SECTION 13 – HOT MIX ASPHALT, HMA, PAVEMENT

13.1 INTRODUCTION *(Rev. 09-29-09)*

INDOT has specifications 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 Standard Specifications. All design mix formulas (DMF) are reviewed for compliance with the Standard Specifications.

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

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

(Rev. 09-29-09)

The contractor is responsible for QC of all phases of asphalt operations. The tolerances that the contractor must operate and control the quality within are defined in Sections 401 and 402, as appropriate.

For Section 401 pay items, to ensure that the contractor's QC procedures provide a finished product that is within the defined tolerances, the Department follows QA procedures. These procedures are designed to provide for inspection of the contractor's processes and random sampling of the material placed. The QA process is completed by the performance of testing of the samples by District Testing personnel.

For Section 402 pay items, the contractor provides a Type D certification in accordance with Section 916 as the basis of acceptance. No sampling of asphalt mixtures is required in conjunction with Section 402 work.

13.3 QUALITY CONTROL PLAN (QCP) *(Rev. 09-29-09)*

The contract specific steps that the contractor intends to use in its paving operations to ensure the construction of a quality pavement are included in its Quality Control Plan (QCP). The QCP must be prepared in accordance with ITM 803 and submitted by the contractor in accordance with 401.02.

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, not to incorporate the reviewer's personal preferences into the QCP. If there are any questions regarding QCP contents, the AE and District Testing 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 and return it to the contractor as soon as possible with a clear description of the deficient aspects of the plan. A primary review criterion for the QCP is whether or not 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 its 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 a 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 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 current approved version of the QCP remains in effect until the addendum is approved. Do not allow the proposed change be implemented 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 Specifications to resolve the problem. If a joint solution cannot be determined, contact the AE. The AE has resources at District Testing, Office of Materials Management, and Division of Construction Management 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 it and return it to the contractor with a clear description of the deficiencies with the addendum.

13.4 QUALITY ASSURANCE PROCEDURES (SECTION 401) *(Rev. 09-29-09)*

QA procedures are performed by the Department to verify that the contractor's work meets the requirements of the Standard Specifications. QA procedures require plate samples of the mixture to be taken from the mat after placement by the paver. The samples are then transported to District laboratory facilities for a battery of tests to determine the following volumetric properties:

- Binder Content
- Air Voids
- Voids in Mineral Aggregate, VMA

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

District Testing personnel will provide QA test results for mixture properties and density.

Pavement smoothness is another criterion which requires QA review. On some contracts, longitudinal profile is measured by a profilograph. Longitudinal profile on portions of these contracts that do not meet the warrants for a profilograph use a 16 ft straightedge to verify the longitudinal profile.

On contracts that do not include the profilograph pay item, use the 16 ft straightedge to verify longitudinal profile of the constructed pavement.

Regardless of the instrument used to measure the longitudinal profile, use a 10 ft straightedge 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 *(Rev. 09-29-09)*
All asphalt mixtures must be supplied by a certified HMA plant in accordance with ITM 583.

Section 401 pay items have a standardized format that provides information about the type of material required. Consider the following sample QC/QA HMA mixture pay item:

QC/QA HMA, 3, 70, Surface 9.5 mm

Where:

QC/QA HMA is read as "Quality Control, Quality Assurance Hot Mix Asphalt"

The **"3"** in the pay item reflects the ESAL category for the mixture. The ESAL category is a reflection of the truck traffic that is anticipated on the roadway. There are 5 ESAL categories and higher numbers reflect higher anticipated truck volumes. Therefore, the higher ESAL category mixtures require more durable aggregates to carry these additional loads.

The **"70"** in the pay item reflects the PG binder grade that is required for the mixture. Typical PG binder grades that appear in pay item descriptions include 58, 64, 70, and 76. Larger PG binder numbers reflect stiffer binders. These stiffer binders are typically required at locations where higher pavement temperatures are anticipated. Therefore, 70s and 76s are usually used in the upper courses of pavement and are more common in pavements in the southern portion of the state. PG 76 binders are also used in open graded mixtures.

The **"Surface"** in the pay item indicates the mixture type. Base, intermediate, and surface courses are the mixture types 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 lift) overlays. Surface mixtures are usually placed on underlying intermediate courses or on a milled pavement surface in mill and fill applications.

The **"9.5 mm"** in the pay item reflects 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, so refer to 401.05 for gradation range information.

The primary difference in the requirements for Section 402 materials compared to QC/QA HMA mixtures is that PG 58-28 and PG 64-28 are only to be used with mixtures that include more than 15% of recycled asphalt products, RAP, by weight.

A sample Section 402 mixture pay item follows:

HMA Surface, Type A

The **"Type A"** portion of the pay item is related to the ESAL category for the mixture. The ESAL categories range from Type A for the lowest anticipated truck traffic volumes to Type D for the pavements with the highest expected truck volumes. Unlike QC/QA HMA, Section 402 pay items do not include any reference to the PG binder required or a specific nominal aggregate size. The Standard Specifications include a minimum PG binder grade for each ESAL category and allow the contractor to select the nominal aggregate size for each mixture.

Asphalt mixtures may also include recycled asphalt pavement (RAP) asphalt replacement shingles (ARS) or a combination of both. There are maximum RAP and ARS amounts allowed in mixtures based on the course and ESAL category. The amount of RAP or ARS included in each mixture is identified in the contractor's DMF or Job Mix Formula (JMF).

Section 401 mixtures may be dense graded or open graded. All Section 402 mixtures are dense graded. Dense graded mixtures are the structural component of the pavement. Open graded mixtures are utilized to drain the pavement structure and provide a means for water to reach the underdrain systems which are utilized in conjunction with these mixtures.

13.6 DESIGN MIX FORMULA (DMF)/JOB MIX FORMULA (JMF) *(Rev. 09-29-09)*

The DMF is the format by which the contractor communicates its design for each HMA mixture to District Testing. ITM 583, Certified Hot Mix Asphalt Producer Program, is the primary document that includes requirements related to the development of DMFs. District Testing personnel should be able 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/ARS Content
- Volumetric Properties
- Mixture Adjustment Factor, MAF
- Other Miscellaneous Design Information

Once a DMF is approved by the District Testing Engineer, it is afforded an adjustment period each construction season that the design is utilized. The adjustment period is 5,000 tons for base and intermediate mixtures and 3,000 tons for surface mixes. During the adjustment period, the gradation and volumetric properties may be adjusted by the contractor. At the end of the adjustment period, all adjustments must be noted in the resulting JMF. The JMF must be submitted by the contractor to District Testing within one working day after the test results for the mixture volumetric properties are available for the adjustment period.

If the contractor elects to use an approved JMF from the beginning of a contract, there is no adjustment period for the approved mixture.

At the preconstruction conference, ask the contractor which DMF/JMFs are planned to be utilized on the contract. Additional questions include which alternate plants may be used on the contract and whether the required DMF/JMF approvals have been obtained for mixtures produced at that plant. Establish lines of communication between the contractor and the District Testing representative at the meeting to reduce the likelihood of misunderstandings between the parties regarding material sources and material sampling requirements for Section 401 mixtures. Make arrangements with the District Testing representative regarding transporting QA samples to the appropriate District Testing laboratory.

