Chapter 8 Materials Testing, Sampling, Acceptance
Section 36 QMP - HMA

Materials sampling and testing methods and documentation procedures prescribed in chapter 8 of the CMM are mobilized into the contract by Standard Spec 106.3.4.1 and Standard Spec 106.3.4.3.1. Hot Mix Asphalt (HMA) Quality Management Program sampling, testing, materials properties, and documentation as prescribed in CMM 8-36 are called into the contract by Standard Spec 460.2.8.

8-36.1 General
This section addresses the standard specification for Quality Management Program (QMP), Asphalitic Mixture.

The QMP for Hot Mix Asphalt (HMA) is detailed in Standard Spec 460.2.8. The following information is provided as additional reference, interpretation, and guidance for procedures outlined in those specifications.

Overview - WisDOT QMP Requirements:
- Personnel and required certifications (CMM 8-36.2 and Standard Spec 460.2.8.2.1.1)
- Laboratory facilities (CMM 8-36.3 and Standard Spec 460.2.8.2.1.2)
- Random sampling and sampling frequency (CMM 8-36.4 and Standard Spec 460.2.8.2.1.3)
- Required testing (and calculated properties) (CMM 8-36.6 and Standard Spec 460.2.8.2.1.3)
  - Mixture bulk specific gravity (Gmb)
  - Mixture maximum specific gravity (Gmm)
  - Air voids (Va)
  - VMA (voids in mineral aggregate)
  - Aggregate gradation
  - Percent binder content
- Documentation (CMM 8-36.8 and Standard Spec 460.2.8.2.1.4)
  - Records
  - Control charts
- Control limits (Standard Spec 460.2.8.2.1.5)
- Job mix formula adjustments (CMM 8-65.8 and Standard Spec 460.2.8.2.1.6)
- Corrective action (Standard Spec 460.2.8.2.1.7)
- Verification program (CMM 8-36.9 and Standard Spec 460.2.8.3.1)

The following sections identify and further attempt to clarify procedures used during field production of HMA under the QMP.

8-36.1.1 Definitions

| Rule of Retained: | Split samples for comparison testing are retained. In order to test a retained portion of any sample, communications must occur between the department and contractor QMP teams. The department has ownership of QMP required split samples. There is implied joint ownership between contractor and department on any additional QC samples recorded. |
| Working days: | Days of production of a specific design mixture being tested. |
| Nonconforming materials: | Mixture not meeting acceptable verification parameters, but allowed to be left in place with appropriate payment reduction. |
| Unacceptable materials: | Mixture not meeting acceptable verification parameters and being required to be removed and replaced. |
| Teams: | Personnel listed on QMP organizational charts. |
8-36.2 Personnel Requirements (Through HTCP)

The following list summarizes minimum personnel requirements and associated certifications to satisfy QMP Asphalt activities.

1. QC: Production process
   - Sampling: HMA Tech certified at a level recognized for mixture production testing (HTCP-certified Transportation Materials Sampling Technician (TMS)).
   - Production Control Testing: HMA Tech certified at a level recognized for mixture production testing (HTCP-certified Hot Mix Asphalt, Technician I, Production Tester (HMA-IPT)).
   - Production process changes: HMA Tech certified at a level recognized for production process control and troubleshooting (HTCP-certified Hot Mix Asphalt, Trouble Shooting, Process Control Technician (HMA-TPC)).
   - Mix design: HMA Tech certified at a level recognized for conducting mix designs and report submittals (HTCP-certified Hot Mix Asphalt, Mix Design, Report Submittals Technician (HMA-MD)).

2. QV: Department quality verification
   - Sampling: HMA Tech certified at a level recognized for mixture production testing (HTCP-certified Transportation Materials Sampling Technician (TMS)).
   - Production Control Testing: HMA Tech certified at a level recognized for mixture production testing (HTCP-certified Hot Mix Asphalt, Technician I, Production Tester (HMA-IPT)).
   - Production process change review: HMA Tech certified at a level recognized for reviewing mix design work (HTCP-certified Hot Mix Asphalt, Mix Design, Report Submittals (HMA-MD) technician).

8-36.3 Laboratory Requirements

The laboratory must be:
- Furnished with equipment to comply with daily testing and communication requirements (calibrated testing equipment, phones, copy machines, etc.).
- Located at the plant site and operational before production.
- A Wisconsin Laboratory Qualification Program participant.

The intent is for the \( G_{mm} \) and \( G_{mb} \) materials to be tested at the same facility.

8-36.4 Sampling Hot Mix Asphalt

At the beginning of each day the contractor determines the anticipated tonnage to be produced. The frequency of sampling (minimum number of required tests for the day’s anticipated production) is defined by the latest (QMP) HMA mixture Standard Spec 460.2.8.2.1.3. A test sample is obtained randomly from each subplot.

**Example 1**

<table>
<thead>
<tr>
<th>Expected day's production is 1,900 tons. The number of required samples = 3 (per QMP standard spec 460.2.8.2.1.3).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample 1 – from 50 to 600 tons.</td>
</tr>
<tr>
<td>Sample 2 – from 601 to 1500 tons.</td>
</tr>
<tr>
<td>Sample 3 – from 1501 to 2700 tons.</td>
</tr>
</tbody>
</table>

The approximate location of each sample within the prescribed sublots is determined by selecting random numbers using ASTM D3665 or by using a calculator or computerized spreadsheet that has a random number generator. The random numbers selected are used in determining when a sample is to be taken and will be multiplied by the sublot tonnage. This number will then be added to the final tonnage of the previous sublot to yield the approximate cumulative tonnage of when each sample is to be taken.

To allow for plant start-up variability, the procedure calls for the first random sample to be taken at 50 tons or greater per production day (not intended to be taken in the first two truckloads). Random samples calculated for 0-50 ton should be taken in the next truck (51-75 ton).
Example 2

<table>
<thead>
<tr>
<th>Required Sample</th>
<th>Sublot Sample Tonnage Range</th>
<th>Random No.</th>
<th>Sublot Sample Ton (Random No. x Sublot Ton)</th>
<th>End of Previous. Range</th>
<th>Cumulative Sample Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50 - 600</td>
<td>0.572</td>
<td>RN x 600= 343</td>
<td>0</td>
<td>343</td>
</tr>
<tr>
<td>2</td>
<td>601 - 1500</td>
<td>0.353</td>
<td>RN x 900= 318</td>
<td>600</td>
<td>918</td>
</tr>
<tr>
<td>3</td>
<td>1501 - 1900</td>
<td>0.656</td>
<td>RN x 400= 262</td>
<td>1500</td>
<td>1762</td>
</tr>
</tbody>
</table>

This procedure is to be used for any number of samples per day.

If the anticipated day’s production is 1900 tons, then the third random sample would be calculated between 1501 and 1900 tons (i.e., \(0.656 \times 400 = 262\) and \(262 + 1500 = 1762\)). If production doesn’t meet the anticipated tonnage to allow for obtaining the next randomly generated sample, then an additional sample will be taken within the last 100 tons of the day to fulfill the sampling frequency requirement defined in Standard Spec 460.2.8.2.1.3.1 (5) (Document reasons for any non-compliance Note: If this scenario occurs, by definition, this sample qualifies as being a random sample within the QMP program frequency requirements, meaning, if anticipated tonnage is exceeded, a second sample should not be taken within the same interval.

It’s intended that the plant operator not be advised ahead of time when samples are to be taken. If the plant operator is involved in recording a Pb (%AC) to match up with the mix sample tonnage, then notification need not be earlier than 60 minutes before the mix sample being taken.

If belt samples are used during troubleshooting, the blended aggregate will be obtained when the mixture production tonnage approximates the sample tonnage. For plants with storage silos, this could be up to 60 minutes in advance of the mixture sample that’s taken when the required tonnage is shipped from the plant.

QC Sample:
- Sample size only requires one “test” portion and one “retained” portion.

