Test, DOTD TR 317, % min		90	90	90
Min.Tack Coat Application Rate, Undiluted gal/sq.yd. (0.40 gal/sq.yd maximum) ⁶		0.08 ⁸	0.15	0.15

¹Compact specimen according to AASHTO T 312.

²Design target voids at mid-point of void requirement. Full range allowed for OGFC.

³As computed using the measure of the physical volume (weight of compacted specimen)/ (height of compacted specimen x area of the compacted specimen).

⁴ Compact LWT specimen to the target voids.

⁵As measured in accordance with ASTM D 6390.

⁶See 501.02.1 for allowable tack coats.

⁷If bleeding, ponding or slipping are evident, these rates may be reduced to a minimum of 0.04 gallon/square yard with a minimum 0.02 gallon/square yard residual with approval of the engineer.

**Table 501-2
Aggregate Physical Properties**

Test	Method	Coarse Mix and OGFC	Dense Mix
¹ Coarse Aggregate:			
Micro Deval, % loss max	AASHTO T-327	18	—
Flat and Elongated Ratio; 3:1, % Max.	ASTM D4791	25	—
Coarse Aggregate Angularity, % Crushed, Double Faced, Min.	DOTD TR 306	90	—
¹ Fine Aggregate:			
² Sand Equivalent, Min.	DOTD TR 120	60	40
Fine Aggregate Angularity (FAA), Min.	DOTD TR 121	45 ³	35 ⁴
Friction Rating		I, II ⁵	I, II, III

¹Applies to individual coarse aggregates having more than 10 percent retained on No. 4 sieve and to individual fine aggregates having more than 10 percent passing the No. 4 sieve.

²If sand equivalent test fails, the Methylene Blue Test in accordance with AASHTO TP 57-99 will be required with a specification maximum of 10.

³Use as-received material and test using AASHTO T-304, Method C, when quantity of material retained on individual sieve sizes do not meet the requirements.

⁴FAA of 45 for gravel calculated on the composite blend

⁵See Table 502-3.

**Table 501-3
JMF Extracted Gradation and Production Tolerances**

U.S. (Metric) Sieve % Passing		Dense Mix	Coarse Mix	OGFC	Production ¹ Tolerances
3/4 inch		100	100	100	±4
1/2 inch		100	75-100	85-100	±4
3/8 inch		90-100	—	55-75	±4
No. 4		—	25-40	10-25	±4
No. 8		35-70	19-28	5-13	±3
No. 16		20-50	—	—	±2
No. 30		—	—	—	±2
No. 50		—	—	—	±2
No. 200		2-10	2.0-5.5	2-4	±1.5
Metered A/C, %					±0.1
Mix Temperature, °F					±25
Gmm	All Mixes				0.015

¹Job Mix Formula (JMF) target based on validated mix design. For OGFC and Coarse Mix, the tolerance will not be allowed above the maximum limits of the No. 200 sieve.

**Table 501-4
Quality Control and Production Tolerances**

Property	Tolerance ¹
Fine Aggregate Specific Gravity, G_{sb}	±0.030
Coarse Aggregate Specific Gravity, G_{sb}	±0.020
Theoretical Maximum Specific Gravity, G_{mm}	±0.015
Air Voids, V_a , %	±1
# 4 Sieve, % passing	±4
#200 Sieve, % passing	±1.5

¹Meet these specifications for all parameters where tolerances are not listed.

Table 501-5¹
Payment Adjustment Schedules

Plant:	Percent of Contract Unit Price per Lot			
	100%	90%	80%	50 ¹ %
Theoretical Maximum Specific Gravity (Gmm) Average Deviation from Validated JMF Target Value	Less than 0.022	0.022-0.025	0.025-.027	> 0.027
Limits on Extracted Aggregate, Average Deviation from Table 501-3, JMF Validated Target ²				
No. 4 Sieve	≤ 5.0	5.1 – 6.0	> 6.0-7.0	> 7.0
No. 200 Sieve	≤ 2.0	2.1 – 2.5	> 2.5-3.0	> 3.0
Roadway:				
Tack Coat Rate (applied undiluted) with a spray paver, gallon/sq. yd. Coarse Mix and OGFC	0.15 (min.)	0.14-0.08	0.08-0.04	< 0.04

¹Reduced pay or reapplication at the contractor expense shall be as directed by the Chief Engineer.

²Gradation pay schedule applies to coarse and OGFC mixtures only.

Table 501-6
Smoothness Payment Adjustment Schedules

Percent of Contract Unit Price per Travel Lane			
	100%	90%	50% ¹
Initial IRI of ≤ 65	≤ 65	66-75	> 75
Initial IRI > 65 to 81	≤ 65 IRI	0-10% Higher IRI number than initial measure	> 10% Higher IRI Number than initial measure
Initial IRI > 81	20% Improvement of initial measure	19% improvement to equal to initial measure.	Higher IRI Number than initial measure

¹50% pay or reapplication at no direct pay shall be as directed by the Chief Engineer.

Section 502 Asphalt Concrete Mixtures

502.01 DESCRIPTION.

502.01.1 General: Furnish and construct asphalt concrete mixtures in accordance with Table 502-6 and in conformance with the lines, grades, thicknesses, and typical sections in the plans.

Comply with Section 503, Equipment and Processes and the Application of Quality Assurance Specifications for Asphalt Concrete Mixtures (QA Manual).

Use a DOTD certified laboratory accredited by AMRL, CMEC, or other accreditation agency approved by DOTD.

502.01.2 Lift Description and Mixture Types: The wearing course is defined as the final lift placed. The binder course is defined as the lift placed prior to the final lift as defined in the plans.

When a Section 501 thin lift mix is used in conjunction with construction of 502 mixtures, it is a finish course.

Mainline mixtures include wearing, binder and base courses for travel lane, ramps greater than 300 feet, interstate acceleration/deceleration lanes, turn lanes, and the two center lanes for airports.

Minor mixes include mixture used for bike paths, crossovers, curbs, detour roads, driveways, guardrail widening, islands, joint repair, leveling, medians, parking lots, shoulders, turnouts, ramps less than or equal to 300 feet, patching, widening, miscellaneous handwork, and any other mixture that is not mainline.

502.02 MATERIALS. Comply with applicable Part X subsections listed herein. Sample in accordance with the Materials Sampling Manual and ensure testing in accordance with the procedures listed in Part X and Table 502-1. Keep accurate records, including proof of deliveries of all materials used in asphalt concrete mixtures. Furnish copies of these records to the engineer upon request.

Aggregates	1003.01 & 1003.06
Anti-Strip Additives	1002.02
Asphalt	1002
Crumb Rubber	1002.02.2.
Hydrated Lime	1018.02
Mineral Fiber	1002.02.5

Mineral Filler	1003.06.6
Mix Release Agent	1018.10
Reclaimed Asphalt Pavement (RAP)	1003.01 & 1003.06.5
Warm Mix Additives	1002.02.4

**Table 502-1
Test Procedures for Asphalt Concrete**

Description	Test Method
Specific Gravity and Density of Compressed Asphalt Mixtures	DOTD TR 304
Theoretical Maximum Specific Gravity, G_{mm}	DOTD TR 327
Asphalt Cement Content, P_b	DOTD TR 323
Mechanical Analysis of Extracted Aggregate	DOTD TR 309
Moisture Content of Loose HMA	DOTD TR 319
Degree of Particle Coating (plant requirement)	DOTD TR 328
Bulk Specific Gravity and Absorption	AASHTO T 84, T 85
Coarse Aggregate Angularity, % Crushed (Double Faced)	DOTD TR 306
Fine Aggregate Angularity	DOTD TR 121
Flat and Elongated Particles	ASTM D 4791
Sand Equivalent	DOTD TR 120
Mixture Conditioning (Aging) of HMA Mixtures	AASHTO R 30
Superpave Volumetric Mix Design	AASHTO M 323
Preparing Gyrotory Samples	AASHTO T 312
Asphalt Cement Draindown	ASTM D 6390
Longitudinal Profile Using Automated Profilers	DOTD TR 644
Thickness and Width of Base and Subbase	DOTD TR 602
Loaded Wheel Tester (LWT)	AASHTO T 324
Semicircular Bend Test (SCB)	TR 330

502.02.1 Asphalt Cement: Comply with Table 502-2.

If the asphalt cement does not comply with the requirements of Section 1002, cease mix production until proper asphalt material is supplied.

**Table 502-2
Asphalt Cement Usage**

Location	Mix Level	Asphalt Grade Required	Substitutions Allowed		
			Lower Grade ¹	Higher Grade	
Mainline Wearing & Binder ^{2,3}	1	PG 70-22m	PG 67-22 (Binder only) with traffic volume < 3500 ADT		PG 82-22rm, and PG 76-22m
Mainline Wearing & Binder ^{2,3,4}	2 and SMA	PG 76-22m	PG 70-22m with Hydrated Lime	PG 70-22m (Binder Only)	PG 82-22rm
Base	1	PG 67-22	PG 58-28 ⁵		PG 82-22rm, PG 76-22m, PG 70-22m
Minor Mixes including Leveling ^{2,3}	ALL	PG 67-22			PG 82-22rm, PG 76-22m, PG 70-22m

¹Lower grade substitutions are only allowed if LWT rut depths < 6mm for the design level.

²For single lift overlay match grade of overlay.

³Semicircular bend test (SCB), minimum, Jc=0.5 KJ/m² required for all substitutions.

⁴Semicircular bend test (SCB), minimum, Jc=0.6 KJ/m² required for all substitutions.

⁵When 21-30% RAP is used, PG 58-28 is required.

502.02.2 Additives.

502.02.2.1 Anti-Strip (AS): Add anti-strip additive at the minimum rate of 0.6 percent by weight of asphalt cement and thoroughly mix in-line with the virgin asphalt cement at the plant. Increase the anti-strip additive or change to different additive as needed to meet Loaded Wheel Test, LWT, requirements. Discontinue production until satisfactory adjustments are made when the amount of anti-strip additive is not in accordance with the approved JMF.

502.02.2.2 Hydrated Lime: When used, specify rate of hydrated lime additive on the Job Mix Formula. Add hydrated lime additive at a minimum of 1.5 percent and thoroughly mix with aggregates in conformance with 503.05.5 as required to meet LWT requirements.

502.02.2.3 Waste Tire Rubber Additive: When used, crumb rubber may be pre-blended or, with approval by the Materials Laboratory,

may be blended at the plant. The maximum rubber replacement is 10 percent by weight of asphalt.

When blending crumb rubber at the contractor's plant, add crumb rubber to a PG 67-22 material on the Approved Materials List. Add 30 mesh (or finer) crumb rubber as required to meet grade PG 82-22rm. Comply with 1002.02.2

502.02.2.4 Latex Additive: When added at the contractor's plant, blend a minimum of 1.0 percent residual latex by weight of asphalt cement to a PG 67-22 material on the Approved Material List, and in accordance with Section 503. Meet PG 70-22m requirement using pre-qualified asphalt material and latex.

502.02.2.5 Warm Mix Asphalt Additives: When used, add only approved warm mix chemical additives. Foaming is allowed.

502.02.3 Aggregates: Use aggregates from approved sources. Blend aggregates to meet Sections 502 and 1003.

502.02.3.1 Friction Ratings: Friction ratings for aggregates are determined in accordance with 1003.01.2.4. Table 502-3 describes the friction ratings and corresponding usage allowed for the current average daily traffic (ADT) shown on the plans. Friction rating requirements apply to the mainline wearing course only, unless a finish course is applied. If a finish course is applied, then the friction rating requirements do not apply to wearing course.

All binder and base mixes and minor mixes do not have aggregate friction rating requirements.

**Table 502-3
Aggregate Friction Rating**

Friction Rating	Allowable Usage
I	All mixtures
II	All mixtures
III	All mixtures, except mainline wearing courses with plan Average Daily Traffic (ADT) greater than 7000 ¹
IV	All mixtures, except mainline wearing courses ²

¹ When plan current average daily traffic (ADT) is greater than 7000, blending of Friction Rating III aggregates and Friction Rating I and/or II aggregates will be allowed for travel lane wearing courses at the following percentages. At least 30 percent by weight (mass) of the total aggregates shall have a Friction Rating of I, or at least 50 percent by weight (mass) of the total aggregate shall have a Friction Rating of II. The frictional aggregates used to obtain the required percentages shall not have more than 10 percent passing the No. 8 (2.36 mm) sieve.

² When the average daily traffic (ADT) is less than 2500, blending of Friction Rating IV aggregates with Friction Rating I and/or II aggregates will be allowed for travel lane wearing courses at the following percentages. At least 50 percent by weight (mass) of the total aggregate in the mixture shall have a Friction Rating of I or II. The frictional aggregates used to obtain the required percentages shall not have more than 10 percent passing the No. 8 (2.36 mm) sieve.

502.02.3.2 Reclaimed Asphalt Pavement (RAP): Keep reclaimed asphalt pavement separate from other materials at the plant in such a manner that will allow for Department inspection and acceptance. Keep stockpiles uniform and free of soil, debris, foreign matter and other contaminants. Allowable RAP percentages are defined in Table 502-6. Screen or crush RAP to pass a maximum of 2 inch sieve prior to use. Additional RAP is allowed in all mixes except for Airports and SMA when RAP stockpile is pre-screened on a 1 inch scalping screen.

502.02.3.3 Mineral Filler: When used, comply with the requirements of 1003.06.6.

502.02.3.4 Natural Sand: When used, meet the requirements of Table 502-6 and 1003.06.3.

502.02.3.5 Fibers: When required to prevent draindown, use cellulose or mineral fiber, meeting the requirements of 1002.02.5. When used, add fibers at a rate sufficient to prevent draindown.

502.03 DESIGN OF ASPHALT MIXTURES AND JOB MIX FORMULA (JMF) APPROVAL. Design all asphalt mixtures for optimum asphalt content in compliance with the mix design in accordance with AASHTO M323, AASHTO M325 for SMA, and the requirements of Table 502-6 and Table 1003-14.

At minimum, all design submittals must include the recommended materials proportions, extracted gradation, recommended mix and compaction temperatures, and supporting design data. Submit the recommended JMF electronically through Site Manager Materials (SMM) or other data system as designated by the Department for District Laboratory Engineer acceptance with all supporting design data. No mixture shall be produced until the proposed JMF has been accepted.

Indicate the optimum mixing and compaction temperatures as suggested by the asphalt binder supplier on the JMF. Mix temperatures are recommended by the asphalt supplier as determined by rotational viscosity or other means. Warm Mix Asphalt technology may be used to reduce this temperature and must be noted on the JMF. Warm mix asphalt may be substituted with a minimum production temperature of 275°F.

Once a plant is producing an acceptable JMF, keep JMF production within the specified tolerances. Changes will be reviewed and accepted by the District Laboratory Engineer as necessary.

The engineer may require a new mix design when roadway acceptance requirements are not being met or plant quality data indicates non-compliance.

502.03.1 Mixtures Design Substitutions: Use only Warm Mix Asphalt (WMA) additives that are listed on the Approved Material List.

The 3/4-inch Nominal Maximum Size (NMS) wearing course may be substituted for binder course but not substituted for base course. The 1-inch NMS binder course may be substituted for base course.

The 1/2-inch NMS wearing course may be substituted for incidental paving, Level A. Shoulders may be any mixture type shown in Table 502-4 regardless of design level except that shoulder wearing must be a 1/2-inch or 3/4-inch NMS mixture.

Apply all specification requirements for the substituted mixture with the following exceptions: When wearing course is substituted for binder course, Table 502-3 does not apply. When wearing or binder are substituted for binder or base, the allowable RAP percentage shall meet the intended use specified in Table 502-6.

When a 501 finish course and a 502 wearing course are required on a project, allowable RAP percentage for wearing may meet binder course requirement.

502.04 JOB MIX FORMULA VALIDATION AND APPROVAL.

The Department and contractor will jointly test plant mix to validate each JMF for mainline mixture and accept each JMF whenever a plant begins initial operations for the Department in a specific plant location, or whenever a plant experiences a change in materials or change in source of materials, or when there are significant changes in equipment, such as the introduction of a new crusher, drum mixer, burner, foaming device, etc. Evaluate each JMF at least once every two years. Meet LWT requirements and all applicable requirements of Table 502-6.

For Minor Mixes, validation is not required for mixture designs, but the mixture must meet specification requirements. In order to validate minor mixes, the plant G_{mm} must be determined.

