836 QMP - HMA

Hot Mix Asphalt (HMA) QMP sampling, testing, materials properties, and documentation as prescribed in 836 are mobilized into the contract by standard spec 460.2.8.

836.1 General

836.1.1 Overview

This section addresses the standard specification for QMP, Asphaltic Mixture.

The QMP for Hot Mix Asphalt (HMA) is detailed in standard spec 460.2.8. Overview - WisDOT QMP Requirements:

- Personnel and required certifications (836.2 and standard spec 460.2.8.2.1.1)
- Laboratory facilities (836.3 and standard spec 460.2.8.2.1.2)
- Random sampling and sampling frequency (836.4 and standard spec 460.2.8.2.1.3)
- Required testing (and calculated properties) (836.6 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 (836.8 and standard spec 460.2.8.2.1.4)
  - Records
  - Control charts
- Control limits (standard spec 460.2.8.2.1.5)
- Warning bands
- Job mix formula adjustments (836.6.13.1 and standard spec 460.2.8.2.1.6)
- Corrective action (standard spec 460.2.8.2.1.7)
- Verification program (836.9 and standard spec 460.2.8.3.1)

836.1.2 Definitions

Interpret HMA related definitions used in 836 as follows:

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.
Mixture production 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.

836.2 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: HMATech certified at a level recognized for reviewing mix design work (HTCP-certified Hot Mix Asphalt, Mix Design, Report Submittals (HMA-MD) technician)) or 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)).

836.3 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.

836.4 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 sublot.

Example 1

Expected day's production is 1,900 tons. The number of required samples = 3 (per QMP standard spec 460.2.8.2.1.3).

Sample 1 – from 50 to 600 tons.
Sample 2 – from 601 to 1500 tons.
Sample 3 – from 1501 to 2700 tons.

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 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 will 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

Required Sample	Sublot Sample Tonnage Range	Random No. ASTM D3665	Sublot Sample Ton (Random No. x Sublot ton)	End of Previous. Range	Cumulative Sample Tonnage
1	50 - 600	0.572	RN x 600= 343	0	343
2	601 - 1500	0.353	RN x 900= 318	600	918
3	1501 - 1900	0.656	RN x 400= 262	1500	1762

This procedure is 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 x 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.

The plant operator should not be advised ahead of time when samples are to be 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.

836.4.1 Sampling from the Truck Box

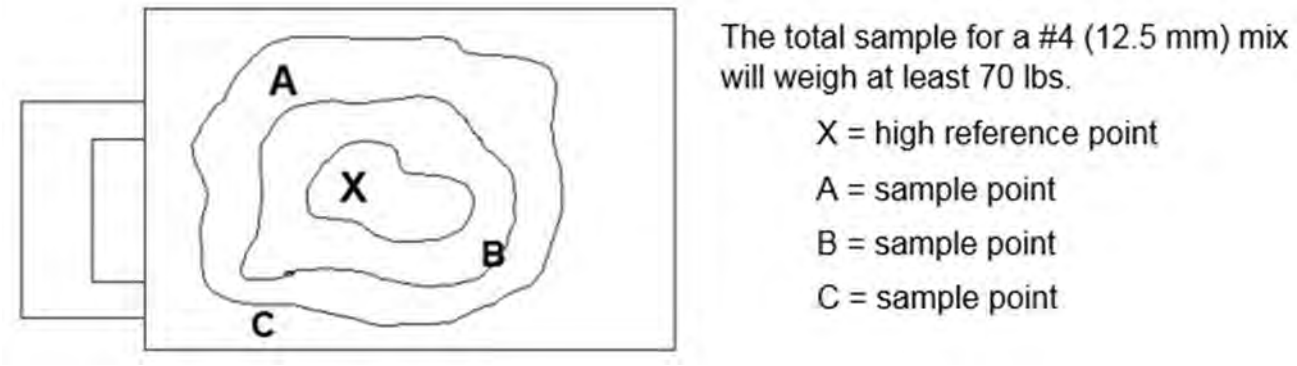
Sampling will be the contractor's responsibility. Truck box sampling presents some safety hazards because it is necessary to climb atop the truck box and stand on the hot mixture while sampling. Special care should be exercised by the contractor or his designated representative as the sample is procured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

836.4.2 Sample Location in Truck

When the last batch has been dumped into the truck box, an HMA Tech certified at a level recognized for mixture sampling or production testing collects a sample from 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 836-1. After removing the upper two to three inches of mix the sampling shovel or other approved device can be inserted into the underlying mixture to extract the sample increments.

FIGURE 836-1 Truck Box Sampling



836.4.2.1 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.

Mixture NMAS	Minimum Individual Sample Size	
	HMA	SMA
≤ 12.5mm (1/2"), Gradation # 4-5	35 lbs	70 lbs
19.0mm - 25.0mm (3/4" - 1"), Gradations # 2-3	50 lbs	-
> 37.5mm (1-1/2"), Gradation # 1	80 lbs	-

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 836.5.1.
- 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 836.5.2.

Additional guidance on reducing split samples to testing sizes is presented in 836.5.4 and 836.5.5 for HMA and SMA, respectively.

836.4.2.2 QV Sample Sizes:

Use same guidance as QC sample size (trouble shooting may involve need for a gradation).

836.5 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 836-2 provides an example label. The label must include the following items:

1. Contractor, testing Lab.
2. Certified technician name and HTCP number.
3. Sample type: QC, QC-ret, QV, QV-ret.
4. State project ID.
5. Date.
6. Sample number.
7. Type of asphaltic mixture.
8. State mix design ID (250-XXXX-YR).
9. Percent binder from current JMF.
10. Daily tonnage sampled.
11. Current G_{sb}.
12. For QV samples: the name, HTCP number, and company of the witness representing the department.

FIGURE 836-2 Example of Sample Labeling

Contractor - Lab:	ABC Paving - I39 Lab
Sampling Technician:	John Doe, 123433
Sample Type:	QV
State Project ID:	1155-01-01
Date:	10/1/2019
Sample Number:	9-1
Mix Type:	4 MT 58-28 S
State Mix ID:	250-1001-19
Current JMF % Binder:	5.1%
Current Gsb:	2.722
Daily Tonnage Sampled:	1,206
QV Sample Witness:	Jack Smith, 123456, XYZ Engineering

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

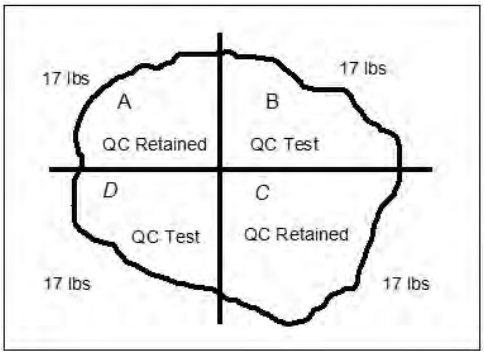
836.5.1 Two-Part Splitting of HMA Samples

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 836.5.1.1 or by using the Quartermaster™ described in 836.5.1.2. After splitting, the QC & QV test samples are then further reduced to testing size according to 836.5.4 for HMA or 836.5.5 for SMA.

836.5.1.1 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 836-3. For #4 (12.5 mm) mixes start with at least a total of 70 lbs of HMA.

FIGURE 836-3 Two-Part Split Sample Quartering, 70 lbs



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).

836.5.1.2 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 836-4.

FIGURE 836-4 Quartermaster Quartering Device

Example 3: Two-Part Split using the Quartermaster™

1. Dump initial truckbox samples into the machine, noting the chute capacity limit.
2. Throw lever to allow material to flow into the four quartering buckets. Repeat until all material has been quartered.
3. Combine diagonally opposite buckets to form the test sample (A + C) and the retained sample (B + D) making sure to distribute any clinging fines into each bucket.
4. From this point, remove the QC test material to a heated splitting table for further reduction to testing portions. Bag the retained sample, label, and store appropriately.
5. Clean sides and quartering slats before next use.