QV Sample:
- Must be directly observed by the project engineer.
- Project engineer takes immediate possession.
- The initial split of QV and QV-retained, can be performed by using a quartermaster. If the contractor performs this split, the project engineer, before taking possession, must directly observe it.
- Any dispute resolution testing requires QV personnel to obtain any backward QC-retained samples accumulated each time a QV sample is collected. This process also requires contractor to accumulate QC-retained samples between QV samples. If QC-retains are not available for verification testing if/when needed, liability for that mixture may include back/forward to production start-up/end or next available QV sample test result in either direction.

8-36.4.1 Sampling from the Truck Box
Sampling will be the contractor’s responsibility. Truck box sampling presents some safety hazards because it is necessary to climb atop the truck box and stand on the hot mixture while sampling. Special care should be exercised by the contractor or his designated representative as the sample is procured to prevent falls or burns.

A shovel or mechanical sampling device approved by the department should be of such size and configuration that the sample can be obtained without spilling or roll off. Note: To satisfy this requirement with a flat bottom shovel, it is necessary to attach 2- to 4-inch vertical sides to the shovel.

8-36.4.2 Sample Location in Truck
When the last batch has been dumped into the truck box, the sampler must establish a reference point on the surface of the load, either at the high point, if a conical shape exists, or near the middle of the truck box if the surface shows no such conical shape. Then at least three incremental sample points (unless approved mechanical sampling device is capable of obtaining a representative minimum sample size in less than 3 locations) should be established about midway between the previously established point and the sides of the truck and equally spaced around the load as seen in Figure 1. The sampling shovel or other approved device can be inserted into the upper two to three inches of mixture to extract the sample increments.
8-36.4.2.1 QC Sample Sizes:
Minimum individual sample sizes are referenced below. These are the minimum amounts of material required for each QC testing, QV testing and retained sample.

<table>
<thead>
<tr>
<th>Mixture NMAS</th>
<th>Minimum Individual Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 12.5mm (1/2&quot;), Gradation # 4-5</td>
<td>35 lbs</td>
</tr>
<tr>
<td>19.0mm - 25.0mm (3/4&quot; – 1&quot;), Gradations # 2-3</td>
<td>50 lbs</td>
</tr>
<tr>
<td>&gt; 37.5mm (1-1/2&quot;), Gradation # 1</td>
<td>80 lbs</td>
</tr>
</tbody>
</table>

The total amount of material collected from the truck for all mixtures will be enough to provide the required minimum testing and retained samples.

- For an individual sample size exceeding 50 lbs, the sample will be split into two separate boxes.
- For a two-part split sample, the amount of material collected will be twice the individual sample size shown above (e.g. for a #4 12.5mm HMA, 2 x 35 is 70 lbs), yielding “test” and “retained” portions for either QC or QV. Additional guidance on two-part split samples is presented in CMM 8-36.5.1.
- For a three-part split sample, the total amount of material collected from the truck will be three or four times the individual sample size shown above, depending on the method of splitting used. Additional guidance on three-part split samples is presented in CMM 8-36.5.2.

Additional guidance on reducing split samples to testing sizes is presented in CMM 8-36.5.4 and CMM 8-36.5.5 for HMA and SMA, respectively.

8-36.4.2.2 QV Sample Sizes:
Use same guidance as QC sample size (trouble shooting may involve need for a gradation).

8-36.5  Sample Identification
The contractor is responsible for obtaining and splitting samples.

When a mixture sample is procured, it must be quartered, and the QV and retained portions placed in a box. For HMA mixtures, the required box must have dimensions of 10” x 8” x 8” (such as Uline S-19062). Each box must be labeled as directed below. Figure 2 provides an example label. The label must include the following items:

1. Contractor Testing Lab and Certified Technician Name
2. QC, QC-ret, QV, QV-ret
3. State project ID
4. Date
5. Sample number
6. Type of asphaltic mixture
7. State mix design ID (250-XXXX-YR)
8. Percent binder
9. Daily tonnage sampled
10. Current $G_{sb}$

![Figure 2 Example of Sample Labeling](image)

The cumulative/total tons representing mix design production are recorded on the QC data sheets.

8-36.5.1 Two-Part Splitting of HMA Samples

For QC or QV samples requiring only single testing and retained portions the HMA material is mixed and split according to the two-part quartering method described in CMM 8-36.5.1.1 or by using the Quartermaster™ described in CMM 8-36.5.1.2. After splitting, the QC & QV test samples are then further reduced to testing size according to CMM 8-36.5.4 for HMA or CMM 8-36.5.5 for SMA.

8-36.5.1.1 Two-Part Quartering Method

1. Place entire sample on table, quickly re-mix and quarter to minimize temperature loss. Quarter the Test & Retained samples as shown in Figure 3. For #4 (12.5 mm) mixes start with at least a total of 70 lbs of HMA.

![Figure 3 Two-Part Split Sample Quartering, 70 lbs](image)

2. Diagonal quarters, as indicated on the sketch, must be combined to form the retained sample (A + C) and the test sample (B + D). The retained sample must be boxed, labeled, and stored in a safe dry place. The retained samples may be tested using the “rule of retained” (see “Definitions” section).

8-36.5.1.2 Two-Part Splitting Using the Quartermaster™

Other devices to assist in the sampling and quartering procedures may be used with department approval. The Quartermaster™ is one such device and is shown in Figure 4.
Three-Part Splitting of HMA Samples

For volumetric samples requiring a QC and QV test portion as well as a retained portion, a three-part splitting procedure is used. Volumetric samples requiring a three-part split sample include SMA test strip volumetric samples and all volumetric samples for PWL projects. To attain a three-part split, material is either divided into three individual samples using the three-part quartering method described in CMM 8-36.5.2.1 or passed through a Quartermaster per CMM 8-36.5.2.2. In a three-part split, the individual samples are labeled/referred to in accordance with the team expected to test that split. In other words, this process must yield a QC, QV, and retained sample for WisDOT’s Bureau of Technical Services (BTS), if needed. After splitting, the QC & QV test samples are then further reduced to testing size according to CMM 8-36.5.4 for HMA or CMM 8-36.5.5 for SMA.

Three-Part Quartering Method

1. When using the three-part quartering method for a three-part split, collect three times the minimum split-sample size shown in CMM 8-36.4.2.1 (e.g. for #4 (12.5 mm) mixes start with at least a total of 105 lb of HMA). Place entire sample on table, quickly re-mix and split to minimize temperature loss. Split the sample into QC test, QV test, and Retained samples as shown in Figure 5.

2. For a three-part split shown in Figure 5, opposite diagonal sections, as indicated on the sketch, must be combined.
to form the QV sample (A+D), retained sample (B+E) and the QC sample (C+F). The retained sample must be boxed, labeled, and stored in a safe dry place. The retained samples may be tested using the “rule of retained” (see “Definitions” section).

**8-36.5.2.2 Three-Part Splitting Using the Quartermaster**

When using a Quartermaster for a three-part split, it is required to collect four times the minimum split-sample size shown in [CMM 8-36 4.2.1](#) (e.g. for #4 (12.5mm) HMA, 4 x 35 is 140 lbs). The Quartermaster is used to split the asphalt mixture to minimize any segregation during the splitting process. Figure 6 illustrates the steps used to ensure uniform splits for each party and should be followed each time the Quartermaster device is used for a three-part split sample. If the forth quadrant of material (“extra”) is not needed it may be discarded.

**Figure 6 Three-Part Split Sample Using Quartermaster Device (140 lbs)**

*Step 1:* Grab 4 buckets of loose mix from truck (if using a Department-approved mechanical sampling device & increased-capacity hopper, place the minimum material sample weight requirement in the hopper and skip to step 3):

![Diagram showing four buckets](image)

*Step 2:* Send Buckets 1 & 2 thru Quartermaster to fill half of each A thru D. Then split Buckets 3 & 4 to fill remaining half of buckets A thru D.

