

## DIVISION 400 - PAVEMENTS

## SECTION 401 - ASPHALT CONCRETE PAVEMENT

**401.01 Description.** This work includes constructing one (1) or more courses of plant mixed asphalt concrete pavement on a prepared surface according to the contract. \*|  
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The pavement may include a wearing course mixture and a binder course mixture, as specified herein. \*|  
\*|

**401.02 Materials.** Materials shall conform to the following: \*

Bituminous Material (Asphalt Cement, Grades AR 60)	702.01	
Asphalt Paint (Emulsified Asphalt)	702.04	
Aggregate	703.09	
Filler	703.15	
Blending Sand	703.22	
Hydrated Lime	712.03	

The Contractor shall furnish the samples of the individual material required for testing of mix designs. The Contractor shall submit the samples of the individual material required for testing of mix designs fifteen (15) working days before production. The Engineer will observe and supervise the sampling. \*|  
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The Engineer may change the grade of the bituminous material one (1) step at no change in unit price. \*|  
\*|

The plant mixed asphalt concrete includes a mixture of aggregate, filler or blending sand, if acceptable, and bituminous material. The Contractor shall size, uniformly grade, and combine several aggregate fractions in such proportions that the resulting mixture meets the grading requirements of the job-mix formula. \*|  
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The Contractor shall submit for acceptance, a job-mix formula for each mixture that the Contractor plans to supply for this project. The job-mix formula shall show the grade of bituminous material in the mixture. The Contractor shall furnish only one (1) grade of bituminous material for the project. The Contractor shall make grade changes only upon written acceptance by the Engineer. The Contractor shall submit for acceptance a new job-mix formula before using the new material. The job-mix formula with the allowable tolerances shall be within the master range specified for the particular type of asphalt concrete. The job-mix formula for each mixture shall be in effect \*|  
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401.02

until modified by the Engineer. The job-mix formula for each mixture shall \*|  
establish: \*

- (1) a percent of aggregate passing each required sieve size, \*
- (2) a percent of bituminous material added to the aggregate, and \*
- (3) a temperature the mixture is delivered to the point of discharge. \*

After the job-mix formula is established, the mixtures furnished for the \*|  
project shall conform within the ranges of tolerances in Table 401-I: \*

TABLE 401-I - RANGE OF TOLERANCES FOR JOB-MIX FORMULA	
Passing No. 4 and larger sieves (percent)	+7
Passing No. 8 to No. 100 sieves (inclusive) (percent)	+4
Passing No. 200 sieve (percent)	+2
Bitumen (percent)	+0.4
Temperature of mixture (degrees Fahrenheit)	+20

If the Contractor makes a change in the source of material, the \*|  
Contractor shall establish a new job-mix formula before the new material is \*|  
used. When the results or other conditions are unsatisfactory, the Engineer \*|  
may establish a new job-mix formula. \*

The Contractor may use a nominal quantity of blending sand not exceeding \*|  
five (5) percent of the total weight of aggregate if acceptable by the \*|  
Engineer. \*

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

TABLE 401-II - LIMITS OF BITUMINOUS BINDER CONTENT					
MIX NO.	II	III	IV	V	VI
Used For	Binder Course	Binder or Surface Course	Surface Course	Surface Course	County Surface Course (Extra Fine)
Compacted Thickness Individual Layers	1-1/2" to 3"	1-1/4" to 3"	1-1/4" to 3"	3/4" to 3"	1" to 2-1/2"
Bituminous Binder Content Limits - expressed as % 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

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

The Engineer will base the asphaltic concrete job-mix formula on tests according to AASHTO T245 or T246. The mixture shall conform to Tables IIIA and IIIB. The Contractor shall 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
Percent air voids	4-6
Marshall Method Mix Criteria	Binder and Surface Course
Compaction, number of blows each end of specimen	75
Stability, minimum pounds	2,000
Flow, 0.01 inch	8-16
Percent air voids	4-6

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, Percent HVEEM Method	11	12	13	14	15
VMA, Percent Marshall Method	12	13	14	15	16

The Contractor shall submit, before usage, a Certificate of Compliance, accompanied by substantiating test data, for each lot or batch of asphalt cement. The Engineer will not accept the asphalt cement without adequate documentation.

