Amend **Section 401 - Asphalt Concrete Pavement** to read as follows:

"SECTION 401 - ASPHALT CONCRETE PAVEMENT

401.01 Description. This section applies to the construction of asphalt concrete pavement on a prepared surface according to the contract.

Include pavement wearing course mixture and a binder course mixture when specified herein.

401.02 Materials. The plant mixed asphalt concrete includes a mixture of aggregate, filler or blending sand, if acceptable, and asphalt cement. Size, uniformly grade, and combine aggregates so that the resulting mixture meets the grading requirements of the job-mix formula. Conform to the following:

Asphalt Cement	702.01
Emulsified Asphalt	702.04
Aggregate for Hot Plant Mix Bituminous Pavement	703.09
Filler	703.15
Blending Sand	703.22
Hydrated Lime	712.03

Asphalt cement shall be PG 64-16.

401.03 Job-Mix Formula and Tests.

(A) Job-Mix Formula. Submit for acceptance, a job-mix formula for each mixture to be supplied for this project. The job-mix formula shall show the grade of cement in the mixture. Furnish only one grade of asphalt cement for the project. The Engineer may change the grade of the asphalt cement one step at no change in unit price. Make grade change only upon written acceptance by the Engineer. Submit a Certificate of Compliance, with substantiating test data, before using each lot or batch of asphalt cement. The Engineer will not accept the asphalt cement without adequate documentation.

The job-mix formula with allowable tolerances shall be within the master range for the type of asphalt concrete. The job-mix formula for a mixture shall be in effect until modified by the Engineer. Submit for acceptance a new job-mix formula before using the new material.

The job-mix formula for each mixture shall establish:

(1) a percent of aggregate passing each required sieve size,

(2) a percent of asphalt cement added to the aggregate, and

(3) a temperature the mixture is delivered to the point of discharge.

The job-mix formula of the mixture furnished shall be within tolerances in Table 401-I:

TABLE 401-I - RANGE OF TOLERANCES FOR JOB-MIX FORMULA	
Passing No 4 and larger sieves (%)	± 7
Passing No. 8 to No. 100 sieves (inclusive) (%)	± 4
Passing No. 200 sieve (%)	± 2
Bitumen (%)	± 0.4
Temperature of mixture (^{O} F)	± 20

When changing the source of material, establish a new job-mix formula before using the new material. When the results or conditions are unsatisfactory, the Engineer will require the Contractor to establish a new job-mix formula.

The Engineer may allow use of a nominal quantity of blending sand not exceeding 5 percent of the total weight of aggregate.

The Engineer may allow the use of filler material to correct deficiencies in materials passing the No. 200 sieve. Filler added shall not exceed 3 percent by weight of the fine aggregates.

Table 401-II - Limits of Bituminous Binder Content specifies the limits for each type of mixture. In case of dispute as to the optimum asphalt content, discontinue plant operations and allow the Engineer sufficient time to do the necessary laboratory testing. The Contractor may exceed the bituminous binder limits for porous aggregate only if acceptable in writing by the Engineer.

TABLE 401-II - LIMITS OF BITUMINOUS BINDER CONTENT					
MIX NO.	I	II	IV	V	VI
Used For	Binder Course	Binder or Surface Course	Surface Course	Surface Course	County Surface Course (Extra Fine)
Compacted Thickness Individual Layers (Inches)	1.5 to 3	1.25 to 3	1.25 to 3	0.75 to 3.0	1 to 2.5
Bituminous Binder Content Limits (% of dry weight of total aggregate)	4.0 - 6.5	4.5 - 6.5	4.5 - 6.6	5.0 - 7.5	6.0 - 8.0

(B) Tests. Base asphalt concrete job-mix formula on tests according to AASHTO T 245 (ASTM D 1559) or AASHTO T 246 (ASTM D 1560). The mixture shall conform to Table 401-IIIA - Job Mix Formula Design Criteria and Table 401 IIIB - Minimum Percent Voids in Mineral Aggregates. Submit the test data used to develop the job mix formula.

TABLE 401-IIIA - JOB-MIX FORMULA DESIGN CRITERIA	
HVEEM Method Mix Criteria	**Binder and Surface Course**
Stability, minimum	37
Swell, maximum (inch)	0.030
Air voids (%)	3 – 5
Marshall Method Mix Criteria	**Binder and Surface Course**
Compaction, Number of Blows each end of specimen	75
Stability, minimum (pounds)	1,800
Flow, 0.01 inch	8 – 16
Air voids (%)	3 – 5

TABLE 401-IIIB - MINIMUM PERCENT VOIDS IN MINERAL AGGREGATES					
Nominal Maximum Particle Size, (Inches)	1.5	1.0	0.75	0.50	0.375
VMA, (%) HVEEM Method	11	12	13	14	15
VMA, (%) Marshall Method	12	13	14	15	16

401.04 Bituminous Mixing Plant Requirements and Process.

(A) Plant Operation.

