Section 13:

Hot Mix Asphalt, HMA, Pavement

SECTION 13 – HOT MIX ASPHALT, HMA, PAVEMENT

13.1 INTRODUCTION

The Department has SS for both QC/QA HMA (Section 401) and non-QC/QA HMA (Section 402) mixtures. The major differences between the two specifications are the acceptance and documentation requirements.

The Contractor is responsible for designing the asphalt mixtures in accordance with the SS. All DMFs are reviewed for compliance with the SS.

These instructions apply to both 401 and 402 HMA pavements unless specifically indicated otherwise.

13.2 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA)

The Contractor is responsible for QC of all phases of asphalt operations. The operational and quality control tolerances are defined in 401 and 402, as appropriate.

To ensure the Contractor's QC procedures provide a finished product that is within the defined tolerances, the Department follows QA procedures for 401 pay items. These procedures are designed to provide inspection of the Contractor's processes and random sampling of the material placed. The QA process is completed with the conclusion of testing of samples by DMT personnel.

The Contractor provides a Type D certification, in accordance with 916 of the SS, as the basis of acceptance for 402 pay items. No sampling of asphalt mixtures is required in conjunction with 402 HMA work.

13.3 QUALITY CONTROL PLAN (QCP)

The contract specific steps the Contractor intends to use for their paving operations are included in their QCP. The QCP must be prepared in accordance with ITM 803 and submitted by the Contractor in accordance with 401.02.

The PEMS must review the QCP and approve it if the plan addresses all appropriate ITM 803 checklist items in a clear and complete manner. The intent of the review is to verify that all checklist items are addressed and not to incorporate the reviewer's personal preferences into the QCP. If there are any questions regarding QCP contents, the AE and DMT personnel are available resources. The Contractor cannot begin paving operations until the QCP is approved, so review of the QCP must be a high priority. Reject the QCP if it does not address the checklist items. Return the rejected plan to the Contractor as soon as possible with a clear description of the deficient aspects. A primary review criterion for the QCP is whether the plan addresses all contract specific issues related to the paving operation. A generic "cut and paste" QCP is not appropriate for contracts on which specific problems are anticipated.

Once the QCP is approved, enforce it to the same extent as any other contract document. If the Contractor is performing work contrary to the QCP, attempt to resolve the discrepancy as soon

as possible. If the issue cannot be resolved with the Contractor, notify the AE. It is appropriate for the paving operation to be suspended for the Contractor's failure to follow the contents of its QCP. However, suspension of the paving operation should be handled in accordance with guidelines established within the District.

Once a QCP is approved, the Contractor can propose changes to the approved plan by submitting an addendum. The addendum must include a complete description of the proposed change, including any element of the approved plan that is modified or deleted. Review the addendum and approve it as quickly as possible. If the addendum is incomplete compared to the ITM 803 checklist, reject the addendum and note the deficiencies in the reply to the Contractor. The most recently approved version of the QCP remains in effect until an addendum is approved. Do not allow implementation of the proposed change until the addendum is approved. Once an addendum is approved, attach it to the original QCP. Approved addenda have the same standing as any element of the originally approved QCP.

If a situation which is not covered by the QCP arises, work with the Contractor to determine an appropriate solution within the SS to resolve the problem. If a mutual solution cannot be determined, contact the AE. The AE has resources at DMT, M&T, and CM available to resolve the issue. After a solution is reached, require the Contractor to document the agreement by submitting an addendum to the QCP. If the solution is documented correctly, approve the addendum and attach the approved addendum to the original QCP. If the addendum requires correction or additional clarification, reject the addendum and return it to the Contractor with a clear description of the deficiencies with the addendum.

13.4 QUALITY ASSURANCE PROCEDURES (SECTION 401)

QA procedures are performed by the Department to verify that the Contractor's work meets the requirements of the SS. QA procedures require plate samples of the mixture to be taken from the course after placement by the paver. The DMT "hub" acts as a central collection point for all HMA acceptance samples. The hub personnel pick up and/or receive all HMA samples in the District. The hub personnel check sample input information to ensure that Construction has entered all the correct information. If there is a discrepancy with the entered information, District hub personnel contact the appropriate Construction contract field staff to correct the discrepancy. The samples are then transported to District's M&T laboratory facilities for a battery of tests to determine the following volumetric properties:

- Binder Content
- Volume of Effective Binder, V_{be}
- Air Voids.

In addition, cores are taken to determine the in-place density of each compacted mixture.

M&T personnel will enter QA test results into Pay Wizard for mixture properties and density. All QA adjustments for QC/QA HMA mix properties and density are available and stored in the HMA Pay Wizard application. Automatic emails are sent to the PEMS from Pay Wizard to notify them

that the QA test results are available. Two exceptions include QA test results for stone matrix asphalt, SMA, samples and open graded, OG, samples, each of which are currently sent to the PEMS by DMT personnel.

A material Sample ID is used to identify a material sample taken from and submitted by the field. It is defined by a 12 digit number beginning with the capital letter "**R**".

Example of a Sample ID = **RYYDSSSS12345**
where:

R = Report (must always be a capital "R")

YY = Last 2 digits of the current year

D = District number (1 through 6), or Materials and Testing (7), or Toll Road (8)

SSSS = 4 digit submitter number for the individual submitting the sample

12345 = Unique sequential number for the sample. Generated by the PEMS for the particular contract.

Pavement smoothness is another topic which requires QA review. On contracts which include the pay item for Inertial Profiler, HMA, the Contractor is responsible to furnish, calibrate, and operate a high-speed inertial profiler, certified by the Department, for the measurement of longitudinal profile on the mainline traveled way and adjacent acceleration and deceleration lanes. For comprehensive information on Pavement Smoothness utilizing the IRI index and Inertial Profiler equipment refer to Section 11 of these Instructions.

On contracts that do not include the Inertial Profiler, HMA pay item, the 16 ft straightedge will be used to verify longitudinal profile of the constructed pavement. For these situations, smoothness is checked using a 16 ft straightedge supplied and operated by the Contractor.

Regardless of the instrument used to measure the longitudinal profile, a 10 ft straightedge is used to verify the slopes transverse to the mainline direction of traffic. This includes longitudinal profiles of all public road approaches, commercial driveways, and residential driveways.

13.5 MATERIALS

All asphalt mixtures must be supplied by a certified HMA plant in accordance with ITM 583.

There is a standardized format that provides information about the type of material required for 401 pay items.

The following is a sample QC/QA HMA mixture pay item:

QC/QA-HMA, 3, 58E-28, Surface, 9.5 mm
where:

The **"QC/QA-HMA**" portion of the pay item is read as "Quality Control, Quality Assurance, Hot Mix Asphalt".

The number **"3"** indicates the ESAL category for the mixture. The ESAL category reflects the truck traffic anticipated for the roadway. Higher ESAL category numbers indicate higher anticipated truck volumes. Higher ESAL category mixtures require more durable aggregates to carry the additional loads.

The number **"58"** indicates the PG binder high temperature grade that is required for the mixture. This number reflects the high pavement temperature, in Celsius degrees, at which the binder is expected to perform. In this case the high pavement temperature is expected to be 58˚C (136˚F).

The letter "**E**" designation after the binder identification indicates the traffic loading designation. Typical designations include:

- "**S**" for Standard grade which represents a neat binder with no grade bumps,
- "**H**" for Heavy grade indicating heavy or slow-moving traffic, and
- "**E**" for Extreme grade.

The number "**-28**" represents the low temperature value, in Celsius degrees, at which the binder is expected to perform. In this case, the low pavement temperature is expected to be -28˚C (-18˚F).

The word **"Surface"** indicates the mixture type. Base, intermediate, and surface courses are the mixture types typically utilized in pavement. Base courses are usually placed on treated subgrades, but occasionally they are used for structural (three or more lifts) overlays and are placed on a milled existing pavement. Intermediate courses are typically placed on underlying base courses or a milled pavement for functional (two lifts) overlays. Surface mixtures are usually placed on underlying intermediate courses or on a milled pavement surface in "mill and fill" applications.

The term **"9.5 mm"** identifies the nominal aggregate size utilized in the mixture. The available nominal aggregate sizes are 4.75 mm, 9.5 mm, 12.5 mm, 19.0 mm, and 25.0 mm. Mixtures with larger nominal aggregate size designations have larger particle sizes in their gradations. The maximum particle size in a mixture is larger than the size in the nominal aggregate designation. Refer to 401.05 of the SS for gradation range information.

HMA mixes for 402 pay items shall include transverse rumple strips, temporary pavements, and wedge and level courses. The mixture type specified for temporary pavements and wedge and level courses is required to be in accordance with 402 of the SS.

13.6 DESIGN MIX FORMULA (DMF)

The DMF is the process by which the Contractor conveys their design for each HMA mixture to DMT. ITM 583, Certified Hot Mix Asphalt Producer Program, is the primary document that includes requirements for the development of a DMF. DMT personnel are a resource to answer questions regarding DMFs.

The DMF includes the following information related to the mixture design:

- Producer (Contractor)
- Plant Location
- Material Identification/Sources-PG binder, coarse and fine aggregates
- DMF number
- Applicable ESAL Categories
- Mixture Course and Nominal Aggregate Designation
- Gradation Information
- Specific Gravity
- Lab and Plant Mixture Temperatures
- RAP/RAS Content
- Volumetric Properties
- Mixture Adjustment Factor, MAF
- Other Miscellaneous Design Information.

A DMF must be accepted by the DMTE and assigned to an appropriate CLN by the Contractor prior to paving. The Contractor cannot use an HMA mixture on a contract until a DMF has been assigned a mixture number by the DMTE. The mixture number will be assigned for each calendar year and is not intended to construe acceptance. DMF numbers are automatically generated by DMF Entry after review and approval by the districts, based on the year and plant. All DMFs for QC/QA HMA are available and stored in the DMF Entry application. This can be accessed through the INDOT Technical Application Pathway (ITAP).

At the preconstruction conference, the PEMS must ask the Contractor which DMF are planned to be utilized on the contract. Additional questions include which alternate plants are intended to be used on the contract and whether the required DMF has been obtained for mixtures produced at those plants. Establish lines of communication between the Contractor and the DMT representative at the meeting to reduce the likelihood of misunderstandings between the parties regarding material sources and material sampling requirements for 401 mixtures. Make arrangements with the DMT representative regarding transporting QA samples.

The PEMS must become familiar with each DMF number as well as the PG binder content, MAF, and pay item related information. Each mixture weigh ticket brought to the contract site must

include information in accordance with 109.01(b). The DMF number is included in that list of required information. Omission of any of the required information is sufficient cause for the load to be rejected. Discuss this at the Preconstruction Conference. When asphalt mixtures arrive at the site, it will be necessary to verify that the DMF number listed on the ticket is appropriate for the mixture associated with the current paving operation.

An explanation of how a DMF number is generated by DMF Entry is indicated below:

- A DMF is a 9-digit number. An example would be **R253323001**:
    - Beginning letter "R"
    - First 2 digits = Sample Year (e.g., 25 for 2025)
    - Next 4 digits = Plant number (e.g., 3323 = Milestone - Lafayette Plant)
    - Final 3 digits = Unique mix design number (e.g., 001).
- Approved DMFs are available through the DMF Entry application on ITAP.

13.7 MATERIAL SAMPLING AND TESTING (SECTION 401)

Material sampling for QC/QA HMA pay items is very important because the pay items include a QA Adjustment pay factor. The pay factor either provides the Contractor with additional compensation for situations where the QA test results exceed SS requirements or provides the Department a credit if the test results fall short of these requirements. Sampling must be performed in accordance with ITM 580.

