



n-30-1-87728- Des SUPERSEDED BY EII EI 02-001 Bld EFFECTIVE 7/11/02 MC 0730,		New York State Department of Transportation ENGINEERING INSTRUCTION	EI 98-041
Title: QUALITY PAYMENT ITEMS FOR HOT MIX ASPHALT PERFORMANCE RELATED SPECIFICATIONS			
Distribution: <input type="checkbox"/> Manufacturers (18) <input type="checkbox"/> Surveyors (33) <input checked="" type="checkbox"/> Main Office (30) <input checked="" type="checkbox"/> Consultants (34) <input checked="" type="checkbox"/> Local Govt. (31) <input checked="" type="checkbox"/> Contractors (39) <input checked="" type="checkbox"/> Regions/Agencies (32) <input type="checkbox"/> _____ ()	Approved:  R. Denhison, Deputy Chief Engineer, Design Division <div style="text-align: right;"> <i>12/8/99</i> Date </div>		

This Engineering Instruction supersedes EI 97-010, EI 98-021, EI 98-031 and EB 98-057. *The attachments to EI 98-031 are being reissued with some modifications.* All attachments to EI 98-031 and EB 98-057 should be discarded.

EFFECTIVE DATE: *This instruction will be effective on all Department contracts let on or after 1/14/99.*

PURPOSE: EI 98-031 changed *Quantity Adjustment Factors* to *Quality Adjustment Factors* (QAFs) in the method of measurement and basis of payment for hot mix asphalt (HMA) items paid for by the metric ton (or short ton). It issued revised specifications, new specifications, design guidance, and guidance for field personnel. This EI seeks to clarify some of EI 98-031's attachments and gives more guidance to the designers with respect to item numbers.

All existing items with "root" 403 are being disapproved. The attachments contain new book "403" items and superpave items for general use. See "Guidance to Regional Spec Coordinators" for additional information.

DISAPPROVED BOOK ITEMS:

- 403.11 M Asphalt Concrete - Type 1 Base Course
- 403.12 M Asphalt Concrete - Type 2 Base Course
- 403.13 M Asphalt Concrete - Type 3 Binder Course
- 403.15 M Asphalt Concrete - Type 5 Shim Course
- 403.16 M Asphalt Concrete - Type 6 Top Course
- 403.17 M Asphalt Concrete - Type 6F Top Course (High Friction) Marshall Design
- 403.18 M Asphalt Concrete - Type 7 Top Course
- 403.19 M Asphalt Concrete - Type 7F Top Course (High Friction) Marshall Design
- 403.21 M Asphalt Concrete - Truing and Leveling Course
- 608.0201 M Asphalt Concrete Sidewalks, Driveways and Bicycle Paths
- 624.0201 M Asphalt Concrete Gutter

DISAPPROVED SPECIAL SPEC ITEMS:

- All existing special spec items with "root" number 403 (xx403.xxxxxx M)
- 01407.0196 M Tack Coat
 - 01490.0196 M Cold Milling Asphalt Concrete

EI 98-041 Page 2 of 8

TRANSMITTED MATERIALS

NEW BOOK ITEMS:

403.110001 M	Asphalt Concrete - Type 1 Base Course	Metric Ton
403.110010 M	Plant Production Quality Adjustment to 403.110001 M	Quality Unit
403.120001 M	Asphalt Concrete - Type 2 Base Course	Metric Ton
403.120010 M	Plant Production Quality Adjustment to 403.120001 M	Quality Unit
403.130001 M	Asphalt Concrete - Type 3 Binder Course	Metric Ton
403.130010 M	Plant Production Quality Adjustment to 403.130001 M	Quality Unit
403.150001 M	Asphalt Concrete - Type 5 Shim Course	Metric Ton
403.150010 M	Plant Production Quality Adjustment to 403.150001 M	Quality Unit
403.160001 M	Asphalt Concrete - Type 6 Top Course	Metric Ton
403.160010 M	Plant Production Quality Adjustment to 403.160001 M	Quality Unit
403.170001 M	Asphalt Concrete - Type 6F Top Course (High Friction) Marshall Design	Metric Ton
403.170010 M	Plant Production Quality Adjustment to 403.170001 M	Quality Unit
403.180001 M	Asphalt Concrete - Type 7 Top Course	Metric Ton
403.180010 M	Plant Production Quality Adjustment to 403.180001 M	Quality Unit
403.190001 M	Asphalt Concrete - Type 7F Top Course (High Friction) Marshall Design	Metric Ton
403.190010 M	Plant Production Quality Adjustment to 403.190001 M	Quality Unit
403.210001 M	Asphalt Concrete - Truing and Leveling Course	Metric Ton
403.210010 M	Plant Production Quality Adjustment to 403.210001 M	Quality Unit
608.020101 M	Asphalt Concrete Sidewalks, Driveways and Bicycle Paths	Metric Ton
608.020110 M	Plant Production Quality Adjustment to 608.020101 M	Quality Unit
624.020101 M	Asphalt Concrete Gutter	Metric Ton
624.020110 M	Plant Production Quality Adjustment to 624.020101 M	Quality Unit

NEW ITEM SPECIFICATIONS:

18403.255101 M	SUPERPAVE HMA, 25.0 mm	Metric Ton
18403.255110 M	Plant Production Quality Adjustment to 18403.255101	Quality Unit
18403.255120 M	Pavement Density Quality Adjustment to 18403.255101	Quality Unit
18403.125101 M	SUPERPAVE HMA, 12.5 mm FX	Metric Ton
18403.125110 M	Plant Production Quality Adjustment to 18403.125101	Quality Unit
18403.125120 M	Pavement Density Quality Adjustment to 18403.125101	Quality Unit
18403.955101 M	SUPERPAVE HMA, 9.5 mm FX	Metric Ton
18403.955110 M	Plant Production Quality Adjustment to 18403.955101	Quality Unit
18403.955120 M	Pavement Density Quality Adjustment to 18403.955101	Quality Unit

