ADDITIONAL INFORMATION:

This Engineering Instruction (EI) is effective beginning with projects submitted for the lettings on or after September 1, 2016.

This EI does not supersede any other issuances.

The revisions issued with this EI will be incorporated into the Standard Specifications that will be effective on September 1, 2016.

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:

- Joint Adhesive will be required to be applied to all the joints in the surface course and the item will be included in the contract. However, under §402-3.01E Scheduling HMA Placement, Joint Adhesive will be required to be applied to the Base or Binder layer at the Contractor’s expense if his/her scheduling does not allow top course to be placed before the end of the season.

- The following changes were made under the §402-3.07 Compaction:
  - A density gauge will be required under 50, 60, and 70 Series compaction. Previously, the use of a gauge on 50 Series was optional. This will ensure density monitoring on other areas such as shoulders.
  - For 50 Series, if the quantity for a paving day exceeds 2000 tons, an additional core will be required for every additional 500 tons. The maximum number of cores is 8. That means any quantity over 3500 will require 8 cores. Previously, only four were taken regardless of the quantity placed.
  - For 60 Series, additional cores are required every 3 days of paving to verify density. Cores taken that do not meet density requirements will be subject to disincentive.
  - For 70 Series, the Engineer may request cores to verify project target density (PTD), if necessary. This will ensure a reasonable density will be achieved.

- The revised Section 402 eliminates multiple quality adjustment items for each HMA item. Now only one quality adjustment item for Plant Production, Pavement Density and Test Section will be used.

- Pay items have been included for temporary pavements. Quality adjustment items are not applicable for these items because they will not be part of the permanent pavement section.

- All items listed in Section 402 are revised by changing the last digit (6th digit), which indicates the revision number, from 2 to 3. For example, 402.XXYZQ2 is now 402.XXYZQ3.
**Cost Impact.** There may be a slight cost increase due to additional coring and joint adhesive application requirements.

**DESIGN GUIDANCE**

**Quality Units (QUs)**
- **Plant Production Quality Adjustment:** The Designer will calculate Plant Production quality units (QUs) for each HMA item and sum them up. The designer will then use the sum as a single quantity for the Plant Production Quality Adjustment item.
- **Pavement Density Quality Adjustment:**
  - For a project with both 50 and 60 Series items, the Designer will calculate QUs for each HMA 50 Series item and sum them up. The designer will then enter this number into a single Density Quality Adjustment item. There is no need to calculate QUs for 60 Series items because there is no incentive. There may be a disincentive and therefore, adjustment will be made using the Pavement Density Quality Adjustment item.
  - If a project has 60 Series pay items (402.XX6Y03) only, the Designer does not have to calculate QUs since there is no incentive. However, there may be a disincentive and therefore, adjustment will be made using the Density Quality Adjustment item. The Designer will enter 1 QU under Density Quality which will be used to make negative adjustment using the Quality Index Price.
- **Test Section Adjustment:** If a project has 50, 60, or both 50 and 60 Series items, the Designer will calculate the total QUs for the test sections using the following guidelines:
  - The maximum number of QUs for each test section for 50 Series and 60 Series items is 100 QUs for a total of 200 QUs per item because the specification allows up to two test sections per item for the adjustment.
  - The Designer will sum up the test section QUs and enter the quantity for a single Test Section Adjustment item.

**IMPLEMENTATION:**
- The revisions to the Standard Specifications will be included in the contract documents beginning with projects submitted for the lettings on or after September 1, 2016.
- Regional Special Specification Coordinators should review their 402 special specifications and amend accordingly.

All standard specification 402.XXYZQ2 items are deleted and replaced with the following items in the table below. A complete list of the new items and their descriptions can be found in the revised Section 402. Regional Designers need to review their Regional special specifications to ensure they comply with the revised Section 402.
TRANSMITTED MATERIALS:
- Attached are both US Customary and Metric versions of 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 appropriate by the Department.

One of the revisions was the requirement of joint adhesive application to all the pavement joints. This requirement was optional for Top Course with the issuance of EI 14-024. Recent research has shown the joint adhesive application has improved the joint performance by reducing the intrusion of moisture at the joints.

Additional cores were added for 50 Series compaction method as the quantity placed on a day increases beyond 2000 tons. Currently, four cores are taken regardless of the quantity placed and this creates an increased risk for both the Contractor and the Department as these cores are statistically analyzed for incentive/disincentive payment. Requiring additional cores based on the additional quantity placed beyond 2000 tons reduces that risk.

The number of quality items has been reduced by creating a single quality item each for Plant Production, Pavement Density, and Test Section adjustments, simplifying contract administration.

Other changes which were made previously and transmitted with separate EIs are incorporated into this revision.

CONTACT: Direct questions regarding this EI to Zoeb Zavery of the Materials Bureau at (518) 485-5277 or via e-mail at zoeb.zavery@dot.ny.gov.
Incorporate the following changes to the Standard Specifications that will be effective on September 1, 2016.

**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 suppliers listed in the Department’s Approved List for Fine and Coarse Aggregates and Performance Graded (PG) Binders for Hot Mix Asphalt (HMA) Paving respectively. 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 mixture 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 ensure the materials incorporated into the work are in conformity with the contract documents.

402-3 CONSTRUCTION DETAILS. The Engineer will conduct a pre-paving meeting prior to any HMA placement. The attendance at this meeting will include Regional Materials Engineer, Paving Superintendent, Chief Inspector or Paving Inspector(s), HMA plant representative, density gauge operator, depending on the compaction method used, and work zone traffic control (WZTC) competent person. Be prepared to discuss the operation necessary to complete the work successfully. Participants will review all aspects of the requirements including, but not limited to, the following:

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

Provide a certified density gauge operator to monitor pavement density using a density gauge for 50 Series, 60 Series, and 70 Series compaction methods with a current Density Gauge Inspector Certification from the Associated General Contractors, New York State, or its equivalent, as determined by the Director, Materials Bureau.
SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

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

<table>
<thead>
<tr>
<th>Nominal Compacted Lift Thickness</th>
<th>Surface Temperature Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 1 in</td>
<td>50°F</td>
</tr>
<tr>
<td>1 in &lt; Thickness ≤ 3 in</td>
<td>45°F</td>
</tr>
<tr>
<td>&gt; 3 in</td>
<td>40°F</td>
</tr>
</tbody>
</table>

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 course placement.

C. Temporary HMA Placements. HMA mixture placement for temporary detours, which are not and will not become part of the permanent pavement, are not subject to the temperature and seasonal limitations, but must be approved by the Engineer when placed outside temperature and seasonal limits. Repair any damaged areas deemed necessary by the Engineer on the temporary HMA placements within one work day after the notification.

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 work.

E. Scheduling HMA Placement. Schedule paving operations such that all HMA mixture 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 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 at no additional cost to the State.

If the approved schedule indicates that Base or Binder course, which will be permanently incorporated into the work, is to be left open to traffic over the winter, apply joint adhesive to all the joints in accordance with Section 418 Asphalt Pavement Joint Adhesive.

If the top course is not placed within the seasonal limits as scheduled, apply joint adhesive on top of the exposed joints in the Binder course at least 4 inches centered on the exposed joint at no additional cost to the State.

Repair any damage to the Base or Binder course left over the winter prior to placing subsequent course(s) at no additional expense to the State.

402-3.02 HMA Pavers. Provide pavers capable of spreading and finishing courses of HMA mixture 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.
- When used for placing the initial paving course, Base, Binder, and Top Courses, provide pavers equipped with approved automatic transverse slope and longitudinal grade screed controls. Provide controls that automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities in the existing surface. Provide controls capable of maintaining the proper transverse slope and be readily adjustable so transitions and super-elevated curves can be satisfactorily paved. Provide controls that 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.

402-3.03 Hauling Equipment. Provide HMA transport trucks approved by the Engineer 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 except for live-bottom trucks that have channelized tarp systems. The inside surface of the vehicle body may be lightly coated with a release agent listed on the Approved List for Release Agents. Do not use petroleum products or solvents as release agents. All hauling equipment is subject to approval by the Engineer.

402-3.04 Rollers. Provide rollers of vibratory, oscillatory, static steel wheel type, or pneumatic tire rollers capable of compacting HMA mixture. The Engineer will inspect rollers prior to start of paving operations to determine acceptability. Provide a minimum of two rollers, one for breakdown and one for
finish rolling, unless the HMA mixture placement is on a bridge deck, bridge approaches, or other areas where one roller may be sufficient to achieve the required density. Provide rollers in good mechanical condition, and capable of operating at speeds slow enough to avoid displacement of the mixture. Do not use equipment which results in excessive crushing of aggregate.

Ensure the manufacturer or supplier provides recommended settings for amplitude, frequency, and tire pressure (pneumatic) for each roller model for the thickness of pavement being rolled. The recommendations may either be on a sticker or a plate installed on the roller or a document readily available to the Engineer. For night time paving, provide a roller equipped with at least one light on each fender, or alternatively, at least one light above the roller, visible from a distance of 200 feet. Provide a roller equipped with an automatic audible warning signal when operating in reverse.

A. Vibratory and Oscillatory Rollers. Provide rollers designed for the compaction of HMA mixture. Provide self-propelled roller having single or dual drums meeting the requirements as stated below, weighing at least 8 tons and capable of maintaining set frequency and amplitude.

1. Nominal Amplitude 0.05 inches, maximum
2. Frequency 1500 vpm minimum
3. Drum Width (dual drums) 54 inches, minimum
   (single drum) 84 inches, minimum
4. Speedometer ½ mph or 50 ft per minute increment, maximum

Provide rollers equipped with indicators that provide the operator with the speed, amplitude, and frequency setting readouts. Set the rollers such that they will produce a minimum of 12 impacts per foot during the compaction process.

Provide vibratory and oscillatory rollers equipped with an automatic disconnect system that automatically shuts off the vibration and oscillation when the roller is in a stationary position. Provide a roller equipped with mechanical override systems in the event of temporary failure of the automatic disconnect system.

B. Static Steel-wheel Rollers. Provide self-propelled two axle types with a minimum weight of 8 tons.

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

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

D. Small Vibratory Rollers. Provide rollers of ride or walk behind type having dual vibratory drums meeting the following requirements:

1. Minimum Drum Width 24 inches
2. Minimum frequency 1500 vpm

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.
SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

Fill any depressions and wheelpath ruts prior to paving Truing and Leveling course using Table 402-2 Mixture Selection for Filling Wheelruts & Depressions, to select the appropriate mixture 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 (T&L) course is specified in the contract documents, place the course(s) of a minimum variable thickness of proper plant mixture necessary to bring the surface of the existing pavement to the same transverse slope and longitudinal grade required for the finished pavement surface. Use Table 402-3 Mixture Selection for T&L Course, to select the appropriate mixture type. Select a mixture such that dragging of stones at the thin edge is minimized, including when constructing wedges for super-elevation. If dragging is excessive in any T&L course, select a different T & L mixture for the application. The surface of this course will be tested in the same manner prescribed in §402-3.10 Surface Tolerance, ensure that the allowable variation from the true surface after compaction does not exceed ⅜ inch.