The PEMS must verify that the Contractor is performing QC sampling and testing in accordance with the approved QCP. Because the Department is responsible for QA testing, the PEMS must determine the random QA sample locations, witness the material sampling performed by the Contractor's Certified Technician, and take immediate possession of the samples.

In promoting safety during QA sampling, the PEMS must provide the Contractor with an appropriate advance notice of the QA sample location. This advance notice enables the Contractor to coordinate necessary personnel, notify the paving train and haul trucks, and allow for the accurate and secure placement of sample plates on the roadway.

For base and intermediate mixtures, which typically require larger quantities due to their foundational nature, the PEMS should provide advance notice of an upcoming sample in approximately 200 tons, or about 10 trucks. This lead time helps to ensure that the Contractor can adequately prepare for the samples, minimize disruptions, and maintain safe working conditions.

On the other hand, surface mixes, which generally cover more area per ton, require less lead time. A notice of approximately 100 tons, or 5 trucks, should be provided for surface mixtures. This smaller lead tonnage notification should be adequate to ensure that plates are safely placed without interrupting the paving process unnecessarily.

District hub personnel pick up and/or receive all HMA samples in the District and then send them to M&T for testing as described earlier in this section. Lab personnel run the required tests on

the samples to verify conformance to 401 requirements. The mixture properties determined by the QA testing process include binder content, V_{be}, and air voids. In addition, after the paving operation has been completed, cores are taken to measure in-place density. The smoothness of the pavement surface may be measured by the inertial profiler to complete all the pay factors for the individual QC/QA HMA pay items.

After material samples are taken from the newly placed pavement course, verify that the plate sample locations are satisfactorily repaired by the Contractor.

After density cores are taken from the pavement, the PEMS must verify that Contractor personnel mark the course for which the density is to be determined on the core and check that all core holes are filled with asphalt material or rapid setting bridge deck repair material within one working day after the cores are taken.

It is important to properly document the plate sample boxes and cores. Be sure to include the sample ID number, which is the most important part.

After the sample has been obtained, the sample location will be recorded. If the sample is obtained by the Contractor for the Department's acceptance testing, the Contractor representative who obtained the sample and the Department representative who witnessed the sample being taken will be identified on the transmittal information. The following information shall be on all box ends for plate samples and core cylinder containers:

1. A/B sample (A1, A2, A3, B1, B2, Core 1, Core 2)
   where:
   A1 = sample used for MSG and binder content
   A2 = samples used for gyratory specimens
   A3 = samples to determine aggregate bulk specific gravity
   B1 = backup sample for MSG
   B2 = backup sample for gyratory specimens
   Core 1, Core 2 = Core samples for density or thickness.
2. Contract Number
3. DMF/JMF Number
4. Item (CLN) Number
5. Lot/Sublot
6. Material Description: Size, Course, ESAL Category, PG Grade
7. Sample Date
8. Sample ID Number.

The required sampling frequency is based on lots and sublots, in accordance with the SS. It is necessary to keep track of the quantity of each QC/QA mixture/DMF combination as it is being placed so the appropriate number of samples are obtained from the proper locations. Sample locations are determined randomly based on procedures within ITM 802.

It is necessary to track the quantity of each QC/QA mixture/DMF combination as it is being placed to determine the physical limits of each lot and sublot. The PEMS must develop their own system for tracking lots and sublots. Record the beginning and ending stations and lane designation for each lot and sublot in a Daily Work Report for the appropriate date. If the paving operation changes lanes prior to reaching the end of a lot and sublot, record the ending station and lane designation for the first lane and the beginning station and lane designation for the new lane in a Daily Work Report for the appropriate date.

Partial sublots with a quantity of 100 tons or less are considered to be part of the previous sublot and no additional sampling or testing is required. Partial sublots with quantities greater than 100 tons are considered to be a full sublot and all sampling and testing normally associated with a sublot is required. The PEMS should notify the DMTE when a partial sublot is utilized on a contract.

On contracts that require the placement of additional mixture the following year, terminate the sublot at the end of each construction season and notify the DMTE of the termination. In addition, if production of an individual QC/QA HMA mixture will be halted due to construction phasing or other similar reason, coordinate with the Contractor and the DMTE to determine whether an agreement can be made to terminate the sublot at the temporary end of production. This agreement may be advantageous should a failed materials issue arise because all the mixture subject to the Failed Materials Committee action would be contained within one area or construction phase. If either the Contractor or DMTE does not agree to the early termination of the sublot, the PEMS should include the mixture previously placed upon the resumption of production for the original sublot.

13.8 MISCELLANEOUS MIXTURES (SECTION 402)

HMA mixtures within 402 of the SS include those used for the following miscellaneous applications:

- transverse rumble strips,
- wedge and level courses,
- temporary pavement, and
- curbs.

When used for these special applications, some requirements for HMA materials used in typical paving operations do not apply. Conversely, there are additional restrictions that apply to these special applications that are not applicable for typical HMA pavement mixtures.

13.9 PAVER SEGREGATION PREVENTION FEATURES

The Contractor is required to submit documentation indicating each paver utilized on the contract has been manufactured or retrofitted with equipment designed to prevent segregation of coarse aggregate during the paving operation. The documentation requirements are outlined in 401.10 and also outline additional requirements related to specific pavers proven to be

susceptible to segregation issues. The Contractor is also required to demonstrate that all required modifications have been implemented on each paver used.

Typically, these features mitigate segregation caused by the paver's gearbox. The segregation usually occurs in the middle of the course and, in most cases, eventually results in a longitudinal crack on the finished pavement.

13.10 SUBGRADE TREATMENT OR EXISTING PAVEMENT SURFACE PREPARATION REQUIREMENTS

Prior to constructing a full depth pavement or widening adjacent to an existing pavement, the subgrade on which the base mixture is placed must be treated in accordance with 207. Refer to the Typical Sections or the Standard Drawings for the type of subgrade treatment required.

Prior to placing an overlay, the existing pavement surface must be properly treated. Typically, existing asphalt surfaces are milled prior to placement of the overlay. Existing concrete pavements are typically milled, rubblized, or cracked and seated prior to overlay placement. Rubblized concrete pavement surfaces require the application of prime coat, in accordance with 405, prior to overlay placement. All other existing asphalt or concrete pavement surfaces require tack coat to be applied prior to placement of the overlay, in accordance with 406. When spray pavers are utilized, emulsion is required to be applied in accordance with 409 and the specific Laydown Equipment option.

13.11 WEATHER LIMITATIONS

There are two weather limitations pertaining to 401 QC/QA paving operations discussed in 401.13. The first pertains only to mixtures with planned lay rates less than 138 lb/syd. This stipulation discusses the air temperature and the underlying surface temperature requirements for mixes meeting this lay rate. The second limitation listed states that no mixture is to be placed on a frozen subgrade. In situations where late season paving is required, the PEMS should contact the AE for guidance.

Additional weather constraints apply for 402 mixtures. Refer to 402.12 for these limitations.

If any portion of the paving operation is performed during a rain event, verbally notify the Contractor that any additional mixture placed is at the Contractor's risk. The verbal notification must be followed up with written notification. Include the correspondence in the project file. After conclusion of the rain event, hold an inspection of the affected pavement with the Contractor as soon as possible. Mark all areas of pavement that are found to require repair or replacement. If there is any disagreement regarding the scope of corrective action, the PEMS contact the AE.

In situations where a rain event occurs while mixture is being placed on a treated subgrade, suspend the paving operation immediately if the subgrade deforms unacceptably while loaded by trucks, paver, or other equipment included in the paving train. For this purpose, unacceptable deformation is defined as deformation requiring corrective action if identified during a proofrolling operation. Note the suspension in the Engineer's Diary and notify the AE.

13.12 SPREADING AND FINISHING

As mixture is delivered to the site, spread by the paver, and compacted by rollers, the PEMS or HT must pay attention to and notify the Contractor when problems occur with the following:

- Maintenance of traffic associated with paving operation, particularly at intersections and driveway approaches.
- Performance of the subgrade or underlying pavement while being loaded by trucks and paving equipment.
- Application of prime coat or tack coat as appropriate.
- Defects in the course behind the paver—segregation, flushing, roller marks, petroleum spills, etc.
- Correct placement of the course in relation to depth and width checks as well as yield calculations.
- Alignment of paver.
- Temperature and compaction requirements if density is not controlled by cores.
- Use of paver extensions.
- Allowable dropoffs and the matching of existing lanes if paving is performed under traffic.
- Equipment used for placement of mainline and shoulder mixtures.
- Roller operation.

The PEMS must verify that the Contractor has adequate work zone signage and flaggers available to enable trucks hauling material to the site to enter and leave the paving train in a safe manner. When paving is being performed adjacent to traffic, it may be necessary for the Contractor to employ additional flaggers or signs as the paving train approaches intersections or other site-specific locations. If there are deficiencies in the Contractor's work zone traffic control, suspend the paving operation immediately until corrective action is taken. Document the suspension of work in the Engineer's Diary and notify the AE.

If the mixture is being placed on a treated subgrade, verify that the subgrade does not show unacceptable deformation under paving train loading. Although proofrolling is required prior to paving in accordance with 207.03, it is necessary to monitor the performance of the subgrade during the paving operation. If the subgrade deforms in a manner that would require corrective action during a proofroll operation, suspend the paving operation until the appropriate subgrade repairs are made. Document the suspension of work in the Engineer's Diary and notify the AE. For situations where the mixture is being placed on a milled existing pavement surface, verify that the milled surface is not raveling during the paving operation. If raveling is occurring, contact the AE for additional guidance.

In situations where prime coat or tack coat is required in accordance with 405 or 406 respectively, verify the material has been applied at the appropriate rate, has no streaking, and has uniform coverage. Common deficiencies in application of prime or tack coat include unacceptable coverage due to improper or clogged nozzles, improper spray bar height or width on the distributor, or inappropriate distributor speed or mechanical problems with distributor equipment.

Inspect the course behind the paver periodically and note any defects requiring correction. Besides segregation and flushing, defects include areas where petroleum products or hydraulic fluids are spilled. These liquids damage asphalt pavements. Petroleum products are often used by the Contractor to clean hand tools associated with the paving operation. Do not allow open containers of any petroleum product to be placed on the paver or other pieces of paving equipment. Contamination defects can also be introduced to the course by leaking hydraulic fluid hoses on the paver or other paving train equipment. It is usually necessary to remove the contaminated mixture from the course and replace it with new material.

The PEMS or the HT must verify that the Contractor is placing the course to the appropriate depth and width. Width checks are especially important when a base course is placed on a treated subgrade. If these courses are placed too wide, overlying mixtures will be placed too wide as well. Perform depth and width checks approximately every 500 ft. Check the yield associated with five to ten trucks at least twice a day. This is done as follows:

- Determine the approximate beginning station associated with the first truck.
- Determine the approximate ending station associated with the last truck.
- Calculate the weight of the mixture placed from the trucks by adding the weight from individual weigh tickets.
- Calculate the area covered by the mixture from the trucks by using the difference between the stations to determine the length and the average paving width accounting for the edge slope for the mixture on either or both edges as appropriate.
- Calculate the in-place lay rate of the course by dividing the weight of the mixture by the area over which it is placed.