401.03

401.03 Construction Requirements.

(A) **Weather Limitations.** The Contractor shall not place the bituminous plant mix on wet surface, when: \*|

(1) the air temperature is below fifty (50) degrees Fahrenheit, or \*|

(2) weather conditions prevent the proper handling or finishing of the bituminous mixtures. \*|

(B) **Equipment**

(1) **Bituminous Mixing Plant.** The supplier shall provide sufficient storage space for each size aggregate. The supplier shall keep the different aggregate sizes separated until the supplier delivers the aggregate to the system feeding the drier. The supplier shall maintain the storage yard neatly and orderly, and the separate stockpiles shall be readily accessible for sampling. \*|

Plants used for: \*|

(1) the preparation of bituminous mixtures shall conform to Subsection 401.03(B)(1)(a), except that the scale requirements shall apply only where the supplier uses weight proportioning; \*|

(2) batch mixing plants shall conform to Subsection 401.03(B)(1)(b); \*|

(3) continuous mixing plants shall conform to Subsection 401.03(B)(1)(c); and

(4) drier-drum mixing plants shall conform to Subsection 401.03 (B)(1)(d).

(a) **Requirements for Plants.** Mixing plants shall be capable of handling the proposed bituminous construction. The supplier shall coordinate its schedule to handle the proposed bituminous construction. \*|

1. **Plant Scales.** Scales shall be accurate to 0.5 percent of the maximum load that the Contractor may require. The manufacturer shall design the poises to be locked in positions to prevent unauthorized change of position. Instead of plant and truck scales, the Contractor may provide an acceptable automatic printer system that prints the weights of the material delivered. The Contractor shall use the system with an acceptable automatic batching and mixing control system. The Contractor shall show evidence of such weights by a weight ticket for each load. \*|

The Engineer will have the scales inspected and sealed as often as the Engineer may deem necessary to assure their continued accuracy. The Contractor shall have on hand not less than ten (10) fifty (50) pound weights for testing the scales. \*

**2. Equipment for Preparation of Bituminous Material.** The supplier shall equip the tanks for the storage of bituminous material to heat and hold the material at the required temperature. The supplier shall heat the tanks by steam coils, electricity, or other acceptable means so that no flame shall be in contact with the tank. The manufacturer shall design the circulating system for the bituminous material to assure proper and continuous circulation during the operating period. \*

The Supplier shall make provisions for measuring and sampling of material in storage tanks. The supplier shall calibrate the asphalt storage tanks to an accuracy of two (2) percent of its storage capacity. The storage tank shall be accessible for measuring. The Contractor shall provide in the bitumen feed lines, connecting the plant storage tanks to the bitumen weighing system or spray bar, a sampling outlet including a valve installed so that the Engineer may withdraw samples from the line slowly during plant operation. The supplier shall 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. The supplier shall provide a drainage receptacle for flushing the outlet before sampling. \*

**3. Feeder for Drier.** The supplier shall provide the plant with accurate mechanical means for uniformly feeding the aggregate into the drier so that the supplier can obtain a uniform production and uniform temperature. \*

**4. Drier.** The plant shall include a drier or driers that continuously agitate the aggregate during the heating and drying process. \*

**5. Screens.** The supplier shall provide plant screens, capable of screening aggregates to the specified sizes and proportions and having normal capacities over the full capacity of the mixer. \*

**6. Bins.** The plant shall include storage bins divided into at least three (3) compartments and arranged to insure separate and adequate storage of appropriate fractions of the aggregate. The supplier shall provide each bin with overflow pipes, of such sizes and at such \*

locations as to prevent backing up of material into other \*  
 compartments or bins. The supplier shall provide each \*  
 compartment with its individual outlet gate. The supplier \*  
 shall construct the outlet gate so that no leakage occurs \*  
 when closed. The gates shall cut off quickly and \*  
 completely. The supplier shall construct the bins so that \*  
 the Engineer can get samples readily. \*

**7. Bituminous Control Unit.** The supplier shall provide \*  
 satisfactory means, either by weighing or metering, to \*  
 obtain the proper quantity of bituminous material in the \*  
 mixer within the tolerance specified. The supplier shall \*  
 provide means for checking the quantity or rate of flow of \*  
 bituminous material into the mixer. \*