18403.376101 M	SUPERPAVE HMA, 37.5 mm	Metric Ton
18403.376110 M	Plant Production Quality Adjustment to 18403.376101	Quality Unit
18403.256101 M	SUPERPAVE HMA, 25.0 mm	Metric Ton
18403.256110 M	Plant Production Quality Adjustment to 18403.256101	Quality Unit
18403.196101 M	SUPERPAVE HMA, 19.0 mm	Metric Ton
18403.196110 M	Plant Production Quality Adjustment to 18403.196101	Quality Unit
18403.126101 M	SUPERPAVE HMA, 12.5 mm FX	Metric Ton
18403.126110 M	Plant Production Quality Adjustment to 18403.126101	Quality Unit
18403.956101 M	SUPERPAVE HMA, 9.5 mm FX	Metric Ton
18403.956110 M	Plant Production Quality Adjustment to 18403.956101	Quality Unit
18403.376201 M	SUPERPAVE HMA, 37.5 mm	Metric Ton
18403.376210 M	Plant Production Quality Adjustment to 18403.376201	Quality Unit
18403.256201 M	SUPERPAVE HMA, 25.0 mm	Metric Ton
18403.256210 M	Plant Production Quality Adjustment to 18403.256201	Quality Unit
18403.196201 M	SUPERPAVE HMA, 19.0 mm	Metric Ton
18403.196210 M	Plant Production Quality Adjustment to 18403.196201	Quality Unit
18403.126201 M	SUPERPAVE HMA, 12.5 mm F	Metric Ton
18403.126210 M	Plant Production Quality Adjustment to 18403.126201	Quality Unit
18403.956201 M	SUPERPAVE HMA, 9.5 mm F	Metric Ton
18403.956210 M	Plant Production Quality Adjustment to 18403.956201	Quality Unit
18403.377101 M	SUPERPAVE HMA, 37.5 mm	Metric Ton
18403.377110 M	Plant Production Quality Adjustment to 18403.377101	Quality Unit
18403.257101 M	SUPERPAVE HMA, 25.0 mm	Metric Ton
18403.257110 M	Plant Production Quality Adjustment to 18403.257101	Quality Unit
18403.197101 M	SUPERPAVE HMA, 19.0 mm	Metric Ton
18403.197110 M	Plant Production Quality Adjustment to 18403.197101	Quality Unit
18403.127101 M	SUPERPAVE HMA, 12.5 mm FX	Metric Ton
18403.127110 M	Plant Production Quality Adjustment to 18403.127101	Quality Unit
18403.957101 M	SUPERPAVE HMA, 9.5 mm FX	Metric Ton
18403.957110 M	Plant Production Quality Adjustment to 18403.957101	Quality Unit
18403.377201 M	SUPERPAVE HMA, 37.5 mm	Metric Ton
18403.377210 M	Plant Production Quality Adjustment to 18403.377201	Quality Unit
18403.257201 M	SUPERPAVE HMA, 25.0 mm	Metric Ton
18403.257210 M	Plant Production Quality Adjustment to 18403.257201	Quality Unit

EI 98-041 Page 4 of 8

18403.197201 M	SUPERPAVE HMA, 19.0 mm	Metric Ton
18403.197210 M	Plant Production Quality Adjustment to 18403.197201	Quality Unit
18403.127201 M	SUPERPAVE HMA, 12.5 mm F	Metric Ton
18403.127210 M	Plant Production Quality Adjustment to 18403.127201	Quality Unit
18403.957201 M	SUPERPAVE HMA, 9.5 mm F	Metric Ton
18403.957210 M	Plant Production Quality Adjustment to 18403.957201	Quality Unit
18403.128201 M	SUPERPAVE HMA, SHOULDER COURSE 12.5 mm	Metric Ton
18403.128210 M	Plant Production Quality Adjustment to 18403.128201	Quality Unit
18403.958201 M	SUPERPAVE HMA, SHOULDER COURSE 9.5 mm	Metric Ton
18403.958210 M	Plant Production Quality Adjustment to 18403.958201	Quality Unit
18403.218201 M	SUPERPAVE HMA, TRUING AND LEVELING	Metric Ton
18403.218210 M	Plant Production Quality Adjustment to 18403.218201	Quality Unit
18403.100201 M	ASPHALT-TREATED PERMEABLE BASE COURSE	Metric Ton
18403.100211 M	Plant Production Quality Adjustment to 18403.100201	Quality Unit

REVISED SPECIFICATIONS: The following specifications were revised to include Quality Adjustment pay items as shown in the attached shelf notes.

Section 401 - Plant Mix Pavements - General

Section 402 - Quality Control Asphalt Concrete Production

Section 403 - Hot Mix Asphalt Concrete Production

Section 608 - Sidewalks, Driveways, Bicycle Paths, Brick Paving, Grouted Stone Block Paving, and Precast Concrete Paving

Section 624 - Paved Gutters

GUIDANCE TO REGIONAL SPEC COORDINATORS: For simplicity, all existing items with root number "403" will be disapproved in the TRNS-PORT database. **If you need** any of these specifications, please modify them, if necessary, and submit to Design Quality Assurance Bureau for approval as you normally do. Most of the specifications for HMA need to delete their Method of Measurement and Basis of Payment and instead **refer** to the book sections 401-4, 402-4 **and** 403-4 for Method of Measurement and 403-5 for Basis of Payment. In addition to modifying the HMA specifications, it will also be necessary to create pay items for the Quality Adjustment Factors for HMA items that are paid for by the Metric Ton. Re-number the specification using the six digit (after the decimal) numbering scheme as outlined in this EI and *include* the required Quality Unit pay item(s) in the specification.

e.g. - specification with item xx403.xxxx M (paid by Metric Ton) when modified will now have

xx403.xxxx0R M for main item

xx403.xxxx1R M for plant production quality item

xx403.xxxx2R M for pavement density quality item (if required)

where R is the revision number starting with 1 (one).

BACKGROUND: NYSDOT began making payment adjustments for the quality of HMA in 1990 for in-place

density and in 1996 for plant production. These payment adjustments were based on the density of the finished pavement and/or the production of asphalt paving material to the proper mix design targets. Payment adjustments, either incentive or disincentive, were made by modifying the quantity of the HMA items. This method of payment complicated the record keeping of the Contractor, Producer and NYSDOT, because it was difficult to track the actual tons of HMA placed. Also, asphalt and fuel adjustments were paid on the adjusted quantity.