The average of the first five (5) plant G_{mm} s will become the new JMF target.

For all mixes, validation is not required when the asphalt grade has changed or asphalt source has changed, but must meet LWT requirements and all applicable requirements of Table 502-6.

502.04.1 Validation Plant Lot: The validation plant lot (“VP-lot”), is a maximum of 2000 tons of plant produced mix. Divide into 5 equal parts for validation sampling and testing.

502.04.2 Validation: Report the mean, standard deviation, Quality Index and percent within limits (PWL) of the test results in accordance with the QA manual. The JMF is considered conditionally validated if the

following parameters are 71 percent within limits of the JMF and meet the specifications.

1. Theoretical Maximum Specific Gravity (G_{mm}),
2. Percent G_{mm} at $N_{initial}$,
3. Percent passing the No. 8 and No. 200 sieves,
4. Percent Air Voids at N_{design} , and
5. VFA.

The average of all other validation tests shall meet the specifications limits in Table 502-6. The production can continue during conditional validation. The JMF is considered validated with passing LWT results. If the LWT fails twice, cease production and re-design. Upon validation of the JMF, the average of the validated results will become the JMF targets.

502.04.3 Payment for Plant Validation: Payment will be in accordance with 502.15.

The validation mixture is not paid separately, but is considered part of the roadway lot.

502.05 QUALITY CONTROL AND PLANT ACCEPTANCE. All quality control information, plant records, etc. will be considered part of the Department's acceptance decision. Exercise quality control over all materials and their assembly, design, processing, production, hauling, laydown and associated equipment to ensure compliance with Table 502-4 and all other specifications herein. At the end of each production day, notify the District Lab Engineer (DLE) and the DOTD Asphalt District Inspector (ADI) of the next scheduled mix production run and placement.

For plant quality control, a plant lot, or "P-Lot" is defined as 1000 tons of continuously produced mixture from one JMF. Obtain a sample of plant mixture and test the mixture once every 1000 tons using a random sampling approach. Minimum quality control testing for each P-Lot is as follows:

Loose Mix

1. Theoretical Maximum Specific Gravity, G_{mm}
2. % Asphalt Cement Content
3. Gradation
4. % Crushed
5. Temperature, and
6. % Moisture content

Compacted Specimen, N_{design}

1. % G_{mm} at $N_{initial}$
2. % Air Voids, V
3. % VMA
4. % VFA, and
5. % G_{mm} at N_{max} (1 per 5 P-Lots)

Age all loose mix tested for G_{mm} or volumetrics for one hour in accordance with AASHTO R30 prior to testing. Age warm mix for two hours.

Determine the rolling five test results average and standard deviation for aggregate gradation, asphalt content, air voids, and G_{mm} . Take corrective action or cease production when the latest rolling five test results show:

1. Air voids or G_{mm} fall below 71 PWL (based on the latest rolling five test results); or
2. Average VFA is outside of specification limits; or
3. Gradation for the No. 8 and No. 200 sieve is outside of specification limits; or
4. Asphalt content is $\pm 0.2\%$ the JMF target.

Enter all plant quality control data into the Department's approved data management system. The full range of gradation mix tolerances will be allowed even if they fall outside the control points. The District Laboratory Engineer may require re-validation of the mix when the average of the Quality Control data indicates non-compliance with the specified limits or tolerances.

Measure the moisture content of the cold feed aggregates daily in accordance with DOTD TR 403. The moisture content of the final mixture, measured daily, shall not exceed 0.3 percent by weight (mass) when tested in accordance with DOTD TR 319.

502.06 PLANT INSPECTION AND AUDITS. All Department inspection procedures, including sampling and testing, and the contractor's quality control data form the basis for acceptance of the asphalt. The Department's Certified Asphalt Plant Inspector will randomly visit and inspect asphalt plants, sample and test material, and review documentation to ensure conformance to specification requirements. In particular, the inspector will take a minimum of the following samples which may be tested for verification:

Loose Mix

1. Theoretical Maximum Specific Gravity, G_{mm} ,
2. % Asphalt Cement Content,
3. Gradation, and
4. % Crushed

Compacted Specimen, N_{design} (Using contractor's equipment)

1. % G_{mm} at $N_{initial}$,
2. % Air Voids, V_a ,
3. % VMA, and
4. % VFA.

Compacted Specimen, $7.0 \pm 0.5\%$ AV (Using contractor's equipment)

1. Loaded Wheel Testing (LWT) as needed.

The inspector will review contractor data and documentation. The inspector will check the plant equipment, lab equipment and plant operations. The inspector will sample asphalt cement working tank and or transport during random plant visits and will obtain random asphalt cement transport samples as requested by the Materials Lab.

Lack of conformance after 5 P-lots to specification requirements may result in increased sampling, reduced pay, removal and replacement of the asphalt mixture, decertification of the technician, and/or decertification of the plant. Correct deficiencies or cease operations.

502.07 ROADWAY OPERATIONS.

502.07.1 Weather Limitations: Apply asphalt concrete mixtures on a dry surface when the ambient temperature is above 50°F for wearing courses and 40°F for base and binder courses. Material in transit, or a maximum of 100 tons in a surge bin or silo used as a surge bin, at the time plant operation is discontinued may be placed. All mixture placed is expected to perform satisfactorily and meet specification requirements. Inclement weather will be sufficient reason to terminate or not begin production.

When base course mixtures are placed in plan thicknesses of 2 3/4 inches or greater, disregard temperature limitations provided all other specification requirements are met. When a wearing course is substituted for a binder course mixture, apply the temperature limitation for binder course.

502.07.2 Surface Preparation: Maintain the surface being covered. Acceptance is required for each surface prior to placement of subsequent surface.

Roadway slope shall be established at the base course level unless otherwise authorized by the engineer. The absolute minimum lift thickness placed shall be 1/4 inch greater than the nominal maximum aggregate size as shown on Table 502-6. Failure to meet minimum thickness is subject to removal.

502.07.2.1 Cleaning: Sweep the surface to be covered clean of dust, dirt, caked clay, caked material, vegetation, and loose material by revolving brooms or other mechanical sweepers supplemented with hand equipment as directed. Remove excess joint filler from the surface by an approved method when mixtures are to be placed on portland cement concrete pavement or previously overlaid portland cement concrete. Remove any existing raised pavement markers prior to asphalt concrete overlay operations. Payment for removal of pavement markings will be in accordance with the applicable item.

Wash the surface with water in addition to brooming when brooming alone does not adequately clean the surface.

When tack coat is exposed to traffic for more than one (1) calendar day, becomes contaminated, or degrades due to inclement weather, reapply the tack coat at the initial recommended rate at no direct pay.

502.07.2.2 Applying Tack Coat:

502.07.2.2.1 Existing Pavement Surfaces: Before constructing each course, apply an approved asphalt tack coat in accordance with Section 504. Protect the tack coat and spot patch as required.

502.07.2.2.2 Raw Aggregate Base Course and Raw Embankment Surfaces: Apply an approved asphalt prime coat to unprimed surfaces, or protect in-place prime coat and spot apply prime coat as required, in accordance with Section 505.

502.07.2.2.3 Cement and Lime Stabilized or Treated Embankment and Base Course Surfaces: Apply an approved asphalt curing membrane when none is in place, or protect the in-place curing membrane and spot apply, as required, with asphalt material in accordance with Section 506.

502.07.2.2.4 Other Surfaces: Cover contact surfaces of curbs, gutters, manholes, edges of longitudinal and transverse joints, and other structures with a uniform coating of an approved asphalt tack coat complying with Section 504 before placing asphalt mixtures.

502.07.3 Joint Construction:

502.07.3.1 Longitudinal Joints: When constructing longitudinal joints, set the screed to allow approximately 2 inches onto the adjacent pass. Use approved 10-foot static straight edge to maintain no greater than 1/8-inch deviation in grade. Make necessary correction in joint before continuing operations. Offset longitudinal joints in one layer over those in the layer below by a minimum of 3 inches; however, keep the top layer joint 6 inches to 9 inches from the centerline of two lane highways. Offset 6 inches to 9 inches from lane lines when the roadway is more than two lanes. Construct the narrow strip first.

502.07.3.2 Transverse Joints: Construct transverse joints by milling or hand forming paper butt joints. Use an approved 10-foot static straightedge to identify the location to be cut back to maintain no greater than a 1/8-inch deviation in grade. Lightly tack the cut face of the previously placed mat before fresh material is placed. Rest the screed on shims that are approximately 25 percent of lift thickness placed on the compacted mat. Provide an adequate crew to form transverse joints. Additionally, meet the transverse joint surface tolerance requirements of Table 502-5. Make necessary corrections to the joint before continuing placement operations.

Offset transverse joints in succeeding lifts by at least 3 feet.

502.08 HAULING, PAVING AND FINISHING. Transport mixtures from the plant and deliver to the paver at a temperature no cooler than 25°F below the lower limit of the approved job mix formula, maintaining a temperature of the WMA mix not cooler than 245°F going through the paver. Send no loads so late in the day that completion of spreading and compaction of the mixture cannot be completed during daylight, unless artificial lighting has been approved and is on site.

Load haul trucks to minimize segregation.

Place each course of asphalt mixture in accordance with the specified lift thickness shown in Table 502-6.

With the engineer's approval, motor patrols may be used to level isolated depressions in the initial layer, provided this construction does not result in unsatisfactory subsequent lifts.

502.08.1 Coordination of Production: Coordinate and manage plant production, transportation of mix and placement operations to achieve a high quality pavement. Provide sufficient hauling vehicles to ensure continuous plant and roadway operations. The engineer will order a halt to operations when sufficient hauling vehicles are not available.

On final wearing course construction under traffic with pavement layers of 2 inches compacted thickness or less, the contractor will be permitted to

pave one travel lane for a full day and the adjacent travel lane the next work day. When the adjacent travel lane is not paved the next work day and the longitudinal joint is exposed to traffic for more than 3 calendar days, and it has been determined that the roadway edge is not true to line and grade as previously constructed, cut back the entire length of exposed longitudinal joint to lift thickness to a vertical edge and heavily tack unless a notch wedge device is used. When pavement layers are greater than 2 inches compacted thickness, place approximately 1/2 of each day's production in one lane and the remainder in the adjacent lane unless an approved notched wedge device is used.

Protect pavement from traffic until it has sufficiently hardened to the extent the surface is not damaged.

502.08.2 Paving Operations: When placing the final two lifts of asphalt concrete on the roadway travel lanes, use a material transfer vehicle (MTV) as described in 503.14. During continuous paving, maintain temperature of the mixture constant. At no time shall there be more than 50°F difference in temperature as measured in 300 linear feet of paving or 25°F across the full paved width. All mixtures shall flow through the paver hopper. Lift into the hopper any mixture dropped in front of the paver or reject such material and cast it aside. Deliver material to the paver at a uniform rate and in an amount within the capacity of paving and compacting equipment. Adjust the paver speed and number of trucks to maintain one truck waiting in addition to the one at the paver in order to maintain continuous paving operations. Maintain a uniform height of material in front of the screed.

Keep the paver steady and in constant alignment during mix transfer. Maintain a level of mix higher than the paver hopper feed slats at all times. Use pavers and operators capable of placing mixtures to required line, grade and surface tolerance without resorting to hand finishing.

Construct longitudinal joints and edges along established lines. Utilize some form of longitudinal control for the paver to follow, preferably a string line. Position and operate the paver to closely follow the established line. Correct irregularities in alignment by trimming or filling directly behind the paver. Check the texture for uniformity after each load of material has been placed. Check the adjustment of screed, feed screws, hopper feed, etc., frequently and adjust as required to assure uniform spreading of the mix to proper line and grade and adequate compaction. When segregation of materials or other deficiencies occur, suspend paving operations until the cause is determined and corrected.

Correct surface irregularities directly behind the paver. Hand placement will be allowed in accordance with 502.08.3 for surface repair, taking care never to cast material over the fresh surface.

Discontinue paving operations when any screed control device malfunctions during binder or wearing course placement operations. When malfunctions occur, limit material through the paver to that which is in transit. Assume responsibility of meeting all specifications and yield requirements, and bear the cost of any overrun during malfunctions. Do not resume paving operations until the malfunction is fixed.

When paving operations are interrupted, remove and replace at no direct pay, mixture that has cooled below the point that it cannot be finished, or compacted to meet specifications. When additional mix is required to increase superelevation in curves, the use of automatic slope control is optional. However, ensure slope by measuring with a slope board. Allow the engineer use of the slope board upon request.

Use the traveling reference plane method of construction for airport runways unless designated otherwise on the plans. Unless the erected string line is required or directed, use the 27-foot (minimum) traveling reference plane method of construction for roadway travel lanes. The requirements of 502.08.2.1, 502.08.2.2, and 502.08.2.3 shall apply for mechanical pavers.

502.08.2.1 Traveling Reference Plane: Obtain approval of the traveling reference plane method before use. After the initial paving strip of each lift is finished and compacted, place adjacent paving strips to the grade of the initial paving strip using the traveling reference plane or shoe device to control grade and a slope control device to control cross slope.

On multilane pavements, the initial paving strip and the sequence of lane construction will be subject to approval.

When both outside edges of the paving strip being placed are flush with previously placed material, do not use the slope control device. A grade sensor is required for each side of the paver.

In superelevated curves, the cross slope shall be changed from that specified for tangents to that specified for superelevation in gradual increments while the paver is in motion so a smooth transition in grade is obtained. This change in cross slope shall be accomplished within the transition distance specified.

This is the minimum acceptable method and the contractor must meet or exceed current surface tolerance specifications.

502.08.2.2 Erected Stringline: Use the erected stringline method in isolated areas as directed by the engineer. This method may be used on the first lift of asphalt when the underlying new or reconstructed

bases do not have grade control requirements. Equip pavers for roadway travel lanes with automatic screed and slope control devices when used with an erected stringline.

An erected stringline shall consist of a piano wire or approved equal stretched between stakes set at no greater than 25-foot intervals. Tension the stringline between supports so that there is less than 1/8 inch variance between supports when the sensor is in place. If required, place the initial paving strip of the first lift constructed using an erected stringline referenced to established grade. When permitted, mixtures required to level isolated depressions may be placed without automatic screed control. Subsequent lifts may be constructed by use of the traveling reference plane, provided surface and grade tolerances are met on the previous lift.

Only one grade sensor and the slope control device are necessary for roadways with a normal crown on tangent alignment. Superelevated curves will require the use of two grade sensors and two erected stringlines to obtain proper grade and slope; however, when the automatic screed control device is equipped with a dial or other device which can be conveniently used to change the cross slope in small increments, superelevated curves may be constructed using this device and one erected stringline.

After the initial paving strip of the first lift is finished and compacted, lay adjacent paving strips using an approved traveling reference plane.

502.08.2.3 Without Automatic Screed Control: When permitted, pavers without automatic screed control may be used for pavement patching, pavement widening, paved drives and turnouts.

502.08.3 Hand Placement: When the use of mechanical finishing equipment is not practical, the mix may be placed and finished by hand to the satisfaction of the engineer. During paving operations, material shall be thoroughly loosened and uniformly distributed. Material that has formed into lumps and does not break down readily will be rejected. Check the surface before rolling and correct irregularities.

502.09 ROLLING AND COMPACTION.

502.09.1 General: After placement, uniformly compact mixture by rolling while still hot, to a density that complies with Table 502-5. If continuous roller operation is discontinued, move rollers to cooler areas of the mat where they will not leave surface indentations. The use of steel wheel rollers in the vibratory mode, which result in excessive crushing of aggregate, will not be permitted.

Utilize experienced operators when rolling the mixture using consistent rolling sequences and uniform methods to achieve specified density and

smoothness. Uniformly overlap preceding passes of individual roller passes to ensure complete coverage of the paving area. Do not tear or crack the mat by varying the roller speed, amplitude, vibration frequency or other roller operation. Operate non-vibrating steel wheel rollers with drive wheels toward the paver. Correct any operation causing displacement, tearing or cracking of the mat.

Prohibit use of equipment, which leaves tracks or indented areas that cannot be corrected in normal operations or fails to produce a satisfactory surface. Stop use of equipment resulting in accumulation of material and subsequent shedding of accumulated material into the mixture or onto the mat.

Keep rollers of steel wheel rollers properly moistened without excess water to prevent adhesion of mixture to rollers.