(1) Preparation of Asphalt Cement. Heat the asphalt cement to the specified temperature to avoid local overheating. Provide a continuous supply of the asphalt cement to the mixer at a uniform temperature.

(2) Preparation of Aggregate. Dry and heat the aggregate for the mixture to the required temperature. Do not exceed 320 degrees F. Properly adjust the flames used for drying and heating to avoid damage to the aggregate and soot on the aggregate. The aggregate, when dried, shall not contain more than 1 percent moisture by weight.

Immediately after heating and drying, screen the aggregates for batch plants into three or more fractions as specified. Convey the aggregates into separate compartments ready for batching and mixing with asphalt cement.

(3) Mixing. Combine the dried aggregates in the mixer in the quantity of each fraction of aggregates required to meet the job-mix formula. Measure or gage and introduce the asphalt cement into the mixer in the quantity specified by the job-mix formula.

After introducing the required quantities of aggregate and asphalt cement into the mixer, mix the materials until a complete and uniform coating of the particles and a thorough distribution of the asphalt cement throughout the aggregate is secured. The Engineer will determine wet mixing time for each plant and for each type of aggregate used.

For hot mix bituminous pavement, produce the mixture at the lowest temperature for a workable mix; however, do not exceed 325 degrees F. Introduce the asphalt cement and aggregate into the mixer within 25 degrees F. of each other's temperature.

(B) Storage of Aggregates. Provide sufficient storage space for each size aggregate. Keep the different aggregate sizes separated until the aggregate is delivered to the system feeding the drier. Maintain the storage yard neatly and orderly. The separate stockpiles shall be readily accessible for sampling.

(C) General Requirements for Mixing Plants. Mixing plants shall be capable of handling the proposed bituminous construction.

(1) Scales. The scale requirements shall apply only where proportioning by weight is used;

(a) Plant Scales. Plant scales shall be accurate to 0.5 percent throughout the range to be weighed by the Contractor. The poises shall be locked in positions to prevent unauthorized change of position. Instead of plant and truck scales, an acceptable automatic printer system may be provided that prints the weights of the material delivered. Use a system with an acceptable automatic batching and mixing control system. Show evidence of such weights by a weight ticket for each load.

Measurement Standards Division of the State Department of Agriculture or its authorized representatives will inspect and seal the scale as often as the Engineer may deem necessary to assure their continued accuracy. Have not less than ten 50 pound weights for testing the scales.

(b) Truck Scales. Weigh the bituminous mixture on acceptable scales furnished by the Contractor or on public scales at no cost to the State. The Measurement Standards Division of the State Department of Agriculture or its authorized representatives shall inspect and seal such scales as often as the Engineer deems necessary.

(2) Equipment for Preparation of Asphalt Cement. The storage tanks for the asphalt cement shall be equipped to heat and hold the material at the required temperature. The tanks shall be heated by steam coils or electricity so no flame is in contact with the tank. The circulating system for the asphalt cement shall assure proper and continuous circulation during the operating period.

Equip storage tanks with provisions for measuring and sampling of material. Calibrate the asphalt storage tanks to an accuracy of 2 percent of the actual amount stored its storage capacity. The storage tank shall be accessible for measuring. Install a sampling outlet including a valve in the bitumen feed lines connecting the plant storage tanks to the bitumen weighing system or spray bar, so samples from the line may be withdrawn slowly during plant operation. Install the sampling outlet between the pump and the return line discharge in such a location that the sampling outlet is readily accessible and free from obstruction. Provide a drainage receptacle for flushing the outlet before sampling.

(3) Feeder for Drier. Provide an accurate mechanical means for uniformly feeding the aggregate into the drier so a uniform production and uniform temperature can be obtained.

(4) Drier. Include driers that continuously agitate the aggregate during the heating and drying process.

(5) Screens. Provide plant screens, capable of screening aggregates to the specified sizes and proportions and having normal capacities greater than the full capacity of the mixer.

(6) Bins. Storage bins shall be divided into at least three compartments to provide separate storage of appropriate fractions of the aggregate. Provide each bin with overflow pipes, of such sizes and at such locations to prevent material from backing up into other compartments or bins. Provide each compartment with an individual outlet gate. The outlet gate shall not leak when closed. The gates shall cut off quickly and completely. The bins shall have means to sample the aggregates.