Quality Adjustment Payment Items: The change from Quantity Adjustment Factors to Quality Adjustment Factors includes the creation of a new pay unit called a **Quality Unit**. All HMA quality adjustments will be measured in **Quality Units**. All quality units will be paid at a predetermined **Index Price**. The HMA **Index Prices** have been created based on HMA weighted average bid prices. One index price will be used for all HMA quality adjustment items in a contract and will apply for the duration of the contract. Index prices will be established and updated by Engineering Bulletin annually and will be preprinted in the contract documents.

In order to simplify the accounting procedures, separate quality payment items were created for each of the possible quality payment adjustments: plant production, pavement density, longitudinal joint density (future), and pavement smoothness (future). All quality adjustment items will be paid using the appropriate item in the contract documents. The new pay items for quality adjustments are linked to the core HMA pay items already in use as shown below. The fifth digit to the right of the decimal of any eligible asphalt pay item designates the appropriate quality adjustment. The sixth digit to the right of the decimal is reserved for revisions. All the necessary quality adjustment items have been entered into the addenda catalog system for use in the contract proposals.

Quality Adjustment Items for:

__403.____0_ M = Specified Contract Item

Quality Adjustment Items	Apply Quality Adjustments to the following Items:
__403.____1_ M = Plant Production Quality Adjustment	All asphalt items paid by the metric ton (or short ton) except for ice retardant asphalt.
__403.____2_ M = Pavement Density Quality Adjustment	Only apply to Superpave 50 series items.*
__403.____3_ M = Longitudinal Joint Density Quality Adjustment	Not for general use at this time.*
__403.____4_ M = Pavement Smoothness Quality Adjustment	Not for general use at this time.**

* The Quality Units for pavement density and longitudinal joint density adjustments are computed from the **mainline top and binder course** tonnage, **not** the entire tonnage which includes shoulders, maintenance crossovers, etc. The tonnage used for the calculation must agree with the core item's Method of Measurement.

** The Quality Units for pavement smoothness adjustments are computed from the **mainline top course** tonnage, **not** the entire tonnage which includes shoulders, maintenance crossovers, etc. The tonnage used

El 98-041 Page 6 of 8

for the calculation must agree with the core item's Method of Measurement.

Example as seen in the proposal:

18403.125101 M - Superpave HMA, 12.5 mm FX	Metric Ton
18403.125110 M - Plant Production Quality Adjustment to 18403.125101 M	Quality Unit
18403.125120 M - Pavement Density Quality Adjustment to 18403.125101 M	Quality Unit

DESIGN GUIDANCE

Standard Book Items: The new book items are being issued primarily for the local governments. Designers are advised to use Superpave items as much as possible. More guidance on this matter will be issued in the near future by the Materials Bureau.

Project Proposals: The designer will include the quality adjustment items in the contract proposal. The current published (annually via EB) Index Price will be the Unit Bid Price for the quality adjustment items and the total dollars allocated for those items (estimated Quality Units x Index Price) will be included as the Amount Bid. Bidders will not be able to modify these fields in the bid.

An estimate of quality units for the applicable pay items will be made by Design Groups as part of the PS&E Package. For estimating purposes, use the maximum allowable QAF of 1.05 for Plant Production Quality Adjustment and (if applicable) 1.05 for Pavement Density Quality Adjustment Items. Calculate the Quality Units for each adjustment using only the tonnage eligible for that adjustment as described in the core item's Method of Measurement and §402-4. The Unit Bid Price and Amount Bid will be preprinted in the contract proposals. See sample Bid Sheet attached (last page of El)

Example: If an estimated quantity of 5645 MT (4000 MT for mainline and 1645 MT for shoulders) of item 18403.125101 M were to be included in the proposal, the calculation of the maximum number of Quality Units to be added to the Plant Production and Pavement Density Items would be completed as follows:

Plant Production

$$(1.05 - 1.00) \times 5645 \text{ MT} = 282.25 \text{ rounded up to } 283 \text{ Quality Units}$$

Pavement Density

$$(1.05 - 1.00) \times 4000 \text{ MT} = 200 \text{ Quality Units}$$

In the project documents, 283 Quality Units would be allocated for a Plant Production Quality Adjustment Item and 200 Quality Units would be allocated for a Pavement Density Quality Adjustment Item.

GUIDANCE FOR FIELD PERSONNEL

Calculating Quality Units: The Engineer in Charge will calculate all quality payment adjustments for each day of paving using that day's QAFs for plant production, in-place pavement density, longitudinal joint density and/or pavement smoothness as specified. Calculate the Quality Units for each adjustment using only the

tonnage eligible for that adjustment as described in the core item's Method of Measurement and §402-4. The plant production QAF will be included in the plant production report for each day. The QAF for pavement density will be provided by the Regional Materials Engineer. (Longitudinal joint and pavement smoothness adjustment factors are not in general use at this time.) Quality Units will be calculated as shown.

Quality Units = (Daily Quality Adjustment Factor - 1.00) x (Appropriate Accepted Tons of HMA)

It is possible to calculate negative Quality Units if the daily Quality Adjustment Factor is less than 1.00. In this situation, a dollar value charge to the Contractor (equal to the dollar value of the negative Quality Unit calculation) should be entered against the appropriate Quality Adjustment item. A negative Quality Unit quantity should never be entered.

When it is necessary to increase the quantity of the existing asphalt items or add new asphalt items to an ongoing contract by order-on-contract, the corresponding quality adjustment items may also need to be increased for existing items or added for new items. Adjustments to the existing quality items should provide enough quality units to cover incentive payments on the additional asphalt quantities. For example, if the contractor has used most of the quality units established for the Plant Production Quality Adjustment Item, the quantity of quality units should be increased to accommodate the maximum quality adjustment allowed(QAF = 1.05) for the additional asphalt quantities added. For new asphalt items, the new corresponding quality items should be established to also accommodate the maximum possible quality adjustment.

ENGLISH ITEMS: Designers needing English unit quality pay items and specifications should contact Zoeb Zavery of the Materials Bureau at (518) 457-4582.

ACTIONS BY MAIN OFFICE DESIGN QUALITY ASSURANCE BUREAU: The revised specifications will be inserted into proposals by the Main Office Design Quality Assurance Bureau.

COST IMPACT: Since only the method of payment is changing, no change in the total cost of hot mix asphalt items is expected.

CONTACT PERSON: Direct questions regarding this EI to Pratip Lahiri of the Design Quality Assurance Bureau at (518) 457-4090. Direct questions regarding the attachments to Zoeb Zavery of the Materials Bureau's Field Engineering II Section at (518) 457-4582.

