To: MODIFIED BY EI 14-007 EFFECTIVE 9/4/14		New York State Department of Transportation ENGINEERING INSTRUCTION	EI 10-009
Title: **REVISION TO SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS**			
SUPERSEDED BY EB 15-031 EFFECTIVE 9/28/15	yors (33) iltants (34) actors (39) _____( )	Approved: Richard L Sack 16 Apr 10 R.L. Sack, P.E. Deputy Chief Engineer, Research	Date

ADMINISTRATIVE INFORMATION:

- This Engineering Instruction (EI) is effective beginning with projects submitted for the Letting of 09/02/2010.
- This EI supersedes EI 06-028, EI 08-028.
- The revisions issued with this EI will be incorporated into a future update of the Standard Specifications Book.

PURPOSE: The purpose of this EI is to revise Standard Specification Section 402, *Hot Mix Asphalt (HMA) Pavements*.

TECHNICAL INFORMATION: This EI issues a revised Section 402 of the Standard Specifications. Some of the highlights of the changes are:

- The revised temperature and seasonal limits transmitted with EI 08-028 are now included in this section.
- Contractors may elect to leave a longitudinal joint of 100 feet (30 meters) or more open to traffic overnight when placing 6.3, 9.5, and 12.5 HMA courses only. The joint must be constructed using a longitudinal wedge joint when this option is selected, except for 6.3 HMA Course where a butt joint may be used. This allowance is not permitted for any other pavement courses.
- For 50 and 60 Series compaction methods, the test section adjustment of 1.5 shall not apply if any HMA of 150 tons or more is placed on the same day, on the same project, other than the quantity required for the construction of the test section.
- For 60 Series, additional cores are required to verify density. Cores taken under this new requirement will be subject to penalty. The specification includes a table showing the frequency of cores based on the duration of the contract.
- New item numbers have been included to pay for the following quantity adjustments. These quantities, which are adjusted quantities and not in-place quantities, will be determined as Quality Units (QU) and paid based on the Index Price. Previously, these adjusted quantities were paid using the item Bid Price:
  - Test Section Adjustment item will be used to make payment for quantities determined under the test section adjustment for both 50 and 60 Series compaction methods.
  - Pavement Density Quality Adjustment item will be used to make payment for disincentive under 60 Series compaction method when cores are taken and are subject to adjustment.
- Multiple plants will not be allowed to supply one paver. This will assist in identifying pavement locations where the plant produced HMA does not meet the QC/QA specifications requirements.
- The specification includes a "Dispute Resolution" section for contractors to dispute pavement core test results. This section was included to fulfill the requirements of an incentive/disincentive

specification.

- The requirement transmitted with EI 06-028 to have all gauge operators possess a Density Testing Inspector Certification when monitoring pavement density has been incorporated into the Standard Specification.
- The Warranty Specification previously transmitted via EB 08-28 will be available under MP 402-01, *Warranty Requirements for Hot Mix Asphalt (HMA) Top Course*, instead of being a separate specification as it is currently.
- Materials Procedures (MPs) 96-01 and 96-4 referenced in the current Section 402 will be combined as a single document and will be designated as Materials Procedure (MP) 402-02, *Hot Mix Asphalt (HMA) Pavement Density Determination.*
- The title "Weather and Seasonal Limitations" under §402-3.01 was changed to "Temperature and Seasonal Limitations" since the section addresses temperature and not the weather conditions.
- The edge of the shoulder for all new and reconstructed pavements will be required to meet a slope of 35° or flatter. The purpose of this requirement is to provide safer maneuvering by motorists who veer off the roads. This is critical during the time between when HMA is newly placed and when the shoulder back-up material is placed, or when the shoulder back-up material is washed out. Additional details are provided in a separate Engineering Instruction EI 10-012.

Cost Impact. A slight cost increase may occur due to implementation of this EI as a result of the additional pavement core requirements and the restrictions on the Contractor which limit their ability to do other HMA work when they're constructing the test section.

Design Guidance:

1. **Quality Units**
   - Test Section Adjustment. The maximum number of quality units (QU) for each test section for any 50 Series and 60 Series item is 100. The specification allows up to two sections per item for the adjustment. Therefore, the Designer will enter 200 QUs, the Quality Index Price from the current Engineering Bulletin, and the total amount for each Test Section Adjustment item for the project. Contractors cannot bid this item.
   - Pavement Density Adjustment for 60 Series. There is no need to calculate QUs for this item since there is no incentive. However, there may be a disincentive and therefore, adjustment will be made based on Quality Index price from the current Engineering Bulletin. In the estimate, the Designer will enter 1 QU, the Quality Index price based on the Region, and the total amount. This will provide an item to make negative adjustment using Quality Index Price. Contractors cannot bid this item.

2. **Shoulder Edge Wedge.** The guidance for the shoulder wedge is given under a separate Engineering Instruction EI 10-012.

IMPLEMENTATION:

- Main Office Design Quality Assurance Bureau will insert the Standard Specification Section 402 as a Shelf Note into contract proposals beginning with projects submitted for the letting of 09/02/2010.
- Regional Special Specification Coordinators should review their 402 special specifications and amend accordingly.
- All items listed in Section 402 are revised by changing the last digit (6^{th} digit), which indicates the revision number from 1 to 2. For example, 402.XXYZQ1 is now 402.XXYZQ2.

All 402.XXYZQ1 items are deleted and replaced with the following items. Specific description of the items can be found in the revised Section 402. The Regional Designers need to review their Regional special specifications after the effective date to make sure they comply with the revised Section 402, especially those with 50 and 60 Series compaction methods.

Item No.	Item	Pay Unit
402-XXYZ02	XX Z Superpave HMA, Y Series Compaction	Tons
402.XXYZ12	Plant Production Quality Adjustment to 402.XXYZ02	Quality Unit
402.XXYZ22	Pavement Density Quality Adjustment to 402.XXYZ02	Quality Unit
402.XXYZ52	Test Section Quality Adjustment to 402.XXYZ02	Quality Unit

Mix Type – XX	Compaction Series - Y	Friction - Z	Quality Adjustment - Q
Type 9.5 - 09	50 Series - 5	F1 - 1	HMA Item - 0
Type 12.5 – 12	60 Series - 6	F2 - 2	Plant – 1
Type 19.0 – 19	70 Series - 7	F2 - 3	Density – 2
Type 25.0 – 25	80 Series - 8	F9 - 9	Test Section – 5
Type 37.5 – 37			

TRANSMITTED MATERIALS:

- Attached are both US Customary and Metric shelf notes, *Section 402 – Hot Mix Asphalt (HMA) Pavements.*

BACKGROUND: The revisions to Section 402, transmitted with this issuance, were necessary to enhance the overall quality of the specifications by resolving inconsistencies, ambiguities, and other changes deemed necessary by the Department. One of the changes made was the pavement density adjustment for 60 Series. This adjustment will be made using Quality Index price and not bid price, similar to the way it is done for 50 Series. This makes sense now that the specification for 60 Series requires additional coring. The revised Section 402 includes a Pavement Density Quality item for all 60 Series item.

The other proposed changes were deficiencies in the specifications encountered during the course of its use. One of the proposed changes was to have a Test Section Adjustment item for both 50 and 60 Series. This is necessary since both require the construction of a test section and provides an incentive of 1.5 times up to the first 200 tons placed on the test section. The issue in the field was that the asphalt and fuels price adjustments were applied to these additional quantities (phantom tons) that were never placed on the pavement. In addition, change orders were necessary to pay for these additional tons. To make sure the fuel and asphalt price adjustment are not applied to these phantom tons and to reduce change orders, a new Test Section Adjustment item is created and will be paid based on Quality Index Price.

A requirement of shoulder edge wedge is included in this revision to allow paving of HMA with a shoulder wedge at the edge of the shoulder to improve safety prior to applying shoulder back-up material and if, in the future, the back-up material washes away . This safety feature is recommended by the FHWA based on the study done in New York, Georgia, and other states. This shoulder edge wedge will be required for all new and reconstructed pavements.

Other changes which were made previously and transmitted with separate EIs were also included so that all changes reside in one document.

CONTACT: Direct questions regarding this EI to Zoeb Zavery of the Materials Bureau at (518) 485-5277 or via e-mail at zzavery@dot.state.ny.us. Any questions regarding the Design Guidance, contact Pratip Lahiri of Design Quality Assurance Bureau at (518) 457-4092 or via e-mail at plahiri@dot.state.ny.us.

Make the following changes to the Standard Specifications dated May 1, 2008:
Delete Section 402 – Hot Mix Asphalt (HMA) Pavements in its entirety and ***replace*** it with the following:

SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

402-1 DESCRIPTION. These specifications apply to all plant mixed Hot Mix Asphalt (HMA) produced at a production facility under Section 401, Plant Production, irrespective of aggregate gradation, type, and amount of HMA material or use.

This work will consist of providing, placing, and performing density monitoring of one or more courses of HMA pavement constructed on the prepared foundation in accordance with the contract documents or as directed by the Engineer.

402-2 MATERIALS

402-2.01 General. Use aggregate and PG binder from a supplier listed in the Department's Approved List of Fine and Coarse Aggregates. Use of mineral filler or any other materials for the production of HMA will be accepted in accordance with the State's written instructions.

A PG Binder grade and the Design Estimated Traffic in 80 kN ESALs will be specified by Special Note in the contract documents.

402-2.02 Composition of Mixtures. Supply HMA for the project meeting the requirements of §401-2 of the Standard Specifications and the mixture design procedure as written in Materials Method (MM) 5.16, *Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedures*.

The Contractor will be responsible for the quality and performance of the mixture created from approved components. The Department reserves the right to take samples at any time and location to assure the materials and workmanship incorporated into each Department project are in conformity with the approved plans and specifications.

402-3 CONSTRUCTION DETAILS. The Engineer will conduct a pre-paving meeting prior to any routine HMA placement. The attendance to this meeting will include Regional Materials Engineer, Paving Foreman, Chief Inspector or Paving Inspector(s), HMA plant representative, density gauge operator, if necessary, and traffic protection personnel. Participants will review all aspects of the specifications requirements including, but not limited to, the following:

- HMA mixture delivery temperature
- Equipment and setup
- Mix codes to assure correct mix is delivered to the project
- Gauge operator certification
- Proper construction practice to provide quality product
- Traffic Control Activities

A certified density gauge operator must be present to monitor pavement density using a density gauge for 50 Series (non-mainline areas), 60 Series, and 70 Series compaction methods. The gauge operator must hold a current Density Gauge Inspector Certification from the Associated General Contractors, New York State, or its equivalent, as determined by the Director, Materials Bureau.

Do not place HMA mixture on any wet surface. Wet surface is defined as one that is moistened, covered, or soaked with water.

402-3.01 Temperature and Seasonal Limitations.

A. Surface Temperature

1. Place HMA only when the pavement surface temperature is equal to or greater than those specified in Table 402-1, *Temperature Requirements.*

TABLE 402-1 TEMPERATURE REQUIREMENTS

Nominal Compacted Lift Thickness	Surface Temperature Minimum
≤ 1 in	50°F
1 in < Thickness ≤ 3 in	45°F
> 3 in	40°F

2. Temperature Measurement: Furnish a surface thermometer capable of reading surface temperature to nearest 1° F for the exclusive use of the Engineer. The Engineer will measure pavement surface temperatures on the surface where the mixture is to be placed. The controlling temperature will be the average of three readings taken at locations 25 feet apart utilizing a surface thermometer covered by insulation for 10 minutes or until a constant temperature is reached. Infra Red (IR) temperature guns may be used in lieu of surface thermometer. When IR gun is used and if there is a dispute with the value obtained, the Engineer will determine the temperature using the surface thermometer.

B. Seasonal Limits: Place HMA Top Course on mainline and shoulders between April 1 and November 30 for the counties of Dutchess, Orange, Putnam, Rockland, Westchester, Nassau, Suffolk, and the City of New York. For all other counties, place HMA Top Course between April 15 and October 31.When placing Top Course HMA outside the seasonal limitations, provide a limited warranty against defects in such work. Perform the warranty work in accordance with Materials Procedure (MP) 402-01, *Warranty Requirements for Hot Mix Asphalt (HMA) Top Course*. Unless specified elsewhere in this specification or contract documents, these seasonal limits do not apply for any other HMA layer placement.

C. Temporary HMA Placements: HMA placement for temporary detours, which are not and will not become part of the permanent pavement, will not be subject to the temperature and seasonal limitations but must be approved by the Engineer when placed outside temperature and seasonal limits.

D. Miscellaneous HMA Placements: The Engineer may allow the placement of HMA mixtures for curbs, driveways, sidewalks, gutters, and other incidental construction below the minimum temperature and outside the seasonal limits to expedite the completion of the project.

E. Scheduling HMA Placement: Schedule paving operations such that all HMA placements are completed within the temperature and seasonal limitations, provide safe and adequate work zone traffic control, and protect previously laid courses. Such scheduling will include expediting construction operations to permit paving within the seasonal limitations or by limiting the length of work so that it can be completed before the seasonal shut-down. Should paving operations not be completed within temperature and seasonal limitations, provide, at no additional cost to the state, all temporary materials and work necessary such as shimming of castings and protrusions, drainage of the roadway, providing acceptable rideability, and other work needed for the adequate work zone traffic control. Base or Binder layers which will be permanently incorporated into the work may be left open to traffic over the winter. However, if there is any damage to these layers, repair any damaged areas prior to placing subsequent layer at no additional expense to the State. This requirement also applies to the repairs deemed necessary by the Engineer on the temporary HMA placements. Clean this pavement course in accordance with Section 633, *Conditioning Existing*

Pavement, at no additional expense to the State, prior to applying a tack coat and overlaying. Apply tack coat in accordance with Section 407, Tack Coat, immediately prior to HMA overlay.

402-3.02 HMA Pavers. Provide pavers capable of spreading and finishing courses of HMA plant mix material in lane widths, shoulders, or similar construction applicable to the specified typical section and thicknesses shown on the plans. Repair or replace immediately any paver found to be worn or defective either before or during its use. Provide HMA pavers that meet the following requirements:

- Self-powered with an activated screed or strike-off assembly.
- Capable of operating at forward speeds consistent with satisfactory placement of the mixtures.
- Have a receiving hopper with sufficient capacity for uniform spreading operation and with automatic flow controls to place the mixture uniformly in front of the screed. Heat the screed or strike-off assembly as necessary to produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture.
- When screed extensions are necessary for placement of mainline pavement, provide extensions of the same design as the main screed.
- Mount auger and tunnel extensions on the paver when the screed is extended more than 1 foot for fixed paving widths wider than 12 feet when mat uniformity is not achieved as determined by the Engineer.
- When used for placing the initial paving layer, Base, Binder, and Top Courses, pavers must be equipped with approved automatic transverse slope and longitudinal grade screed controls. The controls shall automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities in the existing surface. The controls shall be capable of maintaining the proper transverse slope and be readily adjustable so transitions and super-elevated curves can be satisfactorily paved. The controls shall operate from suitable fixed or moving references as prescribed in §402-3.06, *Spreading and Finishing*.

  When paving mainline, provide a paver with functional automatic transverse slope and longitudinal grade screed controls that can be operated from either side of the paver. The transverse slope and longitudinal grade screed controls of the HMA paver may be manually adjusted according to the requirements of §402-3.06, *Spreading and Finishing*.

  Engineer will inspect and approve HMA pavers for use prior to the start of paving operations.

402-3.03 Hauling Equipment. Provide HMA transport trucks that have clean, smooth, tight metal beds with waterproof covers for transporting HMA mixtures to the work site. When a flexible cover is used, provide a cover that overlaps the vehicle's sideboards and back by a minimum of 6 inches and is fastened. The inside surface of the vehicle body may be lightly coated with a release agent listed on the Department's Approved List for Release Agents. Petroleum products or solvents are not permitted for use as release agents. All hauling equipment is subject to the approval by the Engineer.

402-3.04 Rollers. Rollers can either be vibratory, static steel wheel type, or pneumatic tire rollers. The Engineer will inspect rollers prior to start of paving operations to determine acceptability. A minimum of two rollers, one for breakdown and one for finish rolling, are required unless the HMA placement is on a bridge deck, bridge approaches, or other areas where a single steel wheel vibratory roller may be sufficient to achieve required density. Rollers must be in good mechanical condition, and capable of operating at speeds slow enough to avoid displacement of the mixture. The use of equipment which results in excessive crushing of aggregate will not be permitted. All rollers for HMA placement must appear on the Department's Approved List for Rollers, available on the Department's website.

A. **Vibratory rollers:** These rollers shall be specifically designed for the compaction of HMA mixture. Vibratory roller models satisfying the specification requirements contained herein will be evaluated by the Materials Bureau to determine compaction capabilities. If acceptable, the roller model will be placed on the Department's Approved List for Hot Mix Asphalt Vibratory Compaction Equipment. Vibratory roller models appearing on this list will be allowed to be used. Alternate types of rollers

may be approved by the Director, Materials Bureau, upon reviewing the specification of the rollers and demonstration that satisfactory results can be achieved.

Provide vibratory rollers that meet the following requirements:

Nominal Amplitude	0.05 in maximum.
Vibration Frequency	1500 vpm minimum.
Drum Width (dual vibrating drums)	54 inches, minimum
(single vibrating drum)	84 inches, minimum

All vibratory rollers shall be equipped with a speedometer that accurately indicates roller speed in either ½ mph or 50 ft per minute increments (maximum) throughout the specified operating range. Vibratory rollers must also be equipped with a speed control device that can be set to prevent the roller from traveling in excess of 2 ½ mph or 220 ft per minute when the roller is in vibratory mode. The type of speed control device will be subject to the approval of the Director, Materials Bureau. When rollers have pneumatic drive wheels, release agents listed on the Department's Approved List may be used on the tires to prevent material pickup.

B. Static steel-wheel rollers. These rollers shall be self-propelled and be either 10 to 12 ton three axle types or 8 to 10 ton two axle types.