<table>
<thead>
<tr>
<th>TABLE 402-3 Mixture Selection for T&amp;L Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compacted Thickness Range (in)</td>
</tr>
<tr>
<td>≤ 2</td>
</tr>
<tr>
<td>2 &lt; Thickness ≤ 3</td>
</tr>
<tr>
<td>3 &lt; Thickness ≤ 5</td>
</tr>
</tbody>
</table>

402-3.06 Spreading and Finishing

**A. Tack Coat.** Apply tack coat between all HMA pavement lifts prior to placing HMA mixture regardless of time period between lifts. Do not apply tack coat more than 24 hours prior to the placement of HMA mixture unless approved by the Engineer. Apply tack coat to all contact surfaces of existing HMA and Portland Cement Concrete including such areas as adjacent pavement edges, curbing, gutters, manholes, and other structures where the HMA mixture will be in contact. 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.

**B. Joint Adhesive.** Apply joint adhesive to all pavement edges in accordance with Section 418 Asphalt Pavement Joint Adhesive prior to placing the asphalt mixture in order to provide bonding with the newly laid pavement. The application of joint adhesive is for Top Course only unless it is specified for other courses in the contract documents or as required under §402-3.01E. Scheduling HMA Placement.

**C. HMA Mixture 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 HMA mixtures to the work site, and incorporate into the
work within 20°F of the specified temperature. For 80 Series compaction method, select the desired mixture temperature with the concurrence of the Engineer.

**D. HMA Mixture from Multiple Plants.** Do not supply HMA mixture from multiple plants to a single paver.

**E. Reference Line.** Erect and maintain taut reference line positioned at or near the pavement centerline or edge to guide the paver when the initial pavement course is laid for new or reconstructed pavement. Support the reference line at approximately 25 foot intervals on tangent sections and at closer intervals on curves. Tension the line sufficiently to remove any sagging. Use a moving reference of at least 30 feet in length in lieu of a reference line with approval of the Engineer. The moving reference may be a floating beam, ski, or other suitable type such that the resulting pavement course surface is 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. Any course in an adjacent lane may be used as the reference for the use of a short ski. If the proposed floating beam or the short ski does not produce the results similar to those obtained using a taut reference line, discontinue the use of these devices and erect a taut reference line.

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.

**F. HMA Mixture Placement.** Use HMA paver(s) to place the HMA mixture either over the entire width or over a partial width that is practical. Operate the paver at a consistent steady speed, correlated to the rate of material delivery, in order to produce a mat free of bumps and dips, resulting in a smooth ride. Place the HMA mixture on a clean, tack coated surface. Ensure trucks deliver the mixture into the paver upon arrival at the site. Immediately spread and strike off HMA mixture to the required width and loose depth to established line and grade, to obtain the required compacted thickness at the completion of work. If the areas to be paved are less than 1000 square feet 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 contract documents.

Place all pavement courses using one of the reference line methods required above. 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. Ensure the placement equipment wheels and/or other appurtenances do not interfere with the distribution and placement of the Shim Course material.

**G. Top Course Texture and Color.** Supply Top Course HMA mixture from a single plant for the duration of the work such that the pavement surface has a uniform color and texture, except when a contract includes multiple paving sites, or the paving length is more than 5 miles and supply from multiple plants to either end of the paving length is practical. In that case, the above requirement will apply to each paving site and locations at either end of the paving length 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 if the aggregate used for producing the HMA mixture is from the same source, with the concurrence of the Regional Materials
Engineer. When tandem paving is utilized, multiple plants may be used to supply mixture provided the aggregate used is from the same source. The provisions of §402-3.06 D apply.

402-3.07 Compaction. Compact the HMA mixture 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 compacting HMA mixture using 50, 60, or 70 series methods, control all operations of the rollers including speed, amplitude settings, vibration frequency, and the type of rollers.

Compact the HMA mixture using rollers meeting the requirements of §402-3.04 Rollers. Compact the HMA mixture immediately after placement, and 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.

Immediately correct any displacement caused by reversing the direction of the roller, or any 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 mat. Keep the wheels properly moistened with water, water mixed with small quantities of detergent, or other approved material, to prevent adhesion of the mixture to the rollers. Do not use petroleum products or solvents.

Upon completion of the HMA mixture placement, ensure there are no visible defects in the pavement, such as shallow ruts, ridges, roller marks, cracking, tearing, segregation, bleeding, or any other irregularities. Correct any defects that become apparent or replace the defective pavement at no additional cost to the State.

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

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

Make a minimum of three passes of a pneumatic rubber tire roller for compaction when Shim Course or 9.5 Top Course is used for filling wheel ruts. Make a minimum of two passes when Shim Course is used as a skim coat. Use other types of rollers with the approval of the Engineer.

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 50, 60 and 70 Series compaction using density gauges specified in §402-3.07E Density Gauges. Ensure the density gauge operator possesses a current Density Gauge Inspector Certification from The New York State Associated General Contractors, 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 pavement density adjustment. 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.
SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

<table>
<thead>
<tr>
<th>TABLE 402-4 COMPACTION METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compaction Methods</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>A=50 series</td>
</tr>
<tr>
<td>B=60 series</td>
</tr>
<tr>
<td>C=70 series</td>
</tr>
<tr>
<td>D=80 series</td>
</tr>
</tbody>
</table>

NOTE: XX = 37, 25, 19, 12, 09, 05, 01  
F = Friction requirement (1, 2, 3, 9)  
R = Revision number

A. 50 Series Compaction Method. On the first day of mainline paving, place and compact the HMA mixture in accordance with the provisions of Option 1 or Option 2. Routine paving is the placement and compaction of HMA mixture after the test section or first day paving.

1. Option 1 (Test Section). Place and compact a test section on the mainline a maximum of 1,500 feet long, at a location approved by the Engineer to determine if the HMA mixture can be compacted uniformly within the 92-97% of MMTD. Ensure the thickness of the test section is the same as the course it represents. Use the first 150 feet of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select and mark 4 pavement core locations, excluding the first 150 feet, in accordance with §402-3.08 Pavement Density Samples.

Extract pavement cores at the marked locations before the road is open to traffic. Take loose mix samples as specified under §402-3.08. Deliver all the samples to the Regional Materials Laboratory for testing and analysis. The following will apply to the test section.

- Place only one test section per day. Subsequent test sections are subject to approval by the Engineer.
- Test Section Adjustment will apply for up to 200 tons placed on each test section.
- A maximum of two test sections per item will be subject to the Test Section Adjustment.
- The Test Section Adjustment will not apply for a test section if any HMA mixture of 150 tons or more is placed on the same day, other than the quantity required for the construction of the test section or permeable base placed under the test section location.
- Pavement Density Quality Adjustment will not apply to the first two test sections. Subsequent test section(s) located on the mainline are subject to Pavement Density Quality Adjustment.
- Do not place HMA mixture under Routine Paving until the results of the pavement cores from the test section have a minimum pavement density QAF of 1.00.
- If the pavement density QAF is less than 1.00, construct another test section.
- If the calculated QAF is 0.60, the Test Section Adjustment will not apply and the RME will evaluate the test section in accordance with §402-3.14 Pavement Evaluation to determine if it can be left in place.

2. Option 2 (First Day Routine Paving). Do not construct a test section on the first day of paving. The Test Section Adjustment will not apply. All material placed and compacted will be subject to a Pavement Density Quality Adjustment in accordance with Routine Paving, below. If the pavement density QAF on the first day of paving is less than 1.00, construct a test section in accordance with Option 1.
3. **Routine Paving.** A paving lot is defined as a day’s production of at least 200 tons. Each paving lot will be equally divided into sublots in accordance with Materials Procedure (MP) 402-02 *Hot Mix Asphalt (HMA) Pavement Density Determination*, based on the quantity placed.

When the quantity placed is less than 200 tons in a day, pavement samples are not required. The density QAF for that day will be 1.00 provided the procedures used in these areas to obtain pavement densities are similar to previously placed pavement sections based on the density gauge test data.

When the quantity placed is more than 200 tons but less than or equal to 2000 tons, the Engineer will divide the lot into 4 equal sublots.

When the quantity exceeds 2000 tons, the Engineer will select one additional pavement core location for up to every 500 tons over 2000 tons, up to a maximum number of cores for a lot of 8.

The Engineer will select and mark a pavement core location in each sublot in accordance with §402-3.08 once the compaction operation is completed, excluding the first 150 feet of the day’s paving.

Extract pavement cores at the marked locations in each sublot before the road is open to traffic, fill the pavement core holes, take loose mix samples representing the lot, and deliver the sealed pavement cores and loose mix samples to the Regional Materials Laboratory in accordance with §402-3.08 *Pavement Density Samples*. The Department will test samples and analyze the results within one work day of the delivery of the samples. The results of this analysis will be used to determine the pavement density QAF in accordance with MP 402-02. When HMA mixture placement is less than the anticipated quantities, obtain a minimum of two loose mix samples before placement is terminated.

When paving over extended time periods using multiple crews, a new lot will be established when a change in the paving crew occurs. When the work includes multiple paving operations, each paving operation will be considered a lot and evaluated separately.

When two consecutive lots are found to have a density QAF equal to or less than 0.85, stop paving operations and construct a new test section in accordance with *Option 1*.

Monitor density on the material placed on shoulders, widening, crossovers, bridges and ramps with a uniform full-width section of less than 1250 feet in length using the same density gauge(s) and target density used on the mainline. Record the density values on appropriate BR form based on the type of gauge used, in accordance with MP 402-02. If the shoulder subbase is structurally insufficient to sustain the level of compaction such that the shoulder shows signs of distress during compaction, decrease the compaction effort until no further damage occurs to the shoulder or subbase.

B. **60 Series Compaction Method.** On the first day of mainline paving, place and compact the pavement under the provisions of *Option 1* or *Option 2*. Routine paving is the placement and compaction of HMA mixture after *Option 1* or after *Option 2*. Do not place HMA mixture under this method unless both a density gauge and a certified operator are present.

1. **Option 1 (Test Section Only).** Place and compact a test section on the mainline a maximum of 1,500 feet long, at a location approved by the Engineer to determine a Project Target Density (PTD) using the correlation of a density gauge(s) to the pavement cores results and to determine if the mixture can be compacted uniformly within the 92-97% of MMTD. Use the same equipment and procedures to construct the test section that will be used in the construction of the remainder of the course being laid. Ensure the thickness of the test section is the same as the course it represents. Use the first 150 feet of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select and mark 4 pavement core locations, excluding the first 150 feet, in accordance with §402-3.08 *Pavement Density Samples*.

Take density gauge readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density
gauge readings with the gauge type, model, and serial number to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples on Form BR 109.

Extract pavement cores at the marked location in each sublot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver density gauge readings, sealed pavement cores and loose mix samples to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

The Department will test the samples and analyze the results within one work day of the delivery of the samples and density gauge readings. The results of the analysis will be used to establish a PTD for each density gauge in accordance with MP 402-02. The following will apply to the test section.

- Place only one test section per day. Subsequent test sections are subject to approval by the Engineer.
- Test Section Adjustment applies for up to 200 tons placed on each test section.
- A maximum of two test sections per item will be subject to the Test Section Adjustment.
- The Test Section Adjustment will not apply for a test section if any HMA mixture of 150 tons or more is placed on the same day, other than the quantity required for the construction of the test section or permeable base placed under the test section location.
- If the average density of the four pavement cores results in a QAF of 0.60, the Test Section Adjustment will not apply and the RME will evaluate the test section in accordance with §402-3.14 Pavement Evaluation to determine if it should be left in place.

