**Section 400**

**HOT MIX ASPHALT**

**SECTION 401 - PLANT PRODUCTION**

**401-1 DESCRIPTION.** The contractor is responsible for Quality Control (QC). QC is defined as all activities required to produce HMA that meets all specification requirements. The contractor will incorporate a Quality Control system for all plant production of hot mix asphalt (HMA) and assume responsibilities for all QC activities at the production facilities.

The contractor shall produce the HMA according to the specifications herein and provide production documentation. Quality Adjustment Factors (QAFs) will be used to assess HMA production quality and these factors will be applied to calculate a quality payment adjustment.

The State is responsible for Quality Assurance (QA). QA is defined as all activities performed by the State to assure that HMA production meets the specification requirements. The State will determine quality payment adjustments for each day’s production using a daily QAF obtained from the calculations of the average absolute values for volumetric and non-volumetric mixes in accordance with Materials Procedure (MP) 96-02, Quality Control and Quality Assurance Procedures for Quality Control Hot Mix Asphalt Production. The daily QAFs measure production variation from the mean of the specification limits.

**401-2 MATERIALS.** The provisions of §402-2, Materials, apply and are as modified herein. Produce HMA in accordance with the requirements outlined in this specification, including all applicable Test Methods and Materials Procedures. HMA mixture designs must be acceptable to the State prior to any HMA production.

The State reserves the right to suspend any mixture design when the mixture demonstrates unacceptable paving quality or exhibits properties that will affect the anticipated pavement performance.

**401-2.01 Hot Mix Asphalt Designs.** Produce HMA in accordance with the procedures outlined in NYSDOT’s Materials Method (MM) 5.16, Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedures.

Formulate and submit a HMA design to the Regional Materials Engineer (RME) that satisfies all design criteria outlined in MM 5.16. When the submitted HMA design is assigned verification status, the design must be verified during production as outlined in MM 5.16. Notify the RME at least 24 hours prior to the start of verification status production. When producing under Verification Status, make necessary adjustments to control the process. Apply daily QAFs to both verification and production status mix designs. Mixtures produced under Verification Status, as outlined in MM 5.16, are allowed for use on State projects.

For any HMA permeable base and shim mixtures required by the contract documents, formulate and submit to the RME a job mix formula that satisfies the General Limits imposed by Table 401-1, Composition of Hot Mix Asphalt Mixtures.

**401-2.02 Aggregates.** Aggregate must be from a source approved by the State. Use fine aggregate that consists of materials conforming to the requirements of §703-01, Fine Aggregate. In addition, fine aggregate may consist of screenings, free from deleterious materials and manufactured from sources of stone, gravel, or slag meeting the requirements of §703-02, Coarse Aggregate.

Use coarse aggregate that consists either of crushed stone, crushed gravel, or crushed slag conforming to the requirements of §703-02, Coarse Aggregate and the requirements outlined in MM 5.16.

Use slag aggregate on State projects only when an alternate pay item which takes the mix yield differential into account is included on the plans or in the itemized proposal.

When coarse aggregates for the mixture are from more than one source or of more than one type of material, proportion and blend them to provide a uniform mixture.
### TABLE 401-1 COMPOSITION OF HOT MIX ASPHALT MIXTURES

<table>
<thead>
<tr>
<th>Screen Sizes</th>
<th>Permeable Base Mixture Requirements</th>
<th>Type 1</th>
<th>General Limits</th>
<th>Job Mix</th>
<th>Tolerance %</th>
<th>Type 2</th>
<th>General Limits</th>
<th>Job Mix</th>
<th>Tolerance %</th>
<th>Shim</th>
<th>Type 5</th>
<th>General Limits</th>
<th>Job Mix</th>
<th>Tolerance %</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% Passing</td>
<td>%</td>
<td>%</td>
<td></td>
<td>%</td>
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<td>%</td>
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<tr>
<td>50.0 mm</td>
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<td>100</td>
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<td>100</td>
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<tr>
<td>37.5 mm</td>
<td></td>
<td>95-100</td>
<td>-</td>
<td>75-100</td>
<td>±7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>25.0 mm</td>
<td></td>
<td>80-95</td>
<td>±6</td>
<td>55-80</td>
<td>±8</td>
<td>-</td>
<td>-</td>
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<td></td>
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<tr>
<td>12.5 mm</td>
<td></td>
<td>30-60</td>
<td>±6</td>
<td>23-42</td>
<td>±7</td>
<td>-</td>
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<tr>
<td>6.3 mm</td>
<td></td>
<td>10-25</td>
<td>±6</td>
<td>5-20</td>
<td>±6</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>3.2 mm</td>
<td></td>
<td>3-15</td>
<td>±6</td>
<td>2-15</td>
<td>±4</td>
<td>80-100</td>
<td>±6</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td></td>
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<tr>
<td>850 µm</td>
<td></td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>32-72</td>
<td>±7</td>
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<td>-</td>
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<td></td>
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<tr>
<td>425 µm</td>
<td></td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>18-52</td>
<td>±7</td>
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<td>-</td>
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<td>-</td>
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<tr>
<td>180 µm</td>
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<td>-</td>
<td>-</td>
<td>7-26</td>
<td>±4</td>
<td>-</td>
<td>-</td>
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<td></td>
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<tr>
<td>75 µm</td>
<td></td>
<td>0-4</td>
<td>±2</td>
<td>-</td>
<td>-</td>
<td>2-12</td>
<td>±2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asphalt Content, %</td>
<td></td>
<td>2.0-4.0</td>
<td>NA</td>
<td>2.5-4.5</td>
<td>NA</td>
<td>7.0-9.5</td>
<td>NA</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### NOTES:
1. All aggregate percentages are based on the total weight of the aggregate.
2. The asphalt content is based on the total weight of the mix. When using slag aggregates in the mix, the asphalt content shall be increased accordingly, a minimum of 25 percent for an all slag mix.
3. Use a PG binder appropriate for the project location as specified in Table 6-4 of the Comprehensive Pavement Design Manual.

**A. Coarse Aggregate Type F1 Conditions**

1. Limestone, dolomite or a blend of the two having an acid-insoluble residue content of not less than 20.0%.
2. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.
3. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:
   a. 12.5 mm Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 3.2 mm particles must comprise a minimum of 30.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). Additionally, a minimum of 95.0% of plus 9.5 mm particles must be non-carbonate.
   b. 9.5 mm Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 3.2 mm particles must comprise a minimum of 30.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). Additionally, a minimum of 95.0% of plus 4.75 mm particles must be non-carbonate.

**B. Coarse Aggregate Type F2 Conditions**

1. Limestone, dolomite, or a blend of the two having an acid-insoluble residue content of not less than 20.0%.
2. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.
3. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:

   a. 12.5 mm Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 3.2 mm particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). Additionally, a minimum of 20.0% of plus 9.5 mm particles must be noncarbonate.

   b. 9.5 mm Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 3.2 mm particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). Additionally, a minimum of 20.0% of plus 4.75 mm particles must be noncarbonate.

C. Coarse Aggregate Type F3 Conditions

1. Limestone or a blend of limestone and dolomite having an acid-insoluble residue content of not less than 20.0%.
2. Dolomite.
3. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.
4. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:

   a. 12.5 mm Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 3.2 mm particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). Additionally, a minimum of 20.0% of plus 9.5 mm particles must be noncarbonate.

   b. 9.5 mm Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 3.2 mm particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). Additionally, a minimum of 20.0% of plus 4.75 mm particles must be noncarbonate.

D. Coarse Aggregate Type F9 Conditions. Use coarse aggregate meeting the requirements of §703-02, Coarse Aggregate.

401-2.03 Mineral Filler. Mineral filler will conform to the requirements of §703-08, Mineral Filler.

401-2.04 Performance-Graded Binder. Use the Performance-Graded Binder (PG Binder) in the production of these mixtures that meets the AASHTO MP1 - Standard Specification for Performance-Graded Asphalt Binder.

   Initial acceptance of the PG Binder is based on the primary source appearing on the State’s Approved List for Bituminous Material Primary Sources, A. Performance-Graded Binders for Paving. Acceptance of the PG Binder is contingent upon satisfactory test results from samples taken, as required by the State’s procedural directives, at the location where the material is incorporated into the work. A primary source is defined as a firm that samples, tests, and certifies by Production Lot that the PG Binder is in conformance with the specifications. The procedural directives for sampling, testing, and certifying the PG Binder, and for achieving and maintaining approved list status, are available from the Materials Bureau.

   The temperature of PG Binder delivered to the HMA Production Facility will not exceed 175°C, unless the PG Binder supplier recommends it.

401-2.05 Reclaimed Asphalt Pavement. Reclaimed Asphalt Pavement (RAP) will meet the requirements as written in MM 5.16.

401-3 CONSTRUCTION DETAILS.
§401-3.01 Quality Control. Perform all sampling and testing in accordance with procedures supplied by or approved by the State. Document all QC test results and records in a legible manner and provide them to the State at the end of each production season or when requested by the RME. HMA produced without the required sampling, testing and documentation may be rejected.

A. Control Plan. Provide a control plan for each HMA mixing plant. Only one control plan is needed when more than one plant is located at the same site. Identify all plants at the site in the control plan.

List the personnel associated with HMA production, including the names and their functions necessary to implement the QC program. Include in the list, the control plan administrator, designated assistant, QC personnel, and phone numbers. Assume the responsibility of administration of the control plan.

Submit the control plan to the RME for initial approval at least 15 working days prior to HMA production for the State from the facility. After the control plan has been assigned initial approval, submit a statement outlining the control plan status to the RME each subsequent year at least 15 working days prior to any HMA production. Also, submit amendments to the control plan, or personnel changes for approval annually prior to production and as changes occur during the construction season. The State reserves the right to suspend production in the event the control plan is not followed. Control plan guidelines are available from the RME.

B. Quality Control Organization

1. Plan Administrator. The plan administrator is a representative of the HMA manufacturer and will have full authority to institute all operations of the control plan. The plan administrator is responsible to ensure all requirements are in conformance with the specification. The plan administrator's signature will be legally binding. One plan administrator is allowed to be responsible for multiple production locations. An assistant plan administrator may be designated in the absence of the plan administrator. The plan administrator or assistant must be available to communicate with the State personnel at all times. The State reserves the right to stop production when the plan administrator or designee is not available. In addition, the plan administrator is responsible for the following:

a. Location and control of friction aggregate stockpiles.
b. Outlining testing frequencies, testing procedures, and documentation procedures.
c. Periodic verification during production that the proper friction aggregate and the correct amount of friction aggregate is being included into the State mixes as outlined in NYSDOT’s Materials Method (MM) 28, Friction Aggregate Control and Test Procedures.
d. Documentation of all friction related activities (e.g. corrections to problems, modifications to friction aggregate mix controls and routine friction aggregate inspections during production) on NYSDOT form BR 303 Quality Control Daily Diary.

2. Quality Control Technician (QCT). The QCT must possess a current New York Construction Materials Association Certification or its equivalent, as determined by the Director, Materials Bureau. The production facility must have a sufficient number of QCTs to perform QC sampling and testing, but at least one certified QCT at each production facility site. Non-certified technicians may be utilized to augment the certified QCT. HMA production is not acceptable unless the certified QCT is present during production. A certified QCT is not required to be present for HMA production of 150 metric tons or less, if approved by the RME. Technicians associated with private testing organizations must meet the requirements specified above.

The State reserves the right to stop plant production in the event unacceptable technician performance is noted. The RME or representative will immediately inform the plan administrator regarding the reasons for stopping production operations.

The State may require the HMA manufacturer to replace unacceptable technicians before HMA production is allowed to continue.
§401

401-3.02 Production Facility Laboratory. Maintain an approved production facility site laboratory to perform all required HMA sampling and testing. All sampling and testing equipment must meet the requirements pertaining to test procedures detailed in this specification. Unless otherwise outlined in the MM 5.16, calibrate all testing equipment requiring calibration annually and certify that all testing equipment meets the required operational tolerances. The State will perform verification of the production facility site laboratory and testing equipment annually. Additional verification will be performed when deemed necessary. Make laboratory sampling and testing equipment available to the State’s QA personnel. The requirements specified in §401-3.08 A.13. Inspection Facilities, apply.

401-3.03 Plant Lots and Sublots. Determine plant lots and sublots on a daily basis in accordance with MP 96-02.

A plant lot is defined as the quantity in metric tons of HMA produced per plant for each mix design in one day. When different mix designs are produced on the same day, each mix design represents a separate plant lot. For each mix design produced, number the plant lots consecutively (1-200) throughout the production season starting with the number one at the beginning of each calendar year’s production and increase the lot number by one for each day’s production.

Plant lots are subdivided into sublots and are based on anticipated daily production. A sublot is defined as a portion of a plant lot not to exceed 1250 metric tons. When production exceeds 1250 metric tons and the excess is not greater than 150 metric tons, incorporate the excess into the previous sublot. Sublots are assigned a consecutive letter (A-E) and begins with “A” each production day.

QC testing is allowed on any portion of a plant lot, including any production less than 150 tons, as documented in the Control Plans, when an option of testing quantities less than 150 metric tons is selected.

QC testing is not required on the first or last 150 metric ton portion of a lot. This testing exclusion does not apply for lots greater than 150 but less than 300 metric tons, retest samples, or any sample obtained when production is terminated before the anticipated production for that plant lot. When a lot is greater than 150 but less than 300 metric tons, obtain a sample from the portion greater than 150 metric tons.

When production stops before a sublot sample is obtained, incorporate the untested sublot quantity into the previous sublot of the same day. If there is no previous sublot to incorporate it into, consider the stored quantity a new plant lot.

A retest may be performed on any portion of a plant sublot providing the retest sample is obtained after the required random sample. The retest sample does not have to be obtained randomly. When a sublot is retested, average the absolute difference test value from the retest sample with the required random sample’s absolute difference test value. This average represents the sublot’s test value in the calculation of the daily QAF. When a retest is performed, document all actions on NYSDOT form BR 303, Quality Control Plant Diary.

When the daily plant lot quantity is between 150 metric tons and 500 metric tons, report the daily QAF as 1.00 providing the required QC sample yields a QAF between 0.90 and 1.00. If the required test result yields a QAF greater than 1.00, report the actual QAF. If the required test result yields a QAF less than 0.90, the State will evaluate the subject production in accordance with procedures outlined in §401-4, Method of Measurement.

A. Certified Lot Production. HMA production without the required QC testing is allowed to be certified for plant lot quantities of 150 metric tons or less. Certified plant lots have a QAF of 1.00. All certified production must meet the requirements outlined in this specification. Obtain friction aggregate samples as outlined in MM 28 for all certified production placed in pavement courses requiring friction aggregate. Transmit BR-307, Quality Control HMA Certification, to the Project Engineer on a daily basis for the quantity of certified production.

B. Volumetric Mixture Storage. When volumetric mixtures are stored prior to delivery, incorporate the stored quantity into the plant lot associated with the date of delivery. If there is no production to incorporate into, consider the stored quantity a new plant lot.
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C. Non-Volumetric Mixture Storage. When non-volumetric mixtures are stored prior to delivery, incorporate the stored quantity into the plant lot associated with the date of production. The lot number and daily QAF determined during production will be associated with the stored quantity.

D. Night Production. During night production, associate the plant lots as specified in this subsection. If continuously producing for a calendar day or more, the plant lot will be defined when the plant’s employee shift change occurs. Notify the RME which option will be used at least one day prior to any production of this type.

E. Highway Permit Production. HMA production supplied to highway permit projects will meet all requirements outlined in this specification. Quality payment adjustments are not applicable.

401-3.04 Quality Control Sampling and Testing. Obtain QC samples as outlined in MP 96-02. The QCT will perform QC sampling and testing meeting the requirements outlined in §401-3.01 B. 2, Quality Control Technician. The State will determine Daily QAFs using the QCT’s test results as outlined in §401-3.03 and §401-3.04.

QC test procedures are verified by the Quality Assurance Technician (QAT), a State’s representative, on a random basis by split sample testing. The QC sample is split into two representative samples and individually tested by the QCT and the QAT. The QAT’s test results are compared to the QCT’s test results.

The QCT/QAT test results must be within the allowable tolerances outlined in Table 401-2, Allowable Split Sample Testing Tolerances.

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Tolerance Within Lab</th>
<th>Lab to Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation ≥ 425 µm Sieve</td>
<td>5.0 %</td>
<td>7.0 %</td>
</tr>
<tr>
<td>Gradation &lt; 425 µm Sieve</td>
<td>2.0 %</td>
<td>3.0 %</td>
</tr>
<tr>
<td>Bulk Specific Gravity</td>
<td>0.020</td>
<td>0.028</td>
</tr>
<tr>
<td>Maximum Specific Gravity</td>
<td>0.011</td>
<td>0.019</td>
</tr>
</tbody>
</table>

When the test results exceed the allowable tolerance, perform a split sample retest on the test property that exceeded the allowable tolerance. The retest must be performed on the day the material is produced or delivered. When the retest exceeds the allowable tolerance, the State will terminate the production and all QC test results up to this point will be used to determine the daily QAF. Production is not allowed until the RME is satisfied that the cause for the excessive deviation in the split sample verification is resolved.

Obtain all required HMA samples, including the maximum specific gravity and a composite aggregate (hot bin) split sample. Obtain a minimum of one aggregate split sample per day for each mix type produced. Prepare the HMA specimens and reduce the aggregate split sample to testing size in accordance with MM 5.16. Dry the composite aggregate samples and air dry the compacted specimens and the maximum specific gravity samples prior to packaging. Package hot bin aggregate samples separately by hot bins and retain all samples together. Identify and retain all the samples at the production site for a minimum of ten (10) business days. The identification of the retained samples will include the facility number, production date, plant lot, sublot, and mix description.

Unless directed by the RME, discard all retained specimens and samples at the end of the specified time period. The State reserves the right to witness any or all QC sampling and testing, and test any or all retained samples.

Perform all sampling and testing using test procedures and frequencies outlined in Table 401-3, Quality Control Sampling and Testing.

A. Random Sampling. Obtain QC samples for aggregate and HMA randomly using the procedures outlined in MP 96-02. Random sample numbers may be re-selected to accommodate...
changes in anticipated production quantity. Obtain other required QC samples as outlined in B. Quality Control Testing, and Table 401-3, Quality Control Sampling and Testing.

**B. Quality Control Testing**

1. **Aggregate Gradation.** Perform the aggregate gradation analysis using the procedures outlined in AASHTO T-27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregate. An ignition furnace can be used to prepare samples for an aggregate gradations analysis using the procedures outlined in Test Method NY 400-13C.

   a. **Volumetric Design Mixes.** Perform an aggregate gradation analysis on every other sublot produced. Perform a minimum of one gradation analysis per day for each HMA mix design used for production. Determine aggregate consensus properties and specific gravities at the beginning of each production season and subsequently at the midpoint of the production season using test methods outlined in MM 5.16. Coarse aggregate specific gravity may be determined on a composite aggregate blend in-lieu of testing each aggregate size designation (i.e., 1A’s, 1’s, and 2’s).

   b. **Non-Volumetric Design Mixes.** Perform an aggregate gradation analysis on every sublot for each HMA mix design used for production.

| TABLE 401-3  QUALITY CONTROL SAMPLING AND TESTING |
|----------------|----------------|----------------|----------------|
| **Plant Test**  | **Sample Location**  | **Test Method**  | **Quality Control Frequency**  |
| **Property**  |  |  |  |
| Aggregate Gradation | NYSDOT MM 5.0 | AASHTO T27 | Note 1  |
| Aggregate Moisture | NYSDOT MM 5.0 | NYSDOT | 1 every other sublot  |
| Air Voids | NYSDOT MM 5.0 | AASHTO T166 & T209 MM 5.16M | Minimum 2 per day  |
| Mix Moisture | NYSDOT MM 5.0 | NYSDOT | 1 per sublot  |
| Mix Temperature | Plant and Haul Vehicle | N/A | Routinely, minimum 4 per day  |
| Asphalt Binder Content | NYSDOT MM 5.0 | NYSDOT | Routinely, minimum 4 per day/mix  |
| RAP Binder Content | NYSDOT MM 5.0 | NY400-13C | 2 per week  |
| RAP Gradation | NYSDOT MM 5.0 | AASHTO T 27 | 2 per week  |
| RAP Moisture | NYSDOT MM 5.0 | NYSDOT | 1 per day  |
| Asphalt Binder Sampling | NYSDOT MM 8.1 | NYSDOT | 1 per day  |
| Friction Aggregate | NYSDOT MM 28 | NYSDOT | As outlined in MM 28 |

**NOTES:**
1. Volumetric design mixes - one test every other sublot, minimum one per day.
2. Non-Volumetric design mixes - one test every sublot.
3. Required for drum mix plants, or as requested by the RME for batch plants.
4. Required for volumetric design mixes.
5. Required for batch and drum mix plants when producing recycled mixes.
6. The State is responsible for sample submission.
7. Required for drum mix plants only.
2. Air Void Analysis - Volumetric Design Mixes. Perform an air void analysis for each sublot of volumetric HMA mix design used for production. Use HMA samples obtained from the delivery vehicle. When holding bins are used for storage, perform the air void analysis on HMA samples taken after storage. Perform the air void analysis using procedures outlined in MM 5.16.

When performing the air void analysis, use Table 401-4, Allowable Specimen Tolerance Range, to determine if sample specimens are valid for analysis. The Allowable Specimen Tolerance Range listed in Table 401-4 is applicable to all QC and retest samples. The difference between the specimen test results should not exceed the tolerance range values in Table 401-4. If the results exceed the allowable tolerance range, the specimens are not valid and the test results will not be used in the calculation of the daily QAF.