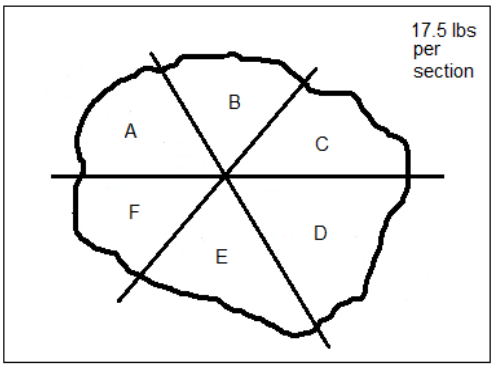
836.5.2 Three-Part Splitting of HMA Samples

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 836.5.2.1 or passed through a Quartermaster per 836.5.2.2. 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 BTS, if needed. After splitting, the QC & QV test samples are then further reduced to testing size according to 836.5.4 for HMA or 836.5.5 for SMA.

836.5.2.1 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 836.4.2.1 (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 836-5.

FIGURE 836-5 Quartering Process for Three-part Split Sample (105 lbs).

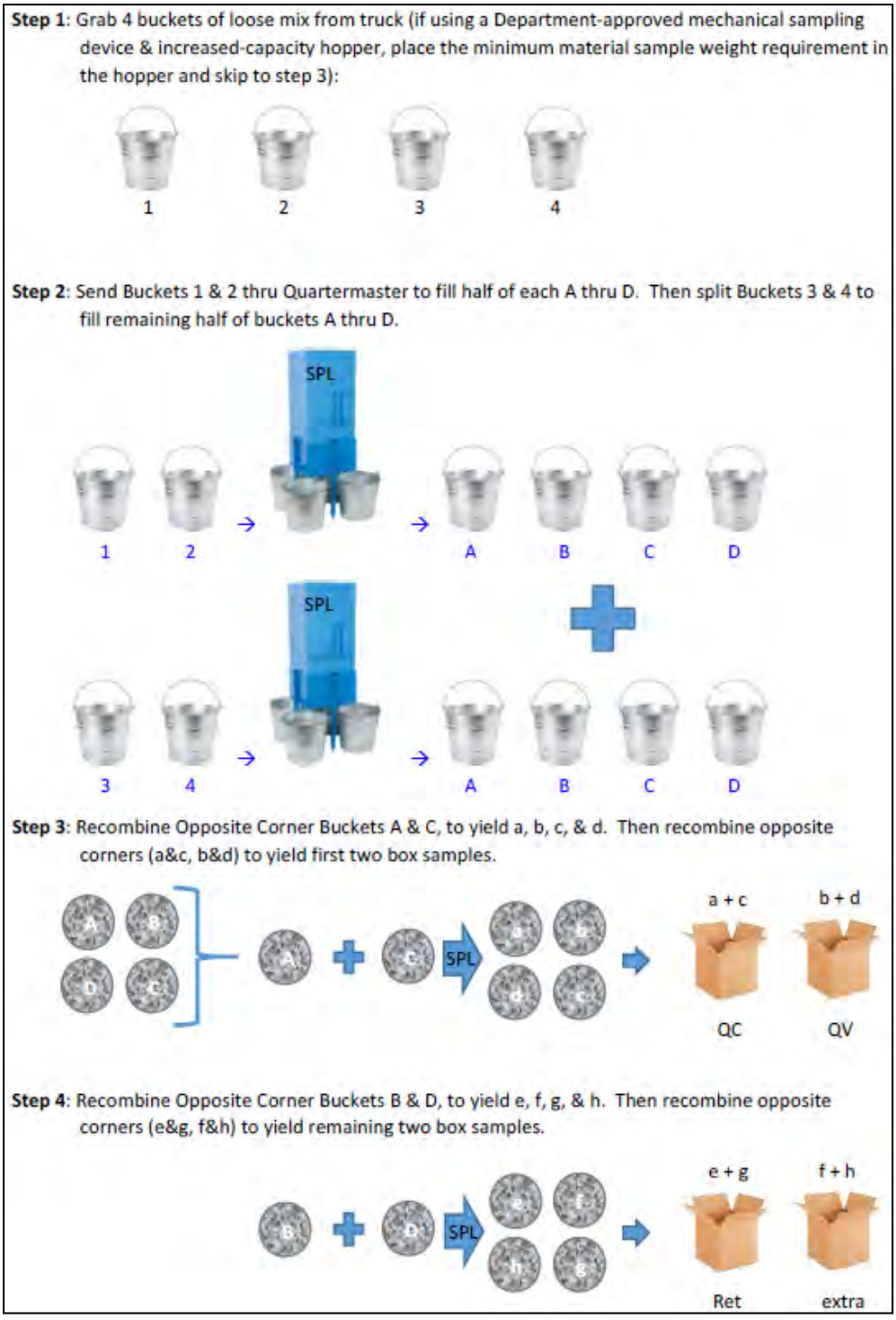


2. For a three-part split shown in figure 5, opposite diagonal sections, as indicated on the sketch, must be combined to form the QV sample (A+D), retained sample (B+E) and the QC sample (C+F). The retained sample must be boxed, labeled, and stored in a safe dry place. The retained samples may be tested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

836.5.2.2 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 836.4.2.1 (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 836-6 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 836-6 Three-Part Split Sample Using Quartermaster Device (140 lbs)



836.5.3 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).

836.5.4 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 further reduced for testing. Figure 836-7 shows the approximate breakdown of a #4 12.5mm HMA mixture (35 lbs). Figure 836-8 shows the appropriate HMA testing sizes.

FIGURE 836-7 HMA Individual Sample, (35 lbs)

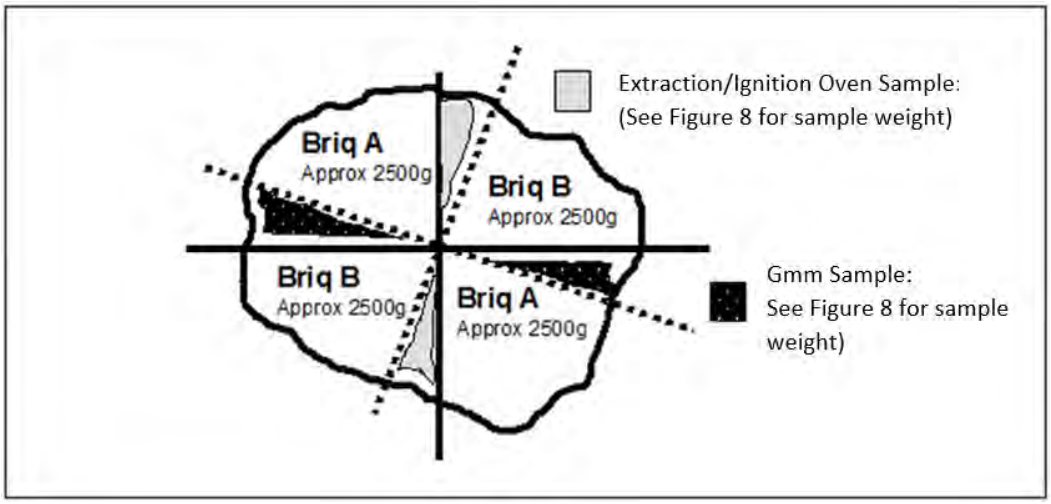


FIGURE 836-8 Minimum HMA & SMA Testing Sample Sizes

Gmm (RICE) Sample Size	
37.5 mm (#1)	4000 grams
25.0 mm (#2)	3000 grams
19.0 mm (#3)	2000 grams
12.5 mm (#4)	1500 grams
9.5 mm (#5)	1000 grams
4.75 mm (#6)	1000 grams