Sample Bid Sheet From Contract Proposal: See Example from page 6 of 8.

ITEM NUMBER	ESTIMATE OF QUANTITIES	ITEMS WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT BID PRICE		AMOUNT BID	
			DOLLARS	CTS	DOLLARS	CTS
18403.125101 M	5,645	<p>METRIC TONS, SUPERPAVE HOT MIX ASPHALT, 12.5 MM FX NOMINAL MAX SIZE</p> <p>This item requires both plant and density quality adjustment items</p> <p>FOR _____ PER METRIC TON</p>				
18403.125110 M	<p>283</p> <p>(1.05 - 1.00) x 5,645 MTS 283 QUs</p>	<p>PLANT PRODUCTION QUALITY ADJUSTMENT TO 18403.125101 M</p> <p>FOR _____ PER QUALITY UNIT</p>	<p>\$35</p> <p>(Index Price per annual EB)</p>	00	<p>\$9,905</p> <p>283 QUs x \$35.00 \$9,905.00</p>	00
18403.125120 M	<p>200</p> <p>(1.05 - 1.00) x 4,000 MTS 200 QUs</p>	<p>PAVEMENT DENSITY QUALITY ADJUSTMENT TO 18403.125101 M</p> <p>FOR _____ PER QUALITY UNIT</p>	<p>\$35</p> <p>(Index Price per annual EB)</p>	00	<p>\$7,000</p> <p>200 QUs x \$35.00 \$7,000.00</p>	00
			CARRY FORWARD			

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

Make the following *changes* to the Standard Specifications of January 2, 1995:

Page 4-25, line 27

Under **§401-4 METHOD OF MEASUREMENT**, *delete* the entire subsection and *replace* it with the following:

“401- 4 METHOD OF MEASUREMENT. The provisions of §402- 4, Method of Measurement shall apply including the following:

Each delivery vehicle supplying hot mix asphalt production shall be accompanied by a delivery ticket indicating the total quantity in metric tons being delivered. The delivery ticket quantity shall be determined from the automated proportioning system or the delivery vehicle weigh system. The method of determining the delivered quantity shall be subject to the approval of the Regional Materials Engineer. The delivery ticket shall contain the following minimum information:

- A. Delivery Ticket Number
- B. Plant Identification
- C. Contract Number
- D. Material Description, (including the PG-Binder Grade)
- E. Quantity of Material in Vehicle
- F. Date and Time

One legible copy of the delivery ticket shall be made available to the state paving inspector prior to the placement of the mixture.”

Page 4-26, line 1

Under **§401-5 BASIS OF PAYMENT**, *delete* the entire subsection and *replace* it with the following:

“401- 5 BASIS OF PAYMENT. The provisions of §403-5 shall apply.”

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

ATTENTION

The Contractor is advised that this Contract Proposal contains a specification, *Section 402 Quality Control Asphalt Concrete - General*, which is a Quality Control performance-related specification by which the contractor, through the hot mix asphalt manufacturer, is responsible for all Quality Control activities relating to the production of hot mix asphalt. The hot mix asphalt manufacturer is required to perform and document all Quality Control sampling and testing activities in accordance with procedures outlined by the Department. These procedures are available through the Regional Materials Section or the Central Office Materials Bureau.

The contractor shall also be aware this specification contains quality payment adjustments for all hot mix asphalt production. Quality Adjustment Factors (*QAF's*) will be used to determine quality payment adjustments for each days production. The Quality Adjustment Factor Conversion Table below incorporates *QAF's* that will apply during each noted Calendar year.

The *QAF's* specified in *Section 402, Tables 402-3 and 402-4*, shall be changed accordingly. However, all *QAF's* listed in *Section 402* that are used for process control and acceptance shall not be changed and shall be referenced to the original specified factors.

Quality Adjustment Factor Conversion Table

Phase-in Quality Adjustment Factors (QAF's)			
Specified in Tables 402-3 and 402-4	Calendar Year Production		
	1998	1999	2000 & Beyond
1.05	1.05	1.05	1.05
1.04	1.04	1.04	1.04
1.03	1.03	1.03	1.03
1.02	1.02	1.02	1.02
1.01	1.01	1.01	1.01
1.00	1.00	1.00	1.00
0.99	1.00	0.995	0.99
0.98	1.00	0.990	0.98
0.97	1.00	0.985	0.97
0.96	1.00	0.980	0.96
0.95	1.00	0.975	0.95
0.94	1.00	0.970	0.94
0.93	1.00	0.965	0.93
0.92	1.00	0.960	0.92
0.91	1.00	0.955	0.91
0.90	1.00	0.950	0.90
0.85 (1)	0.85 (1)	0.85 (1)	0.85 (1)

(1) Refer to §402-4, Method of Measurement.

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

Make the following *changes* to the Standard Specifications of January 2, 1995:

Page 4-26, line 4

Delete the entire **SECTION 402-QUALITY CONTROL ASPHALT CONCRETE - GENERAL** and *replace* it with the following **"SECTION 402-QUALITY CONTROL ASPHALT CONCRETE - GENERAL (dated 8/10/98)."**

SECTION 402 - QUALITY CONTROL ASPHALT CONCRETE - GENERAL

402-1 DESCRIPTION. This performance related specification applies to the manufacture of all hot mix asphalt utilizing a Quality Control/Quality Assurance system for governing production. Quality Control is defined as all activities required to produce hot mix asphalt that meets all specification requirements. The Contractor, through the hot mix asphalt Manufacturer, is ultimately responsible for all Quality Control activities relating to the production of hot mix asphalt.

The Manufacturer shall produce hot mix asphalt according to specification requirements and provide daily documentation on production quality. Production Quality Adjustment Factors (QAF's) will be used to assess hot mix asphalt production quality and will be applied to calculate a production quality payment adjustment for each days production.

The Department is responsible for Quality Assurance. Quality Assurance is defined as all activities performed by Department personnel to assure that the production of hot mix asphalt meets the specification requirements. The Department will determine a daily production quality payment adjustment for each mixture type by using a daily QAF. QAF's contained in this specification are used to measure production variation from the mean of the specification limits.