C. Pneumatic rubber-tired rollers: These rollers shall be self-propelled and consist of two axles on which multiple pneumatic-tired wheels are mounted in such a manner that the rear wheels shall not follow in the tracks of the forward wheels and will be spaced to give essentially uniform coverage with each pass. The axles will be mounted in a rigid frame provided with means for adding ballast. The wheels shall be mounted so as to oscillate individually or in pairs. The tires must be smooth and show no tread pattern, be of equal size and diameter, and be uniformly inflated. Pneumatic rollers shall meet the following requirements unless otherwise approved:

Maximum Wheel Load	5,600 lbs
Tire Compression on Pavement	80±5 psi
Maximum Axle Load	22,400 lbs

402-3.05 Conditioning of Existing Surface. When specified in the contract documents, clean the surface of the existing pavement, fill joints and cracks, and level the surface to a uniform grade and cross slope prior to the application of a new HMA course in accordance with the provisions of Section 633, *Conditioning Existing Pavement*. Clean any foreign material from the pavement resulting from construction operations at no additional cost to the State.

Prior to placing new HMA, apply a thin, uniform tack coat as specified in Section 407, *Tack Coat*, to all contact surfaces of existing HMA and Portland Cement Concrete layers including such areas as adjacent pavement edges, curbing, gutters, manholes, and other structures where the HMA will be in contact.

Fill any depressions and wheelpath ruts prior to paving Truing and Leveling course, as directed by the Engineer. Use Table 402-2, *Mixture Selection for Filling Wheelruts & Depressions*, to select the appropriate mix type.

TABLE 402-2 MIXTURE SELECTION FOR FILLING WHEELRUTS & DEPRESSIONS

Depth Range (in)	Mixture Type
< ¼	No treatment
¼≤ Depth < ¾	Shim
≥ ¾	9.5 Top Course

If a Truing and Leveling course is specified in the plans or in the itemized proposal, place the course(s) of a minimum variable thickness of proper plant mix necessary to bring the surface of the existing pavement to the same transverse slope and longitudinal grade required for the finished pavement surface. The surface of this course shall be tested in the same manner prescribed in §402-3.10, *Surface Tolerance*, except that the allowable variation from the true surface after compaction must not exceed ⅜ inch. Unless a mixture type is specified in the plans, use Table 402-3, *Mixture Selection for T&L Course*, to select the appropriate mix type such that dragging of stones is minimized during placement of the mixture.

TABLE 402-3 MIXTURE SELECTION FOR T&L COURSE

Compacted Thickness Range (in)	Mixture Type
≤ 2	9.5 or 12.5 Top Course
$2 <$ Thickness ≤ 3	19.0 or 25.0 Binder Course
$3 <$ Thickness ≤ 5	25.0 Binder Course or 37.5 Base Course

Select a mixture such that dragging of stones at the thin edge is minimized when constructing wedges for super-elevation. If dragging is excessive in any T&L course, the Engineer shall disallow the selected T & L mixture for the application.

402-3.06 Spreading and Finishing

A. Surface Tolerance: The requirements of §402-3.10, *Surface Tolerance*, shall apply.

B. Mix Temperature: For 50, 60, and 70 series compaction methods, select a desired HMA mixture temperature to be delivered within the mixing and compaction range of 250°F and 325°F, or as recommended by the PG Binder manufacturer. Notify the Engineer of the desired delivery temperature. Produce and deliver mixtures to the work site, and incorporate into the work within 20°F of the specified temperature. For 80 Series compaction method, the Contractor will select the desired mix temperature with the concurrence of the Engineer.

C. Tack Coat: Apply tack coat on the contact surfaces between all HMA pavement lifts in accordance with Section 407, *Tack Coat*, prior to placing HMA mixture regardless of time period between lifts. Tack coat is not required on the surface of Permeable Base courses. Paving over a tack coat should not commence until the emulsion has broken (goes from brown to black) or is tacky when touched.

D. HMA Mixture from Multiple Plants: Supply of HMA mixture from multiple plants to a single paver is prohibited.

E. Top Course Texture and Color: Supply Top Course HMA from a single plant for the entire project duration such that the pavement surface has a uniform color and texture as determined by the Engineer. Exception to this requirement is when a contract includes multiple paving sites or the project length is at least 5 miles and supply from multiple plants at discrete points of terminus is practical. In that case, the above requirement will apply to each paving site and locations between discrete points of terminus as approved by the Regional Materials Engineer. Limits of each site will be subject to approval by the Regional Materials Engineer. If a plant breaks down, another plant may supply mixture meeting the requirements of §402-2.02 if the aggregate used for manufacturing of the HMA is from the same source with the concurrence of the Regional Materials Engineer.

F. Reference Line: When the initial pavement course is laid with automatic HMA pavers on a new or a reconstruction project, use a taut reference line positioned at or near the pavement centerline or edge to guide the paver. Erect and maintain the reference line to the satisfaction of the Engineer. Support the reference line at approximately 25 feet intervals on tangent sections and at closer intervals on curves. Tension the line sufficiently to remove any sagging. The Engineer may permit a moving

reference of at least 30 feet in length in lieu of a reference line. The moving reference may be a floating beam, ski, or other suitable type such that the resulting pavement layer surface is sufficiently even. A short ski or shoe may also be used for the initial course with the approval of the Engineer if a satisfactory fixed reference such as a curb, gutter, or other fixed reference is adjacent to the pavement. In addition, any course in an adjacent lane may be used as the reference for the use of a short ski. When the proposed floating beam or the short ski does not produce the results similar to those obtained using a taut reference line, the Engineer shall disapprove the use of these devices. The Engineer has final approval of the method chosen by the Contractor.

The automatic screed controls are not required for shoulders, temporary detours, behind curbs, where existing grades at roadway intersection or drainage structure must be met, or in other areas where its use is impractical.

G. Mix Placement: Use HMA paver(s) to place the mixture either over the entire width or over a partial width that may be practical. Place the mixture on a clean, tack coated surface. Upon arrival at the site, the trucks will deliver the mixture into the paver. Immediately spread and strike off to the required width and appropriate loose depth to established grade, elevation, and to obtain the required compacted thickness at the completion of work. If the areas to be paved are less than 1000 ft^2 or small and scattered, the HMA mixture may be spread by hand or other method approved by the Engineer. For these areas, dump and spread the mixture such that the compacted thickness meets the thickness specified in the plans.

Place all pavement courses using one of the reference line methods mentioned in §402-3.06 F. Prior to the beginning of rolling, check the loose mat, adjust any irregularities, and remove and replace all unsatisfactory material.

When filling wheel ruts with Shim Course or 9.5 Top Course mixture in an existing pavement, place mixture in each wheelpath rut separately. Use a drag box configuration or approved equal having side forms to shim the ruts. Spread and strike off the Shim Course material to a uniform width of approximately 4 feet. The intent of the operation is to fill the low area only and not to place the material over the pavement's full lane width. The placement equipment wheels and/or other appurtenances must not interfere with the distribution and placement of the Shim Course material.

402-3.07 Compaction. Compact the HMA pavement sufficiently using the appropriate compaction method specified in Table 402-4 *Compaction Methods*, to achieve pavement densities in a range of 92% to 97%, expressed as a percentage of the mixture's maximum theoretical density (MMTD).

When placing HMA mixture using 50, 60, or 70 series compaction method, control all operation of the rollers including speed, amplitude settings, vibration frequency, and the type of rollers.

Immediately compact the HMA using rollers meeting the requirements of §402-3.04, *Rollers,* after the mixture has been placed. Compact the HMA when the mixture is in the proper condition such that the rollers do not cause displacement, cracking, or shoving. Initially, compact all courses with the roller traveling parallel to the centerline of the pavement, beginning at each edge and working toward the center. Compact super-elevated curves starting at the low-side edge and working toward the higher edge.

Correct immediately any displacement occurring as a result of reversing the direction of the roller, or from other causes, using rakes and additional HMA mixture as required. Exercise care in rolling so as not to displace the line and grade of the edges of the HMA mixture. To prevent adhesion of the mixture to the rollers, keep the wheels properly moistened with water, water mixed with small quantities of detergent, or other approved material. Petroleum products or solvents are not permitted.

Upon completion of the HMA placement, there shall be no visible defects in the pavement, such as shallow ruts, ridges, roller marks, cracking, tearing, segregation, bleeding, or any other irregularities. Any defects that become apparent shall be corrected, or the defective pavement replaced, to the satisfaction of the Engineer, at no additional cost to the State.

Along forms, curbs, headers, walls, and other areas not accessible to rollers, compact the mixture thoroughly with mechanical tampers. On depressed areas, use a trench roller or a small vibratory roller with the approval by the Engineer.

Remove any mixture that becomes loose and broken, mixed with dirt, or is in any way defective and

replace with fresh HMA mixture. Compact the mixture to conform to the surrounding area. Correct any area showing an excess or deficiency of HMA material.

When Shim Course or 9.5 Top Course is used for filling wheel ruts, make a minimum of three passes of a pneumatic rubber tire roller for compaction. Otherwise, make a minimum of two passes when Shim Course is used as a skim coat. The Engineer may allow the use of other types of rollers.

Do not use vibratory compaction when HMA mixture is placed on structural bridge decks or other structures with less than 2 feet of cover over the structure or when specified in contract documents. If vibratory compaction is used, repair all damages which may occur to the highway components and adjacent property, including buried utility and service facilities, at no additional cost to the State.

Monitor density for 60 and 70 Series projects with density gauges specified in §402-3.07 E, *Density Gauges.* The density gauge operator shall possess a current Density Gauge Inspector Certification from The Associated General Contractors, New York State, or its equivalent, as determined by the Director, Materials Bureau. Any pavement section placed under 60 or 70 Series which is monitored by a gauge operator whose certification is revoked for reasons outlined in the New York State Inspector Certification Program manual under "Decertification", will be evaluated by sampling and testing of pavement cores in accordance with §402-3.08, *Pavement Density Samples*, and subject to payment adjustment in accordance with Table 402-10, *Density Quality Adjustment Factors for 60 Series*. The above requirement also applies when a density gauge is used for monitoring pavement density in the areas other than mainline under 50 Series compaction method.

Table 402-4, *Compaction Methods*, associates specific item being placed to the required compaction method.

TABLE 402-4 COMPACTION METHODS

Compaction Methods	Item Number
A=50 series	402.XX5FQR
B=60 series	402.XX6FQR
C=70 series	402.XX7FQR
D=80 series	402.XX8FQR & other

NOTE: XX = 37, 25, 19, 12, 09, 05, 01
F = Friction requirement (1, 2, 3, 9)
Q = Quality item number (core item = 0, plant = 1, density = 2)
R = Revision number

Below is a detailed requirement for each of the compaction methods:

A. 50 Series Compaction Method. On the first day of mainline paving, construct the pavement under the provisions of "*Option 1 - Test Section*" or "*Option 2 – First Day Routine Paving*."

1. **Option 1 - Test Section.** Construct a test section on the project site at a location approved by the Engineer. The purpose of the test section is to determine if the mixture can be compacted uniformly within the 92-97% of MMTD. The test section will be the same depth specified for the construction of the course which it represents. The test section length shall be at least 300 linear feet but not to exceed 1,500 linear feet when the test section is on the mainline. If required by the Engineer, construct full pavement width to close the joint(s). Use the first 150 feet of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select core locations, excluding the first 150 feet, in accordance with §402-3.08, *Pavement Density Samples*. Before the road is open to traffic, take the cores at the marked locations. Also, take loose mix samples as specified under §402-3.08, *Pavement Density Samples*. In addition to the above requirements, the following shall apply to the test section provision:

- Only one test section will be placed per day. Subsequent test sections are subject to approval by the Engineer.
- The first 200 tons of quantity placed on a test section will be adjusted by a factor of 1.5 as a Test Section Adjustment. The adjusted quantity will be paid based on the Quality Index price. The remaining quantity will be paid at the bid price. A maximum of two test sections per item will be subject to this adjustment.
- The test section adjustment factor of 1.5 shall not apply for a test section if any HMA of 150 tons or more is placed on the same day, on the same project, other than the quantity required for the construction of the test section.
- Pavement Density Quality Adjustment Factors (QAF) shall not apply for the first two test sections. Subsequent test section(s) located on the mainline is subject to pavement density QAF.
- Placing HMA under *"Routine Paving"* provisions for this item is not permitted until the results of the cores from the test section have a minimum pavement density QAF of 1.00.
- When the pavement density QAF is less than 1.00, the Contractor shall construct another test section in accordance with *"Option 1, Test Section."*
- When the calculated QAF is 0.60 or less, the Engineer will evaluate the test section to determine if it can be left in place. The guidance for evaluation can be found under §402-4, *Method of Measurement*. The Test Section Adjustment shall not apply for the test section.

2. **Option 2 – First Day Routine Paving.** It is not necessary to construct a test section on the first day of paving. Any HMA placed under this provision shall meet the following:

   - The test section adjustment of 1.5 shall not apply.
   - All material placed will be subject to a pavement density QAF.
   - If the pavement density QAF on the first day of paving is less than 1.00, construct a test section in accordance with the provisions of the *"Option 1 - Test Section"* under this method.
   - Evaluate density in accordance with 3. *Routine Paving*, below.

3. **Routine Paving.** Place all HMA beyond the *"Option 1 - Test Section"* using the provisions described below.

   A paving lot is defined as a day's production of at least 200 tons. Each paving lot will be equally divided into four sublots in accordance with Materials Procedure (MP) 402-02, *Hot Mix Asphalt (HMA) Pavement Density Determination*. The Engineer will select and mark a core location in each sublot in accordance with §402-3.08, *Pavement Density Samples* once the compaction operation is completed. The Engineer will exclude the first 150 feet of the day's paving. Extract a core at the marked location in each sublot. Take four loose mix samples representing the lot. Pavement cores and loose mix samples will be tested and analyzed by the Department in accordance with MP 402-02 to determine the pavement density QAF. If the quantity placed is less than 200 tons on any day, pavement cores and loose mix samples are not required. The density QAF for that day will be reported as 1.00, provided the density gauge used on previous sections is utilized and the Engineer is satisfied that the procedures used in these areas to obtain pavement densities are similar to previously placed pavement sections. When paving is continuous within a 24-hour period, a new lot will result when a change occurs in the paving crew. When a project includes multiple paving operations, each paving operation will be considered a lot and evaluated separately.

   When consecutive lots are found to have a density QAF equal to or less than 0.85, stop paving operations and immediately construct a new test section in accordance with the provisions of *"Option 1 - Test Section"*, described previously in this section.

The density QAF shall not apply to material placed on shoulders, maintenance widening, crossovers, bridges and ramps with a uniform full-width section of less than 1250 feet in length. Payment for these areas shall be based on satisfactory placement and compaction. Placement and compaction procedures will be satisfactory when the procedures used in these areas obtain pavement density similar to that obtained on the mainline pavement sections. When the shoulder shows signs of distress during compaction, decrease the compaction effort until no further damage occurs to the shoulder or subbase. If density gauge(s) is used to monitor mainline paving, use the same gauge(s) to monitor density on the above referenced areas.

B. 60 Series Compaction Method. On the first day of mainline paving, construct the pavement under the provisions of "*Option 1 - Test Section*" or "***Option 2 – Test Section and Continue Paving***." The Engineer will approve the location of the test section. Placement of HMA under this method will not be allowed unless both a density gauge and a certified operator are present.

1. **Option 1 - Test Section Only.** Prior to routine paving operations for this item, construct a test section at a location approved by the Engineer. The purpose of constructing a test section is to determine a Project Target Density (PTD) for this item and correlation of a density gauge(s) to the cores. It is advisable to use the same equipment and procedures to construct the test section which will be used in the construction of the remainder of the course being laid. The test section will be the same depth specified for the construction of the course which it represents. The test section length shall be at least 300 linear feet but no more than 1,500 linear feet. If required by the Engineer, construct full pavement width to close the joint(s). Use the first 150 feet of the test section to stabilize the paving operation. At the conclusion of the test section, the Engineer will randomly select four 6-inch core locations on the test section in accordance with §402-3.08, *Pavement Density Samples* excluding the first 150 feet and mark the locations.

   During construction of the test section, take loose mix samples in accordance with §402-3.08, *Pavement Density Samples* such that they represent the material placed on the test section. Take density gauge(s) readings at each core location prior to drilling the cores in accordance with Materials Procedure (MP) 402-02, *Hot Mix Asphalt (HMA) Pavement Density Determination,* based on the type of density gauge used. Take cores at each of the marked core location.

   Deliver the cores, loose mix samples, and the four density gauge readings with the gauge type, model, and serial number to the Regional Materials Engineer in accordance with §402-3.08, *Pavement Density Samples*. The Regional Materials Engineer will test the samples and establish a PTD for each density gauge in accordance with Materials Procedure (MP) 402-02 within one business day of the delivery of the samples and density gauge readings. In addition to the above requirements, the following shall apply to the test section provision:

   - Only one test section will be placed per day. Subsequent test sections are subject to approval by the Engineer.
   - The first 200 tons of quantity placed on a test section will be adjusted by a factor of 1.5 as a Test Section Adjustment. The adjusted quantity will be paid based on the Quality Index price. The remaining quantity will be paid at the bid price. A maximum of two test sections per item will be subject to this adjustment.
   - The test section adjustment factor of 1.5 shall not apply for a test section if any HMA of 150 tons or more is placed on the same day, on the same project, other than the quantity required for the construction of the test section.
   - Placing HMA under "Routine Paving" provisions for this item is not permitted until a Project Target Density has been established.
   - When the average density of the four cores is less than 88% of the maximum theoretical density, the Engineer may evaluate the test section to determine if it should be left in place. The guidance for evaluation can be found under §402-4, *Method of Measurement*. The Test Section Adjustment shall not apply for the test section.

2. **Option 2 – Test Section and Continue Paving.** The following shall apply when HMA is placed on the first day under this option:

   - Construct a test section as described under "*Option 1 - Test Section Only*." Establish an Interim PTD as described in Materials Procedure (MP) 402-03 based on the density gauge used. Use this Interim PTD to monitor pavement density until the Actual PTD is established by the Regional Materials Engineer.
   - The test section adjustment factor of 1.5 shall not apply.
   - All material placed after the test section for that day shall be subject to a payment adjustment.
   - Take additional loose mix samples, other than those taken under the "Test Section" provisions, in accordance with §402-3.08 and store these samples at the plant.
   - Take density gauge(s) readings over the entire day's placement in accordance with Materials Procedure (MP) 402-02.
   - When this option is selected and if the density readings at two consecutive locations fall below 96% or above 103% of the Interim PTD or if the moving average of the last 10 nuclear density readings falls below 98% of the Interim PTD, stop routine paving operations and wait for the Actual PTD.
   - Submit a copy of the appropriate BR form(s) at the end of the first day's paving to the Engineer as described in Materials Procedure (MP) 402-02. The Engineer will determine whether the density readings taken using the Interim PTD are acceptable, based on the Actual PTD in accordance with Materials Procedure (MP) 402-02. If not, the Engineer will randomly select four core locations over the entire placement under Interim PTD, excluding the test section, and drill cores at the selected locations. Prior to drilling these cores, take density readings at each core location. Deliver the core samples, density gauge readings, and the loose mix samples to the Regional Laboratory in accordance with §402-3.08, *Pavement Density Samples*. If the average density of the pavement cores is not between 92% and 97% of the mixture's maximum theoretical density, the Engineer will make a payment adjustment in accordance with Table 402-10, *Density Quality Adjustment Factors for 60 Series*, to the material placed on that day and the subsequent days, excluding the material placed on the test section. Otherwise, continue under "*Routine Paving*".

