INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Memorandum

February 11, 2008

CONSTRUCTION MEMORANDUM
08-04

TO: District Deputy Commissioners
District Highway Operation Directors
District Construction Engineers
District Testing Engineers
District Area Engineers
Project Engineers/Supervisors

FROM: Mark A. Miller, Director
Division of Construction Management

SUBJECT: Zero Dollar Change Order to Change QC/QA HMA Pay Items to PWL QC/QA HMA

Some Contractors have expressed an interest in converting QC/QA HMA pay items in existing contracts to PWL QC/QA HMA. Because the Department is interested in gathering as much data as possible regarding PWL QC/QA HMA mixtures, it is acceptable to convert these pay items under the following circumstances:

1. The Contractor makes a written request to convert specific existing contract QC/QA HMA pay items to their PWL QC/QA counterparts. The request may include pay items related to mainline or shoulder mixtures.
2. The Contractor agrees that the conversion to PWL QC/QA pay items will be made without any additional compensation.
3. The Contractor agrees that the pay item conversion will not be cause to extend any existing contract duration parameters, such as milestone dates or closure periods.

If all of the above conditions are met by the Contractor, the PE/PS should process a zero dollar change order to facilitate the conversion of the pay items included in the request to PWL QC/QA HMA. The change order should deduct the remaining quantity of each requested existing QC/QA HMA pay item and the addition of the corresponding PWL QC/QA HMA pay item with the same quantity and contract unit price. The following special provision should also be attached to the change order to incorporate the associated specification requirements into the contract.

If District Construction personnel have any questions regarding the implementation of this memo, please contact your Division of Construction Management Field Engineer. If there are any questions regarding the contents of the PWL QC/QA HMA special provision, District Testing and Office of Materials Management personnel are available for guidance.

MAM:jgj
Attachment

SECTION 400 – ASPHALT PAVEMENTS

SECTION PWL – QUALITY CONTROL/QUALITY ASSURANCE, QC/QA, HOT MIX ASPHALT, HMA, PAVEMENT USING PWL ACCEPTANCE

PWL.01 Description

This work shall consist of one or more courses of QC/QA HMA base, intermediate, or surface mixtures constructed on prepared foundations in accordance with 105.03 and accepted on the basis of percent-within- limits (PWL).

PWL.02 Quality Control

The HMA shall be supplied from a certified HMA plant in accordance with ITM 583; Certified Volumetric Hot Mix Asphalt Producer Program. The HMA shall be transported and placed according to a Quality Control Plan, QCP, prepared and submitted by the Contractor in accordance with ITM 803; Contractor Quality Control Plans for Hot Mix Asphalt Pavements. The QCP shall be submitted to the Engineer at least 15 days prior to commencing HMA paving operations.

ITM 583 shall be modified to address the following items:

a) The interpretation of all references to 401 shall be equivalent to PWL for the operation of this contract.

b) The interpretation of all references to QC/QA HMA shall be equivalent to QC/QA HMA, PWL for the operation of this contract

c) Section 10.1: The adjustment period shall be from the beginning of production and extending until 5000 t (5000 Mg) of base or intermediate mixtures or 3000 t (3000 Mg) of surface mixture has been produced.

d) Section 11.5: Control charting limits for QC/QA HMA, PWL shall be revised as follows:

Binder Content of Mixture, %	± 0.4
VMA @ Ndes ,% (QC/QA HMA)	Specification Limits

e) ~~Section 9.1(e): One random sample shall be obtained in each sublot and tested for binder content, VMA at N_{des}, and air voids at N_{des}. The sample location will be determined by the Engineer in accordance with ITM 802.~~

ITM 803 shall be modified to address the following items:

a) The interpretation of all references to 401 shall be equivalent to PWL for the operation of this contract.

b) ~~Section 5.8.3: Two random cores shall be obtained in each sublot and tested for density. The sample locations will be determined by the Engineer in accordance with ITM 802 and the cores shall be cut in accordance with ITM 580.~~

MATERIALS

PWL.03 Materials

Materials shall be in accordance with the following:

Asphalt Materials
PG Binder.....902.01(a)
Coarse Aggregates 904
Base Mixtures - Class D or Higher
Intermediate Mixtures - Class C or Higher
* Surface Mixtures - Class B or Higher
Fine Aggregates 904
* Surface aggregate requirements are listed in 904.03(d).

PWL.04 Design Mix Formula

A design mix formula, DMF, shall be prepared in accordance with PWL.05 and submitted in a format acceptable to the Engineer one week prior to use. The DMF shall state the maximum particle size in the mixture. The DMF shall state the calibration factor, test temperature and absorption factors to be used for the determination of binder content using the ignition oven in accordance with ITM 586, the binder content by extraction in accordance with ITM 571, and a Mixture Adjustment Factor (MAF). The DMF shall state the source, type, and dosage rate of any stabilizing additives. Approval of the DMF will be based on the ESAL and mixture designation. A mixture number will be assigned by the Engineer. No mixture will be accepted until the DMF has been approved.