Maintain adequate heat for pneumatic tire rollers to prevent mix from adhering to tires. Operate the pneumatic tire roller at a contact pressure which will result in a uniform, tightly knit surface. Keep the pneumatic tire roller approximately 6 inches from unsupported edges of the paving strip; however, when an adjacent paving strip is down, overlap the adjacent paving strip approximately 6 inches.

Vibratory rollers may be used provided they do not impair the stability of the pavement structure or underlying layers. Vibratory rollers shall not be used on the first lift of asphalt concrete placed over the asphalt treated drainage blanket. When mix is placed on newly constructed cement or lime stabilized or treated layers, do not use vibratory rollers until base is approved by the engineer and not for at least 5 days after such stabilization or treatment.

It is the responsibility of the contractor to determine the number, size, and type of rollers to sufficiently compact the mixture to the specified density and surface smoothness. Ensure that the rolling equipment is capable of maintaining the pace of the paver and conforms to 503.16.

The surface of mixtures after compaction shall be smooth and true to cross slope and grade within the tolerances specified. Remove mixtures that become loose, broken, contaminated or otherwise defective and replace with fresh hot mixture compacted to conform to the surrounding mixture.

Excessive rippling of the mat surface will not be accepted. Ripples are small bumps in the pavement surface which usually appear in groups in a frequent and regular manner. No more than 12 ripples or peaks will be allowed in any 100-foot section. Rippling indicates a problem with the paving operation or mix that requires immediate corrective action by the

contractor; otherwise cease operations. Correct unacceptable areas at no direct pay.

After rolling, ensure that newly finished pavements have a uniform, tightly knit surface free of cracks, tears, roller marks or other deficiencies. Correct deficiencies at no direct pay and adjust operations to correct the problem. This may require the contractor to adjust the mix or furnish additional or different equipment.

502.09.2 Hand Compaction: Along forms, curbs, headers, walls and at other places inaccessible to rollers, compact the mixture uniformly to the satisfaction of the engineer with approved hand tampers or mechanical tampers, conforming to 503.17.

502.10 ROADWAY LOT SIZES. A roadway lot is determined as mix placed consecutively on the project from a specific JMF.

502.10.1 Mainline Mix Lot Sizes:

The mainline subplot size is 7500 linear lane feet; the mainline lot is five sublots or 37,500 linear lane feet. Any project with less than 37,500 linear lane feet for any mix type is also defined as a lot. The final mainline lot size may be extended one subplot with the approval of the engineer.

502.10.2 Minor Mix:

Minor mix lots will be defined as 1000 tons delivered to the project by mix type. The following types should be kept in separate lots.

502.10.2.2 Minor Lots with Density Requirement: Minor mix lots with density requirements are 1000 tons. These include bike paths, crossovers, detour roads, parking lots, patching, widening, uniform leveling thicker than 1.5 inches, tapers, and shoulders paved independently which are less than 8 feet wide.

502.10.2.3 Minor Lots without Density Requirement: Minor mix lots such as curbs, driveways, guardrail widening, islands, joint repair, spot leveling, medians, turnouts and ≤ 4 feet shoulder paved with the mainline do not have density requirements. Make compaction effort to the satisfaction of the engineer. Lots are 1000 tons.

For projects, or separate locations within a project, requiring less than 250 tons, the JMF, materials, and plant and paving operations shall be satisfactory to the engineer. Sampling and testing requirements may be modified by the engineer and the payment adjustment for deviations waived.

502.11 ROADWAY ACCEPTANCE. Acceptance testing for pavement density and dimensional tolerances will be conducted on that portion of the

lot placed on each contract. Acceptance testing for surface tolerance will be conducted upon completion of mainline paving.

Do not place asphalt concrete mixture exhibiting deficiencies such as segregation, contamination, lumps, non-uniform coating, excessive temperature variations, or other deficiencies apparent on visual inspection.

Correct and/or replace at no direct pay any asphalt concrete mix exhibiting deficiencies, such as segregation, contamination, alignment deviations, variations in surface texture and appearance or other deficiencies, apparent on visual inspection. Poor construction practices such as handwork, improper truck exchanges, improper joint construction, or other deficiencies, apparent on visual inspection, will be corrected at no direct pay.

502.11.1 Density: Obtain pavement samples from each subplot within 24 hours after placement. When this falls on a day the contractor is not working, sampling will be done within 3 calendar days. Sample at locations determined by the PE using random number tables shown in DOTD S605.

When the sampling location determined by random sampling falls within areas that are to be replaced or within 18 inches of the unsupported pavement edge, another random sampling location will be used.

Take cores, approximately 6 inches in diameter, with an approved core drill. Furnish samples cut from the completed work. Replace removed pavement with hot or cold mixture and refinished during the work day coring is performed at no additional pay. Sample in the presence of the engineer's representative. Do not use cores less than 1 3/8 inches thick for payment determination. For transport by parties other than DOTD representatives, ensure that the cores are individually wrapped, sealed, signed, and dated by the DOTD inspector or representative using an approved method. Any evidence of tampering with the core will result in the cores being rejected and additional pavement samples being required.

The engineer or his representative will transport cores in approved transport containers. When allowed, the contractor or third party will transport in an approved, locked transport container.

Divide the 7500-linear-lane-foot subplot into three segments of 2500 linear feet each. Obtain one acceptance core from each segment for a total of three cores. Take a verification core randomly from the 7500-linear-foot subplot. Take a resolution core randomly from the 7500-linear-foot subplot. There are five 7500-foot sublots for each 37,500 linear foot lot. For each lot, there are a total of 15 acceptance cores, 5 verification cores and 5 resolution cores.

For project lots between 2500 and 5000 linear feet, take two acceptance cores per subplot. Projects having less than 2500 linear feet will require 3

cores. Sampling for projects with less than 250 tons may be modified by the Project Engineer.

502.11.1.1 Testing of Roadway Cores (Method 1): The District Laboratory will calculate the density of each acceptance roadway core using the G_{mb} of the core and the representative maximum specific gravity, G_{mm} , in accordance with 502.05.

The density requirement for each lot is shown in Table 502-5. Cores will be retained for a period of 10 days after density is reported.

502.11.1.2 Testing of Roadway Cores (Method 2)
Contractor's Testing of Roadway Cores in Acceptance Decision:

With proven plant production consistency, and when recommended by the District Laboratory Engineer and approved by the Materials Engineer, contractor may request to be allowed to sample and test roadway cores for acceptance at no cost to the Department in lieu of District Laboratory acceptance testing. Density calculations for each acceptance roadway and verification core will utilize the G_{mb} of the core and the representative maximum specific gravity, G_{mm} as determined in accordance with 502.05. Refer to 502.11.1 for core responsibility. The District Laboratory roadway lot verification will be based on a means comparison between the District Laboratory verification average and the contractor acceptance average for each lot. If the means comparison produces a difference, use the resolution cores for pay determination. The Department will send the resolution cores to a certified Independent Assurance (IA) laboratory to determine pay in accordance with 502.11.1.5.

For Method 2: The plant production consistency will be determined as follows: The Department will continuously monitor plant data and roadway data by JMF, by plant, by contractor. Plant data will be monitored in accordance with 502.06. Roadway data will be monitored using statistical methods comparing means and variances (F and t) tests. Continued use of Method 2 is allowed unless the plant or roadway data fail to verify with data set of a minimum of 45 contractor acceptance tests and 15 DOTD verification tests results, and it is determined by the DLE and Independent Assurance team that the contractor's production data meets requirements.

If the F and t test fail an investigation shall be conducted by the IA team. If the contractor data after F and t analysis is performed and is found to be error, DOTD acceptance testing of roadway cores will resume and independent accredited laboratory could be required for plant testing at no cost to the Department until such time as the problem is identified and resolved.

502.11.1.3 “Minor with Density” Requirements: For Method 1: When density is specified in Table 502-5, the roadway inspector will identify core locations to be cut by the contractor. The District Laboratory will test three cores for density every 1000 tons per mix type placed per roadway sampling procedure mentioned above and pay in accordance with Table 502-7. The District Laboratory will calculate the density of each roadway core using the G_{mb} of the core and the representative maximum specific gravity, G_{mm} , in accordance with 502.05. For Method 2: The contractor will perform acceptance test per above method. Table 502-7 is used to compute pay.

502.11.1.4 Minor Mix without Density: This minor mix shall have a neat, uniform appearance and be compacted by methods to the satisfaction of the engineer. Collect one loose mix specimen, from roadway, per project, for G_{mm} verification.

502.11.1.5 Verification: One core will be selected every 7500 linear lane feet and will be evaluated by either Method 1 or Method 2 in accordance with 502.11.1.1.

502.11.1.6 Resolution: One core from each 7500 linear lane feet of placed mix will be chosen at random and will be double sealed, signed by both contractor and Department’s certified inspectors in accordance with the Quality Assurance Manual as required or for documentation. The resolution core will be tested at a certified IA laboratory as described in the QA manual.

502.12 SURFACE TOLERANCE EQUIPMENT, QUALITY CONTROL, ACCEPTANCE, MEASUREMENT AND PAYMENT ADJUSTMENT. Measure the top two lifts of the mainline travel lanes with an approved inertial profiler. Maintain record of intermediate measures of smoothness quality as described herein. Final acceptance will be based on the last measurement taken on the final wearing course of the travel lanes. Measurement of the center two lanes will be required for airports.

Constantly monitor equipment, materials, and processes to ensure that surface tolerance requirements are met.

502.12.1 Equipment: For longitudinal surface tolerance quality control testing and acceptance testing on mainline wearing and binder courses, furnish and use a DOTD certified inertial profiler. Certified profilers will have a DOTD decal indicating the date of certification and profiler system parameter settings. Measure longitudinal surface profile in inches per mile in accordance with DOTD TR 644 and report as the International Roughness Index (IRI).

Verify the profiler system parameter settings before each run. Demonstrate the daily set up procedure and pre-operation tests in accordance with the manufacturer's procedures and DOTD TR 644. Ensure that a copy of the manufacturer's setup, pre-operation, and general operating procedures for measuring surface tolerance are available at all times during measurement.

For transverse quality control testing and for longitudinal quality control testing for wearing course on bike paths, detour roads, parking lots, and shoulders; furnish and use an approved 10-foot metal static straight-edge and electronic or static level.

Profiler system parameter settings shall be verified before and during each run by the DOTD inspector. For transverse, cross slope and grade testing, furnish a 10-foot metal static straightedge and electronic or static level for Department use.

502.12.2 Longitudinal Smoothness Quality Control: Within 7 calendar days of placement, for mainline wearing and binder courses, run the certified profiler. View the raw data with ProVAL to determine IRI and to view Profilograph Simulation for each wheelpath. Make corrections to operation and/or mixture to ensure that the overall ride and individual bump requirements are met. Correct all individual bumps which are more than 1/4 inch as identified on Profilograph Simulation or when tested with a 10-foot metal static straightedge. Ensure that the following quality requirements are met:

1. Produce IRI which meets the requirements for 100 percent pay in accordance with Table 502-8. Continued surface tolerance penalties are not allowed.

2. Correct all individual bumps which are more than 1/4 inch when tested with a 10-foot metal static straightedge. Utilize the Profilograph Simulation on ProVAL to help identify these bumps.

3. Correct ripples to the satisfaction of the engineer. Report Profilograph Simulation for areas with 12 or more small, regular bumps in a 100-foot section or for any areas in question.

Minor mixes shall comply with Table 502-5. For minor mixes, use the 10-foot metal static straightedge to check for conformance to specifications.

502.12.3 Transverse Smoothness, Cross Slope, and Grade: The Department will test the surface of the binder and wearing courses at selected locations for conformance to the surface tolerance requirements of this subsection and Table 502-5. Make corrections as directed in accordance with 502.12.4.

502.12.3.1 Transverse Smoothness: Areas with surface deviations in excess of specification limits shall be isolated and corrected in accordance with 502.12.4. Control the transverse surface finish.

502.12.3.2 Cross Slope: When the plans require the section to be constructed to a specified cross slope, take measurements at selected locations using a stringline, a slope board, an electronic or static level mounted on a 10-foot metal static straightedge, or other comparable device. Control the cross slope for each lane to comply with the tolerances shown in Table 502-5. Make corrections in accordance with 502.12.4.

502.12.3.3 Grade: When the plans require the pavement to be constructed to a specified profile grade, test for conformance at selected locations, using a stringline or other comparable device. Control grade variations so that the tolerances shown in Table 502-5 are not exceeded. Grade tolerances shall apply to only one longitudinal line, such as the centerline or outside edge of pavement. Make corrections in accordance with 502.12.4.

502.12.4 Correction of Deficient Areas: Correct areas as required in 502.12.2 and those not meeting Table 502-5, and Table 502-8. Correct wearing and binder courses by grinding. In lieu of grinding, the Project Engineer may penalize the contractor \$800 per area of small individual bumps, and/or per “Ripple” as defined in 502.12.2.

502.12.4.1 Deficiencies in Mainline Wearing Course: Correct deficiencies in the final wearing course by removing and replacing mixture, or by diamond grinding or other approved device across the lane and applying a light tack coat, or by furnishing and placing a supplemental layer of wearing course mixture at least 1 1/2 inches compacted thickness for the full width of the roadway meeting specification requirements at no direct pay. If the supplemental layer does not meet specification requirements to the satisfaction of the engineer, remove and replace or correct it by other methods approved by the engineer.

For areas that will not be improved by grinding such as minor dips, extreme vertical curves, areas with < 1/4 inch bump as measured with a 10 feet metal static straight edge, the engineer may waive the requirement to grind.

502.12.4.2 Deficiencies in Mainline Binder Courses: Correct deficiencies in binder course: longitudinal, transverse, cross slope, and grade to meet specification requirements at no direct pay. Make corrections before subsequent courses are constructed.

502.12.4.3 Deficiencies in Minor Mixes: Correct deficiencies in minor mixes by diamond grinding or approved method at the project engineer's direction.

502.12.5 Surface Tolerance Acceptance: Measure the top two lifts of the mainline travel lanes with an approved inertial profiler. Final acceptance will be based on the last measurement taken on the final wearing course of the travel lanes. Measurement of the center two lanes will be required for airports.

502.12.5.1 Longitudinal Surface Tolerance Acceptance: Measure surface tolerance at the completion of the project and after all corrections have been made or at an approved portion of the project in accordance with 502.12.2. Measure the mainline wearing course continuously from start to finish in the direction of travel. The measurement shall be performed by the contractor in the presence of a Department representative. The measurement may also be made by the Materials and Testing Section, or by a private company approved by the Department. Report one IRI measurement in inches per mile for the entire project. A stand-alone pay adjustment factor will be determined in accordance with 502.15.

Place a start and stop mark at the beginning and end of each travel lane so that measurements can be rerun by the Department if needed. Interim measurements of a portion may be allowed, with approval of the engineer, as follows:

1. For partial acceptance in accordance with 105.17.1.
2. Due to phasing or sequence of construction, this measurement may result in 100 percent pay or less. However, payment exceeding 100 percent for this section of roadway will only be allowed if the smoothness re-measured at the completion of the project meets the requirements of Table 502-8.
3. For an unavoidable lengthy delay, apply the same payment criteria as No. 2 above.

The mainline longitudinal surface tolerance IRI specification requirements are shown in Table 502-8. Perform profiler testing and submit data to the engineer before starting paving operations. To ensure that the contractor has corrected deficiencies, the Department will spot check for 1/4 inch bumps in accordance with 502.12.2. Although grinding may be waived by the engineer, the measured roughness will still contribute to the total IRI for the project.

A DOTD inspector will be present for the final test run and will immediately receive a copy of the raw data, the ".erd file" and any files with information about the project, the operator, the equipment, the settings, daily

pre-operation results, and a copy of the IRI results via USB flash drive provided by the contractor. In addition to the data transferred by USB storage device, provide to the engineer a paper copy of the IRI report. Acceptance for the project will be in accordance with Tables 502-8, based on the data. The Department may elect to perform and utilize independent ride quality test results for acceptance at any time.

502.12.5.2 Exclusions: The final IRI measurement shall be taken in entirety, without exclusions. The Department will then review the profile report obtained for each lane of the mainline wearing course. In special cases or extenuating circumstances, the engineer may isolate or exclude sections of the profile. These include the following:

1. Bridge ends, and sections that are within 150 feet of bridge ends.
2. Outside wheelpath of curb and gutter sections that require adjustment in order to maintain adequate drainage.
3. Manholes, catch basins, valve and junction boxes.
4. Street intersections or rail road crossings of a different grade.
5. Structures located in the roadway which cause abrupt deviations in the profile.
6. Transitions to and from ramps and turn lanes and sections within 200ft of the limits of the project if the limits begin or end at an intersection.
7. Sections where the project engineer determines that attaining smoothness is beyond the contractor's reasonable control.