Become familiar with each DMF/JMF number as well as the PG binder content, MAF, and the pay item related information. Each weigh ticket associated with mixture brought to the contract site must include the information included in 109.01(b)—the DMF/JMF 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 is necessary to verify that the DMF/JMF number listed on the ticket is appropriate for the mixture associated with the current paving operation.

13.7 MATERIAL SAMPLING AND TESTING (SECTION 401) *(Rev. 09-29-09)*

Material sampling is very important because the contracts with QC/QA HMA pay items also include a QA Adjustment pay item which either provides the contractor with additional compensation for situations where the QA test results exceed Standard Specification requirements or provide the Department a credit if the test results fall short of these requirements. Sampling must be performed in accordance with ITM 580.

Verify that the contractor is performing QC sampling and testing in accordance with the approved QCP. Because INDOT is responsible for QA testing, determine the random QA sample locations, witness the material sampling performed by the contractor’s Certified

Technician, and take immediate possession of the samples. After the samples are taken to the appropriate District lab, District Testing personnel will run the required tests on the samples to verify conformance to 401 requirements. The mixture properties which are determined by the QA testing process include binder content, VMA, and air voids. In addition, after the paving operation is complete, cores are taken to measure in-place density and the smoothness of the pavement surface may be measured by the profilograph to complete the list of pay factors for the individual QC/QA HMA pay items.

After material samples are taken from the newly placed mat, verify that the plate sample locations are satisfactorily repaired by contractor personnel.

After cores are taken from the pavement to determine density, verify that contractor personnel physically mark the course for which the density is to be determined on the core and ensure that all core holes are filled with asphalt material within one working day after the cores are taken.

The required sampling frequency is based on lots and sublots, which are defined in 401.07. It is necessary to keep track of the quantity of each QC/QA mixture/DMF/JMF combination as it is being placed so the appropriate number of samples is obtained and that the samples are taken at the proper locations. Sample locations are to be random and the procedure required for determining these locations is included in ITM 802.

It is necessary to track the quantity of each QC/QA mixture/DMF/JMF combination as it is being placed in order to determine the physical limits of each sublot and lot. The PE/S should develop their own system for tracking lots and sublots. Record the beginning and ending stations and lane designation for each sublot or lot in the SiteManager DWR for the appropriate dates. If the paving operation changes lanes prior to reaching the end of a sublot or lot, record the ending station and lane designation for the first lane and the beginning station and lane designation for the new lane in the SiteManager DWR 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. Notify the DTE 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 DTE of the termination. In addition, if production of an individual QC/QA HMA mixture is going to be halted due to construction phasing or other similar reason, work with the contractor and the DTE to determine whether an agreement can be made to terminate the sublot at the temporary end of production. This may be advantageous should a failed materials issue arise because all of the mixture subject to the Failed Materials Committee action would be contained within one area or construction phase. If either the contractor or DTE does not agree to the early termination of the sublot, include the mixture placed at the

resumption of production in the original sublot.

13.8 MISCELLANEOUS MIXTURES (SECTION 402) *(Rev. 09-29-09)*
Section 402 mixtures include those used for the following miscellaneous applications—rumble strips, wedge and level courses, temporary pavement, and curbs. When used for these specific applications, there are some requirements for HMA materials used in normal paving operations that do not apply and in some situations, there are additional restrictions that apply to these specialty applications that are not applicable for normal HMA pavement mixtures.

13.9 PAVER SEGREGATION PREVENTION FEATURES *(Rev. 09-29-09)*
The contractor is required to submit documentation indicating that 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. The section also outlines additional requirements related to specific pavers which have been proven to be especially susceptible to segregation problems in the past. In addition to providing the documentation, the contractor is required to demonstrate that all of the modifications have been implemented on the paver.

Typically, these features mitigate segregation that is caused by the paver's gearbox. This segregation usually occurs in the middle of the mat and in most cases eventually results in a longitudinal crack.

13.10 SUBGRADE TREATMENT OR EXISTING PAVEMENT SURFACE PREPARATION REQUIREMENTS *(Rev. 09-29-09)*
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, while all other existing asphalt or concrete pavement surfaces require tack coat to be applied prior to placement of the overlay in accordance with 406.

13.11 WEATHER LIMITATIONS *(Rev. 09-29-09)*
There are two weather limitations pertaining to Section 401 paving operations that are specifically discussed in 401.13. The first one pertains only to mixtures with planned lay rates less than 138 lb/syd and it requires that the air temperature and the underlying surface temperature to be 45^{o} F or above. The other limitation listed is that no mixture is to be placed on a frozen subgrade. In situations where late season paving is required, contact the AE for guidance.

For Section 402 mixtures, additional weather constraints apply. Refer to 402.12 for these limitations.

If any portion of the paving operation is performed during a rainfall event, verbally notify the contractor that any additional mixture that is placed is at the contractor's risk. Follow up the verbal notification in writing and include the correspondence in the project file. After conclusion of the rainfall 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 with the contractor regarding the scope of corrective action, contact the AE.

In situations where a rainfall event occurs while mixture is being placed on a treated subgrade, suspend the paving operation immediately if the subgrade deforms in an unacceptable manner while loaded by trucks, paver, or other equipment included in the paving train. For this purpose, unacceptable deformation is defined as that which would require corrective action if noted during a proofroll operation. Note the suspension in the Engineer's Diary and notify the AE.

13.12 SPREADING AND FINISHING *(Rev. 09-29-09)*

As mixture is delivered to the site, spread by the paver, and compacted by rollers, pay attention to the following:

- Traffic control 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 mat behind the paver—segregation, flushing, roller marks, petroleum spills, etc.
- Verify correct placement of the mat—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 matching existing lanes if paving is performed under traffic
- Equipment used for placement of mainline and shoulder mixtures
- Roller operation

Verify that the contractor has adequate 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 to employ additional flaggers or signs as the paving train approaches intersections or other site specific locations. If there are deficiencies in the traffic control being provided by the contractor, 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 significant 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 while the paving operation is ongoing. 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, ensure that the application is uniform, complete, and at the appropriate rate. Common deficiencies in application of prime or tack coat include improper or incomplete coverage due to improper or clogged nozzles, incomplete coverage due to an improper spray bar height or width on the distributor, or improper application rates due to inappropriate distributor speed or mechanical problems with distributor equipment.

Periodically inspect the mat behind the paver and note any defects that need correction. There will be additional discussion regarding segregation and flushing below. Other defects include areas where petroleum products or hydraulic fluids are spilled. These liquids damage asphalt pavements. Petroleum products are often used by contractor personnel 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. Hydraulic fluids can be introduced to the mat by leaking hoses on the paver or other paving train equipment. It is usually necessary to remove the contaminated mixture from the mat and replace with new material.

Verify that the mat is being placed 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 also be placed too wide as well. Perform depth and width checks 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 by 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 mat by dividing the weight of the mixture by the area over which it is placed.

Compare the in-place lay rate to the target lay rate for the mixture—the target lay rate equals the planned lay rate from the appropriate typical section or Standard Drawing multiplied by the MAF. If there is more than a five percent difference between the in-place and target lay rates, notify the contractor that appropriate corrective action must be

taken.