The ESAL category identified in the pay item correlates to the following ESAL ranges:

ESAL CATEGORY	ESAL
1	< 300,000
2	300,000 to < 3,000,000
3	3,000,000 to < 10,000,000
4	10,000,000 to < 30,000,000
5	≥ 30,000,000

PWL.05 Volumetric Mix Design

The DMF shall be determined for each mixture from a volumetric mix design by a design laboratory selected from the Department's list of approved Mix Design Laboratories. A volumetric mixture shall be designed in accordance with the respective AASHTO and ASTM references as listed below.

Standard Specification for Superpave
Volumetric Mix Design .....AASHTO M 323

Standard Specification for
Stone Matrix Asphalt (SMA).....AASHTO MP 8

Standard Practice for Mixture Conditioning of
Hot-Mix Asphalt (HMA) .....AASHTO R 30

Standard Practice for Superpave Volumetric
Design for Hot-Mix Asphalt (HMA) ..... AASHTO R 35

Theoretical Maximum Specific Gravity and Density of
Hot-Mix Asphalt Paving Mixtures..... AASHTO T 209

Resistance of Compacted Hot-Mix Asphalt (HMA) to
Moisture-Induced Damage..... AASHTO T 283

Preparing and Determining the Density of
Hot-Mix Asphalt (HMA) Specimens by Means of the
Superpave Gyratory Compactor ..... AASHTO T 312

The single percentage of aggregate passing each required sieve shall be within the limits of the following gradation tables.

	Dense Graded, Mixture Designation – Control Point (Percent Passing)				
	25.0 mm	19.0 mm	12.5 mm	9.5 mm	4.75 mm
Sieve Size					
50.0 mm					
37.5 mm	100.0				
25.0 mm	90.0 - 100.0	100.0			
19.0 mm	< 90.0	90.0 - 100.0	100.0		
12.5 mm		< 90.0	90.0 - 100.0	100.0	100.0
9.5 mm			< 90.0	90.0 - 100.0	95.0 -100.0
4.75 mm				< 90.0	90.0 - 100.0
2.36 mm	19.0 - 45.0	23.0 - 49.0	28.0 - 58.0	32.0 - 67.0	
1.18 mm					30.0 - 60.0
600 µm					
300 µm					
75 µm	1.0 - 7.0	2.0 - 8.0	2.0 - 10.0	2.0 - 10.0	6.0 - 12.0

PCS Control Point for Mixture Designation (Percent Passing)					
Mixture Designation	25.0 mm	19.0 mm	12.5 mm	9.5 mm	4.75 mm
Primary Control Sieve	4.75 mm	4.75 mm	2.36 mm	2.36 mm	NA
PCS Control Point	40	47	39	47	NA

Dust/Calculated Effective Binder Ratio shall be from 0.6 to 1.2, when the aggregate gradation passes above the primary control sieve (PCS) control point and 0.8 to 1.6 when the aggregate gradation passes beneath the PCS. The Dust/Calculated Effective Binder Ratio for 4.75 mm mixtures shall be 0.9 to 2.0.

The optimum binder content for dense graded mixtures shall produce 4.0% air voids at N_{des}. The design for dense graded mixtures shall have at least four points, including a minimum of two points above and one point below the optimum. The maximum specific gravity of the uncompacted mixture shall be determined in accordance with AASHTO T 209.

Dense graded mixture shall be tested for moisture susceptibility in accordance with AASHTO T 283 except that the loose mixture curing shall be replaced by mixture conditioning for 2 h in accordance with AASHTO R 30. The minimum tensile strength ratio, TSR, shall be 80%. The 6 in. (150 mm) mixture specimens shall be compacted in accordance with AASHTO T 312. If anti-stripping additives are added to the mixture to be in accordance with the minimum TSR requirements, the dosage rate shall be submitted with the DMF.

A PG binder grade or source change will not require a new mix design. If the upper temperature classification of the PG binder is lower than the original PG grade, a new TSR value is required. A new DMF shall be submitted for a binder grade change and shall reference the originating DMF/JMF number.

The MAF equals the Gmm from the mixture design divided by the following: 2.465 for 9.5 mm mixtures and 2.500 for 12.5 mm, 19.0 mm, and 25.0 mm mixtures. If the MAF calculation results in a value where $0.980 \leq MAF \leq 1.020$, then the MAF shall be considered to be 1.000. If the MAF is greater than 1.020, the calculated MAF value shall have 0.020 subtracted from the value. If the MAF is less than 0.980, the calculated MAF value shall have 0.020 added to the value.

Changes in the source or types of aggregates shall require a new DMF. A new DMF shall be submitted to the District Materials and Tests Engineer for approval one week prior to use.

The mixture design compaction temperature for the specimens shall be 300 ± 9°F (150 ± 5°C) for dense graded mixtures.

