

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 / Mineral Filler	1002.02.4.2

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 Gyratory 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 82-22m, and PG 76-22m
Mainline Wearing & Binder ^{2,4}	2 and SMA	PG 76-22m	PG 70-22m with Hydrated Lime	PG 70-22m (Binder Only)	PG 82-22m
Base, Minor Mixes, including Leveling ^{2,3}	ALL	PG 67-22	PG58-28 when 21-30% RAP is used		PG 82-22m, PG76-22m, PG70-22m

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

²For single lift overlay match grade of overlay

³ Semicircular 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

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 For mainline wearing courses when plan current average daily traffic (ADT) is greater than 7000, at least 50 percent by weight of the total aggregate shall have a Friction Rating of I or at least 75 percent by weight of the total aggregate shall have a Friction Rating of II.

²When the ADT is less than 2500, blending of Friction Rating IV aggregates with Friction Rating I and/or II aggregates will be allowed for mainline wearing courses at the following percentages. At least 50 percent by weight of the total aggregate in the mixture shall have a Friction Rating of I or II.

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 1002.02.4. 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 Warm Mix Asphalt (WMA) additives as 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.

Re-validation is not required for mixture designs used solely for minor mixes, but the mixture must meet specification requirements. The average of the first five (5) G_{mm} 's will become the new JMF target. Re-validation is not required when the asphalt grade has changed or asphalt source has changed. In order to validate minor mixes, the plant G_{mm} must be determined.

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 production can continue during conditional validation. The JMF is considered validated with passing LWT results and the signature of the District Laboratory Engineer. If the LWT fails, revalidate. The average of all other validation tests shall meet the specifications limits in Table 502-6. 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. Notify the District Laboratory Engineer and the DOTD certified plant technician by the close of the present day of the next scheduled asphalt 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

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 and asphalt content. Determine the rolling five percent within limits (PWL) for air voids and for G_{mm} . Take corrective action or cease production when the rolling five test results are as follows:

1. Air voids or G_{mm} fall below 71 PWL, or Average VFA is outside of specification limits, or
2. Average gradation for the No. 8 and No. 200 sieve is outside of specification limits

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.

Sample asphalt cement from each working tank daily and retain for the Department's use.

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,
4. % Crushed, and
5. Loaded Wheel Testing (LWT).

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

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

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

Continued lack of conformance 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. When a Section 507 Asphalt Surface Treatment (AST) interlayer Type E is required by plans, some wetting to prevent tracking is allowed. 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.

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 burning method when mixtures are to be placed on portland cement concrete pavement or 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. On the first day of production, ensure that the rolling pattern set achieves a longitudinal joint density (the area within 2 feet of the edge of the paving mat) that is a maximum of 3 percent less than the density measured on the mainline area when measured with a non-destructive testing device.

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 with a minimum of three separate drops of mix.

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, except for shoulder 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 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, tapers, 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. Use the random number tables shown in DOTD S605 to determine sample locations.

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, by 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. Ensure that the cores are individually wrapped, sealed, signed, and dated by the DOTD inspector 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.

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 roadway core using the G_{mb} of the core and the representative maximum specific gravity, G_{mm} , listed on the validated JMF. The District Laboratory will randomly select one core to break down and measure G_{mm} . If the difference in G_{mm} is greater than 0.024 from the JMF plant measured G_{mm} , the District Laboratory will

randomly select two additional cores and measure G_{mm} . If the average of these three G_{mm} 's exceed the tolerance of 0.024, the District Laboratory will send five resolution cores to a partner District Laboratory or another certified laboratory to measure all resolution cores for G_{mm} determination which will become the basis for pay for the lot. The relative density will be determined using the ratio of the G_{mb} of the original acceptance cores and the average of the G_{mm} measured on all of the resolution cores,

The density requirement for each lot is shown in Table 502-5.

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

When recommended by the District Laboratory Engineer and approved by the Materials Engineer, contractors will be allowed to sample and test roadway cores for acceptance at no cost to the Department in lieu of District Laboratory acceptance testing. 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 average for each lot. If the difference in the mean exceeds 1.5 percent use the resolution cores for pay determination, the Department will send the resolution cores to an independent laboratory or a partner District Laboratory to determine pay in accordance with 502.11.1.5.