**8. Thermometric Equipment.** The supplier shall fix an \*  
 armored thermometer of adequate range in temperature \*  
 reading in the bituminous feed line at a suitable location \*  
 near the charging valve at the mixer unit. \*

Also, the supplier shall equip the plant with an \*  
 acceptable dial-scale, mercury-actuated thermometer, an \*  
 electric pyrometer or other acceptable thermometric \*  
 instrument so placed at the discharge chute of the drier \*  
 as to register automatically or show the temperature of \*  
 the heated aggregate. The heat indicating device shall be \*  
 accurate to the nearest ten (10) degrees Fahrenheit. The \*  
 supplier shall install the heat indicating device such \*  
 that the heat indicating device shall reflect a \*  
 fluctuation of ten (10) degrees Fahrenheit on the \*  
 aggregate temperature within one (1) minute. \*

The Engineer may require replacement of thermometers \*  
 by an acceptable temperature-recording apparatus for \*  
 better regulation of the temperature of aggregate. \*

**9. Dust Collector.** The supplier shall equip the plant \*  
 with a dust collector constructed to waste or return \*  
 uniformly to the hot elevator the material collected as \*  
 ordered. \*

**10. Truck Scales.** The supplier shall weigh the bituminous \*  
 mixture on acceptable scales furnished by the Contractor \*  
 or on public scales at no cost to the State. The Division \*  
 of Measurement Standards or its authorized representatives \*  
 shall inspect and seal such scales as often as the \*  
 Engineer deems necessary. (See Subsection 401.03(B)(1)(a)1 \*  
 - Plant Scales). \*

11. **Safety Requirements.** The supplier shall provide adequate and safe stairways to the mixer platform and sampling points. The supplier shall place guarded ladders to other plant units at points where accessibility to plant operations is required. The supplier shall 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. The supplier shall 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. The supplier shall thoroughly guard and protect gears, pulleys, chains, sprockets and other dangerous moving parts. The supplier shall provide ample and unobstructed space on the mixing platform. The supplier shall maintain a clear and unobstructed passage in and around the truck loading area. The supplier shall keep this area free of dripping from the mixing platform.

12. **Mineral Filler Feed.** The supplier shall feed the filler, if used, to an accuracy of ten (10) percent of the required weight. The supplier shall thoroughly dry and not feed the filler through the drier system. The supplier shall feed the filler material directly into the mixer as near the center as possible for batch type operation.

(b) **Requirements for Batching Plants.**

1. **Weigh Box or Hopper.** The equipment shall 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 the supplier is weighing a batch.

2. **Bituminous Control.** The equipment used to measure the bituminous material shall be accurate to within  $\pm 0.5$  percent. The bituminous material bucket shall be a non-tilting type with a loose sheet metal cover. The supplier shall introduce the binder uniformly into the mixer along the center of the mixer parallel to the mixer shafts, or by pressure spraying. The supplier shall adequately heat the discharge valve or valves and spray bar of the bituminous material bucket. The supplier shall efficiently drain the steam jackets, if used. The supplier shall construct the connections so that they shall not interfere with the efficient operation of the bituminous scales. The capacity of the bituminous material bucket shall be at least fifteen (15) percent

over the weight of bituminous material required in \*  
 batches. The plant shall have an adequately heated quick- \*  
 adequately heated quick-acting, non-drip, charging valve \*  
 located directly over the bituminous material bucket.

The indicator dial shall have a capacity of at least \*  
 fifteen (15) percent over the quantity of bituminous \*  
 material used in a batch. The dial shall be in full view \*  
 of the mixer operator. The supplier shall discharge the \*  
 bituminous material required for one (1) batch in not more \*  
 than fifteen (15) seconds after the flow has started. The \*  
 size and spacing of the spray bar openings shall provide a \*  
 uniform application of bituminous material the full length \*  
 of the mixer. The supplier shall 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 a bituminous \*  
 material bucket. \*

**3. Mixer.** The batch mixer shall be an acceptable type \*  
 capable of producing a uniform mixture within the job-mix \*  
 tolerances. If not enclosed, the supplier shall equip the \*  
 mixer box with a dust hood to prevent loss of dust. The \*  
 supplier shall construct the mixer so that the content \*  
 does not leak. \*