Design criteria for each mixture shall be based on the ESAL shown in the contract documents and shall be as follows:

GYRATORY COMPACTION EFFORT - DENSE GRADED					
ESAL	N_{ini}*	N_{des}*	N_{max}*	Max. % Gmm @ N_{ini}	Max. % Gmm @ N_{max}
< 300,000	6	50	75	91.5	98.0
300,000 to < 3,000,000	7	75	115	90.5	98.0
3,000,000 to < 10,000,000	8	100	160	89.0	98.0
10,000,000 to < 30,000,000	8	100	160	89.0	98.0
≥ 30,000,000	9	125	205	89.0	98.0

* N_{ini}, N_{des}, N_{max} - definitions are included in AASHTO R 35.

VOIDS IN MINERAL AGGREGATE (VMA) CRITERIA @ N_{des}	
Mixture Designation	Minimum VMA, Percent
4.75 mm	16.0
9.5 mm	15.0
12.5 mm	14.0
19.0 mm	13.0
25.0 mm	12.0

VOIDS FILLED WITH ASPHALT (VFA) CRITERIA @ N_{des}	
ESAL	VFA, Percent
< 300,000	70 - 80
300,000 to < 3,000,000	65 - 78
3,000,000 to < 10,000,000	65 - 75
10,000,000< 30,000,000	65 - 75
≥ 30,000,000	65 - 75

Note 1:For 9.5 mm mixtures, the specified VFA range shall be 73% to 76% for design traffic levels ≥ 3 million ESALs.
Note 2:For 25.0 mm mixtures, the specified lower limit of the VFA shall be 67% for design traffic levels < 0.3 million ESALs.
Note 3:For 4.75 mm mixtures, the specified VFA range shall be 75% to 78% for all design traffic levels ≥ 3 million ESALs.

PWL.06 Recycled Materials

Recycled materials may consist of reclaimed asphalt pavement, RAP, or asphalt roofing shingles, ARS, or a blend of both. RAP shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP shall be processed so that 100% will pass the 2 in. (50 mm) sieve when entering the HMA plant. ARS shall consist of waste from a shingle manufacturing facility. No tear-off materials from roofs will be allowed. ARS shall be stockpiled separately from other materials. The coarse aggregate in the recycled materials shall pass the maximum size sieve for the mixture being produced.

Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures. When only RAP is used in the mixture, the RAP shall not exceed 25.0% by weight (mass) of the total mixture. When only ARS is used in the mixture, the ARS shall not exceed 5.0% by mass (weight) of the total mixture. For substitution or use, 1.0% of ARS is considered equal to 5.0% RAP. The percentages of recycled materials shall be as specified on the DMF.

Recycled materials shall not be used in ESAL Category 3, 4, or 5 surface mixtures.

The combined aggregate properties of a mixture with recycled materials shall be determined in accordance with ITM 584 and shall be in accordance with 904. Gradations of the combined aggregates shall be in accordance with PWL.05.

Mixtures containing 15.0% or less RAP, shall use the same grade of binder as specified. The binder for mixtures containing greater than 15.0% and up to 25.0% RAP

shall be reduced by one temperature classification, 6°C, for both the upper and lower temperature classifications.

PWL.07 Lots and Sublots

Lots from the same DMF/JMF will be defined as 5000 t (5000 Mg) of base or intermediate mixtures or 3000 t (3000 Mg) of surface mixture. Lots will be further sub-divided into sublots not to exceed 1000 t (1000 Mg) of base or intermediate mixtures or 600 t (600 Mg) of surface mixture. Partial lots of two sublots or less will be added to the previous lot. Partial sublots of 100 t (100 Mg) or less will be added to the previous sublot. Partial sublots greater than 100 t (100 Mg) constitute a full sublot.

PWL.08 Job Mix Formula

A job mix formula, JMF, shall be developed by a certified HMA producer. A JMF used in the current or previous calendar year that was developed to N_{des} will be allowed. The mixture compaction temperature shall be 300 ± 9°F (150 ± 5°C) for dense graded mixtures. The JMF for each mixture shall be submitted to the Engineer and shall use the same MAF as the DMF.

PWL.09 Acceptance of Mixtures

Acceptance of mixtures for binder content, VMA at N_{des}, and air voids at N_{des} for each lot will be based on tests performed by the Engineer. The Engineer will randomly select the location(s) within each sublot for sampling in accordance with the ITM 802. The first 300 t (300 Mg) of base, intermediate, or surface mixtures of the first sublot of the first lot will not be sampled. An acceptance sample will consist of two plate samples with the first being at the random location and the second 2 ft (0.6 m) ahead station. A backup sample consisting of two plate samples shall be located 2 ft (0.6 m) towards the center of the mat from the acceptance sample.

Samples from each location shall be obtained from each sublot from the pavement in accordance with ITM 580.

The binder content will be determined in accordance with ITM 586 or ITM 571 as directed by the Engineer. The maximum specific gravity will be determined in accordance with AASHTO T 209. The Air Voids will be determined in accordance with AASHTO R 35 based on the average bulk specific gravity from two gyratory specimens and the MSG for the sublot. The VMA will be determined in accordance with AASHTO R 35 based on the average bulk specific gravity from two gyratory specimens, the percent aggregate in the mixture from the sublot and the BSG of the aggregate blend from the DMF/JMF as applicable. The gyratory pills will be prepared in accordance with AASHTO T 312.