Compare the calculated actual placed lay rate to the target lay rate for the mixture. The target lay rate is obtained from the planned lay rate of the appropriate typical section or Standard Drawing multiplied by the Mix Adjustment Factor, MAF. If there is more than a five percent difference between the calculated actual placed rate and target lay rate, notify the Contractor that appropriate corrective action must be taken.

The PEMS or the HT must periodically confirm that the paver is progressing in a straight manner along the subgrade or existing pavement to be overlaid. Pavers that are overloaded or experiencing mechanical problems can deviate from an intended straight path. If the paving is taking place on a steep grade, it may be necessary for the trucks to remain unhitched from the paver and dump partial hopper loads to allow the paver to remain on the intended alignment

path. To help maintain consistent placement of the course, it is necessary for the paver to move as straight as possible.

If density of a 401 QC/QA mixture is not controlled by cores, additional requirements are included in 401.14.

Verify the mixture temperature immediately behind the paver and check that the paver maximum speed is not exceeded. It is not necessary to check mixture temperatures or paver speeds for other QC/QA HMA mixtures.

Verify the paver operator is not using hydraulic extensions in situations where a constant paving width is being placed. It is permissible to use the hydraulic extensions at tapered paving locations.

If the paving is being performed under traffic, verify the Contractor is matching adjacent lanes in accordance with 401.14, when applicable.

Mainline lanes and shoulders which are 8 ft and wider must be placed with equipment employed with automatic grade and slope controls, in accordance with 409.03. Essentially, this requires that a paver be used in these situations. Verify that the Contractor's equipment meets this requirement. Shoulders that are narrower may be placed with a widener.

Since 402 mixtures are accepted by certification instead of testing in-place, there are specific requirements for 402 mixes that do not apply to 401 materials.

The primary differences are:

- Additional spreading and finishing requirements such as:
    - maximum paver speed,
    - temperature requirements based on the DMF mixing temperature,
    - requirement for tarp protection for HMA mixes being hauled to the contract site, and
    - wedge and level course lay rate variances based on the DMF. Refer to 402.13 for additional information.

- The standard roller train compaction requirements based on the number of passes made by rollers of various types, in accordance with 402.15. In addition, the SS include information related to maximum allowable roller speeds, method of compaction, compaction equipment requirements for areas which are inaccessible to rollers, and the emphasis that the finish rolling operation shall leave no roller marks.

- For low temperature paving situations, 402.16 provides additional requirements to ensure proper compaction of HMA materials. These requirements come into

play especially during the late construction season when trying to "button up" a contract for the winter.

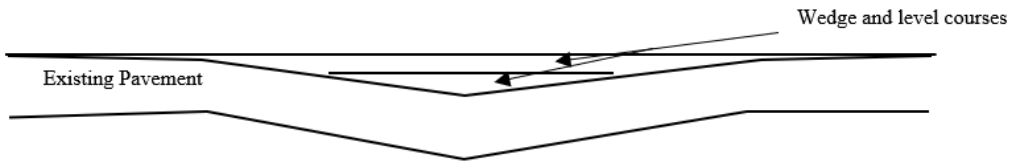
13.13 WEDGE AND LEVEL CONSTRUCTION (SECTION 402)

One of the more common miscellaneous 402 mixture applications is a wedge and level course. A wedge and level application are defined as one or more HMA courses utilized to transition from an existing deficient base profile or section into a more uniform depth QC/QA HMA or HMA course. This newly constructed transition can then be used as a base to construct a pavement with an acceptable profile and section. Common examples of wedge and level courses include:

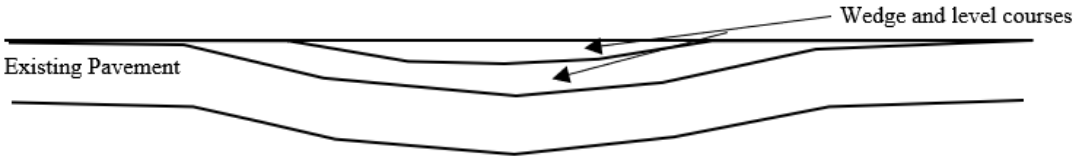
- correcting settlement over or at the approach to a structure,
- establishing the proper crown on a tangent section of roadway,
- correcting a deficient superelevation on a curve,
- correction of wheel path rutting, and
- construction of an improved section where the existing pavement is badly distorted.

Ordinarily, the quantity estimated for these purposes will be indicated in the contract or plans and will vary according to the condition of the road to be resurfaced.

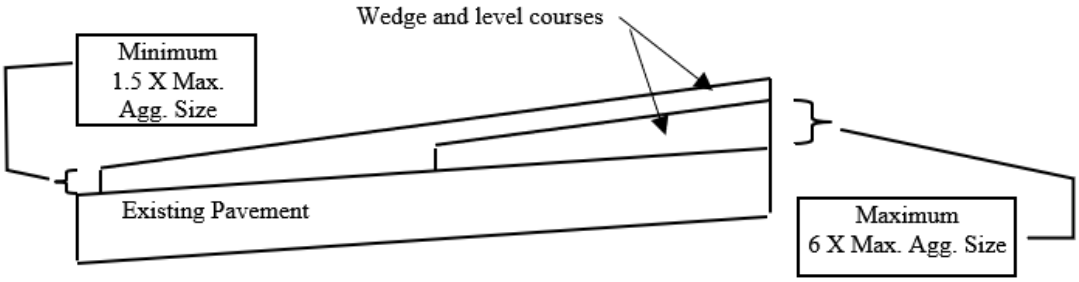
The **correct** method of longitudinally wedging a dip or settlement in an existing pavement is shown below:



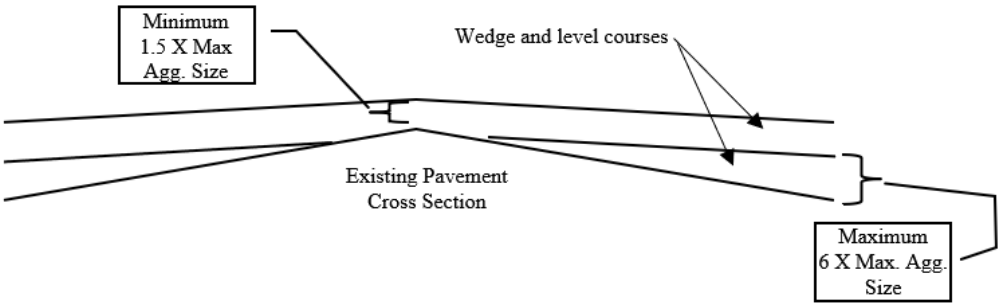
An example of an **incorrect** method of longitudinally correcting a dip or settlement in an existing pavement is shown below:



The number of wedge courses necessary to construct a desired superelevation on a curve is dependent on the maximum size aggregate used in the mixture and the total depth to be placed.



Wedges may also be used to reestablish a crown on a deficient tangent roadway. Again, the number of wedge courses necessary to rebuild the crown depends on the total depth of the wedge to be constructed and the maximum size aggregate in the mixture.



If an undistributed quantity of HMA wedge and level mixture is included in the contract, the PEMS should inspect the existing pavement to determine the limits for wedge and level construction and mark them on the pavement. After this is complete, compare the quantity to the plan quantity for the HMA wedge and level mixture pay item. If the proposed quantity resulting from the layout overruns or underruns the plan quantity by more than five percent, contact the AE for additional guidance. The AE should contact the PM and request a recommendation regarding the resolution of the potential overrun or underrun funding and scope.

13.14 JOINT CONSTRUCTION

Proper construction of joints is critical in obtaining the design life of the pavement. Two primary causes of premature asphalt pavement failure are improper longitudinal joint construction and deficient joint density. The PEMS must verify that the longitudinal joint for each course is offset approximately 6 in. from the longitudinal joint of the underlying course. This makes the joint more resistant to infiltration of water and allows for better compaction of the material placed in subsequent courses at the joint.

13.14.1 Longitudinal Joints

HMA and SMA longitudinal joints are required to be treated with either Void Reducing Asphalt Membrane, VRAM, or joint adhesive. These treatments artificially create density by filling in the

air voids at the joint. VRAM is typically used for surface joints while joint adhesive is used for intermediate joints. Base courses do not require treatments at the longitudinal joint.

VRAM is placed on top of the existing course, prior to the surface layer. It is centered under the surface's intended longitudinal joint location and migrates upward as the hot surface mix is placed on top. For milling inlay situations or when only half of the joint is exposed, VRAM can be applied at half-width. The adjacent vertical face of the cold joint is also required to be coated with VRAM.

Joint adhesive is placed on the cold joint prior to placement of the adjacent lane. Joint adhesive is required to be placed between the intermediate joints. It must also be used on surface joints in areas exempted from VRAM use as indicated within the plans or SS. It is not necessary for a surface joint to have both VRAM and joint adhesive treatments applied.

13.14.2 Transverse Joints

Transverse joints are required at the end of the day's work, when moving from one lane to another, upon suspension of work for an extended period of time, at paving exceptions, when matching with adjacent pavement sections, and as indicated in the plans. Lapped joints are not permitted for these situations.

If traffic is to be maintained across a transverse joint, the joint must be tapered sufficiently to allow a smooth ride. It is necessary to place paper or other bond breaker material under the tapered pavement to facilitate removal of the taper material prior to resuming the paving operation. When paving resumes at the joint location, the paver should be positioned so that the screed rests approximately over the joint line. After the hot mixture is conveyed into position, sufficient time should be allowed to reheat the joint area before the forward movement of the paver begins. The paver is then advanced ahead of the joint enough to allow the workers to perform the necessary handwork to transition the new material the old. The use of a straightedge throughout this process is of primary importance. Paving should continue only after the joint has been satisfactorily shaped, rolled and finished.

The QCP must address the Contractor's method for constructing these transverse joints. Pay special attention to the method of placing and compacting transverse joints at bridges, paving exceptions, and contract limits. The lower courses are of particular concern because the roller cannot be operated across the joint between the newly placed course and the adjacent existing pavement. These areas require transverse rolling or special compaction equipment.

13.15 COURSE DEFECTS

After completion of the finish rolling portion of the paving operation, the PEMS should review the newly placed course for defects. Segregation, flushing, and pulling or tearing are common defects found in newly placed courses.

Segregation occurs when the fine and coarse aggregates become separated from each other during the hauling or paving operation. Segregated course feature locations where there are primarily coarse aggregate particles with no fines. The appearance is similar to an open graded

mixture. There will be other locations within a segregated course where there are few, if any, pieces of coarse aggregate and mainly consists of asphalt coated fines. The appearance is similar to a sand surface. Common causes of segregation include improper loading of trucks, faulty paver auger operation, and situations where a paver is forced to stop because the hopper runs out of mixture. To avoid the paver having to stop, many paving trains include a material transfer device sometimes referred to as an MTD or a "shuttle buggy". Shuttle buggies essentially provide a larger hopper capacity for the paver and permit the paving operation to progress as long as a sufficient number of trucks hauling mixture are available.

Flushed pavements have locations where liquid asphalt collects on the surface of the course. This may result from excess tack coat being brought up through the course, improper mixing of the materials, or too much PG binder in the mixture.

The remedy for segregated courses usually requires removal of the affected areas and replacement with suitable material. Minor areas of segregation can be repaired using a sand seal coat. Larger and more significant flushed pavement areas shall require removal and replacement, diamond grinding, or other fine milling to remove the excess asphalt. Mark all segregated or flushed areas for correction by the Contractor prior to the course being covered by another lift of material or opened to traffic. Corrective action should be in accordance with the Contractor's QCP. If the QCP does not address the repair of segregated or flushed pavements and an agreement on a solution cannot be reached with the Contractor, contact the AE. The M&T, CM, and the Department's Highway and Pavement Design section are all available resources for determining the scope of the required repair.