The clearance of blades from fixed and moving parts \*  
 shall not exceed one (1) inch unless the maximum diameter \*  
 of the aggregate in the mix exceeds one and one fourth (1- \*  
 1/4) inches, in which case the clearance shall not exceed \*  
 one and one half (1-1/2) inches. \*

**4. Control of Mixing Time.** The supplier shall equip the \*  
 mixer with a timing device that shows by a definite \*  
 audible or visual signal the expiration of the mixing \*  
 period. The device shall measure the time of mixing within \*  
 the accuracy of five (5) 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 bituminous material. The wet \*  
 mixing period is the interval of time between the start of \*  
 introduction of bituminous material and the opening of the \*  
 mixing gate.

**(c) 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 (1) dimension adjusted by positive mechanical means provided with a lock.

The supplier shall provide indicators for each gate to show the respective gate opening in inches. \*|  
\*|

The supplier shall equip the fine bin with a vibrating unit or other equipment that effectively prevent "hang-ups" of material while the plant is operating. The supplier shall provide a positive system to show the level of material in each bin, and as the level of material in one (1) 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. \*|  
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**2. Weight Calibration of Aggregate Feed.** The plant shall include a means for calibration of gate openings by weighing test samples. The supplier shall make provisions so that the supplier may bypass the materials fed out of individual orifices to individual test boxes. The supplier shall equip the plant to conveniently handle individual test samples weighing not less than two hundred (200) pounds. The supplier shall provide accurate scales of adequate capacities to weigh such test samples. \*|  
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**3. Synchronization of Aggregate Feed and Bituminous Material Feed.** The supplier shall provide satisfactory means to afford positive interlocking control between the flow of aggregate from the bins and the flow of bituminous material from the meter or other proportioning device. The supplier shall control this by interlocking mechanical means or by other positive methods according to the contract. \*|  
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The supplier shall connect the aggregate feeders that are mechanically driven directly with the drive on the asphalt binder pump. The supplier shall equip the drive shaft on the feed with a revolution counter reading to one-one hundredth (1/100) revolution and with sufficient capacity to register the total number of revolutions in a day's run. \*|  
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4. **Mixer.** The plant shall include a continuous mixer of an acceptable type, adequately heated and capable of producing a uniform mixture within the job-mix tolerances.

The supplier shall equip the mixer with 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. The supplier shall provide charts showing the rate of feed of aggregate per minute for the aggregate being used.

(d) **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 Mix No. II into three (3) or more sizes. The supplier shall separate the virgin aggregate for Mix Nos. III, IV, V and VI into two (2) or more sizes. If the Contractor wishes to separate the aggregate for Mix No. II into less than three (3) sizes, the Contractor shall request for acceptance from the Engineer in writing.

After the aggregate is separated, the supplier shall store each size separately. Each of the storages, except storages for filler material, shall contribute a minimum of ten (10) percent to the total weight of the aggregate.

2. **Drying.** The supplier shall feed the aggregates directly to a drier-drum mixer at a uniform rate.

The supplier shall provide the drier-drum mixer with a device that shows the temperature of the material leaving the drier-drum mixer. The temperature-indicating device shall be accurate to the nearest ten (10) degrees Fahrenheit. The supplier shall install the temperature-indicating device so that changes of ten (10) degrees Fahrenheit in temperature of the material will be shown within one (1) minute.

The supplier shall provide the drier-drum mixers with dust collectors. The supplier shall return the dust so collected to the aggregate or disposed of.

3. **Proportioning for Continuous Mixing.** When drier-drum is used, the supplier shall introduce the asphalt binder into the mixer through a meter. The supplier shall

maintain constant pressure at the meter. The supplier shall 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 forty (40) degrees Fahrenheit. The supplier shall heat and insulate the meter and lines. The supplier shall equip the storage of binder with a device for automatic plant cut-off when the level of binder is lowered sufficiently to expose the pump suction line.

When filler is used, the supplier shall proportion the filler by weight or volume by a method that uniformly feeds the material within ten (10) percent of the required amount. The supplier shall discharge the filler material from the proportioning device directly into the mixer.