Periodically confirm that the paver is progressing in a straight manner down the subgrade or existing pavement to be overlaid. Pavers that are overloaded or experiencing mechanical problems can fishtail. 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 at a time to allow the paver to operate in a straight manner. In order to ensure consistent placement of the mat, it is necessary for the paver to move as straight as possible.

If density of a Section 401 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.

Ensure that 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 that the contractor is matching adjacent lanes in accordance with 401.14, if 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(c)1. Essentially, this means that a paver must be used in these situations. Verify that the contractor's equipment meets this requirement. Shoulders that are narrower may be placed with a widener.

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

The primary differences are as follows:

- There are additional spreading and finishing requirements such as maximum paver speed; temperature requirements based on the DMF/JMF mixing temperature; requirement for tarp protection for HMA mixes being hauled to the contract site; and wedge and level course lay rates can vary from 1.5 to 6 times the maximum particle size listed in the DMF/JMF. Refer to 402.13 for additional information.
- The compaction requirements are based on the number of passes made by rollers of various types—these roller combinations are sometimes commonly referred to as a standard compaction train. For lay rates which are less than or equal to 440 lb/syd, four different roller combinations are illustrated and the number of passes made by each roller type is given. For lay rates which are less than 440 lb/syd, there are two different roller combinations shown with the associated pass requirements tabulated. In addition to the above noted requirements, the Standard Specifications include information related to maximum allowable roller speeds,

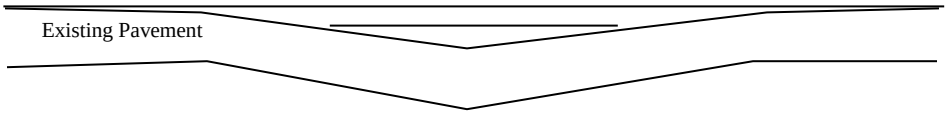
method of compaction, compaction equipment requirements for areas which are inaccessible to rollers, and emphasizes that the finish rolling operation shall leave no roller marks. For additional information related to compaction of HMA mixtures, refer to 402.15.

- If it becomes necessary to pave in low temperature situations, additional requirements to ensure proper compaction of HMA materials are contained in the specifications. These requirements especially come into play during the late construction season frenzy to get contracts buttoned up for the winter. Low temperature compaction requirements are contained in 402.16.

13.13 WEDGE AND LEVEL CONSTRUCTION (SECTION 402) *(Rev. 09-29-09)*

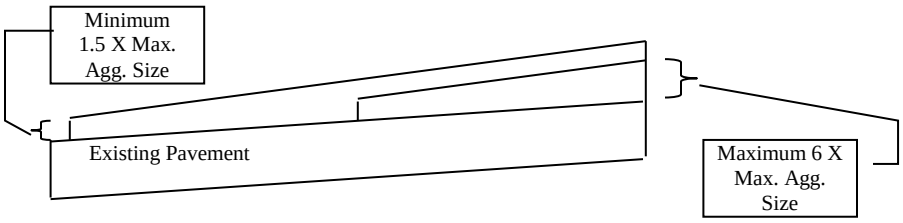
One of the more common miscellaneous Section 402 mixture applications is a wedge and level course. The wedge and level application is defined as HMA courses utilized to transition from an existing base with a deficient profile or section to one where uniform depth QC/QA HMA or HMA courses can be used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

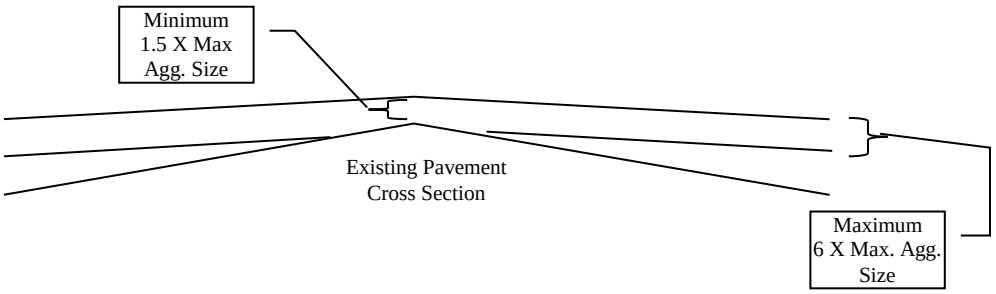


An example of an incorrect method of longitudinally correcting a dip or settlement in an existing pavement is shown below:

The number of wedge courses necessary to construct the desired superelevation on 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, 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.

13.14 JOINT CONSTRUCTION *(Rev. 09-29-09)*

Proper construction of joints is very important. Two primary causes of premature asphalt pavement failure are improper longitudinal joint construction and deficient joint density. 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 at the joint.

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, matching with adjacent pavement sections, and where indicated in the plans. Lapped joints for this purpose are not permitted.

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 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 such that the screed rests approximately over the joint line. After the hot mixture is conveyed into position, it should be allowed sufficient time 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. 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 mat and the adjacent existing pavement. These areas require transverse rolling or special compaction equipment.

13.15 SEGREGATION/FLUSHING *(Rev. 09-29-09)*

After completion of the rolling portion of the paving operation, look for defects in the newly placed mat. Segregation and flushing are two common problems. Segregation occurs when the fine and coarse aggregates become separated from each other during the hauling or paving operation. Segregated mats 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 mat where there are few, if any, pieces of coarse aggregate and mainly consists of asphalt coated fines—appearing like a sand surface. Common causes of segregation include improper loading into trucks, faulty paver auger operation, and situations where a paver is forced to stop because the hopper runs out of mixture. In order to avoid this situation, 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 for the paver and permit the paving operation to proceed almost indefinitely down the road 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 mat. This may result from excess tack coat being brought up through the mat, improper mixing of the mixture, or too much PG binder in the mixture.

The remedy for segregated mats usually requires removal of the affected areas and replacement with suitable material. Minor areas of segregation can be repaired by using a sand seal coat. Flushed pavement areas may require removal and replacement or diamond grinding or other fine milling to remove the excess asphalt. Mark all segregated or flushed areas for correction by the contractor prior to being covered up 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 Office of Materials Management, Division of Construction Management and Office of Pavement Engineering are all available resources for determining the scope of the required repair.

Another common defect in a newly placed mat is pulling or tearing. The mat can be torn or pulled by a paver that is traveling too fast, a paver with a screed that is worn or not heated properly, compacted by a roller that is traveling too fast or rolling a mix that is too tender. Mark all torn areas when discovered so they can be repaired prior to placing

another mixture on top or opening the road 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 mat, contact the AE if no agreement on an appropriate repair can be reached with the contractor.

13.16 COMPACTION/DENSITY *(Rev. 09-29-09)*

For Section 402 mixtures, compaction is performed in accordance with 402.15. Since cores are not taken to verify in-place density, ensure that the contractor is performing its rolling operation in accordance with the requirements of 402.15.

For Section 401 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, so refer to 401.16 to determine whether cores are required in these situations. When cores are not required, the density is assumed to be 92% 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 compaction beyond what is provided by the paver's vibratory screed. The intermediate rolling process compacts and seals the mixture. The finish rolling is necessary to take out roller marks and other imperfections that are present in the mat.