![Diagram showing split process](image)

*Step 3:* Recombine Opposite Corner Buckets A & C, to yield a, b, c, & d. Then recombine opposite corners (a&c, b&d) to yield first two box samples.

![Diagram showing recombination](image)

*Step 4:* Recombine Opposite Corner Buckets B & D, to yield e, f, g, & h. Then recombine opposite corners (e&g, f&h) to yield remaining two box samples.

![Diagram showing final box samples](image)
8-36.5.3 Splitting of SMA during Main Production

After completion of the test strip, a 3-part sample is no longer used and sampling/splitting returns to two-part splits, yielding portions for testing and retained portions (i.e., QC sample yields a QC for testing and a QC-retained, while a QV sample must yield a QV sample for testing plus a QV-retained, at a minimum).

8-36.5.4 Further Reduction of HMA to Testing Size

The individual HMA material for testing acquired from either a two-part or three-part splitting procedure is to be further reduced for testing. Figure 7 shows the approximate breakdown of a #4 12.5mm HMA mixture (35 lbs). Figure 8 shows the appropriate HMA testing sizes.

![Figure 7: HMA Individual Sample, (35 lbs)](image)

**Figure 7** HMA Individual Sample, (35 lbs)

- Extraction/Ignition Oven Sample: (See Figure 8 for sample weight)
- Gmm Sample: (See Figure 8 for sample weight)

**Figure 8: Minimum HMA & SMA Testing Sample Sizes**

<table>
<thead>
<tr>
<th>Gmm (RICE) Sample Size</th>
<th>37.5 mm (#1)</th>
<th>25.0 mm (#2)</th>
<th>19.0 mm (#3)</th>
<th>12.5 mm (#4)</th>
<th>9.5 mm (#5)</th>
<th>4.75 mm (#6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000 grams</td>
<td>3000 grams</td>
<td>2000 grams</td>
<td>1500 grams</td>
<td>1000 grams</td>
<td>1000 grams</td>
<td>1000 grams</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extraction/Ignition Oven Sample Size</th>
<th>37.5 mm (#1)</th>
<th>25.0 mm (#2)</th>
<th>19.0 mm (#3)</th>
<th>12.5 mm (#4)</th>
<th>9.5 mm (#5)</th>
<th>4.75 mm (#6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000 grams</td>
<td>3000 grams</td>
<td>2000 grams</td>
<td>1500 grams</td>
<td>1200 grams</td>
<td>1000 grams</td>
<td>1200 grams</td>
</tr>
</tbody>
</table>

8-36.5.5 Further Reduction of SMA Samples to Test Sizes

The approximately 70 lbs of SMA material is to be further reduced for testing according to Figure 9. As shown in Figure 9, combine opposite diagonal sections to yield the following:

- Four Gmb specimens
- Two Gmm specimens
- One Extraction/Gradation specimen

Testing sample sizes for SMA are shown in Figure 8.
8-36.6 Required Testing and Calculated Properties

If the number you are rounding is followed by 5, 6, 7, 8, or 9, round up. If the number you are rounding is followed by 0, 1, 2, 3, or 4, round down. For example, 14.150 becomes 14.2 and 14.840 becomes 14.8.

8-36.6.1 QC Tests

QC testing must be completed, and data posted, on the day the sample was taken or as approved by the project engineer.

For administration of projects requiring only one, two, or three single tests per mix design, apply the following tolerances table for mixture evaluation:

- \( V_a = 1.5 \text{ – } 5.0\% \) (2.5 \text{ – } 6.5\% for SMA)
- \( V_{MA} = -1.0 \) from required minimums for Table 460-1
- \( AC = \) within -0.5 of JMF (determined by ignition oven method according to AASHTO T308 as modified in CMM 8-36.6.3.6, chemical extraction according to AASHTO T164 Method A or B, or automated extraction according to ASTM D8159 as modified in CMM 8-36.6.3.1).

For results not meeting the above ranges, apply pay in accordance with the “Produced Outside JMF Limits” guidance listed in Standard Spec 460.2.8.2.1.7(6).

8-36.6.2 QV Tests

The following tests are to be performed in determining product Quality Verification:

- Bulk specific gravity of the mixture (\( G_{mb} \) per AASHTO T166)
- Maximum specific gravity of the mixture (\( G_{mm} \) per AASHTO T209)
- Air voids (\( V_A \) per AASHTO T269, calculation)
- Voids in the mineral aggregate (per AASHTO R35, using current field \( G_{sb} \))
- Asphalt Content (determined by ignition oven method according to AASHTO T308 as modified in CMM 8-36.6.3.6, chemical extraction according to AASHTO T164 Method A or B, or automated extraction according to ASTM D8159 as modified in CMM 8-36.6.3.1).

8-36.6.3 Asphalt Binder Content (AC) Determination

Asphalt binder content will be determined by one of the following methods:

- Chemical extraction according to AASHTO T164 Method A or B
- Automated extraction according to ASTM D8159 as modified in CMM 8-36.6.3.1.
8-36.6.3.1 Automated Extraction of Asphalt Binder (AC) WisDOT-Modified ASTM D8159
Automated extraction refers to use of the Asphalt Analyzer™ or similar equipment meeting the requirements of ASTM D8159 for asphalt binder content determination. Follow ASTM D8159 Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by Automated Extraction, with the following modifications:

Delete 1.4.

7.1 Obtain Specimens in accordance with AASHTO T168.

7.2.2 Prior to testing in an automated extraction device, oven dry the HMA specimen to a constant mass at a temperature of 110 +/- 5° C (230 +/- 9 ° F). Constant mass is defined as less than 0.05% loss in mass between 15-minute intervals.

8-36.6.3.2 Vacant

8-36.6.3.3 Vacant

8-36.6.3.4 Vacant

8-36.6.3.6 Asphalt Content by Ignition Oven (AC) WisDOT-Modified AASHTO T308
Revisit 8-36.6.3.6 (Asphalt Content by Ignition Oven (AC) WisDOT-Modified AASHTO T308) to delete Annex Section A2.8.2 from AASHTO T308 and include Annex Sections A2.9 through A2.9.2 for contractors only.

Effective for mix designs submitted and projects let after Dec 1, 2018: all mix designs used on WisDOT projects must have an ignition oven asphalt binder correction factor. Mix designers must collect sufficient lab-batched material (at 3.0% air voids for HMA or 4.5% air voids for SMA) to provide the region(s) and BTS with one ignition oven correction factor (IOCF) split sample each. Each IOCF split sample will be sufficient for seven individual ignition oven tests. Lab batched material may be packaged as individual ignition oven test samples before sending to the regional lab(s). At least 10 days before producing the mix design on a WisDOT contract, the contractor must send a minimum of two lab-batched IOCF split samples to the regional lab(s) providing QV testing. Regional labs send one IOCF split sample to BTS within one day of receiving the sample for possible AC content verification. The following shows the minimum ignition oven test sample weight and minimum IOCF split sample weight for ignition oven correction factor determination based on nominal max aggregate size:

<table>
<thead>
<tr>
<th>Nominal Max Aggregate Size (mm)</th>
<th>Individual Ignition Oven Test Sample Minimum Weight (grams)</th>
<th>Ignition Oven Correction Factor (IOCF) Split Sample Minimum Weight (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1 (37.5)</td>
<td>4,000</td>
<td>28,000</td>
</tr>
<tr>
<td>No. 2 (25.0)</td>
<td>3,000</td>
<td>21,000</td>
</tr>
<tr>
<td>No. 3 (19.0)</td>
<td>2,000</td>
<td>14,000</td>
</tr>
<tr>
<td>No. 4 (12.5)</td>
<td>1,500</td>
<td>11,000</td>
</tr>
<tr>
<td>No. 5 (9.5)</td>
<td>1,200</td>
<td>10,000</td>
</tr>
<tr>
<td>No. 6 (4.75)</td>
<td>1,200</td>
<td>10,000</td>
</tr>
</tbody>
</table>

Before using a mix design on a WisDOT project, both the contractor and regional lab will determine an ignition oven asphalt binder correction factor and the contractor shall determine the appropriate aggregate correction factor for each mix design and oven in accordance with AASHTO T308, Annex A as modified below. BTS reserves the right to verify the asphalt content for each split sample provided to the regional lab using automated extraction according to ASTM D8159 as modified in CMM 8-36.6.3.1.