<table>
<thead>
<tr>
<th>Mix Types</th>
<th>Number of Specimens</th>
<th>All Mix Types except the 37.5 mm Maximum Sp.Gr</th>
<th>37.5 mm Maximum Sp.Gr</th>
<th>37.5 mm Maximum Sp.Gr</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>.020</td>
<td>.011</td>
<td>.019</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>.023</td>
<td>------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>.025</td>
<td>------</td>
<td>------</td>
<td></td>
</tr>
</tbody>
</table>

When a plant lot consists of one sublot and the test specimen value exceeds the allowable tolerance, perform a retest. If production is terminated before a retest sample can be obtained, the QAF for that plant lot will be reported as 1.00. When a plant lot consists of multiple sublots and the test specimen value for a sublot exceeds the allowable tolerance, perform a retest on the material within that sublot. If a retest is not or cannot be performed, use an absolute difference value of 0.92 for that sublot to calculate the plant lot daily QAF in accordance with MP 96-02.

3. Determination of Asphalt Binder Content. Determine the asphalt binder content using the procedures outlined in Materials Method (MM) 5, Plant Inspector’s Manual for Bituminous Concrete Production. Calculate the asphalt binder content during initial production and then routinely throughout production for a minimum of four times per day per HMA mix design used for production.

4. Mixture Temperature. Determine the mix temperature for each mix type at the beginning of each production day starting with the first or second delivery vehicle and then routinely throughout the production day. Determine a minimum of four temperatures per day independent of HMA mix design used for production. Record the temperature on the delivery ticket and transmit to the project paving site with the delivery vehicle. When holding bins are loaded for storage, determine the mix temperature routinely throughout the loading time.

5. Aggregate and Mix Moisture Content. Determine moisture content of the aggregate, the recycled mixtures, and the HMA mixture in accordance with procedures outlined in MM 5.0. Aggregate moisture testing of individual components is allowed. Determine the aggregate moisture content daily in accordance with the frequency detailed in Table 401-3. Perform one test during the initial production and at least one test per day on a composite aggregate sample. The frequency for determining the moisture content in the HMA and HMA with RAP mixtures is a minimum once per day. If excessive mix moisture results are obtained, the testing frequency may be increased as directed by the RME. The moisture content of the mixtures upon discharge from the mixing unit will not exceed 0.5 percent.

6. Asphalt Binder Sampling. Obtain asphalt binder samples in accordance with procedures outlined in Materials Method (MM) 8.1, Quality Assurance Procedure for Paving Asphalt Cement. Obtain a minimum of one sample for each production day. The frequency may be increased at the discretion of the RME. Asphalt binder samples are not required when production is 150 metric tons or less. Identify all samples as determined by the RME and store them at the
facility site. The State will supply sample containers, document and submit these samples for testing.

7. Friction Aggregate. The friction aggregate will meet the requirements outlined in §401-2.02, Aggregates. Perform sampling and testing of friction aggregate at the production facility using procedures outlined in MM 28.

8. Recycled Mixes. Perform sampling and testing of HMA containing reclaimed asphalt pavement (RAP) using procedures outlined in MM 5.0. The frequency of sampling and testing is outlined in §401-3.04, Quality Control Sampling and Testing, except perform the following tests at frequencies outlined in MM 5.0 and Table 401-3.

   a. RAP Moisture Test  
   b. RAP Binder Content  
   c. Recycled Mix Moisture Test

C. Air void and Gradation Reporting. Report the air void test values to the nearest 0.01 of a percent and aggregate gradation test values to the nearest 0.1 of a percent. When determining test result acceptability, the air void test value is referenced to the mix design median of 4.00 percent and the gradation test value is referenced to the Job Mix Formula (JMF) target value.

D. Significant Decimals. For reporting the results, use the following rules for rounding off for all calculations:

1. When the digit to be dropped (1 digit beyond the significant digit) is less than 5, the preceding digit will not change.
2. When the digit to be dropped (1 digit beyond the significant digit) is 5 or greater, the preceding digit will be increased by 1.

E. Volumetric Plant Production Tolerances. Determine the volumetric properties outlined in Table 401-5, Volumetric Plant Production Tolerance, for every sublot of HMA volumetric design produced. When any mix design test property consistently falls outside any tolerance value, the design may be rescinded as outlined in MM 5.16.

<table>
<thead>
<tr>
<th>TABLE 401-5 VOLUMETRIC PLANT PRODUCTION TOLERANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test Property</strong></td>
</tr>
<tr>
<td>Voids in the Mineral Aggregate, VMA</td>
</tr>
<tr>
<td>Voids Filled with Binder, VFB</td>
</tr>
</tbody>
</table>

NOTES:  
1. Compact all gyratory specimens to N_{design}.  
2. Tolerances are referenced to the specification value.

F. Sampling and Testing Disputes. The State will perform referee sampling and testing to settle all disputes. Referee samples will be obtained randomly and independently from the QC samples and tested at the Regional or Central Office laboratory. If production is terminated, the State will test the samples retained at the production facility. The State's independent referee test results are final, and will be used to determine the daily QAF for the disputed quantity and the acceptance of the in-place production material.

401-3.05 Production Control. Make necessary process control adjustments during production as long as the target values do not exceed the specification general limits. However, strive for the mix design target values when making necessary process control adjustments. Only the aggregate gradation production tolerance is allowed to exceed the general limits. Also, when adjustments are made to any volumetric mixture design during production, all specified properties must remain within the specified production limits. Record all adjustments, including new target values, on BR-303 QC Daily Diary. When
any test value consistently falls outside the allowable production tolerance, take corrective actions. In addition, notify the RME prior to production of any subsequent adjusted sublot.

Production may be terminated at any time, in which case, notify the RME immediately. When production is terminated, the HMA quantity produced up to that point is considered a plant lot and the daily QAF is determined using all required and all additional QC test values. HMA in storage from any terminated plant lot having a QAF less than 0.90, or any required testing not in conformance with the specification requirements, will be considered unacceptable.

When the daily QAF is less than 0.90 for two consecutive production days, terminate production. When production is terminated due to unacceptable production quality, demonstrate by trial production that the production process yields a QAF of 0.90 or greater before resuming production for the State. Also, notify the RME when any sublot yields a QAF of less than 0.90.

The State may rescind a “Production Status” of a mix design if the design consistently produces a mixture that yields a daily QAF less than 1.00 and/or has volumetric properties outside the plant production tolerances.

During production of any HMA design assigned “Verification Status” as outlined in MM 5.16 or the first production day of the construction season for any HMA design assigned “Production Status”, the State will report a daily QAF of 1.00 provided the required test results yield a daily QAF between and including 0.90 and 1.00. When the required test results yield a daily QAF greater than 1.00, the State will report the actual daily QAF. When the required test results yield a daily QAF less than 0.90, the State will evaluate the subject production in accordance with procedures outlined in §401-4, Method of Measurement.

A. Mixing Plant Control. All mix production must be in the automatic mode. If any material is produced and shipped to State projects in a non-automatic mode, notify the RME immediately. Do not ship any material produced in the automatic mode that exceeds twice the production tolerance. Material produced in the automatic mode that is between the single and double production tolerance may be shipped. However, the RME will determine if the material is acceptable to the State.

B. Friction Aggregate Control. Use the following friction aggregate criteria:

1. If the friction aggregate test results are greater than the JMF requirements, continue friction aggregate controls.
2. If the friction aggregate test results are greater than the State’s minimum specifications, but less than the JMF requirements, perform aggregate adjustments and retest.
3. If the friction aggregate test results are less than the State’s minimum specifications, stop production, notify the RME, correct the problem and retest before resuming production.

401-3.06 Production Quantities. Whenever production is made for the State, notify the Regional Materials office by 3:00 p.m. the day before the day of production.

Maintain a record of each day’s production quantity for each mix design supplied to the project site daily. Retain these records at the production facility. These records must be available to the State’s representative for review. Ship all production quantities to the project site as outlined in §401-4 Method of Measurement.

401-3.07 Documentation. Record all QC test data for each plant on the appropriate forms provided by the State. Update the QC test data within 24 hours following each plant lot production and retain these records at the plant site laboratory. Also, keep a copy of the plant automation printout at the plant facility for each mix type produced and make them available for review at all times. Transmit a summary of all test data weekly to the RME.

401-3.08 HMA Mixing Plant. HMA mixing plants must be of sufficient design and capacity to produce HMA as specified. HMA mixing plants that differ from conventional designs will be considered for use by the Director, Materials Bureau. All HMA mixing plants must be approved for metric production by January 2, 2003.
A. Requirements for All Plants

1. Acceptance. Each HMA mixing plant requires initial and annual approval by the Director, Materials Bureau. The RME may disapprove use of a previously approved mixing plant at any time for non-conformance with specifications. Once disapproved, production for State projects will not be allowed until corrective measures have been implemented satisfactory to the RME.

2. Friction Aggregate Management. Provide training to plant process control personnel regarding friction aggregate stockpiling, blending and batching procedures and/or verification testing at the plant facility. If necessary, provide additional training midway through the production season. Also, list the names of each individual and the training received and maintain this record at the plant facility for review by State’s representative. As a minimum the following personnel must be thoroughly familiar with all friction aggregate control procedures.

a. Plant Superintendent
b. Quality Control Technician
c. HMA Plant Operator
d. Loader Operator/Truck Driver feeding HMA plant

3. Failure of Equipment

a. Printer Breakdown. When the automated proportioning system or delivery weigh system printer is not properly working, the producer must notify the QAT at the plant site. However, when a QAT is not present, the producer must notify the RME immediately. Production is allowed during the breakdown period providing the tons produced are properly documented as outlined by the RME. The breakdown period shall not exceed 48 hours.

b. Gyratory Compactor Breakdown. When a breakdown of gyratory compactor occurs, the RME will be notified immediately. The RME may allow production to continue for an initial limited time period (not to exceed 48 hours). Mix type, placement location, test results and/or any problems occurring with the mixture at the plant or project will be primary considerations for determining if, and how long, production will be allowed to continue. When permitted during the breakdown period, the following shall apply:

1. HMA samples (enough for at least 2 specimens) will be taken at the normal specified required frequency, retained until the gyratory compactor is repaired, then tested for informational purposes.
2. Aggregate gradations will be performed and recorded for each sublot produced during the breakdown period.
3. The final QAF shall be 1.00 for all mix accepted by the Project Engineer during the breakdown period.

4. Scales, Continuous Weigh Systems and Meters. Perform tests on scales, continuous weigh systems, and meters for accuracy, at no cost to the State. These tests must be performed by a qualified technician using procedures outlined in Materials Method (MM) 27, Plant Equipment Inspection Manual. Perform the test as follows:

a. Annually, prior to use for State work.
b. At intervals of not more than 90 calendar days.
c. Whenever the plant changes location.
d. At any time directed by the RME.

Provide standard test weight and a platform, cradle or hanger approved by the RME or the authorized representative for testing each scale. Provide at least 10 standard 25 kg test weights for testing the springless dial or load cell type scales. Provide a sufficient number of test weights to test belt scales within production range.
5. Equipment for PG Binder Material. Tanks for the storage of PG Binder must be capable of heating and maintaining the required binder temperature. Where meters are used, the binder temperature at the meter must be within 15°C of the temperature for which the meter is calibrated. Provide separate tanks and pipe lines when asphalt binder and other liquid asphaltic materials are mixed in the same mixer.

Equip all mixing plants with a sampling valve designed to be non-clogging, safe and completely divorced from any solvent clean-out operations. For plants having multiple tanks, locate the sample valve in the line between the tanks and the mixing plant or in the return line. When plants have only one tank, locate the sample valve directly on the tank. Clearly label “Sample Valve”. The type and location of the valve requires the RME’s approval.

6. Aggregate Cold Feed Bins. Use separate cold feed bins for each aggregate size for the production of HMA mixes. The RME may permit methods of blending. The cold feed bins must be of sufficient size to maintain a continuous and uniform flow of material during HMA production.

7. PG Binder Control Unit. Provide a satisfactory means to add the proper amount of PG Binder to the mixture. Maintain the required temperatures of the PG Binder in the pipelines, meters, weigh buckets, spray bars, and other containers or flow lines. When a meter system is used, provide a by-pass so that the binder quantity and flow rate can be checked in accordance with MM 27.

8. Thermometric Equipment. All plants must have provisions to determine the asphalt binder temperature prior to entry into the mixing unit. Batch plants must have provisions to determine the aggregate temperature during discharge from the dryer. Drum mix plants must have provisions to determine the HMA mixture temperature during discharge from the mixing unit. All temperature measuring devices must be accurate within 3°C.

9. Dust Collector. Equip all plants with adequate dust collectors constructed to remove or return uniformly all or portions of the collected dust to the system.

10. Truck Scales. Truck scales used, or required to be used at a plant site, must be a platform type scale conforming to the requirements of National Institute of Standards and Technology Handbook 44. Test the truck scales as outlined in §401-3.08 A.4. Scales, Continuous Weigh Systems and Meters. All truck scales must have sufficient capacity and size to weigh the largest loaded vehicle in one weighing.

Equip truck scales used for determining delivered quantity at the mixing plant site with a recording device approved by the Director, Materials Bureau. The recording device must produce a ticket with a time-date print and any two of the following weights:

a. Gross weight
b. Net weight
c. Tare weight

Print tare weights by weighing each truck empty for each delivery. Do not manually manipulate truck scales during the printing process. In addition, the truck scale weigh system must be interlocked to allow printing only when the scale has come to a complete rest.

11. Safety Requirements. All mixing plants must be in compliance with all applicable state and federal safety requirements. Provide a platform(s) or other suitable device for accessibility to the top of truck bodies to obtain HMA samples and mix temperatures.

12. RAP Delivery System. Feed RAP into the plant using equipment specifically designed for recycling. All RAP equipment requires approval of the Director, Materials Bureau. Install
scalping screens, grizzlies or similar devices on RAP feed bins. These devices must be capable of removing foreign material in excess of 100 mm.

13. Inspection Facilities. At each HMA mixing plant site, provide a weatherproof building or trailer type unit for use as a QC/QA inspection facility consisting of a testing laboratory and office. The inspection facility must meet all applicable uniform fire prevention and building code requirements. Partition the QA office area from the testing laboratory. The inspection facility will have a minimum gross area of 22 square meters with a layout providing a minimum internal width of 2.1 meters and a ceiling height of not less than 2.3 meters. The laboratory must have tables, work benches, shelving, and other necessary equipment required for testing HMA. Should the HMA manufacturer elect or be required to provide additional testing equipment, increase the internal area proportionally to house and operate the additional testing equipment.

When multiple plants are located at one site, the inspection facility will be proportionally larger. The laboratory and office space must be of a sufficient size to accomplish an acceptable performance of QC/QA duties during all HMA production. The inspection facility’s use will be exclusively for its intended purpose and have protection from a noise level greater than an 8 hour time weighted average of 85 dBA. The State will have priority use when more than one inspection authority is using the inspection facility.

The inspection facility and the location requires the approval of the RME. The inspection facility must have the following well-maintained items: (Note: The Gyratory Compactor, Specimen Mold Assembly, and Specimen Extractor are not required to be onsite at the facility during the inspection; however, they must be onsite during production.)

a. Office Equipment. A standard size office desk having a minimum surface size of 750 mm by 1500 mm with drawers and a chair. A fireproof file cabinet with at least two lockable drawers and two keys with access only to State personnel.

b. First Aid Kit. An adequately stocked first aid kit will be available at the plant site. The laboratory area will have an emergency eye wash station.

c. Toilet. A flush type toilet and necessary supplies. The toilet must be enclosed in a separate room properly vented and complying with applicable sanitary codes. Provide a lavatory with running water. When a plant is set up on a temporary basis for a specific project, a portable toilet is acceptable in lieu of the above.

d. Lighting. Electric lights, non-glare type to provide a minimum illumination level of 1100 lux at the desk and work bench level.

e. Laboratory Sink. Sink and faucet having an adequate supply of clean running water.

f. Heating and Cooling. Adequate heating and cooling equipment to maintain an ambient temperature of 20° C ± 3°.

g. Ventilation. Adequate ventilation system to remove dust and fumes from the laboratory. A 6 m³/min. (minimum) exhaust hood vented to the atmosphere will be located over the extractor, sample drying area and aggregate sieve shakers when located inside.

h. Telephone. A telephone for the exclusive and private use of State personnel located in the laboratory office. A fax machine must be available for State use.

i. Potable Water. A water cooler or other source of potable water will be available at the inspection facility or plant site.

j. Maintenance. Maintain the inspection facility, office, and testing equipment such that they are in good operating condition. Also, keep the facility clean.
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**k. Fire Extinguisher.** Furnish and locate a properly maintained 4.5 kg capacity multi-class ABC fire extinguisher in the laboratory area.

**l. Extractor.** For plants producing recycled mixtures, equip the laboratory facility with a chemical extractor or an ignition oven to determine the binder content.

**m. Coarse and Fine Aggregate Sieve Shaker.** Sieve shakers must meet the requirements of AASHTO T27. When a shaker is located outside the inspection facility, fully enclose and weatherproof it.

**n. Sample Splitter.** The sample splitter meeting the requirements of AASHTO T248.

**o. Balances.** Balances meeting the requirements of AASHTO M231, Class G2.

**p. Sample Drying Appliance.** Oven, stove or hot plate of sufficient size for rapidly drying aggregate samples.

**q. Miscellaneous Equipment.** Miscellaneous items including but not limited to, sample containers, scoops, and other equipment deemed necessary by the RME. Sieves of proper size for all mix types produced.

**r. Gyratory Compactor.** Gyratory compactor meeting the requirements of AASHTO TP4 calibrated at a frequency outlined in MM 5.16. When a compactor is used at a remote location during a breakdown period, outline the details in the Control Plan.

**s. Specimen Mold Assembly.** Mold assembly will meet the requirements of AASHTO TP4. Provide a minimum of four mold assemblies and an adequate supply of paper discs.

**t. Specimen Extractor.** The extractor will meet the requirements of AASHTO TP4.

**u. Oven.** Supply a thermostatically controlled convection type oven having a minimum capacity of 0.15 cubic meter to preheat the specimen mold assemblies and asphalt mix samples. The oven must have a controlled temperature range up to 200°C with a 3°C accuracy throughout the range.

**v. Maximum Specific Gravity Equipment.** Equipment meeting the requirements of AASHTO T209.

**w. Bulk Specific Gravity Equipment.** Equipment meeting the requirements of AASHTO T166.

### B. Requirements for Batching Plants

**1. Drier.** Equip the plant with a drier or driers which continuously agitate the aggregate during the heating and drying process. The drier equipment must be capable of supplying uniformly heated and dried material in sufficient quantities equivalent to the operating capacity of the plant.

**2. Screens.** Provide plant screens with nominal capacities in excess of the full capacity of the mixer. The screens must be capable of screening all aggregates to the specified sizes.

**3. Hot Bins.** The plant storage bins must be of sufficient storage capacity to supply the mixer when it is operating at full capacity. The plant must have at least four storage bins so arranged as to assure separate and adequate storage of the appropriate fractions of the aggregates required to give proper proportioning to the mix. Each bin must include an overflow chute of such size and at such location as to prevent backing up of material into other compartments or bins. Each compartment must have an individual outlet gate so that there is no leakage when closed. The
gates must quickly and completely cut off the flow of material. Equip bins with devices in the bins at the lower quarter points to indicate when the aggregates fall below this point. Provide a separate dry storage for mineral filler or baghouse fines when they are added to the mixture as a separate material.

4. Hot Bin Sampling Devices. Provide adequate facilities to obtain representative aggregate samples from the full width and depth of the discharge area from each aggregate hot storage bin while the plant is in operation. The device must consist of a sampling tray of adequate capacity which is structurally supported during the sampling operation. Alternative sampling device may be provided subject to approval of the RME. Access to sampling facilities must meet the requirements of §401-3.08 A.11. Safety Requirements.

5. Weigh Hopper. The equipment must include some means for accurately weighing each size of aggregate in a weigh hopper suspended on scales and of ample size to hold a full batch. When the weigh hopper gate is closed, material must not leak into the mixer while weighing a batch.

6. Aggregate and Asphalt Binder Scales. Scales must conform to the requirements of the National Institute of Standards and Technology Handbook 44, except that the number of scale divisions must not be less than 500 or greater than 2000. Scales installed on or after January 2, 1987 must be either the springless dial or load cell type and must indicate the load at all stages of the weighing operation from zero to full capacity. Scales installed after January 2, 2003 shall be only load cell type scales which indicate the load at all stages of the weighing operation from zero to full capacity. The minimum resolution of repeating dials or digital displays must be equivalent to or less than the minimum graduations on the primary scale. Repeating dials or digital displays must match the primary scale within one graduation. Locate the scales, repeating dials, or digital displays so they are easily readable from the operator's work station by direct sight. Prevent any manipulation of scale weight.

7. Asphalt Binder Bucket. The asphalt binder bucket must be large enough to handle a batch in a single weighing. Configure the filling system and bucket so that the asphalt binder will not overflow, splash, or spill outside the bucket during filling and weighing. The bucket must be steam or oil jacketed or equipped with electric heating units. The equipment shall deliver the asphalt binder in a thin uniform sheet or in multiple sprays over the full length of the mixer.