2. **Option 2 (Test Section and Continue Paving).** Place and compact a test section as described under Option 1 on the mainline a maximum of 1,500 feet long, at a location approved by the Engineer to determine a Project Target Density (PTD) using the correlation of a density gauge(s) to the pavement cores results and to determine if the mixture can be compacted uniformly within the 92-97% of MMTD. Use the same equipment and procedures to construct the test section that will be used in the construction of the remainder of the course being laid. Ensure the thickness of the test section is the same as the course it represents. Use the first 150 feet of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select and mark 4 pavement core locations, excluding the first 150 feet, in accordance with §402-3.08 Pavement Density Samples.

   Take density gauge readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density gauge readings with the gauge type, model, and serial number on Form BR 109, to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

   Extract pavement cores at the marked locations in each sublot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver sealed pavement cores and samples to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

   Establish an Interim PTD as described in MP 402-02 based on the density gauge used. Use the Interim PTD to monitor pavement density until the Actual PTD is established by the RME. Prior to the determination of an Actual PTD, take 4 additional loose mix samples, in accordance with §402-3.08 and store these samples at the plant.

   - The Test Section Adjustment factor will not apply.
   - All material placed after the test section for that day will be subject to Pavement Density Quality Adjustment.
Take density gauge readings at every 200 feet along the length of the pavement for each paver pass, at locations randomly selected and marked by the Engineer, in accordance with MP 402-02.

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 density readings falls below 98% of the Interim PTD, stop 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 MP 402-02. If the moving average of the last 10 density readings is below 98% of the Actual PTD, the Engineer will randomly select and mark 4 pavement core locations in accordance with §402-3.08 over the day’s placement under Interim PTD, excluding the test section.

Take density gauge readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density gauge readings with the gauge type, model, and serial number on Form BR 109, to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

Extract pavement cores at the marked locations in each sublot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver sealed pavement cores and samples to the Regional Materials laboratory in accordance with §402-3.08 Pavement Density Samples.

The Department will test the samples and analyze the results within one work day of the delivery of the samples and density gauge readings. The results of the analysis will be used to establish a PTD for each density gauge in accordance with MP 402-02.

If the average density of the pavement cores is not between 92% and 97% of the MMMD, the Engineer will apply Pavement Density Quality Adjustment to the material placed under Interim PTD, excluding the material placed on the test section.

3. Routine Paving. Do not place HMA mixture under Routine Paving until a PTD has been established. Use only density gauge(s) that have been correlated with pavement cores during the construction of the test section and a PTD has been determined by the Regional Materials Engineer. For other gauge(s), construct a new test section under the provisions of “Test Section” to establish a PTD. Compact the pavement sufficiently to achieve the PTD value at each test location. Take density gauge readings at every 200 feet along the length of the pavement for each paver pass, at locations randomly selected by the Engineer, in accordance with MP 402-02. Record density values on the appropriate BR form based on the type of gauge used. Ensure the minimum density reading is at least 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.

Monitor the density on shoulders, ramps, widening and crossovers with the same density gauge to ensure the PTD is achieved. Use the appropriate BR form based on the gauge used to record the density readings in accordance with MP 402-02. 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 further damage occurs to the shoulder or subbase.

When HMA mixture placement is less than the anticipated quantities, obtain a minimum of two loose mix samples before placement is terminated. Before extracting the pavement cores, take density gauge readings and record on Form BR 109. Deliver the sealed pavement cores, loose mix samples, and the density gauge readings to the Regional Materials Laboratory for testing.

In addition to the daily density monitoring with a gauge, the Engineer will select and mark 4 pavement core locations every 3rd day of HMA mixture placement on the mainline from that
SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

day’s placement for pavement density verification. Extract a set of pavement cores and loose mix samples in accordance with §402-3.08, Pavement Density Samples.

The RME will calculate the PTD based on additional pavement cores taken every 3rd day of HMA mixture placement for pavement density verification. If the calculated PTD differs from the previous PTD by more than 2 lbs/ft³, the Engineer will establish a new PTD.

If the average density of the pavement cores is not between 92% and 97% of the MMTD, the Engineer will apply Pavement Density Quality Adjustment to the material placed on day.

a. Provide additional pavement samples to verify pavement density of 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.
   - Plant production QAF is 0.85 and need to evaluate the pavement section in accordance with §401-4.10 Evaluation of Sublots Represented by 0.85 QAF, to determine whether to keep it in place.

   The Engineer will select and mark 4 pavement core locations in accordance with §402-3.08 Pavement Density Samples.

   Take density gauge(s) readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density gauge readings with the gauge type, model, and serial number to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples on Form BR 109.

   Extract a pavement core at the marked location in each sublot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver sealed pavement cores and samples to the Regional Materials laboratory in accordance with §402-3.08 Pavement Density Samples.

   The RME will establish a new PTD based on these pavement cores. If the average density of the pavement cores is not between 92% and 97% of the MMTD, the Engineer will apply Pavement Density Quality Adjustment to the material placed under these situations.

b. Provide additional pavement samples to verify PTD used for the situations listed below. The material placed under these situations will not be subject to Pavement Density Quality Adjustment.
   - Changes in condition of existing pavement being overlaid.
   - Excessive plant mixture variations.
   - Using a different Job Mix Formula or a different HMA plant other than the one used to produce mixture for the test section, as long as the aggregate and PG Binder sources do not change.

4. Multiple Paving Sites. When the work includes multiple paving sites, construct a test section at the initial paving site to establish a PTD. For the rest of the paving sites, provide pavement cores, loose mix samples, and gauge readings on the first day to verify PTD.

   The Engineer will direct that a test section be constructed if a different HMA plant other than the one used at previous site(s) is supplying the HMA mixture using different aggregate and PG Binder sources. The Test Section Adjustment will apply.

   When a contract includes multiple sites, the requirement of additional set of pavement cores
applies to each paving site.

**C. 70 Series Compaction Method.** Place and compact HMA mixture in accordance with the contract documents. Do not place HMA mixture, including the construction of the test section, unless both a density gauge and a certified operator are present.

1. **Test Section.** On the first day of paving, place and compact a test section on the mainline, a maximum of 1,500 feet long in one lane, 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, to determine the Project Target Density (PTD) using the “peak” method. Ensure the thickness of the test section is the same as the course it represents. Use the first 150 feet of the test section to stabilize the paving operation. Initially, compact the pavement with a breakdown roller once sufficient HMA mixture is placed in the testable area. Select three random locations in accordance with 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. Make necessary vibratory and static passes to “peak” the pavement density such that the density gauge reading is within 92-97% of the MMTD. Take density readings at the three selected sites after every additional machine pass until a “peak” density is achieved. A “peak” density is achieved when the increase in density is less than 2 lbs/ft³ with compaction at 175°F or less. Stop further compaction if the pavement shows signs of distress.

Determine the PTD by calculating the average of the highest density reading from each of the random locations. Use the calculated PTD to monitor the pavement density. The Engineer may request pavement cores to verify the PTD in accordance with MP 402-02.

Routine paving operations may begin after construction of the test section, and after a PTD has been established and been verified by the Engineer based on the evaluation of density readings.

2. **Routine Paving.** Use only the density gauge(s) that were correlated during the construction of the test section and its corresponding PTD to monitor pavement density during routine paving operations.

Begin routine paving after the PTD has been established. Compact the pavement sufficiently to achieve the PTD value at each test location. Ensure the minimum density reading is at least 96% and no greater than 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 every 200 feet along the length of the pavement for each paver pass, at locations randomly selected by the Engineer, in accordance with the MP 402-02. 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 construct a new test section.

Monitor density on shoulders, ramps, widening and crossovers with the same density gauge to ensure the PTD is achieved. Use the appropriate BR form based on the gauge used to record the density readings in accordance with MP 402-02. 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.

The Engineer may request pavement samples for density verification of HMA placed under the following situations at no additional cost to the State.

- 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.
**D. 80 Series Compaction Method.** Place and compact HMA mixture using either a static compaction or vibratory compaction method.

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. Perform all turning of the rollers 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 applicable. Oscillatory rollers may be used for either rolling option.

<table>
<thead>
<tr>
<th>Pavement Courses</th>
<th>Static Compaction</th>
<th>Vibratory Compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steel Wheel Rollers</td>
<td>Pneumatic Rollers</td>
</tr>
<tr>
<td>37.5 Base (Each Lift)</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>25 Binder</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>19 Binder</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>12.5 Top</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>9.5 Top</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Permeable Base²</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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

1. **Static Compaction.** Use static compaction only when the compacted thickness of the finished mat is 4 inches or less. Compact the HMA mixture using a 3 static roller train. Ensure the rollers move at a uniform speed and do not exceed 3 mph. Ensure the roller drive wheel or drum is 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. Compact the HMA mixture with steel-wheel rollers operating in a static mode. Ensure each pass overlaps the previous roller pass by one-half the width of the roller.

   Compact the HMA mixture with a steel-wheel roller immediately followed with a pneumatic rubber-tired roller. Make a minimum of 3 passes of the rubber-tired roller. 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 mixture 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. **Vibratory Compaction.** Furnish a vibrating reed tachometer for the exclusive use of the Engineer. Provide a vibrating reed tachometer having a frequency range of 1,000 vpm to 4,000 vpm with a minimum reed interval of 50 vpm between 1,000 vpm and 2,000 vpm and a minimum reed interval of 100 vpm between 2,000 vpm and 4,000 vpm.
Ensure the settings on the rollers produce a minimum of 12 impacts per foot during the compaction process. Impacts are defined as the number of times a drum hits the pavement within one foot of travel and are determined using the following formula:

\[
\text{Impacts per foot} = \frac{\text{VPM}}{\text{Speed}}
\]

VPM = Frequency of the roller (vibration per minute)  
Speed = Speed of the roller (feet per minute)

If the impacts are less than the minimum, adjust the settings and/or the speed to meet the minimum impacts requirement.

If satisfactory compaction is not obtained, or damage occurs to highway components and/or adjacent property using vibratory compaction equipment, cease using the vibratory compaction method and complete the work using static compaction methods in accordance with 1. Static Compaction at no additional cost to the State.

If number of roller passes, the roller setup, or minimum impacts per foot is not being met, stop the paving operation, adjust the process as necessary, and restart the operation with the approval of the Engineer.

E. Density Gauges. Provide density gauge(s) to monitor pavement density in accordance with MP 402-02.

1. Nuclear Density Gauge. Submit a Safety Control plan at least two weeks prior to using the gauge. Provide nuclear density gauge meeting the following requirements:
   - Consist of a radioactive source, scaler, and other basic components housed in a single backscatter unit.
   - Calibrated at least every two years.
   - Operated by personnel trained in the principles of nuclear testing and safety practices.

2. Non-nuclear Density Gauge. Provide non-nuclear density gauge meeting the following requirements:
   - Capable of functioning in the temperature and moisture levels experienced during HMA mixture paving.
   - Capable of determining the density of HMA pavements by measuring changes in the electromagnetic field resulting from the HMA compaction process.
   - 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 subplot in accordance with MP 402-02. Take 6 inch diameter pavement cores from within the 10-inch diameter circles outlined by the Engineer. The Engineer will not designate pavement core locations before the rolling operation is completed, and all compaction equipment has moved off the subplot designated for coring. Notify the Engineer immediately if a pavement core is in a location that is believed to not represent the subplot. Extract the pavement cores no later than the end of the following day’s placement. If necessary, cool the pavement so that the core samples are not damaged during coring. Do not separate the core sample from the underlying layers if the pavement core sample does not debond during coring. 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 except for the following situations:
As described in §402-3.08G Pavement Density Core Test Results

To establish an Interim Project Target Density on the first day of paving. In that case, 2 cores maybe taken during the construction of a test section

To perform quality control tests during routine paving. A maximum of two cores are allowed with prior permission of the Engineer. Do not take core(s) adjacent to the project cores.