During production, provide to the Department, results of Ignition Oven burns conducted in accordance with the following:

Follow AASHTO T308 Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by Ignition Method, Method A, with the following modifications:

1.1 This test method covers the determination of asphalt binder content of hot mix asphalt (HMA) by ignition oven at temperatures that reach the flashpoint of the binder in a furnace. The means of specimen heating must be the convection method. The aggregate remaining after burning can be used for sieve analysis using AASHTO T30.

3.1 The asphalt binder in the HMA is ignited using the furnace equipment applicable to the particular method. This
procedure covers two methods. Method A requires an ignition furnace with an internal balance.

5.1 Ignition Furnace – A forced-air ignition furnace that heats the specimens by convection method. The convection-type furnace must be capable of maintaining a temperature of 538 +/- 5°C (1000 +/- 9°F). The furnace chamber dimensions shall be adequate to accommodate a specimen size of 3500 g. The furnace door shall be equipped so that the door cannot be opened during the ignition test. A method for reducing furnace emissions shall be provided. The furnace shall be vented into a hood or to the outside and, when set up properly, shall have no noticeable odors escaping into the laboratory. The furnace shall have a fan capable of pulling air through the furnace to expedite the test and reduce the escape of smoke into the laboratory.

7.1.1 For the convection-type furnace, preheat the ignition furnace to 482 +/- 5°C (900 +/- 9°F) or to the temperature determined by the correction factor process in the Annex. Manually record the furnace temperature (set point) prior to the initiation of the test if the furnace does not record automatically.

7.1.2 Delete this step.

7.1.3 Delete Note 6

Delete Section 8

10.1.1 Test Method A;

A2.4 Prepare two correction specimens at the JMF design asphalt content and gradation. Aggregate used for the correction specimens shall be sampled from the material designated for use in production

A2.6 Test the specimens in accordance with Method A or Method B of the procedure.

A2.8.1 If the asphalt binder correction factor exceeds 1.0 percent, the test temperature should be lowered to 427 +/- 5°C (800 +/- 8°F) for a convection-type furnace. If there is no improvement in the correction factor, it is permissible to use the higher temperature.

Note A2 – The temperature for determining the asphalt binder content of HMA specimens by this procedure shall be the same temperature determined for the correction specimens.

Delete A2.8.2.

Section A2.9 is only required for QC laboratories.

8-36.6.3.7 Ignition Oven Correction Factor

Revise 8-36.6.3.7 (Ignition Oven Correction Factor) to include lab-batched material as an option to be used for IOCFs of mix designs approved or reapproved before 12/1/2018 and define that the current JMF is used to determine the need for recalculation of the IOCF.

Ignition oven asphalt binder content and aggregate correction factors are specific to each mix design and oven and are not transferable. Mix designs approved prior to Dec 1, 2018 may use lab-batched material according to CMM 8-36.6.3.6 or plant-produced material for IOCFs according to CMM 8-36.6.3.7.1. IOCFs for all mix designs approved or reapproved after Dec 1, 2018 will be initially determined from lab-batched material unless otherwise approved by BTS.

If an IOCF needs to be recalculated during production, the contractor must provide the regional lab(s) with sufficient material according to CMM 8-36.6.3.6 for the regional lab(s) and BTS. Each IOCF split sample will be divided into separate boxes and delivered to the regional lab no more than one production day after the previous IOCF for the mix being produced is determined to be invalid. The regional lab will send an IOCF split sample to BTS within one day of receiving it for asphalt binder content determination by automated extraction according to WisDOT Modified ASTM D8159. The correction factor method and type of material to be used for each mix design is summarized in the following table:

<table>
<thead>
<tr>
<th>Mix Design Approval/Reapproval</th>
<th>CMM Section used for Ignition Oven Correction Factor</th>
<th>Plant-Produced or Lab-Batched Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 12/1/2018</td>
<td>8-36.6.3.7.1</td>
<td>Lab-Batched or Plant-Produced</td>
</tr>
<tr>
<td>After 12/1/2018</td>
<td>8-36.6.3.6</td>
<td>Lab-Batched</td>
</tr>
</tbody>
</table>

The IOCF procedure for a given mix must be verified (re-calculated) annually in accordance with CMM 8-36.6.3.6 or if any of the following occur:

- Exceed 50,000 tons of mixture produced
- An individual aggregate (virgin or RAP) changes by more than 5 percent from the JMF at the time the current IOCF was determined.
- Any change in the percentage of RAS

Additionally, if the department or contractor determine that the ignition oven correction factor no longer accurately represents the mix being produced, proceed according to CMM 8-36.6.3.8.

8-36.6.3.7.1 Ignition Oven Correction Factor for Mix Designs Approved Before Dec 1, 2018

The contractor shall determine an ignition oven asphalt binder content and aggregate correction factor prior to the first day of production for any WisDOT project. For mix designs approved prior to Dec 1, 2018, the regional lab ignition oven correction factor may be determined using material obtained at the plant on the first day of production. Contractors must collect sufficient plant-produced material to provide the regional lab(s) and BTS with one IOCF split sample each. The weight of each plant-produced IOCF split sample will be collected according to CMM 8-36.6.3.6. The contractor shall send each plant-produced ignition oven split sample to the regional lab(s) providing QV testing in separate boxes. The regional lab will send one split sample to BTS for AC content verification within one day of receiving the sample. BTS will use automated extraction according to WisDOT Modified ASTM D8159 (CMM 8-36.6.3.1) to provide the asphalt content to the regional lab for use in calculating the ignition oven asphalt binder correction factor per oven, per mix design, in accordance with the following:

1. The contractor will obtain a representative sample of mixture, witnessed by a department representative, from the truck box on the first day of plant production. The sample size must be sufficient for three split samples of minimum weight specified for the mix nominal max aggregate according to CMM 8-36.6.3.6. The contractor will split the sample using a quartermaster and supply a minimum of two split samples to the department representative.

2. The department representative will take possession of the split samples and delivers them to the WisDOT regional laboratory within 12 hours of sampling.

3. The WisDOT regional lab will send one of the initial split sample boxes to the WisDOT BTS Central Laboratory within one working day of receiving the sample. Central laboratory will perform one automated extraction according to ASTM D8159 as modified in CMM 8-36.6.3.1 to determine an extracted asphalt binder content of the mixture. Results will be completed and reported by the end of the second working day after arrival at BTS.

4. The contractor has the option to run an automated extraction according to ASTM D8159 as modified in CMM 8-36.6.3.1 or a chemical extraction according to AASHTO T164 Method A or B, for comparison to the result obtained by BTS.

5. If the Contractor wishes to dispute the extracted asphalt content results obtained by BTS, the following apply:
   A. If results from both parties are within 0.40 %AC of each other, the BTS result is considered validated and will be used for the correction factor of all department ignition ovens.
   B. If the two results are not within 0.40 %AC of each other, a retest of the material will be conducted by WisDOT (BTS) from the same split sample. If the retest is within 0.20 % AC of the first sample run by the department, the average of the two WisDOT test results will be used for the correction factor of all department ignition ovens.
   C. If the retest does not meet the tolerance of 0.20 %AC, a third split of the same sample will be tested by WisDOT (BTS) and compared to the first two sample results. If the result is within 0.20 %AC of one of the first two tests, the average value of those two closest test results will be used for the correction factor of all department ignition ovens.

6. The regional lab will test two ignition oven calibration samples from the same split sample (step 1). WisDOT modified AASHTO T308 will be conducted in accordance with CMM 8-36.6.3.6.

