Regional Engineers
Maureen M. Addis

Special Provision for Hot-Mix Asphalt – Quality Control for Performance
March 10, 2017

This special provision was developed by the Central Bureau of Materials to provide procedures for production, placement and payment of hot-mix asphalt (HMA) under the quality control for performance (QCP) program. It has been revised to include the construction specifications for “Intelligent Compaction”.

Intelligent compaction (IC) refers to an improved compaction process using rollers equipped with an integrated measurement system that consists of a highly accurate GPS, accelerometers, onboard computer reporting system, and infrared thermometers. IC rollers integrate measurement, documentation, and control systems thus allowing for real-time monitoring and corrections in the compaction process. IC rollers also maintain a continuous record of color-coded plots that indicate the number of roller passes and temperature of the HMA mat.

This special provision should be inserted into HMA contracts utilizing the QCP quality management program. The QCP quality management program is to be used for the following HMA mixtures.

1. Mainline mixture quantities between 1,200 and 8,000 tons (1,016 and 7,620 metric tons).
2. Shoulder applications that are greater than 8 feet (2.4 meters) wide and 1,200 tons (1,016 metric tons) and greater.
3. Leveling binder applications that are 1,200 tons (1,016 metric tons) and greater.

Note to designers: The option of using intelligent compaction should be given to the contractor (i.e. a number of roller passes should be entered in the HMA mix table on the plans) for leveling binder which will be placed at variable depth/thickness (i.e. used to correct cross-slope or rutting).

The Bureau of Design & Environment will insert this special provision for the April 28, 2017 and June 16, 2017 lettings. It will be officially issued for the August 4, 2017 letting. The districts should include the BDE Check Sheet marked with the applicable special provisions for the August 4, 2017 and subsequent lettings. The Project Development and Implementation Section will include a copy in the contract.

This special provision will be available on the transfer directory April 21, 2017.

80383m
HOT MIX ASPHALT – QUALITY CONTROL FOR PERFORMANCE (BDE)

Effective: April 1, 2017
Revised: April 2, 2017

Description. This special provision describes the procedures for production, placement and payment of hot-mix asphalt (HMA) under the quality control for performance (QCP) program; as well as the requirements for intelligent compaction. This special provision shall apply to the HMA mixtures specified in the plans. This work shall be according to the Standard Specifications except as modified herein.

Delete Articles:

406.06(b)(1), 2\textsuperscript{nd} Paragraph (Temperature Requirements)
406.06(b)(2)d. (Temperature Requirements)
406.06(b)(3)b. (Temperature Requirements)
406.06(e), 3\textsuperscript{rd} Paragraph (Paver Speed Requirements)
406.07(b) (Rolling)
406.07(c) (Density)
1030.05(a)(4, 5, 9,) (QC/QA Documents)
1030.05(d)(2)a. (Plant Tests)
1030.05(d)(2)b. (Dust-to-Asphalt and Moisture Content)
1030.05(d)(2)d. (Small Tonnage)
1030.05(d)(2)f. (HMA Sampling)
1030.05(d)(3) (Required Field Tests)
1030.05(d)(4) (Control Limits)
1030.05(d)(5) (Control Charts)
1030.05(d)(7) (Corrective Action for Field Tests (Density))
1030.05(e) (Quality Assurance by the Engineer)
1030.05(f) (Acceptance by the Engineer)
1030.06(a), 2\textsuperscript{nd} paragraph (Before start-up…)

Definitions.

(a) Quality Control (QC). All production and construction activities by the Contractor required to achieve the required level of quality.

(b) Quality Assurance (QA). All monitoring and testing activities by the Engineer required to assess product quality, level of payment, and acceptability of the product.

c) Pay Parameters. Pay parameters shall be field voids in the mineral aggregate (Field VMA), voids, and density. Field VMA will be calculated using the combined aggregates bulk specific gravity (G_{sb}) from the mix design.

(d) Mixture Lot. A mixture lot shall begin once an acceptable test strip has been completed and the adjusted job mix formula has been determined. If the test strip is waived, a mixture lot shall begin with the start of production. A mixture lot shall consist of four
sublots unless it is the last or only lot, in which case it may consist of as few as one sublot.

(e) Mixture Sublot. A mixture sublot for Field VMA, voids, and dust/AC shall be a maximum of 1000 tons (910 metric tons).

(1) If the remaining quantity is greater than 200 tons (180 metric tons) but less than 1000 tons (910 metric tons), the last mixture sublot will be that quantity.