B. Filling Core Holes. Fill all pavement core holes with a similar HMA mixture 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 mixture 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. Use an alternative method approved by the Engineer if it provides acceptable results. If core holes are not filled within 2 work 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 4 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 mixture placement. The RME may utilize loose mix maximum theoretical specific gravity values from plant HMA QC/QA testing. When requested, supply the QCT and QAT results by e-mail or fax to the RME.

D. Securing Pavement Cores. The Engineer will secure and seal the pavement cores in accordance with MP 402-02 once they have been extracted from the pavement.

E. Sample Delivery. Deliver the sealed cores, loose mix samples, and gauge density readings, when required, to the Regional Materials Laboratory no later than the end of the following day’s placement. Submit pavement cores, density gauge readings, and loose mix samples as required for 50, 60, or 70 Series methods 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, stop paving operations until the samples are delivered and tested.

F. Unacceptable Pavement Cores. Pavement cores damaged during extraction, pavement cores delivered to the Regional Materials Laboratory for testing that are damaged, or pavement cores with damaged or missing security seals will not be tested. The Engineer will select new pavement core locations within a foot forward of the original locations at the same offset. Extract new pavement cores from the newly identified locations.

G. Pavement Density Core Test Results. Upon receipt of test results of the pavement cores and loose mix samples provided by the Regional Materials Laboratory, if the results are not representative of the density gauge data or previous results for similar sublots, notify the Engineer and the Regional Materials Engineer, in writing, within 2 work days. Include details as to what specific test results are not representative, and the reasons, with the notification.

402-3.09 Joints. Ensure the finished pavement at all joints complies with the surface tolerance requirements and exhibits 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 approved by the Engineer.

Construct all joints, excluding the tapered wedge joint, such that the exposed edge of the newly placed course is full thickness of the course and straight unless the exposed joint will not be part of the joint. If the edge of the newly placed course is not straight or smoothly curved, correct the edge by using a power saw or other approved tools to cut a neat line. Prior to placing the adjacent course, apply joint
adhesive in accordance with §402-3.06 Joint Adhesive, to all pavement edges in order to provide bonding with the newly laid pavement.

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

A. Transverse Joints. Place 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 placement to expose the full depth of the course.

Set up the paver such that material laid overlaps the previously placed edge by 2 to 3 inches at a thickness of approximately 25% of 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. Do not broadcast the overlap material onto the fresh mat. 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.

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 uncompacted HMA mixture. 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. 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.

B. Longitudinal Joints. 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. Operate rollers 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 the roller 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. Make all turning movements of the roller 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 courses other than Top Course, ensure 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, construct the longitudinal joint using one of the options below. Use a butt joint for all other HMA courses.

1. Option A - Butt Joint. Place the HMA mixture such that it uniformly overlaps the adjacent cold mat 2 to 3 inches at a thickness of approximately 25% of 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. Do not broadcast the overlap material onto the fresh mat. 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 creates a safety hazard. Instead, place the HMA mixture in a manner such that the thickness of the uncompacted course is approximately 25% more than the compacted thickness of the adjacent HMA course 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. 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 at a thickness of approximately 25% of the compacted thickness of the HMA 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. 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 necessary.

Bumping is not required when the use of a rake creates a safety hazard. Instead, place the HMA mixture in a manner such that the thickness of the uncompacted course is approximately 25% more than the compacted thickness of the adjacent HMA course with a ½ to 1 inch overlap.

![Diagram of Tapered Wedge Joint](image)

**C. Exposed Longitudinal Joint.** Expose the longitudinal joint for the Top Course of up to 2 inches to traffic for not more than 24 hours with the following conditions:

- Use Option B, Tapered Wedge Joint, except when the thickness is 1 inch or less where a butt joint may be exposed to traffic.
- 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.
- 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.
- Apply joint adhesive to the exposed joint prior to placement of the adjacent lane in accordance with §402-3.06 Joint Adhesive.

Do not allow exposed joints over the weekends, holidays, or when there are other concerns, such as pending wet weather.

**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 \( \frac{1}{4} \) inch will be appropriately corrected or the pavement be removed and replaced at no additional cost to the State.

**402-3.11 Thickness Tolerance.** 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 thickness indicated for each of the various courses of HMA pavement is the nominal thickness.

The Engineer may request pavement cores to determine the thickness of the completed pavement course for final acceptance and payment. Provide work zone traffic control and take pavement cores in accordance with §402-3.08 Pavement Density Sample, at no additional cost to the State. 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 mixture specified under a single pay item is as follows:

- 1/4 inch or less for a required course whose nominal thickness is 4 inches or less
- 1/2 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:

- 1/4 inch or less when the total nominal thickness indicated on the plans is 4 inches or less
- 1/2 inch or less when the total nominal thickness is over 4 inches but not more than 8 inches
- 5/8 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 1/4 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 courses of multi course 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 HMA mixture placed may be accepted under the following conditions:

- When the individual course 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 mixture 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 course surface. Construct the shoulder edge wedge by using a device attached to the screed. Minimize hand work. Begin the top of the tapered section at the end of the shoulder width 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.

402-3.14 Pavement Evaluation. The Regional Materials Engineer (RME) will evaluate mixtures either placed or produced outside the specification limits which resulted in low quality adjustment factors.

A. Plant Production. When plant production QAF is 0.85, the RME will evaluate the pavement section in accordance with §401-3.10 Evaluation of Sublots Represented by 0.85 QAF, whether to keep it in place.

B. Pavement Density. When a QAF of a paving lot for 50 Series or 60 Series compaction is calculated to be 0.60, the RME will evaluate the lot to determine if it can be left in place. The type of material produced (i.e. Binder, Top), the course 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 mixture can be left in place. If the RME determines that the HMA mixture can be left in place, the Engineer will apply a QAF of 0.60. If the HMA mixture cannot be left in place, remove and replace at no additional cost to the State.

402-4 METHOD OF MEASUREMENT

402-4.01 Hot Mix Asphalt. The quantity of HMA mixture to be measured for payment will be in tons placed to the nearest 0.01 tons.

402-4.02 Plant Production Quality Adjustment. Plant Production Quality Adjustments will be measured in Quality Units determined for each day’s production using the daily Quality Adjustment Factor (QAF) for plant production, determined in accordance with §401-3.07 Documentation. Quality Units for plant production quality adjustments under 50 and 60 Series compaction methods will be calculated using the formula below. No plant production quality adjustments will be made under 70 and 80 Series compaction methods.

\[
\text{Quality Units} = (\text{Quality Adjustment Factor} \times 1.00) \times \text{HMA Placed (Tons)}
\]

402-4.03 Pavement Density Quality Adjustment. Pavement Density Quality Adjustments will be measured in Quality Units determined for each day’s production using the daily Quality Adjustment Factor (QAF) for pavement density. The quantity of 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 mixture placed on ramps with a uniform full width section less than 1250 feet in length, shoulders, widening, crossovers, and bridges. Payment in these areas will be a QAF of 1.00 based on satisfactory placement and compaction.

Quality Units for pavement density quality adjustments under 50 and 60 Series compaction methods will be calculated using the formula below. No pavement density quality adjustments will be made under 70 and 80 Series compaction methods.

\[
\text{Quality Units} = (\text{Quality Adjustment Factor} \times 1.00) \times \text{HMA Placed (Tons)}
\]
SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

A. 50 Series Compaction QAF. The RME will determine the Percent Within Limits (PWL) for the paving lot in accordance with MP 402-02 and determine the QAF as shown in Table 402-7 Quality Adjustment Factors for 50 Series. The Engineer will use the QAF to calculate the Quality Units for the accepted HMA mixture quantity.

<table>
<thead>
<tr>
<th>Percent Within Limits (PWL)</th>
<th>Quality Adjustment Factor (QAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWL_{92-97} &gt; 93</td>
<td>1.05</td>
</tr>
<tr>
<td>PWL_{92-97} ≤ 93</td>
<td>\sum (PWL_{Segment} x Pay Factor_{Segment})</td>
</tr>
</tbody>
</table>

1. PWL_{Segment} will be calculated for each of the density ranges in Table 402-8 Density Segment Pay Factors, using the standard deviation and average density for the lot.

<table>
<thead>
<tr>
<th>Density Segment</th>
<th>Segment Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>88 – 89</td>
<td>0.60</td>
</tr>
<tr>
<td>89 – 90</td>
<td>0.70</td>
</tr>
<tr>
<td>90 – 91</td>
<td>0.80</td>
</tr>
<tr>
<td>91 – 92</td>
<td>0.90</td>
</tr>
<tr>
<td>92 – 93</td>
<td>1.00</td>
</tr>
<tr>
<td>93 – 96</td>
<td>1.05</td>
</tr>
<tr>
<td>96 – 97</td>
<td>1.00</td>
</tr>
<tr>
<td>97 – 98</td>
<td>0.90</td>
</tr>
<tr>
<td>98 – 99</td>
<td>0.80</td>
</tr>
</tbody>
</table>

B. 60 Series Compaction QAF. When pavement density samples are taken and if payment adjustment is applicable, the Engineer will make the adjustment in accordance with Table 402-9 Quality Adjustment Factors for 60 Series. A payment adjustment will be made, based on the Quality Unit Index Price to all the material placed on the mainline for the day the pavement cores represent.

<table>
<thead>
<tr>
<th>Average Pavement Core Density</th>
<th>Quality Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>\leq 92 Density \leq 97</td>
<td>1.00</td>
</tr>
<tr>
<td>91.0 \leq Density &lt; 92.0 or 97.0 \leq Density \leq 98.0</td>
<td>0.95</td>
</tr>
<tr>
<td>90.0 \leq Density &lt; 91.0</td>
<td>0.90</td>
</tr>
<tr>
<td>88.0 \leq Density &lt; 90.0</td>
<td>0.85</td>
</tr>
<tr>
<td>Density &lt; 88.0 or Density &gt; 98.0</td>
<td>0.60</td>
</tr>
</tbody>
</table>

402-4.04 Test Section Adjustment. Test Section Adjustments will be measured in Quality Units using a test section adjustment factor of 0.5 for up to the first 200 tons placed on a test section on the mainline. Quality Units for Test Section Adjustment for 50 and 60 Series compaction methods will be calculated using the formula below.

\[ \text{Quality Units} = 0.5 \times \text{HMA Placed on Mainline (Tons)} \]
402-5 BASIS OF PAYMENT. The unit price bid for all HMA mixture shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including extracting the pavement cores, filling, and compaction of all core holes. Application of tack coat, joint adhesive, and cleaning will be paid separately except when the joint adhesive is applied under §402-3.01E.