There are many aspects of the rolling operation that affect density in the mat. 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. Another factor that affects density is the manner in which the contractor rolls the newly placed mat. Some good information related to 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 as mixture properties and atmospheric conditions affect the compaction of the mat. While rolling, alternate trips or passes should be differing lengths so that the roller is not always reversing direction at the same location. The objective of the rolling operation from a functional perspective is to achieve the highest mat density possible. The contractor should be performing QC testing in conjunction with its rolling operation to maximize the density while minimizing the rolling effort. It is likely that the contractor will periodically have to adjust the number of roller passes as well as the amplitude and frequency of the vibratory rollers to achieve the desired results. From an aesthetic standpoint, there should be no roller marks, creases, or other surface defects in a mat when the rolling operation is complete. The approved QCP should include information regarding corrective action for situations where the rolling operation is not achieving satisfactory density results.

Areas that cannot be compacted by a roller must be thoroughly tamped with mechanical tamps or vibrators. Tampers should be operated in such a manner that the entire surface is thoroughly and uniformly compacted. Often the areas requiring tamping methods of compaction are at critical locations from a drainage standpoint and care must be exercised to avoid creation of low spots which allow water to pond adjacent to a gutter line.

During the rolling operation surface distresses may develop. Common distresses include waviness, surface cracks, honeycombed texture, shoving, and roller chatter in the surface. As is the case in the spreading operation, these may be due to one or a combination 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 of any mixture, the mat must be protected from vehicular traffic until it has sufficiently cooled 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 seal at the joint between the new mat and the adjacent curb or curb and gutter. Thorough compaction adjacent to the curb, at intersections and adjacent to castings is likewise essential to good construction. In addition to the compaction requirements, the finished surface mat must match 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. 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 Standard Specifications do not contain differing 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, contractors will request to have density requirements waived if it becomes necessary to turn off vibratory rollers 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 its vibratory rollers. However, some contractors are reluctant to take the time required to

determine the appropriate amplitude/frequency combination. Do not waive density requirements without OPE or Chief Engineer approval.

13.17 SMOOTHNESS *(Rev. 09-29-09)*

For Section 402 mixtures, verify the longitudinal profile of the newly constructed mat 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 Section 401 mixtures, smoothness is another factor that may be included in the QA Adjustment. The profilograph is the primary instrument that is used to measure pavement smoothness and the profilogram is the computerized output which displays the results of a profilograph run. On contracts which include the profilograph pay item, the contractor is responsible for operating the profilograph, but is required to provide the profilogram immediately after completion of each run. ITM 912 includes the requirements related to the operation of profilographs and includes a checklist of items to inspect prior to each profilograph run. Questions related to the profilograph should be directed to the AE or District Testing.

When the profilograph pay item is included in a contract that includes a full depth pavement or a multiple lift overlay, the contractor is required to run the profilograph on the top lift of QC/QA HMA Intermediate and on the QC/QA HMA Surface courses. The intent for the profilograph run on the QC/QA HMA Intermediate course is to identify individual bumps and dips that require correction prior to placing the surface mixture. In addition, the profilograph run on the QC/QA HMA Intermediate course is not used to determine a profile index to be considered for payment.

There are two purposes for the profilograph run on the QC/QA HMA Surface course. The first is to locate all bumps and dips that require corrective action in accordance with 401.18. Mark all such locations found by a profilograph run.

The second purpose is to determine the profile index associated with the QC/QA HMA Surface mixture. The profile index is used to determine the pay factor associated with smoothness in accordance with 401.19(c).

When the profilograph pay item is included in the contract, it is only used to measure smoothness on the lanes which meet all of the criteria contained in 401.18 and are not exempted by criteria included in ITM 912. 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 profilograph pay item in the contract, the 16 ft and 10.0 straightedges are used to check the newly placed QC/QA HMA mixtures as described above for Section 402 pavements. If these situations, smoothness is not considered in the QA Adjustment calculation.

Department personnel are responsible for furnishing and operating straightedges. 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 specification limits. Another method sometimes used involves heating the area requiring corrective action and compacting the warmed material. If this technique is used, verify that an open flame is not allowed to come in contact with the pavement. 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.

ITM 912 also includes information regarding areas which are exempt from smoothness measurements and how to accommodate partial sections encountered due to project limits or paving exceptions. Questions regarding these topics should be directed to the AE or the Office of Materials Management.

The contractor must include all possible methods of corrective action in the QCP. If a 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/QUALITY ASSURANCE ADJUSTMENTS (SECTION 401) *(Rev. 09-29-09)*

When a contractor produces a QC/QA HMA mixture to construct an asphalt pavement or overlay, payment for this work is 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 may have two components. The first component is based on mixture properties and density. Secondly, if the contract includes the profilograph pay item, there will be a QA Adjustment based on the profile index measured after the full depth pavement or overlay is constructed.

For all dense graded mixtures with a pay item/DMF/JMF combination quantity greater than one lot, the pay factors are determined based on percent within limits (PWL) methodology in accordance with 401.19(a). The final PWL Acceptance Worksheets for each pay item/DMF/JMF combination provided by District Testing includes composite pay factors for each lot based on mixture properties and density. Use this information to determine the QA Adjustment associated with mixture properties and density for each lot. Add all of the lot QA Adjustments for mixture properties and density to determine the overall QA Adjustment for mixture properties and density.

For all open graded mixtures and dense graded mixtures with pay item/DMF/JMF 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 in accordance with 401.19(b). The final Volumetric Acceptance Worksheets for each pay item/DMF/JMF

combination provided by District Testing includes composite pay factors for all mixture properties and density for each sublot. Use this information to determine the QA Adjustment associated with mixture properties and density for each sublot. Add all of the QA Adjustments for all mixture sublots to determine the overall QA Adjustment attributed to mixture properties and density.

Ensure that the final versions of the PWL or Volumetric Worksheets are used for determining the QA Adjustment associated with mixture properties and density. The contractor has a right to appeal QA test results and until appeals are finalized, the QA test results and pay factors are not final. Also, if the final version of either worksheet indicates a QA test failure, verify that correspondence related to disposition of this failed material has been received. If no such correspondence has been received, request a copy from District Testing.

For contracts that include the profilograph pay item, the smoothness QA adjustment is determined by the profile index determined by the profilograph for individual sections of pavement and is independent of the lot and sublot concept. Refer to 401.19(c) and ITM 912 for the definition of a smoothness section and the procedure for determining smoothness section limits.

After reviewing the profilogram, locate and mark all bumps and dips that exceed the 401.18 limits. In addition, smoothness sections which have a profile index that exceeds the limits included in 401.19(c) require corrective action to reduce the profile index to acceptable levels. After all contractor repairs are made, a new profile index will be determined for all affected smoothness sections by rerunning the profilograph. Verify that the repairs do not expose underlying pavement courses. If underlying courses are exposed, they require repair in accordance with 401.18.

Use 401.19(c) and the final profilogram to determine the pay factor for individual smoothness sections and the composite smoothness pay factor to determine the smoothness contribution to the QA Adjustment.

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

13.19 METHOD OF MEASUREMENT/BASIS OF PAYMENT *(Rev. 09-29-09)*

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 in the work. If a partial load is returned to the HMA plant, discuss with the contractor’s foreman to estimate the amount returned and record the amount on the ticket. If agreement cannot be reached on the amount returned, request a “weigh back” ticket for the truck.

13.20 WARRANTY HMA CONTRACTS (RECURRING SPECIAL PROVISION) *(Rev. 09-29-09)*

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

The scope of inspection on warranty QC/QA HMA mixtures is as follows:

- Collect weigh tickets
- Check in-place yield of mixture in accordance with 401.9 of this document.

On warranty contracts, the contractor is taking 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 its QCP. Requiring the contractor to perform its paving operation in a manner contrary to its documented intent may void the warranty.

There may be non-warranty QC/QA HMA and HMA pay items in warranty contracts. For these pay items, all normal specification requirements apply and normal QA sampling, QA testing, certification requirements, and inspection procedures are required.

13.21 DOCUMENTATION REQUIREMENTS *(Rev. 09-29-09)*

Keep the following documents in the project file:

- Approved DMF/JMFs
- QC Plan, Including Addenda
- QC Plan Approval or Rejection Correspondence
- PWL Acceptance Worksheets or Volumetric Acceptance Worksheets
- Profilograms
- Type D Certifications

It is acceptable to maintain hard copies of the above documents in a project file and/or scan them into SiteManager.

For Section 401 mixtures, maintain a running total of the quantity of mixture associated with each pay item/DMF/JMF combination outside of SiteManager in order 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 SiteManager 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 in lane two into the SiteManager 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 SiteManager 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 a file in the field office and incorporate them into the FCR.

For mixtures with QA pay factors that are calculated in accordance with 401.19(a), utilize

the completed PWL Acceptance Worksheet received from District Testing as documentation of pay factors associated with mixture properties and density by including a hard copy in the FCR. Include hard copies of all calculations for determining the quality assurance adjustment for mixture properties and density. Include hard copies of any correspondence related to failed materials in the FCR as well.

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

For contracts with the profilograph pay item, include a tabulation of the individual smoothness section pay factors, as well as the calculations of smoothness QA adjustments for individual sections and the total smoothness QA adjustment for the contract in the FCR.

The FCR also needs to include a tabulation of the overall contract QA Adjustment if there are both smoothness and mixture property/density components.

13.22 TACK COAT *(Rev. 09-29-09)*

Tack coat is used to prepare an existing pavement or a previously constructed course or asphalt pavement 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 commencing paving. Verify that 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.

13.22.3 Tack Coat Equipment

Tack coats are applied to the pavement surfaces by an asphalt distributor meeting the requirements of 409.03(a). 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 is to enhance bond between the newly placed mat and the existing pavement surface. Soil or other debris on the surface to be tacked prevents this bonding from taking place and defeats the purpose of applying the tack coat. All soil and other debris need to be removed from the existing surface prior to application of tack. A rotary power broom is commonly used for this purpose. If there are any areas that require additional cleaning after the power broom operation, this can be accomplished by hand methods.

13.22.5 Tack Coat Application

The surfaces that are to be tacked need to be dry to maximize bonding between the existing surface and the proposed mat. A common area of contention between contractors and the Department is related to how dry is sufficient to allow tack coat to be placed. In reality, it is acceptable to apply tack coat when there are isolated wet spots on the surface to be tacked. By isolated, 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 performance of the tack coat and paving operations is at its risk and that any delaminated areas shall be repaired at no cost to the Department.

It is important that the existing pavement be coated with the appropriate amount of tack in a uniform manner. One common deficiency is caused by clogged nozzles on the distributor spray bar. In situations where one or more of the spray bar nozzles is 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 emulsion.

Another problem which results in inadequate coverage of asphalt emulsion is improper distributor spray bar height. In order to achieve the proper coverage, the individual nozzle sprays must overlap sufficiently. If the spray bar is installed too low, 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 emulsion being sprayed from the distributor spray bar.

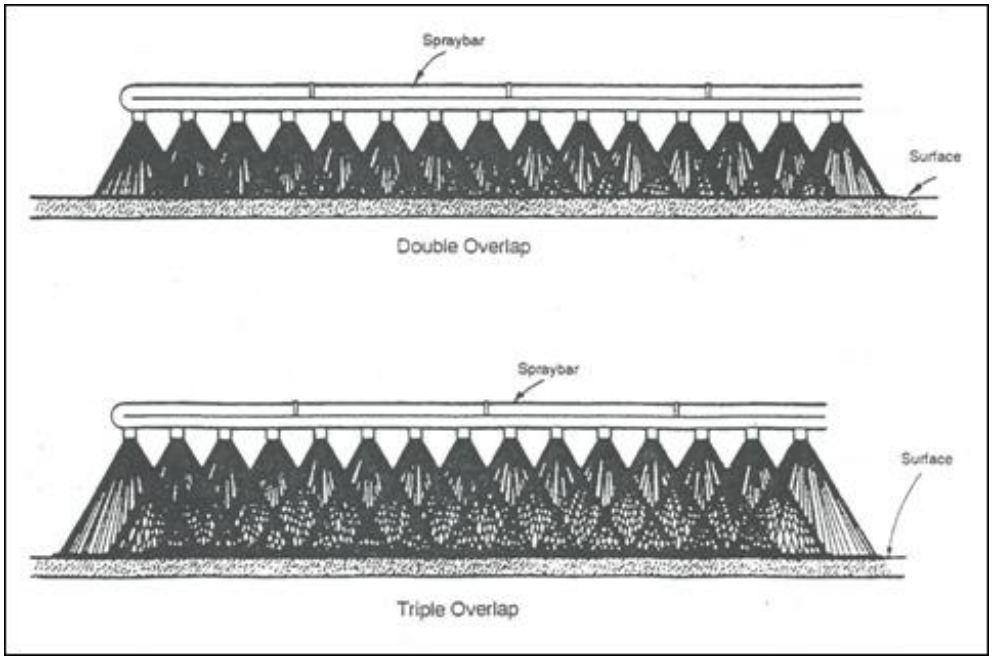


Figure 13.22-1 Desired Double or Triple Overlap

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

improper height.

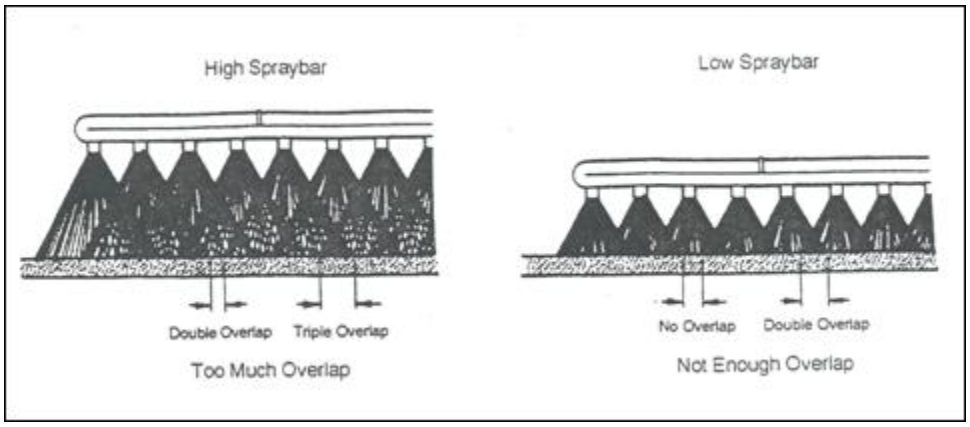


Figure 13.22-2 Non-Uniform Coverage Due to Improper Spray Bar Height

Distributor operation must be performed such that tack is only applied to the intended surfaces. Sometimes wind can or other environmental factors can result in wayward tack application. Usually, this problem can 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 they are inaccessible to the distributor must be coated by hand prior to construction of the overlying mat.

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. The new asphalt mat should not be placed onto the tacked surface until the break has occurred. The time required to achieve the tack coat break 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 SiteManager DWR. Maintain a hard copy of the daily calculations and sketches in a file in the field office and ultimately include in the FCR.

If tack coat is paid for by weight, collect the weigh tickets for each day. Run a daily total of weigh tickets to determine the daily quantity and enter in the SiteManager DWR for each day that tack coat is placed. Maintain the weigh tickets and calculator tapes in a file in the field office and include in the FCR.

13.23 SEAL COAT *(Rev. 09-29-09)*

Seal coat work consists of one or more applications of asphalt material, each followed by an application of aggregate. Some people refer to this work as chip sealing.

13.23.1 Seal Coat Quality Control

The quality control requirements for seal coat operations are included in 404.02. Review the QCP as soon as possible after receipt. The seal coat operation cannot begin until QCP approval is obtained. Refer to ITM 803 for the Seal Coat QCP checklist. The intent of the QCP review is to verify that 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, discuss all checklist items for which there are questions with the contractor.

13.23.2 Seal Coat Materials

The acceptable asphalt materials are listed in 404.03. The cover aggregate requirements are detailed in 404.04.

13.23.3 Seal Coat Types

The types of seal coats are listed in 404.04.

The types are identified by a number between 1 and 7 inclusive. In addition, a letter "P" may be added to the type, which indicates 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 an application of asphalt emulsion, followed by an application of cover aggregate, followed by a second application of emulsion, followed by a second layer of cover aggregate.

13.23.4 Seal Coat Weather Limitations

The weather limitations for the application of seal coats are listed in 404.05. In general, seal coats need to be applied to dry pavements on warm days. The emulsions used in seal coats must have the water evaporate, or commonly referred to break, in order for the seal coat to be able to withstand traffic. Surface water or cool temperatures delay the break and require traffic to stay off of the pavement longer than typically accepted by the general public. If it becomes necessary to perform seal coat work outside the weather parameters contained in 404.05, 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 is used to clean the existing pavement surface prior to application of the asphalt emulsion and to sweep excess aggregate from the seal coated surface. An asphalt distributor is used to apply the emulsion to the pavement surface. An aggregate spreader, or chip box, is used to distribute the cover aggregate to the surface after the emulsion is applied. A pneumatic tire roller is used to seat the cover aggregate into the emulsion. Steel wheeled rollers cannot be used in conjunction with a seal coat operation.

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 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 emulsion, ensure that all snowplowable pavement markers, structure castings, detector housings, and other items in the existing pavement are covered for protection. After completion of the seal coat operation, make sure 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 emulsion, and the cover aggregate. A common area of contention between contractors and the Department is related to how dry is sufficiently dry to allow seal coat to be placed. In reality, it is acceptable to apply seal coat when there are isolated wet spots on the surface. By isolated, 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 performance of the seal coat operation is at its risk and that any de-lamination that occurs must be repaired at no expense to the Department.

It is important that the existing pavement be coated with the appropriate amount of asphalt emulsion in a uniform manner. One common deficiency is caused by clogged nozzles on the distributor spray bar. In situations where one or more of the spray bar nozzles is 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 nozzles repaired or replace prior to resumption of application of the asphalt emulsion.

Another problem which results in inadequate coverage of asphalt emulsion is improper distributor spray bar height. In order to achieve the proper coverage, the individual nozzle sprays must overlap sufficiently. If the spray bar is installed too low, there will be insufficient overlap. If the spray bar is set too high, the overlap will not be uniform. Figure 13.23-1 illustrates the proper double or triple overlap resulting from the asphalt emulsion being sprayed from the distributor spray bar.

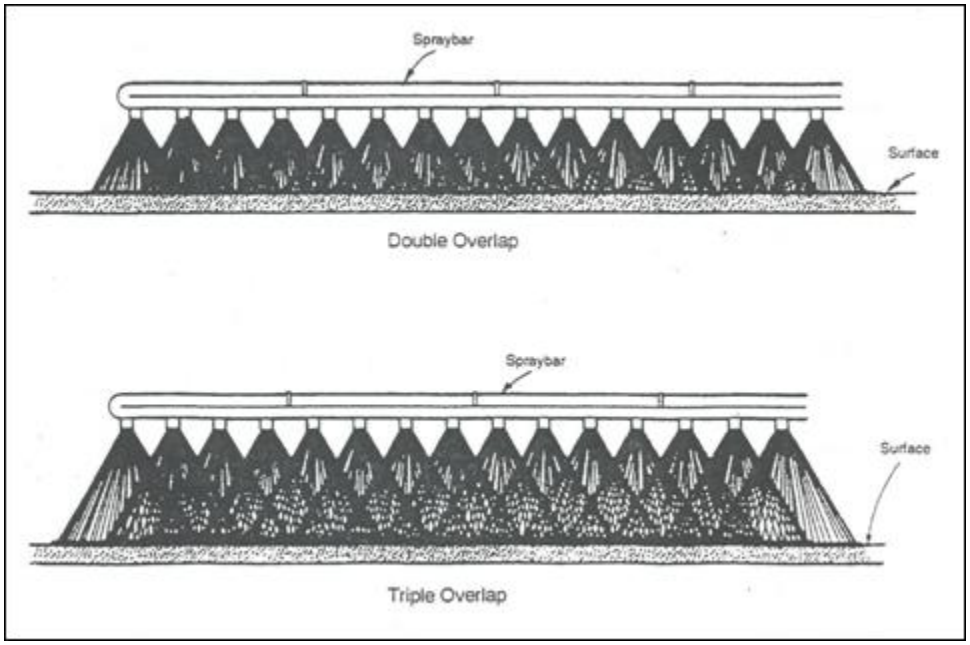


Figure 13.23-1 Desired Double or Triple Overlap

Figure 13.23-2 illustrates non-uniform coverage resulting from a spray bar installed at an improper height.

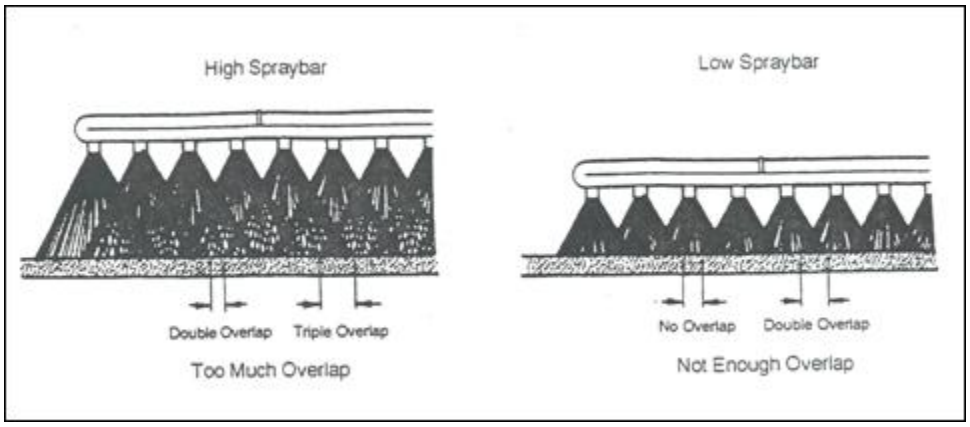


Figure 13.23-2 Non-Uniform Coverage Due to Improper Spray Bar Height

13.23.8 Application of Seal Coat Cover Aggregate

It is important that the cover aggregate be applied to the asphalt emulsion as soon as possible. When the asphalt 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 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 as soon as possible.

13.23.9 Rolling of Seal Coat Cover Aggregate

The intent of the rolling operation is to seat the cover aggregate instead of compacting a

mixture as is the case for traditional asphalt paving. In order to seat the cover aggregate properly, the required roller passes need to be performed prior to the break of the asphalt material.

13.23.10 Seal Coat Operation Traffic Control

Traffic control is a very important aspect of a seal coat operation. Verify that the contractor has enough signs and flaggers to direct traffic around the seal coat operation while it is ongoing and that the traffic control is adequate throughout the entire work area. It is necessary for 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 very important to limit the speed of the motoring public so that aggregate is not displaced by the traffic prior to being allowed to embed itself in the emulsion. This usually will 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. In addition, ensure 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

It is important to perform a brooming operation within approximately 24 hours after traffic has been placed on the newly seal coated surface. This will reduce the likelihood of damage to windshields and other vehicle parts. This rotary power broom should be applied lightly as the intent is to remove excess aggregate. The asphalt emulsion has not fully cured at this time, so the broom must be applied lightly enough not to dislodge aggregate that is coated, but not locked into the emulsion.

13.23.12 Seal Coat Documentations

Seal coat is measured and paid for by the square yard. On a daily basis, determine the area covered by the seal coat operation and note the quantity in the SiteManager DWR. Include all daily calculations and sketches in a file in the field office and in the FCR.

13.24 ASPHALT PAVING EQUIPMENT *(Rev. 09-29-09)*

13.24.1 Asphalt Mixing Plant

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

A batch plant gets its name from the fact that it produces HMA in batches. The maximum batch size that a plant can produce 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 batch plants can be erected, utilized at a location for a period of time, disassembled, and taken to a different location to repeat the process. Stationary batch plants are erected and operated at a fixed location.

Typically, aggregates are stockpiled until the asphalt mixture production begins. The aggregates are then transported into the cold feed bins. Next, it is necessary to heat and

dry the aggregates prior to screening and facilitate 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 next produces the mixture by mixing the proper proportions of the aggregates and the PG binder. Finally, the resulting mixture is loaded into the hauling trucks for transport to the contract site.

At a drum plant, the mixing of the aggregates and binder takes place in the same drum as 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 palatives, and other applications. An asphalt distributor is shown in Figure 13.24-1.

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 need to be tight, clean, and smooth. Approved anti-adhesive agents are to be utilized to prevent mixture from adhering to the truck bed. Also, the truck beds require waterproof covers to protect the mixture 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 the newly placed mat when a paver is required to stop because it has run out of mixture. Figure 13.24-2 is a photo of an MTD.

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 mixture. Pavers must be self propelled, but may be either equipped with wheels or tracks. Augers and vibratory screeds are used to distribute the mixture to the pavement mat. Most pavers also employ automatic grade and slope controls which enable the asphalt mat to be placed at the proper profile and cross slope. Other paver features include extendable screeds and extendable augers. A typical paver is depicted in Figure 13.24-3.

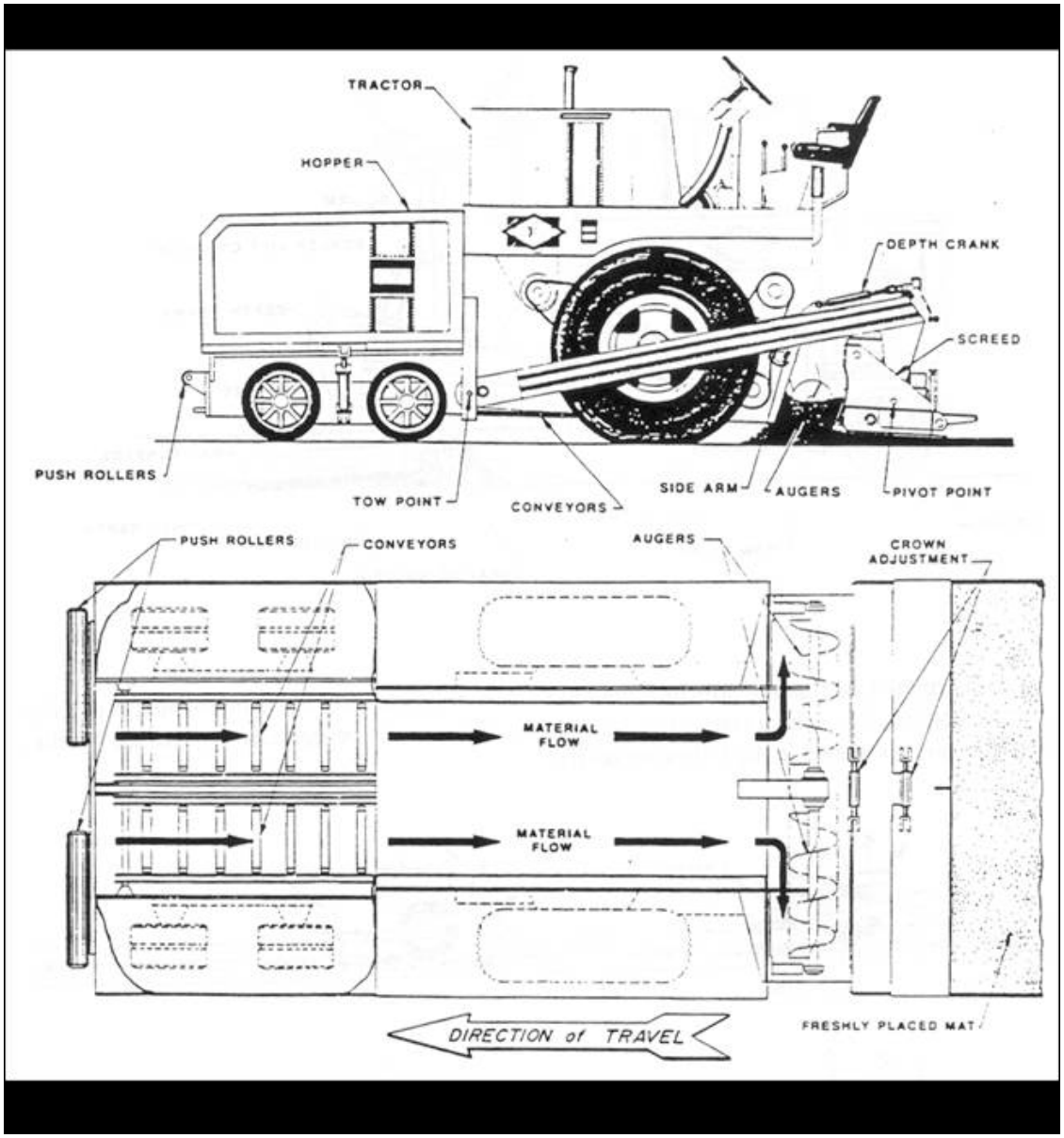


Figure 13.24-3 Asphalt Paver

13.24.6 Wideners

Wideners are used in situations where the required paving width is insufficient to accommodate a paver. The term “widener” is derived from the fact that 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 mat to the proper grade and slope. Figure 13.24-4 depicts a typical widener.