Extraction/Ignition Oven Sample Size	
37.5 mm (#1)	4000 grams
25.0 mm (#2)	3000 grams
19.0 mm (#3)	2000 grams
12.5 mm (#4)	1500 grams
9.5 mm (#5)	1200 grams
4.75 mm (#6)	1200 grams

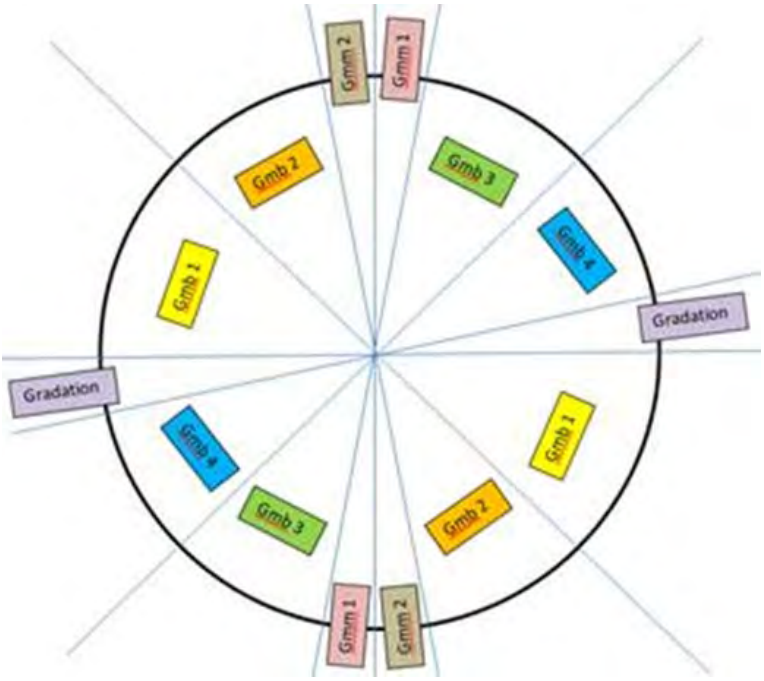
836.5.5 Further Reduction of SMA Samples to Test Sizes

The approximately 70 lbs of SMA material is further reduced for testing according to figure 836-9. As shown in figure 836-9, 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 836-8.

FIGURE 836-9 SMA Sample (Laboratory Split of approx. 70 lbs)



836.6 Required Testing and Calculated Properties

If the digit or decimal place you are rounding to is followed by 5, 6, 7, 8, or 9, round up. If the digit or decimal place you are rounding to is followed by 0, 1, 2, 3, or 4, round down. For example, when rounding to the tenths place, 14.150 becomes 14.2 and 14.149 becomes 14.1.

836.6.1 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 for mixture evaluation:

- Va = 1.5 - 5.0% (2.5 - 6.5% for SMA)
- VMA = - 1.0 from required minimums specified in standard spec 460.2.2.3, table 460-1
- AC = within -0.5 of JMF (determined by ignition oven method according to AASHTO T308 as modified in 836.6.3.6, chemical extraction according to AASHTO T164 Method A or B, or automated extraction according to ASTM D8159 as modified in 836.6.3.1).

For results not meeting the above ranges, apply pay in accordance with the "Produced Outside JMF Limits" guidance listed in standard spec 460.5.2.1.

836.6.2 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 836.6.3.6, chemical extraction according to AASHTO T164 Method A or B, or automated extraction according to ASTM D8159 as modified in 836.6.3.1).

836.6.3 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 836.6.3.1.
- Ignition oven according to AASHTO T308 as modified in 836.6.3.6)

Unless the region indicates otherwise, regional labs will determine AC by ignition oven according to AASHTO T308 as modified in 836.6.3.6. Regardless of the method the contractor uses to determine AC, the contractor needs to supply the regional lab with ignition oven correction factor (IOCF) material according to 836.6.3.7. BTS will use automated extraction according to ASTM D8159 as modified in 836.6.3.1 for all AC verification and dispute resolution testing. Assuming the contractor uses an ignition oven for AC determination, the contractor must have the mix design's IOCF for AC and aggregate determined before producing the mix design on a WisDOT contract.

836.6.3.1 Automated Extraction of Asphalt Binder (AC) by 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, with the following modifications:

Delete 1.4.

7.1 Obtain Specimens in accordance with AASHTO T168.

7.2.2 Before 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.

836.6.3.2 (Vacant)

836.6.3.3 (Vacant)

836.6.3.4 (Vacant)

836.6.3.5 (Vacant)

836.6.3.6 Move general requirements unrelated to test procedure modifications to 836.6.3.7.

836.6.3.6 Asphalt Content by Ignition Oven WisDOT-Modified AASHTO T308

During production, provide to the Department, results of ignition oven burns conducted according to AASHTO T308, 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) before beginning 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;

11.1 Precision - Criteria for judging the acceptability of ignition burn results for asphalt content obtained by Method A is given in Table 2.

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 specimens according to Method A.

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.

836.6.3.7 Rewrite to clarify and increase flexibility by decoupling contractor IOCFs from department IOCFs.

836.6.3.7 Ignition Oven Correction Factor

836.6.3.7.1 General

Ignition ovens used for AC determination should be installed, operated, and maintained according to AASHTO R96. Mix designs with AC determined by ignition oven must have appropriate ignition oven correction factors (IOCF). Ignition oven asphalt binder content and aggregate correction factors are specific to each mix design and oven and are not transferable.

836.6.3.7.2 Initial Ignition Oven Correction Factor Determination

Mix designers collect and furnish lab-batched material, at 3.0% air voids for HMA or 4.5% air voids for SMA, to provide the region with ten individually packaged IOCF split samples of appropriate weight according to table 836-1 at least 10 days before producing the mix design on a WisDOT contract. Regional labs send three individually packaged IOCF split samples to a department lab within one day of receiving them for asphalt binder content determination by automated extraction.

TABLE 836-1 Minimum IOCF Sample Weight

Nominal Max Aggregate Size (mm)	Individually-Packaged Ignition Oven Correction Factor (IOCF) Sample Minimum Weight (grams)[1]
No. 1 (37.5)	4,000
No. 2 (25.0)	3,000
No. 3 (19.0)	2,000
No. 4 (12.5)	1,500
No. 5 (9.5)	1,200
No. 6 (4.75)	1,200

[1] IOCF samples must be no more than 500 grams greater than the minimum weight provided.

Label the following information on each individually packaged IOCF sample:

1. Contractor testing lab and certified technician name.
2. Date.
3. Type of asphaltic mixture.
4. Lab-batched or field produced material.
5. Contractor's mix ID for lab batched or WisDOT ID (250-XXXX-YR) for plant-produced.
6. Percent binder, virgin aggregate, and RAM.
7. Reason for submittal, choose one of the below:
   - New design.
   - Reverification, listing a reason from table 836-2.

TABLE 836-2 Reasons to Reverify the IOCF

1. Annual mix reverification.
2. Exceed 50,000 tons of mixture produced since the last IOCF determination/reverification.
3. An individual aggregate, virgin or RAP, changes by more than 5 % from the JMF for the current IOCF.
4. Percentage of RAS is changed.
5. Equipment is changed, replaced, or recalibrated.
6. The department questions their own IOCF.
7. The contractor questions the accuracy of their own IOCF.

Both the contractor and regional lab independently determine an ignition oven asphalt binder correction factor and the contractor must determine the appropriate aggregate correction factor for each mix design and oven according to AASHTO T308, Annex A as modified in 836.6.3.6. Contractors must determine their IOCFs before the first day of production. The contractor must note on the percent binder control charts the IOCF and the date the IOCF became effective. The department verifies the asphalt content for each split sample provided to the regional lab using automated extraction according to ASTM D8159 as modified in 836.6.3.1.