8. Proportioning Control. All batch plants must proportion materials by an automatic proportioning system approved by the Director, Materials Bureau. Install the system in a dust and weather protected area of at least 4.0 square meters with no internal dimension less than 2.0 meters. The system must accurately proportion various mixture components by mass or volume, and control the cycle sequence and timing during the mixing operation. All systems must operate in metric units on or before January 2, 2003, unless otherwise indicated in the contract documents. The entire batching and mixing cycle shall be continuous without any manual operations. There must be an interlock system that will interrupt and stop the automatic batching operations whenever a component proportion exceeds the allowable batching tolerance. The automatic proportioning system must be capable of consistently delivering individual design components within the full range of batch sizes with the following batching tolerances:

<table>
<thead>
<tr>
<th>Component</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each Aggregate</td>
<td>1.5%</td>
</tr>
<tr>
<td>Mineral Filler</td>
<td>0.5%</td>
</tr>
<tr>
<td>Asphalt Binder</td>
<td>0.1%</td>
</tr>
<tr>
<td>Zero Return (Aggregate)</td>
<td>0.5%</td>
</tr>
<tr>
<td>Zero Return (Asphalt Binder)</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

The preceding percentages are based on the total batch weight of the HMA mixture, except that the zero return tolerance is based on the minimum batch size.

If mineral filler is used, the allowable tolerance for the aggregate component weighed prior to the filler in a cumulative weighing system is 0.5 percent. If a separate tolerance control is not provided for mineral filler, then reduce all aggregate tolerances to 0.5 percent.
9. **Recording of Batching.** Equip all plants with automatic digital recording devices approved by the Director, Materials Bureau, and locate these devices such that the operator can access and read them from the work station. The recording device must be able to record the quantities of aggregate, mineral filler, asphalt binder, and the total weight of each batch of HMA mixture produced. All recording of batches must show the day, month, year and time to the nearest minute for each batch. The printout must permanently identify each batch. Provide the State with a clear and legible copy of the recording for each batch.

Record asphalt binder quantities separate from aggregate and filler and record as weight. If measured in volume (liters), convert the volume to weight in kilograms at 15°C.

Record the weights as indicated on the batching scale or display within an accuracy of 1 scale graduation or increment. The minimum resolution of digital recorders shall be equivalent to or less than the minimum graduation or increment on the scale or display.

Automation systems installed on or after January 2, 1987 shall clearly identify on the recordation when a batch is initiated without satisfying all conditions of fully automated production under these specifications. The recordation shall also identify when the system is taken out of the fully automated mode during the batching sequence. The recordation must provide a clear identification when an out of tolerance condition is accepted during batching, when a system produces a “demonstration” or “simulated” batch, and when a system reprints a batch ticket.

In addition to the above information, if the automation is capable of making batches other than standard sizes (full, ½ or ¼ Mg increments), the recordation must show for each aggregate (mineral filler and RAP, if used) and asphalt material, the target weight and the calculated over and under weights, OR, the calculated over and under weights and the theoretical batch total. The State requires this heading to be printed once for each load, regardless of the number of batches per load. If loading storage silos, consider each full ticket as a load.

10. **Mixer Unit.** The plant must include a batch mixer of an approved pugmill type capable of producing a uniform mixture within the permissible job mix tolerances. The mixer must have a capacity of not less than one metric ton. The blades of the mixer shall have a clearance not in excess of 20 mm from all fixed and moving parts. Replace paddle blades which are worn in excess of 25 percent in face area from their new condition. If not enclosed, the mixer must be equipped with a dust hood to prevent loss of dust. The mixer must be constructed to prevent leakage of the contents and must not cause significant segregation during the mixture discharge.

11. **Control of Mixing Time.** The mixer must be equipped with an accurate time lock properly coordinated with the automation of batching equipment to control the operations of a complete mixing cycle. It must lock the aggregate weigh hopper after charging of the mixer until the closing of the mixer gate at the completion of the cycle. It must lock the asphalt binder delivery system throughout the dry mixing period and lock the mixer gate throughout the complete mixing period. The following are terms related to the timing of the mixing cycle:

- **Cycle Time** - the interval of time between successive openings of the mixer discharge gate for succeeding batches.
- **Mixing Time** - the interval of time between the opening of the aggregate weigh box gate and the opening of the mixer discharge gate.
- **Dry Mixing Time** - the interval of time between the opening of the aggregate weigh box gate and the beginning of application of asphalt binder.
- **Wet Mixing Time** - the interval of time between the beginning of application of asphalt binder and the opening of the mixer discharge gate.
- **Finish Mixing Time** - the interval of time between the termination of application of asphalt binder and the opening of the mixer discharge gate.

The control of the timing must be flexible and capable of being set at intervals of five seconds or less throughout the total cycle time. Once the cycle times are set, manipulation of the set times is not allowed.
C. Requirements for Drum Mix Plants

1. Aggregate Feed Bins. Aggregate feed bins shall have adequate separation to keep aggregates from overflowing from one bin to another. Configure the feed bins so that material in excess of 100 mm cannot be placed into the bin. Clearly label all feed bins to identify the aggregate size used.

Each feed bin shall proportion aggregate accurately and uniformly. The section of the bin that controls the feed rate flow must be adjustable and have a method to identify the opening. Interlock each feed bin so that HMA production is interrupted within five seconds if any feed bin becomes empty or the flow is obstructed.

2. Mineral Filler System. Mineral filler shall be delivered to the mixing plant independently from the aggregates. The filler system shall proportion the mineral filler at adjustable rates accurately and uniformly. The filler system must be accurate to 0.25 percent based on the total weight of the HMA mixture. Interlock the filler system so that HMA production is interrupted within five seconds if the system becomes empty or the flow is obstructed.

3. Aggregate Weigh System. The plant shall weigh the aggregates continuously with a system meeting the requirements of National Institute of Standards and Technology Handbook 44. The weigh system will be tested as outlined in §401-3.08 A.4. Scales, Continuous Weigh Systems and Meters. Provide means for diverting the aggregate after passing over the weigh system and prior to entry into the drum. The weigh system must be readable to the nearest 0.01 metric ton during testing.

The Director, Materials Bureau will consider other weighing systems different from conventional designs. The following tolerances apply to all continuous weigh systems:

a. Acceptance tolerance. Acceptance tolerance is 0.5% of the test load and applies to initial installation of the weigh system, to the annual approval prior to production, and whenever the equipment is tested because it fails to meet the maintenance tolerance during production.

b. Maintenance tolerance. Maintenance tolerance is 1.0% of the test load and applies during all times other than those where acceptance tolerance apply.

4. PG Binder System. The plant shall continuously proportion PG Binder at adjustable rates accurately and uniformly. The binder system must be accurate to 0.1 percent based on the total weight of the HMA mixture. The binder system will be tested as outlined in §401-3.08A.4. Scales, Continuous Weigh Systems and Meters. The binder system must be interlocked so that production is interrupted within five seconds if the PG Binder flow to the mixer unit ceases. Install a temperature compensating device in conjunction with the meter to correct the quantity of asphalt binder at 15°C.

5. Proportioning Control. All drum mix plants shall proportion materials by an automatic proportioning system that will increase and decrease the production rate using a single input. Install the system in a dust and weather protected area of at least 4.0 sq. meters with no internal dimensions less than 2.0 meters. The system shall accurately proportion various mixture components by mass or volume. All systems must operate in metric units on or before January 2, 2003, unless otherwise indicated in the contract documents.

a. Aggregate Feed Rate Control. The plant must have an adjustable feed rate control for each aggregate bin feeder and mineral filler feeder. The controls must maintain an aggregate flow accuracy such that the total variation of all materials being drawn per interval of time must not exceed an amount equal to 1.5 percent of total weight of HMA mixture per interval of time. Add mineral filler with a maximum variation of 0.5 percent of the total weight of HMA mixture per interval of time.
The flow rates of aggregate and mineral filler must be continuously displayed in the control room in metric tons per hour. The maximum resolution will be 1 metric ton per hour for dry aggregate and 0.1 metric ton per hour for mineral filler.

b. Aggregate Weight Indicators. Weight indicators in the control room must display the weights of dry aggregate and mineral filler in metric tons. They must continuously accumulate weights of material during the production period. The maximum resolution will be 0.1 metric tons for dry aggregate and 0.01 metric tons for mineral filler if added separately. The indicators must be resettable to zero and have provisions to prevent manipulation.

c. Aggregate Moisture Compensator. A moisture compensation device must be capable of electronically converting the wet weight of aggregate to dry aggregate weight. The moisture compensation may be input based on composite or individual aggregate bin moisture. The maximum graduations on the compensator shall be 0.1 percent.

d. PG Binder Control. The PG Binder control must be capable of inputting the binder content as a percentage based on total weight of mixture. The maximum graduation on the binder input control is 0.1 percent. The asphalt binder delivery system must be linked with the aggregate delivery system to automatically maintain the required proportions as the aggregate flow varies. The delivery tolerance for asphalt binder is 0.1 percent based on the total HMA mixture weight. The flow rate of asphalt binder must be continuously displayed in the control room in metric tons per hour and have a maximum resolution of 0.1 metric ton per hour.

e. PG Binder Quantity Indicator. The PG Binder quantity indicator in the control room must display the quantity of the binder in metric tons and must continuously accumulate the quantity of binder during the production period in the day. The maximum resolution will be 0.01 metric tons. The indicator must be resettable to zero and have provisions to prevent manipulation.

6. Recordation of Proportions. The mixing plant must be equipped with an automatic digital recording device approved by the Director, Materials Bureau, which simultaneously records the accumulated weights of dry aggregate, mineral filler and PG Binder at five minute intervals during production and on demand. The recordation must include the actual PG Binder content as a percentage of the total HMA mixture weight. The maximum resolution will be 0.1 metric tons for dry aggregate, 0.01 metric tons for mineral filler, if added separately, 0.01 metric tons for PG Binder, and 0.1% for PG Binder content. All recordation must show the day, month, year, and time to the nearest minute for each print. Provide a clear and legible copy of the recordation to the State.

Automation systems installed on or after January 2, 1992 must clearly identify on the recordation when a batch is initiated without satisfying all conditions of fully automated production under these specifications. The recordation should also identify when the system is taken out of the fully automated mode during the batching sequence.

7. Automatic Aggregate Sampling Device. Provide an automatic aggregate sampling device which will divert a representative combined aggregate sample into a hopper or container for the purpose of gradation testing. The device shall effectively sample the full width and depth of the aggregate flow without losing any portion of the sample. The sampling point must be after the aggregate is proportioned and prior to its mixing with asphalt binder.

8. Mixer Unit. The plant shall include a continuous mixer of a type approved by the Director, Materials Bureau, having an automatic burner control and being capable of producing a uniform mixture within the job-mix tolerances. Repair or replace flights within the drum which are missing, loose, broken, bent, scalloped or worn excessively from their new condition to the
§401. Satisfaction of the RME. Discharge the HMA mixture into a HMA holding bin meeting the requirements of §401-3.09, Hot Mix Asphalt Holding Bins.

9. Truck Scales. Each drum mix plant site shall have a platform scale conforming to the requirements outlined in §401-3.08A.10. Truck Scales.

401-3.09 Hot Mix Asphalt Holding Bins. HMA mixtures may be held in holding bins which are especially designed for that purpose. The holding bins require initial approval by the Director, Materials Bureau.

A. Holding Times. Holding time is defined as the time interval beginning with the introduction of HMA mixture into the bin to the time of completion of discharge from the bin. Standard holding times are 12, 24, and 48 hours. Standard surge time is six hours.

B. Acceptance Criteria. The HMA mixture, after storage, must meet the criteria outlined in Table 401-6, HMA Holding Bin Acceptance Criteria.

C. Quantity Documentation. The quantity of the mixture drawn from holding bins and delivered to State projects shall be measured and recorded by one of the following:

1. A truck scale conforming to the requirements of §401-3.08A.10. Truck Scales.
2. A weight box or hopper suspended beneath the holding bin. The Director, Materials Bureau must approve all scale systems or other weighing devices prior to State use. Scales installed after January 2, 2003 must be load cell type scales which indicate the load at all stages of the weighing operation from zero to full capacity. The scale shall measure the actual weight to within an accuracy of 0.1 percent of full scale or one graduation, whichever is less. The minimum graduation will have a value not exceeding 10 kg or 0.01 metric tons. The minimum resolution of repeating dials or digital displays will be equivalent to or less than the minimum graduations on the primary. There must be an interlock cutoff circuit to prevent the

<table>
<thead>
<tr>
<th>Property</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix Temperature</td>
<td>±10°C from pugmill discharge temperature.</td>
</tr>
<tr>
<td>Aggregate Gradation</td>
<td>Within Job Mix Formula tolerances (applies to pugmill discharge mean gradation).</td>
</tr>
<tr>
<td>Asphalt Binder Content</td>
<td>±0.4% (applies to pugmill discharge mean asphalt binder content).</td>
</tr>
<tr>
<td>Asphalt Binder Recovered from Mixtures</td>
<td>( G^*/\sin \delta ), min., 2.20 kPa</td>
</tr>
</tbody>
</table>

commencement operation if the scale is outside of the zero return tolerance. The zero return tolerance will be from 0 to a maximum of plus 70 kilograms or 0.07 metric tons whichever is applicable.

Each installation shall be equipped with a recording device approved by the Director, Materials Bureau. The recorder shall produce a ticket with a time-date print and the total amount of mixture discharged into the truck. The minimum resolution of the recorder must be equivalent to or less than the minimum graduations on the scale or digital display. Manual manipulation of the scales during weighing and printing process is not allowed. In addition, interlock the system to allow printing only when the scale has come to a complete rest.

D. Holding Bin Evaluation and Approval. Prior to use on State projects, the Director, Materials Bureau must evaluate and approve each holding bin. The scope of the evaluation conducted will depend upon the standard holding times request. The evaluation is based on sampling and testing of HMA mixtures held in the bin.

If the HMA mixture from a holding bin shows signs of aggregate segregation, PG Binder migration, PG Binder hardening, or improper temperature control, delivery from the holding bin shall
be discontinued until satisfactory results can be achieved to the satisfaction of the RME. The State reserves the right to evaluate any approved bin any time.

401-3.10 Preparation of PG Binder. Heat the PG Binder to the temperature recommended by the PG Binder supplier in a manner that will avoid overheating and provide a continuous supply to the mixer at a uniform temperature.

401-3.11 Preparation of Aggregates.

A. Requirements for All Plants. Keep all State approved aggregates from different sources separate from each other unless approved by the RME. Separate all State approved aggregates from non-approved aggregates.

B. Requirements for Batch Plants. Stockpile all aggregates, including RAP, on free draining and clean bases such that the aggregates are not contaminated with foreign materials. When a batch plant is located at an approved aggregate processing facility, aggregate is permitted to be transferred from the facilities discharge point to the plant’s cold feed bin. However, if the RME determines that non-uniform aggregate gradation or moisture content results, this transfer of aggregate will no longer be permitted.

Dry the aggregates for the mixture and heat to the required temperature. Aggregates are considered dry when the moisture content just prior to batching does not exceed 0.5 percent of oven dried weight. Drying and heating must not damage or contaminate the aggregate. After heating and drying, screen the aggregates into fractions and place into separate compartments.

RAP will be last in the aggregate weigh sequence and the RAP design batch weight must be increased to compensate for moisture content. All requirements pertaining to aggregates apply to RAP, including the equipment requirements for automated proportioning and recordation stipulated for aggregates in §401-3.08, HMA Mixing Plant.

C. Requirements for Drum Mix Plants. Stockpile all aggregates, including RAP, on free draining and clean bases such that the aggregates are not contaminated with foreign materials. Direct transfer of aggregates from the processing facility’s discharge point to the plant’s cold feed bin is not permitted.

The aggregates for the mixture must be from supplies having a uniform gradation and moisture content. The aggregates must have stable moisture contents as determined by the QCT.

Determine the final acceptance for aggregate gradation from samples of the composite aggregate taken by the automatic sampling device described in §401-3.08 C.7. Automatic Aggregate Sampling Device.

Introduce RAP into the drum so that it will not come in direct contact with the burner flame. Mixing RAP with other aggregates must occur before the asphalt binder introduction point. All requirements pertaining to aggregates apply to RAP including the equipment requirements for automated proportioning and recordation outlined in §401-3.08, HMA Mixing Plant. In addition, add RAP with a maximum variation of 0.5 percent of the total weight of HMA per interval of time. RAP shall be accumulatively recorded as dry material separately from other aggregates.

401-3.12 Mixing. The mixer must be capable of producing a well-coated and homogeneous mixture at the specified temperature. The finished mixture must contain a minimum percentage of fully coated particles of 85 percent for base course and 95 percent for binder and surface course. The procedure for determining particle coating is available from the RME.

A. Requirements for Batch Plants. The volume of aggregates and PG Binder in the mixer shall not extend above the tips of the mixing blades and shall not exceed the manufacturer's rated capacity of the mixer. In addition, the total quantity of material mixed shall not be less than 50 percent of the manufacturer's rated capacity of the mixer.

The standard dry and wet mixing times for batch plants are 15 and 45 seconds, respectively. Any deviation from standard mixing times must meet the requirements outlined below and be approved by the RME.
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1. **Base Course Mixes.** Dry mix the base course mixes for at least the period of time necessary to discharge all aggregates into the mixer. The wet mixing period must then commence and continue until at least 85 percent of the coarse aggregate particles are fully coated or the finish mixing time exceeds ten seconds, whichever is longer.

2. **Top and Binder Course Mixes.** Dry mix the top and binder course mixes for at least the period of time necessary to discharge all aggregates into the mixer or 10 seconds, whichever is longer. The wet mixing period must then commence and continue until at least 95 percent of the coarse aggregate particles are fully coated or the finish mixing time exceeds 10 seconds, whichever is longer.

**B. Requirements for Drum Mix Plants and for recycle mixes in Batch Plants.** The moisture content of the mixture upon discharge into the haul unit will not exceed 0.5 percent when tested in accordance with procedures outlined in MM 5.0.

401-4 **METHOD OF MEASUREMENT.** Determine the quantities daily for each plant. The quantity is the number of actual metric tons determined from the automated proportioning system, the delivery vehicle weigh system, or the HMA holding bin weigh system. Measure or calculate the quantity based on the measured amount and report to the nearest 0.01 of a metric ton.

A delivery ticket indicating the total quantity in metric tons being delivered must accompany each delivery vehicle supplying HMA. The method of determining the delivered quantity is subject to the approval of the RME. Make one legible copy of the delivery ticket available to the State’s paving inspector prior to the placement of the mixture. The delivery ticket shall show the following minimum information and the HMA coded as outlined in Table 401-7, Delivery Ticket Mix Coding.

- Ticket number
- Plant identification
- Contract number
- Mix Codes
- Quantity of material in vehicle
- Date and Time

The QAT will determine a daily QAF for each day’s production from either Table 401-8, Air Voids in Plant Mixture (Volumetric Designs) or Table 401-9, Percent Passing (Non-Volumetric Designs) using the calculations of the average absolute difference values in accordance with MP 96-02. The Engineer will use the daily QAF to calculate quality payment adjustment for each day’s production.

**A. Volumetric Designs** - Quality payment adjustment for volumetric design mixtures is based on plant mixture air voids. The Engineer will obtain the daily QAF for volumetric design mixtures from Table 401-8, Air Voids in Plant Mixture. When hot mix asphalt holding bins are used for volumetric design mixtures, the Engineer will determine the daily QAF for the stored mixture on the day of delivery.

<table>
<thead>
<tr>
<th>TABLE 401-7 DELIVERY TICKET MIX CODING³</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mix Type</strong></td>
</tr>
<tr>
<td>9.5 mm</td>
</tr>
<tr>
<td>12.5 mm</td>
</tr>
<tr>
<td>19.0 mm</td>
</tr>
<tr>
<td>25.0 mm</td>
</tr>
<tr>
<td>37.5 mm</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

NOTES:
1. Friction Aggregate Classification Codes
2. When at least 75% of a layer is deeper than 100 mm below the pavement surface, the >100 mm aggregate consensus properties apply for that layer.
3. Delivery Ticket Mix Coding Example: 12.5 mm, <30 million design, <100 mm from surface, PG 64-28 Mix Coding on Delivery Ticket: 12F24Y.
TABLE 401-8 AIR VOIDS IN PLANT MIXTURE
(Volumetric Designs)

<table>
<thead>
<tr>
<th>Average Absolute Value (Test Value - 4.0)</th>
<th>Quality Adjust. Factor (QAF)</th>
<th>Average Absolute Value (Test Value - 4.0)</th>
<th>Quality Adjust. Factor (QAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 - 0.17</td>
<td>1.05</td>
<td>1.31 - 1.40</td>
<td>0.96</td>
</tr>
<tr>
<td>0.18 - 0.33</td>
<td>1.04</td>
<td>1.41 - 1.50</td>
<td>0.95</td>
</tr>
<tr>
<td>0.34 - 0.50</td>
<td>1.03</td>
<td>1.51 - 1.60</td>
<td>0.94</td>
</tr>
<tr>
<td>0.51 - 0.67</td>
<td>1.02</td>
<td>1.61 - 1.70</td>
<td>0.93</td>
</tr>
<tr>
<td>0.68 - 0.83</td>
<td>1.01</td>
<td>1.71 - 1.80</td>
<td>0.92</td>
</tr>
<tr>
<td>0.84 - 1.00</td>
<td>1.00</td>
<td>1.81 - 1.90</td>
<td>0.91</td>
</tr>
<tr>
<td>1.01 - 1.10</td>
<td>0.99</td>
<td>1.91 - 2.00</td>
<td>0.90</td>
</tr>
<tr>
<td>1.11 - 1.20</td>
<td>0.98</td>
<td>over 2.00</td>
<td>0.85</td>
</tr>
<tr>
<td>1.21 - 1.30</td>
<td>0.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Non-Volumetric Designs - Quality payment adjustment for non-volumetric design mixtures is based on plant mixture aggregate gradation. The daily QAF will be calculated for non-volumetric design mixtures for all Job Mix Formula sieves having design target values less than 90 percent passing. The daily QAF for non-volumetric design mixtures will be the lowest factor obtained from Table 401-9, Percent Passing. If each individual QAF is equal to or greater than 1.00, the highest calculated QAF will be used.