Another common defect in a newly placed course is pulling or tearing. The course can be torn or pulled by:

- a paver that is traveling too fast
- a paver with a worn screed, or a screed that is not heated properly
- compacted by a roller that is traveling too fast or rolling a mix that is too tender.

Mark all torn areas so they can be repaired by the Contractor prior to the course being covered by another lift of material or opened to traffic. All torn areas must be repaired in accordance with the QCP. If the QCP does not address the repair of tears in the course, contact the AE if no agreement on an appropriate repair can be reached with the Contractor.

13.16 COMPACTION AND DENSITY

For 402 mixtures, compaction is performed in accordance with 402.15. Since cores are not taken to verify in-place density, the PEMS must verify that the Contractor is performing the rolling operation in accordance with the SS requirements.

For 401 QC/QA mixtures, density is one of the properties included in the QA Adjustment calculation. In most situations, it is necessary to take cores to determine the density pay factor.

However, there are exceptions to core density control related to overlays placed on shoulders. The PEMS should refer to 401.16 to help determine whether cores are required for these situations. When cores are not required, the density is assumed to be 94% MSG and the pay factor for that sublot is assumed to be 1.00.

In general, there are three compaction phases:

- Breakdown or Initial Rolling
- Intermediate Rolling
- Finish Rolling.

Breakdown rolling provides the initial compaction of the mix beyond the small amount of compaction provided by the paver's vibratory screed. This initial rolling process helps seat the mix and introduces aggregate interlock. The intermediate rolling process helps further compact and seal the newly placed mixture. Finish rolling is necessary to remove roller marks and other imperfections present in the new course.

There are many aspects of the rolling operation that affect density in the course. Roller speed is one such factor and maximum roller speed requirements for situations where density is not controlled by cores are included in 401.15. Be aware that there are different maximum speeds for static and dynamic rollers.

Density of the newly placed mixture is affected by the way the Contractor rolls the course. Information related to acceptable compaction is included in 402.15. The finish rolling operation should be performed while the mixture is still sufficiently warm to compact. There is no set rule for the timing and spacing of rollers. Mixture properties and atmospheric conditions affect the compaction of the course. During the rolling operation, roller passes should be differing lengths so that the roller is not always reversing direction at the same location. Achieving the highest course density possible is the objective of the rolling operation.

The Contractor must be performing QC testing in conjunction with their rolling operation to maximize the course density while minimizing the rolling effort. Periodically, the Contractor may need to adjust the number of rollers passes, as well as the amplitude and frequency of the vibratory rollers, to achieve density requirements. There should be no roller marks, creases, or other surface defects in a course when the rolling operation has been completed. The approved QCP should include information regarding corrective action for situations where the rolling operation has not achieved satisfactory density results.

Areas that cannot be compacted by a roller must be thoroughly tamped with mechanical tamps or vibrators. Tampers should be operated to achieve a thoroughly and uniformly compacted surface over the entire course. Often the areas requiring tamping methods of compaction are at critical locations. Care must be exercised to avoid over-tamping the mix and creating low spots which allow water to pond.

During the rolling operation surface distresses may develop. Common distresses include waviness, surface cracks, honeycombed texture, shoving, and roller chatter in the surface. Similar to the spreading operation, these distresses may be due to one or more of the following causes:

- Rolling too soon
- Rolling too fast
- Excessive rolling which crushes coarse aggregate
- Turning the roller too abruptly
- Too much slack in the roller drives
- Reversing the roller too abruptly
- Allowing the roller to stand on fresh surface
- Insufficient rolling
- Roller too light
- Mixture temperature
- Mixture composition
- Incorrect vibratory roller frequency or amplitude.

Upon completion of the rolling operation, the course must be protected from vehicular traffic until it has sufficiently cooled (approximately 175˚F) to prevent damage from the traffic. The required cooling time varies due to atmospheric conditions.

Urban construction often requires compaction practices that differ from rural paving operations. It is essential to have a good joint seal between the new course and the adjacent curb or curb and gutter. Thorough compaction adjacent to the curb, at intersections, and adjacent to castings is essential to produce quality construction. In addition to the compaction requirements, the finished surface course must match or be slightly higher than the grades of adjacent gutters and castings to ensure proper drainage. In many situations, an improper matching of grades between a pavement surface and an adjacent gutter line or inlet casting can cause water to pond over a significant area. The PEMS or HT must verify that the roller operator does not allow the roller to bridge the mixture placed adjacent to a combined curb and gutter by allowing the roller drum to ride on the gutter pan instead of the mixture.

The SS contain the same density requirements for urban and rural contracts. Achieving the proper density is as important on an urban street as it is on a rural roadway. In many situations, the Contractor will request density requirements be waived when vibratory rollers are turned off due to potential damage to adjacent property or underlying utility facilities. In many situations, proper density can be achieved if the Contractor adjusts the amplitude and frequency associated with the vibratory rollers. However, some Contractors are reluctant to take the time required to determine the appropriate amplitude and frequency combination. Do not waive density requirements without the Department's Pavement Design or DCM approval.

13.17 SMOOTHNESS

For 402 mixtures, the PEMS must verify the longitudinal profile of the newly constructed course in all mainline lanes and shoulders by using a 16 ft straightedge. Verify smoothness transverse to the direction of traffic on the mainline by using a 10 ft straightedge. The 10 ft straightedge is also used to verify the longitudinal profile of public road approaches, commercial driveways, and residential driveways.

For pavements constructed using 401 QC/QA mixtures, smoothness is a factor to be included in the QA Adjustment. The inertial profiler is the primary instrument that is used to measure pavement smoothness and the IRI is used to analyze and report smoothness results. On contracts which include the Inertial Profiler, HMA pay item, the Contractor is responsible for operating the profiler and submitting all IRI data files for each lane completed on the contract. For comprehensive information on Pavement Smoothness utilizing the IRI index and Inertial Profiler equipment refer to Section 11 of these Instructions.

When the Inertial Profiler, HMA pay item is included in the contract, it is only used to measure smoothness on the lanes which meet all the criteria contained in 401.18 and are not exempted by criteria included in ITM 917. The 16 ft straightedge is used to check longitudinal profile at all other locations. The 10 ft straightedge is used to verify the smoothness of all slopes transverse to the mainline at the same locations as described above for Section 402 pavements.

If there is no Inertial Profiler, HMA pay item in the contract, the 16 ft and 10 ft straightedges are used to check the newly placed QC/QA HMA mixtures as described above and for all non-QC/QA HMA pavements. For these situations, smoothness is not calculated in QA Adjustments. For these situations, smoothness is checked using a 16 ft straightedge supplied and operated by the Contractor.

The Contractor is responsible for furnishing and operating the 16 ft straightedge, while Department personnel are responsible for furnishing and operating the 10 ft straightedge. The Contractor is responsible for providing all traffic control required to operate the straightedge.

Diamond grinding is a common method for correcting bumps and dips which exceed SS limits. In situations where severe low spots have resulted from the paving operation, it may be necessary to grind longitudinally in one or both directions from the low area and wedge with asphalt material.

Areas of grinding do not require sealing with tack coat or fog seal. Sealing these areas can create undesirable friction problems. The appearance of areas of grinding will eventually blend with the surrounding asphalt surfaces.

ITM 917 also includes information regarding areas which are exempt from Inertial Profiler smoothness measurements and how to accommodate partial sections encountered due to contract limits or paving exceptions. Questions regarding these topics should be directed to the AE, DMT, or the District's assigned FE.

The Contractor must indicate their potential methods of corrective action in the QCP. If their QCP does not address proposed methods to correct smoothness deficiencies and no agreement with the Contractor can be reached, contact the AE.

13.18 PAY FACTOR DETERMINATION AND QUALITY ASSURANCE ADJUSTMENTS (SECTION 401)
When a Contractor produces a 401 QC/QA mixture for a pavement or overlay, payment for this work will be made at the contract unit price per ton of mixture delivered to the contract. In addition, these contracts include a QA Adjustment pay item which provides additional payment to the Contractor or a credit to the Department based on the results of the QA testing.

The QA Adjustment Pay Factor may involve reviewing two components. The first component is based on mix properties and density. The second involves the component of smoothness and would only be reviewed if the contract includes the Inertial Profiler, HMA pay item. When the profilograph or the inertial profiler item is present on the contract, the QA Adjustment Pay Factor is based on the profile index or IRI results measured after the full depth pavement or overlay is constructed.

All QA adjustments for QC/QA HMA mix properties and density are available and stored in the HMA Pay Wizard application. This can be accessed through the INDOT Technical Application Pathway, ITAP.

All QA adjustments for QC/QA HMA smoothness are stored in the Intelligent File Cabinet in the ProjectWise Intelligent File Cabinet system within the Pay Items Documentation folder.

For all dense graded mixtures with a pay item/DMF combination quantity **greater than or equal to one lot**, the pay factors are determined based on a percent within limits, PWL, basis in accordance with 401 of the SS. The final PWL Acceptance results for each pay item/DMF combination includes composite pay factors for each lot based on mixture properties and density. The PEMS uses this information to determine the pay factors and the QA Adjustment associated with mixture properties and density for each lot in accordance with the SS.

For all dense graded mixtures with pay item/DMF combination quantity **less than one lot**, the volumetric property/density portion of the QA Adjustment pay item is based on individual sublot QA test results. For all open graded mixtures, the volumetric test method is used regardless of lot or sublot size. The final Volumetric Acceptance results for each pay item/DMF combination includes composite pay factors for all mixture properties and density for each sublot. The PEMS uses this information to determine the pay factors and the QA Adjustment associated with mixture properties and density for each sublot in accordance with the SS.

The PEMS must verify that the final versions of the PWL or Volumetric results are used for determining the pay factors and the QA Adjustment associated with mixture properties and density. The Contractor has a right to dispute QA test results and until disputes are finalized, the QA test results and calculated pay factors are not final. If the final results indicate a QA test

failure, the PEMS needs to verify that correspondence related to disposition of this failed material has been received. If no correspondence has been received, request a copy from DMT.

For contracts where the Inertial Profiler, HMA pay item has been included, use IRI for smoothness determination, the smoothness QA adjustment is determined by the IRI for individual sections of pavement. Refer to 401 and ITM 917 for the definition of an IRI smoothness section and the procedure for determining smoothness section limits.

After reviewing the IRI data, locate and mark all bumps and dips that exceed the smoothness limits in accordance with the SS. Sections of pavement evaluated for smoothness exhibiting an IRI that exceeds the limits indicated in the SS, may require corrective action to reduce the IRI to acceptable levels. After the Contractor has made corrections, additional runs with the profiler are required to verify all affected sections meet the smoothness requirements. The PEMS must verify that any repairs made by the Contractor do not expose underlying pavement courses. If underlying courses are exposed, repairs shall be made in accordance with the SS.

The PEMS should refer to 401 and use the IRI data to determine the smoothness pay factor for individual sections. The Department's Construction Information website provides IRI field guides and pay adjustment spreadsheets for use when analyzing IRI data from the ProVal application for QA adjustments.

Regardless of the tabulated value, the maximum pay factor for a section where corrective action has been performed will be 1.00.

After the total QA Adjustment for the contract has been determined, process a change order to facilitate the payment to the Contractor or the credit to the Department as appropriate. Attach all documentation used in calculating the QA Adjustment to the change order.