**4. Proportioning for Drier-Drum Mixing with Cold-Feed Control.** When cold-feed control is used with drier-drum mixing, the supplier shall equip the asphalt feeder, each of the aggregate feeders, the filler material feeder, if used, and the combined aggregate feeder, with devices by which the supplier can determine the rate of feed while the plant is in full operation.

The supplier shall weigh the combined aggregate using a belt scale. The belt scale shall be of such accuracy that, when the plant is operating between thirty (30) percent and one hundred (100) percent of belt capacity, the average difference between the shown weight of material delivered and the actual weight delivered shall not exceed one (1) percent of the actual weight for three (3) two (2) minute runs. For the three (3) individual two (2) minute runs, the shown weight of material delivered shall not vary from the actual weight delivered by more than two (2) percent of the actual weight. The supplier shall determine the actual weight of material delivered by a vehicle platform scale that has been sealed. The supplier shall equip the plant so that the supplier can make this accuracy check after each relocation and set-up before the first operation and at other times as ordered by the Engineer.

The supplier shall interlock the belt scale for the combined aggregate, the proportioning devices for filler material, if used, and the asphalt proportioning meter so that the supplier shall adjust the rates of feed of the aggregates and asphalt automatically to maintain the bitumen ratio (pounds of asphalt per 100 pounds of dry aggregate including filler if used) designated by the

Engineer. The supplier shall not operate the plant unless \*|  
 this automatic system is operating and in good working \*|  
 condition. \*

The supplier shall equip the asphalt meters and \*|  
 aggregate belt scales used for metering the aggregates and \*|  
 asphalt into the mixer with resettable totalizers, so that \*|  
 the supplier can determine the actual asphalt and \*|  
 aggregate introduced into the mixer. \*

The supplier shall equip the bin(s) containing the \*|  
 fine aggregate and filler, if used, with a vibrating unit \*|  
 or other equipment that will prevent hang-ups of material \*|  
 while the plant is operating. Before the quantity of \*|  
 material in one (1) bin reaches the strike-off capacity of \*|  
 the feed gate, a device shall automatically close down the \*|  
 plant. \*

The Contractor shall determine the moisture content \*|  
 of the aggregate at least once during each production day, \*|  
 and shall 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, the Contractor shall provide other  
 suitable sampling means acceptable to the Engineer.

When filler is used, the supplier shall install a \*|  
 suitable, safe sampling device in each feed line or surge \*|  
 tank preceding the proportioning device for the filler. \*

5. **Mixing.** The supplier shall mix the aggregate, filler \*|  
 and asphalt binder in a drier-drum mixer. \*

6. **Drier-Drum Mixing.** When asphalt concrete is produced  
 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. \*

The supplier shall discharge the drier-drum mixer \*|  
 into a storage silo or into a surge bin. The supplier \*|  
 shall 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.

If a surge bin is used:

- a. the supplier shall not hold the mixture \*|  
beyond one (1) hour, \*
- b. the supplier shall 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.

**7. Asphalt Concrete Storage.** When stored, the supplier \*|  
shall store the asphalt concrete only in silos. The \*|  
supplier shall not stockpile the asphalt concrete. The \*|  
minimum quantity of asphalt concrete in storage during \*|  
mixing shall be twenty (20) tons except for the period \*|  
immediately following a shutdown of the plant of two (2) \*|  
hours or more. The supplier shall provide a means to \*|  
show that the supplier is maintaining the storage into \*|  
each silo as required. \*

The supplier shall equip the storage silo to prevent \*|  
segregation of the completed mixture as the mixture is \*|  
discharged into the silo. \*

The supplier shall not use asphalt concrete with \*|  
hardened lumps in the mixture. The supplier shall not \*|  
use the storage facilities that contained the material \*|  
with the hardened lumps for further storage until the \*|  
cause of the lumps is corrected. \*

**(2) Hauling Equipment.** Trucks used for hauling bituminous \*|  
mixtures shall have tight, clean, smooth and metal beds that have \*|  
been thinly coated with a minimum quantity of detergent, paraffin \*|  
oil, lime solution, or other acceptable material 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 or other suitable \*|  
material of such size as to protect the mixture from the weather. \*|  
The Contractor shall protect each load from the weather with \*|  
covering securely fastened. \*

(3) **Bituminous Pavers.** Bituminous pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and 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.