When any material with plant air voids of less than 2% or greater than 6% which results in daily QAF of 0.85, the Engineer will evaluate the subject material to determine if it will be left in-place. The considerations for determining whether the material in question is left in place are, but not limited to:

- Type of material produced
- The layer in which the material was placed
- The location of the project

If the subject material is left in-place, the Engineer will use a daily QAF of 0.85 to calculate the quality payment adjustment. If the subject material is not left in-place, remove and replace the material at no cost to the State. The daily QAF for the replaced material shall be determined as outlined in this subsection. The daily QAF applies to all production quantity deemed acceptable by the Engineer.

TABLE 401-9 PERCENT PASSING (Non-Volumetric Designs)

<table>
<thead>
<tr>
<th>Average Absolute Value (Test Value - JMF Target Value)</th>
<th>Quality Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size 425µm and Larger</td>
<td></td>
</tr>
<tr>
<td>0.0 - 0.8</td>
<td>1.05</td>
</tr>
<tr>
<td>0.9 - 1.5</td>
<td>1.04</td>
</tr>
<tr>
<td>1.6 - 2.3</td>
<td>1.03</td>
</tr>
<tr>
<td>2.4 - 3.0</td>
<td>1.02</td>
</tr>
<tr>
<td>3.1 - 4.5</td>
<td>1.01</td>
</tr>
<tr>
<td>4.6 - 6.0</td>
<td>1.00</td>
</tr>
<tr>
<td>6.1 - 6.3</td>
<td>0.99</td>
</tr>
<tr>
<td>6.4 - 6.6</td>
<td>0.98</td>
</tr>
<tr>
<td>6.7 - 6.9</td>
<td>0.97</td>
</tr>
<tr>
<td>7.0 - 7.2</td>
<td>0.96</td>
</tr>
<tr>
<td>7.3 - 7.5</td>
<td>0.95</td>
</tr>
<tr>
<td>7.6 - 7.8</td>
<td>0.94</td>
</tr>
<tr>
<td>7.9 - 8.1</td>
<td>0.93</td>
</tr>
<tr>
<td>8.2 - 8.4</td>
<td>0.92</td>
</tr>
<tr>
<td>8.5 - 8.7</td>
<td>0.91</td>
</tr>
<tr>
<td>8.8 - 9.0</td>
<td>0.90</td>
</tr>
<tr>
<td>over 9.0</td>
<td>0.85</td>
</tr>
</tbody>
</table>

| Sieve Size 180µm                                      |                          |
| 0.0 - 0.5                                             | 1.05                     |
| 0.6 - 1.0                                             | 1.04                     |
| 1.1 - 1.5                                             | 1.03                     |
| 1.6 - 2.0                                             | 1.02                     |
| 2.1 - 3.0                                             | 1.01                     |
| 3.1 - 4.0                                             | 1.00                     |
| 4.1 - 4.2                                             | 0.99                     |
| 4.3 - 4.4                                             | 0.98                     |
| 4.5 - 4.6                                             | 0.97                     |
| 4.7 - 4.8                                             | 0.96                     |
| 4.9 - 5.0                                             | 0.95                     |
| 5.1 - 5.2                                             | 0.94                     |
| 5.3 - 5.4                                             | 0.93                     |
| 5.5 - 5.6                                             | 0.92                     |
| 5.7 - 5.8                                             | 0.91                     |
| 5.9 - 6.0                                             | 0.90                     |
| over 6.0                                              | 0.85                     |
SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS

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

This work will consist of one or more courses of HMA pavement constructed on the prepared foundation in accordance with these specifications, the specific requirements of the item under contract, and as shown in the contract documents or as directed by the Engineer.

Prior to routine paving, the Engineer will conduct a pre-paving meeting with all parties working under this specification.

402-2 MATERIALS

402-2.01 General. Obtain State approval of materials before any material is mixed at any HMA plants. Obtain approval of aggregate sources for coarse and fine mineral aggregates from the Regional Materials Engineer. Performance-Graded Binder (PG Binder), mineral filler or any other materials that are used in the mix will be accepted according to the State’s written instructions. The PG Binder and the Design Estimated Traffic in 80 kN ESALs will be specified by a special note in the contract documents.

402-2.02 Composition of Mixtures. Formulate and submit, to the Regional Materials Engineer, a Superpave Mix Design that satisfies the requirements of §401-2 and the mixture design procedure as written in Materials Method (MM) 5.16, Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedures.

Table 402-1, General Description, lists the specification types of compaction methods and their use.

<table>
<thead>
<tr>
<th>Specification Types</th>
<th>50 Series</th>
<th>60 Series</th>
<th>70 Series</th>
<th>80 series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Agg. Type = F1 &amp; Coarse Agg. Type = F2</td>
<td>Use</td>
<td>Compaction monitoring using 4 cores every day.</td>
<td>Compaction monitoring using PTD based on average of 4 cores.</td>
<td>Compaction monitoring using a density gauge.</td>
</tr>
<tr>
<td>Coarse Agg. Type = F3</td>
<td>Use</td>
<td>Mainline paving for controlled access highways, i.e., interstate, parkways.</td>
<td>Mainline paving other than 50 or 70 Series.</td>
<td>Mainline paving on low volume roadways.</td>
</tr>
<tr>
<td>Coarse Agg. Type = F9</td>
<td>Use</td>
<td>Compaction monitoring using 4 cores every day.</td>
<td>Compaction monitoring using PTD based on average of 4 cores.</td>
<td>Compaction monitoring using a density gauge.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mainline paving other than 50 or 70 Series.</td>
<td>Mainline paving on low volume roadways.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Compaction monitoring using PTD based on average of 4 cores.</td>
<td>Compaction monitoring using a density gauge.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mainline paving for controlled access highways, i.e., interstate, parkways.</td>
<td>Mainline paving on low volume roadways.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Compaction monitoring using 4 cores every day.</td>
<td>Compaction monitoring using a density gauge.</td>
</tr>
</tbody>
</table>

NOTES: 402.XXYZQR
§402

XX = Mixture’s nominal maximum aggregate size (37, 25, 19, 12, 09, 05, 01)
Y = Compaction requirements (50, 60, 70, 80)
Z = Friction requirement (1, 2, 3, 9)
Q = Quality item number
R = Revision number

For 50, 60, and 70 series compaction methods, notify the Engineer of a desired mix temperature to be delivered to the project. For the 80 series compaction method, the Engineer will specify the desired mix temperature. The mixtures will be produced, delivered to the work site, and incorporated into the work within 10°C of the specified temperature. The specified temperature must be within the mixing and compaction range of 120°C and 165°C, or as recommended by the PG Binder manufacturer.

402-3 CONSTRUCTION DETAILS

402-3.01 Weather and Seasonal Limitations. Do not place HMA plant mix on any wet surface or when the surface temperature is less than specified in Table 402-2, Temperature and Seasonal Requirements, or when weather conditions will prevent proper handling or finishing of the HMA mixtures.

Discontinue paving as soon as the surface temperature falls below the requirements which are shown in Table 402-2 and applies for all pavement and shoulder courses.

<table>
<thead>
<tr>
<th>Nominal Compacted Lift Thickness</th>
<th>Surface Temperature Minimum (Note 1)</th>
<th>Seasonal Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mm</td>
<td>5°C</td>
<td>None</td>
</tr>
<tr>
<td>50 mm but &lt;100 mm</td>
<td>8°C</td>
<td>(Notes 2 &amp; 3)</td>
</tr>
<tr>
<td>&lt;50 mm</td>
<td>10°C</td>
<td>(Notes 2 &amp; 3)</td>
</tr>
</tbody>
</table>

NOTES:
1. Measure all temperatures on the surface where the mixture is to be placed and the controlling temperature will be the average of three temperature readings taken at locations 8 meters apart.
2. Place Top Course only during the period of April 1st up to and including the third Saturday of November in the counties of Dutchess, Orange, Rockland, Putnam, Westchester, Nassau, Suffolk, and the City of New York.
3. Place Top Course only during the period of May 1st up to and including the third Saturday of October in all counties except as noted in Note 2.

HMA pavement for temporary detours, which are not and will not become part of the permanent pavement, will not be subject to the above requirements in regard to temperature and seasonal limitations, but must be placed as approved by the Engineer.

Place HMA paving mixtures for curbs, driveways, sidewalks, gutters, and other incidental construction on surfaces having a minimum temperature of 10°C. The Engineer may allow the placement of these mixtures below the minimum temperature to expedite the completion of the project.

Schedule the paving operations such that all paving necessary to provide safe and adequate maintenance and protection of traffic or for protection of previously laid courses is completed within the weather and seasonal limitations. Such scheduling will include expediting construction operations to permit paving within the seasonal limitations or by limiting the length of work to that which can be completed before the seasonal shut-down. The cost of scheduling and sequencing of work to conform with the seasonal limitations will be reflected in the unit bid prices for the related contract items. Should paving operations not be completed within weather and seasonal limitations, provide all temporary materials and work necessary, such as the shimming of castings and protrusions, drainage of the roadway, providing acceptable rideability, and other work needed for the adequate maintenance and protection of traffic until paving operations can be completed the following paving season, and will not be reimbursable by the State.

Repair any damage to the base and binder course which has been placed and which will be permanently incorporated into the work and left open to traffic over the winter, at no additional expense to the State. In addition, clean this pavement course in accordance with Section 633, Conditioning.
§402

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

The contractor may propose to place surface course HMA pavement outside seasonal and/or weather limitations by providing a limited warranty against defects in such work. Warranty information can be provided by the Engineer.

402-3.02 HMA Pavers. Provide a self-powered HMA paver with an activated screed or strike-off assembly. The machine shall be capable of spreading and finishing courses of HMA plant mix material in lane widths applicable to the specified typical section and thicknesses shown on the plans. When screed extensions are necessary for placement of mainline pavement, such extensions shall be of the same design as the main screed. Auger and tunnel extensions are required to be mounted on the paver when the screed is extended more than 0.3 meter for fixed paving widths wider than 3.6 meters. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of HMA plant material in widths shown on the plans. The paver shall 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 laying mixtures, the paver shall be capable of operating at forward speeds consistent with satisfactory placement of the mixtures.

HMA pavers used for placing the initial paving layer, base, binder, and surface courses shall be equipped with approved automatic transverse slope and longitudinal grade screed controls. The controls shall automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities that are in the surface being paved. The controls shall be capable of maintaining the proper transverse slope and be readily adjustable so transitions and super-elevated curves can be satisfactorily paved. The controls shall operate from suitable fixed or moving references as prescribed in §402-3.06, Spreading and Finishing. When paving width is in excess of 5.2 meters, a paver must have approved automatic transverse slope and longitudinal grade screed controls that operate from both sides 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. The HMA pavers must be at the project site prior to the start of paving operations to allow examination and approval by the Engineer. Repair or replace immediately any paver found to be worn or defective either before or during its use.

402-3.03 Hauling Equipment. Transport HMA mixtures to the work site in vehicles having clean, smooth and tight metal beds. Cover the HMA mixture with waterproof covers during transportation. If a flexible cover is used, it must overlap the vehicle’s sideboards and back by a minimum of 150 mm and be securely fastened. The inside surface of the vehicle body may be lightly coated with a release agent. Release agents must meet all applicable State and Federal environmental requirements. Petroleum products or solvents having an adverse effect upon the HMA pavement will not be permitted for use as release agents. All hauling equipment is subject to the approval of the Engineer.

402-3.04 Rollers. All rollers shall be an approved vibratory, static steel wheel type, or pneumatic tire type used according to the requirements of §402-3.07, Compaction. All rollers shall be in good mechanical condition, free from excessive backlash, and capable of operating at speeds slow enough to avoid displacement of the mixture. The number and weight of rollers must be sufficient to satisfactorily compact the mixture while it is still in a workable condition. The use of equipment which results in excessive crushing of aggregate will not be permitted.

A. Vibratory rollers shall be of a type that are specifically designed for the compaction of HMA mixture. Vibratory roller models satisfying the specification requirements contained herein will be evaluated by the Materials Bureau to determine compaction capabilities. If acceptable, the roller model will be placed on the State’s current Approved List for Hot Mix Asphalt Vibratory Compaction Equipment. For all State projects, use only the vibratory roller models appearing on this list. Alternate types of rollers may be approved by the Director, Materials Bureau, for 50, 60, 70, and 80
series compaction methods, if, upon reviewing the specification of the rollers and demonstration that satisfactory results can be achieved.

Vibratory rollers shall meet the following requirements:

- Nominal Amplitude: 1.25 mm maximum.
- Vibration Frequency: 1500 vpm minimum.
- Drum Width (dual vibrating drums): 1.3 m, minimum
  (single vibrating drum): 2.1 m, minimum

When the rollers have pneumatic drive wheels, apply release agents to the tires to prevent material pickup.

All vibratory rollers shall be equipped with a speedometer that accurately indicates roller speed in either 1 km/hr or 15 m/min increments (maximum) throughout the specified operating range. Vibratory rollers must also be equipped with a speed control device that can be set to prevent the roller from traveling in excess of 4 km/hr or 67 m/min when the roller is in vibratory mode. The type of speed control device will be subject to the approval of the Director, Materials Bureau.

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

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

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

**402-3.05 Conditioning of Existing Surface.** When specified in the contract, 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 concrete course. Clean the surface and fill the joints and cracks under the provisions of Section 633, Conditioning Existing Pavement. Clean any foreign material resulting from construction operations from the pavement at no additional cost to the State. Leveling of the pavement surface prior to new HMA placement will be in conformance with the requirements stated below:

a. Apply a thin, uniform tack coat as specified in Section 407, Tack Coat, to all contact surfaces of existing HMA and Portland Cement Concrete layers including such areas as adjacent pavement edges, curbing, gutters, manholes, and other structures, immediately prior to placing the HMA mixture against them.

b. Fill depressions and wheel path ruts prior to the paving of the truing and leveling course, as directed by the Engineer. For wheel path ruts with a depth of 7 mm, but less than 20 mm, use Shim Course. For ruts greater than 20 mm, use a 9.5 mm mixture.

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

<table>
<thead>
<tr>
<th>Compacted Thickness Range (mm)</th>
<th>Mixture Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 40</td>
<td>9.5 mm or 12.5 mm</td>
</tr>
<tr>
<td>&gt;40</td>
<td>19.0 mm or 25.0 mm</td>
</tr>
</tbody>
</table>

**NOTE:** 37.5mm mixture may be used when the compactive thickness is greater than or equal to 75mm.

When constructing wedges for super-elevation, select a mixture such that dragging of stones at the thin edge is minimized. If dragging is excessive in any T&L course, as determined by the Engineer, the selected mixture will be disallowed for use for the application. Pay special attention to the proper compaction of thin sections.

### 402-3.06  Spreading and Finishing

Apply tack coat on the contact surfaces between all HMA pavement lifts in accordance with Section 407, Tack Coat, prior to placing HMA mixture regardless of time period between lifts. The only exception to this is 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.

Lay the mixture upon an approved clean, tack coated surface. Spread and strike off to the established grade and elevation. Use HMA paver(s) to distribute the mixture either over the entire width or over such partial width as may be practicable. Upon arrival at the site, the trucks will dump the mixture into the paver. Immediately spread and strike off to the required width and appropriate loose depth to obtain the required compacted thickness at completion of the work.

When the initial pavement course is laid with automatic HMA pavers, guide the paver by a taut reference line positioned at or near the pavement centerline or edge. Erect and maintain the reference line to the satisfaction of the Engineer. Support the reference line at approximately 8 meter intervals on tangent sections and at closer intervals on curves. Tension the line sufficiently to remove any sags. The Engineer may permit a moving reference of at least 9 meters in length in lieu of a reference line. The moving reference may be a floating beam, ski, or other suitable type such that the resulting pavement layer surface is sufficiently even. A short ski or shoe may also be used for the initial course with the approval of the Engineer if a satisfactory fixed reference such as a curb, gutter, or other fixed reference is adjacent to the pavement. When the proposed floating beam or the short ski does not produce the results similar to those obtained using a taut reference line, the Engineer shall disapprove the use of these devices.

Place subsequent pavement courses over the initial course using one of the above methods. In addition, any course in an adjacent lane may be used as the reference for the use of a short ski. The Engineer has final approval of the method chosen by the Contractor.

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

If there are less than 1250 square meters in the contract, or the areas to be paved are small and scattered, the HMA mixture may be spread by hand methods. For these areas, dump and spread the mixture such that the compacted thickness meets the specified thickness in the plans.

Prior to the beginning of rolling, check the loose mat, adjust any irregularities, and remove and replace all unsatisfactory material.

When placing the Shim Course to fill wheel ruts in an existing pavement, each wheel path rut must be paved separately. The placement equipment will be a drag box configuration or approved equal having side forms. Use the equipment to 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 for the pavement's full lane width. The placement equipment wheels and/or other appurtenances must not interfere with the distribution and placement of the shim course material. Deliver the placement equipment to the project site prior to the placing operation to allow sufficient time for examination and approval by the Engineer.

### 402-3.07  Compaction

Compact the HMA mixture using the appropriate compaction method specified in Table 402-4, Compaction Methods, associated to specific items being placed.
Immediately after the HMA mixture has been spread, struck off, and surface irregularities adjusted to uniformity, compact it using rollers meeting the requirements of §402-3.04, Rollers. Roll the surface when the mixture is in the proper condition and when the rolling does not cause displacement, cracking, or shoving. Initially roll all courses with the roller traveling parallel to the centerline of the pavement, beginning at each edge and working toward the center. Roll banked curves starting at the low-side edge and working toward the superelevated edge.

Correct at once any displacement occurring as a result of reversing the direction of the roller, or from other causes, by the use of rakes and addition of fresh HMA mixture as required. Exercise care in rolling so as not to displace the line and grade of the edges of the HMA mixture. To prevent adhesion of the mixture to the rollers, keep the wheels properly moistened with water, water mixed with small quantities of detergent or other approved material. Petroleum products or solvents having an adverse effect upon the HMA pavement will not be permitted.

When the rolling operation is complete, defects, such as shallow ruts, ridges, roller marks, cracking, tearing, segregation, or any other irregularities, as determined by the Engineer, shall not be visible in the pavement. If these defects are present, correct these defects to the satisfaction of the Engineer or replace the pavement at no additional cost to the State.

Along forms, curbs, headers, walls, and other areas not accessible to rollers, thoroughly compact the mixture with mechanical tampers. On depressed areas, use a trench roller or a small vibratory roller with the approval by the Engineer. Cleated compression strips also may be used under the roller to transmit compression to the depressed area.

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

When Shim Course is used for filling wheel ruts, compact with a minimum of three passes of a pneumatic rubber tire roller. When Shim Course is used as a skim coat, use pneumatic rubber tire rollers unless other rollers are approved by the Engineer.

Vibratory compaction is not permitted when compacting HMA mixtures on structural bridge decks, or other structures with less than 0.6 meters of cover. When using vibratory compaction, repair all damages which may occur to the highway components and adjacent property, including buried utility and service facilities, at no cost to the State.

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

For 60 and 70 series compaction methods, use at least one of the density gauges specified in §402-3.07 E of this section.

Use the following compaction methods based on the item numbers for HMA placements on all Department contracts.

A. **50 Series Compaction Method.** On the first day of mainline paving, select one of the following options:

1. **Option 1: Test Section.** Prior to routine paving of this item, construct a test section on the project site at a location approved by the Engineer. The test section will be a maximum of 500

### TABLE 402-4 COMPACCTION METHODS

<table>
<thead>
<tr>
<th>Compaction Methods</th>
<th>Item Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A=50 series</td>
<td>402.XX5ZQR</td>
</tr>
<tr>
<td>B=60 series</td>
<td>402.XX6ZQR</td>
</tr>
<tr>
<td>C=70 series</td>
<td>402.XX7ZQR</td>
</tr>
<tr>
<td>D=80 series</td>
<td>402.XX8ZQR &amp; other</td>
</tr>
</tbody>
</table>

**NOTES:**
- XX = 37, 25, 19, 12, 09, 05, 01
- Z = Friction requirement (1, 2, 3, 9)
- Q = Quality item number
- R = Revision number
lane meters on the mainline. Construct the full width of the pavement if necessary. The test section will be the same depth specified for the construction of the course which it represents. Use the first 100 linear meters of the test section to stabilize the paving operation. There is no maximum length if the test section is not on the mainline. The first 200 metric tons of quantity placed on a test section will be paid at a factor of 1.5 times the bid price. The remaining quantity will be paid at the bid price. A maximum of two test sections per item will be paid at the 1.5 adjustment. Pavement density Quality Adjustment Factors (QAFs) will not apply to the first two test sections. If more than two test sections are required, the pavement density QAF will apply when the additional test sections are located on the mainline. Only one test section per item per day will be placed. Subsequent test sections after the initial passing test section will be subject to approval by the Engineer. Once the test section is completed, the Engineer will select core locations and have cores taken in accordance with §402-3.08, Pavement Density Samples. When the average density of the cores is less than 88% of the maximum theoretical density, the Engineer will evaluate the test section to determine its acceptability. If found acceptable, payment will be adjusted by a factor of 0.60. If found unacceptable remove and replace at no additional cost to the State and the 1.5 factor will not apply.