QA adjustments are calculated per DMF/per CLN/per YEAR. These should be made at the end of paving for each course or annually for multi-season contracts.

13.19 METHOD OF MEASUREMENT/BASIS OF PAYMENT

Because all HMA pay items are measured and paid for by the ton, collect weigh tickets from every truck that brings HMA material to the contract site. Determine if the entire load is placed on the contract. If a partial load is returned to the HMA plant, discuss the estimated tonnage returned with the contractor's foreman. Record the returned tonnage on the ticket. If agreement cannot be reached on the amount returned, request a "weigh back" ticket for the truck.

When E-ticketing is utilized on the contract, the PEMS should contact the AE or the appropriate CM Field Engineer to discuss the options and implementation of the process. Material delivery tickets may be either in paper or electronic ticket, E-ticket, format.

When E-ticketing is utilized, the Contractor is required to either use the Department's E-ticketing system or be approved by the Engineer to use an alternate E-ticketing system.

13.19.1 QC/QA-HMA Mixture Substitution

According to the SS, when original project plans call for a 19.0 mm HMA intermediate to be paved on top of a 25.0 mm HMA base course, the Contractor has the opportunity to pave both courses of pavement with 19.0 mm intermediate. The option is at the Contractor's discretion and at no additional cost to the Department. When this option is selected, it is an advantage for the Department. The reason for the advantage is that 19.0 mm is more desirable than 25.0 mm HMA because of the greater binder content, and the ease in achieving density. This option is also advantageous for the Contractor in the reduction of construction costs and allowance for thicker paving courses. Although, this does not exempt the Contractor from the limitations set forth in the SS for finished paving thickness, where 19.0 mm HMA can be paved up to 5 inches.

When this option is selected, a new 19.0 mm HMA pay item will be created by change order. The new computed unit price will be based on the original contract quantities and bid prices of the 19.0 mm and 25.0 mm HMA pay items. The new pay item will be the same course binder grade and category as the original 19.0 mm intermediate HMA pay item. The assigned quantity for the new pay item will be the summation of the original contract quantities of the 19.0 mm and 25.0 mm HMA pay items. Furthermore, the original 19.0 mm and 25.0 mm HMA pay item quantities will be subtracted on the change order to balance the new pay item.

An example calculation:
Using the original contract quantities from the example contract documents.

CLN	Item Description	Unit Price	Original Quantity Amount
0038	QC/QA-HMA, 4, 70, INTERMEDIATE, 19.0 mm	$94.20	840.00000
		TON	$79,128.00
0039	QC/QA-HMA, 4, 64, BASE, 25.0 mm	$80.00	2,056.00000
		TON	$164,480.00

New Unit Price = Sum of Contract Amounts / Sum of Contract Quantities

= ($79,128.00 + $164,480.00) / (840.00 ton + 2,056.00 ton)

= $243,608.00 / 2,896.00 ton

= $84.12/ton

A new pay item for "QC/QA, 4, 70, Intermediate, 19.0 mm" should be created by change order with a unit price of $84.12/ton for 2,896.00 tons.

13.20 WARRANTY HMA CONTRACTS (411 and 413)

The intent of warranty contracts is to establish performance criteria for the warranty pay items and require the Contractor to verify these criteria are met or exceeded throughout the warranty period. Therefore, no QA testing is required for any warranty pay items during construction.

The scope of inspection on warranty mixtures is as follows:

- Collect weigh tickets or utilize E-ticketing
- Check in-place yield of mixture.

On warranty contracts, the Contractor takes full responsibility for the performance of the constructed pavement during the warranty period. Therefore, Department personnel should not give direction to the Contractor which is contrary to the QCP. Requiring the Contractor to perform the paving operation in a manner contrary to their documented QCP intent may void the warranty objective.

There may be non-warranty pay items in warranty contracts. For these non-warranty pay items, normal SS requirements apply and normal sampling, testing, certification requirements, and inspection procedures are required.

13.21 DOCUMENTATION REQUIREMENTS

Keep the following documents in the contract file:

- Approved DMF
- QC Plan, Including Addenda
- QC Plan Approval or Rejection Correspondence
- PWL Acceptance Worksheets or Volumetric Acceptance Worksheets
- IRI Data Files
- Type D Certifications.

Hard copies of the above documents should be converted to digital format and stored in the project file or AWP as appropriate.

For 401 QC/QA mixtures, the PEMS should maintain a running total of the quantity of mixture associated with each pay item/DMF combination outside of AWP to determine the limits associated with individual lots and sublots. Document the limits of individual lots and sublots by entering the lane designation, beginning station, and ending station into the DWR on the applicable dates. When paving operations change lanes within a sublot, note the ending station in the first lane as well as the beginning station of the second lane into the DWR for the date that the lane change is made.

On a daily basis, calculate the total weight represented by the weigh tickets associated with each mixture pay item and record the weight into the DWR for the date that the mixture was placed.

Attach the calculator printer output to the weigh tickets for the day and maintain them in the contract file. If E-ticketing is used, maintain digital documentation of individual tickets and/or a summary log and store the documentation in the contract file.

If E-ticketing is used, maintain digital documentation of individual tickets and a summary log and store the documentation in the contract file.

For mixtures with QA pay factors calculated in accordance with 401.19(a), utilize the completed PWL Acceptance results obtained from the Department's HMA Pay Wizard application as documentation of pay factors associated with mixture properties and density by maintaining a digital copy in the contract files. Include copies of all calculations for determining the quality assurance adjustment for mixture properties and density. Include copies of any correspondence related to failed materials in the contract files as well.

For mixtures with QA pay factors that are calculated in accordance with 401.19(b), include digital copies of all Volumetric Acceptance results in the contract files as documentation of the pay factors associated with mixture properties and density. Include copies of all quality assurance adjustment calculations in the contract files. Include copies of any correspondence related to quality assurance adjustments for failed materials in the contract files as well.

For contracts with the Inertial Profiler, HMA pay item include all data files utilized for analysis of pavement section smoothness pay factors, the calculations of smoothness QA adjustments for individual sections, and the total smoothness QA adjustment for the contract within the contract files.

The contract files also need to include a digital tabulation of the overall contract QA Adjustment if both smoothness and mixture property/density components are required for the contract.

13.22 TACK COAT

Tack coat is used to prepare PCCP, milled, new, and existing asphalt surfaces for construction of an overlay or subsequent course of asphalt pavement.

13.22.1 Tack Coat Quality Control

Details regarding the tack coat operation are included in the QCP submitted by the Contractor prior to beginning paving operations. The PEMS must verify the Contractor follows all approved QCP content related to application of tack.

13.22.2 Tack Coat Materials

Tack coat materials include certain types of asphalt emulsions and PG binders. These materials are identified in 406.02 of the SS.

13.22.3 Tack Coat Equipment

Tack coat is applied to the pavement surface using an asphalt distributor meeting the requirements of 409.03(a) of the SS. Additional information regarding asphalt distributors can be found later in this document.

13.22.4 Surface Preparation for Tack Coat

The purpose for applying tack coat to a surface is to increase the bond between newly placed course mixture and the existing surface. Soil or other debris on the existing surface prevents this bond from occurring and defeats the purpose of applying the tack coat. All soil and other debris must be removed from the existing surface prior to applying tack.

A rotary power broom is commonly used for this purpose. If there are areas that require additional cleaning after the power broom operation, other measures must be taken to remove the objectionable material.

13.22.5 Tack Coat Application

The surfaces to be tacked need to be saturated surface dry to maximize bonding between the existing surface and the proposed course. A common area of contention between the Contractor and the Department is related to the degree of dryness necessary to place tack. It is acceptable to apply tack coat when there are isolated wet spots on the surface to be tacked. Isolated defined as the rough percentage of damp areas should be less than five percent.

There should be no standing water in any of these areas. If there is any question regarding whether the surface is too wet, notify the Contractor in writing that placement and performance of the tack coat as well as the paving operation is being performed at the Contractor's risk. Any delaminated areas shall be repaired by the Contractor at no additional cost to the Department.

It is important that the existing pavement be coated with the appropriate amount of tack in a uniform manner in accordance with the SS.

One common application problem is caused by clogged nozzles on the distributor spray bar. In situations where one or more of the spray bar nozzles are clogged, there will be portions of the existing pavement that are either lightly coated or not coated at all. If a distributor spray bar nozzle becomes clogged, the distributor should be stopped and the clogged nozzle or nozzles repaired or replaced prior to resumption of application of the asphalt tack emulsion.

Another problem which results in inadequate coverage of asphalt tack emulsion is improper distributor spray bar height. To achieve proper coverage, the individual nozzle spray streams must overlap sufficiently. If the spray bar is set too low to the surface, there will be insufficient overlap. If the spray bar is set too high, the overlap will not be uniform.

Figure 13.22-1 illustrates the proper double or triple overlap resulting from the asphalt tack emulsion being sprayed from the distributor spray bar.

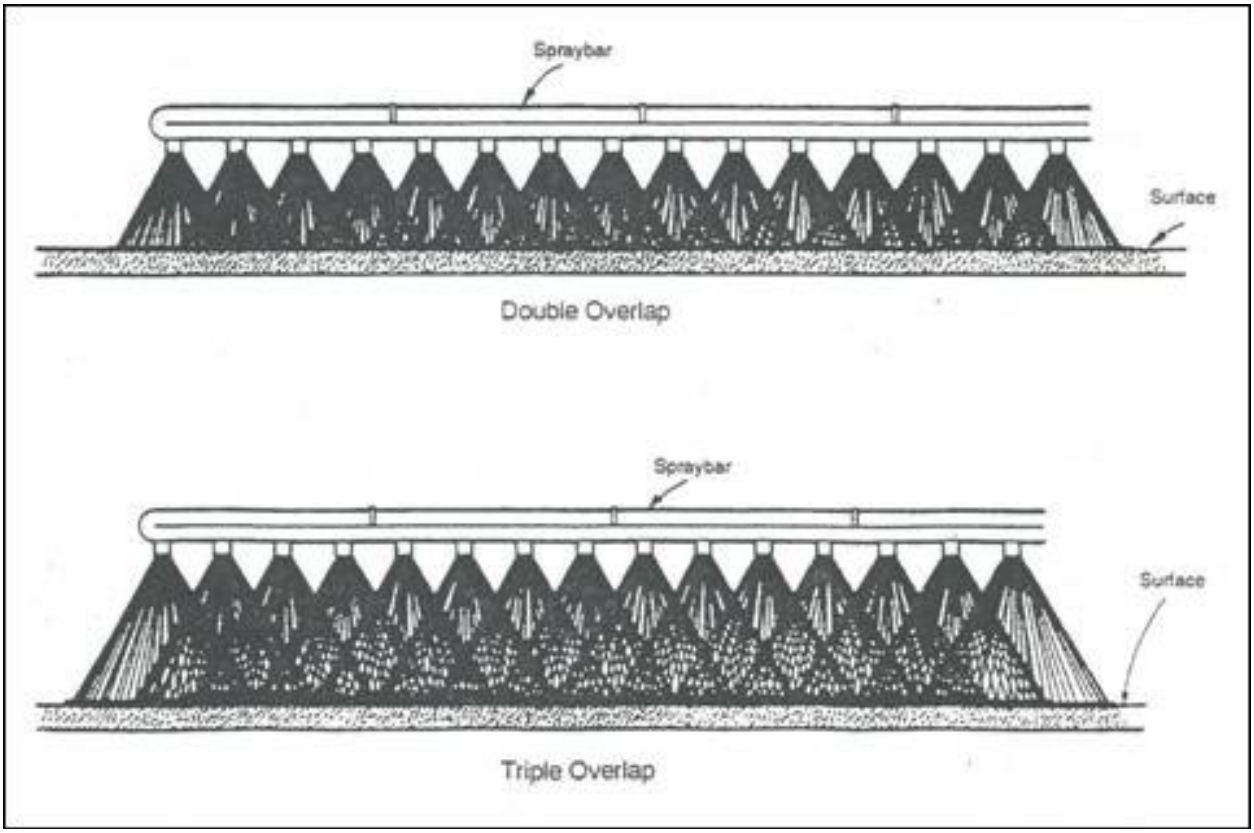


Figure 13.22-1. Desired Double or Triple Overlap

Figure 13.22-2 illustrates non-uniform coverage resulting from a spray bar installed at an improper height.