(7) Bituminous Control Unit. Provide satisfactory means, either by weighing or metering, to obtain the proper quantity of asphalt cement in the mixer within the tolerance specified. Provide means for checking the quantity or rate of flow of asphalt cement into the mixer.

(8) Thermometric Equipment. An armored thermometer of adequate range shall be included in the bituminous feed line near the charging valve at the mixer unit.

Also, the plant shall be equipped with a dial-scale, mercury-actuated thermometer, or an electric pyrometer placed at the discharge chute of the drier to register automatically or show the temperature of the heated aggregate. The heat indicating device shall be accurate to the nearest 10 degrees F. Install the heat indicating device such that it will reflect a fluctuation of 10 degrees F on the aggregate temperature within one minute.

The Engineer may require replacement of thermometers by an acceptable temperature-recording apparatus for better regulation of the aggregate temperature at no cost to the State.

(9) Dust Collector. The plant shall be equipped with a dust collector constructed to waste or return uniformly to the hot elevator the material collected.

(10) Safety Requirements. Provide adequate and safe stairways to the mixer platform and sampling points. Place guarded ladders to other plant units at points where accessibility to plant operations is required. Provide accessibility to the top of truck bodies by a platform or other suitable device to enable the Engineer to obtain sampling and mixture temperature data. Provide a hoist or pulley system to raise scale calibration equipment, sampling equipment and other similar equipment from the ground to the mixer platform and return. Thoroughly guard and protect gears, pulleys, chains, sprockets and other dangerous moving parts. Provide ample and unobstructed space on the mixing platform. Maintain a clear and unobstructed passage in and around the truck loading area. Keep this area free of drippings from the mixing platform.

(11) Mineral Filler Feed. Feed the filler, when used, to an accuracy of 10 percent of the required weight. Thoroughly dry the filler. Do not feed the filler through the drier system. Feed the filler material directly into the mixer as near the center as possible for batch type operation.

(D) Requirements for Batching Plants.

(1) Weigh Box or Hopper. Include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales and ample in size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material shall leak into the mixer while weighing a batch.

(2) Asphalt Cement Control. The equipment used to measure the asphalt cement shall be accurate to within ± 0.5 percent. The asphalt cement bucket shall be a non-tilting type with a loose sheet metal cover. Introduce the binder uniformly into the mixer along the center of the mixer parallel to the mixer shafts, or by pressure spraying. Heat the discharge valve or valves and spray bar of the asphalt cement bucket adequately. Drain the steam jackets efficiently, when used. The connections shall not interfere with the efficient operation of the bituminous scales. The capacity of the asphalt cement bucket shall be at least 15 percent greater than the weight of asphalt cement required in batches. The plant shall have an adequately heated, quick-acting, non-drip, charging valve located directly over the asphalt cement bucket.

The indicator dial shall have a capacity of at least 15 percent greater than the quantity of asphalt cement used in a batch. The dial shall be in full view of the mixer operator.

Discharge the asphalt cement required for one batch in not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of asphalt cement for the full length of the mixer. Provide the section of the bituminous line between the charging valve and the spray bar with a valve and outlet for checking the meter when a metering device is substituted for an asphalt cement bucket.

(3) Mixer. The batch mixer shall be capable of producing a uniform mixture within the job-mix tolerances. When not enclosed, equip the mixer box with a dust hood to prevent loss of dust. The mixer shall be leak-tight.

The clearance of blades from fixed and moving parts shall not exceed 1 inch unless the maximum diameter of the aggregate in the mix exceeds 1.25 inches, in which case the clearance shall not exceed 1.5 inches.

(4) Control of Mixing Time. The mixer shall have a timing device that shows by a definite audible or visual signal the expiration of the mixing period. The device shall accurately measure the time of mixing to within five seconds.

The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of asphalt cement. The wet mixing period is the interval of time between the start of introduction of asphalt cement and the opening of the mixing gate.

(E) Requirements for Continuous Mixing Plants.

(1) Aggregate Proportioning. The plant shall include means for accurately proportioning each size of aggregate.

The plant shall have a feeder mounted under each compartment bin. Each compartment bin shall have an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from each compartment. The feeding orifice shall be rectangular with one dimension adjusted by positive mechanical means provided with a lock.

Each gate shall have indicators to show the respective gate opening in inches.

The fine bin shall have a vibrating unit. Provide a positive system to show the level of material in each bin, and as the level of

material in one bin approaches the strike-off capacity of the feed gate, the device shall automatically close down the plant instantly. The Engineer will not permit the plant to operate unless this automatic system is in good working condition.