The bulk specific gravity of gyratory specimens for dense graded mixtures will be determined in accordance with AASHTO T 166 except samples are not required to be dried overnight.

The Engineer's acceptance test results for each sublot will be available after the sublot and testing are complete.

Air voids, binder content and VMA values will be reported to the nearest 0.01%. Rounding will be in accordance with 109.01(a).

The Contractor may request an appeal of the Engineer's test results in accordance with PWL.20.

In the event that an acceptance sample is not available to represent a sublot(s), the PWL for the lot will be determined on the basis of the remaining sublots. If the remaining lot has less than three sublot test results, all of the sublots will be added to the previous lot.

CONSTRUCTION REQUIREMENTS

PWL.10 General

Equipment for HMA operations shall be in accordance with 409. The Contractor shall submit to the Engineer a written Certificate of Compliance that includes the manufacturer's make, model, serial number, manufactured year, and the manufacturer's literature with pictures. The Certificate of Compliance shall be submitted prior to use and shall certify that the paving equipment proposed for the project is new and includes the modifications or have been modified in accordance with the following.

The paver shall be equipped with means of preventing the segregation of the coarse aggregate particles when moving the mixture from the paver hopper to the paver augers. The means and methods used shall be in accordance with the paver manufacturer's instructions and may consist of chain curtains, deflector plates, or other such devices, or any combination of these.

The following specific requirements shall also apply to identified HMA pavers:

1. Blaw-Knox HMA pavers shall be equipped with the Blaw-Knox Materials Management Kit, MMK.

2. Cedarrapids HMA pavers shall be those that were manufactured in 1989 or later.

3. Barber-Green/Caterpillar HMA pavers shall be equipped with deflector plates as identified in the December, 2000 Service Magazine entitled "New Asphalt Deflector Kit {6630-DFL, 6631-DFL, or 6640-DFL}".

The Contractor is also required to demonstrate to the Engineer prior to use, that the modifications to the paving equipment have been implemented on all pavers to be used on the project.

Fuel oil, kerosene, or solvents shall not be transported in open containers on equipment. Cleaning of equipment and small tools shall not be accomplished on the pavement or shoulder areas.

Segregation, flushing or bleeding of HMA mixtures will not be permitted. Corrective action shall be taken to prevent continuation of these conditions. Segregated, flushed or bleeding HMA mixtures shall be removed if directed. All areas showing an excess or deficiency of binder shall be removed and replaced.

All mixtures that become loose and broken, mixed with dirt, or are in any way defective shall be removed and replaced.

PWL.11 Preparation of Surfaces to be Overlaid

The subgrade shall be shaped to the required grade and sections, free from all ruts, corrugations, or other irregularities, and uniformly compacted and approved in accordance with 207. Milling of an existing pavement surface shall be in accordance with 306. Surfaces on which a mixture is placed shall be free from objectionable or foreign materials at the time of placement.

Compacted aggregate bases and rubblized pavements shall be primed in accordance with 405. PCCP, milled asphalt surfaces, and asphalt surfaces shall be tacked in accordance with 406. Contact surfaces of curbing, gutters, manholes, and other structures shall be tacked in accordance with 406.

PWL.12 Process Control

The Engineer and Contractor will jointly review the operations to ensure compliance with the QCP. Continuous violations of compliance with the QCP will result in suspension of paving operations.

PWL.13 Weather Limitations

HMA courses of less than 138 lb/syd (75 kg/m^2) shall be placed when the ambient temperature and the temperature of the surface on which it is to be placed is 45°F (7°C) or above. No mixture shall be placed on a frozen subgrade.

PWL.14 Spreading and Finishing

The mixture shall be placed upon an approved surface by means of laydown equipment in accordance with 409.03(c). Prior to paving, both the planned quantity and lay rate shall be adjusted by multiplying by the MAF. When mixture is produced from more than one DMF or JMF for a given pay item, the MAF will be applied to the applicable portion of the mixture for each. The temperature of each mixture at the time of spreading shall not be more than 18°F (10°C) below the minimum mixing temperature as shown on the JMF for mixtures compacted in accordance with 402.15.

Planned HMA courses greater than 165 lb/syd (90 kg/m^2) placed under traffic, shall be brought up even with each adjacent lane at the end of each work day. Planned HMA courses less than or equal to 165 lb/syd (90 kg/m^2) shall be brought forward concurrently, within practical limits, limiting the work in one lane to not more than one work day of production before moving back to bring forward the adjacent lane.

Hydraulic extensions on the paver will not be permitted for continuous paving operations. Fixed extensions or extendable screeds shall be used on courses greater than the nominal width of the paver except in areas where the paving widths vary. Hydraulic extensions may be used in tapers and added lanes less than 250 ft (75 m) in length.