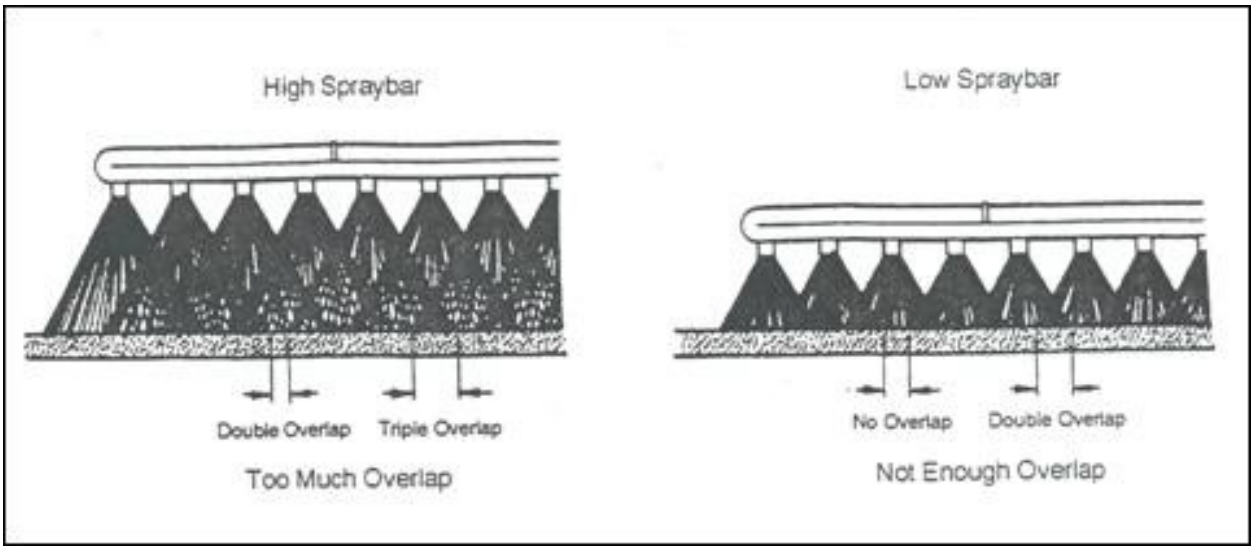


Figure 13.22-2. Non-Uniform Coverage Due to Improper Spray Bar Height

Distributor operation must be performed so tack is only applied to the intended surfaces. Wind or other environmental factors can result in uneven tack application. This problem can usually be solved by attaching a plate to the spray bar to contain the spray to the intended area.

Existing surfaces that cannot be tacked, because of inaccessible to the distributor, must be coated by using the distributor's hand spray wand or by hand application prior to construction of the overlying course.

When the tack coat is applied, it will be brown in color. After a period of time, the tack coat will turn black. At the time that this occurs, it is said that the tack coat has "broken". Once tack has broken, additional time may still be necessary for the tack coat to "set" to minimize tracking from equipment. The new asphalt course should not be placed onto the tacked surface until the break and set have occurred. The time required to achieve the tack coat break and set varies based on weather conditions such as temperature, humidity, and wind.

13.22.6 Tack Coat Documentation Requirements

Depending on the contract, tack coat is measured and paid for by either the ton or the square yard.

If tack coat is being paid for by area, determine the area covered by tack on a daily basis and enter the daily quantity in the DWR. Maintain a digital copy of the daily calculations and sketches in the contract file.

If tack coat is paid for by weight, collect the weigh tickets for each day. Calculate a daily total of weigh tickets to determine the daily quantity and record it in a DWR for each day that tack coat is placed. Retain the weigh tickets and calculator tapes as part of the contract file. Sometimes, a truck may need to be sent back to the weigh scales to obtain a weigh-back ticket. This ticket indicates the remaining weight of the truck and material after the day's application. The weigh-back ticket can be subtracted from the original ticket to obtain the material weight used for the application Another way to confirm tonnage used is to track the gallons placed. Many distributor trucks are equipped with a calibrated meter. A standard conversion is 240 gal/ton. It may be necessary to verify the meter's calibration and deduct and incidental quantity for daily maintenance.

If E-ticketing is used, maintain digital documentation of individual tickets and/or a summary log and store the documentation in the contract file.

13.23 SEAL COAT

The process of placing seal coat consists of one or more applications of asphalt material, each asphalt application is followed by an application of cover aggregate. This work may be referred to as "chip seal".

13.23.1 Seal Coat Quality Control

Quality control requirements for seal coat operations are found within 404.02 of the SS. The PEMS should review the Contractor's QCP as soon as possible after receipt. Seal coat operations cannot begin until QCP approval is provided to the Contractor. The PEMS should refer to ITM 803 for the Seal Coat QCP checklist. The intent of the QCP review is to verify all checklist items are included in the QCP. It is not intended to incorporate personal preferences of the reviewer into the QCP. However, prior to approval of the QCP, the PEMS should discuss all questions on checklist items with the Contractor.

13.23.2 Seal Coat Materials

The acceptable materials for seal coat asphalt and cover aggregate are listed in 404.03 and 404.04, respectively.

13.23.3 Seal Coat Types

The different types of seal coats are listed in 404.04. Types are identified by numbers from 1 to 7. In addition, a letter "P" may be added to the type, indicating that a polymer modified asphalt emulsion is required. Types 1 through 4 and 1P through 4P consist of one application of asphalt emulsion and one layer of cover aggregate. Types 5 through 7 and 5P through 7P consist of two applications of asphalt seal coat emulsion, with each emulsion application followed by an application of cover aggregate.

13.23.4 Seal Coat Weather Limitations

The weather limitations for seal coat application are listed in 404.05. Seal coats are required to be applied to dry pavements on warm days. The emulsions used in seal coats must "break" (as described in 13.22.5 above), in order for the seal coat to withstand traffic. Surface water or cool temperatures delay the emulsion "break" process and require traffic to remain off the treated pavement surface for longer periods of time. If it becomes necessary to perform seal coat operations outside the weather parameters of the SS, the PEMS should contact the AE for guidance.

13.23.5 Seal Coat Equipment

The following equipment is required for a seal coat operation:

- Rotary Power Broom
- Asphalt Distributor
- Aggregate Spreader
- Pneumatic Tire Roller.

A rotary power broom cleans the existing pavement surface prior to application of the asphalt seal coat emulsion and sweeps excess cover aggregate from a seal coated surface. An asphalt distributor applies the seal emulsion to the pavement surface. An aggregate spreader ("chip box" or "spreader box") spreads the cover aggregate onto the surface after the seal coat emulsion is applied. A pneumatic tire roller seats the cover aggregate into the seal coat emulsion. Steel

wheeled rollers cannot be used in conjunction with seal coat operations. More information regarding equipment used in seal coat operations is included later in this document.

13.23.6 Surface Preparation for Seal Coat

Prior to applying the asphalt seal coat emulsion, the existing pavement surface must be clean. If the rotary power broom is not capable of removing all dirt or other material from the existing pavement surface, other measures must be taken to remove the objectionable material.

Prior to application of the seal coat emulsion, the PEMS should verify that all snowplowable pavement markers, structure castings, detector housings, and other items in the existing pavement requiring protection are covered. After completion of the seal coat operations, the PEMS must verify that the Contractor removes all protective coverings.

13.23.7 Seal Coat Asphalt Material Application

The surfaces that are to be seal coated need to be dry to maximize bonding between the existing surface, the asphalt seal coat emulsion, and the cover aggregate. A common area of contention between the Contractor and the Department is related to the degree of dryness necessary to place seal coat. It is acceptable to apply seal coat when there are isolated wet spots on the surface. Isolated defined as the rough percentage of damp areas should be less than five percent. There should be no standing water in any of these areas. If there is any doubt regarding whether the existing surface is too wet, notify the Contractor in writing that placement and performance of the seal coat operation is being performed at the Contractor's risk. Any de-lamination that occurs shall be repaired by the Contractor at no additional cost to the Department.

It is important that the existing pavement be coated with the appropriate and uniform amount of asphalt seal coat emulsion. One common deficiency is caused by clogged nozzles on the distributor spray bar. In situations where one or more of the spray bar nozzles are clogged, portions of the existing pavement will either be lightly coated or not coated at all. If a distributor spray bar nozzle becomes clogged, the distributor should be stopped and the clogged nozzles repaired or replace prior to resumption of application of the asphalt seal coat emulsion.

Another problem which results in inadequate coverage of asphalt seal coat emulsion is improper distributor spray bar height. To achieve the proper coverage, individual nozzle spray streams must overlap sufficiently. If the spray bar is set too low, there will be insufficient overlap. If the spray bar is set too high, the overlap will not be uniform. Refer to Figures 13.22-1 and 13.22-2 for proper double or triple overlap resulting from the asphalt seal coat emulsion being sprayed from the distributor spray bar.

13.23.8 Application of Seal Coat Cover Aggregate

Cover aggregate must be applied to the asphalt seal coat emulsion as soon as possible. When the asphalt seal coat emulsion is applied to the pavement, it will be brown in color. After a period of time, the emulsion will "break" or turn black. **After the seal coat emulsion has broken, it is too late to apply and seat the cover aggregate.** Since the breaking time depends on environmental factors such as temperature and wind, it is important that the cover aggregate be placed before the seal coat emulsion breaks.

13.23.9 Rolling of Seal Coat Cover Aggregate

The rolling operation seats the cover aggregate instead of compacting a mixture as in traditional asphalt paving. To seat the cover aggregate properly, the required roller passes must be performed prior to the break of the asphalt material.

13.23.10 Seal Coat Operation Traffic Control

To maintain safety for the traveling public during seal coat operations, the PEMS must verify that the Contractor has appropriate and sufficient quantity of signs and flaggers to direct traffic around an ongoing seal coat operation. The Contractor shall make accommodations for all emulsion tankers and aggregate hauling trucks to enter and leave the work area in a safe manner. In addition, once a seal coated lane is reopened to traffic, it is important to limit the speed of the traveling public so aggregate is not displaced by traffic prior to being embedded in the emulsion. This may require use of pilot vehicles to escort motorists through the contract area at a sufficiently slow speed.

Discuss traffic control with the Contractor at the Preconstruction Conference. The PEMS must verify that the Contractor is complying with the traffic control procedures included in the QCP during performance of the seal coat operation.