7. Once the regional lab has completed their ignition oven tests, they will average the values obtained from their respective two tests and calculate the difference between that average value and the asphalt content provided by BTS determined from step 3 or 5, as applicable, to be used as the asphalt binder correction factor for that mix and oven.

8. Each ignition oven shall have proper documentation indicating the following: contractor mix identification, date of ignition oven calibration, WisDOT 250#, mixture testing temperature, and correction factor.

8-36.6.3.8 Optional QC and QV Asphalt Binder Content Comparison

The contractor has the option to compare their ignition oven results with those of the regional lab during production. An additional QC split sample may be collected with the first random QV sample of each project for ignition oven asphalt binder content comparison testing between the contractor and regional lab. Results of the contractor portion of the comparison test are for information only and will not be added to the QC four-point running average for asphalt content.

In addition to the ignition oven comparison test, the contractor will conduct a chemical extraction according to
AASHTO T164 Method A or B or an automated extraction according to ASTM D8159 as modified in CMM 8-36.6.3.1. If the contractor and department test results from this comparison test differ by more than 0.40 % AC or if either test differs by more than 0.40 % AC from the contractor’s chemical or automated extraction result, the QV-retained sample will be sent to BTS within one day for referee testing using automated extraction according to ASTM D8159 as modified in CMM 8-36.6.3.1. The BTS referee test results will be used by the department and contractor to calculate a new IOCF for the mix according to CMM 8-36.6.3.7.1 using the remainder of the split sample material.

8-36.6.4 HMA Compaction - AASHTO T312

1. Preheat specimen molds (charging funnels, spatulas, etc.) to 300°F.

2. Heat sample, in an open container, to a compaction temperature of 275°F ± 5°F in an oven between 285°F – 320°F for no more than 1 hour. If binder modifiers or additives are used, compact to the supplier’s temperature recommendations. Note, for such mixes, e.g. WMA, this compaction temperature should match that specified on the mix design submittal. After quartering to test size, if the mix sample is within the proper compaction temperature range, then the specimen can be compacted without further heating.

3. Place specimen protection disc into the bottom of the mold and charge the mold with the mix sample. The sample size should be enough to attain a final specimen height of 115mm ± 5mm and is unique to the mix design. For Wisconsin aggregates and designs a range of 4700 – 4900g is generally appropriate. Charging the mold should be accomplished in one lift action or motion so as to avoid segregating the sample inside the mold. Additional funnels or scoop chutes may be used in order to accomplish this.

4. Lightly level off the top of the sample and place a specimen protection disc on top.

5. Load the mold into the SGC and compact to the appropriate Ndes for the mixture type being produced by applying 600kPa ± 18kPa, at an internal angle of 1.16 degrees.

6. After compaction is completed the specimen is extruded, protection papers are removed, the briq is labeled, and cooling by fan is required for a period of at least 1 hour. If the mixture is extremely fine or tender, then the initial 5-10 minutes of cooling should take place while the specimen is only partially extruded to aid in handling.

7. Height measurements should be recorded and retained with each specimen.

8. Reheat the mold to the compaction temperature if reusing for the second specimen.

All SGCs being used for QMP specimen preparation will conform to the requirements for calibration as listed in the departments Laboratory Qualification Program. Recalibration may be necessary if the testing variation between labs exceeds allowable differences or when a continued bias exists in the data attributed to the preparation of the specimen.

8-36.6.5 Bulk Specific Gravity (Gmb) AASHTO T166

Determine bulk specific gravity, Gmb, using AASHTO T166.

- Weigh the specimens in air and record (designated this weight as A).
- Immerse the specimens in 77 ± 2°F water bath for 3 to 5 minutes.
- Weigh in water, and record (designating this weight as C).
- Surface dry the specimens by blotting quickly with a damp towel and then weigh in air (include any water that may drain from voids in specimens), and record (designating this weight as B).

- Calculate the Gmb to three decimal places (0.001).

\[
G_{mb} = \frac{A}{(B - C)}
\]

Determine the average bulk specific gravity for both specimens. If one of the individual specimens deviates by more than ±0.015 from the average, results are considered suspect and a new set of specimens is to be compacted from the contractor retained sample (following the rule-of-retained).

Determine bulk specific gravity, Gmb for SMA by using (Corelok™ System or equivalent vacuum system) in accordance with AASHTO T331.

Additional information on using the Corelok™ for Gmb is provided in the following video: [https://youtu.be/HFT9xlR2lnI](https://youtu.be/HFT9xlR2lnI)

For the QC or QV testing, determine the average bulk specific gravity, Gmb, for SMA material by averaging 4 specimens. If one of the individual specimens deviates by more than +/- 0.015 from the average, results are considered suspect and the result furthest from the average should be removed from the calculation. Calculate the average using the remaining 3 specimens.
After compaction, place mold in front of a fan for approximately 15 minutes before extruding.

**8-36.6.6 Maximum Specific Gravity of the Mixture (G_{mm}) - AASHTO T209**

Determine maximum specific gravity, G_{mm}, using AASHTO T209.

- Use the appropriate sample size Figure 8.
- Subject the G_{mm} sample to the same heating condition and time period as the G_{mb} material.
- Begin to cool the sample. While sample is cooling, break up sample to pieces no greater than ¼”, and continue to cool to an ambient room temperature.
- Place material into a calibrated container and determine the actual dry weight of the sample.
- Add 77°F water to cover the sample.
- Apply required vacuum for 15 ± 2 minutes, agitating material every 2 minutes minimum.
- After the vacuum time period, completely fill the container with 77°F water and determine the volume of the sample.
  - In-water method (bowl method): by suspending the container underwater and weighing.
  - In-air method (flask method): by weighing the container filled with water and sample (in air).
- Correct the G_{mm} with a dryback test procedure or by applying a dryback correction factor if aggregates have a moisture absorption of > 2.0% (see next subsection).
- Calculate the G_{mm} to three decimal places (0.001).
- The following formula is for the mass determination in water method:

\[
G_{mm} = \frac{A}{A - B}
\]

Where:

- A = mass of the oven-dry sample in air
- B = mass of the sample in water at 77°F.

G_{mm} for SMA requires averaging 2 samples. If one of the individual samples deviates by more than 0.015 from each other, results are considered suspect and an additional set of samples is to be measured.

**8-36.6.7 Dryback Procedure (Corrected G_{mm}) for Absorptive Aggregates (AASHTO T209, Supplemental Procedure for Porous Aggregates)**

- Run a dryback procedure on Day 1-Sample 1, and determine a dryback correction factor for that test. Average the test dryback correction factor with the design JMF dryback correction factor and apply to the test data for a new G_{mm}. If the new average correction factor changes the G_{mm} by less than 0.010 then use the design JMF dryback correction factor until otherwise determined by additional testing.
- Run a dryback procedure every other day of production on the first test sample, or any time there is a change in binder content greater than 0.1%, or a change in component blend percentages greater than 10% (or 20% combined), using the same averaging method as above to validate the original design JMF dryback correction factor.
- If any average dryback correction factor changes the G_{mm} by more than 0.010, check for math or testing error first, otherwise a new dryback correction factor must be established by running drybacks on the next three samples. Average the new dryback correction factors and establish that average as the new JMF dryback correction factor.