Automatic slope and grade controls shall be used as outlined in the QCP.

HMA mainline and HMA shoulders which are 8.0 ft (2.4 m) or more in width shall be placed with paving equipment in accordance with 409.03(c)1.

When laying mixtures with density not controlled by cores, the speed of the paver shall not exceed 50 ft (15 m) per min. Rollers shall be operated to avoid shoving of the HMA and at speeds not to exceed 3 mph (4.5 km/h). However, vibratory rollers will be limited to 2.5 mph (4 km/h).

The finished thickness of any course shall be at least two times but not more than four times the maximum particle size as shown on the DMF.

PWL.15 Joints

Longitudinal joints in the surface shall be at the lanelines of the pavement. Longitudinal joints below the surface shall be offset from previously constructed joints by approximately 6 in. (150 mm), and be located within 12 in. (300 mm) of the lane line.

Transverse joints shall be constructed by exposing a near vertical full depth face of the previous course. For areas inaccessible to rollers, other mechanical devices shall be used to achieve the required density.

If constructed under traffic, temporary transverse joints shall be feathered to provide a smooth transition to the driving surface.

PWL.16 Density

Acceptance will be based on lots in accordance with PWL.07.

Density of the compacted dense graded mixture will be determined from cores except where:

(a) the total planned lay rate to be placed over a shoulder existing prior to the contract award is less than 385 lb/syd (210 kg/m^2); or

(b) the first lift of material placed at less than 385 lb/syd (210 kg/m^2) over a shoulder existing prior to the contract award.

Compaction in these areas shall be in accordance with 402.15.

Density acceptance by cores will be based on samples obtained from two random locations selected by the Engineer within each sublot in accordance with ITM 802. One core shall be cut at each random location in accordance with ITM 580. The transverse core location will be located so that the edge of the core will be no closer than 3 in. (75 mm) from a confined edge or 6 in. (150 mm) from a non-confined edge of the course being placed. The maximum specific gravity will be determined from the sample obtained in PWL.09.

The Contractor shall obtain cores in the presence of the Engineer with a device that shall produce a uniform 6 in. (150 mm) diameter pavement sample. Coring shall be completed prior to the random location being covered by the next course. Surface courses shall be cored within two work days of placement. Damaged core(s) shall be discarded and replaced with a core from a location selected by adding 1.0 ft (0.3 m) to the longitudinal location of the damaged core using the same transverse offset.

The Contractor and the Engineer shall mark the core to define the course to be tested. If the core indicates a course thickness of less than 2.0 times the maximum particle size, the core will be discarded and a core from a new random location will be selected for testing.

The Engineer will take immediate possession of the cores. If the Engineer's cores are subsequently damaged, additional coring will be the responsibility of the Department. Subsequent core locations will be determined by subtracting 1.0 ft (0.3 m) from the random location using the same transverse offset.

The density for each core will be expressed as the percentage of maximum specific gravity (%MSG) obtained by dividing the bulk specific gravity of the core by the maximum specific gravity for the sublot, times 100. The Engineer will determine the BSG of the cores in accordance with AASHTO T 166 from samples prepared in accordance with ITM 572. The maximum specific gravity will be determined in accordance with AASHTO T 209.

Within one work day of coring operations the Contractor shall clean, dry, and refill the core holes with HMA of similar or smaller size particles.

The Engineer's acceptance test results for each sublot will be available when the sublot and sublot testing are complete. Acceptance of the pavement for density (%MSG) will be reported to the nearest 0.01%. Rounding will be in accordance with 109.01(a).

PWL.17 Shoulder Corrugations

Shoulder corrugations shall be in accordance with 606.

PWL.18 Pavement Smoothness

The pavement smoothness will be accepted by means of a profilograph, a 16 ft (4.9 m) long straightedge, or a 10 ft (3 m) long straightedge.

The profilograph shall be used where all of the following conditions are met:

(a) the design speed is greater than 45 mph (70 km/h),

(b) the pavement lanes are full width and 0.1 mi (. 0.16 km) or longer, and

(c) the HMA is placed on a milled surface or the total combined planned lay rate of surface, intermediate, and base is 385 lb/syd (210 kg/m^2) or greater.

If a pay item, Profilograph, HMA, is included in the contract, and the above conditions are met, the Contractor shall furnish, calibrate, and operate an approved profilograph in accordance with ITM 912. The profilogram produced shall become the property of the Department. The profilograph shall remain the property of the Contractor. When a profilograph, HMA, is not included as a pay item, and the above conditions are met, the Department will furnish, calibrate, and operate the profilograph or the Department will develop a change order in accordance with 109.05 to include profilograph, HMA as a pay item.

Within the limits of a smoothness section where the posted speed is 40 mph (65 km/h) or less, smoothness of that section may be measured by a profilograph or a 16 ft (4.9 m) long straightedge. The Contractor shall notify the Engineer of the selected process prior to placement of the HMA. Smoothness pay adjustments are only applicable when measured by a profilograph.