13.23.11 Excess Seal Coat Cover Aggregate Removal

The Contractor shall perform a brooming operation within approximately 24 hours after traffic has been placed on the newly seal coated surface. This prompt brooming operation will reduce the likelihood of damage to windshields and other vehicle parts due to excessive loose cover aggregate. A rotary power broom should be applied lightly to remove excess aggregate. The asphalt emulsion will not have fully cured therefore, the broom must be applied lightly and not dislodge aggregate that is coated, but not locked into the emulsion.

13.23.12 Seal Coat Documentations

Seal coat is measured and paid by the square yard. The PEMS must determine, on a daily basis, the area covered by the seal coat operation and note the quantity in the DWR. Include all daily calculations and sketches in the contract file.

13.24 ASPHALT PAVING EQUIPMENT

13.24.1 Asphalt Mixing Plant

HMA mixing plants are typically either batch plants or drum plants.

A batch plant produces HMA in batches. The maximum batch size is limited by the capacity of its pugmill. The pugmill is the chamber where the aggregate and the PG binder are mixed together.

Batch plants may be portable or stationary. Portable plants can be erected and utilized at a location for a certain period of time. They can then be disassembled and taken to a different location to repeat the process. Stationary plants are erected and operated at a fixed location for extended periods of time.

Typically, aggregates are stockpiled until the asphalt mixture production begins. The aggregates are then transported into the cold feed bins. It is then necessary to heat and dry the aggregates prior to screening and storing of the heated aggregates. It is also necessary for the PG binder to be stored and heated prior to beginning the mixing process.

The batch plant produces the asphalt mixture by combining the proper proportions of the aggregates and the PG binder. Finally, the resulting mixture is loaded into the hauling trucks and transported to the job site.

At a drum plant, the mixing of the aggregates and PG binder takes place in the same drum where the aggregates are heated and dried. Also, the aggregate gradation is controlled at the cold feed bins rather than undergoing a screening process as is the case at a batch plant.

13.24.2 Asphalt Distributor

Asphalt distributors are used to apply asphalt material associated with tack coats, prime coats, dust palliatives, and other types of liquid applications. Figure 13.24-1 shows an asphalt distributor in use.

Figure 13.24-1. Asphalt Distributor

13.24.3 Hauling Equipment

Typically, tri-axle trucks haul asphalt mixtures from the mixing plant to the job site.

The truck beds are required to be tight, clean, and smooth. Approved anti-adhesive agents are required to be utilized to prevent residual mixture from adhering to the truck bed. Also, the truck beds require waterproof covers to protect the mixture from adverse weather conditions, prevent contamination of the mixture, and to maintain temperature on cool weather days.

13.24.4 Material Transfer Device

Material transfer devices, sometimes referred to as shuttle buggies or MTDs, are sometimes utilized in a paving operation. An MTD effectively increases the size of a paver's hopper. This is beneficial because segregation can occur in a newly placed course when a paver is required to stop when it runs out of mixture. Figure 13.24-2 shows an MTD taking a tri-axle load of mixture into its hopper and simultaneously transferring mixture into the paver's hopper.

Figure 13.24-2. Material Transfer Device

13.24.5 Paver

The paver is the piece of equipment that receives the asphalt mixture from the haul truck or MTD and places it on the treated subgrade, existing pavement, or a previously placed course. Pavers must be self propelled and may be either equipped with wheels or tracks. Augers and vibratory screeds are used to distribute the mixture.

Most pavers also employ automatic grade and slope controls which enable the paver to place the asphalt course at the proper profile and cross slope. Other paver features include extendable screeds and extendable augers.

A typical paver is depicted in Figure 13.24-3a.

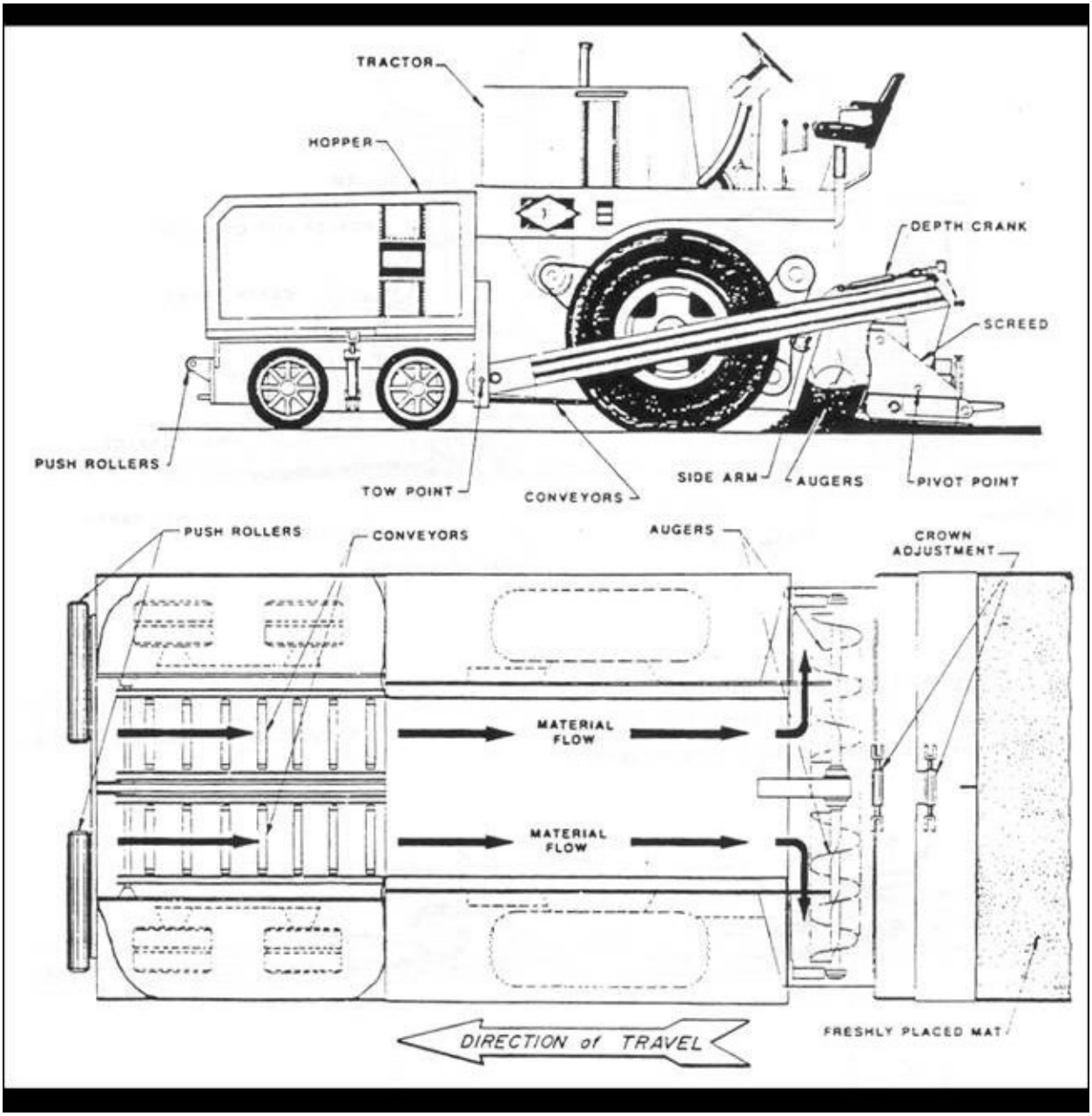


Figure 13.24-3a. Asphalt Paver

The use of spray pavers may be an option for the Contractor to consider for paving operations. Spray pavers combine the processes of both the paver and distributor truck into one machine. Spray pavers allow the Contractor to perform the application of an emulsion tack coat and the placement of an asphalt paving course in one process. The paver utilizes rows of emulsion

distribution nozzles placed in front of the hopper and near the rear axle. The distribution nozzles can coordinate spray patterns to place a uniform coat of emulsion on the existing surface.

The distribution nozzles provide a consistent and uniform application just prior to the placement of the asphalt pavement course. This process helps eliminate the potential for the traveling public or the paver to track emulsion on tires or treads.

These pavers can also perform paving operations without utilizing their emulsion application process. Spray pavers must be in accordance with 409.

A typical spray paver is shown in Figure 13.24-3b.

Spray paver nozzle distribution of emulsion is depicted in Figures 13.24-3c and 3d.

Figure 13.24-3b. Typical Spray Paver

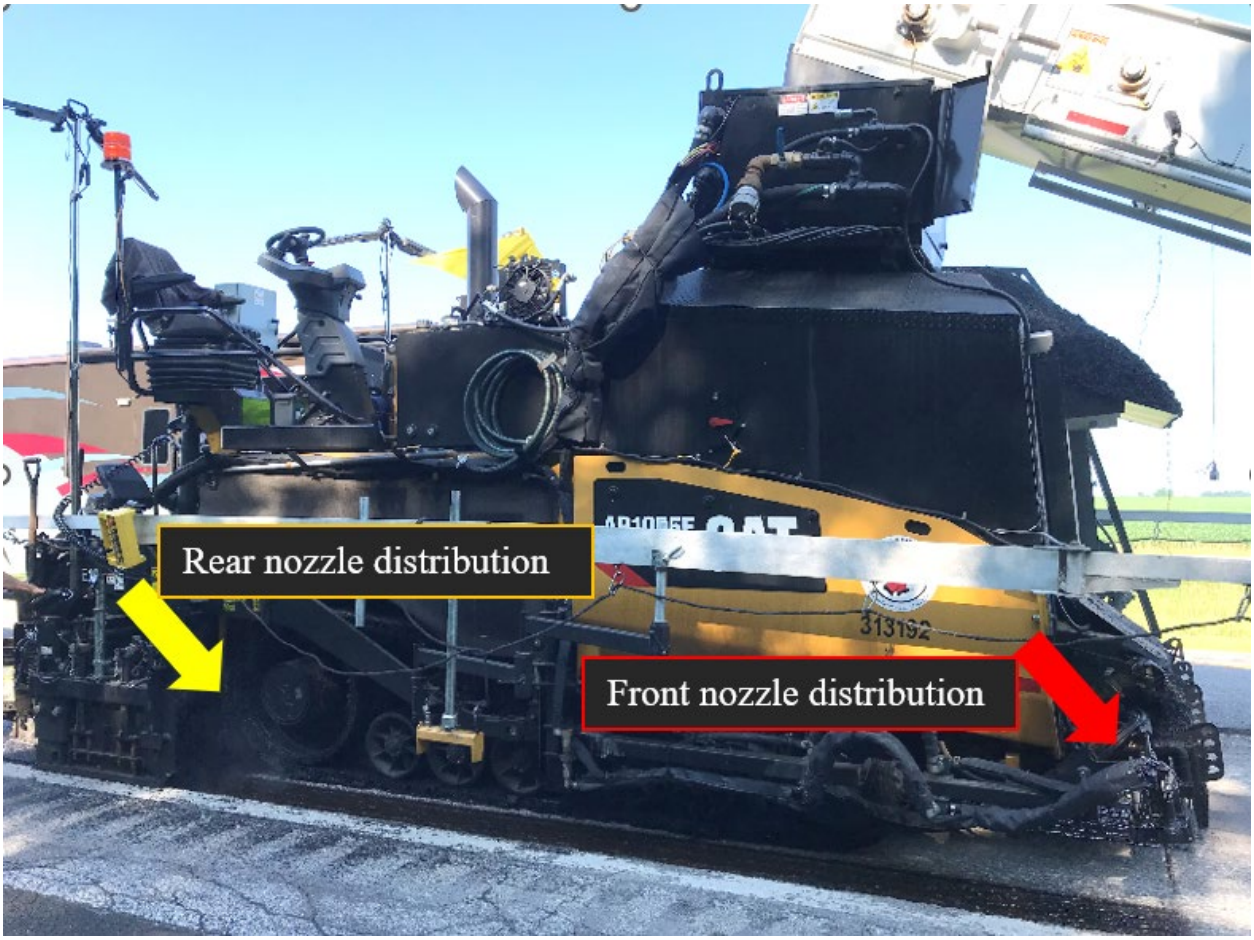


Figure 13.24-3c. Spray Paver With Front and Rear Nozzles Identified

Figure 13.24-3d. Spray Paver Emulsion Application Locations
Red indicates front nozzle application, and
Yellow indicates rear nozzle application

13.24.6 Wideners

Wideners are used in situations where the required paving width is insufficient to accommodate a paver. This piece of equipment typically casts the mixture to the side and is usually used to widen an existing pavement. Wideners are equipped with an adjustable screed which is capable of constructing a course to the proper grade and slope.