402-2 MATERIALS. The provisions of §401-2, Materials, shall apply unless otherwise specified in the contract plans or proposal and as modified herein. All hot mix asphalt supplied to Department projects shall be produced in accordance with the requirements outlined in this specification, and all applicable Test Methods and Materials Procedures. Hot mix asphalt mixture designs shall be formulated as required and must be acceptable to the Department prior to any project production.

During production of any mix design assigned verification status or the first production day of the construction season for any mix design assigned production status, a daily QAF of 1.00 will be used providing the required test results yield a daily QAF between 0.90 and 1.00. When the required test results yield a daily QAF greater than 1.00, the actual daily QAF will be used. When the required test results yield a daily QAF less than 0.90, the subject production will be evaluated in accordance with procedures outlined in §402-4, Method of Measurement.

The Department reserves the right to reject any hot mix asphalt that demonstrates unacceptable quality or exhibits properties that will affect the anticipated performance in accordance with Section 105, Control of Work and Section 106, Control of Material.

402-3 CONSTRUCTION DETAILS. The details of §401-3, Construction Details, shall apply except as modified below:

The Contractor shall make arrangements with the Manufacturer to provide a production control system to produce hot mix asphalt for Department projects that conforms to all specification requirements.

The Manufacturer shall sample and test hot mix asphalt prior to acceptance on Department projects. The sampling and testing shall be performed in accordance with procedures approved by the Department. The Manufacturer shall maintain complete records of all Quality Control test results and actions taken. The records shall indicate the nature and type of deficiencies and corrective actions taken. All Quality Control test results

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

shall be documented in a legible manner and provided to the Department. Hot mix asphalt produced without the required sampling, testing and documentation may be rejected.

A. Control Plan. The Manufacturer shall provide the Regional Materials Engineer with a control plan. The control plan shall outline all phases of the production process and actions necessary to ensure specification conformance. The control plan shall display in organizational form, a list of all personnel associated with the production of the hot mix asphalt. This list shall identify all personnel names and their functions necessary to implement all elements of the Quality Control program. The plan administrator, designated assistant, quality control personnel and phone numbers shall be included. The administration of the control plan shall be the sole responsibility of the Manufacturer. As a minimum, the control plan shall contain the following:

1. Quality control organizational list.
2. Identification of the plan administrator, designated assistant and quality control personnel.
3. Qualifications and responsibilities of individuals.
4. Lines of communication to the Department.
5. Private testing organization representing the Manufacturer, including services provided.
6. Sampling and testing that ensures process control.
7. A list of all sampling and testing equipment used for process control.
8. Actions and corrective actions that ensures specification conformance.

The control plan shall be submitted annually to the Regional Materials Engineer for approval a minimum of fifteen working days prior to any hot mix asphalt production. Hot mix asphalt production without an approved control plan will not be allowed. Updates or changes to the control plan, or personnel, must receive prior approval by the Regional Materials Engineer. Control plan guidelines are available from the Regional Materials Engineer.

The control plan may be operated by the Manufacturer or a private testing organization representing the Manufacturer. If a private testing organization is used to implement all or part of the control plan, the personnel assigned to the production facility site shall be identified on the organizational list.

A separate control plan shall be submitted for each production facility site. When more than one plant is located at a production facility site, only one control plan is required. All plants located at the production facility site must be outlined in the control plan. All sampling and testing equipment used to implement the control plan shall meet the requirements pertaining to the testing procedure. The Department reserves the right to stop production for Department projects in the event the control plan is not followed.

B. Quality Control Organization. The quality control organization shall consist of the following:

1. Plan Administrator. The plan administrator shall be a representative of the Manufacturer and have full authority to institute all actions necessary for the operation of the control plan. The plan administrator is responsible to ensure all requirements of the specification are in conformance. The plan administrator's signature shall be legally binding for the Manufacturer. One plan administrator is allowed to be responsible for multiple production locations. An assistant plan administrator may be designated in the absence of the plan administrator. The plan administrator or assistant must be available to communicate with the Department's representative at all times. The Department reserves the right to stop production for Department projects when the plan administrator or designee is not available.

2. Quality Control Technician. The Manufacturer shall provide a sufficient number of hot mix asphalt Quality Control Technicians to perform quality control sampling and testing. The Quality Control Technician must possess a current New York State Asphalt Pavement Association Certification for Hot Mix Asphalt Sampling and Testing or its equivalent, as determined by the Director, Materials Bureau. A minimum of one certified Quality Control Technician shall be present at each production facility site. Production facility sites having multiple plants may utilize non-certified Technicians to augment the Certified Technician. Hot mix asphalt production is not acceptable unless the certified Quality Control Technician is present during production. However, the certified Quality Control Technician is not required

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

to be present for production of 135 metric tons or less, if approved by the Regional Materials Engineer. Technicians associated with private testing organizations shall meet the requirements for a Quality Control Technician.

The Department reserves the right to stop plant production for Department projects in the event unacceptable Technician performance is noted. The Regional Materials Engineer or representative will immediately inform the plan administrator regarding the reasons for stopping plant operations.

The Department may require the Manufacturer to replace unacceptable technicians before plant production is allowed to continue. As a minimum, the certified Quality Control Technician shall be responsible for the following:

- a. Have knowledge about all plant equipment used for hot mix asphalt production.
- b. Perform all quality control sampling and testing as required.
- c. Document all quality control test results and actions necessary to ensure process control.
- d. Maintain a separate quality control book for each plant.
- e. Document all quality control test results in a legible manner.
- f. Keep quality control test results and plant diary updated on a daily basis.

402-3.02 Production Facility Laboratory. The Manufacturer shall maintain an approved production facility site laboratory equipped with necessary equipment to perform all required hot mix asphalt sampling and testing. Testing equipment requiring calibration shall be calibrated annually and certified by the Manufacturer that all testing equipment meets the required operational tolerances. Verification of the production facility site laboratory and testing equipment will be performed annually by the Department and whenever deemed necessary. Laboratory sampling and testing equipment shall be made available to the Department's Quality Assurance personnel. The requirements under §401-3.02 A.-II, Inspection Facilities shall apply. In addition, the following equipment is required.

A. Maximum Specific Gravity Equipment. Equipment necessary to determine the maximum specific gravity of bituminous paving mixtures. All sampling and testing equipment shall meet the requirements outlined in AASHTO T209, Standard Test Method for Maximum Specific Gravity of Bituminous Paving Mixtures.