The 16 ft (4.9 m) long straightedge shall be used on overlays where the profilograph is not specified. The 16 ft (4.9 m) long straightedge shall be used on all full width pavement lanes shorter than 0.1 mi (0.16 km), on tapers, within 50 ft (15 m) of a reinforced concrete bridge approach, and within 50 ft (15 m) of an existing pavement, which is being joined.

The 10 ft (3 m) long straightedge shall be used for transverse slopes, approaches, and crossovers.

All wavelike irregularities and abrupt changes in profile caused by paving operations shall be corrected.

Each finished course of base and intermediate shall be subject to approval. The pavement smoothness shall be checked on any new intermediate course located immediately below a surface course and the surface course at the locations as designated in ITM 912.

If grinding of the intermediate course is used for pavement smoothness corrections, the grinding shall not precede the surface placement by more than 30 calendar days if open to traffic.

When the 16 ft (4.9 m) straightedge is used on a surface course, the pavement variations shall be corrected to 1/4 in. (6 mm) or less. When the 10 ft (3 m) straightedge is used, the pavement variations shall be corrected to 1/8 in. (3 mm) or less.

When the profilograph is being used on a surface course, in addition to the requirements for the profile index, all areas having a high or low point deviation in excess of 0.3 in. (8 mm) shall be corrected. Courses underlying the surface courses that are exposed by corrective actions shall be milled to 1 1/2 in. (38 mm) and replaced with the same type surface materials. The initial profile index shall be determined prior to any corrective action. The final profile index will be determined after all corrective action has been completed.

When the profilograph is being used on an intermediate course, all areas having a high or low point deviation in excess of 0.3 in. (8 mm) shall be corrected. When the 16 ft (4.9 m) or 10 ft (3.0 m) straightedge is being used on an intermediate course, all areas having a high or low point deviation in excess of 1/4 in. (6 mm) shall be corrected.

PWL.19 Pay Factors

(a) Mixture

Lot test results for mixture properties will be assigned pay factors in accordance with the following.

The percent within limits (PWL) for each lot shall be determined for air voids, binder content, and VMA as follows:

Determine the average, $\bar{x}$, of the lot mixture properties, where "n" is the number of mixture sublot samples in the lot.

$$\bar{x} = \sum_{i=1}^{n} \frac{x_i}{n}$$

Air voids, binder content and VMA "$\bar{x}$ " values will be reported to the nearest 0.01%. Rounding will be in accordance with 109.01(a).

Determine the standard deviation, "s", of the lot.

$$s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$$

The "s" values for air voids, binder content, and VMA will be reported to the nearest 0.01. Rounding will be in accordance with 109.01(a).

For each mixture property calculate the Upper Quality Index, Q_u, by subtracting the $\bar{x}$ of each mixture property from the Upper Specification Limit (USL) and dividing the results by "s".

$$Q_U = \frac{USL - \bar{x}}{s}$$

For each mixture property calculate the Lower Quality Index, Q_L, by subtracting the Lower Specification Limit (LSL) from the $\bar{x}$ and dividing the result by "s".

$$Q_L = \frac{\bar{x} - LSL}{s}$$

Air voids, binder content and VMA Q_U and Q_L values will be reported to the nearest 0.01. Rounding will be in accordance with 109.01(a).

Determine the percentage of material that will fall within the upper and lower percent within limits (PWL) by entering the table of Quality Index Values with Q_U or Q_L using the column appropriate to the total number of measurements, "n".

For each mixture property determine the percent of material that will fall within the limits by adding the percent within the upper specification limit (PWL_U) to the percent within the lower specification limit (PWL_L), and subtract 100 from the total.

$$\text{Total } PWL_{(\text{Binder Content, Air Voids, and VMA})} = (PWL_U + PWL_L) - 100$$

(b) Density

The density of all cores within a lot will be used to determine the lot pay factor in accordance with the following:

Determine the average, $\bar{x}$, of the lot density values, where "n" is the number of cores in the lot.

$$\bar{x} = \sum_{i=1}^{n} \frac{x_i}{n}$$

In-place density (% Gmm) "$\bar{x}$ " values will be reported to the nearest 0.01%. Rounding will be in accordance with 109.01(a).

Determine the in-place density standard deviation, "s", of the lot.

$$s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$$

In-place density (%Gmm) "s" values will be reported to the nearest 0.01. Rounding will be in accordance with 109.01(a).

Calculate the Lower Quality Index, Q_L, for in-place density (%Gmm) by subtracting the Lower Specification Limit (LSL) from the $\bar{x}$ and dividing the result by "s".

$$Q_L = \frac{\bar{x} - LSL}{s}$$

In-place density (%Gmm) Q_L values will be reported to the nearest 0.01. Rounding will be in accordance with 109.01(a).

Determine the percent within limit (PWL) by entering the table of Quality Index Values using the column appropriate to the total number "n" measurements.