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

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. If spreading equipment leaves ridges, indentations, or other marks in the surface that the Contractor cannot eliminate by rolling or prevented by adjustment in operation, the Contractor shall discontinued its use and furnish other acceptable equipment.

The Contractor shall 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 thirty (30) foot ski for the first pass of new construction work or major reconstruction work. For subsequent passes, the Contractor may substitute one (1) ski with a joint-matching shoe riding on the finished adjacent pavement.

For resurfacing or paving of the second and subsequent lifts, each sensor shall take its grade from a ten (10) foot ski. For subsequent passes of the lift, the Contractor may substitute one (1) ski with a joint-matching shoe riding on the finished adjacent pavement.

The Contractor shall demonstrate the competence of personnel operating the grade and crown control device according to the contract before placing surface courses. If the automatic control system become inoperative during the day's work, the Engineer will permit the Contractor to finish the day's work using manual controls. The Contractor shall not resume work thereafter until the Contractor makes the automatic control system 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. If necessary, the Engineer will limit the load of the haul vehicle such that the Contractor will get satisfactory spreading.

(4) **Rollers.** Rollers shall be the self-propelled, steel-tired tandem pneumatic-tired or vibratory type. Rollers shall be in good mechanical condition, 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. The Engineer will not permit the use of equipment that results in excessive crushing of the aggregate. The Contractor shall operate the rollers according to the manufacturer's recommendations.

(a) **Steel-Tired Tandem Rollers.** The Contractor shall check the steel-wheel rims for wear. If the rolling drum is grooved or pitted, the Contractor shall not use the roller. If the scrapers and wetting pads are excessively worn, the Contractor shall replace them.

Steel-tired tandem rollers used for breakdown (initial) or intermediate rolling passes shall have a minimum gross weight of twelve (12) tons. Steel-tired tandem rollers shall provide a minimum of two hundred fifty (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 (8) tons.

(b) **Pneumatic-Tired Rollers.** Pneumatic tire rollers shall be the oscillating type. The Contractor shall equip the pneumatic tier rollers with smooth (tread) pneumatic tires of equal size and diameter. The Contractor shall inflate and maintain the tires to the designated pressure so that the air pressure will not vary more than five (5) pounds per square inch from the established pressure. The Contractor shall space the tires so that the Contractor covers the gaps between adjacent tires by the following tires.

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

The Contractor shall construct the pneumatic-tired rollers \*  
 used for kneading a finished asphalt surface so that the \*  
 Contractor can vary the total weight of the roller to produce \*  
 an operating weight per tire of not less than one thousand and \*  
 five hundred (1,500) pounds. The tires shall have a minimum \*  
 wheel diameter of fifteen (15) inches and a fifty (50) to sixty \*  
 (60) pounds per square inch tire inflation pressure. |

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

**(5) Hand Tools.** The Contractor shall keep hand tools used in the \*  
 production, hauling, or placement of asphalt concrete pavement clean \*  
 and free of contaminants. The Contractor may use liquids such as \*  
 diesel or mineral spirits in the cleaning of hand tools. The hand \*  
 tools shall be free of visible liquids before returning the hand \*  
 tools to work with the asphaltic material. The Engineer will not \*  
 permit excess liquid to contaminate the asphalt concrete pavement. \* |

**(C) Preparation of Surface.** Before the Contractor lays the asphalt \*  
 concrete pavement, the Contractor shall prepare the surface according to \*  
 the contract. Liquid Asphalt Prime Coat is required between asphalt \*  
 concrete pavement and aggregate base. The prime coat shall conform to \*  
 Section 408 - Prime Coat. If the prepared surface becomes damaged or \*  
 unsatisfactory, the Contractor shall repair the damaged or unsatisfactory \*  
 surface at no cost to the State before work proceeds. \* |

The Contractor shall paint the contact surfaces of curbs, gutters, \*  
 manholes, and other structures with a thin, uniform coating of asphalt \*  
 paint before the Contractor places the bituminous mixture against them. \* |

For resurfacing work, the Contractor shall bring irregular surfaces \*  
 to uniform grade and cross section before the Contractor paves existing \*  
 pavements. The Contractor shall fill and compact holes, cracks and wheel \*  
 ruts with asphalt concrete, Mix No. V, before resurfacing. Also, the \*  
 Contractor shall mark the location of existing manholes, valves, and \*  
 handholes on the roadway so that the Contractor can determine the \*  
 location after paving. \* |