Routine paving operations for this item will not be permitted until the results of the cores from the test section has a minimum pavement density QAF of 1.00. If the pavement density QAF is less than 1.00, construct another test section in accordance with Option 1.

2. Option 2: Routine Paving. Begin paving operations. Test Section Adjustment of 1.5 for the first 200 metric tons will not apply. All material placed will be subject to a pavement density QAF. If the pavement density QAF on the first day of paving is less than 1.00, construct a test section in accordance with Option 1.

During the placement of HMA mixture under this method, including the test section, take cores and loose mix samples in accordance with §402-3.08, Pavement Density Samples.

A paving lot is defined as a day’s production which must be a minimum of 200 metric tons. Each paving lot will be equally divided into four sublots in accordance with Materials Procedure (MP) 96-04, Asphalt Concrete Statistical Pavement Density Determination. When paving is continuous within a 24-hour period, a new lot will result when a change occurs in the paving crew. When a single plant is supplying to multiple paving operations or multiple plants are supplying to multiple paving operations, each paving operation will be evaluated separately. Multiple plants will not be allowed to supply HMA mixture to a single paver. If less than 200 metric tons are placed on any day, pavement cores will not be required and the density QAF will be reported as 1.00 for that day, provided that the Engineer is satisfied that the procedures used in these areas obtain pavement densities similar to previously placed pavement sections.

Compact the pavement sufficiently to achieve densities, expressed as a percentage of the mixture’s average daily maximum theoretical density (%MADMTD), in a range of 92% to 97%. Pavement cores and loose mix samples will be tested and analyzed by the Department in accordance with MP 96-04 to determine the pavement density QAF.

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

The density QAF will not be applied to material placed on ramps with a uniform full-width section of less than 400 m in length, shoulders, maintenance widenings and crossovers, and bridges. Payment for these areas will be based on satisfactory placement and compaction. Placement and compaction procedures will be satisfactory when the procedures used in these areas obtain pavement density similar to that obtained on the mainline pavement sections. If the shoulder shows signs of distress at this level of compaction, decrease the compaction effort until no further damage occurs to the shoulder or subbase. If a density gauge(s) is used to monitor mainline paving, use the same gauge(s) to monitor density of the above referenced areas.

B. 60 Series Compaction Method. On the first day of paving, select one of the options specified below:
1. **Option 1 - Test Section Only.** The test section is constructed to determine a Project Target Density (PTD) for this item and correlation of a density gauge. Prior to routine paving operations for this item, construct a test section at a location approved by the Engineer. Construction of the test section will not be allowed unless both a density gauge and the operator are present. The test section will be a maximum of 500 lane meters on the mainline. The Contractor will construct the full width of the pavement if necessary. The test section will be the same depth specified for the construction of the course which it represents. Use the first 100 linear meters of the test section to stabilize the paving operation. The remainder of the length will be used to determine the PTD.

During construction of the test section, take samples in accordance with §402-3.08, Pavement Density Samples. These samples should represent the material placed on the test section. At the conclusion of the test section, the Engineer will randomly select four 150 mm core locations on the test section (excluding the initial 100 linear meters) in accordance with §402-3.08, Pavement Density Samples. Take density readings with a density gauge(s) at each core location prior to drilling the cores. A density gauge reading is the average of multiple density gauge measurements taken in accordance with the appropriate Materials Procedure. Deliver the samples and the four density gauge readings with the gauge type, model, and serial number for each gauge to be correlated to the Regional Laboratory in accordance with §402-3.08, Pavement Density Samples. The Regional Materials Engineer will use the test section cores and density gauge readings to establish a PTD for each density gauge within one business day of the delivery of the samples and density gauge readings. When the average of the cores is less than 88% of the maximum theoretical density, the Engineer will evaluate the test section to determine its acceptability. If found acceptable, payment will be adjusted by a factor of 0.60. If found unacceptable remove and replace at no additional cost to the State and the 1.5 factor will not apply.

The first 200 metric tons of quantity placed on a test section will be paid at a factor of 1.5 times the bid price. The remaining quantity will be paid at bid price. A maximum of two test sections per item will be paid at the 1.5 adjustment. Place only one test section per item per day. Subsequent test sections after the initial test section will be subject to approval by the Engineer.

Routine paving will only begin after a PTD has been established by the Regional Materials Engineer based on testing of the pavement cores.

2. **Option 2 - Test Section immediately followed by Routine Paving.** Inform the Engineer when this option is selected. Construct a test section as described in Option 1 and continue paving. Take additional loose-mix samples in accordance with §402-3.08. Store these samples at the plant. The 1.5 adjustment for the test section does not apply when this option is selected. Determine an Interim PTD to monitor pavement density as described in the appropriate Materials Procedure. If nuclear density readings over two consecutive locations fall below 96% or above 103% of the PTD or if the moving average of the last 10 nuclear density readings falls below 98% of the PTD, stop routine paving operations and immediately construct a new test section in accordance with requirements of Option 1 - Test Section Only.

At the end of the first day’s paving, submit a copy of the appropriate BR form, as described in MP 96-01 or MP 03-001, to the Engineer. The Engineer will determine whether the density readings taken using the Interim PTD are acceptable based on the Actual PTD in accordance with MP 96-01 or MP 03-001. If not, the Engineer will select core locations randomly over the entire first day’s production excluding the test section. Prior to drilling these cores, take density readings at each core location. Deliver the core samples, density gauge readings, and the loose mix samples to the Regional Laboratory in accordance with §402-3.08, Pavement Density Samples.

If the average density of the pavement cores is not between 92% and 97% of the mixture’s maximum theoretical density, the Engineer will make a payment adjustment in accordance with Table 402-9, Density Quality Adjustment Factors, to the material placed on that day excluding the material placed on the test section.

Use only the gauge(s) correlated during the construction of the test section for monitoring pavement density during routine paving operations.
Compact the pavement sufficiently to achieve the PTD value. The minimum acceptable density reading is 96% and no greater than 103% of the PTD at a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations as determined by a density gauge. Take density gauge readings at each location, randomly selected by the Engineer in accordance with the appropriate Materials Procedure, every 60 meters along the length of the pavement for each pass of the paver. Record these density values on the appropriate BR form.

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

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

Additional pavement core samples may be required for daily density verification from the previously placed HMA. The requirement of these samples shall be based on the following situations:

- Insufficient number of density readings recorded, either at a specific location or at the required frequency.
- Paving without a density gauge on site.
- Paving completed after the only calibrated density gauge on site breaks down.
- Gauge readings do not seem to accurately represent the HMA density.

When pavement samples are required, take cores and density gauge readings at each core location in accordance with §402-3.08, Pavement Density Samples, and deliver them to the Regional Laboratory. The Regional Materials Engineer may establish a new PTD based on these cores. The material placed under the above situations will be subject to a payment adjustment.

Pavement samples may be required to verify PTD used on the contract for the following situations:

- When the contract includes multiple paving locations.
- Changes in existing pavement condition being overlaid.
- Excessive plant mix variations.
- Using a Job Mix Formula different from the mix produced for the Test Section or producing the mix in a plant different from the plant used during the Test Section.

When pavement samples are required, take cores, density gauge readings at each core location, and loose-mix samples in accordance with §402-3.08, Pavement Density Samples, and deliver them to the Regional Laboratory. The material placed under these situations will not be subject to payment adjustment. The Regional Materials Engineer will establish a new PTD if different from the original PTD.

**C. 70 Series Compaction Method.** On the first day of paving, construct a test section on the project site at a location approved by the Engineer, using the same equipment and procedures to be used in the construction of the remainder of the course being laid. The test section is constructed to determine the Project Target Density (PTD). Routine paving operations may begin immediately following the construction of the test section once a PTD has been established based on the evaluation of density readings. Paving operations will not be allowed unless both a density gauge and an operator are present.

**Test Section.** Construct a test section maximum of 500 linear meters on the mainline which has the same depth specified for the construction of the course it represents. Use the first 100 meters of the test section to stabilize the paving operation. The remainder of the length will be
used to determine the Project Target Density (PTD). Once a sufficient amount of material has been placed in the remaining test section, compact the pavement initially with a breakdown roller making four vibratory passes or as recommended by the Engineer. The Engineer will select three random locations in accordance with the appropriate Materials Procedure, and mark these sites so that subsequent density testing can be performed at the same locations. Take density readings at the three selected sites. A density gauge reading is defined as the average of multiple density gauge measurements taken in accordance with the appropriate Materials Procedure. Make additional machine passes using either the intermediate or the finish roller and take additional density readings at the three previously selected sites after each pass until the increase in density is less than 32.0 kg/m³, or until the Engineer stops further compaction because the pavement shows signs of distress.

The Engineer will calculate the average of the highest density reading from each of the random locations. The resulting average will be set as the PTD.

Compact the pavement sufficiently to achieve the PTD value. The minimum acceptable density reading will be 96% or maximum of 103% of the PTD in a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations as determined by a density gauge. Take density gauge readings at each location, randomly selected by the Engineer in accordance with the appropriate Materials Procedure, approximately every 60 meters along the length of the pavement for each pass of the paver. Record these values on the appropriate BR form.

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

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

D. 80 Series Compaction Method. For this compaction method, use either of the compaction options listed below:

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

   Immediately following the initial rolling, roll the mat with an approved pneumatic rubber-tired roller. A minimum of 3 passes of the rubber-tired roller will be required. One pass is defined as one movement of the roller over any point of the pavement in either direction.

   Immediately following the pneumatic rubber-tired rolling, finish rolling the mat with a steel-wheel roller to remove all shallow ruts, ridges, roller marks, and other irregularities from the surface.

   To prevent adhesion of the mixture to the drum(s) and pneumatic tires, keep the drum(s) and the pneumatic tires properly moistened with water, or water mixed with small quantities of detergent or other approved materials.

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

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

Operate vibratory rollers at a uniform speed not exceeding 4 km/hr (67 m/min.) on all pavement courses. Complete all turning of the compaction equipment on material which has had a minimum of one roller pass.

The number of passes listed in Table 402-5, Number of Passes, are recommended and may be increased or decreased to obtain adequate density. Complete all breakdown roller passes before the mat temperature falls below 120º C. One vibratory pass is defined as one movement of one drum of the roller over the pavement in either direction. One static pass is defined as one movement of the roller over the pavement in either direction. Remove all ruts, ridges, roller marks, or other irregularities from the surface using static rolling. The Engineer may approve alternate compaction procedures for areas where the specified procedures are not practical.

If satisfactory compaction is not obtained, or damage to highway components and/or adjacent property occurs using vibratory compaction equipment, immediately cease using this equipment and proceed with the work in accordance with the conventional compaction procedures stipulated under Option A at no additional cost to the State.

### TABLE 402-5 NUMBER OF PASSES

<table>
<thead>
<tr>
<th>Pavement Courses</th>
<th>Option 1 Three Roller Train (Static)</th>
<th>Option 2 Vibratory Rollers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steel Wheel Rollers</td>
<td>Pneumatic Roller</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>
</tbody>
</table>

For the permeable base course, compact the mixture between the temperatures of 60º C and 110º C by applying two static roller passes. Up to 2 additional passes may be required to obtain adequate density.

**E. Density Gauges**

1. **Nuclear Density Gauge.** Use a nuclear density gauge to monitor the pavement density in accordance with this subsection and Materials Procedure (MP) 96-01, Nuclear Gauge Density Data Collection for Hot Mix Asphalt. A nuclear density gauge shall consist of a radioactive source, scaler, and other basic components housed in a single backscatter unit. The gauge must be operated by personnel trained in the principles of nuclear testing and safety practices.

2. **Nonnuclear Density Gauge.** Use a nonnuclear density gauge to monitor the pavement density in accordance with this subsection and Materials Procedure (MP) 03-001, Nonnuclear Density Gauge Data Collection for Hot Mix Asphalt. The nonnuclear density gauge shall function in the temperature and moisture levels experienced during HMA paving. The nonnuclear density gauge shall contain the internal circuitry to determine the density of HMA pavements by measuring changes in the electromagnetic field resulting from the HMA compaction process.

**402-3.08 Pavement Density Samples.**

**A. Pavement Cores.** The Engineer will select one pavement core location for each subplot in accordance with MP 96-04, to represent each paving subplot. The Engineer will define a total of four 150 mm diameter coring locations. The pavement core samples must come from within the 150 mm diameter circles outlined. Under no circumstances will the Engineer designate the coring locations before the rolling operation is completed. The rolling operation is completed when all compaction
equipment has moved off the subplot designated for coring. Obtain the 150 mm diameter pavement core samples no later than a day following placement of the lot. If necessary, cool the pavement so that the core samples are not damaged during coring. Do not intentionally separate the pavement core from the underlying material if it does not debond during coring. The State will separate the pavement core required for testing from the underlying material by sawing, if necessary. Backfill the core holes with a similar HMA material before opening the lane to traffic.

**B. Loose Mix Samples.** On each paving day, take four loose mix samples in accordance with AASHTO T168, Standard Test Method for Sampling Bituminous Paving Mixtures. Take these samples periodically throughout the day so as to represent the entire day’s production. When a low production day is anticipated, it is recommended that a minimum of three loose mix samples be obtained before production is terminated. When operational conditions cause production to be terminated before the specified number of samples have been taken, the following procedures will be used:

1. If only three samples are taken, the loose mix maximum theoretical density (MTD) will be based on the average of the three samples taken.
2. If only one or two samples are taken, the day’s production will be added to the next day’s production and sublots determined based on the total quantity placed during the two days. Therefore a maximum of six loose mix samples will be used to determine the loose mix MTD.

Deliver the loose mix samples to the Regional Laboratory no later than the end of the following day’s placement. If, for any reason, a delay occurs in the delivery of the lot samples for three consecutive lots, paving operations for the item will not be permitted to continue until the samples are delivered and tested.

**C. Security Procedure.** After procuring the pavement cores, secure them in accordance with MP 96-04. Cores arriving at the Regional Laboratory for testing with a damaged or missing security seal will not be tested, and new cores will be taken within 0.3 m from the original core location at the same offset.

**D. Sample Delivery.** Deliver the pavement core samples to the State Regional Laboratory no later than the end of the following day’s placement. If, for any reason, a delay occurs in the delivery of the lot samples for three consecutive lots, paving operations for the item will not be permitted to continue until the samples are delivered and tested.

**E. Core Testing.** The option of testing pavement samples taken under §402.3-08, Pavement Density Samples, for 50 and 60 series compaction methods may be selected with the approval of the Regional Materials Engineer. Under this provision, perform all sample testing as outlined in accordance with the requirements of Materials Procedure (MP) 98-01, Procedure for Testing Cores Taken from All Hot Mix Asphalt (HMA) Performance-Related Specifications. In addition, when this option is selected, the Engineer will define one additional core from two of the sublots within 0.3 m from the original core location at the same offset.

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

In the formation of all joints, excluding the tapered wedge joint, the exposed edge of the newly placed layer that will become part of the joint shall be the full thickness of the layer and straight. If the edge of the newly placed layer is unacceptable, correct the edge by using a power driven saw or other approved tools to cut a neat line. Apply a light coat of HMA material meeting the requirements of Section 702 to the existing pavement edges in order to provide bonding with the newly laid pavement.

The pavement of successive courses will be such that all joints are offset no more than 150 mm from the joint of the lower pavement course, unless otherwise approved by the Engineer.
A. Transverse. Place the courses as continuously as possible to limit the number of transverse joints. Stagger the transverse joints in adjacent lanes a minimum of 3 meters. Form the transverse joint by cutting back on the previous run to expose the full depth of the course.

Set up the paver such that material is laid to overlap the previously placed edge by 50 mm to 75 mm. The thickness of the overlap material will be approximately 1/4 the compacted thickness of the course, so as to result in a smooth and well compacted joint after rolling. Broom the overlapped material back onto the hot mat so that the roller operator can crowd the small excess into the hot side of the joint. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if deemed necessary by the Engineer.

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

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

B. Longitudinal. Carefully plan the placement of the surface course to ensure that the longitudinal joints in the surface course will correspond with the edges of the proposed traffic lanes. Other joint arrangements will require approval of the Engineer. When traffic is maintained on the roadway during paving operations, place the mixture such that no more than 30 meters of the longitudinal pavement joint will be exposed at the end of the working day unless a greater length is permitted in the contract documents. An exposed joint in excess of 30 meters must be a tapered wedge joint. If an exposed joint in excess of 30 meters is allowed overnight, place warning signs at a maximum spacing of 300 meters to alert drivers of the uneven edge. Approval to leave an exposed edge must be requested in writing in advance of paving operations. If approval is granted to leave a longitudinal pavement joint exposed to traffic, plan the paving operation so that the edge is only exposed to traffic for one night and is not exposed over weekends or holidays.

If permission is granted to expose a longitudinal pavement joint overnight and the joint becomes damaged or provides an unsafe condition for motorists, the Engineer will rescind the approval to expose the longitudinal pavement joint overnight. Then, no more than 30 meters of the longitudinal pavement joint may be exposed at the end of the work day.

Use the following options when paving adjoining lanes:

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

2. Option B - Tapered Wedge Joint. Under this option, place the HMA mixture for the first mat with an attachment to the paver to provide a sloping wedge with a vertical stepdown at the longitudinal pavement joint. Extend a wedge of material from the bottom of the stepdown to the existing surface at a slope of 1 on 8 or flatter. Compact the first mat such that the roller compacts up to but does not extend past the stepdown. The vertical stepdown will be 12.5 mm minimum after compaction of the mat. Place the second mat such that it uniformly overlaps the adjacent cold mat 25 to 40 mm. The thickness of the overlap material will be approximately 1/4 the compacted thickness of the HMA layer, so it result in a smooth and well compacted joint after rolling. Broom or rake back the overlapped material onto the adjacent hot lane so that the roller
operator can crowd the small excess into the hot side of the joint. Broadcasting of the overlap material onto the lane is not allowed. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if deemed necessary by the Engineer.

If a dual-drum vibratory roller is used during construction of a longitudinal joint using either Option A or B, operate the roller in vibratory mode and as close to the paver as practicable. 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 protruding onto the cold mat. The roller will apply a second pass to the joint as it travels back away from the paver. If a single-drum vibratory roller with pneumatic drive wheels is used, operate the roller in vibratory mode and follow the same procedure except that the roller will be aligned on the joint so that the pneumatic drive wheels travel on the joint. All turning movements of the roller will be done on previously compacted material. After applying two roller passes on the longitudinal joint, proceed with the roller to the low side of the lane and compact as described in §402-3.07, Compaction.

402-3.10 Surface Tolerance. Construct the pavement surface to a 6 mm tolerance. If the pavement surface is not being constructed or has not been constructed to this tolerance based upon visual observation or upon riding quality, the Engineer may test the surface with a 5 meter straight edge or string line placed parallel to the centerline of the pavement and with a 3 meter straight edge or string line placed transversely to the centerline of the pavement on any portion of the pavement. Variations exceeding 6 mm will be satisfactorily corrected or the pavement relaid at no additional cost to the State.

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

The thickness required for the course specified under one pay item will be acceptable where the required nominal thickness is 100 mm or less. A tolerance not to exceed 13 mm from the nominal thickness required for the course or courses specified under one pay item will be acceptable where the required nominal thickness is over 100 mm. The total thickness of all HMA mixture courses will not vary from the total of the nominal thickness indicated on the plans by more than 6 mm where the total nominal thickness is 100 mm or less; or more than 13 mm where the total nominal thickness is over 100 mm but not more than 200 mm; and by not more than 16 mm where the total nominal thickness is more than 200 mm.

When the HMA mixture is placed on newly constructed subbase material, an additional tolerance of plus 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 except as provided herein. Tolerances indicated for the thicknesses of individual layers of multilayer pavements (including composite pavements) are guides which should be met as closely as practical. Tolerance for the total thickness of such pavement is also a guide. In order to attain a smooth riding pavement true to line and grade, pavements which substantially conform to the plans and specifications, even though the thickness tolerance may not be exactly met, may be accepted and paid for under the following conditions:

Where the total thickness of such pavements is less than the specified thickness including tolerances, the Regional Director, may with approval of the Director, Construction Division, approve, accept and pay for such pavements; where the total thickness of such pavements is greater than the specified thickness, the Regional Director may accept and pay for such pavements when the excess thickness was 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. Cleaning tools and equipment used for HMA placement is not allowed on the pavement surface. Also, do not conduct cleaning near streams, ponds, drainage structures or other areas that are tributaries to waterways. Use an area designated 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. Dispose solid, dry asphalt fragments as exempt construction and demolition waste. Report any petroleum product spillage to the ground to the NYS Department of Environmental Conservation.

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

The HMA will be measured by the number of metric tons of compacted mixture in the accepted work. In addition, quality payment adjustments are applicable for all hot mix asphalt in accordance with these specifications herewith and the provisions outlined in the contract documents. All quality payment adjustments are measured in Quality Units. Quality Units will be determined for each day’s production and placement by using the daily Quality Adjustment Factor (QAF) for plant production, pavement density, longitudinal joint density and pavement smoothness and the appropriate tons accepted by the Engineer.