For in-place density (%Gmm), determine the percent of material that will fall above the lower specification limit (PWL_L).

$$\text{Total } PWL_{Density} = PWL_L$$

PWL SPECIFICATION LIMITS				
Mixture				
	LSL*		USL**	
Air Voids (Va) at Ndes, %	2.60		5.40	
Binder Content By Ignition Furnace, %	- 0.40 from JMF		+ 0.40 from JMF	
Voids In Mineral Aggregate at Ndes, %	Greater Of		Lesser Of	
	Spec- 0.50	JMF -1.20	Spec +2.00	JMF+ 1.20
Density				
	LSL		USL	
Roadway Core Density	91.00		Not Applicable	

(% Gmm), %		

* LSL, Lower Specification Limit
** USL, Upper Specification Limit

Pay factors (PF) are calculated for air voids at Ndes, binder content, VMA at Ndes and in-place density (%Gmm). Any lot with less than six cores will be assigned a Lot Pay Factor for In-Place Density (%Gmm) of 100%. The appropriate pay factor for each property is calculated as follows:

Estimated PWL greater than 90:

$$PF = (105.00-0.50 \times (100.00-PWL))/100$$

Estimated PWL greater than or equal to 42 and equal to or less than 90:

$$PF = (100.00 - 0.000020072 \times (100.00 - PWL)^{3.5877})/100$$

If the Lot PWL for any one of the properties is less than 42, the Lot will be referred to Materials and Tests Division for adjudication as a failed material in accordance with normal Department practice as listed in 105.03.

Air voids, binder content, VMA, and in-place density (%Gmm) PF values will be reported to the nearest 0.01. Rounding will be in accordance with 109.01(a).

A composite pay factor for each lot based on test results for mixture properties and density is determined by a weighted formula as follows:

$$\text{Lot PF} = 0.20(PF_{BINDER}) + 0.35(PF_{VOIDS}) + 0.10(PF_{VMA}) + 0.35\,(PF_{DENSITY})$$ where:

Lot PF	=	Lot Composite Pay Factor for Mixture and Density
PF_{BINDER}	=	Lot Pay Factor for Binder Content
PF_{VOIDS}	=	Lot Pay Factor for Air Voids at N_{des}
PF_{VMA}	=	Lot Pay Factor for VMA at N_{des}
$PF_{DENSITY}$	=	Lot Pay Factor for In-Place Density (%Gmm)

The Lot quality assurance adjustment for mixture properties and density is calculated as follows.

$$q = L \times U \times (\text{Lot PF} - 1.00)/MAF$$

where:

q	=	quality assurance adjustment for the lot
L	=	Lot quantity
U	=	unit price for the material, $/TON ($/Mg)
Lot PF = Lot pay factor		

A PWL/PF computer spreadsheet will be used to calculate the PWL and pay factors.

Quality Index (QI) Values- LookUp Table												
Percent Within Limit (PWL) For a Given Sample Size (n)												
Note: This table was developed using the Excel based BetaDistribution function.												
QI	**n=3**	**n=4**	**n=5**	**n=6**	**n=7**	**n=8**	**n=9**	**n=10**	**n=11**	**n=12**	**n=13**	**n=14**
2.30	100	100	100	100	100	100	100	100	100	100	100	100
2.29	100	100	100	100	100	100	100	100	100	100	100	99
2.28	100	100	100	100	100	100	100	100	100	100	100	99
2.27	100	100	100	100	100	100	100	100	100	100	99	99
2.26	100	100	100	100	100	100	100	100	100	100	99	99
2.25	100	100	100	100	100	100	100	100	100	100	99	99
2.24	100	100	100	100	100	100	100	100	100	99	99	99
2.23	100	100	100	100	100	100	100	100	100	99	99	99
2.22	100	100	100	100	100	100	100	100	100	99	99	99
2.21	100	100	100	100	100	100	100	100	99	99	99	99
2.20	100	100	100	100	100	100	100	100	99	99	99	99
2.19	100	100	100	100	100	100	100	100	99	99	99	99
2.18	100	100	100	100	100	100	100	100	99	99	99	99
2.17	100	100	100	100	100	100	100	99	99	99	99	99
2.16	100	100	100	100	100	100	100	99	99	99	99	99
2.15	100	100	100	100	100	100	100	99	99	99	99	99
2.14	100	100	100	100	100	100	100	99	99	99	99	99
2.13	100	100	100	100	100	100	100	99	99	99	99	99
2.12	100	100	100	100	100	100	99	99	99	99	99	99
2.11	100	100	100	100	100	100	99	99	99	99	99	99
2.10	100	100	100	100	100	100	99	99	99	99	99	99
2.09	100	100	100	100	100	100	99	99	99	99	99	99
2.08	100	100	100	100	100	100	99	99	99	99	99	99
2.07	100	100	100	100	100	100	99	99	99	99	99	99
2.06	100	100	100	100	100	99	99	99	99	99	99	99
2.05	100	100	100	100	100	99	99	99	99	99	99	99
2.04	100	100	100	100	100	99	99	99	99	99	99	99
2.03	100	100	100	100	100	99	99	99	99	99	99	99
2.02	100	100	100	100	100	99	99	99	99	99	99	99
2.01	100	100	100	100	100	99	99	99	99	99	99	98
2.00	100	100	100	100	100	99	99	99	99	99	99	98
1.99	100	100	100	100	100	99	99	99	99	99	98	98
1.98	100	100	100	100	99	99	99	99	99	98	98	98
1.97	100	100	100	100	99	99	99	99	99	98	98	98
1.96	100	100	100	100	99	99	99	99	98	98	98	98
1.95	100	100	100	100	99	99	99	99	98	98	98	98
1.94	100	100	100	100	99	99	99	99	98	98	98	98
1.93	100	100	100	100	99	99	99	98	98	98	98	98
1.92	100	100	100	100	99	99	99	98	98	98	98	98
1.91	100	100	100	100	99	99	99	98	98	98	98	98
1.90	100	100	100	100	99	99	98	98	98	98	98	98
1.89	100	100	100	100	99	99	98	98	98	98	98	98
1.88	100	100	100	100	99	99	98	98	98	98	98	98