**(D) Plant Operation.**

**(1) Preparation of Bituminous Material.** The supplier shall heat \*  
 the bituminous material to the specified temperature to avoid local \*  
 overheating. The supplier shall provide a continuous supply of the \*  
 bituminous material to the mixer at a uniform temperature. \* |



**(2) Preparation of Aggregate.** The supplier shall dry and heat the aggregate for the mixture to the required temperature but shall not exceed three hundred twenty (320) degrees Fahrenheit. The supplier shall properly adjust the flames used for drying and heating to avoid damage to the aggregate and avoid soot on the aggregate. The aggregate, when dried, shall not contain more than one (1) percent moisture by weight.

Immediately after heating and drying, the supplier shall screen the aggregates for batch plants into three (3) or more fractions as specified. The supplier shall convey the aggregates into separate compartments ready for batching and mixing with bituminous material.

**(3) Mixing.** The supplier shall combine the dried aggregates in the mixer in the quantity of each fraction of aggregates required to meet the job-mix formula. The supplier shall measure or gage and introduce the bituminous material into the mixer in the quantity specified by the job-mix formula.

After the supplier introduces the required quantities of aggregate and bituminous material into the mixer, the supplier shall mix the materials until a complete and uniform coating of the particles and a thorough distribution of the bituminous material 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, the supplier shall produce the mixture at the lowest temperature that shall produce a workable mix; however, the supplier shall not exceed the temperature of the mixture by more than three hundred twenty five (325) degrees Fahrenheit. The supplier shall introduce the bituminous material and aggregate into the mixer within twenty five (25) degrees Fahrenheit of each other's temperature.

**(E) Spreading and Finishing.** The Contractor shall lay, spread, and strike off the mixture upon an acceptable surface to the grade and elevation established. The Contractor shall 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 (1) layer shall offset that in the layer immediately below by approximately six (6) inches; however, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises two (2) lanes of width, or at lane lines if the roadway is more than two (2) lanes in width.

The minimum temperature of the bituminous mixture as discharged to the paver shall not be less than two hundred fifty (250) degrees Fahrenheit.

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

When the supplier can maintain the production of the mixture and when practicable, the Contractor shall use the pavers in echelon to place the wearing course in adjacent lanes. \*|  
\*|  
\*|

If the contract requires the Contractor to open the lanes to public traffic, the Contractor shall 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 (1) foot slope shoe attached on the paving machine, that would produce a wedge with a maximum height of three (3) inches down to zero (0) inches. \*|  
\*|  
\*|

The minimum and maximum allowable laying thicknesses for the various types of mixture are specified in Table 401-II.

**(F) Compaction.** Immediately after the Contractor has spread, strike off, the bituminous mixture and adjust surface irregularities, the Contractor shall thoroughly and uniformly compact the mixture by rolling. \*|  
\*|  
\*|

The Contractor shall initiate the compaction of the mixture when the mix temperature is the highest at which the Contractor can compact without excessive horizontal movement. The temperature shall not be below two hundred twenty (220) degrees Fahrenheit. \*|  
\*|  
\*|

The Contractor shall initiate or breakdown the rolling with a pneumatic or steel-tired tandem rollers. The Contractor shall not use pneumatic tire rollers for initial or breakdown rolling on final lifts of a traveled way including auxiliary lanes. \*|  
\*|  
\*|

The Contractor shall finish rolling by means of a tandem roller weighing not less than eight (8) tons. The Contractor shall roll at or above one hundred and seventy-five (175) degrees Fahrenheit. \*|  
\*|  
\*|

Rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, each trip overlapping half (1/2) the roller width, gradually progressing to the crown of the road. If vibratory roller is used, the overlap shall be less than six (6) inches. When paving in echelon or abutting a previously placed lane, the Contractor shall 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. \*|  
\*|  
\*|

The Contractor shall correct the displacements occurring as a result from the reversing direction of a roller, or from other causes, at once by the use of rakes and addition of fresh mixture when required. The Contractor shall exercise care in rolling as not to displace the line and grade of the edges of the bituminous mixture.