Exclusions will not be used to simply isolate sections of road that are in poor condition when the project is let. The roughness in excluded areas will not be included in the total IRI used for payment purposes, but shall meet the requirements of 502.12.2. The quantity of asphalt represented by the length excluded will not receive a pay adjustment for surface tolerance.

502.12.6 Surface Tolerance Measurement: Measure and report the average IRI of each wheel path of each mainline lane in inches per mile and reach mainline lane prorated for the entire project.

The theoretical quantity is computed by using the total length of lanes, the plan thickness, and the plan width, excluding shoulders and minor mixes. Adjust the tons as necessary affected represented for each mainline travel lane.

502.12.7 Payment Adjustment for Surface Tolerance: Apply a percent payment adjustment for the quantity of tons represented in each lane of the mainline wearing course. This pay adjustment is in addition to pay adjustments for density as described in 502.15.2. For mainline wearing course, a separate pay adjustment for surface tolerance measured on the mainline wearing course based on Table 502-8 shall apply. Apply the adjustment to the theoretical lane quantity and contract unit price.

502.13 DIMENSIONAL REQUIREMENTS. Ensure that mixtures conform to the following dimensional requirements only. No other acceptance tests will be required for these mixtures. Over-thickness and over-width will be accepted at no direct pay.

502.13.1 Thickness: For mixture specified for payment on cubic yard or square yard basis, thickness of mixtures will be determined by the Department in accordance with DOTD TR 602. Under-thickness shall not exceed 1/4 inch.

Correct area under-thickness in excess of 1/4 inch to plan thickness at no direct pay. Furnishing and placing additional mixture in accordance with 502.12.4.1. Correct excesses of 1/2 inch for category D, Table 502-8. When grade adjustments do not permit placing additional mixture, remove the deficient under-thickness area and replace at no additional pay.

For mixtures specified for payment on a per ton basis, thickness of mixtures will be determined by the plans, Table 502-6, and that agreed to with the Project Engineer. Under thickness shall not exceed 1/2 inch. Removal and replacement of deficient under-thickness area(s) or other approved remediation agreed to by the Project Engineer will be at no direct pay.

502.13.2 Width: The width of completed courses will be determined in accordance with DOTD TR 602. Correct under-widths by furnishing and placing additional mixture to a minimum width of 1 foot and plan thickness at no direct pay.

502.14 MEASUREMENT. Measure asphalt concrete by the ton of 2,000 pounds from printed weights as provided in Section 503. Provide stamped printer tickets with each truckload of material delivered denoting JMF

number and plant tonnage. Material lost, wasted, rejected or applied contrary to specifications will not be measured for payment.

Estimated quantities of asphalt concrete shown on the plans are based on 110 lb/sq yd/inch thickness. The measured quantity of asphalt mixtures will be multiplied by the following adjustment factors to obtain the pay quantity.

<u>Theoretical Maximum Specific Gravity, (G_{mm}) (DOTD TR 327)</u>	<u>Adjustment Factor</u>
2.340 - 2.360	1.02
2.361 - 2.399	1.01
2.400 - 2.540	1.00
2.541 - 2.570	0.99
2.571 - 2.590	0.98

The adjustment factor for mixtures with theoretical maximum specific gravities less than 2.340 or more than 2.590 will be determined by the following formulas:

Theoretical maximum specific gravity less than 2.340:

$$F = \frac{2.400}{S}$$

Theoretical maximum specific gravity more than 2.590:

$$F = \frac{2.540}{S}$$

where,

F = quantity adjustment factor

S = theoretical maximum specific gravity of mixture from approved job mix formula

502.14.1 Volume or Area Measurement: The quantities for payment will be the design quantities specified in the plans and adjustments thereto. Design quantities will be adjusted when the engineer makes changes to adjust the field conditions or when design changes are necessary. Design quantities are based on the horizontal dimensions and compacted thickness of the completed course shown on the plans.

502.15 PAYMENT.

502.15.1 Payment General. Payment for all mixes will be at the contract unit price of asphalt mixture accepted on the roadway. Payment for asphalt concrete will include furnishing all required materials, producing the mixtures, preparing the surfaces on which the mixtures are placed, hauling the mixtures to the work site, and placing and compacting the mixtures. When the mix does not meet requirements, payment adjustments shall be assessed. Production of mix that is not eligible for 100 percent payment will not be allowed on a continuous basis. When test results demonstrate that payment adjustments are necessary, satisfactory mixture and compaction adjustments shall be made, or production shall be discontinued. All calculations for percent payment adjustments will be rounded to the nearest one (1) percent. Payment for removal of pavement markings will be in accordance with the applicable item. Payment adjustments will be determined in accordance with 502.14 and the QA Manual.

502.15.2 Mainline Mixtures. For all mainline mixtures, adjustments in contract unit price for roadway density as required by Table 502-5 and will be based on PWL using Tables 502-9 and 502-10 for all acceptance cores in the lot. This payment adjustment will be applied to the theoretical mainline lane quantity and contract unit price.

In addition, for mainline wearing course, a separate pay adjustment for surface tolerance based on Table 502-8 shall apply for all travel lanes based on the theoretical mainline lane quantity and contract unit price.

The theoretical quantity is computed by using the plan width, the plan thickness, and the total length of travel lanes, without exclusion areas.

502.15.3 Minor Mixtures.

502.15.3.1 Minor Shoulder Lots, > 4 Feet Wide. Adjustments in contract price for shoulder density will be based on the average density for all cores in the lot and Table 502-5.

502.15.3.2 Minor Lots with Density. Adjustments in contract price will be based on the core density for each lot in accordance with Table 502-7.

502.15.4 Payment for Tack. Tack coat as required in 502.07.2.2 “Applying Tack Coat” will be considered incidental to the 502 item. If the engineer adjusts the application rate of tack coat from that specified by the contract document, payment for the asphalt mixture will be increased or decreased based on the difference in the applied quantity of asphalt emulsion shown on paid invoices (total of charges). The contractor shall provide copies of paid invoices for this determination. Apply 95 percent payment to

the 502 item when the tack coat rates do not meet the application rate as allow by the engineer.

502.15.5 Payment Adjustment for Asphalt Cement. A minimum payment adjustments of 10 percent of the 502 item will apply to mixtures that do not meet specification but are within one grade of the specification. Asphalt that exceeds one lower grade difference in specification will be subject to 50 percent payment reduction or removal at the discretion of the Chief Engineer.

502.15.6 Payment Adjustment for Surface Tolerance.

Payment adjustment will be in accordance with 502.12.7

Apply a percent payment adjustment for quantity of tons represented in each lane of the mainline wearing course. This pay adjustment is in addition to the pay adjustments for density as described in 502.15.2. For mainline wearing course, a separate pay adjustment for surface tolerance measured on the mainline wearing course based on Table 502-8 shall apply. Apply the adjustment to the theoretical lane quantity and contract unit price.

502.15.7 Payment for Erected Stringline. When the use of an erected stringline is not specified, but directed by the engineer, an additional payment of \$3500 per contract plus \$0.25 per linear foot will be made for mixtures placed by the erected stringline method. When the use of an erected stringline is specified, no additional payment will be made.

Payment will be made under:

Item No.	Pay Item	Pay Unit
502-01	Asphalt Concrete	Ton
502-02	Asphalt Concrete	Cubic Yard
502-03	Asphalt Concrete, (Inches Thick)	Square Yard
502-04	Asphalt Concrete (SMA) Wearing Course	Ton

**Table 502-4
Plant Produced Asphalt Mixture Requirements and Tolerances**

U.S. (Metric) Sieve % Passing	REQUIREMENTS FOR EXTRACTED ASPHALT CEMENT AND AGGREGATE GRADATION					
	½ inch SMA	½ inch Nominal	¾ inch Nominal	1 inch Nominal	1.5 inch Nominal	Mix Tolerance ¹
2 inch	—	—	—	—	100	±4
1 1/2 inch	—	—	—	100	90-100	±4
1 inch	—	—	100	90-100	89 Max.	±4
¾ inch	100	100	90-100	89 Max	—	±4
½ inch	90-100	90-100	89 Max	—	—	±4
¾ inch	75 Max.	89 Max.	—	—	—	±4
No. 4	24-34	—	—	—	—	±4
No. 8	16-28	29-58	26-49	23-45	19-41	±3
No. 16	—	—	—	—	—	±2
No. 30	12-25	—	—	—	—	±2
No. 50	11-22	—	—	—	—	±2
No 100	—	—	—	—	—	±2
No. 200	7-13	4.0-10.0	3.0-8.0	2.0-7.0	1.0-6.0	±0.7
Extracted Asphalt, %	6.0 min.	—	—	—	—	±0.2
Mix Temperature	—	—	—	—	—	±25°F

¹Upon validation of the JMF, the validation averages will be used for JMF target values.

Table 502-5				
Asphalt Pavement Requirements				
Density, Min. % of Theoretical Maximum Specific Gravity, -AASHTO T 209 Method C				
Mainline, SMA 93.5				
Mainline 92.0				
Minor with density ref, 502.10.2.2 "Roadway lot," patching, and widening > 2.5-feet 90.0				
Surface Tolerance Variation	Longitudinal ¹ inches	Transverse ^{2,3} inches	Cross Slope ^{2,3} inches [%]	Grade ^{3,4} inches
Mainline Wearing Courses, Category A, B	N/A ⁵	1/8	3/8 [0.3]	1/2
Mainline Wearing Courses, Category C	N/A ⁵	1/4	1/2 [0.4]	1/2
Mainline Wearing Courses, Category D	1/2	1/2	3/4 [0.6]	3/4
Mainline Binder Courses	1/4	1/2	3/4 [0.6]	3/4
Minor Mixes ⁶	3/8	3/8	3/4 [0.6]	3/4
Bike Paths, Detour Roads and Parking Lots	1/2			
Shoulder, Ramps < 300'	1/2			

¹ See 502.12.2.

² Based on 10 feet, using 10-foot static straightedge and static or electronic level.

³ See 502.12.3.

⁴ Applicable only when profile grade is specified.

⁵ Mainline wearing and binder are measured with inertial profiler, see 502.12.

⁶ Except bike paths, detour roads, parking lots, and shoulders.

Table 502-6¹
Asphalt Concrete General Criteria

Nominal Max., Size Agg.	0.5 inch (12.5 mm)			0.75 inch (19 mm)			1.0 inch (25 mm)			1.5 inch (37.5 mm)	SMA	
	Incidental Paving ^{2,9}	Wearing Course		Wearing Course	Binder Course		Binder Course	Base Course ⁹	ATB ^{8,9}	Base Course ⁹	Wearing	
Level ³	A	1	2	2	1	2	1	2	1	1	1	2
Coarse Agg. Angularity, % Crushed, (Double Faced) + No. 4	55	75	95	95	75	95	75	95	75	75	75	98
Fine Agg. Angularity, Min. % - No. 8	40	40	45	45	40	45	40	45	40	40	40	45
Flat and Elongated Particles, % Max. (5:1)	10											
Sand Equivalent, Min. % (Fine Agg.) - No. 4	40	40	45	45	40	45	40	45	40	40	40	NA
Natural Sand - Max. %	NA	15		15			15			25	25	0
Asphalt Binder	Table 502-2, (3% minimum for Asphalt Treated base (ATB), 6% min for SMA)											
Friction Rating ³	Table 502-3											
RAP, Max. % of Mix ⁴	20	15	15	15	20	20	20	20	30	30	30	0
	Compacted Mix Volumetrics ⁴											
VMA, Min. % ⁵	13.5	13.5	13.5	12.5	12.5	12.5	11.5	11.5	11.5	n/a	10.5	16.0
Air Voids, % ⁶	(2.5-4.5); (no limit for ATB)											
VFA, % ⁶	(69-80); no limit for ATB											
N _{initial} 90% max. ⁷ (Gyrations)	7	7	7	7	7	7	7	7	7	n/a	7	7
N _{design} 96.5±1 % (Gyrations)	55	55	65	65	55	65	55	65	55	30	55	65
N _{max} 98 % max. (Gyrations)	90	90	105	105	90	105	90	105	90	n/a	90	65
LWT, max. rut-design, mm @ # passes, @ 50°C	10 @ 10,000	10 @ 20,000	6 @ 20,000	6 @ 20,000	10 @ 20,000	6 @ 20,000	10 @ 20,000	6 @ 20,000	12 @ 20,000	10 @ 10,000	12 @ 20,000	6 @ 20,000
Dust/Effective Asphalt Ratio, %	0.6 – 1.6											
SCB, min, Jc, KJ/m ² @ 25°C	All mix design level 1 must meet minimum 0.5 Jc , All mix design level 2 must meet minimum 0.6 Jc.											
Design Lift Thickness, inch ¹⁰	2.0-	1.5–2.0		1.5–2.0	2.0–3.0		2.5–4.0		2.5+	3.0+	4.0+	1.5-2.0

¹See also Table 1003-1 Asphalt Aggregate Properties.

²May be used for airports, bike paths, crossovers, curbs, driveways, guardrail widening, islands, joint repair, leveling, parking lots, shoulders, turnouts, and other incidental items approved by the engineer. (May be used as a standard roadway mix for local governments.)

³Mixtures shall meet the friction rating requirements in Table 502-3 for travel lane wearing courses with ADT > 7000,

⁴Maximum 20% RAP will be allowed in all shoulder wearing course mixtures. RAP will not be allowed for airports. Five (5) % additional RAP will be allowed in all mixes except for airports and SMA when RAP stockpile is pre-screened on a 1-inch scalping screen.

⁵Air voids, VMA, VFA, % G_{mm} @ $N_{initial}$, and % G_{mm} @ N_{design} are determined on samples compacted to N_{design} ; The parameter of percent G_{mm} @ N_{max} is determined on a sample compacted to N_{max} .

⁶Air voids mix design target is a 3.5%, Mix design minimum VFA is 72.0%; Mix design minimum VFA for PG82-22rm is 75.0% and 71% for 25 mm NMS mixtures

⁷For Level 1 mixtures, $N_{initial}$ shall be 91.0% max. For Level A mixes, $N_{initial}$ shall be 92.0% max.

⁸Asphalt Treated Base (ATB) may be used for patching of base material, for shoulder <3500 ADT and maintenance widening; when used achieve average density of 90% of G_{mm} as measured per minor mix table.

⁹Semicircular Bend Test (SCB) is not required for Level A, Base Course, or ATB mixtures.

¹⁰Absolute minimum of lift thickness across width equal to 1/2 inch lower than minimum lift thickness.

**Table 502-7
Payment Adjustment Schedule for Minor Mixture¹**

Parameter ²	Percent of Contract Unit Price/Lot		
	100	90	50 or Remove ³
Average Roadway Density, % G_{mm}	≥ 90.0	89.9 to 88.1	≤ 88.0

¹See 502.11.1.3.

²Of the total number of cores per lot. Determine surface tolerance in accordance with Table 502-9, if required.

³At the option of the Chief Engineer.

**Table 502-8
Payment Adjustment Schedules for Longitudinal
Surface Tolerance, Maximum International Roughness Index,
Inches per Mile**

Percent of Contract Unit Price ¹	102%	100%	95%	80%	50% or Remove ²
Category A ⁵ All Interstates, Three or more lift construction	<45	<65	65-85	86-149	150
Category B ⁵ Two Lift Overlays over cold plane surface and two lift overlay over improved base.	<55	<75	75-95	96 <149	150
Category C Two lift overlay over existing surface, Single-Lift Overlays with surface prep. Single Lift Overlays Over Cold Planed Surfaces or improved base	<55	<85	85-110	111- 149	150
Category D Single-Lift Overlays Over Unimproved Surfaces ^{3,4}	N/A	20% Improvement, or less than or equal to 65 for all other pavements	0% - 19% Improvement when initial is greater than 95	IRI Greater than Existing when initial is greater than 110	

¹ Based on total theoretical quantity.

² At the option of the Chief Engineer.

³ A project with an unimproved surface has no surface preparation item.

⁴ Contractor shall take IRI measurements before and after construction and shall show a minimum of 20% improvement.

⁵ Remove and replace any individual 0.05-mile segment having greater than an average of 150 in/mile. Removal and replacement will be at the direction of the Chief Engineer. This note does not apply to excluded areas.