Payment of Quality Adjustments will be made based on the number of Quality Units multiplied by the fixed index price for Quality Adjustment to HMA Items listed in the contract documents for the quantity placed on the day the Quality Units represent.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>402.010903</td>
<td>Type 1 F9, Asphalt-Treated Permeable Base Course</td>
<td>Ton</td>
</tr>
<tr>
<td>402.011903</td>
<td>Type 2 F9, Asphalt-Treated Permeable Base Course</td>
<td>Ton</td>
</tr>
<tr>
<td>402.017903</td>
<td>Truing &amp; Leveling F9, Superpave HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.018903</td>
<td>Truing &amp; Leveling F9, Superpave HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.058903</td>
<td>Shim Course F9, Hot Mix Asphalt</td>
<td>Ton</td>
</tr>
<tr>
<td>402.095103</td>
<td>9.5 F1 Top Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.095203</td>
<td>9.5 F2 Top Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.096103</td>
<td>9.5 F1 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.096203</td>
<td>9.5 F2 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.096303</td>
<td>9.5 F3 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.097103</td>
<td>9.5 F1 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.097203</td>
<td>9.5 F2 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.097303</td>
<td>9.5 F3 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.098103</td>
<td>9.5 F1 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.098203</td>
<td>9.5 F2 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.098303</td>
<td>9.5 F3 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.098903</td>
<td>9.5 F9 Top Course HMA, Shoulder Course, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.125103</td>
<td>12.5 F1 Top Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.125203</td>
<td>12.5 F2 Top Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.126103</td>
<td>12.5 F1 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.126203</td>
<td>12.5 F2 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.126303</td>
<td>12.5 F3 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.127103</td>
<td>12.5 F1 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.127203</td>
<td>12.5 F2 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.127303</td>
<td>12.5 F3 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.128103</td>
<td>12.5 F1 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.128203</td>
<td>12.5 F2 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.128303</td>
<td>12.5 F3 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.128903</td>
<td>12.5 F9 Top Course HMA, Shoulder Course, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.195903</td>
<td>19 F9 Binder Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.196903</td>
<td>19 F9 Binder Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.197903</td>
<td>19 F9 Binder Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.198903</td>
<td>19 F9 Binder Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.255903</td>
<td>25 F9 Binder Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.256903</td>
<td>25 F9 Binder Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.257903</td>
<td>25 F9 Binder Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.258903</td>
<td>25 F9 Binder Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.376903</td>
<td>37.5 F9 Base Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.377903</td>
<td>37.5 F9 Base Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.378903</td>
<td>37.5 F9 Base Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.418903</td>
<td>9.5 F9 Temporary Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>Item Code</td>
<td>Description</td>
<td>Unit</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>402.428903</td>
<td>12.5 F9 Temporary Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.438903</td>
<td>19 F9 Temporary Binder Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.448903</td>
<td>25 F9 Temporary Binder Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.000013</td>
<td>Plant Production Quality Adjustment to HMA Items</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.000023</td>
<td>Pavement Density Quality Adjustment to HMA Items</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.000053</td>
<td>Test Section Adjustment to HMA Items</td>
<td>Quality Unit</td>
</tr>
</tbody>
</table>
Incorporate the following changes to the Standard Specifications that will be effective on September 1, 2016.

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 suppliers listed in the Department’s Approved List for Fine and Coarse Aggregates and Performance Graded (PG) Binders for Hot Mix Asphalt (HMA) Paving respectively. 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 mixture 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 ensure the materials incorporated into the work are in conformity with the contract documents.

402-3 CONSTRUCTION DETAILS. The Engineer will conduct a pre-paving meeting prior to any HMA placement. The attendance at this meeting will include Regional Materials Engineer, Paving Superintendent, Chief Inspector or Paving Inspector(s), HMA plant representative, density gauge operator, depending on the compaction method used, and work zone traffic control (WZTC) competent person. Be prepared to discuss the operation necessary to complete the work successfully. Participants will review all aspects of the requirements including, but not limited to, the following:

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

Provide a certified density gauge operator to monitor pavement density using a density gauge for 50 Series, 60 Series, and 70 Series compaction methods with 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. Surface Temperature. Place HMA mixture only when the pavement surface temperature is equal to or greater than those specified in Table 402-1 Temperature Requirements.

<table>
<thead>
<tr>
<th>Nominal Compacted Lift Thickness</th>
<th>Surface Temperature Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 25 mm</td>
<td>10°C</td>
</tr>
<tr>
<td>25 mm &lt; Thickness ≤ 75 mm</td>
<td>7°C</td>
</tr>
<tr>
<td>&gt; 75 mm</td>
<td>5°C</td>
</tr>
</tbody>
</table>

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 course placement.

C. Temporary HMA Placements. HMA mixture placement for temporary detours, which are not and will not become part of the permanent pavement, are not subject to the temperature and seasonal limitations, but must be approved by the Engineer when placed outside temperature and seasonal limits. Repair any damaged areas deemed necessary by the Engineer on the temporary HMA placements within one work day after the notification.

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 work.

E. Scheduling HMA Placement. Schedule paving operations such that all HMA mixture 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
SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

not be completed within temperature and seasonal limitations, provide 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 at no additional cost to the State.

If the approved schedule indicates that Base or Binder course, which will be permanently incorporated into the work, is to be left open to traffic over the winter, apply joint adhesive to all the joints in accordance with Section 418 Asphalt Pavement Joint Adhesive.

If the top course is not placed within the seasonal limits as scheduled, apply joint adhesive on top of the exposed joints in the Binder course at least 100 mm centered on the exposed joint at no additional cost to the State.

Repair any damage to the Base or Binder course left over the winter prior to placing subsequent course(s) at no additional expense to the State.

402-3.02 HMA Pavers. Provide pavers capable of spreading and finishing courses of HMA mixture 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.
- When used for placing the initial paving course, Base, Binder, and Top Courses, provide pavers equipped with approved automatic transverse slope and longitudinal grade screed controls. Provide controls that automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities in the existing surface. Provide controls capable of maintaining the proper transverse slope and be readily adjustable so transitions and super-elevated curves can be satisfactorily paved. Provide controls that 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.

402-3.03 Hauling Equipment. Provide HMA transport trucks approved by the Engineer 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 except for live-bottom trucks that have channelized tarp systems. The inside surface of the vehicle body may be lightly coated with a release agent listed on the Approved List for Release Agents. Do not use petroleum products or solvents as release agents. All hauling equipment is subject to approval by the Engineer.

402-3.04 Rollers. Provide rollers of vibratory, oscillatory, static steel wheel type, or pneumatic tire rollers capable of compacting HMA mixture. The Engineer will inspect rollers prior to start of paving operations to determine acceptability. Provide a minimum of two rollers, one for breakdown and one for
SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

finish rolling, unless the HMA mixture placement is on a bridge deck, bridge approaches, or other areas where one roller may be sufficient to achieve the required density. Provide rollers in good mechanical condition, and capable of operating at speeds slow enough to avoid displacement of the mixture. Do not use equipment which results in excessive crushing of aggregate.

Ensure the manufacturer or supplier provides recommended settings for amplitude, frequency, and tire pressure (pneumatic) for each roller model for the thickness of pavement being rolled. The recommendations may either be on a sticker or a plate installed on the roller or a document readily available to the Engineer. For night time paving, provide a roller equipped with at least one light on each fender, or alternatively, at least one light above the roller, visible from a distance of 60 meters. Provide a roller equipped with an automatic audible warning signal when operating in reverse.

A. Vibratory and Oscillatory Rollers. Provide rollers designed for the compaction of HMA mixture. Provide self-propelled roller having single or dual drums meeting the requirements as stated below, weighing at least 8 metric tons and capable of maintaining set frequency and amplitude.

1. Nominal Amplitude 1.25 mm, maximum
2. Frequency 25 Hz, minimum
3. Drum Width (dual drums) 1.3 m, minimum
   (single drum) 2.1 m, minimum
4. Speedometer 1 km/hr or 15 m per minute increment, maximum

Provide rollers equipped with indicators that provide the operator with the speed, amplitude, and frequency setting readouts. Set the rollers such that they will produce a minimum of 40 impacts per meter during the compaction process.

Provide vibratory and oscillatory rollers equipped with an automatic disconnect system that automatically shuts off the vibration and oscillation when the roller is in a stationary position. Provide roller equipped with mechanical override systems in the event of temporary failure of the automatic disconnect system.

B. Static Steel-wheel Rollers. Provide self-propelled two axle types with a minimum weight of 8 metric tons.

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

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

D. Small Vibratory Rollers. Provide rollers of ride or walk behind type having dual vibratory drums meeting the following requirements:

1. Minimum Drum Width 0.6 m
2. Minimum frequency 25 Hz

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.
SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

Fill any depressions and wheelpath ruts prior to paving Truing and Leveling course using Table 402-2 Mixture Selection for Filling Wheelruts & Depressions, to select the appropriate mixture type.

### TABLE 402-2 MIXTURE SELECTION FOR FILLING WHEELRUTS & DEPRESSIONS

<table>
<thead>
<tr>
<th>Depth Range (mm)</th>
<th>Mixture Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 7</td>
<td>No treatment</td>
</tr>
<tr>
<td>7 ≤ Depth &lt; 20</td>
<td>Shim</td>
</tr>
<tr>
<td>≥ 20</td>
<td>9.5 mm Top Course</td>
</tr>
</tbody>
</table>

If a Truing and Leveling (T&L) course is specified in the contract documents, place the course(s) of a minimum variable thickness of proper plant mixture necessary to bring the surface of the existing pavement to the same transverse slope and longitudinal grade required for the finished pavement surface. Use Table 402-3 Mixture Selection for T&L Course, to select the appropriate mixture type. Select a mixture such that dragging of stones at the thin edge is minimized, including when constructing wedges for super-elevation. If dragging is excessive in any T&L course, select a different T & L mixture for the application. The surface of this course will be tested in the same manner prescribed in §402-3.10 Surface Tolerance, ensure that the allowable variation from the true surface after compaction does not exceed 10 mm.

### TABLE 402-3 MIXTURE SELECTION FOR T&L COURSE

<table>
<thead>
<tr>
<th>Compacted Thickness Range (mm)</th>
<th>Mixture Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 50</td>
<td>9.5 mm or 12.5 mm Top Course</td>
</tr>
<tr>
<td>50 &lt; Thickness ≤ 75</td>
<td>19.0 mm or 25.0 mm Binder Course</td>
</tr>
<tr>
<td>75 &lt; Thickness ≤ 125</td>
<td>25.0 mm Binder Course or 37.5 mm Base Course</td>
</tr>
</tbody>
</table>

402-3.06 Spreading and Finishing

**A. Tack Coat.** Apply tack coat between all HMA pavement lifts prior to placing HMA mixture regardless of time period between lifts. Do not apply tack coat more than 24 hours prior to the placement of HMA mixture unless approved by the Engineer. Apply tack coat to all contact surfaces of existing HMA and Portland Cement Concrete including such areas as adjacent pavement edges, curbing, gutters, manholes, and other structures where the HMA mixture will be in contact. 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.

**B. Joint Adhesive.** Apply joint adhesive to all pavement edges in accordance with Section 418 Asphalt Pavement Joint Adhesive prior to placing the asphalt mixture in order to provide bonding with the newly laid pavement. The application of joint adhesive is for Top Course only unless it is specified for other courses in the contract documents or as required under §402-3.01E. Scheduling HMA Placement.

**C. HMA Mixture 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 HMA mixtures to the work site, and incorporate into the
work within 10°C of the specified temperature. For 80 Series compaction method, select the desired mixture temperature with the concurrence of the Engineer.