(2) Weight Calibration of Aggregate Feed. Calibrate gate openings by weighing test samples. Make provisions so that the materials fed out of individual orifices may be bypassed to individual test boxes. Equip the plant to conveniently handle individual test samples weighing not less than 200 pounds. Provide accurate scales of adequate capacities to weigh such test samples.

(3) Synchronization of Aggregate Feed and Asphalt Cement Feed. Provide means to afford positive interlocking control between the flow of aggregate from the bins and the flow of asphalt cement from the meter or other proportioning device satisfactorily. Control this by interlocking mechanical means.

The mechanically driven aggregate feeders shall be connected directly with the drive on the asphalt binder pump. Equip the drive shaft on the feed with a revolution counter reading to 1/100 revolution and with sufficient capacity to register the total number of revolutions in a day's run.

(4) Mixer. Include a continuous mixer of an acceptable type, adequately heated and capable of producing a uniform mixture within the job-mix tolerances.

The mixer shall have a discharge hopper with dump gates that will permit rapid and complete discharge of the mixture. The paddles shall be adjustable for angular position on the shafts and reversible to retard the flow of the mix. The mixer shall have a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on a permanent gage. Provide charts showing the rate of feed of aggregate per minute for the aggregate being used.

(F) Requirements for Drier-Drum Mixing Plant.

(1) Cold Storage for Plants Utilizing Cold-Feed Control. Drier-drum plants equipped with cold-feed control shall separate the virgin aggregate for Asphalt Concrete Mix No. II into three or more sizes. Separate the virgin aggregate for Asphalt Concrete Mix Nos. III, IV, V and VI into two or more sizes. Request written acceptance from the Engineer when separating the aggregate for Asphalt Concrete Mix No. II into less than three sizes.

After separating the aggregates, store each size separately. Each of the storage, except storage for filler material, shall contribute a minimum of 10 percent to the total weight of the aggregate.

(2) Drying. Feed the aggregates directly to a drier-drum mixer at a uniform rate.

The drier-drum mixer shall have a device that shows the temperature of the material leaving the drier-drum mixer. The temperature-indicating device shall be accurate to the nearest 10 ^{o}F and show changes of 10 degrees F. in temperature of the material within one minute.

The drier-drum mixers shall have dust collectors. The dust shall be disposed of or returned to the aggregate.

(3) Proportioning for Continuous Mixing. Introduce the asphalt binder into the mixer at constant pressure through a meter. Install a gage for checking said pressure. The system shall be capable of varying the rate of delivery of binder. During production, the temperature of asphalt binder shall not vary more than 40 degrees F. Heat and insulate the meter and lines. Equip the binder storage with a device for automatic plant cut-off when the level of binder is lowered sufficiently to expose the pump suction line.

When using filler, proportion the filler by weight or volume by a method that uniformly feeds the material within 10 percent of the required amount. Discharge the filler material from the proportioning device directly into the mixer.

(4) Proportioning for Drier-Drum Mixing with Cold-Feed Control. When using cold-feed control with drier-drum mixing, equip the asphalt feeder, the aggregate feeders, the filler material feeder, and the combined aggregate feeder with devices by which the rate of feed can be determined while the plant is in full operation.

Weigh the combined aggregate using a belt scale. The belt scale shall be of such accuracy that, when the plant is operating between 30 percent and 100 percent of belt capacity, the average difference between the shown weight of material delivered and the actual weight delivered shall not exceed 1 percent of the actual weight for three 2-minute runs. For the three individual two-minute runs, the shown weight of material delivered shall not vary from the actual weight delivered by more than 2 percent of the actual weight. Determine the actual weight of material delivered by a vehicle platform scale that has been sealed. Equip the plant so that

this accuracy check can be made after each relocation and set-up, but before the first operation and at other times as required by the Engineer.

Interlock the belt scale for the combined aggregate, the proportioning devices for filler material, and the asphalt proportioning meter so that the rates of feed of the aggregates and asphalt shall be adjusted automatically to maintain the bitumen ratio (pounds of asphalt per 100 pounds of dry aggregate including filler if used) according to the approved mix design. Do not operate the plant unless this automatic system is operating.

Equip the asphalt meters and aggregate belt scales used for metering the aggregates and asphalt into the mixer with resettable totalizers, so that the actual asphalt and aggregate introduced into the mixer can be determined.

Equip the bin(s) containing the fine aggregate and filler with a vibrating unit. Before the quantity of material in one bin reaches the strike-off capacity of the feed gate, a device shall automatically close down the plant.

Determine the moisture content of the aggregate at least once during each production day. Adjust the moisture control equipment accordingly.

In the absence of an acceptable aggregate sampling device for the combined aggregate at a point before the aggregate enters the drum drier and while the plant is in full operation, provide other suitable sampling means acceptable to the Engineer.