Table 502-9
Quality Index Values for Estimating Percent Within Limits
(PWL)

PWL	n = 3	n = 4	n = 5 - 6	n = 7 - 9	n = 10 - 12	n = 13 - 15
99	1.16	1.47	1.68	1.89	2.04	2.14
98	1.15	1.44	1.61	1.77	1.86	1.93
97	1.15	1.41	1.55	1.67	1.74	1.80
96	1.15	1.38	1.49	1.59	1.64	1.69
95	1.14	1.35	1.45	1.52	1.56	1.59
94	1.13	1.32	1.40	1.46	1.49	1.51
93	1.12	1.29	1.36	1.40	1.43	1.44
92	1.11	1.26	1.31	1.35	1.37	1.38
91	1.10	1.23	1.27	1.30	1.32	1.32
90	1.09	1.20	1.23	1.25	1.26	1.27
89	1.08	1.17	1.20	1.21	1.21	1.22
88	1.07	1.14	1.16	1.17	1.17	1.17
87	1.06	1.11	1.12	1.12	1.13	1.13
86	1.05	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.05	1.04	1.04
84	1.02	1.02	1.02	1.01	1.00	1.00
83	1.00	0.99	0.98	0.97	0.96	0.96
82	0.98	0.96	0.95	0.94	0.93	0.92
81	0.96	0.93	0.92	0.90	0.89	0.89
80	0.94	0.90	0.88	0.87	0.85	0.85
79	0.92	0.87	0.85	0.83	0.82	0.82
78	0.89	0.84	0.82	0.80	0.79	0.78
77	0.87	0.81	0.79	0.77	0.76	0.75
76	0.84	0.78	0.76	0.74	0.72	0.72
75	0.82	0.75	0.73	0.71	0.69	0.69
74	0.79	0.72	0.70	0.67	0.66	0.66
73	0.77	0.69	0.67	0.64	0.63	0.62
72	0.74	0.66	0.64	0.61	0.60	0.59
71	0.71	0.63	0.60	0.58	0.57	0.56
70	0.68	0.60	0.58	0.55	0.54	0.54
69	0.65	0.57	0.55	0.53	0.51	0.51
68	0.62	0.54	0.52	0.50	0.48	0.48
67	0.59	0.51	0.49	0.47	0.46	0.45
66	0.56	0.48	0.46	0.44	0.43	0.42
65	0.53	0.45	0.43	0.41	0.40	0.40
64	0.49	0.42	0.40	0.38	0.37	0.37
63	0.46	0.39	0.37	0.35	0.35	0.34
62	0.43	0.36	0.34	0.33	0.32	0.31
61	0.39	0.33	0.31	0.30	0.30	0.29
60	0.36	0.30	0.28	0.27	0.26	0.26
59	0.32	0.27	0.25	0.24	0.24	0.23
58	0.29	0.24	0.23	0.21	0.21	0.21
57	0.25	0.21	0.20	0.19	0.18	0.18
56	0.22	0.18	0.17	0.16	0.16	0.15
55	0.18	0.15	0.14	0.13	0.13	0.13
54	0.14	0.12	0.11	0.11	0.10	0.10
53	0.11	0.09	0.08	0.08	0.08	0.08
52	0.07	0.06	0.06	0.05	0.05	0.05
51	0.03	0.03	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00	0.00

Note 1: For negative values of Q_U or Q_L . PWL_U or PWL_L is equal to 100 minus the tabular PWL_U or PWL_L .

Note 2: If the value of Q_U or Q_L does not correspond exactly to a value in the table, use the next higher value.

Table 502-10
Payment Adjustment for Mainline Pavement Density
(PWL)

Estimated PWL	Percent Payment - %									
	n = 3	n=4	n = 5	n = 6	n = 7	n = 8 to 9	n = 10 to 12	N = 13	n =14 to 17	n = 18 and greater
100 to 81	100	100	100	100	100	100	100	100	100	100
80	100	100	100	100	100	100	100	100	100	99
79	100	100	100	100	100	100	100	100	99	98
78	100	100	100	100	100	100	100	99	99	98
77	100	100	100	100	100	100	99	98	98	97
76	100	100	100	100	100	99	99	98	97	96
75	100	100	100	100	100	99	98	97	97	95
74	100	100	100	100	100	98	98	96	96	94
73	100	100	100	100	99	98	97	96	95	93
72	100	100	100	99	99	97	97	95	94	92
71	100	100	100	99	98	97	96	94	93	92
70	100	100	99	98	98	96	96	94	93	91
69	100	100	98	98	97	95	95	93	92	90
68	100	100	98	97	96	94	94	92	91	89
67	100	100	97	96	96	94	94	91	90	88
66	100	99	97	96	95	93	93	90	89	87
65	100	99	96	95	94	92	92	90	88	86
64	99	98	96	94	94	92	91	89	88	85
63	99	98	95	94	93	91	90	88	87	84
62	99	97	95	93	92	90	89	87	86	83
61	98	96	94	92	91	89	89	86	85	82
60	98	95	94	92	91	89	88	85	84	81
59	97	95	93	91	90	88	87	84	83	80
58	97	94	92	90	89	87	86	83	82	79
57	96	93	91	89	88	86	85	82	81	78
56	95	92	90	89	87	85	84	81	80	77
55	95	92	90	88	86	84	83	79	79	76
54	94	91	89	87	85	83	82	78	77	75
53	93	90	88	86	85	82	80	77	76	74
52	92	89	87	85	84	81	79	76	75	72
51	91	88	85	84	83	80	78	74	74	71
50	90	88	84	83	82	79	77	74	73	70
49	90	87	83	82	81	77	76	72	71	69
48	89	86	82	81	80	76	74	71	70	67

47	88	85	81	80	79	75	73	70	68	66	
46	87	84	80	79	77	74	72	68	67	64	
45	86	83	79	78	76	73	71	67	66	63	
44	85	82	78	77	75	71	69	65	64	62	
43	85	81	77	76	74	70	68	64	63	60	
42	84	80	76	75	73	69	67	63	62	59	
41	83	79	75	73	71	68	65	62	60	58	
40	82	77	74	72	70	66	64	61	59	57	
39	81	76	72	71	69	65	63	59	57	55	
38	80	75	71	70	67	63	61	58	56	54	
37	79	74	70	68	66	62	60	56	55	52	
36	78	73	68	67	65	61	58	55	53	51	
35	77	72	67	66	63	60	57	53	52	50	
34	76	71	66	65	62	58	55	52	50		
33	75	70	65	63	61	57	54	50			
32	74	69	63	61	60	55	52				
31	73	67	62	60	59	54	51				
30	72	66	61	58	57	52	50				
29	71	65	59	57	56	51					
28	70	64	58	55	54	50					
27	69	62	57	54	53						
26	68	61	55	52	52						
25	67	60	52	51	50						
24	66	59	50	50							
23	64	58									
22	63	56		50 Percent or Remove							
21	62	54									
20	61	53									
19	60	53									
18	59	52									
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16	57										
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14	54										
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12	52										
11	51										
10	50										

Section 503

Asphalt Concrete Equipment and Processes

503.01 DESCRIPTION. This section specifies requirements for the certification of asphalt concrete plants and paving equipment. It includes methods and equipment for handling and storing materials, producing asphalt concrete, and transporting and placing asphalt concrete at the job site.

The Department's publication entitled "Application of Quality Assurance Specifications for Asphalt Concrete Mixtures" is hereby made a part of this specification by reference.

503.02 PLANT EQUIPMENT.

503.02.1 General: Provide equipment and processes to proportion aggregates, additives and asphalt cement in accordance with the approved Job Mix Formula (JMF). When the automatic adjustments or other critical control and shutoff devices are not functioning, do not operate the plant. Operate the plant with clean, easily accessible, and accurate thermometers, scales and meters. Immediately repair, replace, or recalibrate equipment when faulty operation is detected.

Provide a system with positive weight control of cold aggregates fed by a belt scale or other device interlocked with the asphalt measuring system to maintain required proportions of combined aggregates and asphalt cement. Heat, dry and mix aggregates with asphalt cement to produce a homogeneous mixture in which all aggregate particles are uniformly coated. Use approved methods to discard the first and last output of the plant after each interruption. Place discarded material in a separate dedicated area.

Digitally display the total quantities and the rates of production of every material used on a DOTD project.

503.02.2 Certification and Calibrations: The Department will certify plants furnishing asphalt mixtures every two years with current Departmental procedures or when any major component is repaired, replaced or upgraded. The plant owner is required to report any major component upgrades to the District Laboratory Engineer. Forward all documentation available upon request by the Department. All plant components and processes are subject at any time to inspection and approval by the District Laboratory Engineer. The plant owner is required every 90 days to have the laboratory gram scales, ignition oven scales, truck platform scales, and weight batchers tested, inspected, and calibrated by a qualified independent

scale service or the Weights and Measures Division, Louisiana Department of Agriculture and Forestry.

Within 10 working days of the 90 days plant scale recalibration, the Certified Asphalt Concrete Plant Technician, in accordance with 503.09, will verify calibration of the plant's cold feed bins, RAP feed bins, weight bridges, asphalt pump, and additives measuring devices to stated DOTD standards. The Certified Asphalt Concrete Plant Technician shall notify the DOTD certifying District Laboratory two days prior to plant calibration.

Provide a plant site laboratory conforming to 722.02 as a part of the plant facilities at no direct pay, except as modified herein. Each plant laboratory shall have a minimum floor space of 400 square feet. Laboratories are to be provided for all Quality Assurance testing. Calibrate, verify and document all laboratory equipment according to the procedures, test methods, and frequency in accordance with the current "LADOTD Laboratory Equipment Manual."

503.03 AGGREGATES.

503.03.1 Stockpiles: Store aggregates at the plant site so that no intermixing, segregation, pooling of water or contamination will occur. Ensure that gradation and other properties of aggregate in stockpiles are combined in proper proportions so that the resulting combined gradation will meet the requirements of the approved JMF.

503.03.2 Cold Feed Bins: Blend and proportion all aggregates in cold feed bins.

Provide cold aggregate bins of sufficient size to store the amount of aggregates required for continuous plant operation. Provide a cold bin feed system capable of uniformly delivering the maximum number of required aggregate sizes in their proper proportion. Extend partitions between bins a minimum of 1 foot above the top of bins sufficient to prevent intermixing of aggregate sizes. Do not use the partition as part of the bin.

Calibrate the cold feed system based on the weight of bin material. Feed material from a bin through the individual orifice and bypass to a container to be weighed, or over the calibrated weigh bridge. Calibrate material from each bin separately. Calibrate with manufacturer's recommended procedures and keep records on file. The calibration process shall be part of the contractor's quality control.

Provide an automatic plant no flow alarm and shutoff to cease operations when any aggregate bin becomes empty or flow is interrupted for 20 seconds. If repeated no flow indications are evident, cease operations until continuous

flow can be maintained. Provide belt scales for conveyor systems and calibrate accordingly.

When more than one cold bin feeder is used, operate each as a separate unit. Integrate the individual controls with a master control for all materials.

503.03.3 Moisture: Make provisions for introducing the latest moisture content of the cold feed aggregates into the belt weighing system, thereby correcting the conversion of wet aggregate weight to dry aggregate weight. Digitally display dry weight of the aggregate flow in appropriate units.

503.03.4 Screens: Provide a static screen system on top of the fine sand cold feed bin system and the RAP bin system, to ensure removal of objectionable material.

When a belt scale is used, provide a vibrating scalping screen between the cold bin system discharge and the belt scale. Size the screens to remove all oversize aggregate and other objectionable material.

503.03.5 Reclaimed Asphalt Pavement (RAP): If RAP is used, provide a separate cold feed system. Include a scalping screen, bin, feeder belt, and weigh bridge which is fully integrated with the cold feed system and asphalt cement supply system. Calibrate this system in accordance with 503.02.2 and 503.03.2. Add RAP to the dryer in a location as recommended by the manufacturer so that it does not expose the material to direct flame.

503.04 ASPHALT CEMENT.

503.04.1 Working Tank: Provide an asphalt cement working tank capable of uniformly heating the material, under positive control, to the required temperature as recommended by the supplier by methods approved by the District Laboratory Engineer. Provide an asphalt circulating system of adequate size to ensure proper and continuous circulation (except while asphalt is being measured). Equip new tanks with paddle-type mixers or agitators which keep the material in motion and minimize prolonged exposure to the heating source. Maintain the proper mixing temperature of the asphalt. Heat and insulate pipelines and fittings. Provide a sampling spigot in each tank and/or the supply line. Place strainers or screens between the working tank and mixing unit to filter undesirable material. Fix a thermometer graduated in 5°F increments and having an accuracy of $\pm 5^\circ\text{F}$ in the asphalt feed line at an approved location near the discharge valve at the mixer unit to indicate the temperature of asphalt from storage.

503.04.2 Measurement: Measure the asphalt cement either by weight or volume. Ensure that all scales and meters are calibrated and

accurate to 0.5 percent. Display by percent the rate of flow of asphalt cement and the total quantity used.

503.04.2.1 Weight Measurement: Provide scales reading to the nearest pound.

503.04.2.2 Volume Measurement: Measure the asphalt cement by volume using a positive displacement pump and record in digital form to the nearest gallon. Periodically check by weight the quantity of asphalt cement delivered. Continuously display in digital form the corrected rate of asphalt cement delivery and the total quantity delivered. Ensure measurement during production is accurate to within 1.0 percent.

503.05 ADDITIVES. When additives are used, digitally display the rate of flow and the total quantity used for each. Provide meters accurate to 0.5 percent.

503.05.1 Anti-Strip: Provide a recirculation anti-strip additive storage tank producing uniform heat with an indicating thermometer at an approved location near the tank discharge point. Place a thermometer graduated in 5°F increments and having an accuracy of $\pm 5^\circ\text{F}$ at an approved point near the anti-stripping tank discharge point before the meter. Disperse anti-strip additive directly into the asphalt feed line at a location between the asphalt control valve and the end of the asphalt discharge line. Ensure that the anti-strip delivery system continuously delivers the proper amount of material and in correct proportion to the asphalt cement. This system must be equipped with a no-flow indicator, which triggers a light or alarm in the control room and an alarm in the plant lab when the anti-strip material is not flowing. If the anti-strip flow is stopped or interrupted for more than 5 minutes, discontinue production until the system is repaired. The equipment shall include a positive displacement accumulating meter which accumulates and displays materials used, and reads to the nearest 0.25 gallon. Additionally, provide a measuring dip stick and a chart correlating tank quantity with the height of anti-strip liquid.

503.05.2 Plant Blending: Equipment required to introduce crumb rubber modifier, latex, or warm mix additives is described herein. Submit a proposed plant equipment diagram to the District Laboratory Engineer for review and forward a copy to the Materials Engineer. Provide written confirmation from the equipment manufacturer that the quantity and type of mixers are appropriate for the proposed materials and flow rates. When modifying asphalt liquid binder at the contractor's plant to meet a new grade of asphalt, provide a Dynamic Shear Rheometer (DSR) for on-site quality control testing.

The District Laboratory Engineer will inspect the plant facilities.

503.05.2.1 In-Line Blending: Provide a sampling spigot in line after the point of mixing and prior to anti-stripping introduction. When modifying the binder with additives, use a totalizing meter to measure the quantity of additive in a similar manner as anti-strip.

503.05.2.2 Single Tank Batch Blending: A single tank system consists of a single blending tank used to blend crumb rubber modifiers. Provide a 20,000-gallon capacity tank or greater, which serves as both a mixing liquid tank and working liquid tank. Continuously mix the liquid and crumb rubber or other additive with paddle type mixers, auger type mixers, or shear mills to properly blend and maintain suspension. Provide a safe and easily accessible sampling spigot.

503.05.2.3 Multiple Tank System: A multiple tank system consists of a blending tank feeding into a working tank used to blend crumb rubber modifiers. The blending tank may be batch or continuous with metered feed controls to accurately maintain proper ratios of crumb rubber or other additive to neat asphalt binder liquid. Properly agitate the mixture in the working tank with paddle type mixers or auger type mixers to maintain suspension of the modified liquid. Provide a safe and easily accessible sampling spigot.

503.05.3 Warm Mix Additives: Provide necessary equipment in accordance with the manufacturer's recommendations and submit a proposed plant equipment diagram to the District Laboratory Engineer for review. Forward a copy to the Materials Engineer.

503.05.3.1 Foaming Using Water Injection: Provide an approved foamed asphalt injection system flow diagram upon request. Provide a control room indicator when using the water injection system.