3. **Routine Paving.** Use only the density gauge(s) that has been correlated with cores during the construction of the test section and a PTD has been determined by the Regional Materials Engineer for pavement density monitoring during routine paving operations. Construct a new test section under the provisions of "Test Section" to establish a PTD for other gauge(s). Compact the pavement sufficiently to achieve the PTD value at each test location. Take density gauge readings at each location in accordance with Materials Procedure (MP) 402-02. The test locations will be every 200 feet along the length of the pavement for each paver pass randomly selected by the Engineer in accordance with Materials Procedure (MP) 402-02. Record these density values on the appropriate BR form based on the type of gauge used. The minimum acceptable density reading is 96% and no greater than 103% of the PTD at a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations.

   If density gauge readings over two consecutive locations fall below 96% or above 103% of the PTD or if the moving average of the last 10 density gauge readings falls below 98% of the PTD, stop routine paving operations and construct a new test section in accordance with requirements of "*Option 1- Test Section Only*."

   Placement and compaction on shoulders, ramps, maintenance widenings and crossovers, and bridges will be deemed satisfactory by the Engineer when the procedures used in these areas obtain pavement density similar to that obtained on the mainline pavement sections. Monitor and record the density of the above referenced areas with the same density gauge to insure the PTD is achieved. If the shoulder subbase is structurally insufficient to sustain the level of compaction

such that the shoulder shows signs of distress, decrease the compaction effort until no damage occurs to the shoulder or subbase.

In addition to the daily density monitoring with a gauge, additional set(s) of pavement cores and loose mix samples are required for pavement density verification at the frequency specified in Table 402-5, *Additional Pavement Samples*. The frequency is based on the days of mainline HMA placement. Take density samples from the same day's placement. The Engineer will select the day of coring and will notify the Contractor 24 hrs prior to the day of coring. When notified, take these samples in accordance with §402-3.08, *Pavement Density Samples.* Before drilling the cores, take density gauge readings and record on the appropriate forms based on the type of gauge used. Deliver all the samples and the density gauge readings to the Regional Materials Engineer for testing.

TABLE 402-5 ADDITIONAL PAVEMENT SAMPLES

HMA Placement Days	Set of Pavement Samples
2 or Less	None
3 – 5	One Set
More than 5	Two Sets

Based on the additional Pavement Samples, the Regional Materials Engineer will establish a new PTD if different from the original PTD. The Engineer shall evaluate core density results using Table 402-10, *Density Quality Adjustment Factors for 60 Series,* and make payment adjustment, if necessary. When a contract includes multiple sites, the requirement under Table 402-05 applies to each paving site.

The Engineer may request pavement samples in accordance with §402-3.08, *Pavement Density Samples,* for density verification from HMA placed under the following situations:

- Insufficient number of density readings recorded, either at a specific location or at the required frequency.
- Paving completed after the only correlated density gauge on site breaks down.
- Gauge readings do not seem to accurately represent the HMA density.
- When the plant production QAF is 0.85 and need to evaluate the pavement section in accordance with §401-4.03, *Evaluation of Sublots Represented by 0.85 QAF,* whether to keep it in place.

When pavement samples are requested for the above situation(s), the Engineer will randomly select core locations. Take cores and density gauge readings at each core location in accordance with §402-3.08, *Pavement Density Samples*, and deliver them to the Regional Materials Laboratory. The Regional Materials Engineer may establish a new PTD based on these cores. The material placed under the above situations will be subject to a payment adjustment in accordance with Table 402-10.

The Engineer may also request additional pavement samples to verify PTD used on the project for the situations listed below and the material placed under these situations will not be subject to payment adjustment:

- Changes in condition of existing pavement being overlaid.
- Excessive plant mix variations.
- Using a different Job Mix Formula or a different HMA plant other than the one used to produce mix for the Test Section, as long as the aggregate and PG Binder sources do not change.

4. **Multiple Paving Sites.** When a project includes multiple paving sites, a test section will be constructed at the initial paving site to establish a PTD. For the rest of the paving sites, the

Engineer will require pavement cores, loose mix samples, and gauge readings on the first day to verify PTD unless it is specified in the contract documents to construct a test section.

A test section may be requested by the Engineer when a different HMA plant other than the one used at previous site(s) is supplying the mixture using different aggregate and PG Binder sources. The provisions of 1.5 test section incentive shall apply.

C. 70 Series Compaction Method. On the first day of paving, construct a test section on the project site at a location approved by the Engineer using the same equipment and procedures to be used in the construction of the remainder of the course being laid. HMA placement under this method, including the construction of the test section, will not be allowed unless both a density gauge and a certified operator are present. The test section is for determining the Project Target Density (PTD) using the "peak" method. Routine paving operations may begin immediately following the construction of the test section once a PTD has been established by the Engineer based on the evaluation of density readings in accordance with the provisions of "Test Section" below.

1. **Test Section.** To establish a PTD prior to routine paving, construct a test section of at least 300 linear feet on the mainline which has the same depth specified for the construction of the course it represents. The maximum length is 1,500 linear feet. Use the first 150 feet of the test section to stabilize the paving operation. Use the remainder of the test section length to determine the Project Target Density (PTD). Initially, compact the pavement with a breakdown roller once sufficient HMA is placed in the testable area. Make four vibratory passes or as recommended by the Engineer. If non-vibratory compaction is specified in the contract documents, make four static passes. The Engineer will select three random locations in accordance with Materials Procedure (MP) 402-02 based on the type of density gauge used and mark these sites so that subsequent density testing can be performed at the same locations. Use either the intermediate or the finish roller for further rolling the test section. Take density readings at the three selected sites after every additional machine pass until the increase in density is less than 2 lbs/ft^3, or until the Engineer stops further compaction because the pavement shows signs of distress.

   The Engineer will determine PTD by calculating the average of the highest density reading from each of the random locations. Use the resulting PTD to monitor the pavement density for the project.

2. **Routine Paving.** Use only density gauge(s) that is correlated during the construction of the test section and the PTD determined by the Engineer to monitor pavement density during routine paving operations. Construct a new test section under the provisions of "Test Section" to establish a PTD for other gauge(s).

   Begin routine paving immediately after the PTD has been established. Compact the pavement sufficiently to achieve the PTD value at each test location. The minimum acceptable density reading will be 96% or maximum of 103% of the PTD in a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations as determined by a density gauge. Take density gauge readings at each location, randomly selected by the Engineer, in accordance with the Materials Procedure (MP) 402-02, approximately every 200 feet along the length of the pavement for each pass of the paver. Record these values on the appropriate BR form based on the type of gauge used.

   If density gauge readings over two consecutive locations fall below 96% or above 103% of the PTD or if the moving average of the last 10 density gauge readings falls below 98% of the PTD, stop routine paving operations and immediately construct a new test section in accordance with requirements of the Test Section.

   Placement and compaction on shoulders, ramps, maintenance widenings and crossovers, and bridges will be deemed satisfactory by the Engineer when the procedures used in these areas obtain pavement density similar to that obtained on the mainline pavement sections. Monitor the density of areas with the same density gauge to insure the PTD is achieved. If the shoulder

subbase is structurally insufficient to sustain the level of compaction such that they show signs of distress, decrease the compaction effort until no damage occurs to the shoulder or subbase.

D. 80 Series Compaction Method. Use one of the compaction options listed below for this method. The rollers used for compaction of the HMA mixtures under this method must be on the Department's Approved List for Rollers.

The number of passes listed in Table 402-6, *Number of Passes*, are recommended and may be increased or decreased by the Engineer to obtain adequate density. One vibratory pass is defined as one movement of a single drum of the roller over the pavement section in each direction. One static pass is defined as one movement of the roller over the pavement in each direction. Complete all breakdown roller passes before the mat temperature falls below 250°F. Remove all ruts, ridges, roller marks, or other irregularities from the surface using static rolling. All turning of the rollers must be performed on material which has had a minimum of one roller pass. The Engineer may approve alternate compaction procedures for areas where the specified procedures are not practical.

TABLE 402-6 NUMBER OF PASSES[1]

Pavement Courses	Option 1 Three Roller Train (Static)		Option 2 Vibratory Rollers	
	Steel Wheel Rollers	Pneumatic Roller	Vibratory Passes	Static Passes
37.5 Base (Each Lift)	8	3	6	4
25.0 Binder	8	3	6	4
19.0 Binder	6	3	4	2
12.5 Top	6	3	4	2
9.5 Top	4	3	4	2
Permeable Base[2]	-	-	-	2

1. Based on 12-foot lane width.
2. For the Permeable Base course, the mixture shall be compacted between 140°F and 230°F. Up to 2 additional passes may be required to obtain adequate density.

1. **Option 1 - Static Compaction.** Use this option only when the compacted thickness of the finished mat is 4 inches or less. The roller speeds shall not exceed 3 mph and will move at a uniform speed. The roller drive wheel or drum shall be nearest to the paver. When paving multiple lanes simultaneously, increase the required number of rollers proportionately for each additional full lane width unless otherwise approved by the Engineer. Under this option, compact the HMA mixtures with steel-wheel rollers operating in a static mode. Each pass shall overlap the previous roller pass by one-half the width of the roller.

   Initially, compact the HMA with a steel-wheel roller immediately followed with a pneumatic rubber-tired roller. A minimum of 3 passes of the rubber-tired roller will be required. One pass is defined as one movement of the roller over any point of the pavement in either direction.

   Use a steel-wheel roller for finish rolling the HMA to remove all shallow ruts, ridges, roller marks, and other irregularities from the surface.

   When the compaction procedure fails to produce acceptable results, adjust the procedure to obtain the desired results.

2. **Option 2 - Vibratory Compaction.** Furnish a vibrating reed tachometer for the exclusive use of the Engineer. The vibrating reed tachometer must have a frequency range of 1,000 to 4,000 vpm

with a minimum reed interval of 50 vpm between 1,000 and 4,000 and a minimum reed interval of 100 vpm between 2,000 vpm and 4,000 vpm.

Operate the vibratory rollers at a uniform speed not to exceed 2 ½ mph (220 ft per minute) on all pavement courses. If satisfactory compaction is not obtained, or damage occurs to highway components and/or adjacent property using vibratory compaction equipment, immediately cease using this equipment and proceed with the work in accordance with compaction procedures stipulated under Option 1 at no additional cost to the State.

E. Density Gauges

1. **Nuclear Density Gauge.** Use a nuclear density gauge to monitor the pavement density in accordance with this sub-section and Materials Procedure (MP) 402-03. Submit a Safety Control plan at least two weeks prior to using the gauge. The nuclear density gauge shall meet the following requirements:
   - The gauge shall consist of a radioactive source, scaler, and other basic components housed in a single backscatter unit.
   - The gauge must be calibrated at least every two years.
   - Must be operated by personnel trained in the principles of nuclear testing and safety practices.

2. **Non-nuclear Density Gauge.** Use a non-nuclear density gauge to monitor the pavement density in accordance with this sub-section. The non-nuclear density gauge shall meet the following requirements:
   - Must be capable of functioning in the temperature and moisture levels experienced during HMA paving.
   - Shall contain the internal circuitry to determine the density of HMA pavements by measuring changes in the electromagnetic field resulting from the HMA compaction process.
   - The gauge must be calibrated at least every two years.

402-3.08 Pavement Density Samples

A. Pavement Cores. The Engineer will select one pavement core location for each sublot in accordance with Materials Procedure MP 402-02, *Hot Mix Asphalt (HMA) Statistical Pavement Density Determination,* to represent each paving sublot. The Engineer will select a total of four 6-inch diameter core locations. The pavement core samples will be taken from within the 6-inch diameter circles outlined. Under no circumstances will the Engineer designate the coring locations before the rolling operation is completed. The rolling operation is completed when all compaction equipment has moved off the sublot designated for coring. Obtain the 6-inch diameter pavement core samples no later than a day following placement of the lot. If necessary, cool the pavement so that the core samples are not damaged during coring. If the core sample does not de-bond during coring, do not intentionally separate the pavement core from the underlying material. The Regional Materials Laboratory will separate the pavement core layer required for testing from the underlying material by sawing, if necessary.

Extraction of companion cores is not allowed. Additional cores may be taken under the following:

- As described in §402-3.08 G, *Dispute Resolution,*
- If it is necessary to establish an interim target density on the first day of paving. In that case, take a core at no more than two core locations during the construction of a test section or two cores within the first 150 feet when a test section is not constructed
- To perform a quality control tests during routine paving. A maximum of two cores is allowed with prior permission of the Engineer. Core(s) shall not be adjacent to the project cores.

B. Filling Core Holes. Backfill all core holes with a similar HMA material immediately after extracting the cores or before opening the lane to traffic. Prior to backfilling, wipe the core hole with a cloth to remove any standing water. Place HMA in the core hole in layers of 3 inches or less and compact each layer with 10-18 lb slide hammer with a diameter of at least 4 inches but less than 6 inches. Use of a shovel or similar method is not allowed. The Engineer may approve alternative method if it will provide acceptable results. If core holes are not filled within 2 business days of placement, the Engineer will stop routine paving until the core holes are filled.

C. Loose Mix Samples. On each paving day when pavement cores are required, take four loose mix samples in accordance with AASHTO T168, *Standard Test Method for Sampling Bituminous Paving Mixtures*. Take these samples such that they represent the day's HMA placement. Loose mix maximum theoretical specific gravity values from plant HMA QC/QA testing may be included as part of the required loose mix samples with prior approval of the RME. When HMA placement is less than the anticipated quantities, it is recommended that a minimum of three loose mix samples be obtained before placement is terminated. When operational conditions cause HMA placement to be terminated before the specified number of samples have been taken, the following procedures will be used:

1. If three samples are taken, the loose mix maximum theoretical specific gravity density will be based on the average of the samples taken.
2. When HMA is placed under 50 Series and if only one or two samples are taken, the day's production will be added to the next day's production and sublots determined based on the total quantity placed during the two days. Therefore, a maximum of six loose mix samples will be used to determine the loose mix maximum specific gravity.

D. Securing Cores. The Engineer will secure the cores which will be tested by the Regional Materials Laboratory in accordance with MP 402-02 once they have been extracted from the pavement by the Contractor.

E. Sample Delivery. Deliver the cores, loose mix samples, and gauge density readings, when required, to the Regional Laboratory no later than the end of the following day's placement. Pavement cores and loose mix samples required under 50 Series or 60 Series methods must be submitted together at the end of the day's placement but no later than ***a day following placement of the lot.*** If these samples are not submitted together for any paving lot, the QAF will be assigned a 1.00 or less for that lot when a QAF is applicable. ***If, for any reason, a delay occurs in the delivery of the lot*** samples for three consecutive lots, paving operations for the item will not be permitted to continue until the samples are delivered and tested.

F. Unacceptable Pavement Cores. Cores arriving at the Regional Laboratory for testing that are damaged or with a damaged or missing security seal will not be tested. The Engineer will select new core(s) within a foot from the original core location(s) at the same offset. The provision of selecting new core location also applies to core(s) that get damaged during extraction.

G. Process for Dispute Resolution. The following items may be disputed:

1. When a core(s) is located in the area that is believed not to represent the entire sublot's placement, notify the Engineer immediately.
2. When the test results of the cores and loose mix samples obtained by the Regional Materials Laboratory are in question, notify the Engineer and the Regional Materials Engineer, in writing, within two business days upon receipt of the results. The notification must include details of the dispute such as the specific test result(s) being disputed and the reason. The Main Office

Materials Bureau will review the information and advise the Engineer and the Regional Materials Engineer on how to proceed with the resolution.

The dispute resolution must be initiated in a timely manner as described above.

402-3.09 Joints. The finished pavement at all joints must comply with the surface tolerance requirements and exhibit the same uniformity of texture and compaction as other sections of the course. Do not pass rollers over the unprotected edges of a freshly laid mixture unless permitted by the Engineer.

Construct all joints, excluding the tapered wedge joint, such that the exposed edge of the newly placed layer is full thickness of the layer and straight unless the exposed joint will not be part of the joint. If the edge of the newly placed layer is unacceptable to the Engineer, correct the edge by using a power driven saw or other approved tools to cut a neat line. Prior to placing the adjacent layer, apply a light tack coat, in accordance with Section 407, to all pavement edges in order to provide bonding with the newly laid pavement.

Place successive HMA courses over a full depth HMA pavement such that all longitudinal joints are offset no more than 6 inches from the joint of the lower pavement course, unless otherwise approved by the Engineer. Place successive HMA courses on the existing PCC pavement such that all longitudinal joints are stacked on top of the joint of the lower PCC pavement.

A. **Transverse.** Place the courses as continuously as possible to limit the number of transverse joints. Stagger the transverse joints in adjacent lanes a minimum of 10 feet. Form the transverse joint by cutting back the previous run to expose the full depth of the course.

Set up the paver such that material is laid to overlap the previously placed edge by 2 to 3 inches. The thickness of the overlap material will be approximately one-fourth the compacted thickness of the course. Bump back the overlapped material onto the adjacent hot mat using a rake so that the roller operator can crowd the material into the hot side of the joint resulting in a smooth and well compacted joint after rolling. Broadcasting of the overlap material onto the fresh mat is not allowed. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if deemed necessary by the Engineer.

Compact the transverse joint in static mode with the roller parallel to the joint and perpendicular to traffic. Place boards of proper thickness at the edge of the pavement for the off pavement movement of the roller. Make the first pass with the roller operating on the previously laid material with 6 to 8 inches of its drum(s) overlapping onto the non-compacted mix. Then make successive passes with the roller drum(s) moving approximately one foot onto the hot material per pass until half the width of the roller is on the hot mat.

If a vibratory roller with pneumatic drive wheels is used, align the first pass with one of the pneumatic wheels directly on the joint and the drum operating in static mode. Then make successive passes with the roller drum moving approximately one foot per pass onto the hot mat until half the width of the roller is on the hot mat.