When using filler, install a suitable, safe sampling device in each feed line or surge tank preceding the proportioning device for the filler.

(5) Drier-Drum Mixing. Mix the aggregate, filler and asphalt binder in a drier-drum mixer. Mixing shall continue for a sufficient time and at a sufficiently high temperature that, at discharge from the mixer, the sizes of aggregates are uniformly distributed through the completed mixture and particles are thoroughly and uniformly coated with asphalt binder.

Discharge the drier-drum mixer into a storage silo or into a surge bin. Provide a means of diverting the flow of asphalt concrete away from the silo or surge bin, when starting and stopping the plant production, to prevent incompletely mixed portions of the mixture from entering the silo.

When using a surge bin:

a. do not hold the mixture beyond one hour,

b. do not segregate the mixture,

c. the mixture shall not be lumpy, and

d. the mixture shall meet temperature and quality requirements of the contract.

The burner used for heating the aggregate in the drier-drum shall achieve complete combustion of the fuel.

(G) Asphalt Concrete Storage. Store the asphalt concrete only in silos. Do not stockpile the asphalt concrete. The minimum quantity of asphalt concrete in storage during mixing shall be 20 tons except for the period immediately following a shutdown of the plant of two hours or more. Provide a means to show that the storage into each silo as required is maintained.

Equip the storage silo to prevent segregation of the completed mixture as the mixture is discharged into the silo.

Do not use asphalt concrete with hardened lumps in the mixture. Do not use the storage facilities that contained the material with the hardened lumps for further storage until the cause of the lumps is corrected.

401.05 Construction Requirements.

(A) Weather Limitations. Do not place the bituminous plant mix:

(1) on wet surfaces, as determined by the Engineer, or

(2) when the air temperature is below 50 degrees F. or

(3) when weather conditions prevent the proper handling or finishing of the bituminous mixtures.

(B) Equipment.

(1) Hauling Equipment. Trucks hauling bituminous mixtures shall have tight, clean, smooth and metal beds that have been thinly coated with a minimum quantity of detergent, paraffin oil, or lime solution to prevent the mixture from adhering to the beds.

The use of diesel or petroleum-based liquids, except for paraffin oil, to prevent the mixture from adhering to the beds is prohibited.

Each truck shall have a canvas cover to protect the mixture from the weather. Protect each load from the weather with the canvas extending over the top of the truck bed and securely fastened on all four sides of the truck bed.

Each truck shall raise their beds with tailgate closed before discharging to prevent segregation.

Do not refuel equipment over newly paved surfaces. Refuel equipment over a catch pan or a surface that will prevent the fuel from coming in contact with the asphalt pavement. After the refueling operation is completed, remove the above devices until needed.

(2) Bituminous Pavers. Bituminous pavers shall be:

(a) self-contained, power-propelled units,

(b) provided with an activated screed or strike-off assembly, heated if necessary, and

(c) capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thicknesses shown in the contract.

Equip the paver with a receiving hopper having sufficient capacity for uniform spreading operation. Equip the hopper with a distribution system to place the mixture uniformly in front of the screed.

Prior to each days paving operation, check the screed or strike-off assembly surface with a straight edge to insure straightness. The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture. When the spreading equipment leaves ridges, indentations, or other marks in the surface that cannot be eliminated by rolling or prevented by adjustment in operation, discontinue its use and furnish other acceptable equipment.

Equip the paver with an acceptable electronic screed control device. The electronic device shall include a grade sensor

mounted on each side of the paver. Each sensor shall take its grade reference from a 30-foot ski for the first pass. For subsequent passes, the Contractor may substitute one ski with a joint-matching shoe riding on the finished adjacent pavement.

Demonstrate the competence of personnel operating the grade and crown control device according to the contract before placing surface courses. When the automatic control system becomes inoperative during the day's work, the Engineer will permit the Contractor to finish the day's work using manual controls. Do not resume work thereafter until the automatic control system is made operative. The Engineer may waive the use of the electronic screed control device when paving gores, shoulders, or transitions and miscellaneous reconstruction areas.

When laying mixtures, the paver shall be capable of operating at forward speeds consistent with satisfactory laying of the mixture. Do not change the forward speed of the paver after start of paving operation. If necessary, the Engineer will limit the load of the haul vehicle such that the Contractor will get satisfactory spreading.

(3) Rollers. Rollers shall be the self-propelled, steel-tired tandem pneumatic-tired or vibratory type. Rollers shall be capable of reversing without backlash. The number and weight of rollers shall be sufficient to compact the mixture to the required density while the mixture is still in a workable condition. Do not use equipment that results in excessive crushing of the aggregate. Operate the rollers according to the manufacturer's recommendations.