503.05.3.2 Chemical Additives: Chemical additives are supplied by the liquid supplier, by mixing in the working tank, by in-line blending, or by introducing as an anti-strip. Provide a system that continuously records the quantity of additive used.

503.05.4 Mineral Filler: Proportion mineral filler separately from a bin equipped with an adjustable feed in accordance with Subsection 503.03.2, which can be accurately and conveniently calibrated and be interlocked with the aggregate. The feeder shall accurately proportion the mineral filler and provide a constant flow of material. For continuous drum mixer plants introduce the mineral filler, if used, to the mix at an approved location sufficiently in advance of the addition of the asphalt cement.

503.05.5 Hydrated Lime: When hydrated lime additive is mixed with aggregate on the belt feed, interlock and synchronize the hydrated lime

additive equipment with cold feed controls. Equip the system with an automatic no flow indicator that will automatically shut the plant down when a malfunction causes an improper supply of additive or water. Equip the hydrated lime additive system with the following:

1. A separate bulk storage bin with a vane feeder or other approved feeding system that can be readily calibrated. The system shall provide for easy sampling of additive and verification of the quantity dispensed by weight (mass). Ensure the feeder system continuously records the total amount of additive dispensed.

2. An approved spray bar, capable of spraying the composite aggregate with potable water before the addition of hydrated lime additive, when the moisture content of the composite aggregate falls below 3 percent. Ensure the approved equipment and methods consistently maintain the aggregates in a uniform, surface wet condition.

3. An approved pug mill after the cold feed system and before the belt scale.

Dispense the hydrated lime additive directly into the pug mill and composite aggregate. Uniformly blend the additive with the composited aggregate before exiting the pug mill. Obtain the District Laboratory Engineer's review of the process and equipment used for mixing the lime additive and aggregate. Ensure that no less than the required amount of additive is continuously blended with the aggregate.

503.05.6 Fibers: Use a separate feed system to accurately proportion and uniformly distribute the required quantity of mineral fibers into the mixture. Interlock the proportioning device with the aggregate feed or weigh system to maintain the correct proportions for all rates of production. Control the fiber proportion to within ± 10 percent of the amount of fibers required. Equip the system with an automatic no flow indicator that will automatically shut the plant down when a malfunction causes an improper supply of fiber. For drum plants, add the fiber adjacent to the asphalt cement discharge location.

503.06 DRUM. Equip the drum with automatic burner controls that continuously agitate aggregates during heating and drying. Provide equipment capable of heating and drying aggregates to meet specifications in the necessary quantities to supply the mixing unit continuously at its operating capacity and at a specified temperature and acceptable moisture content. Slope the drum and maintain flights in accordance with manufacturer's recommendations.

Produce a uniform blend at the specified production rate, with rapid and complete asphalt coating of aggregate. As a minimum, completely coat 95 percent of the coarse aggregate particles retained on the No. 4 sieve when tested in accordance with DOTD TR 328.

Process the mixture at the temperature specified on the approved JMF and within $\pm 25^{\circ}\text{F}$ of the optimum mixing temperature at the discharge. Equip the drum with a thermometer or other temperature device to monitor the discharge temperature of the mix. Use temperature recording device or thermometers graduated in maximum 10°F increments with an accuracy of $\pm 5^{\circ}\text{F}$ and a sensitivity capable of detecting a change of at least 10°F per minute.

503.07 DUST COLLECTION SYSTEM. Return the fines from the dust collection system at a uniform and regulated rate near the asphalt cement discharge.

503.08 STORAGE AND LOADING OF ASPHALT CONCRETE MIXTURES.

503.08.1 Mix Conveyors: Transport the mix directly from plant to the storage silos or surge bin system by means of an enclosed continuous type conveyor system designed to prevent spillage and match the production rate of the plant. Deliver the mixture to the storage silo or surge bin within $\pm 15^{\circ}\text{F}$ of plant discharge temperature.

503.08.2 Storage Silos and Surge Bins: Use approved storage silos or surge bins for storing asphalt concrete mixtures.

Ensure that the use of storage silos or surge bins conform to the limitations on retention time, type of mixture, heater operation, bin atmosphere, bin level or other characteristics set forth in these specifications and other requirements stated in granting approval of these facilities. Affix an indicator device to each bin, visible to the loading operator, which is activated when material in the bin drops below the top of the sloped portion. Maintain mixtures above this level during production, except when the plant is not in operation.

When the mixture is placed into a silo or bins through a surge device, provide an automatic warning system to audibly warn the operator of a gate malfunction. Ensure silo or bin unloading gates are either clam shell gates operating under gravity feed or other approved gates that will not cause segregation or be detrimental to the mix.

503.08.2.1 Storage Silos: Maintain a uniform mixture temperature without localized heating. Maximum allowable overnight storage time is 18

hours, provided the silo has an oil sealed discharge gate. The Department may approve additional storage time provided test results and other data indicate that the additional storage time is not detrimental to the mix.

503.08.2.2 Surge Bins: Maintain the mixture at a temperature not less than 25°F below the optimum mixing temperature on the JMF. Do not store the mixture over night.

503.08.2.3 Loading and Sampling: Use haul trucks conforming to 503.11.

Provide a sturdy secured metal sampling platform, with protective rails, at least 30 square feet in area, and set at the proper height to easily obtain a sample. Protect the sampling platform from loaded trucks with barrier rail.

Equip the plant with an approved pressurized system capable of spraying a uniform coating of an approved asphalt mix release agent into the haul unit bed prior to loading. Do not use diesel as a mix release agent.

503.09 SCALES AND METERS.

503.09.1 Scales: Provide scales and meters accurate to ± 0.5 percent of the indicated load. Design, construct and install scales and meters so that operations do not affect their accuracy. Calibrate in accordance with 503.02.2. Measure all asphalt concrete mixtures by weigh hoppers or truck platform scales to determine weight for pay.

503.09.2 Weigh Hoppers: Provide weigh hoppers to weigh the mixture or individual material components. Provide hoppers that do not leak or cause segregation. Suspend weigh hoppers from calibrated springless dial scales or load cell scales. Equip the weigh hopper with an approved automatic printer system that will print the certified tare weight of the truck, each batch weight, and total weight of mixture loaded into the truck

503.09.3 Platform Scales: Provide truck platform scales of sufficient length to weigh the entire unit transporting the mix. Weigh the truck empty to determine tare weight prior to mixture loading. Equip scales with an approved automatic printer system that will print the tare weight as well as the total weight of the unit and the mix.

503.09.4 Printers: Inform the Department in the event of a breakdown of the printing mechanism. Discontinue operations until the printer is repaired or replaced.

503.10 PAVING EQUIPMENT. The Department will inspect primary roadway equipment, including Material Transfer Vehicle (MTV), asphalt distributors, pavers, and rollers, at the start of each project. .

503.11 HAUL TRUCKS. The Department will certify haul truck and trailers with a maximum of three trailer combinations for legal payload and volume. Comply with load restrictions in accordance with 105.14. Use trucks having tight, clean, and smooth beds. Spray beds daily or as often as directed with an approved asphalt mix release agent.

Provide a canvas or vinyl cover large enough to completely cover the top and extend over the sides of the bed to protect the mixture from the weather or loss of heat. Use sufficient tie-downs to hold the cover.

Discharge the mixture in a continuous manner so the spreader apron of the paver or MTV will not be overloaded. If the truck or paver is causing surface tolerance penalties or excessive bumps, discontinue its use.

Change equipment or operations when size, speed and condition of trucks interfere with orderly paving operations.

Equip haul trucks used for asphalt surface treatments with a mechanism to provide a positive connection to the aggregate spreader.

503.12 ASPHALT MILLING MACHINE. Use an approved self-propelled milling machine or grinder equipment for milling asphalt surfacing. Provide equipment with sufficient power, traction and stability to remove the thickness of asphalt concrete necessary to provide profile grade and cross slope uniformly across the surface. Provide milling equipment capable of controlling grade or cross-slope from an erected stringline, shoe device or approved traveling reference plane that will accurately reflect the average grade of the surface on which it is to be operated and have an automatic system for controlling cross slope at a given rate. The drum shall be round and true with sufficient number of teeth to yield a uniform and fine textured surface. Equip the milling machine with means to control dust created by the cutting action. Provide adequate loading equipment to immediately remove materials cut from the surface and discharge the cuttings into a truck or on the shoulder as specified or directed.

503.13 ASPHALT DISTRIBUTORS. Provide equipment that ensures even distribution of the asphalt or asphalt emulsion across the entire pavement area at the specified rate as measured per ASTM D2995.

503.13.1 Distributors: The asphalt cement distributor shall be capable of maintaining the allowable variation from any specified rate within ± 0.02 gallons per square yard. Equip the distributor with a height adjustable spray bar with spray nozzles recommended by the manufacturer. Assure that the end nozzle over the roadway edge provides a sharp line of asphalt material

parallel to the direction of travel. Ensure nozzles remain clean and free from blockage.

Provide means for an accurate and rapid determination of the control and amount of asphalt materials being applied per square yard of surface. Equip the distributor with thermometers to indicate the temperature of the material in the tank. Equip the distributor with a hand-held spray attachment for applying asphalt materials to areas inaccessible with the spray bar.

Within 12 months prior to use, calibrate the asphalt distributor in accordance with ASTM D 2995. Provide the ASTM calibration and furnish the engineer an accurate and satisfactory calibration record prior to beginning the work. The engineer may at any time require verification of calibration accuracy of the asphalt distributor in accordance with ASTM D 2995.

503.14 MATERIAL TRANSFER VEHICLE (MTV). When placing the final two lifts of asphalt concrete on the roadway travel lanes, use a material transfer vehicle (MTV) or lightweight MTV to deliver mixtures from the hauling equipment to the paving equipment, and to minimize thermal and material segregation of the hot mix asphalt concrete.

Ensure that the MTV provides additional mixing of the asphalt concrete mixtures and then deposits the mixture into the paving equipment hopper to reduce segregation and facilitate continuous production. At a minimum, provide an MTV with a high capacity truck unloading system, which will receive mixtures from the hauling equipment; a 20 ton storage bin in the MTV to continuously mix the mixture prior to discharge to a conveyor system; a discharge conveyor, with the ability to swivel, delivering the mixture to a paving equipment hopper while allowing the MTV to operate from an adjacent lane. If the weight of the MTV is determined by the engineer to cause settlement or movement in the base or sub-base, discontinue use. If the problem persists with the use of a lightweight MTV, discontinue use of the MTV. When a malfunction occurs in the MTV during lay-down operations, immediately discontinue plant operations and do not resume until the MTV malfunctions have been remedied. Mixtures in the silo (≤ 100 tons) or materials in transit may be placed.

Due to the weight of the loaded MTV, apply the following restrictions at bridge crossings:

1. Abide by posted weight limits.
2. Prior to crossing a bridge, be as near empty as possible.
3. Do not move across a bridge with any other vehicles being on the bridge.

4. Move on a bridge only within the limits of the travel lanes and do not move on the shoulders of the bridge.

5. Move at a speed no greater than 5 miles per hour when crossing a bridge.

503.14.1 Lightweight MTV: The lightweight MTV has a smaller capacity, is more fuel efficient and may be used in lieu of the MTV. Lightweight MTV's must meet all requirements of the 503.14 MTV and as modified herein. Use a Thermal Profile system in accordance with section 503.14.3 at all times when a lightweight MTV is used in lieu of the MTV. Discontinue use of lightweight MTV when thermal segregation is observed

The requirement of the 20 ton storage hopper is waived for all lightweight MTVs. The approved remixing methods for lightweight MTV's are:

1. Counter rotating augers,
2. Offset gravity transfer conveyor chute, or
3. Twin interlaced augers.

A tracked or high flotation tires are required for the undercarriage of the MTV to facilitate low ground pressure (< 55 psi).

503.14.2 Windrow Paving: Windrow paving is allowed with the use of an MTV and thermal profile system. Equip the MTV with a windrow head attachment capable of removing 95 percent of the mixture off the pavement. Use a thermal profile system meeting 503.14.3.

503.14.3 Thermal Profile System: The thermal Profile System may be used on all projects. The Thermal Profile System is a device capable of continuously recording the temperature of the full width of pavement as the mixture exits the paver with constant record of the GPS location and distance traveled. The thermal profiles system is required when using a lightweight MTV as described in section 503.13.2. The system requirements include the capability to provide the engineer with the thermal profile of every roadway subplot and roadway lot.

Mount the system with a recording device to the back of the paver. Provide capability of instant review of data on project site at any time keeping permanent record of all temperature and location data daily.

503.15 PAVERS. Use pavers with an automatic grade control device (dual grade may be required) and slope control devices for use with an approved traveling reference plane or erected stringline, as directed.

Use pavers capable of placing mixtures within specified tolerances. Use a screed or strike-off assembly to distribute the mixture over the entire

paving strip. The width of the paving strip must be acceptable to the engineer. Use screed, including screed extensions, to place mixtures that are uniform in appearance and quality. Adjust the screed assembly to provide the required cross section. Equip the screed (including screed extensions) with a heater and a vibrator.

Use a paver insert hopper, in conjunction with the MTV, with a minimum capacity of 5 tons (5 mg).

Equip pavers with hoppers adequately designed and maintained to prevent spillage. Equip pavers with augers to place the mix evenly in front of the screed, including extensions. Equip pavers with a quick and efficient steering device capable of traveling both forward and in reverse. Provide pavers capable of spreading mixes to required thickness without segregation or tearing.

For shoulder construction or other incidental applications, use modified pavers or widening machines when permitted.

Use auger assembly extensions when screed extensions in excess of 2 feet on a side are to be continuously used in the pavement operation. Extend such auger extensions to within 2 feet of the end of the screed. With approval, the use of an auger extension with screed extensions in excess of 2 feet on one side may be waived for transitions, taper sections and similar short sections.

Do not use a strike-off assembly or boxed extension for paving within the traveled way, except when approved for short irregular sections or non-typical sections.

Ensure that the vibratory screed crowns the pavement with adjustable extensions to accommodate the desired pavement profile.

503.15.1 Spray Paver: Spray pavers are designed to distribute the tack coat immediately before placing the asphalt mixture. Comply with 503.13.1 and ensure that spray pavers evenly distribute the tack coat and apply and level thin asphalt concrete concurrently at a rate of 30 to 92 feet per minute. Do not allow a wheel or other part of the paving machine to come in contact with the tack coat before the hot mix asphalt concrete wearing course is applied. Equip the spray paver to include a receiving hopper, feed system, insulated storage chamber for the tack coat, spray bar, tanks with calibrated load cells, and a variable width heated screed unit.

503.16 COMPACTION EQUIPMENT.

503.16.1 General: Provide self-propelled compaction equipment capable of reversing without backlash. Establish a rolling pattern and provide the number, type and size of rollers sufficient to compact the mixture

to the specified density and surface smoothness.

503.16.2 Steel Wheel Rollers: Use either vibratory or non-vibratory steel wheel rollers. Equip the roller with wheels that are true to round and equipped with suitable scrapers and watering devices. Design vibratory rollers for asphalt concrete compaction having separate controls for frequency, amplitude and propulsion.

503.16.3 Pneumatic Tire Rollers: Use treadless tires that are the same size and ply rating, and inflated to a uniform pressure not varying more than ± 5 psi between tires. Equip tires with scrapers to prevent adhesion of mixture. The engineer may require additional cleaning and water apparatus on tires if material adhesion is detrimental to the mat.

503.16.4 Equipment for Asphalt Surface Treatments (AST).

503.16.4.1 Pneumatic Tire Rollers for AST: Use a minimum of two self-propelled rollers, weighing at least 12 tons each. Tires shall be smooth tread, of the same size and ply rating. Inflate to a minimum uniform tire pressure of 60 psi, unless damage occurs. The engineer may require a reduction in roller pressure to prevent damage to the aggregate or underlying base course. Wheels shall not wobble and shall be aligned so that the gaps between tires on one axle are covered by tires of the other axle.

503.16.4.2 Power Broom or Blower for AST: Use a power revolving broom or power blower to clean the surface of dust, dirt, mud, and loose or excess material.

503.16.4.3 Aggregate Spreader for AST: Use a self-propelled, pneumatic tire power spreader designed, equipped, and operated to spread aggregate uniformly at the designated rate within the limits of the desired roadway width. The aggregate spreader shall be capable of maintaining an allowable variation from the specified rate within ± 0.5 pounds per square yard or ± 0.25 pounds per square yard for expanded clay.