**D. HMA Mixture from Multiple Plants.** Do not supply HMA mixture from multiple plants to a single paver.

**E. Reference Line.** Erect and maintain taut reference line positioned at or near the pavement centerline or edge to guide the paver when the initial pavement course is laid for new or reconstructed pavement. Support the reference line at approximately 8 meters intervals on tangent sections and at closer intervals on curves. Tension the line sufficiently to remove any sagging. Use a moving reference of at least 9 meters in length in lieu of a reference line with approval of the Engineer. The moving reference may be a floating beam, ski, or other suitable type such that the resulting pavement course surface is 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. Any course in an adjacent lane may be used as the reference for the use of a short ski. If the proposed floating beam or the short ski does not produce the results similar to those obtained using a taut reference line, discontinue the use of these devices and erect a taut reference line.

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.

**F. HMA Mixture Placement.** Use HMA paver(s) to place the HMA mixture either over the entire width or over a partial width that is practical. Operate the paver at a consistent steady speed, correlated to the rate of material delivery, in order to produce a mat free of bumps and dips, resulting in a smooth ride. Place the HMA mixture on a clean, tack coated surface. Ensure trucks deliver the mixture into the paver upon arrival at the site. Immediately spread and strike off HMA mixture to the required width and loose depth to established line and grade, to obtain the required compacted thickness at the completion of work. If the areas to be paved are less than 93 m² 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 contract documents.

Place all pavement courses using one of the reference line methods required above. 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 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 1.2 meters. 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. Ensure the placement equipment wheels and/or other appurtenances do not interfere with the distribution and placement of the Shim Course material.

**G. Top Course Texture and Color.** Supply Top Course HMA mixture from a single plant for the duration of the work such that the pavement surface has a uniform color and texture, except when a contract includes multiple paving sites, or the paving length is more than 8 kilometers and supply from multiple plants to either end of the paving length is practical. In that case, the above requirement will apply to each paving site and locations at either end of the paving length 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 if the aggregate used for producing the HMA mixture is from the same source, with the concurrence of the Regional
Materials Engineer. When tandem paving is utilized, multiple plants may be used to supply mixture provided the aggregate used is from the same source. The provisions of §402-3.06 D apply.

402-3.07 Compaction. Compact the HMA mixture 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 compacting HMA mixture using 50, 60, or 70 series methods, control all operations of the rollers including speed, amplitude settings, vibration frequency, and the type of rollers.

Compact the HMA mixture using rollers meeting the requirements of §402-3.04 Rollers. Compact the HMA mixture immediately after placement, and 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.

Immediately correct any displacement caused by reversing the direction of the roller, or any 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 mat. Keep the wheels properly moistened with water, water mixed with small quantities of detergent, or other approved material, to prevent adhesion of the mixture to the rollers. Do not use petroleum products or solvents.

Upon completion of the HMA mixture placement, ensure there are no visible defects in the pavement, such as shallow ruts, ridges, roller marks, cracking, tearing, segregation, bleeding, or any other irregularities. Correct any defects that become apparent or replace the defective pavement at no additional cost to the State.

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

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

Make a minimum of three passes of a pneumatic rubber tire roller for compaction when Shim Course or 9.5 mm Top Course is used for filling wheel ruts. Make a minimum of two passes when Shim Course is used as a skim coat. Use other types of rollers with the approval of the Engineer.

Do not use vibratory compaction when HMA mixture is placed on structural bridge decks or other structures with less than 0.6 meters 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 50, 60 and 70 Series compaction using density gauges specified in §402-3.07E Density Gauges. Ensure the density gauge operator possesses a current Density Gauge Inspector Certification from The New York State Associated General Contractors, 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 pavement density adjustment. 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

<table>
<thead>
<tr>
<th>Compaction Methods</th>
<th>Item Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A=50 series</td>
<td>402.XX5F0R</td>
</tr>
<tr>
<td>B=60 series</td>
<td>402.XX6F0R</td>
</tr>
<tr>
<td>C=70 series</td>
<td>402.XX7F0R</td>
</tr>
<tr>
<td>D=80 series</td>
<td>402.XX8F0R &amp; other</td>
</tr>
</tbody>
</table>

NOTE: XX = 37, 25, 19, 12, 09, 05, 01  
F = Friction requirement (1, 2, 3, 9)  
R = Revision number

A. 50 Series Compaction Method. On the first day of mainline paving, place and compact the HMA mixture in accordance with the provisions of Option 1 or Option 2. Routine paving is the placement and compaction of HMA mixture after the test section or first day paving.

1. **Option 1 (Test Section).** Place and compact a test section on the mainline a maximum of 500 meters long, at a location approved by the Engineer to determine if the HMA mixture can be compacted uniformly within the 92-97% of MMTD. Ensure the thickness of the test section is the same as the course it represents. Use the first 50 meters of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select and mark 4 pavement core locations, excluding the first 50 meters, in accordance with §402-3.08 Pavement Density Samples.

   Extract pavement cores at the marked locations before the road is open to traffic. Take loose mix samples as specified under §402-3.08. Deliver all the samples to the Regional Materials Laboratory for testing and analysis. The following will apply to the test section:

   - Place only one test section per day. Subsequent test sections are subject to approval by the Engineer.
   - Test Section Adjustment will apply for up to 200 metric tons placed on each test section.
   - A maximum of two test sections per item will be subject to the Test Section Adjustment.
   - The Test Section Adjustment will not apply for a test section if any HMA mixture of 150 metric tons or more is placed on the same day, other than the quantity required for the construction of the test section or permeable base placed under the test section location.
   - Pavement Density Quality Adjustment will not apply to the first two test sections. Subsequent test section(s) located on the mainline are subject to Pavement Density Quality Adjustment.
   - Do not place HMA mixture under Routine Paving until the results of the pavement cores from the test section have a minimum pavement density QAF of 1.00.
   - If the pavement density QAF is less than 1.00, construct another test section.
   - If the calculated QAF is 0.60, the Test Section Adjustment will not apply and the RME will evaluate the test section in accordance with §402-3.14 Pavement Evaluation to determine if it can be left in place.

2. **Option 2 (First Day Routine Paving).** Do not construct a test section on the first day of paving. The Test Section Adjustment will not apply. All material placed and compacted will be subject to a Pavement Density Quality Adjustment in accordance with Routine Paving, below. If the pavement density QAF on the first day of paving is less than 1.00, construct a test section in accordance with Option 1.
3. **Routine Paving.** A paving lot is defined as a day’s production of at least 200 metric tons. Each paving lot will be equally divided into sublots in accordance with Materials Procedure (MP) 402-02 *Hot Mix Asphalt (HMA) Pavement Density Determination*, based on the quantity placed.

When the quantity placed is less than 200 metric tons in a day, pavement samples are not required. The density QAF for that day will be 1.00 provided the procedures used in these areas to obtain pavement densities are similar to previously placed pavement sections based on the density gauge test data.

When the quantity placed is more than 200 metric tons but less than or equal to 2000 metric tons in a day, the Engineer will divide the lot into 4 equal sublots.

When the quantity exceeds 2000 metric tons, the Engineer will select one additional pavement core location for up to every 500 metric tons over 2000 metric tons, up to a maximum number of cores for a lot of 8.

The Engineer will select and mark a pavement core location in each sublot in accordance with §402-3.08 once the compaction operation is completed, excluding the first 50 meters of the day’s paving.

Extract pavement cores at the marked locations in each sublot before the road is open to traffic, fill the pavement core holes, take loose mix samples representing the lot, and deliver the sealed pavement cores and loose mix samples to the Regional Materials Laboratory in accordance with §402-3.08 *Pavement Density Samples*. The Department will test samples and analyze the results within one work day of the delivery of the samples. The results of this analysis will be used to determine the pavement density QAF in accordance with MP 402-02. When HMA mixture placement is less than the anticipated quantities, obtain a minimum of two loose mix samples before placement is terminated.

When paving over extended time periods using multiple crews, a new lot will be established when a change in the paving crew occurs. When the work includes multiple paving operations, each paving operation will be considered a lot and evaluated separately.

When two consecutive lots are found to have a density QAF equal to or less than 0.85, stop paving operations and construct a new test section in accordance with **Option 1**.

Monitor density on the material placed on shoulders, widening, crossovers, bridges and ramps with a uniform full-width section of less than 400 meters in length using the same density gauge(s) and target density used on the mainline. Record the density values on appropriate BR form based on the type of gauge used, in accordance with MP 402-02. If the shoulder subbase is structurally insufficient to sustain the level of compaction such that the shoulder shows signs of distress during compaction, decrease the compaction effort until no further damage occurs to the shoulder or subbase.

**B. 60 Series Compaction Method.** On the first day of mainline paving, place and compact the pavement under the provisions of **Option 1** or **Option 2**. Routine paving is the placement and compaction of HMA mixture after **Option 1** or after **Option 2**. Do not place HMA mixture under this method unless both a density gauge and a certified operator are present.

1. **Option 1 (Test Section Only).** Place and compact a test section on the mainline a maximum of 500 meters long, at a location approved by the Engineer to determine a Project Target Density (PTD) using the correlation of a density gauge(s) to the pavement cores results and to determine if the mixture can be compacted uniformly within the 92-97% of MMTD. Use the same equipment and procedures to construct the test section that will be used in the construction of the remainder of the course being laid. Ensure the thickness of the test section is the same as the course it represents. Use the first 50 meters of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select and mark 4 pavement core locations, excluding the first 50 meters, in accordance with §402-3.08 *Pavement Density Samples*. 


Take density gauge readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density gauge readings with the gauge type, model, and serial number to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples on Form BR 109.

Extract pavement cores at the marked location in each subplot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver density gauge readings, sealed pavement cores and loose mix samples to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

The Department will test the samples and analyze the results within one work day of the delivery of the samples and density gauge readings. The results of the analysis will be used to establish a PTD for each density gauge in accordance with MP 402-02. The following will apply to the test section.

- Place only one test section per day. Subsequent test sections are subject to approval by the Engineer.
- Test Section Adjustment applies for up to 200 metric tons placed on each test section.
- A maximum of two test sections per item will be subject to the Test Section Adjustment.
- The Test Section Adjustment will not apply for a test section if any HMA mixture or permeable base placed under the test section location.
- If the average density of the four pavement cores results in a QAF of 0.60, the Test Section Adjustment will not apply and the RME will evaluate the test section in accordance with §402-3.14 Pavement Evaluation to determine if it should be left in place.

2. **Option 2 (Test Section and Continue Paving).** Place and compact a test section as described under Option 1 on the mainline a maximum of 500 meters long, at a location approved by the Engineer to determine a Project Target Density (PTD) using the correlation of a density gauge(s) to the pavement cores results and to determine if the mixture can be compacted uniformly within the 92-97% of MMTD. Use the same equipment and procedures to construct the test section that will be used in the construction of the remainder of the course being laid. Ensure the thickness of the test section is the same as the course it represents. Use the first 50 meters of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select and mark 4 pavement core locations, excluding the first 50 meters, in accordance with §402-3.08 Pavement Density Samples.

Take density gauge readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density gauge readings with the gauge type, model, and serial number on Form BR 109, to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

Extract pavement cores at the marked locations in each subplot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver sealed pavement cores and samples to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

Establish an Interim PTD as described in MP 402-02 based on the density gauge used. Use the Interim PTD to monitor pavement density until the Actual PTD is established by the RME. Prior to the determination of an Actual PTD, take 4 additional loose mix samples, in accordance with §402-3.08 and store these samples at the plant.