The contractor may compare their ignition oven results to the region's by proceeding according to 836.6.3.8.

836.6.3.7.3 Reverification of the Ignition Oven Correction Factor

836.6.3.7.3.1 General

Ignition oven correction factors recalculated during production may use plant-produced or lab-batched material. The party requesting reverification must notify the other party and provide one of the reasons listed in table 836-2.

If the IOCF is being recalculated for reasons 1-6, proceed to 836.6.3.7.3.2, otherwise proceed to 836.6.3.7.3.3.

836.6.3.7.3.2 Witnessed Reverification

The contractor and regional lab will coordinate the collection of ten individually packaged IOCF split samples of appropriate weight according to table 836-1, label the samples with the information described in 836.6.3.7.2. The department delivers the IOCF samples to the regional lab within one day of collecting them. The contractor must deliver annual reverification IOCF samples to the regional lab at least 10 days before producing the mix design on a WisDOT contract. The regional lab sends three individually packaged IOCF samples for AC content verification to a department lab for automated extraction according to 836.6.3.7.3.4 within one business day of receiving them.

The department determines the IOCF according to 836.6.3.7.3.4 and the contractor determines an ignition oven asphalt binder correction factor and the appropriate aggregate correction factor for each mix design and oven according to AASHTO T308, Annex A as modified in 836.6.3.6. The contractor must note on the percent binder control charts or running average report each time an IOCF is recalculated and the date the new IOCF becomes effective.

836.6.3.7.3.3 Unwitnessed Reverification

The contractor collects three individually packaged IOCF split samples of appropriate weight according to table 836-1, and labels the samples as described in 836.6.3.7.2, and delivers the IOCF split samples to the regional lab within one day of collecting them. The department reserves the right to verify the asphalt content for each split sample provided to the regional lab according to ASTM D8159 as modified in 836.6.3.1.

The contractor determines an ignition oven asphalt binder correction factor and the appropriate aggregate correction factor for each mix design and oven according to AASHTO T308, Annex A as modified in 836.6.3.6. The contractor must note on the percent binder control charts or running average report each time an IOCF is recalculated and the date the new IOCF becomes effective.

836.6.3.7.3.4 Verification of IOCF by Automated Extraction

The department uses automated extraction to determine the asphalt content used to calculate the ignition oven asphalt binder correction factor for each oven, for each mix design, as follows:

1. The department performs one automated extraction according to ASTM D8159 as modified in 836.6.3.1 to determine an extracted asphalt binder content of the mixture. Results must be completed and reported by the end of the second business day after arrival at BTS.
2. The contractor has the option to run an automated extraction according to ASTM D8159 as modified in 836.6.3.1 or a chemical extraction according to AASHTO T164 Method A or B, for comparison to the result obtained by BTS.
3. If the contractor disputes the department's extracted asphalt content results, the following apply:
    3.1. If results from both parties are within 0.40 % AC of each other, the department result is considered validated and will be used for the correction factor of all department ignition ovens.
    3.2. If the two results are not within 0.40 % AC of each other, BTS will retest material from the same split sample. If the retest is within 0.20 % AC of the first department sample, the average of the two WisDOT test results will be used for the correction factor of all department ignition ovens.
    3.3. If the retest does not meet the tolerance of 0.20 % AC, BTS will test a third split of the same sample and compare 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.
4. The regional lab will test two ignition oven calibration samples from the same split sample according to AASHTO T308 as modified in 836.6.3.6.
5. Once the regional lab has completed their ignition oven tests, they 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.

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

The contractor may compare their ignition oven results to the region's according to 836.6.3.8.

836.6.3.8 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 any 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 reported data for asphalt content.

As a part of the ignition oven comparison test, the contractor will conduct a chemical extraction according to AASHTO T164 Method A or B or conduct an automated extraction according to ASTM D8159 as modified in 836.6.3.1. 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 836.6.3.1. The BTS referee test results will be used by the department and contractor to calculate a new IOCF for the mix according to 836.6.3.7.3.4 using the remainder of the split sample material.

836.6.4 HMA Compaction by WisDOT-Modified AASHTO T312

Cylindrical specimen used for determination of volumetric determination will be 115 +/- 5 mm in height. It may be necessary to produce a trial specimen to achieve this height requirement. For Wisconsin aggregates and designs a range of 4700 - 4900g is generally appropriate to achieve this height for aggregates with combined bulk specific gravities (Gsb) of 2.550 to 2.700, respectively.

Compact cylindrical specimens of asphalt mixtures using the Superpave gyratory compactor according to AASHTO T312, with the following modifications:

8.2.5. Bring the HMA to the compaction temperature range by careful, uniform heating in an oven immediately before molding. 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

9.1. Preheat specimen molds (charging funnels, spatulas, etc.) to 300 F. Remove the heated mold, base plate, and upper plate (if required) from the oven. Place the base plate and a paper disk in the bottom of the mold.

9.7. Note 6 - After compaction is completed the specimen is extruded, protection papers are removed, the briquette is labeled, and cooling by fan is required for a period of at least 1 hour. The specimens can be extruded from the mold immediately after compaction for most asphalt mixtures. 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.

9.8. Note 7 - Reheat the mold to the compaction temperature before using it for subsequent specimen. Using multiple molds will speed up the compaction process.

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.

836.6.5 Bulk Specific Gravity by WisDOT-Modified AASHTO T166

For HMA determine bulk specific gravity, the G_{mb}, using AASHTO T166 modified as follows:

6.2 Delete note 2

9.3 Delete note 4

When testing HMA or SMA cores collected from pavement, the sequence of testing cannot be changed. Always measure the dry mass first using cores dried according to AASHTO R79, followed by the immersed mass and finally the surface-dry mass.

Report the average G_{mb} of 2 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 compacted from the contractor retained sample (following the rule-of-retained).

For SMA mixtures and cores, determine the G_{mb} using the Corelok™ System, or equivalent vacuum system, according to AASHTO T331.

Additional information on using the Corelok™ for Gmb is provided in the following video:

https://youtu.be/HFT9xlR2lnI

For SMA, report the average G_{mb} of 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.

836.6.6 Theoretical Maximum Specific Gravity by WisDOT-Modified AASHTO T209

Determine theoretical maximum specific gravity, the G_{mm}, using AASHTO T209 modified as follows:

7.2 The size of the sample must conform to figure 836-8.

9.2 Subject the G_{mm} sample to the same heating condition and time period as the G_{mb} material under 836.6.5.

For HMA, report the G_{mm} of 1 specimen.

For SMA, report the average G_{mm} of 2 specimens. If one of the individual samples deviates by more than 0.015 from the other, results are considered suspect and an additional set of samples is measured.

836.6.7 Dryback Procedure for Absorptive Aggregates

Run dryback procedure, corrected G_{mm}, using AASHTO T209, Supplemental Procedure for Porous Aggregates.

- The dryback procedure is required for aggregate JMF blends with moisture absorption greater than or equal to 2.0%.
- 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.

836.6.8 Air Voids

Determine air voids, $\%V_a$, using AASHTO T269 and report results to one decimal place.

The air void ($\%V_a$) determination is the relationship between the theoretical maximum specific gravity (G_{mm}) and bulk specific gravity (G_{mb}). Calculate to one decimal place.

$$V_a, \% = \frac{(G_{mm} - G_{mb})}{Gmm} x100$$

836.6.9 Voids in Mineral Aggregate (VMA)

VMA is calculated using the aggregate bulk specific gravity, G_{sb}, from the contractor mix design (unless a blend change has occurred in which case a new Gsb will be calculated), the asphalt content (P_b determined by 836.6.3), and the average SGC specimen bulk specific gravity, G_{mb}, as follows (calculate and record to 0.1.):

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

836.6.10 Performance Testing Procedures

836.6.10.1 Hamburg Wheel-Track Test by WisDOT-Modified AASHTO T324

Test the rutting and moisture-susceptibility of HMA mixtures according to AASHTO T324 modified as follows:

5.1. Hamburg Wheel-Tracking Device: An electrically powered machine capable of moving a 203.2 +/- 2.0-mm (8 +/- 0.08-in.) diameter, 47 +/- 0.5-mm (1.85 +/- 0.02-in.) wide steel wheel over the center (x and y axes) of the test specimen. The load on the wheel is 703 +/- 4.5 N (158.0 +/- 1.0 lb).