**8-36.6.8 Air Voids (%V_{a}) - AASHTO T269**

The air void (%V_{a}) determination is a relationship between maximum specific gravity (G_{mm}) and bulk specific gravity (G_{mb}). Calculate to one decimal place.

\[
V_{a} \text{, } \% = \left(\frac{G_{mb} - G_{mm}}{G_{mm}}\right) \times 100
\]
8-36.6.9 Voids in Mineral Aggregate (VMA)

VMA is calculated using the aggregate bulk specific gravity, Gsb, from the contractor mix design (unless a blend change has occurred in which case a new Gsb will be calculated), the asphalt content (Pb determined by CMM 8-36.6.3), and the average SGC specimen bulk specific gravity, Gmb, as follows (calculate and record to 0.1):

\[
VMA, \% = 100 \times \frac{G_{mb} \times (100 - P_b)}{G_{sb}}
\]

8-36.6.10 Vacant

8-36.6.11 Vacant

8-36.6.12 Additional Formulas and Example Calculations

1. Determining the aggregate effective specific gravity (Gse) for the following:

\[
G_{se} = \frac{100 - P_b}{\left(\frac{P_b}{G_{mm}}\right) - \left(\frac{P_b}{G_b}\right)} = \frac{100 - 4.5}{\left(\frac{4.5}{2.567}\right) - \left(\frac{4.5}{1.030}\right)} = 2.761
\]

Given:
Pb = 4.5
Gmm = 2.567
Gb = 1.030

2. Determining the percent of asphalt content (Pb) for the following:

\[
P_b = 100 \times \frac{G_{se} - G_{mb}}{G_{se} - G_{mb}} = 100 \times \frac{1.030}{2.567} \times \frac{2.761 - 2.567}{2.761 - 1.030} = 4.5
\]

Given:
Gmm = 2.567
Gb = 1.030
Gse = 2.761

3. Determining the asphalt absorption, \(P_{ba}\), for the following:

\[
P_{ba} = 100 \times \frac{G_{se} - G_{mb}}{G_{se} - G_{mb}} \times G_b = \frac{100 \times (2.761 - 2.703)}{(2.703 \times 2.761)} \times 1.031 = 0.058
\]

Given:
Gse = 2.761
Gsb = 2.703
Gb = 1.030

4. Determining the effective asphalt content, \(P_{be}\), of the asphaltic mixture for the following:

\[
P_{be} = P_b - \left(\frac{P_{ba}}{100}\right) \times P_s = 5.3 - \left(\frac{0.058}{100}\right) \times 94.7 = 4.5
\]

Given:
Pb = 5.3
Pba = 0.8
Ps = 94.7

5. Determining the percent voids filled with asphalt (VFA) for the following compacted mixture:

\[
VFA = 100 \times \frac{(VMA - V_a)}{(VMA)} = 100 \times \frac{(14.4 - 3.7)}{14.4} = 74.3
\]

Given:
VMA = 14.4
Va = 3.7

6. Determining the dust to binder ratio (or DP: Dust Proportion):

\[
\text{Dust to Binder Ratio} = \frac{\text{\% passing 0.075}}{P_{be}} = \frac{5.0}{4.5} = 1.1
\]

Given:
Pbe = 4.5
% passing 0.075 = 5.0

8-36.6.13 Field Adjusted JMF

The JMF may be adjusted in the field based on production test results see CMM 8-66.2.
When the JMF asphalt content is increased by 0.2% or more start new running average for Gmm. The compaction target maximum density for the day of the target change can be calculated using the most recent Gse and percent asphalt binder (Pb) for the new JMF and Gb (binder specific gravity) at 77°F from the mix design.

### 8-36.6.13.1 Job Mix Formula (JMF) Changes

A JMF target binder content decrease exceeding 0.1% from the original JMF target will require a new mix design. Changing the contract specified PG requires compliance with [CMM 8-66.2.3.2](#) and the project engineer’s approval. Addition of an additive to a JMF, except approved compaction aids, will require an approved JMF change. Changes of an additive identified on a JMF, or the dosing rate, will require an approved JMF change.

Elimination or addition of any aggregate component requires a new mix design. Changes to the design aggregate component blend percentages are limited to 20% in combination. (See [CMM 8-66.3](#) number 3).

No JMF change requests are to occur prior to completion of three individual production tests. Data from prior production testing do not have to be from state projects, but must be sampled and tested by HTCP certified personnel. Testing must occur in a WisDOT approved laboratory, following WisDOT approved methods. When making a “Request for JMF Change,” all laboratory results shall be submitted (electronically) to substantiate the use of materials from non-WisDOT projects.

The contractor will notify the project engineer of the proposed change using the "Request for JMF Change" form ([Figure 13](#)). Comments must include the sample test number indicating when the change is to become effective. Production adjustments and “Requests for JMF Change” submittals may not cause any target value to violate design requirements. Production tolerances may exceed those targets.

The requested change may become effective up to four individual tests before the request was formally made. Documentation (electronic) that the contractor and project engineer had discussed a possible JMF Change must exist for the change to occur at a point prior to the test number on the formal request.

Further changes will not be allowed until six additional individual test points, according to the normal sampling frequency, for the affected mix property have been documented. Each JMF sieve will be considered as an individual mix property. Control chart(s) for the affected property(ies) will accompany the "Request for JMF Change" ([Figure 13](#)).

#### 8-36.6.14 Production Tensile Strength Ratio Tests

The tensile strength ratio (TSR) is determined according to the procedures in AASHTO T283 (without freeze-thaw conditioning cycles). After manufacturing the specimens at the plant, they may be tested in an offsite laboratory. Use distilled water for saturating and soaking the test specimens. Mixes qualifying for field TSR testing are defined as one of the following:

- Any WMA
- HMA mixes with NMAS of #4 (12.5 mm) or #5 (9.5 mm) gradation with a design TSR < 0.86.

For production TSR, follow WisDOT PWL sampling & splitting procedure, yielding two boxes of material for each the contractor and BTS specifically for TSR testing. The total weight of material sent to the department will be a minimum of 100 lbs. BTS will conduct both TSR and Hamburg Wheel Track Testing (Hamburg at 46°C) on randomly selected samples for 2019 mixtures. The minimum production TSR requirement is 0.80. In the event TSR <0.80, corrective action must be taken and an additional random sample will be taken by the department to monitor impact of corrective action.

#### 8-36.6.15 RAM Stockpile Samples

The minimum test sample size must be determined from extracted aggregate gradation size per AASHTO T164.
That has been divided into aggregate gradation numbers as follows:

<table>
<thead>
<tr>
<th>Nominal Max Size (mm)</th>
<th>Minimum Weight of Test Sample (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 2 (25.0)</td>
<td>3000</td>
</tr>
<tr>
<td>No. 3 (19.0)</td>
<td>2000</td>
</tr>
<tr>
<td>No. 4 (12.5)</td>
<td>1500</td>
</tr>
<tr>
<td>No. 5 (9.5)</td>
<td>1000</td>
</tr>
</tbody>
</table>

When test results indicate that a change has occurred in the RAM asphalt content, a change in the design RAM asphalt percentage may be requested by the contractor or the project engineer. The request will include at least two recent RAM extractions and also identify all applicable mix designs to be affected. For each affected mix design a new Pbr (Percent binder replacement will be calculated and reported). The requested change will be reviewed for the department by an HTCP-Certified HMA Technician at a level recognized for mix design (HMA MD Technician), and a revised JMF can be issued.

8-36.7 HMA Quality Management Program Documentation

The contractor is responsible for documenting all observations, records of inspection, and test results on a daily basis. Results of observations and records of inspection must be noted as they occur in a permanent field record. The testing records and control charts must be available in the QC laboratory at the asphalt plant.

The contractor must maintain standardized control charts. Test results obtained by the contractor must be recorded on the control charts the same day the tests are conducted. The aggregate gradation test data must be recorded on the standardized control charts for all randomly selected production samples tested.

Sieve sizes for aggregate gradation tests must include the maximum aggregate sieve size, the NMAS sieve, and any following sieves falling below: 1” (25.0mm), 3/4”(19.0mm), 1/2”(12.5mm), 3/8”(9.5mm), # 4 (4.75mm), #8(2.36mm), # 16 (1.18mm), # 30 (600μm), # 50 (300μm) # 100 (150μm) and # 200(75μm).