B. **Longitudinal.** Ensure that the longitudinal joints in the Top Course will correspond with the edges of the proposed traffic lanes. Other joint arrangements will require approval of the Engineer. If a dual-drum vibratory roller is used during construction of a longitudinal joint using either Option 1 or 2, operate the roller in vibratory mode, unless static rolling is required. Rollers must be as close to the paver as practical. Make the first pass with the roller traveling toward the paver and operating on the hot mat with 6 to 8 inches of the roller drum overlapping onto the cold mat. Apply a second pass to the joint as it travels back away from the paver. If a single-drum vibratory roller with pneumatic drive wheels is used, operate the roller in vibratory mode and follow the same procedure except that the roller will be aligned on the joint so that the pneumatic drive wheels travels on the joint. All turning movements of the roller will be done on previously compacted material. After applying two roller passes on the longitudinal joint, proceed with the roller to the low side of the lane and compact as

described in §402-3.07, *Compaction*.

For all HMA layers, other than Top Course, place the mixture such that no more than 100 feet of the longitudinal pavement joint is exposed at the end of the working day when traffic is maintained on the roadway during paving operations. For Top Course of 2 inches or less, refer to §402-3.09C, *Exposed Longitudinal Joint*.

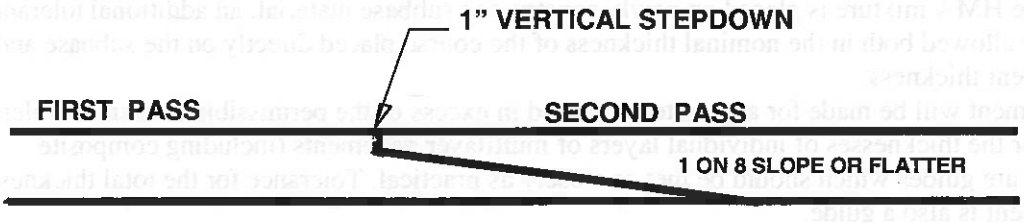
When paving Top Course, select one of the following options to construct the longitudinal joint. Use Option A for all other HMA courses:

1. **Option A - Butt Joint.** Under this option lay the HMA such that it uniformly overlaps the adjacent cold mat 2 to 3 inches. The thickness of the overlap material will be approximately one-fourth the compacted thickness of the course. Bump back the overlapped material onto the adjacent hot lane using a rake so that the roller operator can crowd the material into the hot side of the joint resulting in a smooth and well compacted joint after rolling. Broadcasting of the overlap material onto the fresh mat is not allowed. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if necessary.

   Bumping is not required when the use of a rake is a safety concern, as determined by the Engineer. Instead, place the HMA in a manner such that the thickness of the uncompacted layer is approximately 25% more than the compacted thickness of the adjacent cold HMA layer with a ½ to 1 inch overlap.

2. **Option B - Tapered Wedge Joint.** Use this option when placing Top Course only. Place the HMA mixture for the first mat with an attachment to the paver to provide a sloping wedge with a vertical step-down at the longitudinal pavement joint. Extend a wedge of material from the bottom of the step-down to the existing surface at a slope of 1 on 8 or flatter. Compact the first mat such that the roller compacts up to but does not extend past the step-down. The vertical step-down will be ½ inch minimum after compaction of the mat. Place the second mat such that it uniformly overlaps the adjacent cold mat 1 to 1 ½ inches. The thickness of the overlap material will be approximately one-fourth the compacted thickness of the HMA layer. Bump back the overlapped material onto the adjacent hot lane using a rake so that the roller operator can crowd the material into the hot side of the joint resulting in a smooth and well compacted joint after rolling. Do not broadcast the overlap material onto the lane. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if deemed necessary by the Engineer.

   Bumping is not required when the use of a rake is a safety concern, as determined by the Engineer. Instead, place the HMA in a manner such that the thickness of the uncompacted layer is approximately 25% more than the compacted thickness of the adjacent cold HMA layer with a ½ to 1 inch overlap.



TAPERED WEDGE JOINT

C. **Exposed Longitudinal Joint.** The longitudinal joint for the entire day may be exposed to traffic overnight when the HMA placement is Top Course of up to 2 inches. Exposed joints will not be

permitted for more than one night, over the weekends, holidays, or when there are other concerns, such as pending wet weather. Leaving exposed joints for any other HMA layers below the Top Course is not allowed. If the exposed joint is left open, the following applies:

- Place UNEVEN LANES (W8-11) warning signs posted in advance of the condition, at each ramp, and roadway intersection, and repeated every ½ mile, supplemented with NEXT [X] MILES (W16-4) auxiliary signs to alert drivers of the uneven edge.
- Use Option B, Tapered Wedge Joint, except when the thickness is 1 inch or less where a butt joint is allowed.
- If the exposed longitudinal pavement joint becomes damaged due to rounding of the notched wedge, saw-cut the joint prior to placing the adjacent lane.

402-3.10 Surface Tolerance. Construct each pavement course to a ¼ inch surface tolerance. The Engineer may test the surface with a 16-foot straight edge or string line placed parallel to the centerline of the pavement and with a 10-foot straight edge or string line placed transversely to the centerline of the pavement on any portion of the pavement. Variations exceeding 6 mm will be satisfactorily corrected or the pavement removed and replaced at no additional cost to the State.

402-3.11 Thickness Tolerance. The thickness indicated for each of the various courses of HMA pavement is the nominal thickness. Construct the pavement so that the final compacted thickness is as near to the nominal thickness as is practical, and within the tolerances specified below.

The Engineer may request cores to determine the thickness of the completed pavement layer for final acceptance and payment. Provide work zone traffic control and take cores at no additional cost to the State. Take cores and fill the all core holes in accordance with §402-3.08, *Pavement Density Samples*. The Engineer may use another acceptance method such as yield calculations to determine the final thickness for acceptance and payment.

HMA mixture, placed as a Truing and Leveling course as described in §402-3.05, *Conditioning of Existing Surface*, will not be considered in pavement thickness determinations. The allowable tolerance for HMA specified under a single pay item is as follows:

- ¼ inch or less for a required course whose nominal thickness is 4 inches or less
- ½ inch or less for a course or courses whose nominal thickness is over 4 inches

The tolerance for the total thickness of all HMA mixture courses is as follows:

- ¼ inch or less when the total nominal thickness indicated on the plans is 4 inches or less
- ½ inch or less when the total nominal thickness is over 4 inches but not more than 8 inches
- ⅝ inch or less when the total nominal thickness is more than 8 inches

When the HMA mixture is placed on newly constructed subbase material, an additional tolerance of ¼ inch will be allowed both in the nominal thickness of the course placed directly on the subbase and the total pavement thickness.

No payment will be made for any material placed in excess of the permissible tolerance. Tolerances indicated for the thicknesses of individual layers of multilayer pavements (including composite pavements) are guides which should be met as closely as practical. Tolerance for the total thickness of such pavement is also a guide.

The Regional Director may accept and pay for HMA placed under the following conditions:

- When the individual layer placed does not meet the thickness tolerance but substantially conforms to the plans and specifications, true to line and grade in order to attain a smooth riding pavement.
- When the total thickness of such pavements is less than the specified thickness including tolerances but substantially conforms to the plans and specifications.

- When the total thickness of such pavements is greater than the specified thickness and the excess thickness is necessary to attain a smooth riding pavement surface.

Payment for excess thickness necessary to achieve a smooth riding surface will be considered only in cases where an existing pavement surface has been resurfaced.

402-3.12 Paver and Equipment Cleaning. Do not clean tools and equipment used for HMA placement on the pavement surface, or near streams, ponds, drainage structures or other areas that are tributaries to waterways. Use an area approved by the Engineer for cleaning all paving equipment and tools. If possible, remove solid pieces of asphalt by scraping or other mechanical means prior to application of a cleaning agent. If a petroleum product is used for cleaning, contain all liquid products during cleaning operations using tarpaulins, sand pads, pails, or other collection methods to prevent spillage or accidental release. Use hand sprayers or other similar devices to minimize the amount of petroleum product applied. Properly dispose of sand and collected petroleum products as petroleum contaminated soil at no additional cost to the State.

402-3.13 Shoulder Edge Wedge. When specified, construct a shoulder edge wedge as detailed in the Contract Documents. Place HMA on the pavement shoulders where the outside edge of Top and Binder Course consist of an angle of 35° or flatter measured from finished grade to the preceding layer surface. Construct the shoulder edge wedge by using a device attached to the screed. Hand work should be minimized. The top of the tapered section shall begin at the end of the shoulder width as specified in contract documents such that the tapered section will be an additional width of material outside of the paved shoulder width. The shoulder edge wedge is optional at locations where guiderails are installed.

402-4 METHOD OF MEASUREMENT. Provisions of §401-4 Method of Measurement, apply, including the following:

The HMA will be measured in tons of compacted mixture. Quality payment adjustments are measured in Quality Units. Quality Units will be determined for each day's production and placement by using the daily Quality Adjustment Factor (QAF) for plant production, pavement density, longitudinal joint density, pavement smoothness, and the quantity placed.

Quality Units = (Quality Adjustment Factor - 1.00) x HMA Placed (Tons)

Quality Units will be determined for test sections for 50 and 60 Series compaction methods, when applicable, by using a factor of 1.5 for the first 200 tons placed on the test section.

Quality Units = 0.5 x HMA Placed (Tons) (not to exceed 200 tons)

When the pavement density QAF applies, use one of the following methods of measurement in Table 402-7, *Method of Measurement*, corresponding to the item used on the project:

TABLE 402-7 METHOD OF MEASUREMENT

Method Type	Pay Item Number	Description
A=50 series	402.XX5FQR	QAF based on calculated PWL using four cores.
B=60 series	402.XX6FQR	QAF based on average of four core densities.

The quantity of the HMA mixture subject to adjustment will be determined from quantity placed on the mainline and ramps of uniform width longer than 1250 feet. When shoulders and mainline are placed together, the mainline quantity may be determined using typical sections shown in the contract documents.

The pavement density QAF will not apply to HMA placed on ramps with a uniform full width section less than 1250 feet in length, shoulders, widenings, crossovers, and bridges. Payment in these areas will be a QAF of 1.00 based on satisfactory placement and compaction.

When a QAF of a paving lot for 50 Series or 60 Series is calculated to be 0.60, the lot will be evaluated by the RME to determine if it can be left in place. The type of material produced (i.e. Binder, Top), the layer in which it is used, and the location of use (i.e., mainline or a non-critical area) will be primary considerations in the determination of whether the HMA can be left in place. If the RME determines that the HMA can be left in place, the Engineer will apply a QAF of 0.60. If the HMA cannot be left in place, remove and replace at no cost to the State.

A. 50 Series Method. The RME will determine the paving lot's Percent Within Limits (PWL) in accordance with MP 402-02 and determine the density QAF as shown in Table 402-8, *Quality Payment Schedule for 50 Series*. The Engineer will use the QAF to calculate the Quality Units for the accepted HMA quantity.

TABLE 402-8 QUALITY PAYMENT SCHEDULE FOR 50 SERIES

Percent Within Limits (PWL)	Quality Adjustment Factor (QAF)
$PWL_{92\text{-}97} > 93$	1.05
$PWL_{92\text{-}97} \leq 93$	$\sum (PWL_{Segment} \times \text{Pay Factor}_{Segment})$[1]

1. $PWL_{Segment}$ will be calculated for each of the nine density ranges in Table 402-9, *Density Segment Pay Factors*, using the standard deviation and average density for the lot.

TABLE 402-9 DENSITY SEGMENT PAY FACTORS

Density Segment	Segment Pay Factor
88 – 89	0.60
89 – 90	0.70
90 – 91	0.80
91 – 92	0.90
92 – 93	1.00
93 – 96	1.05
96 – 97	1.00
97 – 98	0.90
98 – 99	0.80

B. 60 Series Method. When pavement density samples are taken and if payment adjustment is applicable, the Engineer will make the adjustment in accordance with Table 402-10, *Density Quality Adjustment Factors for 60 Series*. The Engineer shall make full payment when the average density of the four cores is between 92% and 97% of the mixture's average daily maximum theoretical density. If the average density fails to meet this limit, a payment adjustment will be made, based on Index Price, to all the material placed on the mainline for the day the cores represent, excluding the material placed on the test section.

TABLE 402-10 DENSITY QUALITY ADJUSTMENT FACTORS FOR 60 SERIES

Average Core Density	Quality Adjustment Factor
≤ 92 Density ≤ 97	1.00
$91.0 \leq$ Density < 92.0 or $97.0 <$ Density ≤ 98.0	0.95
$90.0 \leq$ Density < 91.0	0.90
$88.0 \leq$ Density < 90.0	0.85
Density < 88.0 or Density > 98.0	0.60

402-5 BASIS OF PAYMENT. The unit price bid for all pavement courses shall include the cost of all material, labor and equipment necessary to complete the work, including obtaining the pavement cores, filling and compaction of all core holes. Quality Units may apply to the hot mix asphalt items as calculated in §402-4. Payment of Quality Units will be made based on the Index Price listed in the contract documents. The Index Price shown in the itemized proposal for each Quality Unit is considered the price bid. The unit (index) price is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount bid for the Contract.

Payment will be made under:

Item No.	Item	Pay Unit
402.010902	Type 1 F9, Asphalt-Treated Permeable Base Course	Ton
402.010912	Plant Production Quality Adjustment to 402.010902	Quality Unit
402.011902	Type 2 F9, Asphalt-Treated Permeable Base Course	Ton
402.011912	Plant Production Quality Adjustment to 402.011902	Quality Unit
402.017902	True & Leveling F9, Superpave HMA, 70 Series Compaction	Ton
402.017912	Plant Production Quality Adjustment to 402.017902	Quality Unit
402.018902	True & Leveling F9, Superpave HMA, 80 Series Compaction	Ton
402.018912	Plant Production Quality Adjustment to 402.018902	Quality Unit
402.058902	Shim Course F9, Hot Mix Asphalt	Ton
402.058912	Plant Production Quality Adjustment to 402.058902	Quality Unit
402.095102	9.5 F1 Top Course HMA, 50 Series Compaction	Ton
402.095112	Plant Production Quality Adjustment to 402.095102	Quality Unit
402.095122	Pavement Density Quality Adjustment to 402.095102	Quality Unit
402.095152	Test Section Adjustment to 402.095102	Quality Unit
402.095202	9.5 F2 Top Course HMA, 50 Series Compaction	Ton
402.095212	Plant Production Quality Adjustment to 402.095202	Quality Unit
402.095222	Pavement Density Quality Adjustment to 402.095202	Quality Unit
402.095252	Test Section Adjustment to 402.095202	Quality Unit
402.096102	9.5 F1 Top Course HMA, 60 Series Compaction	Ton
402.096112	Plant Production Quality Adjustment to 402.096102	Quality Unit
402.096122	Pavement Density Quality Adjustment to 402.096102	Quality Unit
402.096152	Test Section Adjustment to 402.096102	Quality Unit
402.096202	9.5 F2 Top Course HMA, 60 Series Compaction	Ton
402.096212	Plant Production Quality Adjustment to 402.096202	Quality Unit
402.096222	Pavement Density Quality Adjustment to 402.096202	Quality Unit
402.096252	Test Section Adjustment to 402.096202	Quality Unit
402.096302	9.5 F3 Top Course HMA, 60 Series Compaction	Ton
402.096312	Plant Production Quality Adjustment to 402.096302	Quality Unit
402.096322	Pavement Density Quality Adjustment to 402.096302	Quality Unit

402.096352	Test Section Adjustment to 402.096302	Quality Unit
402.097102	9.5 F1 Top Course HMA, 70 Series Compaction	Ton
402.097112	Plant Production Quality Adjustment to 402.097102	Quality Unit
402.097202	9.5 F2 Top Course HMA, 70 Series Compaction	Ton
402.097212	Plant Production Quality Adjustment to 402.097202	Quality Unit
402.097302	9.5 F3 Top Course HMA, 70 Series Compaction	Ton
402.097312	Plant Production Quality Adjustment to 402.097302	Quality Unit
402.098102	9.5 F1 Top Course HMA, 80 Series Compaction	Ton
402.098112	Plant Production Quality Adjustment to 402.098102	Quality Unit
402.098202	9.5 F2 Top Course HMA, 80 Series Compaction	Ton
402.098212	Plant Production Quality Adjustment to 402.098202	Quality Unit
402.098302	9.5 F3 Top Course HMA, 80 Series Compaction	Ton
402.098312	Plant Production Quality Adjustment to 402.098302	Quality Unit
402.098902	9.5 F9 Top Course HMA, Shoulder Course, 80 Series Compaction	Ton
402.098912	Plant Production Quality Adjustment to 402.098902	Quality Unit
402.125102	12.5 F1 Top Course HMA, 50 Series Compaction	Ton
402.125112	Plant Production Quality Adjustment to 402.125102	Quality Unit
402.125122	Pavement Density Quality Adjustment to 402.125102	Quality Unit
402.125152	Test Section Adjustment to 402.125102	Quality Unit
402.125202	12.5 F2 Top Course HMA, 50 Series Compaction	Ton
402.125212	Plant Production Quality Adjustment to 402.125202	Quality Unit
402.125222	Pavement Density Quality Adjustment to 402.125202	Quality Unit
402.125252	Test Section Adjustment to 402.125202	Quality Unit
402.126102	12.5 F1 Top Course HMA, 60 Series Compaction	Ton
402.126112	Plant Production Quality Adjustment to 402.126102	Quality Unit
402.126122	Pavement Density Quality Adjustment to 402.126102	Quality Unit
402.126152	Test Section Adjustment to 402.126102	Quality Unit
402.126202	12.5 F2 Top Course HMA, 60 Series Compaction	Ton
402.126212	Plant Production Quality Adjustment to 402.126202	Quality Unit
402.126222	Pavement Density Quality Adjustment to 402.126202	Quality Unit
402.126252	Test Section Adjustment to 402.126202	Quality Unit
402.126302	12.5 F3 Top Course HMA, 60 Series Compaction	Ton
402.126312	Plant Production Quality Adjustment to 402.126302	Quality Unit
402.126322	Pavement Density Quality Adjustment to 402.126302	Quality Unit
402.126352	Test Section Adjustment to 402.126302	Quality Unit
402.127102	12.5 F1 Top Course HMA, 70 Series Compaction	Ton
402.127112	Plant Production Quality Adjustment to 402.127102	Quality Unit
402.127202	12.5 F2 Top Course HMA, 70 Series Compaction	Ton
402.127212	Plant Production Quality Adjustment to 402.127202	Quality Unit
402.127302	12.5 F3 Top Course HMA, 70 Series Compaction	Ton
402.127312	Plant Production Quality Adjustment to 402.127302	Quality Unit
402.128102	12.5 F1 Top Course HMA, 80 Series Compaction	Ton
402.128112	Plant Production Quality Adjustment to 402.128102	Quality Unit
402.128202	12.5 F2 Top Course HMA, 80 Series Compaction	Ton
402.128212	Plant Production Quality Adjustment to 402.128202	Quality Unit
402.128302	12.5 F3 Top Course HMA, 80 Series Compaction	Ton
402.128312	Plant Production Quality Adjustment to 402.128302	Quality Unit
402.128902	12.5 F9 Top Course HMA, Shoulder Course, 80 Series Compaction	Ton
402.128912	Plant Production Quality Adjustment to 402.128902	Quality Unit
402.195902	19 F9 Binder Course HMA, 50 Series Compaction	Ton
402.195912	Plant Production Quality Adjustment to 402.195902	Quality Unit
402.195922	Pavement Density Quality Adjustment to 402.195902	Quality Unit