Delete note 1

7.3 Determine the air void content of the specimens in accordance with T 269. The required target air void content is 7.0 +/- 0.5 percent for laboratory-compacted SGC cylindrical specimens and 7.0 +/- 1.0 percent for laboratory-compacted slab specimens. Field specimens may be tested at the air void content at which they are obtained.

8.6.1 Select the test temperature of 46 C.

836.6.10.2 Indirect Tensile Cracking Test by WisDOT-Modified ASTM D8225

Test the intermediate temperature cracking-susceptibility of HMA mixtures(CT index) according to ASTM D8225 modified as follows:

8.2.2 Aging: Laboratory-compacted test specimens shall be properly conditioned before the compaction.

Note 2: For laboratory-mixed and laboratory-compacted (LMLC) mixes, condition specimens before compaction according to the short-term and long-term conditioning procedures specified in AASHTO R30 as modified in 836.6.10.3. For plant-mixed and laboratory-compacted mixes (PMLC), condition specimens before compaction according to the long-term conditioning procedures specified in AASHTO R30 7.3.1 as modified in 836.6.10.3.

8.2.3 Air Void Content: Prepare a minimum of three specimens at the target air void content 7.0 +/- 0.5 percent.

Delete note 3

9.1 Precondition test specimens in a water bath at a target intermediate test temperature 25 +/- 1 C for 2 h +/- 10 min.

Delete note 5

836.6.10.3 Mixture Conditioning of HMA by WisDOT-Modified AASHTO R30

Condition HMA mixtures according to AASHTO R30 as directed within each testing procedure modified as follows:

Delete 7.1.3.

7.3.1 The long-term conditioning for the mixture mechanical property testing procedure applies to laboratory-prepared mixture that have been subjected to the short-term conditioning for the mixture mechanical property testing procedure described in Section 7.2, and plant-mixed HMA. All long-term conditioning for WisDOT mixture mechanical property testing will be completed on loose HMA.

For long-term conditioning of loose mix: Place the loose mix in a pan or pans to achieve a layer thickness between 3/4" - 1" thick. Place the mixture and pan in the convection oven for 6 h +/- 5 min at a temperature of 135 +/- 3 C (275 +/- 5 F).

If the compaction temperature of the mix is less than 280 F proceed directly to compaction according to AASHTO T312. Otherwise, heat the mixture to compaction temperature before compaction. After compaction cool each specimen to room temperature before testing by placing in front of a fan for a minimum of 2 h or at room temperature for a minimum of 16 h.

Delete 7.3.2 through 7.3.6.

836.6.11 (Vacant)

836.6.12 Additional Formulas and Example Calculations

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

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

Given:

Pb = 4.5
Gmm = 2.567
Gb = 1.030

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

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

Given:

Gmm = 2.567
Gb = 1.030
Gse = 2.761

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

$$P_{ba} = 100 \times \frac{(G_{se} - G_{sb})}{(G_{sb} \times G_{se})} \times G_b =$$

$$100 \times \frac{(2.761 - 2.703)}{(2.703 \times 2.761)} \times 1.031 = 100 \times \frac{0.058}{7.463} \times 1.031 = 0.8$$

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:

$$P_{be} = P_b - \left(\frac{P_{ba}}{100}\right) \times P_s = 5.3 - \left(\frac{.8}{100}\right) \times 94.7 = 4.5$$

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):

$$Dust\,to\,Binder\,Ratio = \frac{\%\ passing\ 0.075}{P_{be}} = \frac{5.0}{4.5} = 1.1$$

Given:

Pbe = 4.5
% passing 0.075 = 5.0

836.6.13 Field Adjusted JMF

The JMF may be adjusted in the field based on production test results see 866.2.

When the JMF asphalt content is increased by 0.2% or more start new running average for G_{mm}. The compaction target maximum density for the day of the target change can be calculated using the most

recent G_{se} and percent asphalt binder (P_b) for the new JMF and G_b (binder specific gravity) at 77 F from the mix design.

836.6.13.1 Job Mix Formula (JMF) Changes

Changes made to the current JMF during production must be submitted to the HMA-MD Technician representing the department for approval. Scenarios requiring a JMF change include but are not limited to the following:

- Decrease in JMF target binder content of 0.1% maximum.
- Change in asphalt binder PG grade (with the project engineer's approval and complying with 866.2.3.2).
- Addition of an additive, except approved compaction aids.
- Changes to an additive type or dosage rate identified on a JMF.
- Change to JMF aggregate gradation percentages within aggregate gradation master range according to table 460-1.

A JMF target binder content decrease exceeding 0.1% from the original JMF target, elimination or addition of any aggregate component, or changes to the design aggregate component blend percentages exceeding 20%, in combination will require a new mix design.

No JMF change requests are to occur before completion of three individual production tests for changes to a control sieve or mixture AC content. Recycled asphaltic binder change requests require two RAM extractions according to 836.6.15. 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 requesting JMF changes, laboratory results must be submitted electronically to substantiate using materials from non-WisDOT projects.

The contractor notifies the project engineer of proposed changes using the "Request for JMF Change" form shown in figure 836-13. Comments must include the sample test number indicating when the change becomes effective. Production adjustments and JMF change request submittals cannot cause target values to violate design requirements. Production tolerances may exceed those targets.

The requested change can become effective up to four individual test points before the current average of four that is indicated on the submitted form. Electronic documentation indicating that the contractor and project engineer had discussed a possible JMF Change must exist, and support this request, if the department is to accept the change. The "Request for JMF Change" form must indicate the lot and sublot where the JMF change will become effective.

Further changes are not allowed until six additional individual test points, according to the normal sampling frequency, for the affected mix property are documented. Each JMF sieve is considered an individual mix property. Control charts for affected properties must accompany JMF change requests.

836.6.14 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.

836.6.15 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:

Nominal Max Size (mm)	Minimum Weight of Test Sample (grams)
No. 2 (25.0)	3000
No. 3 (19.0)	2000
No. 4 (12.5)	1500
No. 5 (9.5)	1000

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 percent binder replacement (Pbr) needs to 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.