B. Bulk Specific Gravity Equipment. Equipment necessary to determine the bulk specific gravity of bituminous paving mixtures. All sampling and testing equipment shall meet the requirements outlined in AASHTO T166, Bulk Specific Gravity and Density of Compacted Bituminous Mixtures using Standard Surface Dry Specimens.

402-3.03 Plant Lots and Sublots. Plant lots and sublots shall be determined on a daily basis using NYSDOT Materials Procedure 94-04M, Testing Frequencies Using Random Sampling at a Hot Mix Asphalt Plant.

A plant lot is defined as the quantity in tons of hot mix asphalt produced per plant for each mix design in one day. When different mix designs are produced on the same day, then each mix design represents a separate plant lot. Plant lots shall be consecutively numbered throughout the production season and start at the beginning of each calendar year's production. Plant lot numbers (i.e., 1-200) will be assigned for each mix design produced and increased by one for each production day. Sublots will be assigned a consecutive letter (A-F) and shall begin with "A" each production day.

Plant lots are subdivided into sublots and are based on the anticipated daily production. A subplot is defined as a portion of a plant lot having a quantity not to exceed 1125 metric tons. When production exceeds a 1125 metric ton subplot, and the excess is not greater than 135 metric tons, the excess will be incorporated into the previous subplot.

Quality control sampling and testing are not required on the first or last 135 metric ton portion of a subplot, providing the subplot quantity is greater than 270 metric tons. If a plant lot only consists of one subplot and the quantity is not greater than 270 metric tons, the quality control sample shall be obtained from the subplot portion greater than 135 metric tons.

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

When production stops before a subplot sample is obtained, the untested subplot quantity will be incorporated into the next subplot. If there is no subsequent subplot, the quantity will be incorporated into the previous subplot. If there is no subsequent or previous subplot to incorporate into, the untested subplot quantity shall be considered a plant lot and the QAF for that amount shall be 1.00. Untested subplot quantities will not be incorporated into any subsequent or previous days plant lot production.

When production stops after a subplot sample is obtained and the quantity is less than 1125 metric tons, it is still considered a subplot.

When the anticipated daily plant lot quantity is between 135 metric tons and 450 metric tons, the daily QAF will be 1.00 providing the required quality control sample yields a QAF of 0.90 or greater. If the required test result yields a QAF greater than 1.00, the actual QAF will be used. If the required test result yields a QAF less than 0.90, the subject production will be evaluated in accordance with procedures outlined in §402-4, Method of Measurement. The Manufacturer must notify the Regional Materials Engineer prior to any production of this type.

A. Certified Lot Production. Hot mix asphalt production without the required quality control testing is allowed to be certified for plant lot quantities of 135 metric tons or less. These certified plant lot quantities will have a QAF of 1.00. All certified production shall meet the requirements outlined in this specification.

B. Volumetric Mixture Storage. When volumetric mixtures are stored prior to delivery, the stored quantity will be incorporated into the plant lot associated with the date of delivery. If there is no subsequent production to incorporate into, the stored quantity shall be subject to the requirements outlined in this subsection.

C. Non-Volumetric Mixture Storage. When non-volumetric mixtures are stored prior to delivery, the stored quantity will be incorporated into the plant lot associated with the date of manufacture. The lot number and daily QAF determined during production will be associated with the stored quantity.

D. Night Production. During night production the contractor has the option to associate plant lots as outlined in this subsection or when plant employee shift change occurs. The Regional Materials Engineer must be notified which option will be used at least one day prior to any production of this type.

402-3.04 Quality Control Sampling and Testing. Quality control samples shall be obtained as outlined in NYSDOT Materials Procedure 94-04M, Testing Frequencies Using Random Sampling at a Hot Mix Asphalt Plant.

Quality control sampling and testing shall be performed by Quality Control Technicians meeting the requirements outlined in §402-3.01 B. 2, Quality Control Technician.

Quality control testing procedures will be verified by the Department on a random basis by split sample testing. The Manufacturer's quality control samples shall be split into two representative samples and individually tested by the Manufacturer and the Department. The Department's test results will be compared to the Manufacturer's test results.

When the split sample test results are within the allowable tolerances as outlined in Table 402-1, Allowable Testing Tolerances, the Manufacturer's quality control test results representing the plant lot quantity will be used to determine the daily QAF.

When the test results of the split sample exceeds the allowable tolerances, retesting of the subject material shall be performed. When the test results of the retest split sample are within the allowable tolerances, the Manufacturer's quality control test results representing the plant lot will be used to determine the daily QAF.

When the test results of the retest split sample exceeds the allowable tolerances, production for Department projects shall be terminated and all the Manufacturer's quality control test results representing the production up to this point will be used to determine the daily QAF. Production for Department projects will not be allowed until the Regional Materials Engineer is satisfied that the cause of the verification problem has been resolved.

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

**TABLE 402-1
ALLOWABLE TESTING TOLERANCES**

Test Property	Tolerance	
	Within Lab	Lab to Lab
Gradation $\geq 425 \mu\text{m}$ Sieve	$\pm 5.0 \%$	$\pm 7.0 \%$
Gradation $< 425 \mu\text{m}$ Sieve	$\pm 2.0 \%$	$\pm 3.0 \%$
Bulk Specific Gravity	± 0.020	± 0.028
Maximum Specific Gravity	± 0.011	± 0.019

Retesting of split samples shall be performed on the day the plant lot material was produced or delivered. If production has been terminated for any reason, the retesting shall be performed during initial production of the next plant lot. When there is no future production, the subject material shall be considered a plant lot and the daily QAF shall be 1.00.

During the required quality control sampling and testing, the Manufacturer shall obtain a hot bin or composite aggregate split sample representative of the quality control sample. A minimum of one aggregate split sample shall be obtained per day for each mix type produced. The aggregate split sample shall be reduced to testing size, identified and retained at the production site for a minimum of ten production days. The retained aggregate split samples shall be identified as to plant lot, subplot, and mix type. Hot bin aggregate samples shall be packaged separately by hot bin and retained together. Composite aggregate samples shall be dried before packaging.

All required compacted hot mix specimens, including the maximum specific gravity samples shall be retained at the production site for a minimum of ten production days. The compacted specimens and gravity samples shall be identified as to the plant lot, subplot, and mix type. The compacted specimens and the gravity samples shall be air dried and packaged.