- The Test Section Adjustment factor will not apply.
- All material placed after the test section for that day will be subject to Pavement Density Quality Adjustment.
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Take density gauge readings at every 60 meters along the length of the pavement for each paver pass, at locations randomly selected and marked by the Engineer, in accordance with MP 402-02.

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 density readings falls below 98% of the Interim PTD, stop 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 MP 402-02. If the moving average of the last 10 density readings is below 98% of the Actual PTD, the Engineer will randomly select and mark 4 pavement core locations in accordance with §402-3.08 over the day’s placement under Interim PTD, excluding the test section.

Take density gauge readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density gauge readings with the gauge type, model, and serial number on Form BR 109, to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

Extract pavement cores at the marked locations in each sublot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver sealed pavement cores and samples to the Regional Materials laboratory in accordance with §402-3.08 Pavement Density Samples.

The Department will test the samples and analyze the results within one work day of the delivery of the samples and density gauge readings. The results of the analysis will be used to establish a PTD for each density gauge in accordance with MP 402-02.

If the average density of the pavement cores is not between 92% and 97% of the MMTD, the Engineer will apply Pavement Density Quality Adjustment to the material placed under Interim PTD, excluding the material placed on the test section.

3. Routine Paving. Do not place HMA mixture under Routine Paving until a PTD has been established. Use only density gauge(s) that have been correlated with pavement cores during the construction of the test section and a PTD has been determined by the Regional Materials Engineer. For other gauge(s), construct a new test section under the provisions of “Test Section” to establish a PTD. Compact the pavement sufficiently to achieve the PTD value at each test location. Take density gauge readings at every 60 meters along the length of the pavement for each paver pass, at locations randomly selected by the Engineer, in accordance with MP 402-02. Record density values on the appropriate BR form based on the type of gauge used.

Ensure the minimum density reading is at least 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.

Monitor the density on shoulders, ramps, widening and crossovers with the same density gauge to ensure the PTD is achieved. Use the appropriate BR form based on the gauge used to record the density readings in accordance with MP 402-02. 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 further damage occurs to the shoulder or subbase.

When HMA mixture placement is less than the anticipated quantities, obtain a minimum of two loose mix samples before placement is terminated. Before extracting the pavement cores, take density gauge readings and record on Form BR 109. Deliver the sealed pavement cores, loose mix samples, and the density gauge readings to the Regional Materials Laboratory for testing.

In addition to the daily density monitoring with a gauge, the Engineer will select and mark 4 pavement core locations every 3rd day of HMA mixture placement on the mainline from that location and 98% of the PTD calculated as a moving average of the last 10 test locations.
day’s placement for pavement density verification. Extract a set of pavement cores and loose mix samples in accordance with §402-3.08, Pavement Density Samples.

The RME will calculate the PTD based on additional pavement cores taken every 3rd day of HMA mixture placement for pavement density verification. If the calculated PTD differs from the previous PTD by more than 32.0 kg/m³, the Engineer will establish a new PTD.

If the average density of the pavement cores is not between 92% and 97% of the MMTD, the Engineer will apply Pavement Density Quality Adjustment to the material placed on day.

a. Provide additional pavement samples to verify pavement density of 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.
   - Plant production QAF is 0.85 and need to evaluate the pavement section in accordance with §401-4.10 Evaluation of Sublots Represented by 0.85 QAF, to determine whether to keep it in place.

   The Engineer will select and mark 4 pavement core locations in accordance with §402-3.08 Pavement Density Samples.

   Take density gauge(s) readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density gauge readings with the gauge type, model, and serial number to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples on Form BR 109.

   Extract a pavement core at the marked location in each sublot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver sealed pavement cores and samples to the Regional Materials laboratory in accordance with §402-3.08 Pavement Density Samples.

   The RME will establish a new PTD based on these pavement cores. If the average density of the pavement cores is not between 92% and 97% of the MMTD, the Engineer will apply Pavement Density Quality Adjustment to the material placed under these situations.

b. Provide additional pavement samples to verify PTD used for the situations listed below. The material placed under these situations will not be subject to Pavement Density Quality Adjustment.
   - Changes in condition of existing pavement being overlaid.
   - Excessive plant mixture variations.
   - Using a different Job Mix Formula or a different HMA plant other than the one used to produce mixture for the test section, as long as the aggregate and PG Binder sources do not change.

4. Multiple Paving Sites. When the work includes multiple paving sites, construct a test section at the initial paving site to establish a PTD. For the rest of the paving sites, provide pavement cores, loose mix samples, and gauge readings on the first day to verify PTD.

   The Engineer will direct that a test section be constructed if a different HMA plant other than the one used at previous site(s) is supplying the HMA mixture using different aggregate and PG Binder sources. The Test Section Adjustment will apply.

   When a contract includes multiple sites, the requirement of additional set of pavement cores
applies to each paving site.

**C. 70 Series Compaction Method.** Place and compact HMA mixture in accordance with the contract documents. Do not place HMA mixture, including the construction of the test section, unless both a density gauge and a certified operator are present.

**1. Test Section.** On the first day of paving, place and compact a test section on the mainline, a maximum of 500 meters long in one lane, 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, to determine the Project Target Density (PTD) using the “peak” method. Ensure the thickness of the test section is the same as the course it represents. Use the first 50 meters of the test section to stabilize the paving operation. Initially, compact the pavement with a breakdown roller once sufficient HMA mixture is placed in the testable area. Select three random locations in accordance with 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. Make necessary vibratory and static passes to “peak” the pavement density such that the density gauge reading is within 92-97% of the MMTD. Take density readings at the three selected sites after every additional machine pass until a “peak” density is achieved. A “peak” density is achieved when the increase in density is less than 32.0 kg/m^3 with compaction at 80°C or less. Stop further compaction if the pavement shows signs of distress.

Determine the PTD by calculating the average of the highest density reading from each of the random locations. Use the calculated PTD to monitor the pavement density. The Engineer may request pavement cores to verify the PTD in accordance with MP 402-02.

Routine paving operations may begin after construction of the test section, and after a PTD has been established and been verified by the Engineer based on the evaluation of density readings.

**2. Routine Paving.** Use only the density gauge(s) that were correlated during the construction of the test section and its corresponding PTD to monitor pavement density during routine paving operations.

Begin routine paving after the PTD has been established. Compact the pavement sufficiently to achieve the PTD value at each test location. Ensure the minimum density reading is at least 96% and no greater than 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 every 60 meters along the length of the pavement for each paver pass, at locations randomly selected by the Engineer, in accordance with the MP 402-02. 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 construct a new test section.

Monitor density on shoulders, ramps, widening and crossovers with the same density gauge to ensure the PTD is achieved. Use the appropriate BR form based on the gauge used to record the density readings in accordance with MP 402-02. 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.

The Engineer may request pavement samples for density verification of HMA placed under the following situations at no additional cost to the State:

- 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.
**SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS**

**D. 80 Series Compaction Method.** Place and compact HMA mixture using either a static compaction or vibratory compaction method.

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. Perform all turning of the rollers 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 applicable. Oscillatory rollers may be used for either rolling option.

<table>
<thead>
<tr>
<th>Pavement Courses</th>
<th>Static Compaction</th>
<th>Vibratory Compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steel Wheel Rollers</td>
<td>Pneumatic Rollers</td>
</tr>
<tr>
<td>37.5 mm Base (Each Lift)</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>25.0 mm Binder</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>19.0 mm Binder</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>12.5 mm Top</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>9.5 mm Top</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Permeable Base²</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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

1. **Static Compaction.** Use static compaction only when the compacted thickness of the finished mat is 100 mm or less. Compact the HMA mixture using a 3 static roller train. Ensure the rollers move at a uniform speed and do not exceed 5 km/hr. Ensure the roller drive wheel or drum is 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. Compact the HMA mixture with steel-wheel rollers operating in a static mode. Ensure each pass overlaps the previous roller pass by one-half the width of the roller.

Compact the HMA mixture with a steel-wheel roller immediately followed with a pneumatic rubber-tired roller. Make a minimum of 3 passes of the rubber-tired roller. 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 mixture 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. **Vibratory Compaction.** Furnish a vibrating reed tachometer for the exclusive use of the Engineer. Provide a vibrating reed tachometer having a frequency range of 20 Hz to 80 Hz with a minimum reed interval of 1 Hz between 20 Hz and 40 Hz and a minimum reed interval of 2 Hz between 40 Hz and 80 Hz.
Ensure the settings on the rollers produce a minimum of 36 impacts per meter during the compaction process. Impacts are defined as the number of times a drum hits the pavement within one meter of travel and are determined using the following formula:

\[ \text{Impacts per meter} = \frac{Hz}{\text{Speed}} \]

VPM = Frequency of the roller (vibration per minute)
Speed = Speed of the roller (meter per minute)

If the impacts are less than the minimum, adjust the settings and/or the speed to meet the minimum impacts requirement.

If satisfactory compaction is not obtained, or damage occurs to highway components and/or adjacent property using vibratory compaction equipment, cease using the vibratory compaction method and complete the work using static compaction methods in accordance with \textit{I. Static Compaction} at no additional cost to the State.

If number of roller passes, the roller setup, or minimum impacts per meter is not being met, stop the paving operation, adjust the process as necessary, and restart the operation with the approval of the Engineer.

\textbf{E. Density Gauges.} Provide density gauge(s) to monitor pavement density in accordance with MP 402-02.

\textbf{1. Nuclear Density Gauge.} Submit a Safety Control plan at least two weeks prior to using the gauge. Provide nuclear density gauge meeting the following requirements:
- Consist of a radioactive source, scaler, and other basic components housed in a single backscatter unit.
- Calibrated at least every two years.
- Operated by personnel trained in the principles of nuclear testing and safety practices.

\textbf{2. Non-nuclear Density Gauge.} Provide non-nuclear density gauge meeting the following requirements:
- Capable of functioning in the temperature and moisture levels experienced during HMA mixture paving.
- Capable of determining the density of HMA pavements by measuring changes in the electromagnetic field resulting from the HMA compaction process.
- Calibrated at least every two years.

\textbf{402-3.08 Pavement Density Samples}

\textbf{A. Pavement Cores.} The Engineer will select one pavement core location for each sublot in accordance with MP 402-02. Take 150 mm diameter pavement cores from within the 250-mm diameter circles outlined by the Engineer. The Engineer will not designate pavement core locations before the rolling operation is completed, and all compaction equipment has moved off the sublot designated for coring. Notify the Engineer immediately if a pavement core is in a location that is believed to not represent the sublot. Extract the pavement cores no later than the end of the following day’s placement. If necessary, cool the pavement so that the core samples are not damaged during coring. Do not separate the core sample from the underlying layers if the pavement core sample does not de-bond during coring. 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 except for the following situations:
As described in §402-3.08G Pavement Density Core Test Results
To establish an Interim Project Target Density on the first day of paving. In that case, 2 cores may be taken during the construction of a test section
To perform quality control tests during routine paving. A maximum of two cores are allowed with prior permission of the Engineer. Do not take core(s) adjacent to the project cores.

B. Filling Core Holes. Fill all pavement core holes with a similar HMA mixture 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 mixture 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. Use an alternative method approved by the Engineer if it provides acceptable results. If core holes are not filled within 2 work 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 4 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 mixture placement. The RME may utilize loose mix maximum theoretical specific gravity values from plant HMA QC/QA testing. When requested, supply the QCT and QAT results by e-mail or fax to the RME.