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

When the pavement density QAF applies, use one of the following methods of measurements in Table 402-6, Methods of Measurements, corresponding to the item used on the project:

<table>
<thead>
<tr>
<th>Method Type</th>
<th>Pay Item Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A=50 series</td>
<td>402.XX5FZR</td>
<td>QAF based on calculated PWL using four cores.</td>
</tr>
<tr>
<td>B=60 series</td>
<td>402.XX6FZR</td>
<td>QAF based on average of four core densities.</td>
</tr>
</tbody>
</table>

A. 50 Series Method. The Engineer will determine the paving lot’s Percent Within Limits (PWL) in accordance with MP 96-4. This PWL will be used to determine the density QAF as shown in Table 402-7, Quality Schedule. The quantity of the HMA mixture subject to possible adjustment will be determined from actual 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 from Table 402-7, Quality Schedule, will apply to the paving lot to determine the payment adjustment. The pavement density QAF will not apply to material placed on ramps with a uniform full width section of less than 400 meters in length, shoulders, maintenance
widenings and crossovers, and bridges. Payment in these areas will be a QAF of 1.00 based on satisfactory placement and compaction as determined by the Engineer.

**B. 60 Series Method.** The State will test all pavement density samples for this item when Option 2 on the initial paving day is selected or if the Engineer requests additional cores on any day after the first day as outlined in the specifications. Full payment will be made when the average density of the four cores is between 92% and 97% of the mixture's average daily maximum theoretical density. If the average density fails to meet this limit, a payment adjustment will be made based on bid price and in accordance with Table 402-9, Density Quality Adjustment Factors, to all the material placed on the mainline for the day the cores represent, excluding the material placed on the test section.

### TABLE 402-7 QUALITY SCHEDULE

<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_Segment x PayFactor_Segment})^{1,2})</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Where PWL\(_{Density\_Range}\) will be calculated for each of the nine density ranges in Table 402-8, Density Segment Pay Factors, using the standard deviation and average density for the lot.
2. If the QAF is determined to be 0.60 or less, then the lot will be evaluated by the Engineer to determine if it may remain in-place. The type of material produced (i.e. binder, top), the layer in which it was used, and the location of use (i.e., mainline or a non-critical area) will be primary considerations in the determination of whether the HMA can be left in-place. If the HMA cannot be left in-place, it will be removed at no cost to the State. However, if the Engineer determines that the HMA can be left in-place, the QAF will be 0.60.

### TABLE 402-8 DENSITY SEGMENT PAY FACTORS

<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>

### TABLE 402-9 DENSITY QUALITY ADJUSTMENT FACTORS

<table>
<thead>
<tr>
<th>Average Core Density</th>
<th>Quality Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>91.0. Density &lt; 92.0 or 97.0 &lt; Density, 98.0</td>
<td>0.95</td>
</tr>
<tr>
<td>90.0. Density &lt; 91.0</td>
<td>0.90</td>
</tr>
<tr>
<td>88.0. 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>

*The lot will be evaluated by the State to determine if it may remain in-place. The type of material produced (i.e. binder, top), the layer in which it is used, and the location of use (i.e., mainline or a non-critical area) will be primary considerations in the determination of whether the HMA can be left in-place. If the HMA cannot be left in-place, it will be removed at no cost to the State. However, if the State determines that the HMA can be left in-place, the Quality Payment Adjustment will be calculated using a QAF of 0.60.

The quantity of the HMA mixture subject to possible adjustment will be determined from actual quantity placed in the accepted work 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 plans. The payment adjustments will be applied to material placed on mainline but not shoulders, ramps, maintenance widenings and crossovers, and bridges.
402-5 BASIS OF PAYMENT. The unit price bid per ton for all pavement courses shall include the cost of all material, labor and equipment necessary to complete the work, including any cleaning pursuant to §402-3.01; cleaning of foreign material from the pavement as a result of construction operations; all necessary repairs to highway components and/or adjacent property caused by construction operations; any necessary work to correct surface tolerances per §402-3.10; the scheduling and sequencing of work to conform with weather and seasonal limitations, and all temporary materials and work and/or repairs associated with paving operations outside the specified weather and seasonal requirements; and any removal and replacement of HMA pursuant to §401-4 and §402-4 Method of Measurement. The unit bid price also includes the cost of all necessary traffic control, equipment, labor and materials required in obtaining the pavement cores, filling all core holes with HMA, and compacting these core holes to the satisfaction of the Engineer. In addition, Quality Units may apply to the hot mix asphalt items as calculated in §402-4. Payment of Quality Units will be made based on the Index Price listed in the contract documents. The index price shown in the itemized proposal for each Quality Unit is considered the price bid. The unit (index) price is NOT to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount bid for the Contract.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>402.010901</td>
<td>Type 1 F9, Asphalt-Treated Permeable Base Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.010911</td>
<td>Plant Production Quality Adjustment to 402.010901 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.011901</td>
<td>Type 2 F9, Asphalt-Treated Permeable Base Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.011911</td>
<td>Plant Production Quality Adjustment to 402.011901 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.017901</td>
<td>True &amp; Leveling F9, Superpave HMA, 70 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.017911</td>
<td>Plant Production Quality Adjustment to 402.017901 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.018901</td>
<td>True &amp; Leveling F9, Superpave HMA, 80 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.018911</td>
<td>Plant Production Quality Adjustment to 402.018901 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.058901</td>
<td>Shim Course F9, Hot Mix Asphalt</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.058911</td>
<td>Plant Production Quality Adjustment to 402.058901 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.095101</td>
<td>9.5 mm F1 Superpave HMA, 50 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.095111</td>
<td>Plant Production Quality Adjustment to 402.095101 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.095121</td>
<td>Pavement Density Quality Adjustment to 402.095101 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.095201</td>
<td>9.5 mm F2 Superpave HMA, 50 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.095211</td>
<td>Plant Production Quality Adjustment to 402.095201 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.095221</td>
<td>Pavement Density Quality Adjustment to 402.095201 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.096101</td>
<td>9.5 mm F1 Superpave HMA, 60 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.096111</td>
<td>Plant Production Quality Adjustment to 402.096101 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.096201</td>
<td>9.5 mm F2 Superpave HMA, 60 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.096211</td>
<td>Plant Production Quality Adjustment to 402.096201 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.096301</td>
<td>9.5 mm F3 Superpave HMA, 60 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.096311</td>
<td>Plant Production Quality Adjustment to 402.096301 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.097101</td>
<td>9.5 mm F1 Superpave HMA, 70 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.097111</td>
<td>Plant Production Quality Adjustment to 402.097101 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.097201</td>
<td>9.5 mm F2 Superpave HMA, 70 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.097211</td>
<td>Plant Production Quality Adjustment to 402.097201 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.097301</td>
<td>9.5 mm F3 Superpave HMA, 70 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.097311</td>
<td>Plant Production Quality Adjustment to 402.097301 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.098101</td>
<td>9.5 mm F1 Superpave HMA, 80 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.098111</td>
<td>Plant Production Quality Adjustment to 402.098101 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.098201</td>
<td>9.5 mm F2 Superpave HMA, 80 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.098211</td>
<td>Plant Production Quality Adjustment to 402.098201 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.098301</td>
<td>9.5 mm F3 Superpave HMA, 80 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.098311</td>
<td>Plant Production Quality Adjustment to 402.098301 M</td>
<td>Quality Unit</td>
</tr>
<tr>
<td>402.098901</td>
<td>9.5 mm F9 Superpave HMA,Shoulder Course,80 Series Compaction</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>402.098911</td>
<td>Plant Production Quality Adjustment to 402.098901 M</td>
<td>Quality Unit</td>
</tr>
</tbody>
</table>
### SECTION 403 - HOT MIX ASPHALT (HMA) PAVEMENTS FOR MUNICIPALITIES

#### 403-1 DESCRIPTION.
These general specifications apply to plant mixed Hot Mix Asphalt (HMA) for use by municipalities such as Towns, Counties, etc. Modifications of these general requirements will be
indicated in the specific requirements for each item. These mixes are suitable for low to moderate traffic volumes.

This work will consist of one or more courses of HMA constructed on the prepared foundation in accordance with these specifications and the specific requirements of the item under contract, and in reasonably close conformance with the lines, grades, thickness and typical sections shown on the plans or established by the Engineer.

Appropriate mix types with corresponding friction aggregates and Performance Graded Binder (PG Binder) grades must be specified and used based on the traffic levels and the project location. When the traffic levels exceed an AADT of 8,000 for two lanes or 13,000 for three or more lanes, then Items in Section 402 must be specified.

403-2 MATERIALS

403-2.01 General. Use all materials for HMA production such as aggregates, PG Binder, Reclaimed Asphalt Pavement (RAP), mineral filler or any other materials meeting the State’s requirements.

403-2.02 Composition of Mixtures. The HMA plant mix will generally be composed of a mixture of aggregate, Reclaimed Asphalt Pavement (RAP), filler if required, and PG Binder. For any HMA required by the plans or itemized proposal, formulate, a job mix formula that satisfies the General Limits imposed by Table 403-1, Composition of Hot Mix Asphalt Mixtures. In addition, the formula will state the mineral aggregate sources, and the PG Binder used in the mixture. For Type 6F2, 6F3, 7F2, and 7F3 mixtures, determine the optimum asphalt content for the proposed gradation using the Marshall Mix Design Method (50 blows).

The resultant mixture shall meet the following Marshall Mix Properties:

<table>
<thead>
<tr>
<th>Mix Property</th>
<th>Type 6F2, 6F3</th>
<th>Type 7F2, 7F3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Voids, %</td>
<td>3.0 - 5.0</td>
<td>3.0 - 5.0</td>
</tr>
<tr>
<td>Voids in Mineral Agg. (VMA), %, min.</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Voids Filled with Binder (VFB), %</td>
<td>65 - 78</td>
<td>65 - 78</td>
</tr>
</tbody>
</table>

Produce, deliver to the work site, and incorporate the mixture into the work within 10°C of the temperature specified by the Engineer but within the mixing and placing temperature range imposed by Table 403-1, Composition of Marshall Designed Plant Mixtures.

The aggregates will be those noted in the job mix formulas. The PG Binder will be accepted on the basis of PG Binder supplier’s certification.

Perform quality control tests during HMA production to ensure specification compliance. The plant mixed material will be accepted after blending and mixing at the plant. The pavement courses will be accepted after all paving operations are completed.

403-2.03 Aggregates. Fine aggregate will consist of materials conforming to the requirements of §703-01, Fine Aggregate. In addition, fine aggregate may consist of screenings, free from deleterious materials and manufactured from sources of stone, gravel, or slag meeting the requirements §703-02, Coarse Aggregate. Coarse aggregate will consist of crushed stone, crushed gravel, or crushed slag conforming to the requirements of §703-02, except for gradation.

When aggregates from approved natural fine sand sources are combined with coarse aggregates in the mixture, aggregate particles will meet additional requirements as follows:

- Particles in the No. 1A and No. 1 primary sizes will meet the quality requirements of §703-02 and will have a minimum of 85 percent, by weight, of the particles with at least two fractured faces.
- Particles in the No. 2, No. 3 and No. 3A primary sizes will meet the quality requirements of §703-02 and will have a minimum of 75 percent, by weight, of the particles with at least one fractured face.

Slag aggregate may be used only when an alternate pay item which takes the mix yield differential into account is included on the plans or in the itemized proposal.

Aggregates for all mixtures specified in Table 403-1, including Type 6 or 7 (F9), shall meet the requirements of §703-02, Coarse Aggregate. In addition, the aggregate requirements for Type 6F2, 6F3, 7F2, and 7F3 mixtures shall meet one of the following requirements based on the mix type specified in the contract documents:
A. Coarse Aggregate Type F2 Conditions

1. Limestone, dolomite, or a blend of the two having an acid-insoluble residue content of not less than 20.0%.
2. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.
3. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:

   a. Type 6F2 Mixes. Noncarbonate plus 3.2 mm particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). Additionally, a minimum of 20.0% of plus 6.3 mm particles must be noncarbonate.

   b. Type 7F2 Mixes. Noncarbonate plus 3.2 mm particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). Additionally, a minimum of 20.0% of plus 3.2 mm particles must be noncarbonate.

---

TABLE 403-1 COMPOSITION OF HOT MIX ASPHALT MIXTURES

<table>
<thead>
<tr>
<th>Mixture Requirements ¹</th>
<th>Base Type 1</th>
<th>Binder Type 2</th>
<th>Shim Type 3</th>
<th>Top³,⁴ Type 6, 6F2, 6F3</th>
<th>Top⁵,⁶ Type 7, 7F2, 7F3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen Sizes</td>
<td>General limits %</td>
<td>Job Mix Tol. %</td>
<td>General limits %</td>
<td>Job Mix Tol. %</td>
<td>General limits %</td>
</tr>
<tr>
<td>50.0 mm</td>
<td>100</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>37.5 mm</td>
<td>90 - 100</td>
<td>75 - 100</td>
<td>7</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>25.0 mm</td>
<td>78 - 95</td>
<td>55 - 80</td>
<td>8</td>
<td>95 - 100</td>
<td>-</td>
</tr>
<tr>
<td>12.5 mm</td>
<td>57 - 84</td>
<td>23 - 42</td>
<td>7</td>
<td>70 - 90</td>
<td>-</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>40 - 72</td>
<td>5 - 20</td>
<td>6</td>
<td>48 - 74</td>
<td>100</td>
</tr>
<tr>
<td>3.2 mm</td>
<td>26 - 57</td>
<td>2 - 15</td>
<td>4</td>
<td>32 - 62</td>
<td>80 - 100</td>
</tr>
<tr>
<td>850 µm</td>
<td>12 - 36</td>
<td>-</td>
<td>7</td>
<td>15 - 39</td>
<td>32 - 72</td>
</tr>
<tr>
<td>425 µm</td>
<td>8 - 25</td>
<td>-</td>
<td>7</td>
<td>8 - 27</td>
<td>18 - 52</td>
</tr>
<tr>
<td>180 µm</td>
<td>4 - 16</td>
<td>-</td>
<td>4</td>
<td>4 - 16</td>
<td>7 - 26</td>
</tr>
<tr>
<td>75 µm</td>
<td>2 - 8</td>
<td>-</td>
<td>2</td>
<td>2 - 8</td>
<td>2 - 12</td>
</tr>
<tr>
<td>PGB Content, %²</td>
<td>4.0 - 6.0</td>
<td>2.5 - 4.5</td>
<td>0.4</td>
<td>4.5 - 6.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Mixing and Placing Temp. Range, ºC</td>
<td>120-165</td>
<td>110-150</td>
<td>120-165</td>
<td>120-165</td>
<td>120-165</td>
</tr>
</tbody>
</table>

NOTES:
1. All aggregate percentages are based on the total weight of the aggregate.
2. The asphalt content is based on the total weight of the mix. When using slag aggregates in the mix, increase the PGB content accordingly, a minimum of 25 percent for an all slag mix.

---

NOTES:
1. All aggregate percentages are based on the total weight of the aggregate.
2. The asphalt content is based on the total weight of the mix. When using slag aggregates in the mix, increase the PGB content accordingly, a minimum of 25 percent for an all slag mix.
3.  6F2, 6F3, 7F2, 7F3 mix types require friction coarse aggregates, and are required for mainline driving surface courses.
4.  For Type 6 and Type 7 (F9) aggregate requirements, Marshall design will not be required. These mix types are suitable where the State’s requirements for F9 aggregate apply.
5.  Introduce the PG Binder into the pugmill between 110°C and 175°C, or as recommended by the PG Binder supplier.

B. Coarse Aggregate Type F3 Conditions

1.  Limestone or a blend of limestone and dolomite having an acid-insoluble residue content of not less than 20.0%.
2.  Dolomite
3.  Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.
4.  Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:
   a. Type 6F3 Mixes. Noncarbonate plus 3.2 mm particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). Additionally, a minimum of 20.0% of plus 6.3 mm particles must be noncarbonate.
   b. Type 7F3 Mixes. Noncarbonate plus 3.2 mm particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). Additionally, a minimum of 20.0% of plus 3.2 mm particles must be noncarbonate.

When coarse aggregates for these mixes are from more than one source or of more than one type of material, proportion and blend them to provide a uniform mixture.

403-2.04 Mineral Filler. Mineral filler, if required in the mix to meet gradation requirements, will conform to the requirements of §703-08, Mineral Filler.

403-2.05 Performance-Graded Binder. The PG Binder will meet the requirements of §401-2.04, Performance Graded Binder. Unless the type of PG Binder is specified in the contract documents, use PG 64-22, or a PG Binder specified in Table 6-4, Performance Graded Binder Selection, of Chapter 6 of the Comprehensive Pavement Design Manual, or other suitable PG Grade as approved by the Engineer.

403-2.06 Reclaimed Asphalt Pavement. Reclaimed Asphalt Pavement (RAP) will meet the requirements as written in Materials Method (MM) 5.16, Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedures.

403-3 CONSTRUCTION DETAILS. The contractor is responsible for Quality Control (QC). QC is defined as all activities required to produce HMA that meets all specification requirements. The Contractor will produce HMA in accordance with the State approved Control Plan and assume responsibilities for all QC activities at the production facilities. If specified in the contract documents, The Quality Control provisions of Section 401 shall apply.

Unless modified in the contract document, the details of §401-3, Construction Details, will apply except for the gyratory compactor, specimen mold assembly, and the extractor of §401-3.08 HMA Mixing Plant are not required. "In addition, the oven's capacity will be a minimum of 0.04 cubic meter." Errata 5/8/03 The HMA mixing plant inspection facilities shall include mixture design equipment for Marshall method as detailed below.

The details of §402-3 Construction Details will apply except for §402-3.05 Conditioning of Existing Surface and §402-3.07 Compaction, and §402-3.08 Pavement Density Samples. The requirements for conditioning of the existing surface and compaction are detailed below.

403-3.01 Equipment for Marshall Design Method

A. Marshall Compactor. A compactor will meet the requirements of AASHTO T245. Mount the compactor on a solid base. The compactor will be automatically driven, have a stroke counter, and be capable of automatically stopping after applying the desired number of strokes. The compaction hammer shall weigh 4.536 kilograms (0.009 kg).
B. Marshall Specimen Mold Assembly. The specimen mold assembly will meet the requirements of AASHTO T245. The assembly shall consist of a compaction mold, base plate, and collar. Provide a minimum of three specimen mold assemblies and an adequate supply of 100 mm paper discs.

C. Marshall Specimen Extractor. Supply an extractor, meeting the requirements of AASHTO T245, to extract the 100 mm Marshall specimens from the compaction molds.

D. Hot Plate. Supply a hot plate suitable for heating the Marshall compaction hammer. A hot plate meeting the requirements of §401-3.08, 13. p. Sample Drying Appliance, will be acceptable.

403-3.02 Conditioning of Existing Surface. Clean the surface of the existing pavement prior to placing any HMA. When specified in the contract documents:

- Clean and fill the joints and cracks under the provisions of Section 633, Conditioning Existing Pavement.
- Apply a thin, uniform tack coat under the provisions of Section 407, Tack Coat, to all contact surfaces of existing HMA and Portland Cement Concrete layers including such areas as adjacent pavement edges, curbing, gutters, manholes and other structures, immediately prior to placing the HMA mixture against them.
- If the pavement surface is rutted, fill all depressions and wheel path ruts prior to the paving of the truing and leveling course, as directed by the Engineer. For wheel path ruts 7 mm or greater, but 20 mm or less, use Shim Course. Otherwise, for ruts greater than 20 mm, use a Type 7 mixture or other appropriate mixture.
- Place a truing and leveling course of a minimum variable thickness of proper plant mix necessary to bring the surface of the existing pavement to the same transverse slope and longitudinal grade required for the finished pavement surface. For compacted thickness up to 50 mm, use a Type 6 or Type 7 mixture. For compacted thickness in excess of 50 mm, use a Type 3 mixture. Pay special attention to the proper compaction of thin sections.

403-3.03 Compaction Immediately after the HMA mixture has been spread, struck off and surface irregularities adjusted, thoroughly and uniformly compact it by rolling. Roll the surface when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving. Initially roll all courses with the roller traveling parallel to the centerline of the pavement beginning at each edge and working toward the center. Roll the banked curves starting at the low side edge and working toward the super-elevated edge.

Correct at once any displacement occurring as a result of reversing the direction of the roller, or from other causes, by the use of rakes and addition of fresh mixture as required. Exercise care in rolling so as not to displace the line and grade of the edges of the HMA mixture. To prevent adhesion of the mixture to the drum(s) and pneumatic tires, keep the drum(s) and the pneumatic tires properly moistened with water or water mixed with small quantities of detergent or other approved material. Any petroleum products or solvents having an adverse effect upon the HMA pavement will not be permitted for use.

There shall be no visible defects, such as shallow ruts, ridges, roller marks, cracking, tearing, segregation, or any other irregularities as determined by the Engineer, in the pavement when the rolling operation is complete. If these defects are present, correct these defects to the satisfaction of the Engineer or relay the pavement at no additional cost.

Along forms, curbs, headers, walls and other areas not accessible to the rollers, thoroughly compact the mixture with mechanical tampers as directed by the Engineer. On depressed areas, use a trench roller or a small vibratory roller with the approval by the Engineer. Cleated compression strips also may be used under the roller to transmit compression to the depressed area.

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

When using vibratory compaction, assume full responsibility for the cost of repairing all damages which may occur to the highway components and adjacent property including buried utility and service facilities.
Use either of the two compaction options listed below except that the shim course must be compacted with a minimum of three passes of a pneumatic rubber tired roller unless otherwise approved by the Engineer for variance. Option B - Vibratory Compaction is not permitted when compacting HMA concrete courses on structural bridge decks, or other structures with less than 0.60 meters of cover.

**A. Option A. Three Roller Compaction Train.** Under this option, initially roll all HMA mixtures with an approved steel-wheel roller operating in a static mode. Overlap the previous roller pass by one-half the width of the roller.