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

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

If the mixture becomes loosed and broken, mixed with dirt, or is defective, the Contractor shall remove, replace, and compact the mixture with fresh hot mixture to conform with the surrounding area. The Contractor shall remove and replace areas showing an excess or deficiency of bituminous material.

Rollers shall move at a slow but uniform speed with the drive wheels nearest the paver. The Contractor shall continue the rolling to attain the desired density and until the Contractor eliminates the roller marks.

**(1) Courses One And One-Half (1-1/2) Inches Thick Or Greater.** The relative compaction requirement for pavement courses that have a nominal compacted thickness of one and one-half (1-1/2) inches or greater shall be not less than ninety-two (92) percent nor greater than ninety-five (95) percent based on AASHTO T-209 modified by deletion of supplemental procedure Section 8. The type of rollers and their relative position in the compaction sequence shall generally be the Contractor's option. However, the Contractor shall include a pneumatic tire roller in the compaction sequence.

**(2) Courses Less Than One And One-Half (1-1/2) Inches Thick.** The Engineer will not require compaction to a specified density for pavement courses that have a nominal nominal compacted thickness of less than one and one-half (1-1/2) inches.

The Contractor shall initiate rolling by a non-vibratory steel-tired tandem roller.

The Contractor shall do intermediate rolling by a pneumatic \*|  
 tired roller. The rolling shall continue until the Contractor has \*|  
 compacted the entire surface by a minimum of four (4) coverages of \*|  
 the roller. The Contractor shall do additional coverages as \*|  
 necessary to obtain thorough compaction of the mixture. \*|

The Contractor shall finish the rolling using a steel-tired \*|  
 tandem roller. The rolling shall continue until the Contractor has \*|  
 compacted the entire surface by a minimum of three (3) coverages of \*|  
 the roller and the Contractor eliminates the roller marks. \*|

The Contractor shall 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 ninety (90) percent based on AASHTO T-209 modified by |  
 deletion of supplemental procedure Section 8. 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 half (1/2) a percentage \*|  
 point above that used for asphaltic concrete pavements. \*|

**(G) 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. The Contractor shall form the transverse joints by cutting \*|  
 back on the previous run to expose the full depth of the course. The \*|  
 Contractor shall use a brush coat of asphalt paint on contact surfaces of \*|  
 transverse joints before additional mixture is placed against the \*|  
 previously rolled material. \*|

**(H) Pavement Samples.** The Contractor shall cut samples from the \*|  
 compacted pavement for testing within twenty four (24) hours of lay down. \*|  
 The cut pavement samples shall be twelve (12) inches by twelve (12) \*|  
 inches or four (4) inch diameter cores, minimum. The Contractor shall \*|  
 take samples of the mixture for the full depth of the course at the \*|  
 location ordered by the Engineer. Where samples were taken, the \*|  
 Contractor shall place and compact new material to conform with the \*|  
 surrounding area. The entire cost of sampling and restoring the area \*|  
 shall be at no cost to the State. The Engineer will not allow \*|  
 compensation. \*|

**(I) Surface Tolerances.** The Engineer will test the surface using a ten \*|  
 (10) foot straightedge at selected locations. The variation of the \*|  
 surface from the testing edge of the straightedge between two (2) \*|  
 contacts with the surface shall not exceed three-sixteenth (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. \*|

If ordered by the Engineer, the Contractor shall correct irregularities of the pavement exceeding the above limits and areas defective in compaction including removal and replacement at no cost to the State.

**(J) 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.

**(K) Tack Coat.** The Contractor shall 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.

**401.04 Method of Measurement.** The Engineer will measure asphalt concrete pavement by the ton according to Subsection 109.01 - Measurement of Quantities or square yard.

**401.05 Basis of Payment.** The Engineer will pay for the accepted quantities of asphalt concrete pavement at the contract price per ton or square yard for the various asphalt concrete paving mixes complete in place.

The Engineer will make payment under:

Pay Item	Pay Unit
Asphalt Concrete Pavement, Mix No. ____	Ton
Asphalt Concrete Pavement, Mix No. ____	Square Yard

If not specified in the proposal, the Engineer will consider prime coat/bituminous tack coat incidental to the various asphalt concrete pavement items. The Engineer will not make payment separately.