All retained aggregate samples, compacted specimens and gravity samples may be discarded at the end of the specified time period, unless otherwise directed by the Regional Materials Engineer.

The Department reserves the right to witness any or all quality control sampling and testing, and test any or all retained samples for specification conformance.

Sampling and testing shall be performed using test procedures and frequencies outlined in the following Table 402-2, Quality Control Sampling and Testing.

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

**TABLE 402-2
QUALITY CONTROL SAMPLING AND TESTING**

Test Property	Sample Location	Test Method	Quality Control Frequency
Aggregate Gradation	NYSDOT MM 5.0	AASHTO T27 MM 5.0	(1)
Aggregate Moisture (2)	NYSDOT MM 5.0	NYSDOT MM 5.0	1 Every other Sublot Minimum 2 Per Day
Air Voids Plant Mixture (3)	NYSDOT MM 5.0	AASHTO T166 & T209 MM 5.13M / MM 5.16M	1 Per Sublot
Wet Analysis Minus 75 μ m sieve	(4)	AASHTO T11	1 Per Week
Plant Mixture Moisture (2), (5)	NYSDOT MM 5.0	NYSDOT MM 5.0	As Required
Plant Mixture Temperature	Plant and Haul Vehicle	N/A	Routinely, Minimum 4 Times Per Day
Plant Mixture Asphalt Content	NYSDOT MM 5.0	NYSDOT MM 5.0	Routinely, Minimum 4 Times Per Day/Mix
RAP Moisture	NYSDOT MM 5.0	NYSDOT MM 5.0	2 Per Week
RAP Extraction	NYSDOT MM 5.0	NYSDOT MM 5.0	2 Per Week
Asphalt Cement Sampling (6)	NYSDOT MM 5.0	N/A	2 Per Day
Friction Aggregate Sampling	NYSDOT MM 5.0	NYSDOT 703-14GM	As Noted on JMF

Notes:

- (1) Volumetric design mixes - one test every other subplot, minimum one per day.
Non -Volumetric design mixes - one test every subplot.
- (2) Required for drum mix plant only.
- (3) Required for volumetric design mixes.
- (4) Batch plant hot bins and drum mix plant composite sample.
- (5) Required for batch and drum mix plants when producing recycled mixes.
- (6) Department will be responsible for sample submission.

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

A. Sampling. Quality control samples for aggregate and hot mix asphalt shall be obtained randomly using the procedures outlined in NYSDOT Materials Procedure 94-04M, Testing Frequencies Using Random Sampling at a Hot Mix Asphalt Plant. Other required quality control samples shall be obtained as outlined below in B., Testing, and Table 402-2, Quality Control Sampling and Testing.

B. Testing. The Manufacturer shall perform all quality control testing as outlined below:

1. Aggregate Gradation. The aggregate gradation analysis shall be determined using the procedures outlined in NYSDOT Materials Method 5.0, Plant Inspector's Manual for Bituminous Concrete Mix Production. Aggregate gradations for any mix type are considered in control when all quality control sieve test values remain within the Job Mix Formula tolerances.

a. Volumetric Design Mixes. An aggregate gradation analysis shall be performed every other subplot of hot mix asphalt produced. A minimum of one analysis per day shall be performed for each mix design produced.

b. Non-Volumetric Design Mixes. An aggregate gradation analysis shall be performed every subplot for each hot mix asphalt mix design produced.

2. Determination of Material Finer than the 75 μ m Sieve. Material finer than the 75 μ m sieve shall be determined in accordance with the procedures outlined in AASHTO T11, Standard Test Method for Materials Finer than 75 μ m Sieve in Mineral Aggregates by Washing. The material finer than the 75 μ m sieve shall be determined for each production plant a minimum of one per week. The analysis shall be performed on the batch plant fine hot bin and the drum mix plant composite sample. Sampling of batch plant coarse aggregate hot bins will be required and/or the testing frequency modified for the fine hot bin if deemed necessary by the Regional Materials Engineer.

3. Air Void Analysis - Volumetric Design Mixes. Air void analysis shall be determined for each subplot of volumetric design hot mix asphalt produced. The air void analysis shall be determined on the hot mix asphalt obtained from the haul vehicle. When hot mix asphalt holding bins are used for standard storage times as outlined in §401-3.03, Hot Bituminous Mixture Holding Bins, the air void analysis shall be determined after the storage time. The air void analysis shall be determined using the procedures outlined in NYSDOT Materials Method 5.13M or 5.16M. The Materials Method used will depend upon the type of mix design specified in the contract documents. In conjunction with the air void analysis, the Voids in Mineral Aggregate (VMA) and Voids Filled with Asphalt (VFA) shall be determined.

4. Determination of Asphalt Content. The asphalt content shall be determined using the procedures outlined in NYSDOT Materials Method 5.0, Plant Inspector's Manual for Bituminous Concrete Mix Production. The asphalt content shall be calculated during initial production and then routinely throughout production a minimum of four times per day per mix type.

5. Mixture Temperature. The mix temperature shall be determined at the beginning of production with the first or second haul vehicle and then routinely throughout the production day. A minimum of four temperatures shall be determined per day independent of mix type. The temperature shall be transmitted to the project paving site with the haul vehicle delivery ticket. When hot mix asphalt holding bins are loaded for storage, the mix temperature shall be determined routinely throughout the loading time.

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

6. Aggregate and Mix Moisture Content (Drum Mix Plant). The aggregate and hot mix asphalt moisture shall be determined using the procedures outlined in NYSDOT Materials Method 5.0. The composite aggregate moisture content shall be determined daily during initial production and then mid-way throughout the production day. A minimum of two aggregate moisture contents shall be determined per day. The hot mix asphalt moisture content shall be determined as deemed necessary by the Regional Materials Engineer.

7. Asphalt Cement Sampling. The Manufacturer shall obtain samples of the asphalt cement in accordance with the procedures outlined in NYSDOT Materials Method 5.0. A minimum of two samples shall be obtained each production day. All samples shall be appropriately identified and stored at the facility site. Sample containers, documentation and submission of the samples will be the Department's responsibility.