Calibrate the aggregate spreader in accordance with ASTM D 5624.

503.16.4.4 Vacuum-Sweeper for AST: Provide a vacuum-sweeper when there is a dusting problem, as determined by the project engineer.

503.17 MISCELLANEOUS EQUIPMENT AND HAND TOOLS.

Provide power revolving brooms or power blowers that are maintained and in satisfactory working condition.

In areas that are inaccessible to conventional rollers, use satisfactory mechanical compaction equipment, or hot hand tampers. Tamping tools may be used for compacting edges.

Section 504

Asphalt Tack Coat

504.01 DESCRIPTION. Prepare and treat existing asphalt or portland cement concrete pavement surfaces with asphalt material in accordance with these specifications and in conformity with the lines and grades shown on the plans or established.

504.02 ASPHALT MATERIALS. Use an undiluted asphalt emulsion Grade NTSS-1HM, CRS-2P, CSS-1H, SS-1H, SS-1L or PET as required by Sections 501, 502, and 507 and as listed on the Approved Materials List and comply with Section 1002.

504.03 WEATHER LIMITATIONS. Do not apply asphalt tack coat on a wet surface or when the ambient air temperature is below 40°F. For full depth patching, do not place asphalt tack coat when ambient air temperature is below 35°F.

504.04 EQUIPMENT. Provide equipment for applying asphalt material and prepare the surface to be tacked. Apply with equipment conforming to 503.13.1 and 503.15.1. A hand-held pressure nozzle may be used for tack coat application in lieu of the spray bar/tachometer combination for irregular sections or short sections of 1500 feet or less.

504.05 SURFACE PREPARATION. Clean the pavement surface by sweeping or other approved methods. Satisfactorily clean edges of existing pavements that will form joints with new pavement before tack coat is applied.

504.06 APPLICATION. Uniformly apply asphalt tack coat to a clean dry surface with no bare areas, streaks or puddles with an asphalt distributor at a rate in accordance with Table 504-1. If bleeding, ponding, or slipping are evident, these rates may be reduced to a minimum of 0.04 gallon/square yard with a minimum 0.02 gal/sq yd residual with approval of the engineer.

**Table 504-1
Section 502 Asphalt Tack Coats**

Surface Type	Rate ¹ ; Gal/Sq yd
Existing Surface Treatment ²	0.12
New Hot Mix	0.06
Existing Hot Mix	0.09
Portland Cement Concrete	0.09
Cold Planed/Milled	0.08

¹Rates are minimum rates of undiluted asphalt emulsion.

²Section 507 Asphalt Surface Treatment Type E Interlayer does not require a tack coat.

The minimum application temperature of the emulsified asphalt Grades NTSS-1HM, CRS-2P and Polymer Emulsion Tack (PET) is 160°F and Grades CSS-1H and SS-1H, is 70°F, or as recommended by the manufacturer.

Apply tack coat in such manner as to cause the least inconvenience to traffic. Traffic is not permitted on tacked surfaces prior to application of the mixture placement. The contractor will be permitted to apply the tack coat one calendar day prior to the mixture laydown for non-traffic areas. However, when tack coat has been damaged or contaminated by dirt, dust or mud, clean the surface and retack prior to the mixture laydown at no direct pay. Retack previously tacked surfaces exposed to damage or due to inclement weather at no direct pay.

504.07 MEASUREMENT. Asphalt tack coat will not be measured for payment and is considered incidental to the 501 item; however it will be measured by the gallon in-place using a calibrated stick and/or charts on level ground at the application temperature described in 504.06 for specification compliance.

504.08 PAYMENT. Payment of asphalt tack coat will be specified in 501.11, and 502.15.4 subject to the payment adjustment provisions of Section 1002 for specification deviations of the asphalt materials. The Materials and Testing Section will provide the payment adjustment percentage for specification deviations of the asphaltic materials.

Section 505

Asphalt Prime Coat

505.01 DESCRIPTION. An asphalt prime coat is used to seal newly constructed unbound and/or un-stabilized base courses. Prepare and treat a surface with asphalt material in conformance with these specifications and in conformity with lines shown on the plans or established.

505.02 ASPHALT MATERIALS. Prime coat shall be cutback asphalt Grade MC-30, MC-70, or AEP Emulsified Asphalt complying with Section 1002.

505.03 WEATHER LIMITATIONS. Do not apply MC-30 and MC-70 materials on a wet surface. Do not apply asphalt prime coat when ambient air temperature is less than 35°F in the shade.

505.04 EQUIPMENT. Provide the necessary equipment for proper construction of the work. Apply with equipment conforming to 503.13.1. A hand-held pressure nozzle may be used for prime coat application in lieu of the spray bar/tachometer combination for irregular sections or short sections of 1500 feet or less.

505.05 SURFACE PREPARATION. Shape the surface to be coated to required grade and section. Assure that the surface is free from ruts, corrugations, segregated material or other irregularities, and compact to required density. Delays in priming may necessitate reprocessing or reshaping to provide a smooth, compacted surface.

505.06 APPLICATION. Extend prime coat 6 inches beyond the width of surfacing shown on the plans. Do not apply the prime coat until the surface has been satisfactorily prepared.

Apply prime coat at the rates and temperatures shown in Table 505-1.

**Table 505-1
Prime Coats**

Asphalt Grade	Application Rate Gal/Sq Yd		Application Temperature °F	
	Min.	Max.	Min.	Max
MC-30	0.25	0.30	60	120
MC-70	0.25	0.30	100	180
AEP	0.25	0.30	60	120

505.07 PROTECTION. After prime coat has been applied, cure for a minimum of 24 hours before placing the mixture. Keep traffic off the surface until the prime coat has properly cured, unless otherwise permitted by the engineer.

If traffic is permitted, spread approved granular material, as directed by the engineer, over the prime coat at no direct pay.

Maintain the prime coat intact. When required, thoroughly clean the primed surface prior to the placement of mixture.

Where the prime coat has failed, clean the failed area and reapply prime coat to the unbound surface at no direct pay. When the prime coat is generally unsatisfactory, reapply prime coat to the unsatisfactory surface at no direct pay.

505.08 MEASUREMENT AND PAYMENT. Asphalt prime coat will not be measured for payment; however, payment under the contract will be subject to the payment adjustment provisions of Section 1002 for specification deviations of the asphalt materials. The Materials and Testing Section will provide the payment adjustment percentage for asphalt materials. Payment for surface preparation will be made under other items.

Section 506

Asphalt Curing Membrane

506.01 DESCRIPTION. The Asphalt Curing Membrane is used to cure treated or stabilized base/subgrade layers. Apply and maintain an asphalt curing membrane to the surface of cement or lime treated or stabilized materials in compliance with these specifications or as directed.

506.02 MATERIALS. Asphalt for curing membrane shall be an emulsified asphalt or an emulsified petroleum resin (EPR-1) complying with Section 1002. Water shall comply with 1018.01.

506.03 WEATHER LIMITATIONS. Do not apply asphalt curing membrane when the temperature is below 35°F, unless otherwise permitted by the engineer.

506.04 EQUIPMENT. Provide and maintain the necessary equipment for proper construction of this work. Apply with equipment conforming to 503.13.1. A hand-held pressure nozzle may be used for application in lieu of the spray bar/tachometer combination for irregular sections or short sections of 1500 feet or less. A gravity flow distribution system will be allowed.

506.05 SURFACE PREPARATION. Assure that the surface to which curing membrane is to be applied is free from ruts, corrugations, loose material or other irregularities.

506.06 APPLICATION. Apply the asphalt curing membrane immediately upon completion of final finishing of the final lift of the surface. Uniformly apply the emulsified asphalt curing membrane in accordance with Table 506-1. Remove extraneous material which has collected on the base before additional application of asphalt curing membrane. Maintain and repair the surface before additional applications.

**Table 506-1
Asphalt Curing Membrane**

Curing Membrane Type	Application Rate ¹ Gal/Sq Yd	Application Temperature ² °F
	Min.	Min.
EPR-1 ³	0.20	70
Emulsified Asphalt ⁴	0.10	70

¹Rates are minimum rates of undiluted asphalt emulsion. Dilution of the asphalt curing membrane is not permitted.

²Minimum application temperature or as recommended by the manufacturer.

³Undiluted EPR shall consist of 5 parts water and 1 part resin concentrate and comply with Section 1002.

⁴Shall comply with Section 1002.

506.07 PROTECTION. After the curing membrane has been applied, keep public and construction traffic off the surface until the curing membrane has properly cured, unless otherwise directed by the engineer. Maintain the curing membrane at no direct pay until the mixture has been placed. When traffic is permitted, apply additional curing membrane at intervals to protect and cure the surface at no direct pay.

506.08 MEASUREMENT AND PAYMENT. Asphalt curing membrane will not be measured for payment; however, payment under the contract will be subject to the payment adjustment provisions of Section 1002 for specification deviations of the asphalt materials. The Materials and Testing Section will provide the payment adjustment percentage for asphalt materials. Water will not be measured for payment.

Section 507

Asphalt Surface Treatment

507.01 DESCRIPTION. This work consists of furnishing properly distributed asphalt material followed by a uniform application of aggregate for building a riding surface, improving the surface friction of a roadway, sealing cracks in the roadway, reducing the rate of oxidation of a surface mixture, or as an interlayer to delay or reduce the occurrence of reflective cracking.

Asphalt Surface Treatment (AST), sometimes referred to as “chip seal,” consists of a specified emulsion applied “cold” or polymer modified asphalt material applied “hot,” at the temperature range specified in Table 507-1 for cold applications or Table 507-2 for hot applications, respectively. The application rates of asphalt material and aggregates will vary with aggregate size and existing roadway conditions but, for bid purposes only, shall meet the requirements of Table 507-1 or Table 507-2. The engineer will review the actual application rates.

507.02 MATERIALS.

507.02.1 Asphalt: Use asphalt materials complying with Section 1002 that are Approved Material List products. Comply with Table 507-1 or 507-2.

Take samples of asphalt material in the presence of the engineer's representative. The engineer's representative will immediately take possession of the samples.

507.02.2 Aggregates: Aggregates shall comply with 1003.07 and Table 1003-15. Use Approved Material List aggregates shown herein or as designated on the plans.

For hot applications and interlayer applications, precoat aggregates with a paving grade asphalt cement or a cationic emulsion. For precoated aggregates, the residual asphalt content shall be a minimum of 1.4 percent by weight of the aggregate for high absorption aggregates and 0.5 percent minimum by weight for low absorption aggregates as defined in AASHTO T84. The precoat applicator shall certify the quantities of precoat used in the process. Ensure that the precoated aggregate flows freely. The gradation requirements apply to the aggregate after precoating. Submit a gradation Certificate of Analysis with each aggregate shipment of 1000 cubic yards or each project, whichever is less. If an emulsion is used for precoating, cure the stockpiled precoated aggregate prior to use.

507.03 EQUIPMENT. Provide asphalt distributors, pneumatic tire rollers, power brooms or blowers, aggregate spreaders, and vacuum sweepers in accordance with Section 503. Calibrate and maintain the necessary equipment for proper construction.

Keep storage tanks, piping, booster tanks, distributors, and all other equipment used in delivering, storing, or handling asphalt materials clean and in good operating condition.

507.03.1 Power Asphalt Distributor: Provide a computer operated asphalt distributor in accordance with 503.13.1.

507.03.2 Pneumatic-tire Rollers: Use self-propelled rollers, weighing at least 12 tons each in accordance with 503.16.4.1

507.03.3 Power Broom or Blower: Use a power revolving broom or power blower in accordance with 503.16.4.2.

507.03.4 Aggregate Spreader: Use a self-propelled, pneumatic tire power spreader in accordance with 503.16.4.3.

507.03.5 Vacuum-Sweeper: Provide a vacuum-sweeper when there is a dusting problem in accordance with 503.16.4.4.

507.03.6 Haul Trucks: Provide haul trucks in accordance with 503.11.

507.04 WEATHER LIMITATIONS. Do not apply AST if any of the following conditions occur:

1. Wet or moist surface. Consider the pavement to be excessively moist when it is visibly wet or when a one square foot piece of polyethylene film condenses moisture after being tightly placed on the pavement surface for 15 minutes;
2. Rain has occurred within 24 hours (for hot applied AST only);
3. The air temperature or pavement surface temperature in the shade is less than 60°F; or
4. The air temperature is predicted by the National Weather Service to fall below 60°F within 24 hours after placement.

507.05 PREPARATION OF EXISTING SURFACE. Potholes and surface depressions will be repaired by the Department prior to the asphalt surface treatment work unless shown otherwise on the plans.

Prepare existing surface at no direct pay unless otherwise specified on the plans. Immediately prior to application of the asphalt material, clean and de-grass existing pavements over the full width to be treated. Remove raised pavement markers at no direct pay. Sweep the pavement with a power broom or blower to remove all loose material. Clean areas not reached by the power broom or blower by hand brooming or blowing.

If used, ensure that the prime coat or curing membrane, is satisfactorily cured and maintained in accordance with Sections 505 and 506 prior to application of AST.

Obtain the engineer's acceptance of the surface prior to application of AST.

507.06 APPLICATION. After the existing surface has been properly prepared, apply asphalt material and aggregates in the amounts determined by the contractor and accepted by the engineer, and in the sequence specified herein.

Apply and spread asphalt surfacing at the temperatures and sequences given in Table 507-1 or 507-2. The quantities of material given in Table 507-1 or 507-2 may be adjusted by the engineer as field conditions warrant. The type and condition of the surface being covered will affect the required application rate of asphalt material. Use the quantities as recommended by the contractor and accepted by the engineer. Establish the actual rates during the first asphalt and aggregate application.

Before the asphalt surface treatment operation begins, calibrate and set the flow rates of the distributor and spray bar along with the aggregate spreader at a remote location offsite in a manner acceptable to the engineer. Aggregate spread rates may be adjusted by the engineer. It should be noted that after the aggregate spreader passes, the aggregate should never cover 100 percent of the roadway surface. The asphalt coated surface should be visible between the aggregates. Strike off aggregate trucks at the loading area for proper material yield measurements.

The aggregate spreader shall follow immediately behind the asphalt distributor. Make the initial pass with the rollers immediately following the aggregate spreader before the emulsion breaks.

507.06.1 Asphalt Material: In general, the rate of asphalt is increased if the road is absorbent, badly cracked, or coarse, and is decreased if the road is smooth and flushed with asphalt. Guidelines for adjusting the rate of asphalt emulsion in gallons per square yards are shown in Table 507-3.

Do not allow the length of spread of asphalt material to exceed that which can be covered by aggregate within approximately one minute.

Apply asphalt material at a uniform rate for the full width of treatment unless otherwise directed by the engineer. Keep the application of asphalt material consistently within ± 0.02 gallons per square yard, otherwise stop construction and recalibrate the distributor to the satisfaction of the engineer.

Adjust the height of the spray bar and the angle of the nozzles so that individual spray fans do not interfere with each other and uniform double or triple coverage is achieved. Maintain a minimum of 100 gallons of asphalt material in the distributor during operation.

Adjust and maintain one of the special spray nozzles at the ends of the spray bar to provide a sharp edge for the asphalt material on the edge of the roadway surface being covered. When the application is less in width than the length of the spray bar, move these special nozzles to provide the specified edge lines.

When any nozzle becomes blocked during application of asphalt material, immediately stop the flow of material and clean the nozzles. When the engineer directs that application be made over less than the full width of the roadway at a time, slightly overlap adjacent treatments longitudinally. Operate the distributor along a marked edge to keep the surface treatment in proper alignment.

To secure uniform distribution at the transverse junction of two treatments, stop the distributor promptly before the flow decreases. Place building paper or other suitable material over the end of the previous application. Start the joining application on the building paper. Satisfactorily remove and dispose building paper in accordance with Section 202 or as directed. Do not burn building papers.

During application of asphalt material, do not splatter adjacent pavements, structures, and trees with asphalt material. Do not clean or discharge the distributor into ditches, borrow pits, on shoulders or along the right-of-way.

Remove excess asphalt material at the junction between distributor loads or correct satisfactorily. Areas of the surface to be treated, which are not covered with asphalt material directly from the distributor shall be covered by means of a hand-held spray attachment equipped with nozzles.

507.06.2 Aggregates: Begin aggregate spreading operations immediately after the application of the asphalt materials. Place all aggregates for hot applications in a surface dry condition. Apply aggregate material within approximately one minute after application of the asphalt material.