8-36.8 Documentation

8-36.8.1 QC Records

In addition to the requirements of the “Records” subsection of the standard specification, the contractor must provide:

- A cumulative tonnage value to the project engineer daily.
- Random number generation results and associated tonnage for QMP sampling.
- Binder Inventories (inclusive of incremental tonnages used to calculate binder usage for test samples and documentation validating calibration checks)
- When submitting charts and running average calculation sheets the contractor mix design ID and WisDOT 250 report number must be included on each sheet. Full name of qualified sampler, tester and qualified lab locations should be on individual sample test property worksheets.
- Blend change history
- Individual sample test property worksheets (Note: More detailed information may be requested or observed during actual production for evaluation purposes. In order to verify compliance with appropriate test procedure requirements, this information needs to be made available during that on-site evaluation).

Records should be the original (handwritten or electronic) documents. However, the original “source” documents should be maintained in the project records. If the data is entered directly into an electronic document then that is acceptable as the source document. If the original document is handwritten and then transferred to an electronic document, the original handwritten document should be maintained as the “source” document.

When supplying the original "source" document, a scanned copy is acceptable.

Electronic documents are considered to be acceptable during construction, but the original documents need to be submitted after project completion for final project closeout.

8-36.8.2 QV Records

Results of QV testing are posted to the appropriate QC charts for air voids and VMA and represented with a unique symbol (e.g.: red “X”).
8-36.9 Quality Verification Program

8-36.9.1 Monitoring Contractor QMP

8-36.9.1.1 Preconstruction

The QV team is responsible for obtaining the following information:

- Obtain WisDOT test number of the quality test report for the aggregate source being used. If source quality testing hasn’t been completed, notify the department’s Bureau of Technical Services laboratory.
- Obtain the WisDOT test number of the mix design intended for use or a copy of the contractor’s mix design, the review report, if available, from department’s Materials Tracking system, and any contract special provisions.
- Verify that the QC team personnel have the proper certifications.
- Verify that the QC Laboratory facility is WisDOT qualified and has the equipment required by the QMP specification (inclusive of communication devices).

Review any procedures for determining reheat correction factors and for the $G_{mm}$ dry back correction factor (if applicable). Discuss any necessary calibrations, or pending recalibrations, for the gyratory compactor and what procedure will be used.

8-36.9.1.2 During Production

During production, the QV team should, as often as they feel necessary:

1. Random Sampling:
   - Check the QC procedures for proper random number generation for all samples.
   - Verify the QC team is aware they are not to inform the plant before the random sampling will occur.

2. Samples:
   - Ensure all required samples are being taken for mixture properties and blended aggregate gradations.
   - Ensure that proper sampling and splitting procedures are being used and the field sample size is large enough to accomplish required testing.
   - Ensure that stockpile samples are taken and tested for reclaimed asphaltic pavement (RAP) when applicable.
   - Ensure tensile strength ratio (TSR) tests have been conducted at proper intervals for mixtures in CMM 8-36.6.14.
   - Ensure that the retained samples (mix and blended aggregate) are properly labeled and stored in a dry protected area.

3. Testing:
   - Observe the reduction of the field samples to test size.
   - Observe the testing procedures paying attention to temperature of test samples before compaction, compaction efforts, times allotted between tasks, dry backs, etc.
   - Review data calculations.

4. Control charts:
   - Check to see that required control charts are present and up to date.
   - Check to see that control limits and warning bands are accurately drawn.
   - Check to see that the proper values are being plotted correctly.

5. Documentation:
   - Check to see that records of compliance are being documented and are up to date.
   - Check to see that adjustments to mixtures and JMF changes are noted on field records.
   - Check to see that records have been provided to the QV team on a daily basis.

8-36.9.2 Verification Sampling

Product quality verification sampling is the responsibility of the department’s QV team. This requires QV personnel to obtain any backward QC-retained samples accumulated each time a QV sample is collected. This process also requires contractor to accumulate QC-retained samples between QV samples. If QC-retains are not available for verification testing if/when needed, liability for that mixture may include back/forward to production start-up/end or next available QV sample test result in either direction.
8-36.9.2.1 Plant Sampling
Samples from the truck box will be taken by a member of the contractor QC team, and directly observed by the QV team member. In addition, if the initial split (QV / QV-retained) is performed by the contractor, it is also to be directly observed by the QV team member.

The QV team will determine and document the random sampling procedure employed for mixture verification samples. QV random samples should be determined from production tonnage.

If some other method is used, it should be mutually agreed upon between the QV and QC teams and documented before taking place.

The contract language specifies “two mixture production days” after the sample has been obtained by the contractor as the time within which the QV personnel must respond to the QC team relative to the agreement of data results. The intent is to provide information and feedback to the QC team as soon as practical in case there is data disagreement and the potential need to stop mix production.

If the QV mixture sample temperature is 230 degrees F or higher when delivered to the testing facility, quartering may start immediately. If the temperature is below 230F, place in a 300F oven, until workable for quartering, but not to exceed two hours. Microwaves are not to be used to reheat an HMA sample.

8-36.9.3 Determining Acceptable Verification Parameters
Whenever a flag has been raised by disagreement of QV test results with the defined acceptable parameters, immediate investigation will occur using additional testing, troubleshooting, and dispute resolution actions.

8-36.9.3.1 Additional Testing
When a QV test result does not meet the specified acceptance limits per Standard Spec 460.2.8.3.1.6 the following samples will be collected and sent to BTS for dispute resolution testing:

- QV-retained sample.
- All QC-retained samples backward to the last passing QV test or to the beginning of the project if no QV samples have been taken.
- All available QC-retained samples forward to the next passing QV test or to the end of the project.

These samples will be sent to BTS immediately for referee testing. An additional non-random QV sample will be collected either when the department representative goes to the contractor to collect the necessary QC-retained samples (or as soon as production resumes if the mix is not currently being produced). The collection and shipment of necessary QC-retained samples to BTS will not be delayed by the collection of a non-random QV sample if the mix is not currently being produced.

Below are examples of the testing of QV-retained and any needed forward and backward QC-retained samples.

**Example 4**

A QV sample taken following QC test 5-3, falls outside of 2.0 to 4.3% air voids (3.2 to 5.8% for SMA). The WisDOT – BTS lab tests retained portion of QV sample, along with QC-ret sample 5-3 and QC-ret 5-4 once available. The Bureau continues testing of retained samples both forward and back until a test result in each direction meets criteria for 75% pay in accordance with Figure 10 (i.e., 1.8 to 4.6% air voids, or 2.9 to 6.1% for SMA). If this criterion has not been met and no further QC-retained sample exists in a given direction, then liability for that mixture may include back to production start-up/end or QV sample.

BTS is to provide QC retained split sample testing on the nearest forward QC sample as soon as practical, and continue until the QC-retained split sample is 1.8 to 4.6% air voids and (2.9 to 6.1% for SMA) and within 0.7% minimum VMA.

In addition, when the QV team is back on the site to obtain the additional QC-retained samples, another QV sample will be taken.

**Example 5**

The QV sample taken following QC test 5-3, falls outside acceptable parameters. The QV team returns to the plant site on day 7 and obtains any QC-ret samples forward of sample 5-4 available at that time (to be sent to the WisDOT-BTS lab), and directs a new QV sample be taken representing day 7.
8-36.9.3.2 Troubleshooting
The following points are to be considered and re-checked:
- Calculations.
- QC data trends.
- Equipment calibration records.
- Sampling and splitting observations/notes.
- Proper use of re-heat correction factors.

If a 0.020 or greater variability exists between QC and reheated samples (matching QC-retained portion), then a Gmb reheat correction factor is to be determined to aid in troubleshooting.

- Gmb reheat correction factor (calculated to 0.001) = Gmb (un-reheated) / Gmb (reheated).
- Apply the correction factor to the reheated sample: Corrected Gmb = Gmb (reheated) * correction factor.
- When comparing the uncorrected Gmb to the corrected Gmb, if the difference is less than 0.005, then the correction factor will not be used.