836.7 HMA QMP Documentation

836.7.1 General

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 the NMAS sieve in table 460-1:

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 (0.60mm) # 50 (0.30mm) # 100 (0.15mm) # 200(0.075mm)

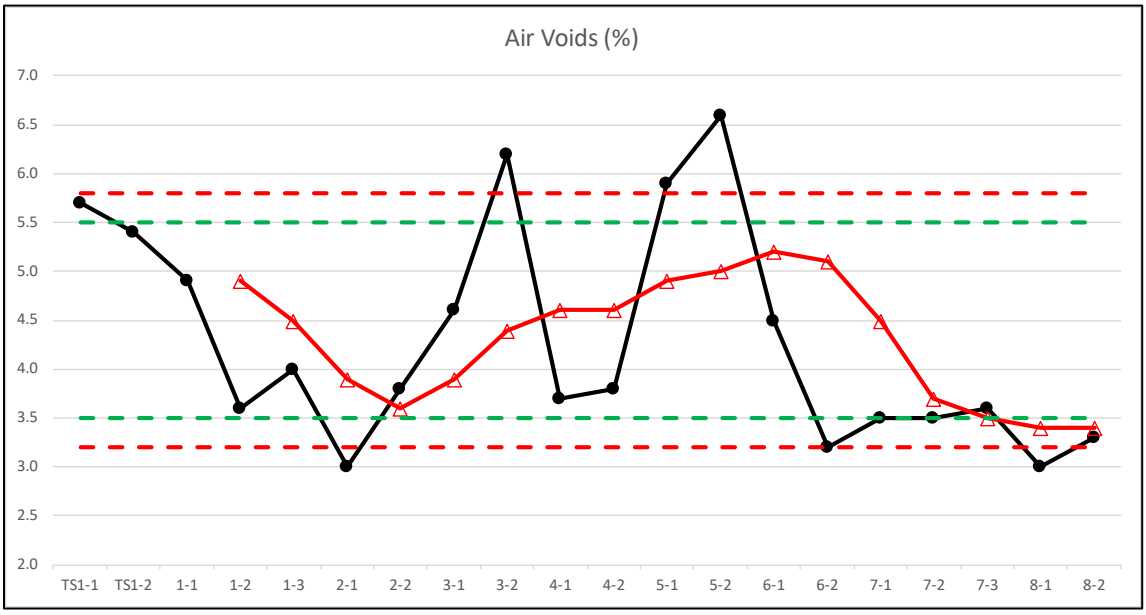
836.7.2 Example Pay Reductions for Control Charts

The engineer will evaluate contractor-supplied control charts and compare the 4-point running average to the control limits specified in standard spec 460.2.8.2.1.5 and the corrective action specified in standard spec 460.2.8.2.1.7. HMA individual data points are not typically analyzed independently. However, individual SMA air voids test results are subject to the additional corrective action criteria specified in standard spec 460.2.8.2.1.7(7) and to pay adjustment as specified in standard spec 460.5.2.1(5) in addition to the control limits that apply to the 4-point running average.

The following example illustrates how to make a pay reduction for SMA air voids.

Example 4

Running Average Analysis of Mixture Samples										
WisDOT Mix ID #: 250-0111-2020				Mix Type: 4 SMA 58-28 V			Site:			
				Cumulative	Gmb		Gmm		Air Voids	
Sample	Sample Date	Lot	Sublot	Sample Tons	Result	Mean	Result	Mean	Result	Mean
5001	7/11/2020	TS1	1	-	2.330		2.470		5.7	
5002	7/11/2020	TS1	2	-	2.360		2.496		5.4	
5755	7/27/2020	1	1	437.0	2.347		2.467		4.9	
5757	7/28/2020	1	2	1495.0	2.373	2.353	2.462	2.474	3.6	4.9
5758	7/28/2020	1	3	2005.0	2.364	2.361	2.463	2.472	4.0	4.5
6500	8/13/2020	2	1	2411.1	2.396	2.370	2.469	2.465	3.0	3.9
6501	8/14/2020	2	2	2846.1	2.375	2.377	2.468	2.466	3.8	3.6
6564	8/14/2020	3	1	3220.7	2.352	2.372	2.466	2.467	4.6	3.9
6567	8/15/2020	3	2	3851.7	2.327	2.363	2.480	2.471	6.2	4.4
6618	8/15/2020	4	1	4650.4	2.377	2.358	2.468	2.471	3.7	4.6
6622	8/15/2020	4	2	5392.4	2.383	2.360	2.477	2.473	3.8	4.6
6738	8/18/2020	5	1	6263.3	2.324	2.353	2.470	2.474	5.9	4.9
6739	8/18/2020	5	2	6941.3	2.307	2.348	2.470	2.471	6.6	5.0
6754	8/19/2020	6	1	7143.0	2.362	2.344	2.473	2.473	4.5	5.2
6758	8/20/2020	6	2	7596.0	2.389	2.346	2.467	2.470	3.2	5.1
7563	9/7/2020	7	1	8031.8	2.392	2.363	2.479	2.472	3.5	4.5
7572	9/8/2020	7	2	9247.8	2.396	2.385	2.483	2.476	3.5	3.7
7573	9/8/2020	7	3	9267.8	2.392	2.392	2.481	2.478	3.6	3.5
7723	9/12/2020	8	1	10472.2	2.397	2.394	2.471	2.479	3.0	3.4
7724	9/12/2020	8	2	10635.2	2.386	2.393	2.468	2.476	3.3	3.4
Count					20		20		20	
Mean					2.366		2.472		4.290	
JMF					2.358		2.469		4.5	
Warning Band (L)									3.5	
Warning Band (H)									5.5	
JMF(L)									3.2	
JMF(H)									5.8	



Example 4A

The first instance of nonconforming air voids in this example involves sublots 2-1, and 3-2. These two individual air voids tests within four consecutive points exceed the JMF limits.

The specified pay adjustment would be applied to the material from the point where an individual test is outside the JMF limit until another individual QV or QC test is within the JMF limits. In this case, the department would pay 80% of the contract unit price for the material from sublot 2-1 to 2-2 (435 tons) and from sublot 3-2 to 4-1 (798.7 tons).

Example 4b

The second instance of nonconforming air voids in this example involves sublots 5-1 and 5-2. These two individual air voids tests within four consecutive points exceed the JMF limits. In this case, the department would pay 80% of the contract unit price for the material from sublot 5-1 to 6-1 (879.7 tons).

Note: Two consecutive four-point running average values (sublots 8-1 and 8-2) exceed the warning limits requiring the contractor to stop production and make adjustments. Production can not resume until the engineer has been notified of the changes made. A new running average will be calculated at the fourth test after the required production stop.

836.8 Documentation

836.8.1 QC Records

In addition to the requirements of standard spec 460.2.8.2.1.4.1, the contractor must provide:

- A cumulative tonnage value and current control charts to the engineer daily.
- Random number generation results and associated tonnage for QMP sampling.
- 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 including percentages of aggregates, RAM, AC%, and additives.
- Individual sample test property worksheets (*Note:* More detailed information may be requested or observed during actual production for evaluation purposes. 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.

836.8.2 QV Records

The contractor needs to post results of department QV testing on the appropriate QC charts for air voids, AC%, and VMA, each represented with a unique symbol.

836.9 Quality Verification Program

836.9.1 Monitoring Contractor QMP

836.9.1.1 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 BTS 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.

836.9.1.2 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 836.6.14.
- 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.

836.9.2 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.

836.9.2.1 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.

836.9.3 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.

836.9.3.1 Additional Testing

When a QV test result does not meet the specified acceptance limits specified in standard spec 460.2.8.3.1.6 the engineer must collect the following samples and send them 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.

The engineer must send these samples 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 5

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 836-10 (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 6

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.

836.9.3.2 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 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) X 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 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.