Figure 13.24-4 depicts a typical widener in use.

Figure 13.24-4. Widener

13.24.7 Tandem Roller

Tandem rollers have two axles/rollers. A tandem roller is used to compact newly constructed courses. The minimum weight for a tandem roller is 10 tons.

Figure 13.24-5 illustrates a tandem roller in use.

Figure 13.24-5. Tandem Roller

13.24.8 Three-Wheel Roller

Three-wheel rollers have three rollers, one on the forward axle and two on the rear axle. There is a minimum bearing requirement for the rear wheels of 300 lb/in in accordance with 409.03(d).

Figure 13.24-6 shows a three wheeled roller in use.

Figure 13.24-6. Three Wheeled Roller

13.24.9 Pneumatic Tire Roller

Pneumatic tire rollers may be used to compact QC/QA HMA or HMA mixtures but are not frequently used for that purpose. They may also aid in achieving density requirements in situations where steel-drum rollers may not suffice due to underlying pavement conditions. Pneumatic tire rollers are required to be used to seat the cover aggregate into the asphalt material in seal coats.

Requirements related to pneumatic tire rollers are included in 409.03.

Figure 13.24-7 shows a pneumatic tire roller in use.

Figure 13.24-7. Pneumatic Tire Roller

Figure 13.24-8 illustrates how the tires on a pneumatic tire roller are offset to facilitate complete coverage of an asphalt mixture or complete seating of seal coat cover aggregate with each pass.

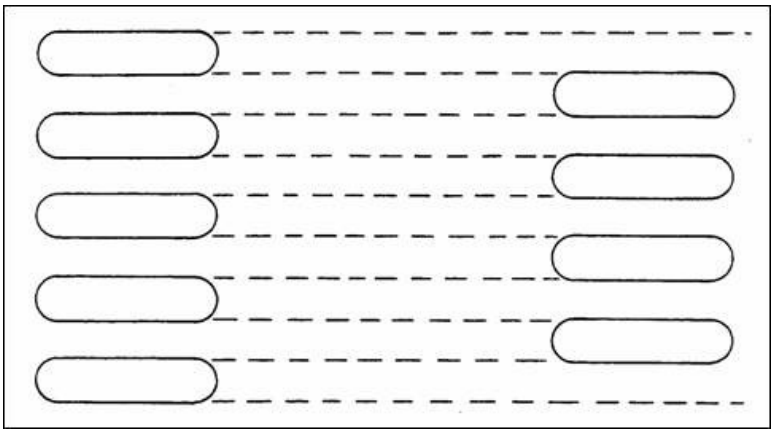


Figure 13.24-8. Pneumatic Tire Roller Tire Offset

13.24.10 Vibratory Roller

The rollers discussed previously use only the weight of the roller to achieve compaction while operating in static mode. Vibratory rollers are capable of imparting an impact loading on the mixture as they vibrate during operation. It is possible to control the frequency and the amplitude of the vibratory effort imparted by the roller.

Figure 13.24-9 shows a vibratory roller in use.

Figure 13.24-9. Vibratory Roller

13.24.11 Trench Roller

Trench rollers can be utilized to compact asphalt mixtures in situations where the width of course to be rolled is too narrow for traditional type rollers.

Figure 13.24-10 shows a trench roller.

Figure 13.24-10. Trench Roller

13.24.12 Aggregate Spreaders

Aggregate spreaders are sometimes referred to as chip boxes or spreader boxes. They are used to distribute cover aggregate over a freshly applied asphalt emulsion in seal coat operations.

Figure 13.24-11 shows an aggregate spreader in use.

Figure 13.24-11. Aggregate Spreader

13.24.13 Rotary Power Broom

Rotary power brooms can be used in multiple applications related to paving operations. They are used to clean existing pavements or previously placed underlying mixtures prior to placing tack coat. They can also be used to clean existing pavements prior to applying asphalt emulsion for seal coat. A third use for power brooms can be to remove excess cover aggregate from a newly placed seal coat.

A rotary power broom is shown below in Figure 13.24-12.

Figure 13.24-12. Rotary Power Broom

13.25 PG ASPHALT BINDER MATERIAL COST ADJUSTMENT

13.25.1 Introduction

Payment adjustments based on the change in cost of PG asphalt binder material is discussed in 109.05.3 of the SS. The cost of virgin PG binder material is tracked as an index on a monthly basis and the SS allows for a payment adjustment if the index for a given month varies more than 10% compared to the index in effect at the time of letting.

At the time a bid proposal is submitted, the Contractor will elect whether or not to enact the PG binder adjustment. This election will be noted on the proposal page of the bidder's submittal.

If the Contractor has opted out of using the PG binder adjustment, the specification and the pay item are not used on the contract. The Contractor cannot decide to utilize the option after submitting their bid.

If the Contractor has opted to include the specification, any HMA pay item with an original or revised quantity greater than or equal to 2,000 tons will require pay adjustments for the PG binder used in all HMA mixture pay items on the contract. It is important to note that the specification does not become effective until at least one HMA item's revised quantity meets or

exceeds the minimum requirements and that only future quantities are eligible for payment adjustments.

Payment adjustments will only be applied to contract pay items for HMA mixtures paid in accordance with 304, 401, 402, 410, 414, 610 and 718.

13.25.2 Calculation of Adjustments

When a Contractor has opted to use the PG binder adjustment specification and the contract meets the quantity requirements, it will be necessary to perform a monthly analysis, in accordance with the SS, to determine whether additional payment is due to either the Contractor or the Department based on fluctuations in the actual PG binder material cost.

PG binder price fluctuations are measured by the ratio of a binder index (BI) to an established letting binder index (LI) for the contract. The BI is determined by M&T and is published on a monthly basis on the Department's website. The letting index (LI) is the BI for the month prior to the contract letting date and will serve as the baseline of comparison for the BI throughout the duration of the contract.

If the BI for a given month is within 10.1% of the LI, no monthly adjustment is required. If the BI is at least 10.1% greater than the LI, then the Contractor is due additional payment for all HMA pay items under consideration in the contract placed during the month. If the BI is at least 10.1% less than the LI, then the Department is due a credit for all HMA pay items under consideration on the contract.

A spreadsheet is maintained on the Department's website and is available to calculate the required monthly payment adjustments as necessary.

After the end of a given month, it will be necessary to determine the quantities associated with each HMA mixture pay item/DMF combination during that month. This information, along with the BI associated with the month of placement, is input into the spreadsheet to determine whether or not a payment adjustment is required. Any monetary adjustment should be incorporated into a progress payment estimate within 30 days of the end of the month being analyzed.

13.25.3 Spreadsheet Data Input Instructions

Locate the spreadsheet on the Department's website and save a copy. Enter the required data for the month and save a copy of the completed spreadsheet as part of the contract files. This process will be repeated for each month throughout the duration of the contract.

The data fields that require user input are highlighted on the spreadsheet. The other boxes in the spreadsheet are locked and are used to display information or results which are calculated automatically.

1. **Contract No.** – Enter the contract number in the format "Prefix-XXXXX".

2. **Letting Date** – Enter the date of the letting in the format MM/DD/YYYY.

3. **Month & Year of Calculation** – Enter the month and year that the adjustment is being calculated for in the format MM/YYYY.

4. **LI** – Enter the binder index for the month before the letting. This information is available from M&T and on the Department's website. The LI is the BI for the month prior to the month of the contract letting. Once the LI value is determined, it will remain the same throughout the contract duration.

5. **BI** – Enter the binder index for the month under consideration for the adjustment determination. This information is available from M&T and on the Department's website.

6. After the **LI** and **BI** are entered, two calculations will be performed:

    a. The **(BI – LI)/100** will be calculated to the nearest 0.001.

    b. The absolute value of **(BI – LI)/100** will be compared to 0.101. If the result is less than 0.101, then no adjustment will be made for the month and the result of $0.00 will be shown in **Payment Adjustment, PG Asphalt Binder.** If the result is equal to or greater than 0.101, then a payment adjustment will be calculated for each pay item on the spreadsheet and the total adjustment for the month will be shown in **Payment Adjustment, PG Asphalt Binder.**

7. **MPA Data** – Enter the information in the highlighted boxes for each qualifying HMA pay item. The data in this section must be broken down by pay item and DMF. If a Contractor uses multiple DMFs for a single pay item, there needs to be separate entries for each pay item/DMF combination. For example, if a Contractor places HMA Base, HMA Intermediate, and HMA Surface during a month under consideration, which is paid in an "HMA for Approaches" pay item, there would be at least three entries for that pay item because each mixture requires a different DMF.

    Once the user has determined all the applicable pay item/DMF combinations, the appropriate data for each combination is entered. This data includes **"HMA Pay Item No."**, **"Pay Item Description"**, **"Q"** (quantity of mixture placed for the month by DMF), **"DMF"**, and **"P_b"** (percentage of virgin PG binder used in the mixture from the DMF). Once this data is input, the spreadsheet automatically calculates the payment adjustment dollar amount for each line and also calculates the total adjustment for all mixtures for the month.

    The quantity of HMA placed, Q, is defined in the SS as "Quantity of a HMA pay item placed, in tons, entered to the actual 0.01 unit placed. The quantity will

be calculated prior to any calculation of any other quantity adjustment". The value of Q is the actual tonnage prior to being adjusted by the MAF.

8. **Item No.** – Below the "MPA Data" table, input the contract pay item number for Payment Adjustment, PG Asphalt Binder from the Schedule of Pay Items.

9. **FCR Page No.** – The spreadsheet is set up to allow the user to print a hard copy of each month's adjustment. The user should input the appropriate page number for the month in sequence throughout the duration of the contract. The spreadsheet has no provision to automatically number the pages, so the data must be input.

An example spreadsheet showing entered data and results is also available on the Department's website. The user can change the LI, BI and Q to see how changes affect the adjustment calculation.

13.25.4 Spreadsheet Data File Management

It is recommended that the spreadsheet for each month be saved using a unique filename as follows (consistent with the Intelligent File Cabinet's document naming convention):

PGBA_123_Binder Index_"Optional Description"_YYMMDD

Where:

PGBA = Alphanumeric document identification for **PG B**inder **A**djustment

123 = Last three digits of the project's DES number

Binder Index = First description of the document

"Optional Description" = Optional secondary description of the document

YYMMDD = Date of document with 2 digits for year, month, and day.

The spreadsheet should then be attached to the Materials file within the contract's Intelligent File Cabinet.

Questions about the PG Binder Index and spreadsheet should be directed to the Construction Field Engineer for the District.