Immediately following the initial rolling, roll the mat with an approved pneumatic rubber-tired roller. A minimum of 3 passes of the rubber-tired roller will be required. One pass is defined as one movement of the roller over any point of the pavement in either direction.

Immediately following the intermediate rolling, finish roll the mat with a steel-wheel roller to remove all shallow ruts, ridges, roller marks, and other irregularities from the surface.

Use this option only when the compacted thickness of the finished mat is 100 mm or less. Unless approved by the Engineer, the roller speeds shall not exceed 5 kilometers per hour. When paving multiple lanes simultaneously, increase the required number of rollers proportionately for each additional full lane width unless otherwise permitted by the Engineer.

**B. Option B - Vibratory Compaction.** Under this option, use vibratory rollers appearing on the current Approved List - HMA Concrete Vibratory Compaction Equipment. For each project where a vibratory roller is used, furnish a vibrating reed tachometer for the exclusive use of the Engineer. The vibrating reed tachometer must have a frequency range of 17 Hz to 67 Hz with a minimum reed interval of 1 Hz between 17 Hz and 33 Hz and a minimum reed interval of 2 Hz between 33 Hz and 67 Hz.

Operate vibratory rollers at a uniform speed not exceeding 4 kilometers per hour (67 meters per minute) on all pavement courses. Complete all turning of the compaction equipment on material which has had a minimum of one roller pass.

The required number of passes listed in Table 403-2, Number of Passes, is recommended and may be increased or decreased if, in the opinion of the Engineer, adequate density can be achieved. Complete all breakdown roller passes before the mat temperature falls below 120° C. One vibratory pass is defined as one movement of one drum of the roller over any point of the pavement in either direction. One static pass is defined as one movement of the roller over any point of the pavement in either direction. Remove all ruts, ridges, roller marks or other irregularities from the surface using static rolling. The Engineer may alter the compaction procedures for small areas where the specified procedures are not practical.

If the Engineer determines that unsatisfactory compaction is being obtained or damage to highway components and/or adjacent property is occurring using vibratory compaction equipment, then immediately cease using this equipment and proceed with the work in accordance with the conventional compaction procedures stipulated under Option A at no additional cost.

<table>
<thead>
<tr>
<th>TABLE 403-2 NUMBER OF PASSES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pavement Courses</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Base (Open Graded Each Lift)</td>
</tr>
<tr>
<td>Base (Dense-Graded)</td>
</tr>
<tr>
<td>Binder (Dense-Graded)</td>
</tr>
<tr>
<td>Top (Dense-Graded All Types)</td>
</tr>
</tbody>
</table>

When the compaction procedure being used fails to produce results acceptable to the Engineer, adjust the procedure to obtain the desired results. Rollers will move at a slow and uniform speed. The roller drive roll or wheel will be nearest the paver.

**403-4 METHOD OF MEASUREMENT.** The Engineer shall measure the quantity of the HMA placed and compacted in the accepted work. The quantity shall be measured in metric tons to the nearest 0.01 and determined from the delivery ticket.
Each delivery vehicle supplying HMA mixture shall be accompanied with a delivery ticket indicating the total quantity in metric tons being delivered. The quantity on the delivery ticket shall be determined from the automated proportioning system or the delivery vehicle weigh system. The delivery ticket shall contain the following minimum information:

- Ticket Number
- Plant Identification
- Contract Number
- Material Description, (including the PG-Binder Grade)
- Quantity of Material in Vehicle
- Date and Time

Make one legible copy of the delivery ticket available to the project inspector prior to the placement of the mixture.

403-5 BASIS OF PAYMENT. The unit bid price per ton for all pavement courses shall include the cost of all material, labor and equipment necessary to complete the work, including any cleaning pursuant to §403-3.02; cleaning of foreign material from the pavement as a result of construction operations; all necessary repairs to highway components and/or adjacent property caused by construction operations; any necessary work to correct surface tolerances per §402-3.10; and the scheduling and sequencing of work to conform with weather and seasonal limitations, and all temporary materials and work and/or repairs associated with paving operations outside the specified weather and seasonal requirements. Cleaning, sealing, and filling the cracks will be paid under Section 633. Tack coat will be paid under Section 407, Tack Coat.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>403.118902</td>
<td>Hot Mix Asphalt, Type 1 Base Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.128902</td>
<td>Hot Mix Asphalt, Type 2 Base Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.138902</td>
<td>Hot Mix Asphalt, Type 3 Binder Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.158902</td>
<td>Hot Mix Asphalt, Type 5 Shim Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.178202</td>
<td>Hot Mix Asphalt, Type 6 F2 Top Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.178302</td>
<td>Hot Mix Asphalt, Type 6 F3 Top Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.178902</td>
<td>Hot Mix Asphalt Type 6 Top Course</td>
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</tr>
<tr>
<td>403.198202</td>
<td>Hot Mix Asphalt, Type 7 F2 Top Course</td>
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<td>Hot Mix Asphalt, Type 7 F3 Top Course</td>
<td>Metric Ton</td>
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<tr>
<td>403.198902</td>
<td>Hot Mix Asphalt Type 7 Top Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.218902</td>
<td>Hot Mix Asphalt, True and Leveling Course</td>
<td>Metric Ton</td>
</tr>
</tbody>
</table>

SECTION 404 (VACANT)

SECTION 405 - COLD MIX BITUMINOUS PAVEMENT (OPEN GRADED)

405-1 DESCRIPTION. This work shall consist of constructing one or more courses of cold mix bituminous pavement on a prepared base in accordance with these specifications and in substantial conformance with the lines, grades, thicknesses, and typical cross-sections shown on the plans or established by the Engineer.

405-2 MATERIALS

405-2.01 Bituminous Material. The bituminous materials required for mixing and for sealing shall meet the requirements of section 702, Bituminous Materials. The type and grade of bituminous material shall be that indicated on the plans or in the proposal.

405-2.02 Aggregates. The aggregates shall be Department approved aggregates meeting the requirements of § 703-02, Coarse Aggregates, for the sizes specified. Screened gravel shall not be permitted unless specified on the plans or in the proposal.
405-2.03 Composition of Mixtures. The bituminous cold mix shall be composed of a mixture of aggregate and bituminous material as ordered and approved by the Engineer. The mix shall be proportioned as specified in Table 405-1, Composition of Cold Bituminous Mixtures.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Mixes</th>
<th>Type 1 General Limits % passing¹</th>
<th>Type 2 General Limits % passing¹</th>
<th>Type 3 General Limits % passing¹</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Limits % passing¹</td>
<td>Limits % passing¹</td>
<td>Limits % passing¹</td>
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<tr>
<td>50 mm</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>37.5 mm</td>
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<td>100</td>
<td>75-100</td>
<td>50-80</td>
</tr>
<tr>
<td>25 mm</td>
<td>100</td>
<td>90-100</td>
<td>50-80</td>
<td></td>
</tr>
<tr>
<td>12.5 mm</td>
<td>90-100</td>
<td>15-45</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>6.3 mm</td>
<td>15-45</td>
<td>0-10</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3.2 mm</td>
<td>0-10</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>75 µm</td>
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<td>0-1.0</td>
<td>0-1.0</td>
<td>3.5-5.5</td>
</tr>
<tr>
<td>Bituminous Material²,³</td>
<td>4.7-7.0</td>
<td>4.0-6.0</td>
<td>Open, Coarse Texture</td>
<td>Open, Coarse Texture</td>
</tr>
<tr>
<td>Description</td>
<td>Surface Course</td>
<td>Intermediate</td>
<td>Open, Coarse Texture</td>
<td>Base Course</td>
</tr>
<tr>
<td>Typical Uses</td>
<td>Open, Coarse Texture</td>
<td>Open, Coarse Texture</td>
<td>Open, Coarse Texture</td>
<td>Open, Coarse Texture</td>
</tr>
</tbody>
</table>

1 Percentage based on total aggregate weight.
2 Total Emulsion Percentage based on total mix weight.
3 When crushed air-cooled blast furnace slag aggregate is selected, the above bituminous material content shall be increased approximately 25%.

405-3 CONSTRUCTION REQUIREMENTS

405-3.01 Weather Limitations. Bituminous material or mixture shall not be applied on any soft surfaces, when the surface is wet, when the temperature of the surface on which the mixture is to be placed is below 7°C, or when other weather conditions would prevent proper construction of the pavement.

405-3.02 Equipment. The following equipment shall be required:

- Either central pugmill mixer and bituminous paver or Travel plant mixer
- Bituminous material distributor
- Steel wheeled roller, 7-11 Metric Ton or Approved vibratory roller
- Chip spreader
- Power broom
- Motor grader, if required
- Miscellaneous equipment to perform the work

All equipment and the condition of the equipment for this work shall be subject to approval of the Engineer at all times.

Mixing shall be done with a rotating twin paddle shaft pugmill providing suitable pressure-kneading action in mixing. Mixing by blading, shoveling and/or scooping will not be permitted.

The materials shall be mixed either by the travel mix plant method or in a central pugmill mixer.

The mixer shall be either a continuous traveling type, central continuous or batch type pugmill designed to accurately proportion either by volume or by weight, so that when the aggregate and bituminous materials are incorporated in the mix, a thorough and uniform coating will result. The mixer shall be equipped to mechanically or electrically interlock the bituminous feed with the aggregate feed such that uniformity of the mixture is assured at all times. The pugmill mixer, either traveling or central type, shall be provided with weighing, volumetric or other gauging equipment which shall be capable of providing accurate control at all times of the amount of aggregate entering the mixer per time interval.

On the central continuous type pugmill a mechanically operated discharge hopper of at least 0.76 cubic
meters capacity shall be provided. The mixer shall be equipped with a positive displacement metering system capable of totalizing the quantity of bituminous material applied to the mixing chamber.

405-3.03 Preparation of the Base. The roadway surface to be covered shall be free from holes, depressions, bumps, waves and corrugations. Any unsuitable surface areas shall be repaired by replacement of the unstable materials or by patching with a material to produce a tight surface having the same elevation as the surrounding surface. The roadway surface shall be broomed when ordered by the Engineer to remove loose material.

405-3.04 Mixing and Spreading. The aggregate and asphalt shall be thoroughly mixed so that the bituminous material is uniformly distributed throughout and all aggregate particles are uniformly coated.

The mixture shall be deposited on the prepared base either in a windrow at the back of the travel mixer or mechanically spread in a uniform layer so as to produce the specified thickness after compaction. If deposited in a windrow, it shall be spread over the entire roadway surface by motor grader or other approved spreader to produce the specified thickness after compaction. The maximum allowable compacted thickness shall be 50 mm for the Type 1 mix (Table 405-1) and 100 mm for the Type 2 and Type 3 mixes (Table 405-1).

405-3.05 Compaction. After spreading, the mixture shall be thoroughly and uniformly compacted with a self-propelled steel-wheeled roller or an approved vibratory roller to obtain a thoroughly compacted pavement. The number of roller passes to achieve the desired compaction shall be approved by the Engineer.

405-3.06 Surface Testing. The finished surface of the pavement shall be tested with a 5 meter straight edge laid parallel with the center line of the pavement. Any area exceeding a 6 mm variation from the surrounding area shall be satisfactorily corrected or removed and replaced.

405-3.07 Pavement Sealing. Either prior to initial compaction or immediately after compacting the mix, No. 1A size key stone meeting the requirements of § 703-02, Coarse Aggregates, shall be uniformly spread upon the surface at the rate of 5-8 kg/m² and the course rolled. No. 1 size key stone meeting the requirements of § 703-02, Coarse Aggregates, at the rate of 5-10 kg/m², may be used for key stone on the base course mixes. After placement of the No. 1A size key stone, the pavement shall be opened to traffic for a minimum of 3 days before placing the seal coat.

Prior to the application of the seal coat, the pavement surface shall be thoroughly swept and cleaned of all excess material. The seal coat shall be bituminous material asphalt emulsion meeting the requirements of § 702-3101 or § 702-4101 applied at the rate of 1.4 to 2.3 L/m² (Type 1 mix, Table 405-1) or 2.3 to 2.9 L/m² (Type 2 mix, Table 405-1). This shall be immediately followed by an application of No. 1A cover aggregate at the rate of 8-10 kg/m² which shall then be rolled. In the case where multiple lifts of Cold Mix Bituminous Pavements are used, only the surface of the top course shall require a seal coat. In multiple lift construction, each lift requires an application of key stone to fill voids in the mat.

405-4 METHOD OF MEASUREMENT. The bituminous cold mix pavement shall be measured by the number of metric tons compacted aggregate, including key and cover stone, placed in accordance with the specifications.

The liquid bituminous material shall be measured by the liter.

405-5 BASIS OF PAYMENT. The unit price bid per metric ton shall include the preparation of base, the cost of furnishing all the aggregate, the mixing, placing, compaction and all labor and equipment necessary to complete the work. The bituminous material will be paid for under its appropriate item.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>405.01</td>
<td>Cold Mix Bituminous Pavement (Open Graded)</td>
<td>Metric Ton</td>
</tr>
</tbody>
</table>

SECTION 406 (VACANT)

SECTION 407 - TACK COAT
§407

407-1 DESCRIPTION. This work shall consist of preparing and treating an existing bituminous or portland cement concrete surface with bituminous tack coat in accordance with these specifications and in reasonably close conformity with the limits shown on the plans or established by the Engineer.

407-2 MATERIALS. The bituminous tack coat shall meet the requirements of the following designation:

Asphalt Emulsion for Tack Coat 702-90

The bituminous tack coat will be sampled and tested in accordance with the Department's written instruction.

407-3 CONSTRUCTION DETAILS

407-3.01 Equipment. The Contractor shall provide a distributor for applying tack coat.

The distributor shall be designed, equipped, maintained and operated so that the tack coat can be heated and applied uniformly on variable widths of surface up to 4.5 meters at readily determined and controlled rates from 0.14 to 9.10 L/m², with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.10 L/m². Distributor equipment shall include a tachometer, accurate metering device or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically.

The distributor may be equipped with an attached bristle broom designed such that it drags on the pavement behind the spray bars. If the broom is used, it shall be adjustable laterally and vertically so that the full width of the applied tack coat is broomed uniformly into the pavement surface.

Distributors shall be equipped with an approved bituminous material sampling valve. The valve shall be installed as described in Department written instructions. When samples are taken through such valves, they shall be considered representative of all material in the tank.

Smaller power spray units of hand spray equipment will be permitted only in areas where the Engineer determines the use of a distributor is impractical.

407-3.02 Application of Bituminous Material. The tack coat shall be uniformly applied by a pressure distributor to a prepared clean pavement. The tack coat shall be applied as approved by the Engineer to offer the least inconvenience to traffic and to permit the one-way traffic, where practical, to prevent pickup or tracking of the bituminous material.

The tack coat shall not be applied on a wet pavement surface or when the pavement surface temperature is below the temperature requirements outlined in Table 402-2 Temperature and Seasonal Requirements of Subsection 402-3.01 HMA Pavements, Weather and Seasonal Limitations. The temperature and areas to be treated shall be approved by the Engineer prior to application. The application rate shall be 0.14 to 0.32 L/m² as approved by the Engineer. Table 407-1 contains recommended application rates for tack coat on various surfaces:

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Application Rate (liters/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Hot Mix Asphalt</td>
<td>0.14 - 0.18</td>
</tr>
<tr>
<td>Milled Surfaces</td>
<td>0.21 - 0.25</td>
</tr>
<tr>
<td>Existing Hot Mix Asphalt</td>
<td>0.21 - 0.25</td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>0.17 - 0.30</td>
</tr>
<tr>
<td>Vertical Surfaces (curbs, concrete drainage structures and appurtenances)</td>
<td>0.27 - 0.32</td>
</tr>
</tbody>
</table>
407-4 METHOD OF MEASUREMENT. The quantity to be paid for will be the number of liters of asphalt emulsion for tack coat measured at 15°C incorporated into the work.

407-5 BASIS OF PAVEMENT. The unit price bid per liter for tack coat shall include the cost of furnishing materials and all equipment and labor necessary to complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>407.01</td>
<td>Tack Coat</td>
<td>Liter</td>
</tr>
</tbody>
</table>

SECTIONS 408 AND 409 (VACANT)

SECTION 410 - BITUMINOUS SURFACE TREATMENT - SINGLE COURSE

410-1 DESCRIPTION. The work shall consist of the construction of a single bituminous surface treatment for both pavements and shoulders in accordance with these specifications in substantial conformance with the limits shown on the plans or established by the Engineer.

410-2 MATERIALS

410-2.01 Bituminous Materials. All the provisions of Section 618 shall apply with the following additions:

A. Bituminous Material Approval. The bituminous material shall be obtained from a storage facility that has been approved by the Director, Materials Bureau within the current calendar year, before the start of work.

B. Bituminous Material Selection. The selected bituminous material shall be compatible with the aggregate to be used. It's the contractors responsibility to ensure compatibility between the bituminous material and aggregate. The selection of bituminous material shall also be subject to the approval of the Engineer. Under the work the Contractor shall select, furnish and apply one of the following bituminous materials to a prepared surface.

1. Bituminous Surface Treatment - Pavement

<table>
<thead>
<tr>
<th>Materials Designation</th>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>702-3101</td>
<td>RS-2</td>
<td>Rapid Setting Asphalt Emulsion</td>
</tr>
<tr>
<td>702-3102</td>
<td>HFRS-2</td>
<td>High Float Rapid Setting Asphalt Emulsion</td>
</tr>
<tr>
<td>702-4101</td>
<td>CRS-2</td>
<td>Cationic Rapid Setting Asphalt Emulsion</td>
</tr>
</tbody>
</table>

When the two-way AADT is greater than 500, the selected bituminous material shall be polymer modified to increase the desired aggregate retention. When the two-way AADT is less than 500, the Contractor may or may not choose to blend the emulsion with a polymer modifier.

2. Bituminous Surface Treatment - Shoulders

<table>
<thead>
<tr>
<th>Materials Designation</th>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>702-3101</td>
<td>RS-2</td>
<td>Rapid Setting Asphalt Emulsion</td>
</tr>
<tr>
<td>702-3102</td>
<td>HFRS-2</td>
<td>High Float Rapid Setting Asphalt Emulsion</td>
</tr>
<tr>
<td>702-3301</td>
<td>HFMS-2</td>
<td>High Float Medium Setting Asphalt Emulsion</td>
</tr>
<tr>
<td>702-4101</td>
<td>CRS-2</td>
<td>Cationic Rapid Setting Asphalt Emulsion</td>
</tr>
</tbody>
</table>

410-2.02 Aggregates. The aggregates for bituminous surface treatments shall conform to the requirements of Subsection 703-02, “Coarse Aggregate” and be from an approved source. Where
aggregates for pavement surface treatment are from more than one source or of more than one type of material, they shall be proportioned and blended to provide a uniform mixture. The procedure used for proportioning shall be approved by the Regional Director or the authorized representative.

**A. Bituminous Surface Treatment - Pavement.** The aggregate size shall be No. 1ST and meet one of the following:

1. Limestone having an acid insoluble content of not less than 20%, excluding particles of chert and similar siliceous rocks. Blends of siliceous and non-siliceous and non-siliceous limestone will not be permitted.
2. Dolomite
3. Sandstone, granite, chert, trap rock, ore tailings or other similar non-carbonate materials.
4. Gravel, or a natural or manufactured blend of two or more of the following types of material; limestone, dolomite, gravel, sandstone, granite, chert, trap rock, ore tailings, slag or other similar materials meeting the following requirements:
   - Non-carbonate plus 3.2 mm particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities).
   - A minimum of 20.0% of plus 4.75 mm particles must be non-carbonate.

**B. Bituminous Surface Treatment - Shoulders.** The required aggregate size shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Screen Sizes</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5 mm</td>
<td>100</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>85-100</td>
</tr>
<tr>
<td>3.2 mm</td>
<td>0-15</td>
</tr>
</tbody>
</table>

**410-2.03 Polymer Modifier.** The minimum amount and type of polymer modifier shall be based on the bitumen content and shall be determined by the laboratory performing the mix design. The minimum polymer modifier content shall be 3% polymer solids, based on bitumen weight. The polymer materials shall be milled or blended into the asphalt or blended into the emulsifier solution prior to the emulsification process.

**410-3 CONSTRUCTION DETAILS**

**410-3.01 Bituminous Surface Treatment - Pavements**

**A. Weather and Seasonal Limitations.** Bituminous material shall not be applied to a pavement surface when the:

1. Surface is wet
2. Ambient temperature is less than 10°C in the shade
3. Ambient temperature is greater than 35°C
4. Weather conditions would prevent proper construction of the surface treatment

The surface on which the bituminous material is applied shall have a temperature of 20°C or higher.

Surface treatments shall be placed during the period of May 1st up to the last Saturday in August (inclusive).

**B. Equipment.** The following equipment shall be required:

1. **Self-propelled Rotary Power Broom.** A self-propelled rotary power broom shall so be designed, equipped, maintained and operated so that the pavement surface can be swept clean. The broom shall have an adjustment to control the downward pressure. The power broom shall meet the approval of the Engineer.
2. Bituminous Material Distributor. The liquid bituminous material distributor shall have been calibrated within the previous 12 months for transverse and longitudinal application rates according to ASTM D2995, Practice for Determining Application Rate of Bituminous Distributors. The bituminous material distributor shall be equipped, maintained, and operated so that the bituminous material can be applied at controlled temperature rates from 0.16 to 6.36 L/m². The distributor shall be capable of applying bituminous material on variable widths up to 4.6 meters. The distributor shall uniformly apply the bituminous material to the specified rate with a maximum allowed variation of 0.064 L/m². Distributor equipment shall include tachometer, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a separate power unit for the pump, and full circulation spray bars adjustable laterally and vertically.