836.9.3.3 Dispute Resolution

For the results of the additional testing conducted according to 836.9.3, 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 business 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:

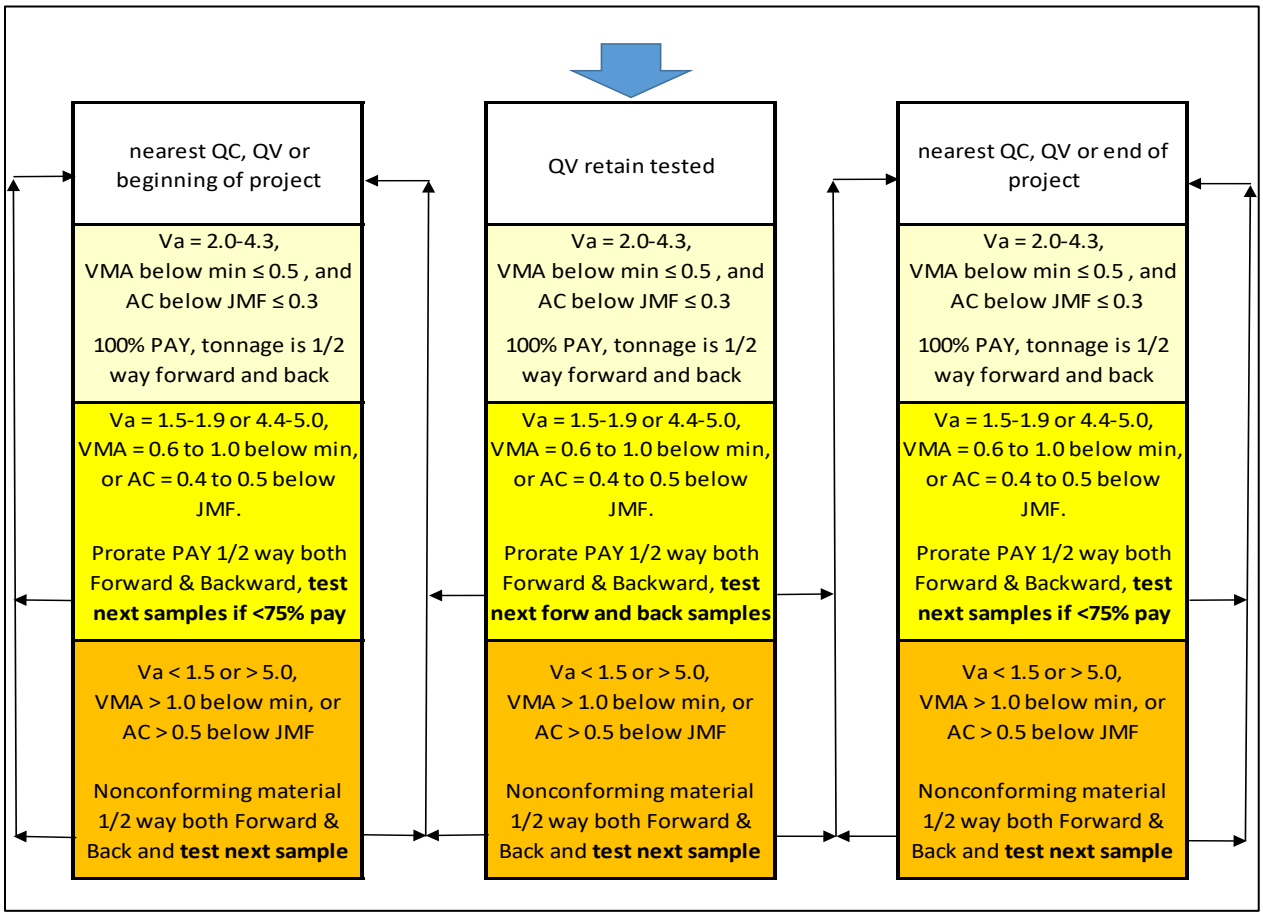
- Gmm & Gmb as measured by BTS.
- Air Voids as calculated from BTS volumetric data.

- 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 836-10. Example scenarios are provided in figure 836-11 (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 836-12 is an example of a spreadsheet used to calculate pay adjustments.

FIGURE 836-10 HMA Dispute Resolution Flow Chart



- Pay of less than 100% on QV-retain test will result in additional testing of forward and back sample.
- Pay of less than 75% on forward or backward QC-retain will result in testing of the next forward or backward sample.
- Unacceptable material must 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:

Description	Criteria	Pay Factor
High Air Voids Pay Factor	4.3% < Va ≤ 5.0%	= 100 - (Va - 4.3) * 71.4
Low Air Voids Pay Factor	1.5% ≤ Va < 2.0%	= 100 * [1 - (2.0 - Va)]
Low VMA Pay Factor	0.5% < VMA below min ≤ 1.0%	= 100 * [1 - (percent below min. - 0.5)]
Low AC Pay Factor	0.3% < AC below JMF ≤ 0.5%	= 75

When using figure 836-10 above for dispute resolution of SMA material apply the following:

- SMA 100% pay requires: Va = 3.2 - 5.8%, VMA below min ≤ 0.5%, and AC% below JMF ≤ 0.3%.
- SMA 50% pay corresponds to: Va < 2.5% or > 6.5%, VMA below min > 1.0%, or AC% below JMF > 0.5%.

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

Description	Criteria	Pay Factor
High Air Voids Pay Factor	5.8% < Va ≤ 6.5%	= 100 - (Va - 5.8) * 71.4
Low Air Voids Pay Factor	2.5% ≤ Va < 3.2%	= 100 - (3.2 - Va) * 71.4
Low VMA Pay Factor	0.5% < VMA below min ≤ 1.0%	= 100 * [1 - (percent below min. - 0.5)]
Low AC Pay Factor	0.3% < AC below JMF ≤ 0.5%	= 75

FIGURE 836-11 HMA Verification Dispute Resolution Scenario Examples

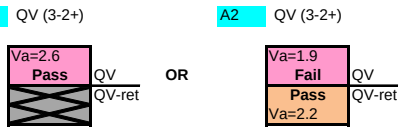
NOTE: *The following diagrams (A-H) represent standard scenarios. Specific project detail and troubleshooting activities may present cause for adjustment to this guidance*

= Testing performed by the Region
= Testing performed by the Referee third party (BTS)
= QC random production sample

A standard recommendation will be assessed based on the following requirements:

- Va is within a range of 2.0 to 4.3 percent.
- VMA is within minus 0.5 of the minimum requirement for the mix design nominal maximum aggregate size.
- AC is within minus 0.3 of the JMF

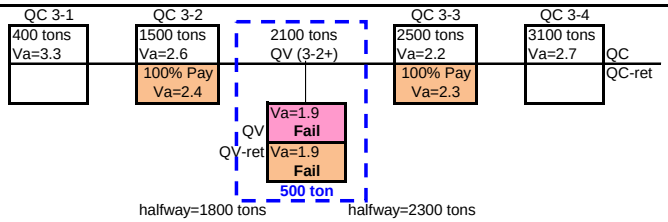
Example A



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 1



END RESULT

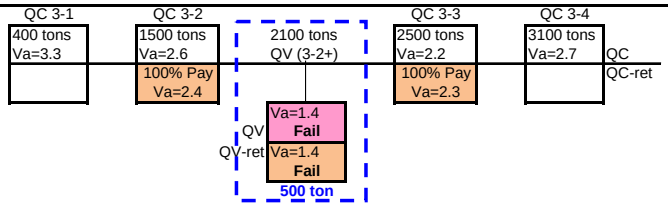
B1 **Isolated Area** : Localized Problem (Prorated)
Backward and forward QC-ret results are acceptable (100% pay)

Calculate halfway from failing QV-ret both forward and back

(ex: 2300 - 1800 = 500 ton @ 90% pay)

Percent pay for any adjustment will be determined by the tiered system presented in Figure 7

Example B 2



END RESULT

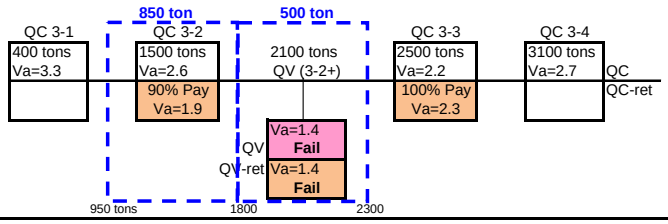
B2 **Isolated Area** : Localized Problem (50%)
Backward and forward QC-ret results are acceptable (100% pay)

Calculate halfway from failing QV-ret both forward and back

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

Percent pay for any adjustment will be determined by the tiered system presented in Figure 7