(a) Steel-Tired Tandem Rollers. Check the steel-wheel rims for wear. When the rolling drum is grooved or pitted, do not use the roller. Excessively worn scrapers and wetting pads shall be replaced.

Steel-tired tandem rollers used for breakdown (initial) or intermediate rolling passes shall have a minimum gross weight of 12 tons. Steel-tired tandem rollers shall provide a minimum of 250 pound weight per linear inch of width on the compaction roller (drive wheel).

Steel-tired tandem rollers used for finish (final) rolling passes shall have a minimum gross weight of eight tons.

(b) Pneumatic-Tired Rollers. Pneumatic tire rollers shall be the oscillating type with smooth (tread) pneumatic tires of equal size and diameter. Inflate and maintain the tires to the designated pressure so that the air pressure will not vary more than five psi from the established pressure. Space the tires so that the gaps between adjacent tires are covered by the following tires.

The pneumatic-tired rollers used for breakdown or intermediate rolling passes shall have a total weight that can be varied to produce an operating weight per tire of not less than 3,000 pounds. The tires shall have a minimum wheel diameter of 20 inches. The tire inflation pressure shall be within 70 psi to 75 psi when cold and 90 psi when hot. During cold or windy weather condition, equip the rollers with skirt-type devices (mounted around the tires) to maintain the temperature of the tires during rolling operations.

The pneumatic-tired rollers used for kneading a finished asphalt surface shall have a total weight that can be varied to produce an operating weight per tire of not less than 1,500 pounds. The tires shall have a minimum wheel diameter of 15 inches and a 50 psi to 60 psi tire inflation pressure.

(c) Vibratory Rollers. Vibratory rollers shall be steel-tired tandem rollers, having a minimum weight of 7 tons. The vibratory rollers shall have amplitude and frequency controls, speedometer, and be specifically designed to compact the material on which the vibratory roller is used. Operate the vibratory roller according to the manufacturer's recommendations.

(4) Hand Tools. Keep hand tools used in the production, hauling, or placement of asphalt concrete pavement clean and free of contaminants. Liquids, such as diesel or mineral spirits, may be used to clean the hand tools. Do not contaminate the asphalt concrete pavement with cleaning liquids. Clean hand tools over a catch pan with the capacity to hold all the cleaning liquid in the container should it spill. Dry the hand tools before using with the asphaltic material.

(5) Material Transfer Vehicle (MTV).

(a) Usage. Unless otherwise indicated in the contract documents, MTV usage applies to paving projects on all islands except Lanai and Molokai. When placing hot mix

asphalt surface course, use MTV to independently deliver mixtures from hauling equipment to paving equipment. MTV usage will not be required for the following:

1. Projects with less than 1,000 tons of hot mix asphalt.

2. Temporary pavements.

3. Bridge deck approaches.

4. Shoulders.

5. Tapes.

6. Turning lanes.

(b) Equipment. When using MTV, install minimum 10-ton-capacity hopper insert in conventional paver hopper. Provide the following equipment:

(1) High capacity truck unloading system in MTV capable of receiving hot mix asphalt from hauling equipment.

(2) MTV storage bin with minimum 15-ton capacity.

(3) Auger mixing system in MTV storage bin, paver hopper insert, or paver hopper to continuously mix hot mix asphalt prior to discharging to conveyor system.

(c) Performance Evaluation. The Engineer will evaluate performance of MTV and mixing equipment by measuring mat temperature profile immediately behind paver screed on first day paving.

Six temperature profile measurements will be taken of mat surface using non-contact thermometers at 50-foot intervals behind paver. Each temperature profile will consist of three surface temperature measurements taken transversely across mat in approximately a straight line from screed while paver is operating. For each profile, temperature will be measured approximately 1 foot from each edge and in middle of mat; and difference between maximum and minimum temperature measurements within each temperature profile shall not exceed 10 degrees F. If

any two or more temperature profiles exceed allowable 10-degree F temperature differential, halt paving operation and adjust MTV or mixing equipment to ensure that material placed by paver meets specified temperature requirements.

Once adjustments are made, the Engineer will repeat measurement procedure to verify that material placed by paver meets specified temperature requirements. Terminate paving if temperature profile requirements are not met during repeated measurement procedure. If equipment fails to meet measurements after measurement procedure is repeated once, equipment replacement will be required before the Engineer conducts any further temperature profile measurements.

The Engineer may perform additional surface temperature profile measurements at any time during project. If two consecutive temperature profiles fail to comply with specified allowable temperature differential, halt paving operation and adjust MTV or mixing equipment to ensure that HMA placed by paver complies with temperature requirements.