The distributor and/or transport shall be equipped with a sampling valve so designed and installed as to be non-clogging and safe. The type of valve and its general location shall be according to Department written instructions. When samples are taken through such valves in accordance with Department instructions, they shall be considered representative of all material in the tank.

3. Self-propelled aggregate spreader. The aggregate spreader shall be a self-propelled unit capable of uniformly spreading the aggregate at the required rate on a minimum width of 150 mm wider than the width of the lane to be treated. The spreader shall meet the approval of the Engineer and be calibrated similar to the test method used in ASTM D2995, within the previous 12 months, for transverse and longitudinal application using a portable scale and several sheets of canvas, 0.3 m x 1 m in size.

4. Pneumatic tire roller A minimum of two pneumatic tire rollers will be required for each project. The Engineer will require a sufficient number of pneumatic tire rollers to permit initial rolling of the aggregate to occur within 5 minutes of the application of the bituminous material and the final of the three coverages to be completed within 30 minutes of the application of the bituminous material. The pneumatic tire rollers shall be self-propelled and have oscillating wheels with smooth tread tires and will have a minimum ballasted weight of 9 metric tons. The tire pressure for all wheels shall be uniform within ±0.035 MPa. The rollers shall be operated at a maximum speed of 8 kilometers per hour. To prevent pick-up of the aggregate to the tires, the tires shall be kept properly moistened with water mixed with small quantities of detergent or other material approved by the Engineer. In no case shall a solvent having affect upon the surface treatment be used.

C. Determination of the Quantities of Materials to be Applied. The Contractor shall place a minimum of three test patches at locations determined by the Engineer. The site or sites selected to apply the test patches should be representative of the various road surfaces on which the surface treatment is to be applied. The detailed instructions for test patch installations are as follows:

1. Test Patch Section. The test patch section shall consist of a minimum of three test patches at varying application rates. Recommended variation of 2.3 L/m² both sides of the selected target as suggested in 2.a. (below). Each test patch shall be a minimum of 1 x 3 meters or big enough to cover sufficient lane width so traffic will drive over it.

2. Suggested Application for Emulsion and Aggregates

   a. Emulsion
      
      i. High Volume Traffic, Tight Surfaces. Emulsion application shall be 1.6 liters/meter²

      ii. Low Volume, Porous Surfaces. Emulsion application shall be 2.0 liters/meter²
b. Aggregate - 1ST(11-13 kg/m2). The actual amount of aggregate should be determined by weighing the amount of aggregate required to completely cover a one square meter area one aggregate layer thick.

3. Determination of Application Quantities

a. Emulsion Quantity. Kilograms of Emulsion Per Patch = Application Rate (L/m²) X Size of Test Patch (square meters) X Unit Weight of Emulsion (1.0 kilogram per liter).

b. Aggregate Quantity. Kilograms of Aggregate Per Patch = Application Rate (kg/m²) X Size of Patch (square meters).

4. Layout Procedure

a. Clean patch area.
b. Mark out patch with chalk and straight edge.
c. In a pre-tarred container weigh out determined amount of aggregate for patch.
d. In a pre-tarred container, weigh out determined amount of emulsion for patch. The emulsion should be at the application temperature and work should proceed rapidly to maintain temperature.
e. Immediately pour the emulsion on the marked patch area, spread with a squeegee until emulsion is evenly spread at uniform thickness throughout the patch area. Squeegeeing should be kept to a minimum to minimize breaking of the emulsion. This whole operation should be done quickly to insure the emulsion doesn't set before cover aggregate is applied.
f. Spread preweighed cover aggregate, by hand, over patch area.
g. With pneumatic tire roller, roll the patch area a minimum of three complete passes.

5. Evaluation of Test Patches. After a minimum of 14 days of traffic over the test patches, the Engineer will evaluate the test patches for aggregate retention, flushing or bleeding, aggregate embedment and bonding to the existing pavement.

The selected patch should retain a minimum of 95% of the cover aggregate, show no signs of flushing or bleeding, have 70% embedment of aggregate into the emulsion residue and be securely bonded to the existing pavement.

D. Preparation of Surface. A self-propelled power broom shall be used to clear any loose material from the pavement surface immediately prior to the application of bituminous material. Potholes shall be patched with an appropriate asphalt concrete truing and leveling course approved by the Engineer. These patched areas shall be fog sealed with the same bituminous material selected for the project at a rate of 1.40 liters/square meter.

Manhole covers, drop inlets, catch basins, curb any other structure within the roadway area shall be protected against the application of surface treatment material.

E. Application of Bituminous Material. Bituminous material shall be applied by means of a pressure distributor in a uniform, continuous spread over the section to be treated and within the temperature range specified. The quantity of bituminous material to be used shall be that established by the test patch unless modified by the Engineer. The allowable variation from this quantity shall not exceed 0.10 L/m². A strip of building paper, at least 1 meter in width and with a length equal to that of the spray bar of the distributor plus 300 millimeters, shall be used at the beginning of each spread. If the cut-off is not positive, the use of paper may be required at the end of each spread. The paper shall be removed and disposed of in a satisfactory manner. The distributor shall be moving forward at the proper application speed at the time the spray bar is opened. If any skipped areas or deficiencies occur, the operation shall be immediately stopped. Junctions of spreads shall be carefully made to assure a smooth riding surface and the deficient areas corrected in a manner approved by the Engineer.

The bituminous material shall not be applied more than 60 meters in advance of the self-propelled stone spreader.
Under no circumstances shall operations proceed in such a manner that bituminous material will be allowed to chill, set up, dry, or otherwise impair retention of the cover aggregate. Traffic will not be allowed to run on uncovered bituminous material.

The distributor, when not spreading, shall be parked so that the spray bar or mechanism will not drip bituminous material on the surface of the traveled way.

### F. Application of the Cover Aggregate.
Immediately following the application of bituminous material, cover aggregate shall be spread at the rate established for the test patch unless modified by the Engineer. The allowable variation from this rate shall not exceed two kg/m². All aggregate used for bituminous surface treatment shall be clean as determined by the Engineer at the time of placement.

Spreading shall be accomplished in such a manner that the tires of the aggregate spreader at no time contact the uncovered and newly applied bituminous material.

Immediately after the cover aggregate is spread, any deficient areas shall be covered by additional material. Pneumatic tire rolling shall begin immediately. The initial pass shall be completed within 5 minutes of the application of the bituminous material and shall be continued until three complete coverages are obtained within 30 minutes of the application of the bituminous material. Pneumatic tire rollers shall come to a complete stop prior to reversing direction.

Any free bituminous material on the surface caused by a deficient amount of cover aggregate shall be covered by broadcasting additional aggregate over the deficient area. Any excess aggregate material shall be swept from the surface in a manner acceptable to the Engineer.

### G. Opening to Traffic.
“Loose Stone” signs meeting requirements of NYSMUTCD shall be posted at 1.6 kilometer intervals throughout the length of the project. These signs shall be erected before surface treatment starts and removed after contract is accepted.

Unless otherwise specified, the highway shall be kept open to traffic at all times. Traffic shall be discontinued on the lane being surface treated; and as soon as the final layer is applied and rolled, controlled traffic may be permitted thereon. Traffic shall be maintained at a speed not to exceed 24 km/h for a period of four hours after placement of the surface treatment by the use of two-way radio equipped patrol vehicles in accordance with the maintenance and protection of traffic details shown on the plans. All patrol vehicles shall be equipped with signs meeting the requirements of Section 254.5 of the Manual of Uniform Traffic Control Devices. The required number of two-way radio-equipped patrol vehicles shall be as follows:

<table>
<thead>
<tr>
<th>Lane Kilometers Length of Surfacing for past 4 hours</th>
<th>Number of Patrol Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6</td>
<td>1</td>
</tr>
<tr>
<td>3.2</td>
<td>3</td>
</tr>
<tr>
<td>4.8 or more</td>
<td>4</td>
</tr>
</tbody>
</table>

Immediately after completion of surface treatment, the section shall be posted for speed limit of 48 km/h for a period of three days. The signs should be posted at 800 meter intervals and signs showing other speed limitations should be covered for this period. All construction signs shall meet the requirements of the NYSMUTCD.

### 410-3.02 Bituminous Surface Treatment - Shoulders.
The requirements of §410-3.01 shall apply except that the sections labeled “A. Weather and Seasonal Limitations,” “C. Determinations of the Quantities of Material to be Applied” and “G. Opening to Traffic” do not apply. The following modifications to A. Weather and Seasonal Limitations and C. Determination of the Quantities of Materials to be applied do apply in their place.

#### A. Weather and Seasonal Limitations.
Bituminous material shall not be applied on a wet surface, when the ambient temperature is less than 10°C and rising, or when weather conditions would prevent proper construction of the surface treatment. The surface on which the bituminous material is applied shall be placed only during the period of May 1st up to and including the last Saturday of September.
C. Determination of the Quantities of Materials to be Applied. The quantity of bituminous material to be used shall be in the range of 1.6-2.3 liters/square meter unless otherwise directed by the Engineer. The cover aggregate shall be spread in a single stone thickness in the range of 8 to 14 kilograms/square meter for the indicated aggregate unless otherwise directed by the Engineer. The actual quantity of bituminous material shall be such that a minimum of 70% of the aggregate particle is embedded in the bituminous material. The actual quantities used will be determined visually by the Engineer at the time of placement.

410-4 METHOD OF MEASUREMENT. Bituminous surface treatments for pavement and shoulders will be measured by the number of square meters of compacted material in place making no deductions for minor untreated areas such as catch basins and manholes.

The bituminous material will be measured by the number liters used.

410-5 BASIS OF PAYMENT

410-5.01 Bituminous Surface Treatment - Pavement and Shoulders. The unit price bid per square meter shall include the cost of all labor, materials, and equipment necessary to perform the work except:

- Bituminous material used for treatment will be paid under separate item.
- Patching material will be paid for under the item for Truing and Leveling.
- Construction signs will be paid for under appropriate items.

The cost of installing test patches and furnishing patrol vehicles when surface treating pavements shall be included in the unit bid price for the surface treatment.

410-5.02 Bituminous Material - Pavement and Shoulders. The unit price bid per liter shall include all the cost of labor, materials, and equipment necessary to perform the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>410.04</td>
<td>Bituminous Surface Treatment (Pavement)</td>
<td>Square Meter</td>
</tr>
<tr>
<td>410.05</td>
<td>Bituminous Surface Treatment (Shoulders)</td>
<td>Square Meter</td>
</tr>
<tr>
<td>410.07</td>
<td>Bituminous Material (Pavement and Shoulders)</td>
<td>Liter</td>
</tr>
</tbody>
</table>

SECTION 411 - STABILIZED GRAVEL SURFACE COURSE

411-1 DESCRIPTION. The work shall consist of placing a stabilized gravel surface course with additive, if specified, on a prepared base in accordance with these specifications and in conformance with the lines and grades shown on the plans or as directed by the Engineer.

411-2 MATERIALS

411-2.01 Gravel. The gravel shall conform to the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mm</td>
<td>100</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>30 - 65</td>
</tr>
<tr>
<td>75 µm</td>
<td>10 - 20</td>
</tr>
</tbody>
</table>

Particles passing the 425 µm sieve size shall have a maximum liquid limit of 30 and a plasticity index ranging from 3 to 8. The maximum loss in 4 cycles of the Magnesium Sulfate Soundness Test shall be 30. If the gravel as obtained from the bank is deficient in any of the requirements specified, such deficiency shall be corrected by screening, processing and/or blending with other acceptable materials before stockpiling. The requirements of §304-2.03, Stockpiling shall apply to all gravel furnished for this work.
411-2.02 Chemical Additives. Chemical additives, if required, shall meet the applicable requirements of the following subsections:

Calcium Chloride 712-02
Sodium Chloride 712-03

411-3 CONSTRUCTION DETAILS

411-3.01 Placement. After the base has been brought to grade and cross section, as shown on the plans, thoroughly compacted, and approved by the Engineer, the Contractor shall place the stabilized gravel surface course.

When calcium or sodium chloride additives are specified, they shall be added by an approved mechanical distributor after the gravel has been spread and prior to the addition of water. Calcium chloride shall be added in the amount of 10 grams per square meter per millimeter of compacted thickness of the course. Sodium chloride shall be added at a rate of 40 grams per square meter per millimeter of compacted thickness of the course which is equivalent to approximately 2% of sodium chloride based on dry weight of aggregate. Water shall then be added to the material in amounts as directed by the Engineer.

If the Contractor so elects, only the calcium chloride may be added to the gravel material as a water solution. In such cases the Contractor shall submit to the Engineer a detailed description in writing of the proposed procedure of operations. Construction shall not be started until the Engineer’s approval is obtained in writing.

411-3.02 Mixing

A. Gravel Without Additive. Water shall be thoroughly dispersed by any appropriate methods which will insure a uniform consistency and moisture content within the limits for proper compaction.

B. Gravel With Additive. The water and the chemical additive shall be thoroughly and uniformly incorporated with the gravel for the full depth of the course, by mixing with an approved power-driven rotary type mixing machine. Mixing shall continue until the material is of uniform composition. The Contractor may elect to mix the materials in an approved plant of the pugmill type. Mixing by blading, shoveling and/or scooping will not be permitted.

411-3.03 Compaction. When the in-place material is of uniform consistency and has a moisture content within the limits for proper compaction, as determined by the Engineer, it shall be thoroughly compacted by the use of self-propelled pneumatic tired or vibratory compactor in accordance with the requirements of §203-3.12. During the compaction operation, light grading shall be done as required to maintain the surface of the course true to grade and cross-section. In confined areas, inaccessible to rollers, mechanical rammers shall be used to obtain the compaction required in §203-3.12. The finished surface of the stabilized gravel course shall be rolled in a float of free water with a smooth steel wheeled roller weighing not less than nine metric tons. In all cases, the material must be so thoroughly compacted that it will not displace under the roller.

This course shall not be placed in excess of 150 linear meters without being shaped, compacted and finish rolled.

When posts for guide railing are to be installed adjacent to a stabilized gravel surface course, extreme care shall be taken during installation of the posts so that the stabilized gravel surface course is not disturbed.

411-3.04 Surface Preparation for Treatment

A. Calcium Chloride Stabilized Gravel Surface Course. After the calcium chloride stabilized gravel surface course has been completed, water shall be applied to the surface in amounts as directed by the Engineer. Immediately following the application of water, calcium chloride shall be applied on the surface with an approved mechanical spreader at the rate of one-quarter kilogram per square meter.
B. Sodium Chloride Stabilized Gravel Surface Course. After the sodium chloride stabilized gravel surface course has been brought to final grade and cross section and rolling has been completed, the course shall be permitted to cure for a minimum of 10 days at a minimum temperature of 15°C before any additional pavement courses are applied. The cured completed surface course shall be broomed to remove dust, before application of the overlying course.


411-4 METHOD OF MEASUREMENT. The quantity for payment, in cubic meters of material, shall be computed within the payment lines shown on the plans or otherwise ordered in writing by the Engineer, and in accordance with the plans and specifications.

411-5 BASIS OF PAYMENT. The unit bid price per cubic meter shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except that the water, the calcium chloride, and the sodium chloride shall be paid for under their appropriate items. No direct payment will be made for any losses of material which may result from shrinkage, compaction, foundation settlement, waste, overflow, erosion, leakage, or any other causes; the cost of such losses shall be included in the price bid for this work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>411.01</td>
<td>Stabilized Gravel Surface Course</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>411.02</td>
<td>Calcium Chloride Stabilized Gravel Surface Course</td>
<td>Cubic Meter</td>
</tr>
<tr>
<td>411.03</td>
<td>Sodium Chloride Stabilized Gravel Surface Course</td>
<td>Cubic Meter</td>
</tr>
</tbody>
</table>

SECTIONS 412 THRU 489 (VACANT)

SECTION 490 - COLD MILLING

490-1 DESCRIPTION. This work shall consist of the milling, shaping and removal of portions of existing surfaces by a cold milling process, and subsequent cleaning, utilizing equipment and procedures meeting the requirements in this specification.

The work shall consist of Miscellaneous Cold Milling or Production Cold Milling of bituminous or portland cement concrete as indicated in the contract documents and as shown on the plans.

490-2 MATERIALS

490-2.01 Equipment. Milling machines shall be power operated, self-propelled machines capable of removing the desired thickness of existing surfaces. The machines shall have sufficient power, traction and stability to accurately maintain depth of cut and slope. They shall be capable of producing a finished profile and cross slope to within 6 mm of that required and shall produce a uniform surface texture free from gouges and ridges greater than 10 mm in depth.

The machines shall be equipped with a means to control dust and other particulate matter created by the cutting action.

The machines shall have an integral loading system or sufficient equipment shall be provided to accomplish complete removal of milled material at a rate equivalent to the milling rate.

Vacuum trucks, street sweepers or power brooms shall be used to clean the milled surfaces. The Engineer may disallow the use of power brooms in urban, residential or other sensitive areas if the dust raised by the broom is deemed by the Engineer to be objectionable.

490-2.02 Disposal of Material. Material removed during the milling process, including foreign debris within or on the pavement, shall become the property of the Contractor and shall be disposed of at a site obtained by the Contractor.

490-3 CONSTRUCTION DETAILS
§490

490-3.01 General. Milling shall be performed at the locations and in accordance with the details indicated on the plans.

When indicated on the plans, profile and cross slope shall be controlled by a taut reference string line. The reference elevation and string line shall be established by the Contractor and subject to the approval of the Engineer.

Areas not accessible to the milling machine, such as around and/or adjacent to inlets, manholes, curbs and transverse joints on structures, may be removed by a small milling machine, handwork or other methods approved by the Engineer.

All milled material, including that removed by other means, shall be immediately removed from the milled surfaces and adjacent surfaces. Surfaces shall be cleaned of all fines and dust prior to opening to traffic. The Contractor shall conduct operations in such a manner that dust is controlled and is not objectionable. Milled and adjacent surfaces shall be cleaned again, as directed by the Engineer, prior to the placement of tack coats, or pavement courses if traffic has been allowed on the milled surface and/or if more than 48 hours have elapsed since the initial cleaning.

The Contractor shall maintain drainage at catch basins, according to the details shown on the plans, or in a manner approved by the Engineer.

When working adjacent to traffic, the Contractor shall immediately remove material that is spilled on the traveled way.

Milled surfaces to be overlaid with asphalt concrete shall be covered with at least a single course of asphalt concrete before the end of the paving season. Portland cement concrete overlays shall be completed over milled surfaces before the end of the paving season. Damage to milled surfaces resulting from traffic or other causes such as, but not limited to, raveling, fuel spillage or any contaminants which would inhibit bond, shall be repaired or remilled by the Contractor in a manner approved by the Engineer.

490-3.02 Production Cold Milling. Production cold milling of bituminous or portland cement surfaces shall be performed in accordance with the details and at the locations indicated on the plans.

490-3.03 Miscellaneous Cold Milling. Miscellaneous cold milling of bituminous or portland cement surfaces shall be performed in accordance with the details and at the locations indicated on the plans.

490-3.04 Production Cold-Mill Surface Planing. Production cold-mill surface planing of bituminous concrete surfaces shall be performed in accordance with the details and at the locations indicated on the plans. When specified, the milling machine shall control the profile and cross slope with a moving reference at least 9 meters in length. The moving reference may be a floating beam, ski, or other suitable type such that the resulting milled surface is sufficiently even.

In areas accessible to the milling machine, construct a milled surface to a maximum 12 mm tolerance. If the pavement surface is not being constructed or has not been constructed to this tolerance based upon visual observation or upon riding quality, 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 12 mm will be satisfactorily corrected at no additional cost to the State.

490-4 METHOD OF MEASUREMENT. The quantity shall be measured as the number of square meters of pavement surface milled in accordance with the plans and this specification.

In no case will a deduction in area be made for minor unmilled areas due to catch basins, manholes, transverse joints, or minor low areas in pavements from the measured surface area that has been milled. Minor unmilled or low areas are those areas of 10 square meters or less.

490-5 BASIS OF PAYMENT. The unit price bid per square meter shall include the cost of furnishing all labor and equipment necessary to complete the milling, including the removal of pavement by other means, the removal and disposal of milled material, the removal and hauling of milled material to a designated storage area when indicated in the contract documents and cleaning the resultant surface after milling. No payment will be made for additional cleaning that may be necessary just prior to placement of any overlaying pavement courses or tack coats. The cost of maintaining drainage shall be included in the price bid for maintenance and protection of traffic. The cost of providing temporary pavement wedges
of asphalt concrete around drainage structures, manholes, valve boxes, bridge abutments and beginning and ends of milled pavement shall be paid for as outlined in §619-5.12 of the Standard Specifications.

Tack coats and overlay courses shall be paid for under their respective items.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<tbody>
<tr>
<td>490.10</td>
<td>Production Cold Milling of Bituminous Concrete</td>
<td>Square Meter</td>
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<td>490.15</td>
<td>Production Cold-Mill Surface Planing of Bituminous Concrete</td>
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<td>490.20</td>
<td>Production Cold Milling of Portland Cement Concrete</td>
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<td>490.30</td>
<td>Miscellaneous Cold Milling of Bituminous Concrete</td>
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<td>490.40</td>
<td>Miscellaneous Cold Milling of Portland Cement Concrete</td>
<td>Square Meter</td>
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SECTIONS 491 THRU 499 (VACANT)