Uniformly spread aggregate over the full width of asphalt material with one pass of the spreading equipment and with the application being sharply defined at edges. Do not drive equipment on uncovered asphalt material. When necessary to obtain uniform coverage, hand broom the surface.

Hand spreading will be permitted in conjunction with self-propelled spreaders over areas inaccessible to spreaders. Cover asphalt material with the appropriate rate of aggregate before rolling.

507.06.3 Multiple Applications: When multiple applications are to be placed, allow a minimum of 48 hours to elapse between each successive application of emulsions. Successive hot applications can be placed without delay.

507.06.4 Interlayers: An interlayer shall be Type E as specified herein and may be placed on raw or stabilized base, on a milled surface, between lifts of asphalt, or over existing portland cement concrete pavement which will be overlaid with asphalt. Use a liquid application rate that corresponds to the proper aggregate size given in Table 507-1 or 507-2 as adjusted by the engineer to meet existing conditions. Do not place asphalt concrete on an emulsion surface treatment for a minimum of five days after application. Hot applied interlayers may be overlaid immediately.

507.07 ROLLING AND BROOMING AGGREGATE MATERIAL.

Roll the surface immediately after spreading the aggregate material using a minimum of three pneumatic tire rollers. Make the first pass within approximately one minute of spreading the aggregate. Proceed rolling in a longitudinal direction, beginning at the outer edges of the application.

Make a minimum of three (3) passes over a single point. Complete all rolling within 1/2 hour after aggregate material has been spread. Immediately correct any deficiencies or damage in the aggregate material detected during rolling and reroll as directed. Continue rolling aggregate material until uniform coverage has been obtained. Roll the remaining applications as specified for the first application. Do not use a steel wheel roller.

Lightly broom or blow the surface to remove loose material. Completely remove all loose material from all roadway surfaces, including paved shoulders. If the engineer determines the amount of loose material is excessive, pick it up and remove from the project instead of brooming onto the adjacent slopes.

507.08 PROTECTION. Traffic shall not be allowed on the surface until the aggregate has been placed, rolled, and, if necessary, lightly broomed or blown. For cold applications, lightly broom or blow each treatment beginning the next morning, and continue removing loose aggregate up to final acceptance of the project, if necessary.

Distribute aggregate material over the surface to absorb any free asphalt, covering any area deficient with aggregate material, and roll as directed at

no direct pay. Do not displace embedded material during maintenance. When placing lightweight aggregate and a dusting problem occurs, use a vacuum sweeper without the sweeper engaged to remove loose aggregate. Loose aggregate material will not be permitted on the surface and shall be promptly removed.

507.09 MEASUREMENT. The quantities of asphalt material and aggregate incorporated into the completed and accepted asphalt surface treatment will be measured separately. Design quantities are based on horizontal dimensions. Design quantities will be adjusted when the engineer makes changes to adjust to field conditions. Each size aggregate will be measured by the square yard per application. Asphalt material will be measured in the distributor by the gallon at application temperatures.

507.10 PAYMENT. Payment for placement and maintenance of asphalt materials and aggregates will be made at the contract unit prices, subject to the payment adjustment provisions of Section 1002 for specification deviations of asphalt materials. The Materials and Testing Section will provide the payment adjustment percentage for asphalt materials. Payment for removal of pavement markings will be included in this pay item.

Payment will be made under:

Item No.	Pay Item	Pay Unit
507-01	Asphalt Material (type)	Gallon
507-02	Aggregate (size)	Square Yard

**Table 507-1
Asphalt Surface Treatment (AST) Requirements
(Cold Application)**

	Course No.	AST TYPE A		AST TYPE B		AST TYPE C	AST TYPE D			AST TYPE E (Interlayer)
Aggregate		Lightweight, Crushed Stone		Lightweight, Crushed Stone		Lightweight, Crushed Stone	Lightweight, Crushed Stone, Crushed Gravel			Crushed Stone, Crushed Gravel
Agg. Friction Rating		I, II		I, II, III		I, II, III	I, II, III, IV			I, II, III, IV
Asphalt Emulsion		CRS-2P		CRS-2P		CRS-2P	CRS-2P			CRS-2P
Application Temp. Minimum Maximum		160°F 175°F		160°F 175°F		160°F 175°F	160°F 175°F			160°F 175°F
Number of Applications		2	1	2	1	1	3	2	1	2
Asphalt Emulsion ¹ Application Rates Per Course	1	0.39	0.41	0.39	0.31	0.41	0.46	0.39	0.31	0.39
	2	0.29	—	0.29	—	—	0.36	0.29	—	0.29
	3	—	—	—	—	—	0.26	—	—	—
Aggregate size and Application Rates Per Course ²	1	S2-0.0111	S2-0.0111	S2-0.0111	S3-0.0075	S2-0.0111	S1-0.0200	S2-0.0111	S3-0.0075	S2-0.0111
	2	S3-0.0075	—	S3-0.0075	—	—	S2-0.0111	S3-0.0075	—	S3-0.0075
	3	—	—	—	—	—	S3-0.0075	—	—	—

¹Application rates are in gallons of asphalt emulsion per square yard of AST.

²Size aggregate and application rates. For example, S2 is Size 2 aggregate and 0.0111 is the application rate in cubic yards of aggregate per square yard of AST. S1A may be used in lieu of S1. Aggregate sizes for AST are shown in Table 1003-15.

**Table 507-2
Asphalt Surface Treatment (AST) Requirements
(Hot Application)**

	Course No.	AST TYPE A		AST TYPE B		AST TYPE C	AST TYPE D			AST TYPE E (Interlayer)
Aggregate		Lightweight, Crushed Stone		Lightweight, Crushed Stone		Lightweight, Crushed Stone	Lightweight, Crushed Stone, Crushed Gravel			Crushed Stone, Crushed Gravel
Agg. Friction Rating		I, II		I, II, III		I, II, III	I, II, III, IV			I, II, III, IV
Asphalt Cement ¹		PAC-15		PAC-15		PAC-15	PAC-15			PAC-15
Application Temp. Minimum Maximum		300°F 360°F		300°F 360°F		300°F 360°F	300°F 360°F			300°F 360°F
Number of Applications		2	1	2	1	1	3	2	1	2
Asphalt Cement ² Application Rates Per Course	1	0.30	0.31	0.30	0.24	0.31	0.36	0.30	0.24	0.30
	2	0.23	—	0.23	—	—	0.28	0.23	—	0.23
	3	—	—	—	—	—	0.20	—	—	—
Aggregate size and Application Rates Per Course ³	1	S2-0.0111	S2-0.0111	S2-0.0111	S3-0.0075	S2-0.0111	S1-0.0200	S2-0.0111	S3-0.0075	S2-0.0111
	2	S3-0.0075	—	S3-0.0075	—	—	S2-0.0111	S3-0.0075	—	S3-0.0075
	3	—	—	—	—	—	S3-0.0075	—	—	—

¹See Table 1002-11.

²Application rates are in gallons of asphalt cement per square yard of AST.

³Size aggregate and application rates. For example, S2 is Size 2 aggregate and 0.0111 is the application rate in cubic yards of aggregate per square yard of AST. S1A may be used in lieu of S1. Aggregate sizes for AST are shown in Table 1003-15.

Table 507-3
Asphalt Emulsion Adjustment Rate

Existing Surface Condition	Adjustment rate in Gallons/Sq Yd
Black, flushed asphalt	-0.1 to -0.06
Smooth, non-porous	0.00
Absorbent, porous, oxidized	0.03 to 0.09

SECTION 508

VACANT

Section 509

Milling Asphalt Pavement

509.01 DESCRIPTION. Remove asphalt concrete surfacing by milling in accordance with these specifications and in conformity with the average depth, width, grade, cross-slope and typical sections shown on the plans or as established.

509.02 EQUIPMENT. Use an approved self-propelled milling machine or grinder for milling asphalt surfacing in accordance with 503.12.

509.03 CONSTRUCTION REQUIREMENTS. Pavement surfaces resulting from milling operations shall be of uniform texture, grade and cross slope and free from loose material. Re-mill surfaces not meeting these requirements at no direct pay. Uneven, undulating surfaces will not be accepted. If ridges are excessive, the engineer may require additional milling, replacement of milling machine teeth, or other corrective action. Limit the maximum depth of milling to 2 inches per day when traffic is being maintained. Maintain a maximum 2-inch depth at milling edge of embankment at all times.

Use a minimum length 25-foot traveling reference plane on the first pass of the milling machine. A shoe device may be used on adjacent passes.

When the entire roadway width has not been planed to a flush surface by the end of a work period, resulting in a vertical or near vertical longitudinal face exceeding 2 inches in height, slope this longitudinal face as directed. Place smooth transitions at transverse joints prior to restoring to traffic by milling or by using an asphalt concrete mix. Do not use RAP. Transitions shall be a minimum length of one linear foot per 1/4 inch of the milled depth. Make provisions at drives and turnouts to maintain local traffic.

Remove asphalt concrete next to structures or in small irregular areas that cannot be removed by the milling machine by other acceptable methods.

Provide drainage of milled areas where needed by cutting through the shoulder to the ditch on the same day that adjacent milling is performed.

The milling operation shall not precede the subsequent paving operation or a shoulder stabilization operation by more than 15 calendar days. If shoulder stabilization has been performed, the paving operation shall commence 7 calendar days after the completion of the shoulder stabilization operation. Delay in starting the paving operations that causes a further

degradation in the milled surface shall be corrected by the contractor by additional milling or providing leveling at no additional pay.

Severe raveling or degradation of the milled surface that occurs shall be reported to the engineer in writing with station locations identified. The engineer will direct corrective action.

Place temporary pavement markings prior to opening the roadway to traffic in accordance with Section 713.

Haul all reclaimed asphalt pavement (RAP) material to be retained by the Department for its recycling program, or by other government entities to the storage facility indicated on the plans and stockpile as directed. The contractor may also be required to retain a specified percentage or quantity of the RAP generated by the project.

Make required joint repairs prior to milling. Complete pavement patching before milling, unless additional areas requiring patching are exposed by the milling. Perform pavement patching and joint repair in accordance with Section 510. The initial face of a butt joint can match the radius of the cold planing milling drum. No true vertical face is required.

509.04 MEASUREMENT. The Department will measure milling by the square yard of asphalt concrete surfacing satisfactorily removed. No additional measurement will be made for multiple passes required to achieve total milling depth shown on the plans. Measurement of contractor retained RAP will be by the cubic yard, theoretical in-place plan quantity, and will be credited to the Department by treating it as a negative quantity in the Schedule of Pay Items.

509.05 PAYMENT. Payment for milling of asphalt pavement will be made at the contract unit price per square yard, which includes the costs for removing, hauling and stockpiling of RAP material. The value of the RAP material retained by the contractor will be credited to the Department at the contract unit price for the retained material.

Drainage cuts placed through the shoulders, drop off transitions and transitions at transverse joints will be at no additional pay.

Payment for temporary pavement markings will be included under appropriate pay items.

Payment will be made under:

Item No.	Pay Item	Pay Unit
509-01	Milling Asphalt Pavement	Square Yard
509-02	Contractor Retained Reclaimed Asphalt Pavement	Cubic Yard

Section 510

Asphalt Concrete Pavement Patching, Widening and Joint Repair

510.01 DESCRIPTION. Use asphalt concrete to patch, widen and repair joints of existing concrete pavements, asphalt concrete pavements, and composite pavements in accordance with these specifications and in conformity with the lines, grades and typical sections shown on the plans or as directed.

510.02 MATERIALS. Use any type of asphalt concrete mixture for patching and widening listed in Section 502, other than 1/2 inch nominal maximum size mixtures. For joint repair, use Incidental Paving Asphalt Concrete (Level A) complying with Section 502. Use asphalt tack coat complying with Section 504.

510.03 EQUIPMENT. Furnish equipment that meets the specification requirements in Section 503 for the types of material used.

510.04 GENERAL CONSTRUCTION REQUIREMENTS. Remove existing surfacing and base materials by sawcutting and perform all required excavation for patching and widening. Sawcuts shall be for the full depth of the pavement along the perimeter of the pavement to be removed as marked by the engineer. Sawcuts shall be made with a diamond bladed concrete concrete saw for the full depth of patch if patching is performed on the final riding surface. Patching performed on underlying surface can be full depth sawed with a rock saw or milled out with a roto-mill or stabilizer, unless otherwise specified in plans. When through traffic is maintained, place the pavement widening material, or fill and compact open areas or trenches at the end of each day's operations. Under-thickness in excess of 1/2 inch will be corrected at no direct pay.

Excavate and dispose of the excess material beyond the right-of-way in accordance with Section 202 at no direct pay. Uniformly compact the subgrade.

For joint repair, clean contact surfaces of existing pavement and apply a thin, uniform layer of approved asphalt tack coat prior to placing asphalt mixture in the joint.

Patch and widen with asphalt concrete conforming to Section 502 except that priming of the subgrade will not be required. Clean contact surfaces of

pavement and apply a uniform layer of approved asphalt tack coat before placement of asphalt concrete. Do not overlay patches for a minimum of 5 calendar days. Spread, finish, and compact the asphalt concrete leaving the surface smooth and slightly above the edge of existing pavement. To provide lateral support, the contractor may construct temporary berms of excavated material against the outside edge of widening strips prior to rolling. If outside edges of widening strips are not edged up by the end of the work day, place super cones or drums on a maximum of 100-foot centers at no direct pay.

510.05 MEASUREMENT.

510.05.1 Patching: The Department will measure patching of pavement by the square yard or ton of existing pavement designated to be removed and replaced. Saw-cutting, removal of existing surfacing, base course, required excavation, and application of tack coat will not be measured for payment.

510.05.2 Widening: The quantities of widening for payment will be the design areas in square yards or ton as shown on the plans and adjustments thereto. Adjust design quantities if the engineer makes changes to adjust to field conditions. Design quantities are based on the horizontal dimensions shown on the plans. No measurement for payment will be made for widening placed outside the dimensions shown on the plans or established by the engineer. Required excavation, removal of existing pavement and base course, asphalt tack coat and disposal of removed material will not be measured for payment. Measure the thickness and width in accordance with DOTD TR 602.

510.05.3 Joint Repair: The Department will measure joint repair by the ton of asphalt concrete used to fill the joint. Measurement will be made in accordance with 502.14.

510.06 PAYMENT.

510.06.1 Patching: Payment for pavement patching will be made at the contract unit prices per square yard or ton, subject to the following provisions:

Payment adjustments for deficiencies in asphalt concrete and asphalt materials will be applied at 1/2 the contract unit price for pavement patching. Asphalt concrete will be subject to the payment adjustment provisions of Section 502, Table 502-7 with 4-inch cores allowed.

When the engineer orders additional thickness of patching in excess of plan thickness, payment for the additional thickness will be made as follows. When patching is on a square yard basis, the value per inch thickness will be

calculated by dividing the contract unit price per square yard by the plan thickness. Thickness of patches will be measured from the surface that exists at the time of patching. Payment for the additional thickness will be made at 50 percent of the value per inch thus determined.

When the engineer approves of an under-thickness of patching less than plan thickness, a deduction in payment will be made. The value per inch will be calculated by dividing the contract unit price per square yard by the plan thickness. This deduction per inch of under-thickness will be made at 50 percent of the value per inch.

When payment for patching is made per ton, no adjustment in unit price will be made for additional thickness or under-thickness. Any patching that develops or is required between the time of initial patching operations and the placement of the first lift of asphalt concrete will be paid for at the contract unit price. Any patching required due to base failure after placement of the first lift of asphalt concrete will be paid for at twice the contract unit price.

510.06.2 Widening: Payment for pavement widening will be made at the contract unit price per square yard or ton. Over-widths will be accepted at no additional pay. Correct under-widths by furnishing and placing additional asphalt concrete to a minimum width of 1 foot and plan thickness at no direct pay. Payment adjustments for deficiencies in asphalt concrete and asphalt materials will be applied at 1/2 the contract unit price for pavement widening. Asphalt concrete will be subject to the payment adjustment provisions of Section 502.

510.06.3 Joint Repair: Payment for pavement joint repair will be made at the contract unit price per ton.

Payment will be made under:

Item No.	Pay Item	Pay Unit
510-01	Pavement Patching	Square Yard
510-02	Pavement Widening	Square Yard
510-03	Pavement Joint Repair	Ton
510-04	Pavement Patching	Ton
510-05	Pavement Widening	Ton