402.195952	Test Section Adjustment to 402.195902	Quality Unit
402.196902	19 F9 Binder Course HMA, 60 Series Compaction	Ton
402.196912	Plant Production Quality Adjustment to 402.196902	Quality Unit
402.196922	Pavement Density Quality Adjustment to 402.196902	Quality Unit
402.196952	Test Section Adjustment to 402.196902	Quality Unit
402.197902	19 F9 Binder Course HMA, 70 Series Compaction	Ton
402.197912	Plant Production Quality Adjustment to 402.197902	Quality Unit
402.198902	19 F9 Binder Course HMA, 80 Series Compaction	Ton
402.198912	Plant Production Quality Adjustment to 402.198902	Quality Unit
402.255902	25 F9 Binder Course HMA, 50 Series Compaction	Ton
402.255912	Plant Production Quality Adjustment to 402.255902	Quality Unit
402.255922	Pavement Density Quality Adjustment to 402.255902	Quality Unit
402.255952	Test Section Adjustment to 402.255902	Quality Unit
402.256902	25 F9 Binder Course HMA, 60 Series Compaction	Ton
402.256912	Plant Production Quality Adjustment to 402.256902	Quality Unit
402.256922	Pavement Density Quality Adjustment to 402.256902	Quality Unit
402.256952	Test Section Adjustment to 402.256902	Quality Unit
402.257902	25 F9 Binder Course HMA, 70 Series Compaction	Ton
402.257912	Plant Production Quality Adjustment to 402.257902	Quality Unit
402.258902	25 F9 Binder Course HMA, 80 Series Compaction	Ton
402.258912	Plant Production Quality Adjustment to 402.258902	Quality Unit
402.376902	37.5 F9 Base Course HMA, 60 Series Compaction	Ton
402.376922	Pavement Density Quality Adjustment to 402.376902	Quality Unit
402.376912	Plant Production Quality Adjustment to 402.376902	Quality Unit
402.376952	Test Section Adjustment to 402.376902	Quality Unit
402.377902	37.5 F9 Base Course HMA, 70 Series Compaction	Ton
402.377912	Plant Production Quality Adjustment to 402.377902	Quality Unit
402.378902	37.5 F9 Base Course HMA, 80 Series Compaction	Ton
402.378912	Plant Production Quality Adjustment to 402.378902	Quality Unit

Mix Type – XX	Compaction Series - Y	Friction - Z	Quality Adjustment - Q
9.5 Top - 09	50 series - 5	F1 - 1	HMA Item - 0
12.5 Top - 12	60 Series - 6	F2 - 2	Plant – 1
19.0 Binder - 19	70 Series - 7	F3 - 3	Density – 2
25.0 Binder - 25	80 Series - 8	F9 - 9	Test Section – 5
37.5 Base - 37			

Make the following changes to the Standard Specifications dated May 4, 2006:
Delete Section 402 – Hot Mix Asphalt (HMA) Pavements in its entirety and ***replace*** it with the following:

SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

402-1 DESCRIPTION. These specifications apply to all plant mixed Hot Mix Asphalt (HMA) produced at a production facility under Section 401, Plant Production, irrespective of aggregate gradation, type, and amount of HMA material or use.

This work will consist of providing, placing, and performing density monitoring of one or more courses of HMA pavement constructed on the prepared foundation in accordance with the contract documents or as directed by the Engineer.

402-2 MATERIALS

402-2.01 General. Use aggregate and PG binder from a supplier listed in the Department's Approved List of Fine and Coarse Aggregates. Use of mineral filler or any other materials for the production of HMA will be accepted in accordance with the State's written instructions.

A PG Binder grade and the Design Estimated Traffic in 80 kN ESALs will be specified by Special Note in the contract documents.

402-2.02 Composition of Mixtures. Supply HMA for the project meeting the requirements of §401-2 of the Standard Specifications and the mixture design procedure as written in Materials Method (MM) 5.16, *Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedures*.

The Contractor will be responsible for the quality and performance of the mixture created from approved components. The Department reserves the right to take samples at any time and location to assure the materials and workmanship incorporated into each Department project are in conformity with the approved plans and specifications.

402-3 CONSTRUCTION DETAILS. The Engineer will conduct a pre-paving meeting prior to any routine HMA placement. The attendance to this meeting will include Regional Materials Engineer, Paving Foreman, Chief Inspector or Paving Inspector(s), HMA plant representative, density gauge operator, if necessary, and traffic protection personnel. Participants will review all aspects of the specifications requirements including, but not limited to, the following:

- HMA mixture delivery temperature
- Equipment and setup
- Mix codes to assure correct mix is delivered to the project
- Gauge operator certification
- Proper construction practice to provide quality product
- Traffic Control Activities

A certified density gauge operator must be present to monitor pavement density using a density gauge for 50 Series (non-mainline areas), 60 Series, and 70 Series compaction methods. The gauge operator must hold a current Density Gauge Inspector Certification from the Associated General Contractors, New York State, or its equivalent, as determined by the Director, Materials Bureau.

Do not place HMA mixture on any wet surface. Wet surface is defined as one that is moistened, covered, or soaked with water.

402-3.01 Temperature and Seasonal Limitations.

A. Surface Temperature

1. Place HMA only when the pavement surface temperature is equal to or greater than those specified in Table 402-1, *Temperature Requirements.*

TABLE 402-1 TEMPERATURE REQUIREMENTS

Nominal Compacted Lift Thickness	Surface Temperature Minimum
≤ 25 mm	10°C
25 mm < Thickness ≤ 75 mm	7°C
> 75 mm	5°C

2. **Temperature Measurement:** Furnish a surface thermometer capable of reading surface temperature to nearest 1° C for the exclusive use of the Engineer. The Engineer will measure pavement surface temperatures on the surface where the mixture is to be placed. The controlling temperature will be the average of three readings taken at locations 8 meters apart utilizing a surface thermometer covered by insulation for 10 minutes or until a constant temperature is reached. Infra Red (IR) temperature guns may be used in lieu of surface thermometer. When IR gun is used and if there is a dispute with the value obtained, the Engineer will determine the temperature using the surface thermometer.

B. Seasonal Limits: Place HMA Top Course on mainline and shoulders between April 1 and November 30 for the counties of Dutchess, Orange, Putnam, Rockland, Westchester, Nassau, Suffolk, and the City of New York. For all other counties, place HMA Top Course between April 15 and October 31. When placing Top Course HMA outside the seasonal limitations, provide a limited warranty against defects in such work. Perform the warranty work in accordance with Materials Procedure (MP) 402-01, *Warranty Requirements for Hot Mix Asphalt (HMA) Top Course*. Unless specified elsewhere in this specification or contract documents, these seasonal limits do not apply for any other HMA layer placement.

C. Temporary HMA Placements: HMA placement for temporary detours, which are not and will not become part of the permanent pavement, will not be subject to the temperature and seasonal limitations but must be approved by the Engineer when placed outside temperature and seasonal limits.

D. Miscellaneous HMA Placements: The Engineer may allow the placement of HMA mixtures for curbs, driveways, sidewalks, gutters, and other incidental construction below the minimum temperature and outside the seasonal limits to expedite the completion of the project.

E. Scheduling HMA Placement: Schedule paving operations such that all HMA placements are completed within the temperature and seasonal limitations, provide safe and adequate work zone traffic control, and protect previously laid courses. Such scheduling will include expediting construction operations to permit paving within the seasonal limitations or by limiting the length of work so that it can be completed before the seasonal shut-down. Should paving operations not be completed within temperature and seasonal limitations, provide, at no additional cost to the state, all temporary materials and work necessary such as shimming of castings and protrusions, drainage of the roadway, providing acceptable rideability, and other work needed for the adequate work zone traffic control. Base or Binder layers which will be permanently incorporated into the work may be left open to traffic over the winter. However, if there is any damage to these layers, repair any damaged areas prior to placing subsequent layer at no additional expense to the State. This requirement also applies to the repairs deemed necessary by the Engineer on the temporary HMA placements. Clean this pavement course in accordance with Section 633, *Conditioning Existing*

Pavement, at no additional expense to the State, prior to applying a tack coat and overlaying. Apply tack coat in accordance with Section 407, Tack Coat, immediately prior to HMA overlay.

402-3.02 HMA Pavers. Provide pavers capable of spreading and finishing courses of HMA plant mix material in lane widths, shoulders, or similar construction applicable to the specified typical section and thicknesses shown on the plans. Repair or replace immediately any paver found to be worn or defective either before or during its use. Provide HMA pavers that meet the following requirements:

- Self-powered with an activated screed or strike-off assembly.
- Capable of operating at forward speeds consistent with satisfactory placement of the mixtures.
- Have a receiving hopper with sufficient capacity for uniform spreading operation and with automatic flow controls to place the mixture uniformly in front of the screed. Heat the screed or strike-off assembly as necessary to produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture.
- When screed extensions are necessary for placement of mainline pavement, provide extensions of the same design as the main screed.
- Mount auger and tunnel extensions on the paver when the screed is extended more than 0.3 m for fixed paving widths wider than 3.6 m when mat uniformity is not achieved as determined by the Engineer.
- When used for placing the initial paving layer, Base, Binder, and Top Courses, pavers must be equipped with approved automatic transverse slope and longitudinal grade screed controls. The controls shall automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities in the existing surface. The controls shall be capable of maintaining the proper transverse slope and be readily adjustable so transitions and super-elevated curves can be satisfactorily paved. The controls shall operate from suitable fixed or moving references as prescribed in §402-3.06, *Spreading and Finishing*.

  When paving mainline, provide a paver with functional automatic transverse slope and longitudinal grade screed controls that can be operated from either side of the paver. The transverse slope and longitudinal grade screed controls of the HMA paver may be manually adjusted according to the requirements of §402-3.06, *Spreading and Finishing*.

  Engineer will inspect and approve HMA pavers for use prior to the start of paving operations.

402-3.03 Hauling Equipment. Provide HMA transport trucks that have clean, smooth, tight metal beds with waterproof covers for transporting HMA mixtures to the work site. When a flexible cover is used, provide a cover that overlaps the vehicle's sideboards and back by a minimum of 150 mm and is fastened. The inside surface of the vehicle body may be lightly coated with a release agent listed on the Department's Approved List for Release Agents. Petroleum products or solvents are not permitted for use as release agents. All hauling equipment is subject to the approval by the Engineer.

402-3.04 Rollers. Rollers can either be vibratory, static steel wheel type, or pneumatic tire rollers. The Engineer will inspect rollers prior to start of paving operations to determine acceptability. A minimum of two rollers, one for breakdown and one for finish rolling, are required unless the HMA placement is on a bridge deck, bridge approaches, or other areas where a single steel wheel vibratory roller may be sufficient to achieve required density. Rollers must be in good mechanical condition, and capable of operating at speeds slow enough to avoid displacement of the mixture. The use of equipment which results in excessive crushing of aggregate will not be permitted. All rollers for HMA placement must appear on the Department's Approved List for Rollers, available on the Department's website.

A. Vibratory rollers: These rollers shall be specifically designed for the compaction of HMA mixture. Vibratory roller models satisfying the specification requirements contained herein will be evaluated by the Materials Bureau to determine compaction capabilities. If acceptable, the roller model will be placed on the Department's Approved List for Hot Mix Asphalt Vibratory Compaction Equipment. Vibratory roller models appearing on this list will be allowed to be used. Alternate types

of rollers may be approved by the Director, Materials Bureau, upon reviewing the specification of the rollers and demonstration that satisfactory results can be achieved.

Provide vibratory rollers that meet the following requirements:

Nominal Amplitude	1.25 mm maximum.
Vibration Frequency	25 Hz minimum.
Drum Width (dual vibrating drums)	1.3 m, minimum
(single vibrating drum)	2.1 m, minimum

All vibratory rollers shall be equipped with a speedometer that accurately indicates roller speed in either 1 km/hr or 15 m/min increments (maximum) throughout the specified operating range. Vibratory rollers must also be equipped with a speed control device that can be set to prevent the roller from traveling in excess of 4 km/hr or 67 m/min when the roller is in vibratory mode. The type of speed control device will be subject to the approval of the Director, Materials Bureau. When rollers have pneumatic drive wheels, release agents listed on the Department's Approved List may be used on the tires to prevent material pickup.

B. Static steel-wheel rollers. These rollers shall be self-propelled and be either 9 to 11 metric ton three axle types or 7 to 9 metric ton two axle types.

C. Pneumatic rubber-tired rollers. These rollers shall be self-propelled and consist of two axles on which multiple pneumatic-tired wheels are mounted in such a manner that the rear wheels shall not follow in the tracks of the forward wheels and will be spaced to give essentially uniform coverage with each pass. The axles will be mounted in a rigid frame provided with means for adding ballast. The wheels shall be mounted so as to oscillate individually or in pairs. The tires must be smooth and show no tread pattern, be of equal size and diameter, and be uniformly inflated. Pneumatic rollers shall meet the following requirements unless otherwise approved:

Maximum Wheel Load	2,600 kg
Tire Compression on Pavement	550±35 kPa
Maximum Axle Load	10,160 kg

402-3.05 Conditioning of Existing Surface. When specified in the contract documents, clean the surface of the existing pavement, fill joints and cracks, and level the surface to a uniform grade and cross slope prior to the application of a new HMA course in accordance with the provisions of Section 633, *Conditioning Existing Pavement*. Clean any foreign material from the pavement resulting from construction operations at no additional cost to the State.

Prior to placing new HMA, apply a thin, uniform tack coat as specified in Section 407, *Tack Coat*, to all contact surfaces of existing HMA and Portland Cement Concrete layers including such areas as adjacent pavement edges, curbing, gutters, manholes, and other structures where the HMA will be in contact.

Fill any depressions and wheelpath ruts prior to paving Truing and Leveling course, as directed by the Engineer. Use Table 402-2, *Mixture Selection for Filling Wheelruts & Depressions*, to select the appropriate mix type.

TABLE 402-2 MIXTURE SELECTION FOR FILLING WHEELRUTS & DEPRESSIONS

Depth Range (mm)	Mixture Type
< 7	No treatment
$7 \leq$ Depth < 20	Shim
≥ 20	9.5 mm

If a Truing and Leveling course is specified in the plans or in the itemized proposal, place the course(s) of a minimum variable thickness of proper plant mix necessary to bring the surface of the existing pavement to the same transverse slope and longitudinal grade required for the finished pavement surface. The surface of this course shall be tested in the same manner prescribed in §402-3.10, *Surface Tolerance*, except that the allowable variation from the true surface after compaction must not exceed 10 mm. Unless a mixture type is specified in the plans, use Table 402-3, *Mixture Selection for T&L Course*, to select the appropriate mix type such that dragging of stones is minimized during placement of the mixture.

TABLE 402-3 MIXTURE SELECTION FOR T&L COURSE

Compacted Thickness Range (mm)	Mixture Type
≤ 50	9.5 mm or 12.5 mm
$50 <$ Thickness ≤ 75	19.0 mm or 25.0 mm
$75 <$ Thickness ≤ 125	25.0 mm or 37.5 mm

Select a mixture such that dragging of stones at the thin edge is minimized when constructing wedges for super-elevation. If dragging is excessive in any T&L course, the Engineer shall disallow the selected T & L mixture for the application.

402-3.06 Spreading and Finishing

A. **Surface Tolerance:** The requirements of §402-3.10, *Surface Tolerance*, shall apply.
B. **Mix Temperature:** For 50, 60, and 70 series compaction methods, select a desired HMA mixture temperature to be delivered within the mixing and compaction range of 120°C and 165°C, or as recommended by the PG Binder manufacturer. Notify the Engineer of the desired delivery temperature. Produce and deliver mixtures to the work site, and incorporate into the work within 10°C of the specified temperature. For 80 Series compaction method, the Contractor will select the desired mix temperature with the concurrence of the Engineer.
C. **Tack Coat:** Apply tack coat on the contact surfaces between all HMA pavement lifts in accordance with Section 407, *Tack Coat*, prior to placing HMA mixture regardless of time period between lifts. Tack coat is not required on the surface of Permeable Base courses. Paving over a tack coat should not commence until the emulsion has broken (goes from brown to black) or is tacky when touched.
D. **HMA Mixture from Multiple Plants:** Supply of HMA mixture from multiple plants to a single paver is prohibited.
E. **Top Course Texture and Color:** Supply Top Course HMA from a single plant for the entire project duration such that the pavement surface has a uniform color and texture as determined by the Engineer. Exception to this requirement is when a contract includes multiple paving sites or the project length is at least 8 kilometers and supply from multiple plants at discrete points of terminus is practical. In that case, the above requirement will apply to each paving site and locations between discrete points of terminus as approved by the Regional Materials Engineer. Limits of each site will be subject to approval by the Regional Materials Engineer. If a plant breaks down, another plant may supply mixture meeting the requirements of §402-2.02 if the aggregate used for manufacturing of the HMA is from the same source with the concurrence of the Regional Materials Engineer.
F. **Reference Line:** When the initial pavement course is laid with automatic HMA pavers on a new or a reconstruction project, use a taut reference line positioned at or near the pavement centerline or edge to guide the paver. Erect and maintain the reference line to the satisfaction of the Engineer. Support the reference line at approximately 8 m intervals on tangent sections and at closer intervals on curves. Tension the line sufficiently to remove any sagging. The Engineer may permit a moving reference of at least 9 m in length in lieu of a reference line. The moving reference may be a floating beam, ski, or other suitable type such that the resulting pavement layer surface is sufficiently even. A short ski or

shoe may also be used for the initial course with the approval of the Engineer if a satisfactory fixed reference such as a curb, gutter, or other fixed reference is adjacent to the pavement. In addition, any course in an adjacent lane may be used as the reference for the use of a short ski. When the proposed floating beam or the short ski does not produce the results similar to those obtained using a taut reference line, the Engineer shall disapprove the use of these devices. The Engineer has final approval of the method chosen by the Contractor.