Example C



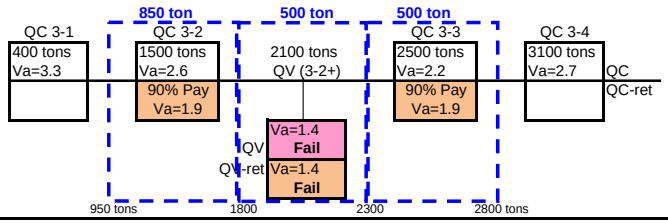
END RESULT

C **Uni-directional QC-ret <100% Pay**
Backward or forward QC-ret <100% Pay

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)

Example D



END RESULT

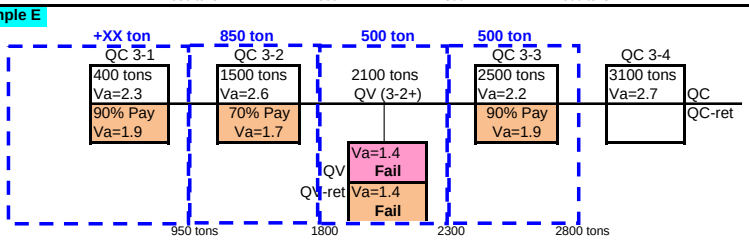
D **Bi-directional QC-ret <100% Pay**
Backward and forward QC-ret <100% Pay

This scenario results in two areas of pay adjustment 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)
(ex: 2800-2300 = 500 ton @ 90% pay)

Example E



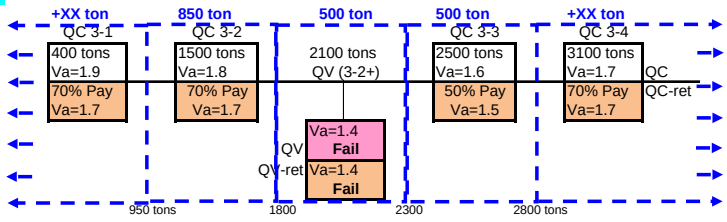
END RESULT

E **Additional Backward testing**
Backward QC-ret is < 75% Pay
Forward QC-ret is > 75% Pay

Backward testing continues beyond QC-ret 3-2, until resulting in ≥75% Pay, as seen with QC-ret 3-1.

Therefore, pay adjustment will affect tonnage halfway back to the last QC test of Day 2

Example F



END RESULT

F **Additional Forward & Backward testing**
Forward QC-ret is <75% Pay
Backward QC-ret is < 75% Pay

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

Pay adjustment may continue to beginning & end of production.
Areas of 50% pay are subject to Remove & Replace

FIGURE 836-12 Adjustment Calculation Example

Project ID: xxxx-xx-xx MIX TYPE: 4 MT xx-xx S MTS Record: x-254-00xx-20xx

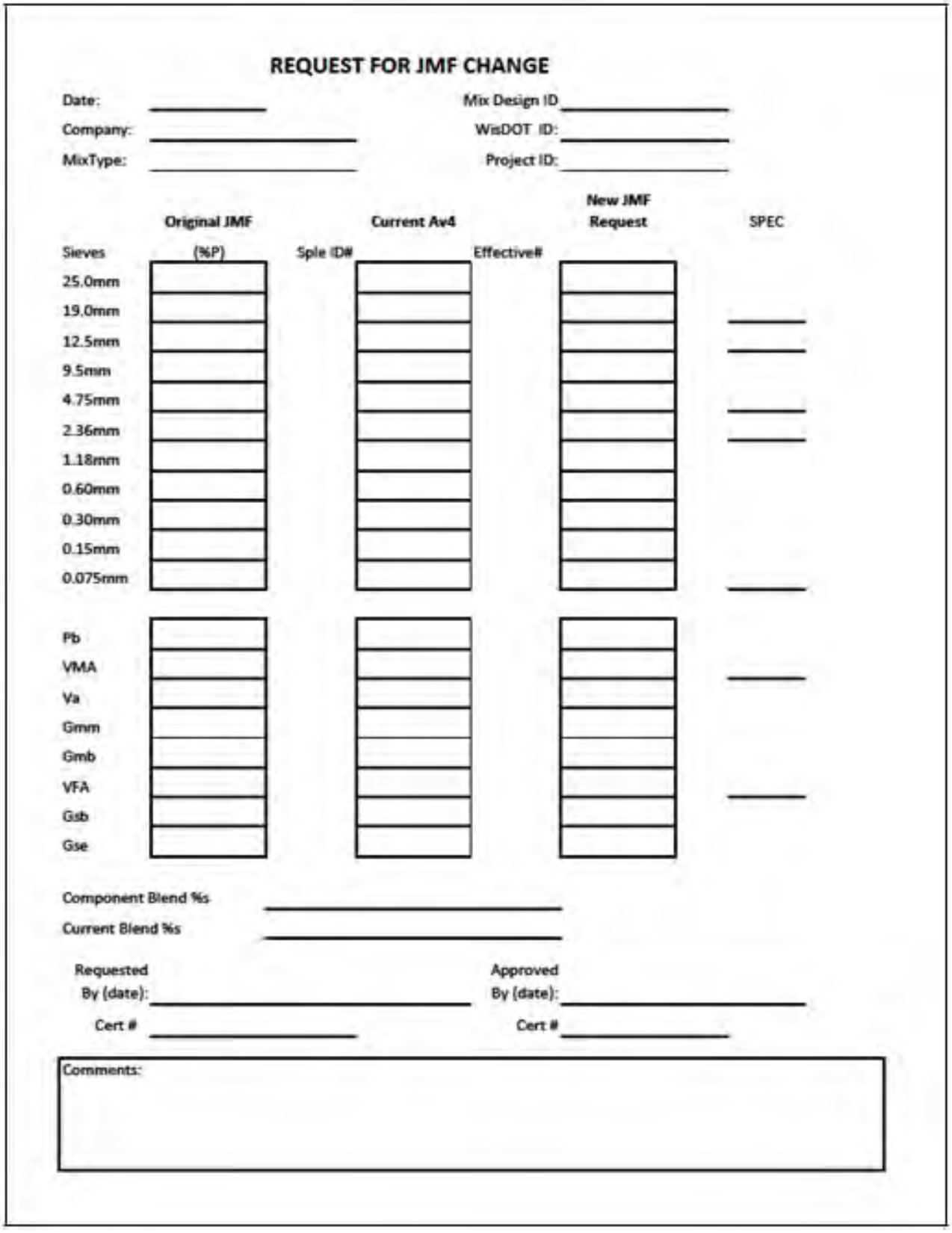
Recommended Adjustments	% Pay SS 460.2.8	Affected Mix Tons	Mix Bid Price	TOTAL Adjustment (w/h)
Air Void Failure	50%	500.0	$ 55.27	$ 13817.50
VMA Failure	75%	0.0	$ 55.27	$ -
				$ 13817.50
Comment:				

Alternate/Final Adjustments	% Pay SS 460.2.8	Affected Mix Tons	Mix Bid Price	TOTAL Adjustment (w/h)
Air Void Failure	50%	500.0	$ 55.27	$ -
VMA Failure	75%	0.0	$ 55.27	$ -
				$ -
REMARKS:				

Contact BTS for further assistance.

836.10 Example Worksheet

FIGURE 836-13 Request for JMF Change



REQUEST FOR JMF CHANGE

Date: _____ Mix Design ID _____

Company: _____ WisDOT ID: _____

MixType: _____ Project ID: _____

Sieves	Original JMF (%P)	Sple ID#	Current Av4 Effective#	New JMF Request	SPEC
25.0mm					
19.0mm					
12.5mm					
9.5mm					
4.75mm					
2.36mm					
1.18mm					
0.60mm					
0.30mm					
0.15mm					
0.075mm					
Pb					
VMA					
Va					
Gmm					
Gmb					
VFA					
Gsb					
Gse					

Component Blend %s _____

Current Blend %s _____

Requested By (date): _____ Approved By (date): _____

Cert # _____ Cert # _____

Comments: