

**CERTIFIED
HOT MIX ASPHALT
PRODUCER PROGRAM
AUDIT CHECKLIST**

Date _____

Page ___ of ___

Plant No. _____

Producer _____

Plant Location _____

INDOT Audit Team Members

	<u>Name</u>	<u>Position</u>
1.	_____	District Testing Engineer
2.	_____	Area Supervisor
3.	_____	Technician
4.	_____	_____
5.	_____	_____
6.	_____	_____

Producer Members

	<u>Name</u>	<u>Position</u>
1.	_____	Management Representative
2.	_____	Certified Asphalt Technician
3.	_____	_____
4.	_____	_____

1. GENERAL INSTRUCTIONS

Audit Team Members

Tasks to be completed before arriving at the Producer’s site:

- Review the QCP
 - Asphalt Technician Certification is current
 - If more than one Technician is listed, check all Technicians
 - Documents referenced in QCP, including test methods with revision dates
- Review previous audits, especially the most recent one
- Coordinate with Independent Assurance Technician for comparison testing schedule
- Bring all approved DMF/JMF cover sheets for current calendar year
 - These can be found at S:\DISTRICT COMMON DATA\HMA 2012 DMF – JMF

Terminology:

QC/QA HMA	Std. Spec. Section 401 (QC/QA Hot Mix Asphalt)
HMA	Std. Spec. Section 402 (Hot Mix Asphalt)
QCP	Quality Control Plan
ASC	Approved Supplier Certification
JMF	Job Mix Formula
DMF	Design Mix Formula
RAP	Reclaimed Asphalt Pavement
SMA	Stone Matrix Asphalt
WMA	Warm Mix Asphalt

Brackets must be filled in as follows:

- [✓] Satisfactory
- [X] Unsatisfactory or deficient; a Corrective Action Sheet must be prepared
- [NA] Not applicable to the audit or Producer
- [O] Observation

* Item is only applicable in some cases; fill in ‘NA’ if not applicable

All items corrected during audit shall be noted on corrective action sheets with indication that item has been resolved.

2. PRODUCER GENERAL INFORMATION

ITM 583 Reference
5.0, 13.2

Audit Team Member: _____

- 2.1 [] QCPs of INDOT and the Producer have the same authentication page revision date: _____
- 2.2 [] Plant location and address in QCP is correct
- 2.3 [] Plant telephone numbers in QCP are correct
- 2.4 []* Fax Number in QCP is correct
- 2.5 [] Management Representative _____
- 2.6 [] Management Representative e-mail address in QCP is correct
- 2.7 [] Certified Asphalt Technician at audit _____
- 2.8 [] Technician’s Certification has not expired Date: _____
- 2.9 []* All other Certified Technicians in QCP are current
- 2.10 []* Technician is Qualified to complete Type D certifications

For information only:

- 2.11 [] Is this plant equipped to produce Warm Mix Asphalt?
- 2.12 [] Is this plant equipped to produce SBR latex modified asphalt by in-line blending?

3. DOCUMENTS

Reference
2.0

Audit Team Member: _____

Determine whether the following current documents are maintained at the Producer’s lab or Plant, either by hard copies or electronically.

- 3.1 [] INDOT Standard Specifications (Including any applicable Supplemental Specifications and Special Provisions)
- 3.2 [] Indiana HMA Quality Assurance Certified Technician Program Manual

Documents (continued)

ITM	AASHTO	ASTM
207 01/01/08 Date _____	R30-02 Date _____	D5821-01 Date _____
571 01/01/08 Date _____	R35-09 Date _____	
572 11/03/11 Date _____	R46-08 Date _____	OTHER TEST METHODS
580 11/09/10 Date _____	T2-91 Date _____	REFERENCED IN QCP
581 11/09/10 Date _____	T11-05 Date _____	
583 11/03/11 Date _____	T27-11 Date _____	
586 06/02/11 Date _____	T30-10 Date _____	
587 04/04/08 Date _____	T40-02 Date _____	
588 04/04/08 Date _____	T166-11 Date _____	
902 03/06/09 Date _____	T209-11 Date _____	
903 04/06/10 Date _____	T248-11 Date _____	
905 11/09/10 Date _____	T255-00 Date _____	
906 01/01/08 Date _____	T269-11 Date _____	
908 01/01/08 Date _____	T275-07 Date _____	
909 04/04/08 Date _____	T305-09 Date _____	
910 04/06/10 Date _____	T312-11 Date _____	
	T331-10 Date _____	
	TP71-09 Date _____	

- 3.3 [] The ITM, AASHTO, and ASTM Test Methods **referenced in QCP**. The documents have the current revision date listed next to the test method. If the ITMs are accessible on the INDOT webpage, hard copies do not need to be in the lab.
- 3.4 [] All approved DMFs and JMFs for current calendar year
 Number of approved DMF/JMFs

DMF/JMF	DMF/JMF
INDOT _____/_____	Producer _____/_____
- 3.5 []* Fines correction data for each DMF/JMF and RAP
- 3.6 [] Bill of ladings for most current day's production indicating material from ASC Supplier
- 3.7 [] Instructions from the ASC Supplier concerning storage and handling of the PG binders
- 3.8 [] Plant calibrations for each DMF/JMF (Calibrations on Plant computer are acceptable)
- 3.9 [] Annual calibrations for plant scales and verification of meters
- 3.10 []* Legitimate Use Approval letter from IDEM for post-consumer shingles

Documents (continued)

- 3.11 [] Weigh tickets adhere to requirements of section 109.01(b) of INDOT Standard Specifications
- 3.12 [] Type A Certifications for PG 58-28 and PG 64-22 binder
- 3.13 []* PG 64-28 and PG 70-22 binder test reports from an AASHTO accredited laboratory whenever PG 58-28 and PG 64-22 are in-line blended with SBR polymer latex
- 3.14 []* Type A certifications for the SBR polymer latex
- 3.15 []* Flow meter calibration reports and flow computer printouts whenever in-line blending with SBR polymer latex
- 3.16 []* Fibers certifications from manufacturer for SMA
- 3.17 []* Instructions from manufacturer concerning storage and handling of fibers for SMA

Plant # _____

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4. CONTROL LIMITS - QC/QA HMA and SMA

Reference
11.0

Audit Team Member: _____

Select one mixture from one current or recently completed contract for review of all test results for all stated properties. Verify the test results are within the control limits of the target value from the DMF or JMF or are within the control limits of the target value identified by Producer.

Target Values

Contract _____ Mixture Selected _____ DMF or JMF _____

4.1 [] Air Void Target Value identified by Producer _____

4.2 [] Mixture Binder Content Target Value from DMF or JMF _____

4.3 [] VMA Target Value from DMF or JMF _____

4.4 Aggregate Stockpiles – Aggregate Size _____

[]* Critical sieve identified is _____

[]* Target Value identified by Producer is _____

4.5 Blended Aggregate – Mixture _____

[]* Belt sample used for gradation

[]* HMA sample used for gradation

[]* Target Values of critical sieves identified by Producer:

Sieve _____

Target from JMF _____

Value recorded _____

4.6 Recycled Materials – Mixture Size _____

[]* Binder Content Target Value from DMF or JMF for RAP _____ and RAS _____

[]* RAP gradation is 100% passing the mixture maximum particle size sieve

[]* RAP gradation is 100% passing the 3/8 in. (9.5 mm) sieve and 95 to 100% passing the No. 4 (4.75 mm) sieve when used in ESAL Category 3, 4, and 5 surface mixtures

[]* RAS gradation is 100% passing the 1/2 in. (12.5 mm) sieve

Control Limits (continued)

Control Limits

- 4.7 [] Air Void Test Results ± 1.0 from Target Value (Dense Graded)
 -or-
 ± 3.0 from Target Value (Open Graded)
- 4.8 [] Mixture Binder Content Test Results $\pm 0.7\%$ from DMF or JMF Target Value
 []* Recycled Materials Binder Content Test Results $\pm 0.7\%$ from DMF or JMF Target Value
- 4.9 [] VMA Test Results $\pm 1.0\%$ from DMF or JMF Target Value
 -or-
 minimum 17% for SMA mixtures
- 4.10 Aggregate Stockpiles – Aggregate Size _____
 []* Gradation Test Results are within the following from Target Value:
- | | | |
|-----------------------|---------------------|----------------------|
| 3/4 in. -- ± 10.0 | No. 8 -- ± 10.0 | No. 50 -- ± 6.0 |
| 1/2 in. -- ± 10.0 | No. 16 -- ± 8.0 | No. 100 -- ± 6.0 |
| No. 4 -- ± 10.0 | No. 30 -- ± 6.0 | No. 200 -- ± 2.0 |
- 4.11 Blended Aggregate – Mixture _____
 []* Gradation Test Results are within the following from Target Value. (The Producer may establish values that are more restrictive).

Sieve	Base and Intermediate Mixtures			Surface Mixture
	25.0 mm	19.0 mm	12.5 mm	
3/4 in.	± 10.0	± 10.0	---	---
1/2 in.	± 10.0	± 10.0	± 10.0	± 10.0
No. 4	± 10.0	± 10.0	± 10.0	± 10.0
No. 8	± 10.0	± 10.0	± 10.0	± 8.0
No. 16	± 8.0	± 8.0	± 8.0	± 8.0
No. 30	± 6.0	± 6.0	± 6.0	± 4.0
No. 50	± 6.0	± 6.0	± 6.0	± 4.0
No. 100	± 6.0	± 6.0	± 6.0	± 3.0
No. 200	± 2.0	± 2.0	± 2.0	± 2.0

5. DIARY

Reference
8.0

Audit Team Member: _____

Select at random one production month for review of the diary. The month chosen can be any month within the past three years. The diary should be in accordance with the following requirements and information.

Month/Year _____

- 5.1 [] Diary on file for 3 years
- 5.2 [] Open book format
- 5.3 [] One or more pages for each day of production
- 5.4 [] Type of Mixture (QC/QA HMA, HMA, SMA) produced and quantity
- 5.5 [] DMF or JMF number
- 5.6 [] Contract or purchase order number the mixture was sent to
- 5.7 [] Time sample obtained and tests completed (samples are required to be tested within two working days of the time the sample was taken. If all samples are tested the same day, a statement indicating that this occurred is acceptable)
- 5.8 []* Significant events or problems
- 5.9 [] Signature of Certified Technician or Management Representative
- 5.10 []* Other person's signature counter-signed by Certified Technician or Management Representative

Review test data for nonconforming tests. If some are found, review the diary on the date of each test for notations regarding action taken.

- 5.11 [] Nonconforming test(s) are noted in diary
 - Control limits are exceeded for Binder Content, Air Voids, VMA, or aggregate gradation
 - Moisture content exceeds 0.30% at the plant or 0.10% behind paver
- 5.12 [] Corrective action was taken

Plant # _____

Page ___ of ___

6. SAMPLING AND TESTING

References
9.1, 9.2

Audit Team Member: _____

Obtain the diary for one **QC/QA HMA or SMA** mixture produced for a selected contract within the past three years. Perform calculations as needed and compare the quantities produced from the diary against the number of tests, thereby determining the frequency of testing.

Contract _____ JMF _____ Mixture _____ Quantity _____

	QCP Frequency	Tests Required	Tests Completed
Blended Aggregates	_____	_____	_____

6.1 [] Sampling and testing of Blended Aggregate is in accordance with QCP

Recycled Materials

Note: For assistance, see example calculation page in appendix

Percent by mass from JMF _____ Total RAP used _____

	QCP Frequency	Tests Required	Tests Completed
Actual Binder Content	_____	_____	_____
Moisture	_____	_____	_____
Gradation	_____	_____	_____
CAA	_____	_____	_____

6.2 []* Sampling and testing of Recycled Materials for actual binder content, moisture content, gradation and coarse aggregate angularity is in accordance with QCP

SAMPLING AND TESTING (continued)

Mixture

Plant	QCP Frequency	Tests Required	Tests Completed
Actual Binder Content	_____	_____	_____
Temperature	_____	_____	_____
Gradation (SMA Only)	_____	_____	_____
Draindown (OG & SMA)	_____	_____	_____
Moisture	_____	_____	_____

6.3 [] Sampling and testing of Mixture at the Plant for actual binder content, temperature, gradation (SMA mixtures only), draindown (open graded and SMA mixtures only) and moisture content is in accordance with QCP

Pavement	QCP Frequency	Tests Required	Tests Completed
Air Voids	_____	_____	_____
VMA	_____	_____	_____
Actual Binder Content	_____	_____	_____
Gradation (SMA only)	_____	_____	_____
Moisture (surface only)	_____	_____	_____

6.4 [] Sampling and testing of Mixture from the pavement for air voids, VMA, actual binder content, gradation (SMA mixtures only), and moisture content (surface HMA only), is in accordance with QCP

Aggregate Stockpiles

6.5 [] Sampling and testing of Aggregate Stockpiles is in accordance with QCP

PG Binder

6.6 [] Sampling of PG Binder is in accordance with QCP

SAMPLING AND TESTING (continued)

References
9.1, 9.2

Obtain the diary for one **HMA** mixture produced for a selected DMF/JMF within the past three years. Perform calculations as needed and compare the quantities produced from the diary against the number of tests, thereby determining the frequency of testing. The frequency of sampling and testing shall be in accordance with the QCP, but not less than:

1. The first 250 t and each subsequent 1000 t of each DMF or JMF for base and intermediate mixtures.
2. The first 250 t and each subsequent 600 t of each DMF or JMF for surface mixtures.

Mixture _____ QCP Frequency _____ Quantity _____

Tests Required _____ Tests Completed _____

- 6.7 [] Sampling and Testing of Mixture for binder content, coarse aggregate angularity, gradation, and air voids is in accordance with QCP.
- 6.8 [] Test results are within requirements as follows:
Air Voids -- $\pm 1.5\%$ from DMF/JMF
Binder Content -- $\pm 0.7\%$ from DMF/JMF
- 6.9 [] Type D certifications are on file
- 6.10 [] Test results shown on Type D certifications match test reports

SAMPLING AND TESTING (continued)References

9.1, 9.2

Select at random one test report for any one **QC/QA HMA or SMA** mixture and check the calculations performed for the Blended Aggregate, RAP, and Mixture. If only **HMA** mixture is produced, check the calculations for that mixture only.

Blended Aggregate

- 6.11 []* Gradation of aggregate from mixture sample is calculated correctly
- 6.12 []* Gradation of aggregate from cold feed belt or belt discharge is calculated correctly (Drum Plants)
- 6.13 []* Gradation of aggregate from each hot bin is calculated correctly and blend calculations are correct (Batch Plants)
- 6.14 []* Moisture content of aggregate is calculated correctly

* Recycled Materials

- 6.15 [] Actual binder content calculated correctly (fines correction, if required, is used in calculation)
- 6.16 [] Gradation of aggregate calculated correctly
- 6.17 []* Moisture content calculated correctly
- 6.18 []* Coarse Aggregate Angularity for RAP calculated correctly

Hot Mix Asphalt -- Location of Sample _____

- 6.19 [] Determination of Air Voids and VMA calculated correctly
- 6.20 [] Actual binder content calculated correctly (fines correction, if required, is used in calculation)
- 6.21 []* Gradation from mixture sample calculated correctly
- 6.22 []* Moisture content calculated correctly
- 6.23 [] Bulk Specific Gravity calculated correctly
- 6.24 [] Maximum Specific Gravity calculated correctly
- 6.25 []* If Ignition oven is utilized, correct calibration factors are used

7. HMA PLANT

Reference
13.2

Audit Team Member: _____

Inspect the site and observe the operation of the Plant to verify that the production process is in accordance with the QCP and the Plant site layout diagram is correct.

Plant Site Layout

- 7.1 [] Stockpile map is current and located as indicated in QCP
- 7.2 []* All stockpiles have signs as indicated in QCP
- 7.3 [] Binder tanks are located correctly
- 7.4 [] Fuel tank is located correctly
- 7.5 []* Fibers supply is located correctly
- 7.6 [] Anti-adhesive supply is located correctly
- 7.7 []* Field laboratory is located correctly
- 7.8 [] Visitor parking area is located correctly
- 7.9 [] Mixing Plant major components are located correctly

Material Stockpiles

- 7.10 []* Stockpiling procedure is in accordance with QCP
- 7.11 [] Stockpiles are adequately spaced and not contaminated
- 7.12 []* Cold bin loading procedure is in accordance with QCP

Binder Tanks

- 7.13 [] Binder tanks are labeled

Baghouse Fines

- 7.14 []* Procedure for addition of baghouse fines is in accordance with QCP

Fibers

- 7.15 []* Procedure for addition of fibers is in accordance with QCP

Anti-Adhesive Agent

- 7.16 []* Procedure for application of anti-adhesive agent is in accordance with QCP
- 7.17 [] Anti-adhesive agent supply is labeled clearly _____
- 7.18 [] Anti-adhesive agent is product on Approved List

Plant # ____

Page ____ of ____

HMA PLANT (continued)

Surge Bins

7.19 []* Procedure for extended storage of mixture is in accordance with QCP

Truck Loading

7.20 []* Procedure for loading trucks is in accordance with QCP

Other Process Control Techniques

7.21 []* Procedures are in accordance with QCP

8. LABORATORY

References
6.0, 7.0

Audit Team Member: _____

The laboratory will be inspected for compliance with the QCP.

- 8.1 Lab location: Plant -or- Offsite
- 8.2 Facility acceptable for testing materials
- 8.3 All equipment listed in QCP at laboratory
- 8.4 All equipment apparently in good working order
- 8.5 * Procedure for transportation of mixture to laboratory not located at plant is in accordance with QCP
- 8.6 Calibration or verification documentation on file for minimum of 3 years

Check the calibration or verification records to verify that the frequency meets the minimum requirements and the documentation includes the following:

- 1. Description of equipment including Model or Serial Number
- 2. Name of person performing calibration or verification
- 3. Identification of calibration equipment
- 4. Date of calibration or verification and next due date
- 5. Reference of procedure used
- 6. Calibration or verification results

			Date Calibrated/Verified
8.7	<input type="checkbox"/>	Balance(s) -- 12 mo.	_____
8.8	<input type="checkbox"/> *	Bore Gauge -- 12 mo.	_____
8.9	<input type="checkbox"/>	Gyratory Compactor -- 1 mo. (verification)	_____
8.10	<input type="checkbox"/>	Gyratory Compactor Internal Angle -- 12 mo.	_____
8.11	<input type="checkbox"/>	Gyratory Gage Blocks or Billet -- 24 mo.	_____
8.12	<input type="checkbox"/>	Gyratory Load Cell/Proving Ring -- 24 mo.	_____
8.13	<input type="checkbox"/>	Gyratory Mold & Plate Dimensions -- 12 mo.	_____
8.14	<input type="checkbox"/>	Ignition Oven (lift test) -- weekly	_____
8.15	<input type="checkbox"/>	Ignition Oven Balance -- 12 mo.	_____
8.16	<input type="checkbox"/>	Mechanical Shaker(s) -- 12 mo.	_____
8.17	<input type="checkbox"/>	Oven(s) -- 12 mo.	_____
8.18	<input type="checkbox"/>	Sieves -- 12 mo.	_____
8.19	<input type="checkbox"/>	Thermometer(s) -- 12 mo.	_____
8.20	<input type="checkbox"/>	Vacuum Gage -- 36 mo.	_____
8.21	<input type="checkbox"/> *	Vacuum Sealer -- 3 mo.	_____
8.22	<input type="checkbox"/> *	Weights, Min. Class 3 -- 12 mo.	_____

9. COMPARISON TESTING

Audit Team Member: _____

Testing procedures required by the QCP shall be observed to verify that they comply with the Sampling, Sample Reduction, and Testing Procedures checklist.

- 9.1 [] Independent Assurance Technician has completed
Date Comparison Testing Completed: _____
- 9.2 [] Independent Assurance Technician will complete
Estimated Comparison Testing Date: _____
- 9.3 [] Will be completed as part of this audit (Provide results to IA)

If comparison testing will be performed as part of this audit, the Producer’s Certified Technician shall obtain a sample of the mixture, the blended aggregate, and the RAP (if applicable). A separate blended aggregate sample is only required if specified by QCP. The samples obtained shall be split by the Producer’s Certified Technician and the Department’s portion given to the INDOT audit team member. Samples shall be tested by both the Producer and INDOT.

- 9.4 [] Sampling procedures are correct
- 9.5 [] Sample Reduction procedures are correct

The following test results will be determined. A copy of all test reports from both the INDOT audit team member and the Producer’s Certified Technician will be attached to the audit checklist. The variation of test results will be shown in the remarks section of the INDOT audit team member’s report for each material sampled and tested. The allowable variation will be as follows:

<u>Sieves</u>	<u>Max % Difference</u>	<u>Binder Content</u>	<u>Max % Difference</u>
*1 in.	5	*RAP	0.5
*3/4 in.	5	Mixture	0.5
*1/2 in.	5		
No. 8	3		
No. 30	3		
No. 200	3		

- 9.6 [] Gradation is within limits
- 9.7 []* Binder content of RAP is within limits
- 9.8 [] Binder content of Mixture is within limits

10. AUDIT CLOSE-OUT

DTE or Area Supervisor

A meeting with the Producer will be conducted at the completion of the audit. The results of the audit will be discussed, and all outstanding matters will be completely resolved or solutions with deadlines will be established. An Audit Close-Out meeting with the Producer will be scheduled for two weeks after the Audit, or if circumstances require, at a time deemed appropriate by the DTE. Any addenda required by items listed on the Addenda Summary Sheet, QCP Annex, or Corrective Action Sheets shall be submitted at this time.

When all items indicated on Corrective Action Sheets have been addressed, and all testing results (if applicable) have been reviewed, the DTE and/or Area Supervisor will verify the audit package is prepared properly and completely. Upon completion of the Audit Close-Out meeting, all documents will be sent to the Asphalt Engineer, Office of Materials Management.

Corrective Action Sheets requiring longer than two weeks must be addressed by the DTE.

DTE/Area Supervisor

Date

CORRECTIVE ACTION SHEET

PLANT # _____

DATE _____

ITEM _____

Problem Explanation: _____

Corrective Action To Be Taken Is: _____

Deadline Date Is: _____

Follow-up **Date** _____

Finding: _____

Corrective Action Sheets requiring longer than two weeks must be addressed by the DTE.

CALCULATIONS

BINDER CONTENT (ITM 571)

$$\% \text{ Binder} = \frac{\text{Wt. of Sample} - (\text{Wt. of Extracted Aggregate} + \text{Wt. of Fines})}{\text{Wt. of Sample}} \times 100$$

HMA or RAP MOISTURE CONTENT (ITM 572)

$$\% \text{ Moisture} = \frac{\text{Wt. of Original Sample} - \text{Wt. of Dried Sample}}{\text{Wt. of Dried Sample}} \times 100$$

VOIDS in the MINERAL AGGREGATE (AASHTO R 35)

G_{sb} = Bulk Specific Gravity of Aggregate (obtained from DMF/JMF)

P_s = Aggregate, percent by total weight of HMA

$$\% \text{ VMA} = 100 - \frac{G_{mb} \times P_s}{G_{sb}}$$

AGGREGATE GRADATION (AASHTO T 27)

$$\% \text{ Passing} = \frac{\text{Wt. Passing Each Sieve}}{\text{Original Dry Sample Wt.}} \times 100$$

HMA or RAP EXTRACTED AGGREGATE GRADATION (AASHTO T 30)

$$\% \text{ Passing} = \frac{\text{Wt. Passing Each Sieve}}{\text{Original Dry Wt. of Aggregate} + \text{Wt. of Fines}^*} \times 100$$

*Not required for ignition oven

BULK SPECIFIC GRAVITY (Dense Graded and SMA) -- G_{mb} (AASHTO T 166)

$$G_{mb} = \frac{\text{Wt. of Specimen in Air}}{(\text{Wt. of Surface-Dry Specimen in Air}) - (\text{Wt. of Specimen in Water})}$$

$$\% \text{ Absorption} = \frac{(\text{Wt. of Surface-Dry Specimen in Air}) - (\text{Wt. of Specimen in Air})}{(\text{Wt. of Surface-Dry Specimen in Air}) - (\text{Wt. of Specimen in Water})}$$

CALCULATIONS (continued)

MAXIMUM SPECIFIC GRAVITY -- G_{mm} (AASHTO T 209)

A = weight of oven dry sample in air

A_1 = weight of surface dry sample

B = weight of container in water, g

C = weight of container and sample in water, g

D = weight of container filled with water at 77°F

E = weight of container filled with sample and water at 77°F

Weighing in Air

$$G_{mm} = \frac{A}{A + D - E}$$

Weighing in Water

$$G_{mm} = \frac{A}{A - (C - B)}$$

Supplemental Procedure

$$G_{mm} = \frac{A}{A_1 + D - E}$$

AGGREGATE MOISTURE CONTENT (AASHTO T 255)

$$\% \text{ Moisture} = \frac{\text{Wt. of Original Sample} - \text{Wt. of Dried Sample}}{\text{Wt. of Dried Sample}} \times 100$$

AIR VOIDS (AASHTO T 269)

$$\% \text{ Air Voids} = \frac{G_{mm} - G_{mb}}{G_{mm}} \times 100$$

DRAINDOWN (Open Graded and SMA) -- (AASHTO T 305)

$$\% \text{ Draindown} = \frac{A - B}{C} \times 100$$

A = final weight of plate or container, g

B = initial weight of plate or container, g

C = initial total sample weight, g

CALCULATIONS (continued)

BULK SPECIFIC GRAVITY (Open Graded) -- G_{mb} (AASHTO T331)

A = weight of dry specimen in air, g

B = weight of dry, sealed specimen, g

E = weight of sealed specimen in water, g

F_t = apparent specific gravity of plastic sealing material at 77°F

$$G_{mb} = \frac{A}{B - E - \frac{B - A}{F_t}}$$

COARSE AGGREGATE ANGULARITY (ASTM D 5821)

$$\% \text{ CAA} = \frac{\text{Wt. of Crushed Particles}}{\text{Wt. of Crushed Particles} + \text{Wt. of Uncrushed Particles}} \times 100$$

CALCULATIONS (continued)

Example Calculation for Recycled Materials Sampling and Testing

Contract R-38721 JM F_120460J Mixture 19.0 mm Int. Quantity 17,500 tons

Recycled Materials

$$\text{Total RAP used} = \text{Total mix quantity} \times \frac{\text{Percent RAP by Mass}}{100}$$

	Binder % RAS	Binder Replacement %	Virgin Binder %
	0.0%	24.7%	2.9%
			%

10.0% + 9.0%
= 19.0% RAP
by mass

Fine RAP/ Coarse RAP/ RAS in mixture, %	10.0%	9.0%	
Fine RAP/ Coarse RAP/ RAS binder, extracted, %	5.7%	4.1%	
Ignition oven test temp (°F)	1000		

$$\text{Total RAP used} = 17,500 \text{ tons mix} \times \frac{19.0\%}{100}$$

$$\text{Total RAP used} = 3,325 \text{ tons RAP}$$

Percent by mass from JM F 19.0 Total used (in tons) 3,325 tons

	QCP Frequency	Tests Required	Tests Completed
Actual Binder Content	<u>1/1000 t RAP</u>	<u>3</u>	<u>5</u>
Moisture	<u>1/1000 t RAP</u>	<u>3</u>	<u>5</u>
Gradation	<u>1/1000 t RAP</u>	<u>3</u>	<u>5</u>
CAA	<u>1/1000 t RAP</u>	<u>3</u>	<u>5</u>

6.4 [✓]* Sampling and testing of Recycled Materials for actual binder content, moisture content, gradation and coarse aggregate angularity is in accordance with QCP