8. Friction Aggregate. The friction coarse aggregate must meet the requirements outlined in §401-2.03 A., Coarse Aggregates. The Manufacturer shall perform friction coarse aggregate sampling and testing using procedures outlined in NYSDOT Materials Method 5.0 and NYSDOT Test Method 703-14GM, Percentage of Non-Carbonate Particles in a Coarse Aggregate Mixture. The friction coarse aggregate test procedure shall be performed at the production facility at frequencies noted on the Job Mix Formula.

9. Recycle Mixes. The Manufacturer shall perform all sampling and testing of hot mix asphalt containing reclaimed asphalt pavement using procedures outlined in NYSDOT Materials Method 5.0. Quality control testing frequencies for recycle mix production shall be followed as outlined in §402-3.04, Quality Control Sampling and Testing, except the following tests shall be performed at frequencies outlined in NYSDOT Materials Method 5.0 and Table 402-2, Quality Control Sampling and Testing.

- a. RAP Moisture Test
- b. RAP Extraction Test
- c. Recycle Mix Moisture Test

C. Air void and Gradation Reporting. Air void control test values shall be calculated to the nearest 0.001 of a percent and reported to the nearest 0.01 of a percent. Aggregate gradation control test values shall be calculated to the nearest 0.01 of a percent and reported to the nearest 0.1 of a percent. When determining test result acceptability, the air void test value shall be referenced to the mix design median of 4.00 percent and the gradation test value referenced to the Job Mix Formula target value.

D. Sampling and Testing Disputes. When sampling and testing disputes occur, the Department will perform referee sampling and testing. Referee samples will be obtained randomly and independently from the quality control samples and tested at the Regional or Central Office laboratory. If production has been terminated, the Manufacturer's retained samples representing the disputed plant lot will be tested. The Department's independent referee test results are final and will be used to determine the daily QAF for the disputed quantity and the acceptance of the in place production material.

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

402-3.05 Production Control. During production the Manufacturer is allowed to make process control adjustments providing the mix design target values are strived for. However, target value adjustments are allowed providing the target value remains within the specification general limits and the adjustments are properly documented in the plant diary. Only the aggregate gradation production tolerance is allowed to exceed the general limits. Adjustments to any volumetric design target value will only be allowed providing all specified volumetric mix properties remain within the specification production limits. When any test value consistently falls outside the allowable production tolerance, corrective actions must be taken. The Regional Materials Engineer must be notified prior to production of any subsequent adjusted subplot.

The Manufacturer may terminate production at any time. The Manufacturer shall immediately notify the Project Engineer and the Regional Materials Engineer when production is terminated. When the Manufacturer terminates production, the hot mix asphalt quantity produced up to that point will be considered a plant lot and the daily QAF will be determined using all the required quality control test values and any additional test values obtained from the terminated plant lot. Hot mix asphalt in storage from any terminated plant lot having a QAF less than 0.90, or any required testing not in conformance with the specification requirements is considered unacceptable for Department projects.

When production of any mix type consistently yields a daily QAF less than 0.94, the mix design may be rejected. When the daily QAF of any mix type is less than 0.90 for two consecutive production days, corrective actions must be taken. If by the end of the third production day, corrective actions did not yield a daily QAF of 0.90 or greater, production of that mix shall be terminated. When production is terminated under these conditions, the Manufacturer shall demonstrate by trial production that the production process yields a QAF of 0.90 or greater. The Manufacturer shall immediately notify the Regional Materials Engineer when production yields a daily QAF less than 0.90.

A. Mixing Plant Control. The provisions of §401-3.02 through §401-3.03 shall apply including the following:

All mix production will be in the automatic mode. Any material produced in a non-automatic mode shall not be shipped and the Regional Materials Engineer notified immediately. Material produced in the automatic mode that exceeds twice the production tolerance will not be shipped. Material produced in the automatic mode that is between the single and double production tolerance may be shipped, however, the Regional Materials Engineer will determine after review of the printed production records if the material is acceptable to the Department.

QUALITY CONTROL ASPHALT CONCRETE PRODUCTION

402-3.06 Production Quantities. The Manufacturer shall notify the Regional Material's office by 3:00 PM on the day before any production for the Department.

The Manufacturer shall maintain a record of each days production quantity for each mix design supplied to the project site. These quantities must be tabulated on a daily basis, retained at the production facility and made available to the Department for review. All production quantities shall be transmitted to the project site. Each delivery vehicle supplying hot mix asphalt shall be accompanied by a delivery ticket indicating the total quantity in metric tons being delivered. The delivery ticket quantity shall be determined from the automated proportioning system or the delivery vehicle weigh system. The method of determining the delivered quantity shall be subject to the approval of the Regional Materials Engineer. The delivery ticket shall contain the following minimum information:

- A. Delivery Ticket Number
- B. Plant Identification
- C. Contract Number
- D. Material Description, (including the PG-Binder Grade)
- E. Quantity of Material in Vehicle
- F. Date and Time

One legible copy of the delivery ticket shall be made available to the state paving inspector prior to the placement of the mixture.

402-3.07 Documentation. The Manufacturer will maintain at each plant facility all process control test data. The test data must be kept in a ringed type book and stored in the production facility laboratory. Test data must be updated in this book within 24 hours following each plant lot production. As a minimum, the book must contain the control plan, job mix formulas, design target values, test data summaries, and daily production quantities. All forms, except control charts will be supplied by the Department. Test data must be documented on NYSDOT Form BR-331M, Production Summary Sheet. A separate Production Summary Sheet shall be used for each mix design produced. All production process control actions shall be outlined in the plant diary. A summary of all test data shall be transmitted weekly to the Regional Materials Engineer.

A copy of the plant automation printout for each mix type produced shall be kept at the plant facility site and must be available for review at all times.

Air void control charts shall be plotted for each volumetric mix type and posted in the laboratory or kept in a separate book. All control charts must be updated within a 24 hour period. As a minimum, the following production actions shall be documented:

- A. Date and time of test sample
- B. Gradation analysis
- C. Wet analysis of material finer than 75 μ m sieve
- D. Air void analysis
- E. Aggregate and hot mix asphalt moisture content
- F. Asphalt content
- G. Production mix temperature
- H. Lot and subplot identification
- I. Random sample test location
- J. Itemized daily production project quantities
- K. Friction aggregate test results
- L. Voids in Mineral Aggregate (VMA) and Voids Filled with Asphalt (VFA)