(d) Transport.

1. Trailered MTV. Transport MTV by means of truck-tractor/trailer combination in accordance with Chapter 104 of Title 19, Department of Transportation, entitled 'The Movement by Permit of Oversize and overweight Vehicles on State Highways'.

2. Crossing Bridges for Self-Powered MTV. When self-powered MTV exceeds legal axle or total weight limits for vehicles under the HRS, Chapter 291, conform to the following when crossing bridges within project limits unless otherwise indicated in the contract documents:

a. Completely remove mix from MTV.

b. Move MTV at relatively constant speed not exceeding 5 miles per hour. MTV will not be allowed to stop on bridge.

c. No other vehicle or equipment will be allowed on bridge.

(C) Preparation of Surface. Before laying the asphalt concrete pavement, prepare the surface according to the contract. For resurfacing work, surface preparation shall include the removal of traffic tapes, and raised pavement markers, prior to application of the tack coat. The removal of thermoplastic line markings and epoxy adhesives are not required. When the prepared surface becomes damaged or unsatisfactory, repair the damaged or unsatisfactory surface at no cost to the State before work proceeds.

Paint the contact surfaces of curbs, gutters, manholes, and other structures with a thin, uniform coating of asphalt paint before placing the bituminous mixture against them.

For resurfacing work, bring irregular surfaces to uniform grade and cross section before paving the existing pavement. Fill and compact the holes, cracks and wheel ruts with Asphalt Concrete Pavement, Mix No. V, before resurfacing. Also, mark the location of existing manholes, valves, and handholes on the roadway so the location after paving can be determined. Unless otherwise noted, adjust all existing frame and cover to new finish pavement finish grade after finish pavement is completed.

(D) Spreading and Finishing. Lay, spread, and strike off the mixture upon an acceptable surface to the grade and elevation established. Use the bituminous pavers to distribute the mixture either over the entire width or over such partial width as may be practicable.

The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6 inches; however, the joint in the top layer shall be at the centerline of the pavement when the roadway comprises two lanes of width, or at lane lines when the roadway is more than two lanes in width.

The minimum temperature of the bituminous mixture as discharged to the paver shall not be less than 250 degrees F.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, spread, rake, and lute the mixture by hand tools. For such areas, dump, spread, and screed the mixture to give the required compacted thickness.

When the production of the mixture can be maintained and when practicable, use the pavers in echelon to place the wearing course in adjacent lanes.

When the lanes are required to be opened to public traffic, pave the full travelway or total width of roadway each day. However, at the discretion of the Engineer, the Contractor may construct a transition taper at the longitudinal pavement drop so as not to leave a vertical face. The transition taper shall be along the lane line and formed by a one foot

slope shoe attached on the paving machine, that would produce a wedge with a maximum height of three inches down to zero inch. Remove the transition taper before placing adjacent lifts.

The minimum and maximum allowable laying thickness for the various types of mixture are specified in Table 401-II - Limits of Bituminous Binder Content.

(E) Compaction. Immediately after spreading and striking off the bituminous mixture and adjusting surface irregularities, thoroughly and uniformly compact the mixture by rolling.

Initiate the compaction of the mixture when the mix temperature is the highest at which the mixture can be compacted without excessive horizontal movement. The temperature shall not be less than 220 degrees F.

Use pneumatic or steel-tired tandem rollers for initial or breakdown rolling. Do not use pneumatic tire rollers for initial or breakdown rolling on final lifts of a traveled way including auxiliary lanes.

Finish rolling using a tandem roller weighing not less than eight tons. Roll at or above 175 degrees F.

Rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, each trip overlapping half the roller width, gradually progressing to the crown of the road. When using vibratory roller, the overlap shall be less than 6 inches. When paving in echelon or abutting a previously placed lane, roll the longitudinal joint first followed by the regular rolling procedures. On superelevated curves, the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline.

Correct the displacements occurring as a result of the reversing direction of a roller, or from other causes, at once by the use of rakes and addition of fresh mixture when required. Roll so as not to displace the line and grade of the edges of the bituminous mixture.

To prevent adhesion of the mixture to the rollers, keep the wheels properly moistened with water or water mixed with very small quantities of detergent. The Engineer will not permit excess liquid. Do not use diesel or petroleum-based liquids on the rollers.

Along forms, curbs, headers, walls and other places not accessible to the rollers, thoroughly compact the mixture with hot hand tampers, smoothing irons or with mechanical tampers. On depressed areas, use a trench roller or cleated compression strips under the roller to transmit compression to the depressed areas.