(2) If the remaining quantity is 200 tons (180 metric tons) or less, the quantity shall be combined with the previous mixture sublot.

(f) Density Interval. Density intervals shall be every 0.2 miles (320 m) for lift thicknesses of 3 in. (75 mm) or less and 0.1 miles (160 m) for lift thicknesses greater than 3 in. (75 mm). If a density interval is less than 200 ft (60 m), it will be combined with the previous density interval.

(g) Density Sublot. A density sublot shall be the average of five consecutive density intervals.

(1) If less than three density intervals remain outside a density sublot, they shall be included in the previous density sublot.

(2) If three or more density intervals remain, they shall be considered a density sublot.

(h) Density Test. A density test shall consist of a core taken at a random location within each density interval.

When establishing the target density, the HMA maximum theoretical gravity \((G_{mm})\) shall be based on the running average of four Department test results. Initial \(G_{mm}\) shall be based on the average of the first four test results. If less than four \(G_{mm}\) results are available, an average of all available Department \(G_{mm}\) test results shall be used.

If the Contractor opts to use intelligent compaction, the Contractor may receive 100 percent for the density pay factor in Equation 1 of the Department’s Manual of Test Procedures for Materials “QCP Pay Calculation” document for each applicable HMA mixture. The Contractor may only select this option if the HMA Mixture Requirements table on the plans specifies values in the “Roller Type / Number of Passes / Compaction Temperature Range” cell. Intelligent compaction shall be performed according to the Department’s Manual of Test Procedures for Materials “Procedure for Intelligent Compaction”.

Quality Control (QC) by the Contractor. The Contractor’s QC plan shall include the schedule of testing for both pay parameters and non-pay parameters required to control the product such as asphalt binder content and mixture gradation. The minimum test frequency shall be according to the following table.
The Contractor’s splits in conjunction with other quality control tests shall be used to control production.

The Contractor shall submit split jobsite mix sample test results to the Engineer within 48 hours of the time of sampling. All QC testing shall be performed in a qualified laboratory by personnel who have successfully completed the Department’s HMA Level I training.

Intelligent Compaction. When a “Number of Roller Passes” is specified in the HMA Mixture Requirements table on the plans, the Contractor may opt to use intelligent compaction (IC) in lieu of density testing.

The IC equipment shall be mounted on the breakdown roller(s) and shall record GPS location data, roller pass counts, roller speeds, and HMA mat temperatures. Each day, the accuracy of the GPS and temperature data shall be verified and documented. If the verification fails or is not performed, the IC data will not be used for the affected density sublots.

The IC data for each density sublot shall be analyzed using Veta software to determine the average roller speed, percent roller coverage, and average mat surface temperature for the final roller pass. The Contractor shall submit these summary results, and if requested the raw data from the IC equipment and the data analysis software, to the Engineer within 24 hours of each day of paving using IC.

The required number of roller passes shall be as specified on the plans. The roller speeds shall be according to Article 406.07. The minimum roller coverage shall be 95 percent. The average HMA mat temperature for the final roller pass shall be according to the following table.

<table>
<thead>
<tr>
<th>Asphalt Mixture Type</th>
<th>Temperature Range (°F (°C))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm Mix Asphalt</td>
<td>215-275 °F (102-135 °C)</td>
</tr>
<tr>
<td>IL-4.75</td>
<td>310-350 °F (155-175 °C)</td>
</tr>
<tr>
<td>HMA using SBS PG76-22</td>
<td>310-350 °F (155-175 °C)</td>
</tr>
<tr>
<td>HMA using SBS PG76-28</td>
<td>310-350 °F (155-175 °C)</td>
</tr>
<tr>
<td>Other HMA not listed above</td>
<td>260-325 °F (125-165 °C)</td>
</tr>
</tbody>
</table>
Quality Assurance (QA) by the Engineer. Quality Assurance by the Engineer will be as follows.

(a) Voids, Field VMA and Dust/AC Ratio. The Engineer will determine the random tonnage and the Contractor shall be responsible for obtaining the sample according to the Department’s Manual of Test Procedures for Materials “PFP Hot-Mix Asphalt Random Jobsite Sampling Procedure”.

(b) Density: After final rolling, the Engineer will identify the random core locations within each density testing interval according to the Department’s Manual of Test Procedures for Materials “PFP and QCP Random Density Procedure”.

The Contractor shall cut the 4 in. (100 mm) cores within the same day and prior to opening to traffic unless otherwise approved by the Engineer. All core holes shall be filled immediately upon completion of coring. All water shall be removed from the core holes prior to filling. All core holes shall be filled with a rapid hardening mortar or concrete which shall be mixed in a separate container prior to placement in the hole. Any depressions in the surface of the filled core holes greater than 1/4 in. (6 mm) at the time of final inspection will require removal of the fill material to the depth of the lift thickness and replacement.

The Engineer will witness and secure all mixture and density samples. The Contractor shall transport the secured sample to a location designated by the Engineer.

The Engineer will test one or all of the randomly selected split samples from each lot for voids, Field VMA and dust/AC ratio. The Engineer will test a minimum of one sample per project. The Engineer will test all of the pavement cores for density unless intelligent compaction is used. All QA testing will be performed in a qualified laboratory by personnel who have successfully completed the Department’s HMA Level I training. QA test results will be available to the Contractor within ten working days from receipt of secured cores and split mixture samples.

The Engineer will maintain a complete record of all Department test results and copies will be provided to the Contractor with each set of sublot results. The records will contain, at a minimum, the originals of all Department test results and raw data, random numbers used and resulting calculations for sampling locations, and quality level analysis calculations.

If the QA results do not meet the 100 percent sublot pay factor limits or do not compare to QC results within the precision limits listed below, the Engineer will test all split mix samples for the lot.

<table>
<thead>
<tr>
<th>Test Parameter</th>
<th>Limits of Precision</th>
</tr>
</thead>
<tbody>
<tr>
<td>$G_{mb}$</td>
<td>0.030</td>
</tr>
<tr>
<td>$G_{mm}$</td>
<td>0.026</td>
</tr>
<tr>
<td>Field VMA</td>
<td>1.0 %</td>
</tr>
</tbody>
</table>
Acceptance by the Engineer. All of the Department’s tests shall be within the acceptable limits listed below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Acceptable Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field VMA</td>
<td>-1.0 – +3.0%¹</td>
</tr>
<tr>
<td>Voids</td>
<td>2.0 – 6.0%</td>
</tr>
<tr>
<td>Density</td>
<td>IL-9.5, IL-19.0, IL-4.75, IL-9.5FG³</td>
</tr>
<tr>
<td></td>
<td>90.0 – 98.0%</td>
</tr>
<tr>
<td></td>
<td>SMA</td>
</tr>
<tr>
<td></td>
<td>92.0 – 98.0%</td>
</tr>
<tr>
<td>Dust / AC Ratio</td>
<td>0.4 – 1.6²</td>
</tr>
</tbody>
</table>

¹/ Based on minimum required VMA from mix design
²/ Does not apply to SMA.
³/ Acceptable density limits for IL-9.5FG placed less than 1 1/4 in. (32 mm) shall be 89.0% - 98.0%

In addition, no visible pavement distresses shall be present such as, but not limited to, segregation, excessive coarse aggregate fracturing or flushing.

Basis of Payment. Payment will be based on the calculation of the composite pay factor using QA test results for each mixture according to the Department’s Manual of Test Procedures for Materials “QCP Pay Calculation” document.

If the intelligent compaction option is chosen and successfully implemented, the Contractor may receive 100 percent for the density pay factor in Equation 1 of the Department’s Manual of Test Procedure for Materials “QCP Pay Calculation” document for each applicable HMA mixture; otherwise, if the specified roller type, passes, temperature and speed requirements are not met, the density tests and pay adjustments will apply. The pay factor for each density sublot will be based upon either intelligent compaction or density tests and the two will not be mixed.

Dust/AC Ratio. A monetary deduction will be made using the pay adjustment table below for dust/AC ratios that deviate from the 0.6 to 1.2 range. If the tested mixture sublot is outside of this range, the Department will test the remaining sublots for dust/AC pay adjustment.

<table>
<thead>
<tr>
<th>Dust/AC Pay Adjustment Table¹/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
</tr>
<tr>
<td>0.6 ≤ X ≤ 1.2</td>
</tr>
<tr>
<td>0.5 ≤ X &lt; 0.6 or 1.2 &lt; X ≤ 1.4</td>
</tr>
<tr>
<td>0.4 ≤ X &lt; 0.5 or 1.4 &lt; X ≤ 1.6</td>
</tr>
<tr>
<td>X &lt; 0.4 or X &gt; 1.6</td>
</tr>
</tbody>
</table>

¹/ Does not apply to SMA.