D. Securing Pavement Cores. The Engineer will secure and seal the pavement cores in accordance with MP 402-02 once they have been extracted from the pavement.

E. Sample Delivery. Deliver the sealed cores, loose mix samples, and gauge density readings, when required, to the Regional Materials Laboratory no later than the end of the following day’s placement. Submit pavement cores, density gauge readings, and loose mix samples as required for 50, 60, or 70 Series methods 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, stop paving operations until the samples are delivered and tested.

F. Unacceptable Pavement Cores. Pavement cores damaged during extraction, pavement cores delivered to the Regional Materials Laboratory for testing that are damaged, or pavement cores with damaged or missing security seals will not be tested. The Engineer will select new pavement core locations within a foot forward of the original locations at the same offset. Extract new pavement cores from the newly identified locations.

G. Pavement Density Core Test Results. Upon receipt of test results of the pavement cores and loose mix samples provided by the Regional Materials Laboratory, if the results are not representative of the density gauge data or previous results for similar sublots, notify the Engineer and the Regional Materials Engineer, in writing, within 2 work days. Include details as to what specific test results are not representative, and the reasons, with the notification.

402-3.09 Joints. Ensure the finished pavement at all joints complies with the surface tolerance requirements and exhibits 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 approved by the Engineer.

Construct all joints, excluding the tapered wedge joint, such that the exposed edge of the newly placed course is full thickness of the course and straight unless the exposed joint will not be part of the joint. If the edge of the newly placed course is not straight or smoothly curved, correct the edge by using a power saw or other approved tools to cut a neat line. Prior to placing the adjacent course, apply joint
adhesive in accordance with §402-3.06 Joint Adhesive, to all pavement edges in order to provide bonding with the newly laid pavement.

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

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

Set up the paver such that material laid overlaps the previously placed edge by 50 to 75 mm at a thickness of approximately 25% of 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. Do not broadcast the overlap material onto the fresh mat. 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.

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 uncompacted HMA mixture. 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. 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.

**B. Longitudinal Joints.** 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. Operate rollers 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 the roller 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. Make all turning movements of the roller 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 courses other than Top Course, ensure 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, construct the longitudinal joint using one of the options below. Use a butt joint for all other HMA courses.

**1. Option A - Butt Joint.** Place the HMA mixture such that it uniformly overlaps the adjacent cold mat 50 to 75 mm at a thickness of approximately 25% of 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. Do not broadcast the overlap material onto the fresh mat. 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 creates a safety hazard. Instead, place the HMA mixture in a manner such that the thickness of the uncompacted course is approximately 25% more than the compacted thickness of the adjacent HMA course 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. 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 at a thickness of approximately 25% of the compacted thickness of the HMA 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. 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 necessary.

Bumping is not required when the use of a rake creates a safety hazard. Instead, place the HMA mixture in a manner such that the thickness of the uncompacted course is approximately 25% more than the compacted thickness of the adjacent HMA course with a 10 to 25 mm overlap.

C. **Exposed Longitudinal Joint.** Expose the longitudinal joint for the Top Course of up to 50 mm to traffic for not more than 24 hours with the following conditions:

- Use Option B, Tapered Wedge Joint, except when the thickness is 25 mm or less where a butt joint may be exposed to traffic.
- 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.
- 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.
- Apply joint adhesive to the exposed joint prior to placement of the adjacent lane in accordance with §402-3.06 Joint Adhesive.

Do not allow exposed joints over the weekends, holidays, or when there are other concerns, such as pending wet weather.

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 appropriately corrected or the pavement be removed and replaced at no additional cost to the State.

**402-3.11 Thickness Tolerance.** 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 thickness indicated for each of the various courses of HMA pavement is the nominal thickness.

The Engineer may request pavement cores to determine the thickness of the completed pavement course for final acceptance and payment. Provide work zone traffic control and take pavement cores in accordance with §402-3.08 Pavement Density Sample, at no additional cost to the State. 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 mixture 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 courses of multi course 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 HMA mixture placed may be accepted under the following conditions:

- When the individual course 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 mixture 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 course surface. Construct the shoulder edge wedge by using a device attached to the screed. Minimize hand work. Begin the top of the tapered section at the end of the shoulder width 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.

402-3.14 Pavement Evaluation. The Regional Materials Engineer (RME) will evaluate mixtures either placed or produced outside the specification limits which resulted in low quality adjustment factors.

   A. Plant Production. When plant production QAF is 0.85, the RME will evaluate the pavement section in accordance with §401-3.10 Evaluation of Sublots Represented by 0.85 QAF, whether to keep it in place.

   B. Pavement Density. When a QAF of a paving lot for 50 Series or 60 Series compaction is calculated to be 0.60, the RME will evaluate the lot to determine if it can be left in place. The type of material produced (i.e. Binder, Top), the course 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 mixture can be left in place. If the RME determines that the HMA mixture can be left in place, the Engineer will apply a QAF of 0.60. If the HMA mixture cannot be left in place, remove and replace at no additional cost to the State.

402-4 METHOD OF MEASUREMENT

402-4.01 Hot Mix Asphalt. The quantity of HMA mixture to be measured for payment will be in metric tons placed to the nearest 0.01 metric tons.

402-4.02 Plant Production Quality Adjustment. Plant Production Quality Adjustments will be measured in Quality Units determined for each day’s production using the daily Quality Adjustment Factor (QAF) for plant production, determined in accordance with §401-3.07 Documentation. Quality Units for plant production quality adjustments under 50 and 60 Series compaction methods will be calculated using the formula below. No plant production quality adjustments will be made under 70 and 80 Series compaction methods.

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

402-4.03 Pavement Density Quality Adjustment. Pavement Density Quality Adjustments will be measured in Quality Units determined for each day’s production using the daily Quality Adjustment Factor (QAF) for pavement density. The quantity of 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 mixture placed on ramps with a uniform full width section less than 400 meters in length, shoulders, widening, crossovers, and bridges. Payment in these areas will be a QAF of 1.00 based on satisfactory placement and compaction.

   Quality Units for pavement density quality adjustments under 50 and 60 Series compaction methods will be calculated using the formula below. No pavement density quality adjustments will be made under 70 and 80 Series compaction methods.

   Quality Units = (Quality Adjustment Factor - 1.00) x HMA Placed (Metric Tons)
A. 50 Series Compaction QAF. The RME will determine the Percent Within Limits (PWL) for the paving lot in accordance with MP 402-02 and determine the QAF as shown in Table 402-7 Quality Adjustment Factors for 50 Series. The Engineer will use the QAF to calculate the Quality Units for the accepted HMA mixture quantity.

<table>
<thead>
<tr>
<th>Percent Within Limits (PWL)</th>
<th>Quality Adjustment Factor (QAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWL(_{92-97} &gt; 93)</td>
<td>1.05</td>
</tr>
<tr>
<td>PWL(_{92-97} \leq 93)</td>
<td>( \sum (\text{PWL}<em>{\text{Segment}} \times \text{Pay Factor}</em>{\text{Segment}}) )</td>
</tr>
</tbody>
</table>

2. PWL\(_{\text{Segment}}\) will be calculated for each of the density ranges in Table 402-8 Density Segment Pay Factors, using the standard deviation and average density for the lot.

<table>
<thead>
<tr>
<th>Density Segment</th>
<th>Segment Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>88 – 89</td>
<td>0.60</td>
</tr>
<tr>
<td>89 – 90</td>
<td>0.70</td>
</tr>
<tr>
<td>90 – 91</td>
<td>0.80</td>
</tr>
<tr>
<td>91 – 92</td>
<td>0.90</td>
</tr>
<tr>
<td>92 – 93</td>
<td>1.00</td>
</tr>
<tr>
<td>93 – 96</td>
<td>1.05</td>
</tr>
<tr>
<td>96 – 97</td>
<td>1.00</td>
</tr>
<tr>
<td>97 – 98</td>
<td>0.90</td>
</tr>
<tr>
<td>98 – 99</td>
<td>0.80</td>
</tr>
</tbody>
</table>

B. 60 Series Compaction QAF. When pavement density samples are taken and if payment adjustment is applicable, the Engineer will make the adjustment in accordance with Table 402-9 Quality Adjustment Factors for 60 Series. A payment adjustment will be made, based on the Quality Unit Index Price to all the material placed on the mainline for the day the pavement cores represent.

<table>
<thead>
<tr>
<th>Average Pavement Core Density</th>
<th>Quality Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \leq 92 ) Density ( \leq 97 )</td>
<td>1.00</td>
</tr>
<tr>
<td>91.0 ( \leq ) Density ( &lt; 92.0 ) or 97.0 ( &lt; ) Density ( \leq 98.0 )</td>
<td>0.95</td>
</tr>
<tr>
<td>90.0 ( \leq ) Density ( &lt; 91.0 )</td>
<td>0.90</td>
</tr>
<tr>
<td>88.0 ( \leq ) Density ( &lt; 90.0 )</td>
<td>0.85</td>
</tr>
<tr>
<td>Density ( &lt; 88.0 ) or Density ( &gt; 98.0 )</td>
<td>0.60</td>
</tr>
</tbody>
</table>

402-4.04 Test Section Adjustment. Test Section Adjustments will be measured in Quality Units using a test section adjustment factor of 0.5 for up to the first 200 metric tons placed on a test section on the mainline. Quality Units for Test Section Adjustment for 50 and 60 Series compaction methods will be calculated using the formula below.

\[
\text{Quality Units} = 0.5 \times \text{HMA Placed on Mainline (Metric Tons)}
\]
SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

402-5 BASIS OF PAYMENT.  The unit price bid for all HMA mixture shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including extracting the pavement cores, filling, and compaction of all core holes. Application of tack coat, joint adhesive, and cleaning will be paid separately except when the joint adhesive is applied under §402-3.01E.

Payment of Quality Adjustments will be made based on the number of Quality Units multiplied by the fixed index price for Quality Adjustment to HMA Items listed in the contract documents for the quantity placed on the day the Quality Units represent.

**Payment will be made under:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>402.010903</td>
<td>Type 1 F9, Asphalt-Treated Permeable Base Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.011903</td>
<td>Type 2 F9, Asphalt-Treated Permeable Base Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.017903</td>
<td>Truing &amp; Leveling F9, Superpave HMA, 70 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.018903</td>
<td>Truing &amp; Leveling F9, Superpave HMA, 80 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.058903</td>
<td>Shim Course F9, Hot Mix Asphalt</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.095103</td>
<td>9.5 mm F1 Top Course HMA, 50 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.095203</td>
<td>9.5 mm F2 Top Course HMA, 50 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.096103</td>
<td>9.5 mm F1 Top Course HMA, 60 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.096203</td>
<td>9.5 mm F2 Top Course HMA, 60 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.096303</td>
<td>9.5 mm F3 Top Course HMA, 60 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.097103</td>
<td>9.5 mm F1 Top Course HMA, 70 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.097203</td>
<td>9.5 mm F2 Top Course HMA, 70 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.097303</td>
<td>9.5 mm F3 Top Course HMA, 70 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.098103</td>
<td>9.5 mm F1 Top Course HMA, 80 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.098203</td>
<td>9.5 mm F2 Top Course HMA, 80 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.098303</td>
<td>9.5 mm F3 Top Course HMA, 80 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.098403</td>
<td>9.5 mm F9 Top Course HMA, Shoulder Course, 80 Series Compaction</td>
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