For the use of 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 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 a rolling data set of a minimum of 30 contractor acceptance tests and 10 DOTD verification tests results, and it is determined by the DLE and Independent Assurance team that the contractor's production data meets requirements. If found to be consistent, DOTD acceptance testing of roadway cores will resume and an 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: 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} , listed on the validated JMF. 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 satisfactory methods.

For verification, the Project Engineer will select three locations for cores per 1000 tons. Cut the verification cores in the presence of the Department representative and send to the District Laboratory

The District Laboratory will test the cores for G_{mm} . The average G_{mm} shall be within 0.024 of the JMF

502.11.1.5 Verification: One core will be selected every 7500 linear lane feet and will be evaluated as Method 1 or Method 2 in accordance with 502.11.1.1. Verification is confirmed by a comparison of the means and a tolerance of 1.5 percent between the acceptance and verification cores.

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 partner District Laboratory or another certified 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 foot 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 502-9, 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 502.15.3. 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. When grade adjustments do not permit placing additional mixture, remove the deficient under-thickness area and replace at no additional 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 adjustments will be determined in accordance with 502.14 and the QA Manual. Payment for tack coat will be by the gallon in accordance with Section 504. 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.

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, \geq 8 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: For projects with 3000 tons or greater of minor mix with density, adjustments in contract price will be based on the core density for each lot in accordance with Table 502-7.

502.15.3.3 Minor Lots without Density: A negative pay adjustment of 5 percent will be applied when plant mix is outside of specifications limits for plant voids.

502.15.3.4 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.

502.15.4 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 grade difference in specification will be subject to 50 percent payment reduction or removal at the discretion of the Chief Engineer.

502.15.5 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 502.15.3. 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.

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

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

U.S. (Metric) Sieve % Passing		REQUIREMENTS FOR EXTRACTED ASPHALT CEMENT AND AGGREGATE GRADATION							Mix Tolerance ¹
		½ inch SMA	½ inch Nominal	¾ inch Nominal	1 inch Nominal	1.5 inch Nominal			
2 inch		—	—	—	—	100	±4		
1 1/2 inch		—	—	—	100	90-100	±4		
1 inch		—	—	100	90-100	89 Max.	±4		
3/4 inch		100	100	90-100	89 Max.	—	±4		
1/2 inch		90-100	90-100	89 Max.	—	—	±4		
3/8 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	93.5 92.0 90.0				
	Mainline, SMA					
	Minor with density ref, 502.10.2.2 "Roadway lot," patching, and widening > 2.5-feet					
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	Wearing Course		Wearing Course	Binder Course		Binder Course		Base Course	ATB ²	Base Course	Wearing
Level ²	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 ²	Table 502-3											
RAP, Max. % of Mix ²	20	15	15	15	20	20	20	20	30	30	30	0
	Compacted Mix Volumetrics ⁴											
VMA, Min. % ⁴	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, % ²	(2.5-4.5); (no limit for ATB)											
VFA, % ²	(69-80); no limit for ATB											
N _{initial} 90% max. ² (Gyrations)	7	7	7	7	7	7	7	7	7	n/a	7	7
N _{design} 96.5±1 % (Gyrations)	65	65	75	75	65	75	65	75	65	30	65	65
N _{max} 98 % max. (Gyrations)	100	100	115	115	100	115	100	115	100	n/a	100	100
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/m2 @ 25°	All mix design level 1 must meet minimum 0.5 Jc, All mix design level 2 must meet minimum 0.6 Jc.											
	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.)

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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 PG82-22mm 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.

⁹ Absolute minimum of lift thickness across width equal to 1/2 inch lower than minimum lift thickness.

¹⁰ SCB is not required for Level A, Base Course or ATB mixtures.

**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}	≥ Lower limit	-0.1 to -1.9 below lower limit	-2.0 below Lower limit

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 95 in/mile. Does not pertain 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									
17	58	50									
16	57										
15	56										
14	54										
13	53										
12	52										
11	51										
10	50										

Section 510

Asphalt Concrete Pavement Patching, Widening and Joint Repair

510.01 DESCRIPTION. Use asphalt concrete to patch, widen and repair joints of existing asphalt concrete 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 and perform all required excavation for patching and widening. 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 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, 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. 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.

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. 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 (Mg).

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 Widening	Ton
510-04	Pavement Joint Repair	Ton