The automatic screed controls are not required for shoulders, temporary detours, behind curbs, where existing grades at roadway intersection or drainage structure must be met, or in other areas where its use is impractical.

G. Mix Placement: Use HMA paver(s) to place the mixture either over the entire width or over a partial width that may be practical. Place the mixture on a clean, tack coated surface. Upon arrival at the site, the trucks will deliver the mixture into the paver. Immediately, spread and strike off to the required width and appropriate loose depth to established grade, elevation, and to obtain the required compacted thickness at the completion of work. If the areas to be paved are less than 93 m^2 or small and scattered, the HMA mixture may be spread by hand or other method approved by the Engineer. For these areas, dump and spread the mixture such that the compacted thickness meets the thickness specified in the plans.

Place all pavement courses using one of the reference line methods mentioned in §402-3.06 F. Prior to the beginning of rolling, check the loose mat, adjust any irregularities, and remove and replace all unsatisfactory material.

When filling wheel ruts with Shim Course or 9.5 mm mixture in an existing pavement, place mixture in each wheelpath rut separately. Use a drag box configuration or approved equal having side forms to shim the ruts. Spread and strike off the Shim Course material to a uniform width of approximately 1.2 m. The intent of the operation is to fill the low area only and not to place the material over the pavement's full lane width. The placement equipment wheels and/or other appurtenances must not interfere with the distribution and placement of the Shim Course material.

402-3.07 Compaction. Compact the HMA pavement sufficiently using the appropriate compaction method specified in Table 402-4 *Compaction Methods*, to achieve pavement densities in a range of 92% to 97%, expressed as a percentage of the mixture's maximum theoretical density (MMTD).

When placing HMA mixture using 50, 60, or 70 series compaction method, control all operation of the rollers including speed, amplitude settings, vibration frequency, and the type of rollers.

Immediately compact the HMA using rollers meeting the requirements of §402-3.04, *Rollers,* after the mixture has been placed. Compact the HMA when the mixture is in the proper condition such that the rollers do not cause displacement, cracking, or shoving. Initially, compact all courses with the roller traveling parallel to the centerline of the pavement, beginning at each edge and working toward the center. Compact super-elevated curves starting at the low-side edge and working toward the higher edge.

Correct immediately any displacement occurring as a result of reversing the direction of the roller, or from other causes, using rakes and additional HMA mixture as required. Exercise care in rolling so as not to displace the line and grade of the edges of the HMA mixture. To prevent adhesion of the mixture to the rollers, keep the wheels properly moistened with water, water mixed with small quantities of detergent, or other approved material. Petroleum products or solvents are not permitted.

Upon completion of the HMA placement, there shall be no visible defects in the pavement, such as shallow ruts, ridges, roller marks, cracking, tearing, segregation, bleeding, or any other irregularities. Any defects that become apparent shall be corrected, or the defective pavement replaced, to the satisfaction of the Engineer, at no additional cost to the State.

Along forms, curbs, headers, walls, and other areas not accessible to rollers, compact the mixture thoroughly with mechanical tampers. On depressed areas, use a trench roller or a small vibratory roller with the approval by the Engineer.

Remove any mixture that becomes loose and broken, mixed with dirt, or is in any way defective and replace with fresh HMA mixture. Compact the mixture to conform to the surrounding area. Correct any area showing an excess or deficiency of HMA material.

When Shim Course or 9.5 mm is used for filling wheel ruts, make a minimum of three passes of a

pneumatic rubber tire roller for compaction. Otherwise, make a minimum of two passes when Shim Course is used as a skim coat. The Engineer may allow the use of other types of rollers.

Do not use vibratory compaction when HMA mixture is placed on structural bridge decks or other structures with less than 0.6 m of cover over the structure or when specified in contract documents. If vibratory compaction is used, repair all damages which may occur to the highway components and adjacent property, including buried utility and service facilities, at no additional cost to the State.

Monitor density for 60 and 70 Series projects with density gauges specified in §402-3.07 E, *Density Gauges.* The density gauge operator shall possess a current Density Gauge Inspector Certification from The Associated General Contractors, New York State, or its equivalent, as determined by the Director, Materials Bureau. Any pavement section placed under 60 or 70 Series which is monitored by a gauge operator whose certification is revoked for reasons outlined in the New York State Inspector Certification Program manual under "Decertification", will be evaluated by sampling and testing of pavement cores in accordance with §402-3.08, *Pavement Density Samples*, and subject to payment adjustment in accordance with Table 402-10, *Density Quality Adjustment Factors for 60 Series*. The above requirement also applies when a density gauge is used for monitoring pavement density in the areas other than mainline under 50 Series compaction method.

Table 402-4, *Compaction Methods*, associates specific item being placed to the required compaction method.

TABLE 402-4 COMPACTION METHODS

Compaction Methods	Item Number
A=50 series	402.XX5FQR
B=60 series	402.XX6FQR
C=70 series	402.XX7FQR
D=80 series	402.XX8FQR & other

NOTE: XX = 37, 25, 19, 12, 09, 05, 01
F = Friction requirement (1, 2, 3, 9)
Q = Quality item number (core item = 0, plant = 1, density = 2)
R = Revision number

Below is a detailed requirement for each of the compaction methods:

A. 50 Series Compaction Method. On the first day of mainline paving, construct the pavement under the provisions of "*Option 1 - Test Section*" or "*Option 2 – First Day Routine Paving.*"

1. **Option 1 - Test Section.** Construct a test section on the project site at a location approved by the Engineer. The purpose of the test section is to determine if the mixture can be compacted uniformly within the 92-97% of MMTD. The test section will be the same depth specified for the construction of the course which it represents. The test section length shall be at least 100 linear meters but not to exceed 500 linear meters when the test section is on the mainline. If required by the Engineer, construct full pavement width to close the joint(s). Use the first 50 meters of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select core locations, excluding the first 50 meters, in accordance with §402-3.08, *Pavement Density Samples*. Before the road is open to traffic, take the cores at the marked locations. Also, take loose mix samples as specified under §402-3.08, *Pavement Density Samples*. In addition to the above requirements, the following shall apply to the test section provision:

   - Only one test section will be placed per day. Subsequent test sections are subject to approval by the Engineer.

- The first 200 metric tons of quantity placed on a test section will be adjusted by a factor of 1.5 as a Test Section Adjustment. The adjusted quantity will be paid based on the Quality Index price. The remaining quantity will be paid at the bid price. A maximum of two test sections per item will be subject to this adjustment.
- The test section adjustment factor of 1.5 shall not apply for a test section if any HMA of 150 metric tons or more is placed on the same day, on the same project, other than the quantity required for the construction of the test section.
- Pavement Density Quality Adjustment Factors (QAF) shall not apply for the first two test sections. Subsequent test section(s) located on the mainline is subject to pavement density QAF.
- Placing HMA under *"Routine Paving"* provisions for this item is not permitted until the results of the cores from the test section have a minimum pavement density QAF of 1.00.
- When the pavement density QAF is less than 1.00, the Contractor shall construct another test section in accordance with "*Option 1, Test Section.*"
- When the calculated QAF is 0.60 or less, the Engineer will evaluate the test section to determine if it can be left in place. The guidance for evaluation can be found under §402-4, *Method of Measurement*. The Test Section Adjustment shall not apply for the test section.

2. **Option 2 – First Day Routine Paving.** It is not necessary to construct a test section on the first day of paving. Any HMA placed under this provision shall meet the following:

- The test section adjustment of 1.5 shall not apply.
- All material placed will be subject to a pavement density QAF.
- If the pavement density QAF on the first day of paving is less than 1.00, construct a test section in accordance with the provisions of the "*Option 1 - Test Section*" under this method.
- Evaluate density in accordance with 3. *Routine Paving,* below.

3. **Routine Paving.** Place all HMA beyond the "*Option 1 - Test Section*" using the provisions described below.

A paving lot is defined as a day's production of at least 200 metric tons. Each paving lot will be equally divided into four sublots in accordance with Materials Procedure (MP) 402-02, *Hot Mix Asphalt (HMA) Pavement Density Determination.* The Engineer will select and mark a core location in each sublot in accordance with §402-3.08, *Pavement Density Samples* once the compaction operation is completed. The Engineer will exclude the first 50 meters of the day's paving. Extract a core at the marked location in each sublot. Take four loose mix samples representing the lot. Pavement cores and loose mix samples will be tested and analyzed by the Department in accordance with MP 402-02 to determine the pavement density QAF. If the quantity placed is less than 200 metric tons on any day, pavement cores and loose mix samples are not required. The density QAF for that day will be reported as 1.00, provided the density gauge used on previous sections is utilized and the Engineer is satisfied that the procedures used in these areas to obtain pavement densities are similar to previously placed pavement sections. When paving is continuous within a 24-hour period, a new lot will result when a change occurs in the paving crew. When a project includes multiple paving operations, each paving operation will be considered a lot and evaluated separately.

When consecutive lots are found to have a density QAF equal to or less than 0.85, stop paving operations and immediately construct a new test section in accordance with the provisions of "*Option 1 - Test Section*", described previously in this section.

The density QAF shall not apply to material placed on shoulders, maintenance widening, crossovers, bridges and ramps with a uniform full-width section of less than 400 meters in length. Payment for these areas shall be based on satisfactory placement and compaction. Placement and compaction procedures will be satisfactory when the procedures used in these areas obtain

pavement density similar to that obtained on the mainline pavement sections. When the shoulder shows signs of distress during compaction, decrease the compaction effort until no further damage occurs to the shoulder or subbase. If density gauge(s) is used to monitor mainline paving, use the same gauge(s) to monitor density on the above referenced areas.

B. 60 Series Compaction Method. On the first day of mainline paving, construct the pavement under the provisions of "*Option 1 - Test Section*" or "***Option 2 – Test Section and Continue Paving***." The Engineer will approve the location of the test section. Placement of HMA under this method will not be allowed unless both a density gauge and a certified operator are present.

1. **Option 1 - Test Section Only.** Prior to routine paving operations for this item, construct a test section at a location approved by the Engineer. The purpose of constructing a test section is to determine a Project Target Density (PTD) for this item and correlation of a density gauge(s) to the cores. It is advisable to use the same equipment and procedures to construct the test section which will be used in the construction of the remainder of the course being laid. The test section will be the same depth specified for the construction of the course which it represents. The test section length shall be at least 100 linear meters but no more than 500 linear meters. If required by the Engineer, construct full pavement width to close the joint(s). Use the first 50 meters of the test section to stabilize the paving operation. At the conclusion of the test section, the Engineer will randomly select four 150 mm core locations on the test section in accordance with §402-3.08, *Pavement Density Samples* excluding the first 50 meters and mark the locations.

   During construction of the test section, take loose mix samples in accordance with §402-3.08, *Pavement Density Samples* such that they represent the material placed on the test section. Take density gauge(s) readings at each core location prior to drilling the cores in accordance with Materials Procedure (MP) 402-02, *Hot Mix Asphalt (HMA) Pavement Density Determination,* based on the type of density gauge used. Take cores at each of the marked core location.

   Deliver the cores, loose mix samples, and the four density gauge readings with the gauge type, model, and serial number to the Regional Materials Engineer in accordance with §402-3.08, *Pavement Density Samples*. The Regional Materials Engineer will test the samples and establish a PTD for each density gauge in accordance with Materials Procedure (MP) 402-02 within one business day of the delivery of the samples and density gauge readings. In addition to the above requirements, the following shall apply to the test section provision:

   - Only one test section will be placed per day. Subsequent test sections are subject to approval by the Engineer.
   - The first 200 metric tons of quantity placed on a test section will be adjusted by a factor of 1.5 as a Test Section Adjustment. The adjusted quantity will be paid based on the Quality Index price. The remaining quantity will be paid at the bid price. A maximum of two test sections per item will be subject to this adjustment.
   - The test section adjustment factor of 1.5 shall not apply for a test section if any HMA of 150 metric tons or more is placed on the same day, on the same project, other than the quantity required for the construction of the test section.
   - Placing HMA under "Routine Paving" provisions for this item is not permitted until a Project Target Density has been established.
   - When the average density of the four cores is less than 88% of the maximum theoretical density, the Engineer may evaluate the test section to determine if it should be left in place. The guidance for evaluation can be found under §402-4, *Method of Measurement*. The Test Section Adjustment shall not apply for the test section.

2. **Option 2 – Test Section and Continue Paving.** The following shall apply when HMA is placed on the first day under this option:

- Construct a test section as described under "*Option 1 - Test Section Only.*" Establish an Interim PTD as described in Materials Procedure (MP) 402-03 based on the density gauge used. Use this Interim PTD to monitor pavement density until the Actual PTD is established by the Regional Materials Engineer.
- The test section adjustment factor of 1.5 shall not apply.
- All material placed after the test section for that day shall be subject to a payment adjustment.
- Take additional loose mix samples, other than those taken under the "Test Section" provisions, in accordance with §402-3.08 and store these samples at the plant.
- Take density gauge(s) readings over the entire day's placement in accordance with Materials Procedure (MP) 402-02.
- When this option is selected and if the density readings at two consecutive locations fall below 96% or above 103% of the Interim PTD or if the moving average of the last 10 nuclear density readings falls below 98% of the Interim PTD, stop routine paving operations and wait for the Actual PTD.
- Submit a copy of the appropriate BR form(s) at the end of the first day's paving to the Engineer as described in Materials Procedure (MP) 402-02. The Engineer will determine whether the density readings taken using the Interim PTD are acceptable, based on the Actual PTD in accordance with Materials Procedure (MP) 402-02. If not, the Engineer will randomly select four core locations over the entire placement under Interim PTD, excluding the test section, and drill cores at the selected locations. Prior to drilling these cores, take density readings at each core location. Deliver the core samples, density gauge readings, and the loose mix samples to the Regional Laboratory in accordance with §402-3.08, *Pavement Density Samples*. If the average density of the pavement cores is not between 92% and 97% of the mixture's maximum theoretical density, the Engineer will make a payment adjustment in accordance with Table 402-10, *Density Quality Adjustment Factors for 60 Series*, to the material placed on that day and the subsequent days, excluding the material placed on the test section. Otherwise, continue under "*Routine Paving*".

3. **Routine Paving.** Use only the density gauge(s) that has been correlated with cores during the construction of the test section and a PTD has been determined by the Regional Materials Engineer for pavement density monitoring during routine paving operations. Construct a new test section under the provisions of "Test Section" to establish a PTD for other gauge(s). Compact the pavement sufficiently to achieve the PTD value at each test location. Take density gauge readings at each location in accordance with Materials Procedure (MP) 402-02. The test locations will be every 60 meters along the length of the pavement for each paver pass randomly selected by the Engineer in accordance with Materials Procedure (MP) 402-02. Record these density values on the appropriate BR form based on the type of gauge used. The minimum acceptable density reading is 96% and no greater than 103% of the PTD at a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations.

   If density gauge readings over two consecutive locations fall below 96% or above 103% of the PTD or if the moving average of the last 10 density gauge readings falls below 98% of the PTD, stop routine paving operations and construct a new test section in accordance with requirements of "*Option 1- Test Section Only.*"

   Placement and compaction on shoulders, ramps, maintenance widenings and crossovers, and bridges will be deemed satisfactory by the Engineer when the procedures used in these areas obtain pavement density similar to that obtained on the mainline pavement sections. Monitor and record the density of the above referenced areas with the same density gauge to insure the PTD is achieved. If the shoulder subbase is structurally insufficient to sustain the level of compaction such that the shoulder shows signs of distress, decrease the compaction effort until no damage occurs to the shoulder or subbase.

   In addition to the daily density monitoring with a gauge, additional set(s) of pavement cores and loose mix samples are required for pavement density verification at the frequency specified in

Table 402-5, *Additional Pavement Samples*. The frequency is based on the days of mainline HMA placement. Take density samples from the same day's placement. The Engineer will select the day of coring and will notify the Contractor 24 hrs prior to the day of coring. When notified, take these samples in accordance with §402-3.08, *Pavement Density Samples.* Before drilling the cores, take density gauge readings and record on the appropriate forms based on the type of gauge used. Deliver all the samples and the density gauge readings to the Regional Materials Engineer for testing.

TABLE 402-5 ADDITIONAL PAVEMENT SAMPLES

HMA Placement Days	Set of Pavement Samples
2 or Less	None
3 – 5	One Set
More than 5	Two Sets

Based on the additional Pavement Samples, the Regional Materials Engineer will establish a new PTD if different from the original PTD. The Engineer shall evaluate core density results using Table 402-10, *Density Quality Adjustment Factors for 60 Series,* and make payment adjustment, if necessary. When a contract includes multiple sites, the requirement under Table 402-05 applies to each paving site.

The Engineer may request pavement samples in accordance with §402-3.08, *Pavement Density Samples,* for density verification from HMA placed under the following situations:

- Insufficient number of density readings recorded, either at a specific location or at the required frequency.
- Paving completed after the only correlated density gauge on site breaks down.
- Gauge readings do not seem to accurately represent the HMA density.
- When the plant production QAF is 0.85 and need to evaluate the pavement section in accordance with §401-4.03, *Evaluation of Sublots Represented by 0.85 QAF,* whether to keep it in place.

When pavement samples are requested for the above situation(s), the Engineer will randomly select core locations. Take cores and density gauge readings at each core location in accordance with §402-3.08, *Pavement Density Samples*, and deliver them to the Regional Materials Laboratory. The Regional Materials Engineer may establish a new PTD based on these cores. The material placed under the above situations will be subject to a payment adjustment in accordance with Table 402-10.

The Engineer may also request additional pavement samples to verify PTD used on the project for the situations listed below and the material placed under these situations will not be subject to payment adjustment:

- Changes in condition of existing pavement being overlaid.
- Excessive plant mix variations.
- Using a different Job Mix Formula or a different HMA plant other than the one used to produce mix for the Test Section, as long as the aggregate and PG Binder sources do not change.

4. **Multiple Paving Sites.** When a project includes multiple paving sites, a test section will be constructed at the initial paving site to establish a PTD. For the rest of the paving sites, the Engineer will require pavement cores, loose mix samples, and gauge readings on the first day to verify PTD unless it is specified in the contract documents to construct a test section.

   A test section may be requested by the Engineer when a different HMA plant other than the one used at previous site(s) is supplying the mixture using different aggregate and PG Binder sources. The provisions of 1.5 test section incentive shall apply.

C. **70 Series Compaction Method.** On the first day of paving, construct a test section on the project site at a location approved by the Engineer using the same equipment and procedures to be used in the construction of the remainder of the course being laid. HMA placement under this method, including the construction of the test section, will not be allowed unless both a density gauge and a certified operator are present. The test section is for determining the Project Target Density (PTD) using the "peak" method. Routine paving operations may begin immediately following the construction of the test section once a PTD has been established by the Engineer based on the evaluation of density readings in accordance with the provisions of "Test Section" below.

1. **Test Section.** To establish a PTD prior to routine paving, construct a test section of at least 100 linear meters on the mainline which has the same depth specified for the construction of the course it represents. The maximum length is 500 linear meters. Use the first 50 meters of the test section to stabilize the paving operation. Use the remainder of the test section length to determine the Project Target Density (PTD). Initially, compact the pavement with a breakdown roller once sufficient HMA is placed in the testable area. Make four vibratory passes or as recommended by the Engineer. If non-vibratory compaction is specified in the contract documents, make four static passes. The Engineer will select three random locations in accordance with Materials Procedure (MP) 402-02 based on the type of density gauge used and mark these sites so that subsequent density testing can be performed at the same locations. Use either the intermediate or the finish roller for further rolling the test section. Take density readings at the three selected sites after every additional machine pass until the increase in density is less than 32.0 kg/m^3, or until the Engineer stops further compaction because the pavement shows signs of distress.

   The Engineer will determine PTD by calculating the average of the highest density reading from each of the random locations. Use the resulting PTD to monitor the pavement density for the project.

2. **Routine Paving.** Use only density gauge(s) that is correlated during the construction of the test section and the PTD determined by the Engineer to monitor pavement density during routine paving operations. Construct a new test section under the provisions of "Test Section" to establish a PTD for other gauge(s).

   Begin routine paving immediately after the PTD has been established. Compact the pavement sufficiently to achieve the PTD value at each test location. The minimum acceptable density reading will be 96% or maximum of 103% of the PTD in a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations as determined by a density gauge. Take density gauge readings at each location, randomly selected by the Engineer, in accordance with the Materials Procedure (MP) 402-02, approximately every 60 meters along the length of the pavement for each pass of the paver. Record these values on the appropriate BR form based on the type of gauge used.

   If density gauge readings over two consecutive locations fall below 96% or above 103% of the PTD or if the moving average of the last 10 density gauge readings falls below 98% of the PTD, stop routine paving operations and immediately construct a new test section in accordance with requirements of the Test Section.

   Placement and compaction on shoulders, ramps, maintenance widenings and crossovers, and bridges will be deemed satisfactory by the Engineer when the procedures used in these areas obtain pavement density similar to that obtained on the mainline pavement sections. Monitor the density of areas with the same density gauge to insure the PTD is achieved. If the shoulder subbase is structurally insufficient to sustain the level of compaction such that they show signs of distress, decrease the compaction effort until no damage occurs to the shoulder or subbase.

D. **80 Series Compaction Method.** Use one of the compaction options listed below for this method. The rollers used for compaction of the HMA mixtures under this method must be on the Department's Approved List for Rollers.

The number of passes listed in Table 402-6, *Number of Passes*, are recommended and may be increased or decreased by the Engineer to obtain adequate density. One vibratory pass is defined as one movement of a single drum of the roller over the pavement section in each direction. One static pass is defined as one movement of the roller over the pavement in each direction. Complete all breakdown roller passes before the mat temperature falls below 120°C. Remove all ruts, ridges, roller marks, or other irregularities from the surface using static rolling. All turning of the rollers must be performed on material which has had a minimum of one roller pass. The Engineer may approve alternate compaction procedures for areas where the specified procedures are not practical.

TABLE 402-6 NUMBER OF PASSES[1]

Pavement Courses	Option 1 Three Roller Train (Static)		Option 2 Vibratory Rollers	
	Steel Wheel Rollers	Pneumatic Roller	Vibratory Passes	Static Passes
37.5 mm Base (Each Lift)	8	3	6	4
25.0 mm Binder	8	3	6	4
19.0 mm Binder	6	3	4	2
12.5 mm Top	6	3	4	2
9.5 mm Top	4	3	4	2
Permeable Base[2]	-	-	-	2

1. Based on 3.6-meter lane width.
2. For the Permeable Base course, the mixture shall be compacted between 60°C and 110°C. Up to 2 additional passes may be required to obtain adequate density.

1. **Option 1 - Static Compaction.** Use this option only when the compacted thickness of the finished mat is 100 mm or less. The roller speeds shall not exceed 5 km/hr and will move at a uniform speed. The roller drive wheel or drum shall be nearest to the paver. When paving multiple lanes simultaneously, increase the required number of rollers proportionately for each additional full lane width unless otherwise approved by the Engineer. Under this option, compact the HMA mixtures with steel-wheel rollers operating in a static mode. Each pass shall overlap the previous roller pass by one-half the width of the roller.

   Initially, compact the HMA with a steel-wheel roller immediately followed with a pneumatic rubber-tired roller. A minimum of 3 passes of the rubber-tired roller will be required. One pass is defined as one movement of the roller over any point of the pavement in either direction.

   Use a steel-wheel roller for finish rolling the HMA to remove all shallow ruts, ridges, roller marks, and other irregularities from the surface.

   When the compaction procedure fails to produce acceptable results, adjust the procedure to obtain the desired results.

2. **Option 2 - Vibratory Compaction.** Furnish a vibrating reed tachometer for the exclusive use of the Engineer. The vibrating reed tachometer must have a frequency range of 17 Hz to 67 Hz with a minimum reed interval of 1 Hz between 17 Hz and 33 Hz and a minimum reed interval of 2 Hz between 33 Hz and 67 Hz.

   Operate the vibratory rollers at a uniform speed not to exceed 4 km/hr on all pavement courses. If satisfactory compaction is not obtained, or damage occurs to highway components and/or adjacent property using vibratory compaction equipment, immediately cease using this equipment and proceed with the work in accordance with compaction procedures stipulated under Option 1 at no additional cost to the State.

E. Density Gauges

1. **Nuclear Density Gauge.** Use a nuclear density gauge to monitor the pavement density in accordance with this sub-section and Materials Procedure (MP) 402-03. Submit a Safety Control plan at least two weeks prior to using the gauge. The nuclear density gauge shall meet the following requirements:
   - The gauge shall consist of a radioactive source, scaler, and other basic components housed in a single backscatter unit.
   - The gauge must be calibrated at least every two years.
   - Must be operated by personnel trained in the principles of nuclear testing and safety practices.

2. **Non-nuclear Density Gauge.** Use a non-nuclear density gauge to monitor the pavement density in accordance with this sub-section. The non-nuclear density gauge shall meet the following requirements:
   - Must be capable of functioning in the temperature and moisture levels experienced during HMA paving.
   - Shall contain the internal circuitry to determine the density of HMA pavements by measuring changes in the electromagnetic field resulting from the HMA compaction process.
   - The gauge must be calibrated at least every two years.

402-3.08 Pavement Density Samples

A. Pavement Cores. The Engineer will select one pavement core location for each sublot in accordance with Materials Procedure MP 402-02, *Hot Mix Asphalt (HMA) Statistical Pavement Density Determination,* to represent each paving sublot. The Engineer will select a total of four 150 mm diameter core locations. The pavement core samples will be taken from within the 150 mm diameter circles outlined. Under no circumstances will the Engineer designate the coring locations before the rolling operation is completed. The rolling operation is completed when all compaction equipment has moved off the sublot designated for coring. Obtain the 150 mm diameter pavement core samples no later than a day following placement of the lot. If necessary, cool the pavement so that the core samples are not damaged during coring. If the core sample does not de-bond during coring, do not intentionally separate the pavement core from the underlying material. The Regional Materials Laboratory will separate the pavement core layer required for testing from the underlying material by sawing, if necessary.

Extraction of companion cores is not allowed. Additional cores may be taken under the following:

- As described in §402-3.08 G, *Dispute Resolution,*
- If it is necessary to establish an interim target density on the first day of paving. In that case, take a core at no more than two core locations during the construction of a test section or two cores within the first 50 meters when a test section is not constructed
- To perform a quality control tests during routine paving. A maximum of two cores is allowed but prior permission of the Engineer is required. Core(s) shall not be adjacent to the project cores.

B. Filling Core Holes. Backfill all core holes with a similar HMA material immediately after extracting the cores or before opening the lane to traffic. Prior to backfilling, wipe the core hole with a cloth to remove any standing water. Place HMA in the core hole in layers of 75 mm or less and compact each layer with 5-8 kilogram slide hammer with a diameter of at least 100 mm but less than 150 mm. Use of a shovel or similar method is not allowed. The Engineer may approve alternative method if it will

provide acceptable results. If core holes are not filled within 2 business days of placement, the Engineer will stop routine paving until the core holes are filled.

C. Loose Mix Samples. On each paving day when pavement cores are required, take four loose mix samples in accordance with AASHTO T168, *Standard Test Method for Sampling Bituminous Paving Mixtures*. Take these samples such that they represent the day's HMA placement. Loose mix maximum theoretical specific gravity values from plant HMA QC/QA testing may be included as part of the required loose mix samples with prior approval of the RME. When HMA placement is less than the anticipated quantities, it is recommended that a minimum of three loose mix samples be obtained before placement is terminated. When operational conditions cause HMA placement to be terminated before the specified number of samples have been taken, the following procedures will be used:

1. If three samples are taken, the loose mix maximum theoretical specific gravity density will be based on the average of the samples taken.
2. When HMA is placed under 50 Series and if only one or two samples are taken, the day's production will be added to the next day's production and sublots determined based on the total quantity placed during the two days. Therefore, a maximum of six loose mix samples will be used to determine the loose mix maximum specific gravity.

D. Securing Cores. The Engineer will secure the cores which will be tested by the Regional Materials Laboratory in accordance with MP 402-02 once they have been extracted from the pavement by the Contractor.

E. Sample Delivery. Deliver the cores, loose mix samples, and gauge density readings, when required, to the Regional Laboratory no later than the end of the following day's placement. Pavement cores and loose mix samples required under 50 Series or 60 Series methods must be submitted together at the end of the day's placement but no later than a day following placement of the lot. If these samples are not submitted together for any paving lot, the QAF will be assigned a 1.00 or less for that lot when a QAF is applicable. If, for any reason, a delay occurs in the delivery of the lot samples for three consecutive lots, paving operations for the item will not be permitted to continue until the samples are delivered and tested.

F. Unacceptable Pavement Cores. Cores arriving at the Regional Laboratory for testing that are damaged or with a damaged or missing security seal will not be tested. The Engineer will select new core(s) within 0.3 m from the original core location(s) at the same offset. The provision of selecting new core location also applies to core(s) that get damaged during extraction.

G. Process for Dispute Resolution. The following items may be disputed:

1. When a core(s) is located in the area that is believed not to represent the entire sublot's placement, notify the Engineer immediately.
2. When the test results of the cores and loose mix samples obtained by the Regional Materials Laboratory are in question, notify the Engineer and the Regional Materials Engineer, in writing, within two business days upon receipt of the results. The notification must include details of the dispute such as the specific test result(s) being disputed and the reason. The Main Office Materials Bureau will review the information and advise the Engineer and the Regional Materials Engineer on how to proceed with the resolution.

The dispute resolution must be initiated in a timely manner as described above.

402-3.09 Joints. The finished pavement at all joints must comply with the surface tolerance requirements and exhibit the same uniformity of texture and compaction as other sections of the course. Do not pass rollers over the unprotected edges of a freshly laid mixture unless permitted by the Engineer.

Construct all joints, excluding the tapered wedge joint, such that the exposed edge of the newly placed layer is full thickness of the layer and straight unless the exposed joint will not be part of the joint. If the edge of the newly placed layer is unacceptable to the Engineer, correct the edge by using a power driven saw or other approved tools to cut a neat line. Prior to placing the adjacent layer, apply a light tack coat, in accordance with Section 407, to all pavement edges in order to provide bonding with the newly laid pavement.

Place successive HMA courses over a full depth HMA pavement such that all longitudinal joints are offset no more than 150 mm from the joint of the lower pavement course, unless otherwise approved by the Engineer. Place successive HMA courses on the existing PCC pavement such that all longitudinal joints are stacked on top of the joint of the lower PCC pavement.

A. Transverse. Place the courses as continuously as possible to limit the number of transverse joints. Stagger the transverse joints in adjacent lanes a minimum of 3 m. Form the transverse joint by cutting back the previous run to expose the full depth of the course.

Set up the paver such that material is laid to overlap the previously placed edge by 50 to 75 mm. The thickness of the overlap material will be approximately one-fourth the compacted thickness of the course. Bump back the overlapped material onto the adjacent hot mat using a rake so that the roller operator can crowd the material into the hot side of the joint resulting in a smooth and well compacted joint after rolling. Broadcasting of the overlap material onto the fresh mat is not allowed. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if deemed necessary by the Engineer.

Compact the transverse joint in static mode with the roller parallel to the joint and perpendicular to traffic. Place boards of proper thickness at the edge of the pavement for the off pavement movement of the roller. Make the first pass with the roller operating on the previously laid material with 150 to 200 mm of its drum(s) overlapping onto the non-compacted mix. Then make successive passes with the roller drum(s) moving approximately 300 mm onto the hot material per pass until half the width of the roller is on the hot mat.

If a vibratory roller with pneumatic drive wheels is used, align the first pass with one of the pneumatic wheels directly on the joint and the drum operating in static mode. Then make successive passes with the roller drum moving approximately 300 mm per pass onto the hot mat until half the width of the roller is on the hot mat.

B. Longitudinal. Ensure that the longitudinal joints in the Top Course will correspond with the edges of the proposed traffic lanes. Other joint arrangements will require approval of the Engineer. If a dual-drum vibratory roller is used during construction of a longitudinal joint using either Option 1 or 2, operate the roller in vibratory mode, unless static rolling is required. Rollers must be as close to the paver as practical. Make the first pass with the roller traveling toward the paver and operating on the hot mat with 150 to 200 mm of the roller drum overlapping onto the cold mat. Apply a second pass to the joint as it travels back away from the paver. If a single-drum vibratory roller with pneumatic drive wheels is used, operate the roller in vibratory mode and follow the same procedure except that the roller will be aligned on the joint so that the pneumatic drive wheels travels on the joint. All turning movements of the roller will be done on previously compacted material. After applying two roller passes on the longitudinal joint, proceed with the roller to the low side of the lane and compact as described in §402-3.07, *Compaction.*

For all HMA layers, other than Top Course, place the mixture such that no more than 30 meters of the longitudinal pavement joint is exposed at the end of the working day when traffic is maintained on the roadway during paving operations. For Top Course of 50 mm or less, refer to §402-3.09C, *Exposed Longitudinal Joint.*

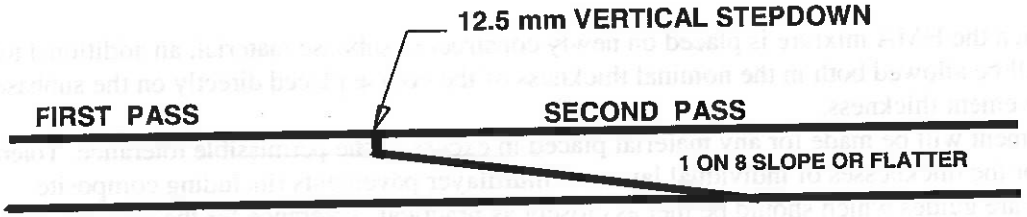
When paving Top Course, select one of the following options to construct the longitudinal joint. Use Option A for all other HMA courses:

1. **Option A - Butt Joint.** Under this option lay the HMA such that it uniformly overlaps the adjacent cold mat 50 to 75 mm. The thickness of the overlap material will be approximately one-fourth the compacted thickness of the course. Bump back the overlapped material onto the adjacent hot lane using a rake so that the roller operator can crowd the material into the hot side of the joint resulting in a smooth and well compacted joint after rolling. Broadcasting of the overlap material onto the fresh mat is not allowed. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if necessary.

   Bumping is not required when the use of a rake is a safety concern, as determined by the Engineer. Instead, place the HMA in a manner such that the thickness of the uncompacted layer is approximately 25% more than the compacted thickness of the adjacent cold HMA layer with a 10 to 25 mm overlap.

2. **Option B - Tapered Wedge Joint.** Use this option when placing Top Course only. Place the HMA mixture for the first mat with an attachment to the paver to provide a sloping wedge with a vertical step-down at the longitudinal pavement joint. Extend a wedge of material from the bottom of the step-down to the existing surface at a slope of 1 on 8 or flatter. Compact the first mat such that the roller compacts up to but does not extend past the step-down. The vertical step-down will be 12.5 mm minimum after compaction of the mat. Place the second mat such that it uniformly overlaps the adjacent cold mat 25 to 40 mm. The thickness of the overlap material will be approximately one-fourth the compacted thickness of the HMA layer. Bump back the overlapped material onto the adjacent hot lane using a rake so that the roller operator can crowd the material into the hot side of the joint resulting in a smooth and well compacted joint after rolling. Do not broadcast the overlap material onto the lane. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if deemed necessary by the Engineer.

   Bumping is not required when the use of a rake is a safety concern, as determined by the Engineer. Instead, place the HMA in a manner such that the thickness of the uncompacted layer is approximately 25% more than the compacted thickness of the adjacent cold HMA layer with a 10 to 25 mm overlap.



TAPERED WEDGE JOINT

C. **Exposed Longitudinal Joint.** The longitudinal joint for the entire day may be exposed to traffic overnight when the HMA placement is Top Course of up to 50 mm. Exposed joints will not be permitted for more than one night, over the weekends, holidays, or when there are other concerns, such as pending wet weather. Leaving exposed joints for any other HMA layers below the Top Course is not allowed. If the exposed joint is left open, the following applies:

- Place UNEVEN LANES (W8-11) warning signs posted in advance of the condition, at each ramp, and roadway intersection, and repeated every 0.8 km, supplemented with NEXT [X] MILES (W16-4) auxiliary signs to alert drivers of the uneven edge.