Figure 13.24-4 Widener

13.24.7 Tandem Roller

Tandem rollers are named based on the fact that they have two axles/rollers. A tandem roller is used to compact newly constructed mats. The minimum weight for a tandem roller is 10 tons. Figure 13.24-5 illustrates a tandem roller.

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 409.03(d).

Figure 13.24-6 is a photo of a three wheeled roller.

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 rarely used for that purpose. They 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(d). Figure 13.24-7 is a photo of a pneumatic tire roller.

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 compaction of an asphalt mixture or complete seating of seal coat cover aggregate with each pass.

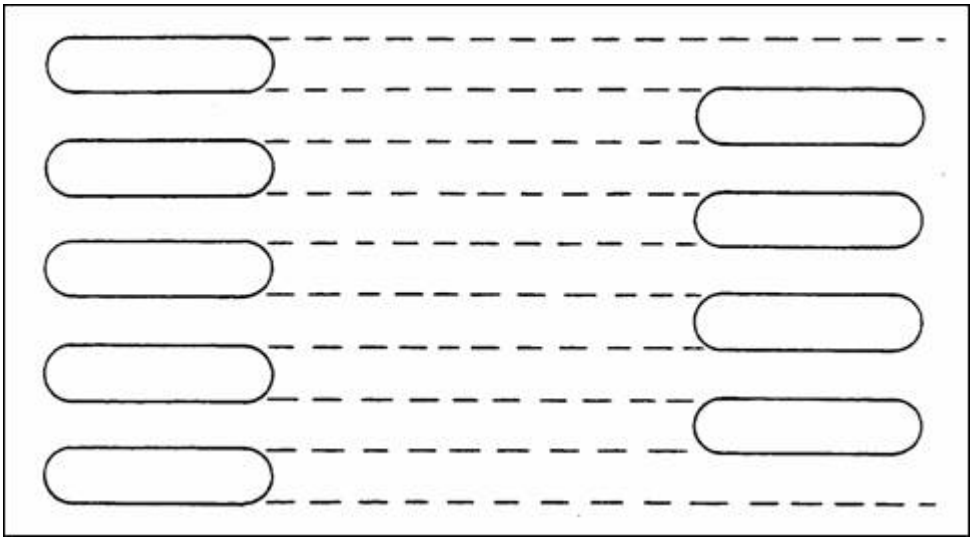


Figure 13.24-8 Pneumatic Tire Roller Tire Offset

13.24.10 Vibratory Roller

The prior rollers discussed only use the weight of the roller to achieve compaction as they operate 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 as well as the amplitude of the vibratory effort imparted by the roller. Figure 13.24-9 is a photo of a vibratory roller.

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 mat to be rolled makes the use of the rollers noted above ineffective. Figure 13.24-10 is a photo of a trench roller.

Figure 13.24-10 Trench Roller

13.24.12 Aggregate Spreaders

Aggregate spreaders are sometimes referred to as chip boxes. They are used to distribute cover aggregate over a freshly applied asphalt emulsion in seal coat operations. Figure 13.24-11 is a photo of an aggregate spreader.

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 an existing pavement or a previously placed underlying mixture prior to placing tack coat. They can also be used to clean an existing pavement prior to application of an asphalt emulsion related to a seal coat. A third use for these power brooms is 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 *(Rev. 09-29-09)*

13.25.1 Introduction

A contract may include a specification that provides for payment adjustments based on the change in cost of PG asphalt binder material. The cost of virgin PG binder material is tracked as an index on a monthly basis and the special provision 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.

Recurring Special Provision 109-C-219 and the associated pay item, "Payment Adjustment, PG Asphalt Binder", is currently included in all contracts let with 304, 401, 402, 410, 610 and 718 pay items. This is to avoid the need to write a Change Order to add the specification and pay item if the bidder opts for the provision.

At the time a bid proposal is submitted, the bidder will elect whether to opt in or out of use of Recurring Special Provision 109-C-219. This election will be noted on the proposal page of the bidder's submittal. A copy of the proposal page submitted by the successful bidder must be obtained from the District to determine if the provision is to be implemented on the contract.

If the Contractor has opted out of using the provision, then the provision and the pay item are not used on the contract. The Contractor cannot change its option after submittal of the bid. There is no need to write a Change Order to delete the provision and pay item if the Contractor has opted out; simply ignore the provision and do not pay any quantity on

the item.

If the Contractor has opted to include the provision, then any contract with at least one 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 provision 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, 610 and 718.

13.25.2 Calculation of Adjustments

When a Contractor has opted to use the provision and the contract meets the quantity requirements, it will be necessary to perform an analysis on a monthly basis in accordance with the recurring special provision to determine whether additional payment is due to the contractor or a credit is due the Department for fluctuations in the actual material cost of asphalt PG binders.

PG binder price fluctuations are measured by the ratio of a monthly binder index (BI) to an established letting binder index (LI) for the contract. The BI is determined by the Office of Materials Management 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 in the contract placed during the month under consideration. If the BI is at least 10.1% less than the LI, then the Department is due a credit for all HMA pay items on the contract.

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

Shortly after the end of a given month, it is necessary to determine the quantities associated with each HMA mixture pay item/DMF/JMF 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 to a folder on the computer. Then 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 the Office of Materials Management 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 the Office of Materials Management 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/JMF. If a contractor uses multiple DMF/JMFs for a single pay item, there needs to be separate entries for each pay item/DMF/JMF combination. For example, if a contractor places HMA Base, HMA Intermediate, and HMA Surface during the month under consideration which is all paid for 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/JMF.
   Once the user has determined all of the applicable pay item/DMF/JMF 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/JMF), **"DMF or JMF"**, and **"Pb"** (percentage of virgin PG binder used in the mixture from the DMF or JMF). Once this data is input, the spreadsheet automatically calculates the payment adjustment amount in dollars for each line and also calculates the total adjustment for all mixtures for the month.
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 print a hard copy of each month's adjustment for the Final Construction Record. The user should input the appropriate page number for the month in sequence throughout the duration of

the contract. As distributed, 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, i.e. – "XXXXX_July_2009.xls", where "XXXXX" is the 5 digit contract number. The spreadsheet should then be attached to the Correspondence Log in SiteManager in the "Other" document category as an "Other" type document.

The spreadsheet has some limitations. There are only fifteen lines available for data input in the "MPA Data" table. If a contractor places more than fifteen pay item/DMF/JMF combinations during the month under consideration, more than one spreadsheet will be required for that month.

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