When the mixture becomes loose and broken, mixed with dirt, or is defective, remove, replace, and compact the mixture with fresh hot mixture to conform with the surrounding area. Remove and replace areas showing an excess or deficiency of asphalt cement.

Rollers shall move at a slow but uniform speed with the drive wheels nearest the paver. Continue the rolling to attain the desired density and until the roller marks are eliminated.

(1) Courses Equal to or Greater Than 1.5 Inches Thick. The relative compaction requirement for pavement courses that have a nominal compacted thickness equal to or greater than 1.5 inches shall be not less than 92 percent nor greater than 97 percent based on AASHTO T 209 modified by deletion of supplemental procedure for Mixtures Containing Porous Aggregate. The type of rollers and their relative position in the compaction sequence shall generally be the Contractor's option.

(2) Courses Less Than 1.5 Inches Thick. Compaction to a specified density for pavement courses that have a nominal compacted thickness of less than 1.5 inches will not be required.

Initiate rolling by a non-vibratory steel-tired tandem roller.

Do intermediate rolling by a pneumatic tired roller. The rolling shall continue until after compacting the entire surface by a minimum of four coverage of the roller. Do additional coverage as necessary to obtain thorough compaction of the mixture.

Finish the rolling using a steel-tired tandem roller. Continue rolling until the entire surface has been compacted by a minimum of three coverage of the roller and the roller marks have been eliminated.

Do not use the vibratory roller.

(3) Special Areas Not Designed For Vehicular Traffic. The relative compaction of areas such as bikeways not shown as part of the roadway and other areas not subjected to vehicular traffic shall be not less than 90 percent based on AASHTO T 209 modified by deletion of supplemental procedure for mixture containing porous aggregate. The type of rollers and their relative position in the compaction sequence shall generally be the Contractor's option. However, the Contractor shall increase the asphalt content by at least 0.5 percent above that used for asphaltic concrete pavements.

(F) Joints. Placing of the bituminous paving shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture. Form the transverse and longitudinal joints by cutting back on the previous run to expose the full depth of the course. Use a brush coat of asphalt paint on contact surfaces of transverse and longitudinal joints before placing additional mixture against the previously rolled material.

(G) Pavement Samples. Cut samples from the compacted pavement for testing within 48 hours of lay down. The cut pavement samples shall be 12 inches by 12 inches or 4-inch diameter cores, minimum. Take samples of the mixture for the full depth of the course at the location shown by the Engineer. Place and compact the sampled area with new materials to conform with the surrounding area.

(H) Surface Tolerances. . The Engineer will test the surface using a ten- foot straightedge at selected locations. The variation of the surface from the testing edge of the straightedge between two contacts with the surface shall not exceed 3/16 inch.

The thickness of the finished pavement shall be within 0.02 foot of the planned thickness at points of the cross section.

When specified by the Engineer, correct irregularities of the pavement exceeding the above limits including removal and replacement at no cost to the State.

(I) Protection of Pavement. In multiple layer construction, the Engineer will not permit construction equipment except those directly connected with paving operations, on intermediate layers without written authorization by the Engineer. An intermediate layer is defined as layers other than the finished surface layer.

The Engineer will not permit traffic on courses of asphalt concrete until the asphalt concrete has cooled and set, except such traffic as may be necessary for construction purpose.

(J) Tack Coat. Apply tack coat to bituminous and concrete surfaces before placing the asphalt concrete pavement. The tack coat shall conform to Section 407 - Bituminous Tack Coat.

401.06 Method of Measurement. The Engineer will measure asphalt concrete pavement per ton.

401.07 Basis of Payment. The Engineer will pay for the accepted asphalt concrete pavement at the contract unit price per ton complete in place.

The price includes full compensation for preparing the surface; removing and disposing of all existing raised pavement markers and traffic tapes; furnishing the asphalt concrete pavement; spreading, furnishing, applying, and protecting the tack coat; compacting, and finishing the asphalt concrete pavement; sampling; protecting the pavement; and furnishing labor, material, tools, equipment, and incidentals necessary to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Asphalt Concrete Pavement, Mix No. _____	Ton

The Engineer may, in lieu of requiring removal and replacement, use the sliding scale pay factor to accept asphalt concrete pavements compacted to 90, 91, or 98 percent. The Engineer will make payment for the material in that production day at a reduced price arrived at by multiplying the theoretical unit price by the pay factor as shown in Table IV.

TABLE IV - SLIDING SCALE PAY FACTOR	
Percent Compaction	**Percent Payment**
>98	Removal
98	95
92 – 97	100
90 – 91	80
<90	Removal

END OF SECTION 401