- Use Option B, Tapered Wedge Joint, except when the thickness is 25 mm or less where a butt joint is allowed.
- If the exposed longitudinal pavement joint becomes damaged due to rounding of the notched wedge, saw-cut the joint prior to placing the adjacent lane.

402-3.10 Surface Tolerance. Construct each pavement course to a 6 mm surface tolerance. The Engineer may test the surface with a 5-meter straight edge or string line placed parallel to the centerline of the pavement and with a 3-meter straight edge or string line placed transversely to the centerline of the pavement on any portion of the pavement. Variations exceeding 6 mm will be satisfactorily corrected or the pavement removed and replaced at no additional cost to the State.

402-3.11 Thickness Tolerance. The thickness indicated for each of the various courses of HMA pavement is the nominal thickness. Construct the pavement so that the final compacted thickness is as near to the nominal thickness as is practical, and within the tolerances specified below.

The Engineer may request cores to determine the thickness of the completed pavement layer for final acceptance and payment. Provide work zone traffic control and take cores at no additional cost to the State. Take cores and fill the all core holes in accordance with §402-3.08, *Pavement Density Samples*. The Engineer may use another acceptance method such as yield calculations to determine the final thickness for acceptance and payment.

HMA mixture, placed as a Truing and Leveling course as described in §402-3.05, *Conditioning of Existing Surface*, will not be considered in pavement thickness determinations. The allowable tolerance for HMA specified under a single pay item is as follows:

- 6 mm or less for a required course whose nominal thickness is 100 mm or less
- 13 mm or less for a course or courses whose nominal thickness is over 100 mm

The tolerance for the total thickness of all HMA mixture courses is as follows:

- 6 mm or less when the total nominal thickness indicated on the plans is 100 mm or less
- 13 mm or less when the total nominal thickness is over 100 mm but not more than 200 mm
- 16 mm or less when the total nominal thickness is more than 200 mm

When the HMA mixture is placed on newly constructed subbase material, an additional tolerance of 6 mm will be allowed both in the nominal thickness of the course placed directly on the subbase and the total pavement thickness.

No payment will be made for any material placed in excess of the permissible tolerance. Tolerances indicated for the thicknesses of individual layers of multilayer pavements (including composite pavements) are guides which should be met as closely as practical. Tolerance for the total thickness of such pavement is also a guide.

The Regional Director may accept and pay for HMA placed under the following conditions:

- When the individual layer placed does not meet the thickness tolerance but substantially conforms to the plans and specifications, true to line and grade in order to attain a smooth riding pavement.
- When the total thickness of such pavements is less than the specified thickness including tolerances but substantially conforms to the plans and specifications.
- When the total thickness of such pavements is greater than the specified thickness and the excess thickness is necessary to attain a smooth riding pavement surface.

Payment for excess thickness necessary to achieve a smooth riding surface will be considered only in cases where an existing pavement surface has been resurfaced.

402-3.12 Paver and Equipment Cleaning. Do not clean tools and equipment used for HMA placement

on the pavement surface, or near streams, ponds, drainage structures or other areas that are tributaries to waterways. Use an area approved by the Engineer for cleaning all paving equipment and tools. If possible, remove solid pieces of asphalt by scraping or other mechanical means prior to application of a cleaning agent. If a petroleum product is used for cleaning, contain all liquid products during cleaning operations using tarpaulins, sand pads, pails, or other collection methods to prevent spillage or accidental release. Use hand sprayers or other similar devices to minimize the amount of petroleum product applied. Properly dispose of sand and collected petroleum products as petroleum contaminated soil at no additional cost to the State.

402-3.13 Shoulder Edge Wedge. When specified, construct a shoulder edge wedge as detailed in the Contract Documents. Place HMA on the pavement shoulders where the outside edge of Top and Binder Course consist of an angle of 35° or flatter measured from finished grade to the preceding layer surface. Construct the shoulder edge wedge by using a device attached to the screed. Hand work should be minimized. The top of the tapered section shall begin at the end of the shoulder width as specified in contract documents such that the tapered section will be an additional width of material outside of the paved shoulder width. The shoulder edge wedge is optional at locations where guiderails are installed.

402-4 METHOD OF MEASUREMENT. Provisions of §401-4 Method of Measurement, apply, including the following:

The HMA will be measured in metric tons of compacted mixture. Quality payment adjustments are measured in Quality Units. Quality Units will be determined for each day's production and placement by using the daily Quality Adjustment Factor (QAF) for plant production, pavement density, longitudinal joint density, pavement smoothness, and the quantity placed.

Quality Units = (Quality Adjustment Factor - 1.00) x HMA Placed (metric mons)

Quality Units will be determined for test sections for 50 and 60 Series compaction methods, when applicable, by using a factor of 1.5 for the first 200 metric tons placed on the test section.

Quality Units = 0.5 x HMA Placed (metric tons) (not to exceed 200 metric tons)

When the pavement density QAF applies, use one of the following methods of measurement in Table 402-7, *Method of Measurement*, corresponding to the item used on the project:

TABLE 402-7 METHOD OF MEASUREMENT

Method Type	Pay Item Number	Description
A=50 series	402.XX5FQR	QAF based on calculated PWL using four cores.
B=60 series	402.XX6FQR	QAF based on average of four core densities.

The quantity of the HMA mixture subject to adjustment will be determined from quantity placed on the mainline and ramps of uniform width longer than 400 meters. When shoulders and mainline are placed together, the mainline quantity may be determined using typical sections shown in the contract documents.

The pavement density QAF will not apply to HMA placed on ramps with a uniform full width section less than 400 meters in length, shoulders, widenings, crossovers, and bridges. Payment in these areas will be a QAF of 1.00 based on satisfactory placement and compaction.

When a QAF of a paving lot for 50 Series or 60 Series is calculated to be 0.60, the lot will be evaluated by the RME to determine if it can be left in place. The type of material produced (i.e. Binder, Top), and the location of use (i.e., mainline or less critical area) will be primary considerations in the determination of whether the HMA can be left in place. If the RME determines that the HMA can be left in place, the Engineer will apply a QAF of 0.60. If the HMA cannot be left in place, remove and replace

at no cost to the State.

A. 50 Series Method. The RME will determine the paving lot's Percent Within Limits (PWL) in accordance with MP 402-02 and determine the density QAF as shown in Table 402-8, *Quality Payment Schedule for 50 Series*. The Engineer will use the QAF to calculate the Quality Units for the accepted HMA quantity.

TABLE 402-8 QUALITY PAYMENT SCHEDULE FOR 50 SERIES

Percent Within Limits (PWL)	Quality Adjustment Factor (QAF)
$PWL_{92\text{-}97} > 93$	1.05
$PWL_{92\text{-}97} \leq 93$	$\Sigma\ (PWL_{Segment} \times \text{Pay Factor}_{Segment})^1$

1. $PWL_{Segment}$ will be calculated for each of the nine density ranges in Table 402-9, *Density Segment Pay Factors*, using the standard deviation and average density for the lot.

TABLE 402-9 DENSITY SEGMENT PAY FACTORS

Density Segment	Segment Pay Factor
88 – 89	0.60
89 – 90	0.70
90 – 91	0.80
91 – 92	0.90
92 – 93	1.00
93 – 96	1.05
96 – 97	1.00
97 – 98	0.90
98 – 99	0.80

B. 60 Series Method. When pavement density samples are taken and if payment adjustment is applicable, the Engineer will make the adjustment in accordance with Table 402-10, *Density Quality Adjustment Factors for 60 Series*. The Engineer shall make full payment when the average density of the four cores is between 92% and 97% of the mixture's average daily maximum theoretical density. If the average density fails to meet this limit, a payment adjustment will be made, based on Index Price, to all the material placed on the mainline for the day the cores represent, excluding the material placed on the test section.

TABLE 402-10 DENSITY QUALITY ADJUSTMENT FACTORS FOR 60 SERIES

Average Core Density	Quality Adjustment Factor
≤ 92 Density ≤ 97	1.00
$91.0 \leq$ Density < 92.0 or $97.0 <$ Density ≤ 98.0	0.95
$90.0 \leq$ Density < 91.0	0.90
$88.0 \leq$ Density < 90.0	0.85
Density < 88.0 or Density > 98.0	0.60

402-5 BASIS OF PAYMENT. The unit price bid for all pavement courses shall include the cost of all material, labor and equipment necessary to complete the work, including obtaining the pavement cores, and filling and compaction of all core holes. Quality Units may apply to the hot mix asphalt items as calculated in §402-4. Payment of Quality Units will be made based on the Index Price listed in the

contract documents. The Index Price shown in the itemized proposal for each Quality Unit is considered the price bid. The unit (index) price is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount bid for the Contract.

Payment will be made under:

Item No.	Item	Pay Unit
402.010902	Type 1 F9, Asphalt-Treated Permeable Base Course	Metric Ton
402.010912	Plant Production Quality Adjustment to 402.010902	Quality Unit
402.011902	Type 2 F9, Asphalt-Treated Permeable Base Course	Metric Ton
402.011912	Plant Production Quality Adjustment to 402.011902	Quality Unit
402.017902	True & Leveling F9, Superpave HMA, 70 Series Compaction	Metric Ton
402.017912	Plant Production Quality Adjustment to 402.017902	Quality Unit
402.018902	True & Leveling F9, Superpave HMA, 80 Series Compaction	Metric Ton
402.018912	Plant Production Quality Adjustment to 402.018902	Quality Unit
402.058902	Shim Course F9, Hot Mix Asphalt	Metric Ton
402.058912	Plant Production Quality Adjustment to 402.058902	Quality Unit
402.095102	9.5 mm F1 Top Course HMA, 50 Series Compaction	Metric Ton
402.095112	Plant Production Quality Adjustment to 402.095102	Quality Unit
402.095122	Pavement Density Quality Adjustment to 402.095102	Quality Unit
402.095152	Test Section Adjustment to 402.095102	Quality Unit
402.095202	9.5 mm F2 Top Course HMA, 50 Series Compaction	Metric Ton
402.095212	Plant Production Quality Adjustment to 402.095202	Quality Unit
402.095222	Pavement Density Quality Adjustment to 402.095202	Quality Unit
402.095252	Test Section Adjustment to 402.095202	Quality Unit
402.096102	9.5 mm F1 Top Course HMA, 60 Series Compaction	Metric Ton
402.096112	Plant Production Quality Adjustment to 402.096102	Quality Unit
402.096122	Pavement Density Quality Adjustment to 402.096102	Quality Unit
402.096152	Test Section Adjustment to 402.096102	Quality Unit
402.096202	9.5 mm F2 Top Course HMA, 60 Series Compaction	Metric Ton
402.096212	Plant Production Quality Adjustment to 402.096202	Quality Unit
402.096222	Pavement Density Quality Adjustment to 402.096202	Quality Unit
402.096252	Test Section Adjustment to 402.096202	Quality Unit
402.096302	9.5 mm F3 Top Course HMA, 60 Series Compaction	Metric Ton
402.096312	Plant Production Quality Adjustment to 402.096302	Quality Unit
402.096322	Pavement Density Quality Adjustment to 402.096302	Quality Unit
402.096352	Test Section Adjustment to 402.096302	Quality Unit
402.097102	9.5 mm F1 Top Course HMA, 70 Series Compaction	Metric Ton
402.097112	Plant Production Quality Adjustment to 402.097102	Quality Unit
402.097202	9.5 mm F2 Top Course HMA, 70 Series Compaction	Metric Ton
402.097212	Plant Production Quality Adjustment to 402.097202	Quality Unit
402.097302	9.5 mm F3 Top Course HMA, 70 Series Compaction	Metric Ton
402.097312	Plant Production Quality Adjustment to 402.097302	Quality Unit
402.098102	9.5 mm F1 Top Course HMA, 80 Series Compaction	Metric Ton
402.098112	Plant Production Quality Adjustment to 402.098102	Quality Unit
402.098202	9.5 mm F2 Top Course HMA, 80 Series Compaction	Metric Ton
402.098212	Plant Production Quality Adjustment to 402.098202	Quality Unit
402.098302	9.5 mm F3 Top Course HMA, 80 Series Compaction	Metric Ton
402.098312	Plant Production Quality Adjustment to 402.098302	Quality Unit
402.098902	9.5 mm F9 Top Course HMA, Shoulder Course, 80 Series Compaction	Metric Ton
402.098912	Plant Production Quality Adjustment to 402.098902	Quality Unit
402.125102	12.5 mm F1 Top Course HMA, 50 Series Compaction	Metric Ton

402.125112	Plant Production Quality Adjustment to 402.125102	Quality Unit
402.125122	Pavement Density Quality Adjustment to 402.125102	Quality Unit
402.125152	Test Section Adjustment to 402.125102	Quality Unit
402.125202	12.5 mm F2 Top Course HMA, 50 Series Compaction	Metric Ton
402.125212	Plant Production Quality Adjustment to 402.125202	Quality Unit
402.125222	Pavement Density Quality Adjustment to 402.125202	Quality Unit
402.125252	Test Section Adjustment to 402.125202	Quality Unit
402.126102	12.5 mm F1 Top Course HMA, 60 Series Compaction	Metric Ton
402.126112	Plant Production Quality Adjustment to 402.126102	Quality Unit
402.126122	Pavement Density Quality Adjustment to 402.126102	Quality Unit
402.126152	Test Section Adjustment to 402.126102	Quality Unit
402.126202	12.5 mm F2 Top Course HMA, 60 Series Compaction	Metric Ton
402.126212	Plant Production Quality Adjustment to 402.126202	Quality Unit
402.126222	Pavement Density Quality Adjustment to 402.126202	Quality Unit
402.126252	Test Section Adjustment to 402.126202	Quality Unit
402.126302	12.5 mm F3 Top Course HMA, 60 Series Compaction	Metric Ton
402.126312	Plant Production Quality Adjustment to 402.126302	Quality Unit
402.126322	Pavement Density Quality Adjustment to 402.126302	Quality Unit
402.126352	Test Section Adjustment to 402.126302	Quality Unit
402.127102	12.5 mm F1 Top Course HMA, 70 Series Compaction	Metric Ton
402.127112	Plant Production Quality Adjustment to 402.127102	Quality Unit
402.127202	12.5 mm F2 Top Course HMA, 70 Series Compaction	Metric Ton
402.127212	Plant Production Quality Adjustment to 402.127202	Quality Unit
402.127302	12.5 mm F3 Top Course HMA, 70 Series Compaction	Metric Ton
402.127312	Plant Production Quality Adjustment to 402.127302	Quality Unit
402.128102	12.5 mm F1 Top Course HMA, 80 Series Compaction	Metric Ton
402.128112	Plant Production Quality Adjustment to 402.128102	Quality Unit
402.128202	12.5 mm F2 Top Course HMA, 80 Series Compaction	Metric Ton
402.128212	Plant Production Quality Adjustment to 402.128202	Quality Unit
402.128302	12.5 mm F3 Top Course HMA, 80 Series Compaction	Metric Ton
402.128312	Plant Production Quality Adjustment to 402.128302	Quality Unit
402.128902	12.5 mm F9 Top Course HMA, Shoulder Course, 80 Series Compaction	Metric Ton
402.128912	Plant Production Quality Adjustment to 402.128902	Quality Unit
402.195902	19 mm F9 Binder Course HMA, 50 Series Compaction	Metric Ton
402.195912	Plant Production Quality Adjustment to 402.195902	Quality Unit
402.195922	Pavement Density Quality Adjustment to 402.195902	Quality Unit
402.195952	Test Section Adjustment to 402.195902	Quality Unit
402.196902	19 mm F9 Binder Course HMA, 60 Series Compaction	Metric Ton
402.196912	Plant Production Quality Adjustment to 402.196902	Quality Unit
402.196922	Pavement Density Quality Adjustment to 402.196902	Quality Unit
402.196952	Test Section Adjustment to 402.196902	Quality Unit
402.197902	19 mm F9 Binder Course HMA, 70 Series Compaction	Metric Ton
402.197912	Plant Production Quality Adjustment to 402.197902	Quality Unit
402.198902	19 mm F9 Binder Course HMA, 80 Series Compaction	Metric Ton
402.198912	Plant Production Quality Adjustment to 402.198902	Quality Unit
402.255902	25 mm F9 Binder Course HMA, 50 Series Compaction	Metric Ton
402.255912	Plant Production Quality Adjustment to 402.255902	Quality Unit
402.255922	Pavement Density Quality Adjustment to 402.255902	Quality Unit
402.255952	Test Section Adjustment to 402.255902	Quality Unit
402.256902	25 mm F9 Binder Course HMA, 60 Series Compaction	Metric Ton
402.256912	Plant Production Quality Adjustment to 402.256902	Quality Unit
402.256922	Pavement Density Quality Adjustment to 402.256902	Quality Unit
402.256952	Test Section Adjustment to 402.256902	Quality Unit

402.257902	25 mm F9 Binder Course HMA, 70 Series Compaction	Metric Ton
402.257912	Plant Production Quality Adjustment to 402.257902	Quality Unit
402.258902	25 mm F9 Binder Course HMA, 80 Series Compaction	Metric Ton
402.258912	Plant Production Quality Adjustment to 402.258902	Quality Unit
402.376902	37.5 mm F9 Base Course HMA, 60 Series Compaction	Metric Ton
402.376922	Pavement Density Quality Adjustment to 402.376902	Quality Unit
402.376912	Plant Production Quality Adjustment to 402.376902	Quality Unit
402.376952	Test Section Adjustment to 402.376902	Quality Unit
402.377902	37.5 mm F9 Base Course HMA, 70 Series Compaction	Metric Ton
402.377912	Plant Production Quality Adjustment to 402.377902	Quality Unit
402.378902	37.5 mm F9 Base Course HMA, 80 Series Compaction	Metric Ton
402.378912	Plant Production Quality Adjustment to 402.378902	Quality Unit

Mix Type – XX	Compaction Series - Y	Friction - Z	Quality Adjustment - Q
9.5 mm Top - 09	50 series - 5	F1 - 1	HMA Item - 0
12.5 mm Top - 12	60 Series - 6	F2 - 2	Plant – 1
19.0 mm Binder - 19	70 Series - 7	F3 - 3	Density – 2
25.0 mm Binder - 25	80 Series - 8	F9 - 9	Test Section – 5
37.5 mm Base - 37			