If a 0.015 or greater variability exists between QC and reheated samples (matching QC-retained portion), then a Gmm reheat correction factor is to be determined to aid in troubleshooting. It should be calculated to 0.001.

- Gmm reheat correction factor (calculated to 0.001) = Gmm (un-reheated) / Gmm (reheated).
- Apply the correction factor to the reheated sample: Corrected Gmm = Gmm (reheated) * correction factor.
- When comparing the uncorrected Gmm to the corrected Gmm, if the difference is less than 0.005, then the correction factor will not be used.

8-36.9.3.3 Dispute Resolution
For the results of the additional testing conducted according to CMM 8-36.9.3, the contract language specifies reporting the results of the referee testing within “three business days” after receipt of the samples”. The receipt day refers to receipt of the samples at BTS. The intent is to provide test information and feedback to the QC/QV team as soon as practical and targeting within 7 working days of the date of the failing QV sample.

At the completion of dispute resolution testing (QV-ret and required backward and forward QC-ret) the BTS personnel dealing with asphalt mix designs will provide documentation to the QV team recommending tonnages to be affected based on the following information:
- Gmm & Gmb as measured by BTS.
- Air Voids as calculated from BTS volumetric data.
- VMA of QC/QV-ret samples tested by BTS.
- Asphalt binder % (AC) as determined by BTS using automated extraction.

The general process flow chart for dispute resolution is shown in Figure 10. Example scenarios are provided in Figure 11 (based on HMA requirements). If the range of affected tonnage is determined to be at the QV (isolated problem), a pay adjustment calculated to tonnage halfway between samples will be assessed. There is no intent to use multiple pay adjustments, but the lowest percent pay will supersede others.

The QV team will further complete documentation responsibilities by determining the dollar amount for any affected mixture tonnage and will forward that information to appropriate project personnel and the QC team. Figure 12 is an example of a spreadsheet used to calculate pay adjustments.
- Pay of less than 100% on QV-retain test will result in additional testing of forward and backward samples.
- Pay of less than 75% on forward or backward QC-retain will result in testing of the next forward or backward sample.
- Unacceptable material shall be removed and replaced at no cost to the department. Alternatively, the engineer may allow the material to remain in place with a 50 percent payment factor.

HMA Prorated Pay Factors (between 50 and 100% pay) are as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Criteria</th>
<th>Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Air Voids Pay Factor</td>
<td>$4.3% &lt; V_a \leq 5.0%$</td>
<td>$100 - (V_a - 4.3) \times 71.4$</td>
</tr>
<tr>
<td>Low Air Voids Pay Factor</td>
<td>$1.5% \leq V_a &lt; 2.0%$</td>
<td>$100 \times [1 - (2.0 - V_a)]$</td>
</tr>
<tr>
<td>Low VMA Pay Factor</td>
<td>$0.5% &lt; V_MA \text{ below min} \leq 1.0%$</td>
<td>$100 \times [1 - (\text{percent below min.} - 0.5)]$</td>
</tr>
<tr>
<td>Low AC Pay Factor</td>
<td>$0.3% &lt; A_C \text{ below JMF} &lt; 0.5%$</td>
<td>$75$</td>
</tr>
</tbody>
</table>

When using Figure 10 for dispute resolution of SMA material apply the following:
- SMA 100% pay requires: $V_a = 3.2 - 5.8\%$, and $V_MA > 0.5\%$ below minimum.
- SMA 50% pay corresponds to: $V_a < 2.5\%$ or $> 6.5\%$, and $V_MA > 1.0\%$ below minimum.

SMA Prorated Pay Factors (between 50 and 100% pay) are as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Criteria</th>
<th>Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Air Voids Pay Factor</td>
<td>$5.8% &lt; V_a \leq 6.5%$</td>
<td>$100 - (V_a - 5.8) \times 71.4$</td>
</tr>
<tr>
<td>Low Air Voids Pay Factor</td>
<td>$2.5% \leq V_a &lt; 3.2%$</td>
<td>$100 - (3.2 - V_a) \times 71.4$</td>
</tr>
<tr>
<td>Low VMA Pay Factor</td>
<td>$0.5% &lt; V_MA \text{ below min} \leq 1.0%$</td>
<td>$100 \times [1 - (\text{percent below min.} - 0.5)]$</td>
</tr>
<tr>
<td>Low AC Pay Factor</td>
<td>$0.3% &lt; A_C \text{ below JMF} &lt; 0.5%$</td>
<td>$75$</td>
</tr>
</tbody>
</table>
HMA Verification Dispute Resolution Scenario Examples

NOTE: The following diagrams (A-H) represent standard scenarios. Specific project detail and troubleshooting activities may present cause for adjustment to this guidance.

Example A

A1 QV (3-2+) A2 QV (3-2+)

A1 QV-ret Va=2.8 Pass A2 QV-ret Va=1.9 Fail
A1 QV Va=2.6 OR A2 QV Va=1.9

END RESULT

A No Adjustment (N/A) QMP Controls

*The Referee third party (BTS) test results determine the Pass/Fail status of the QV sample once it has gone into Dispute Resolution.

Example B

B1 Isolated Area - Localized Problem (Prorated)

END RESULT

B1 Isolated Area - Localized Problem (50%)

END RESULT

Example C

C Uni-directional QC-ret <100% Pay

END RESULT

Example D

D Bi-directional QC-ret <100% Pay

END RESULT

Example E

E Additional Backward testing

END RESULT

Example F

F Additional Forward & Backward testing

END RESULT

Each test result represents the material halfway to the adjacent point. Therefore, this scenario results in one area of pay adjustment (in the Backwards direction) in addition to the initial verified QV-ret area. Testing does not continue if QC-ret >75% Pay

( ex: 1800-950 = 850 ton @ 90% pay)

( ex: 2300-1800 = 500 ton @ 50% pay)

Both Forward & Backward testing continue until a QC-ret results in ≥75% Pay. Pay adjustments are then calculated for the appropriate tonnage per area & corresponding percent pay.

Areas of 50% pay are subject to Remove & Replace.
### Figure 12  Adjustment Calculation Example

<table>
<thead>
<tr>
<th>Project ID:</th>
<th>xxxx-xx-xx</th>
<th>MIX TYPE:</th>
<th>4 MT xx-xx S</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTS Record:</td>
<td>x-254-00xx-20xx</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommended Adjustments</th>
<th>% Pay</th>
<th>Affected Mix Tons</th>
<th>Mix Bid Price</th>
<th>TOTAL Adjustment (w/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Void Failure</td>
<td>50%</td>
<td>500.0</td>
<td>$55.27</td>
<td>$13817.50</td>
</tr>
<tr>
<td>VMA Failure</td>
<td>75%</td>
<td>0.0</td>
<td>$55.27</td>
<td>$0</td>
</tr>
</tbody>
</table>

**Comment:**

<table>
<thead>
<tr>
<th>Alternate/Final Adjustments</th>
<th>% Pay</th>
<th>Affected Mix Tons</th>
<th>Mix Bid Price</th>
<th>TOTAL Adjustment (w/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Void Failure</td>
<td>50%</td>
<td>500.0</td>
<td>$55.27</td>
<td>$0</td>
</tr>
<tr>
<td>VMA Failure</td>
<td>75%</td>
<td>0.0</td>
<td>$55.27</td>
<td>$0</td>
</tr>
</tbody>
</table>

**REMKS:**

Contact Bureau of Technical Services for further assistance.
### Figure 13 Request for JMF Change

<table>
<thead>
<tr>
<th>Sieves</th>
<th>Original JMF (%)</th>
<th>Current Av4</th>
<th>Effective#</th>
<th>New JMF Request</th>
<th>SPEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.0mm</td>
<td></td>
<td></td>
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<td>19.0mm</td>
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<td>0.30mm</td>
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<td>0.15mm</td>
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<tr>
<td>0.075mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Component Blend %s

Current Blend %s

Requested By (date): __________  Approved By (date): __________

Cert #: __________  Cert #: __________

Comments:

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