Quality Index (QI) Values- LookUp Table												
Percent Within Limit (PWL) For a Given Sample Size (n)												
Note: This table was developed using the Excel based BetaDistribution function.												
QI	**n=3**	**n=4**	**n=5**	**n=6**	**n=7**	**n=8**	**n=9**	**n=10**	**n=11**	**n=12**	**n=13**	**n=14**
1.87	100	100	100	99	99	98	98	98	98	98	98	98
1.86	100	100	100	99	99	98	98	98	98	98	98	98
1.85	100	100	100	99	99	98	98	98	98	98	98	98
1.84	100	100	100	99	99	98	98	98	98	98	97	97
1.83	100	100	100	99	99	98	98	98	98	98	97	97
1.82	100	100	100	99	99	98	98	98	98	97	97	97
1.81	100	100	100	99	98	98	98	98	97	97	97	97
1.80	100	100	100	99	98	98	98	98	97	97	97	97
1.79	100	100	100	99	98	98	98	97	97	97	97	97
1.78	100	100	100	99	98	98	98	97	97	97	97	97
1.77	100	100	100	99	98	98	97	97	97	97	97	97
1.76	100	100	100	99	98	98	97	97	97	97	97	97
1.75	100	100	100	99	98	98	97	97	97	97	97	97
1.74	100	100	100	98	98	97	97	97	97	97	97	97
1.73	100	100	100	98	98	97	97	97	97	97	97	97
1.72	100	100	100	98	98	97	97	97	97	97	96	96
1.71	100	100	99	98	97	97	97	97	97	96	96	96
1.70	100	100	99	98	97	97	97	97	96	96	96	96
1.69	100	100	99	98	97	97	97	96	96	96	96	96
1.68	100	100	99	98	97	97	97	96	96	96	96	96
1.67	100	100	99	98	97	97	96	96	96	96	96	96
1.66	100	100	99	98	97	97	96	96	96	96	96	96
1.65	100	100	99	97	97	96	96	96	96	96	96	96
1.64	100	100	99	97	97	96	96	96	96	96	96	96
1.63	100	100	98	97	97	96	96	96	96	96	96	95
1.62	100	100	98	97	96	96	96	96	96	95	95	95
1.61	100	100	98	97	96	96	96	96	95	95	95	95
1.60	100	100	98	97	96	96	96	95	95	95	95	95
1.59	100	100	98	97	96	96	95	95	95	95	95	95
1.58	100	100	98	96	96	96	95	95	95	95	95	95
1.57	100	100	97	96	96	95	95	95	95	95	95	95
1.56	100	100	97	96	96	95	95	95	95	95	95	95
1.55	100	100	97	96	95	95	95	95	95	95	95	95
1.54	100	100	97	96	95	95	95	95	95	94	94	94
1.53	100	100	97	96	95	95	95	95	94	94	94	94
1.52	100	100	97	96	95	95	95	94	94	94	94	94
1.51	100	100	96	95	95	95	94	94	94	94	94	94
1.50	100	100	96	95	95	94	94	94	94	94	94	94
1.49	100	100	96	95	95	94	94	94	94	94	94	94
1.48	100	99	96	95	94	94	94	94	94	94	94	94
1.47	100	99	96	95	94	94	94	94	94	94	93	93
1.46	100	99	95	94	94	94	94	94	93	93	93	93
1.45	100	98	95	94	94	94	93	93	93	93	93	93

Quality Index (QI) Values- LookUp Table												
Percent Within Limit (PWL) For a Given Sample Size (n)												
Note: This table was developed using the Excel based BetaDistribution function.												
QI	**n=3**	**n=4**	**n=5**	**n=6**	**n=7**	**n=8**	**n=9**	**n=10**	**n=11**	**n=12**	**n=13**	**n=14**
1.44	100	98	95	94	94	93	93	93	93	93	93	93
1.43	100	98	95	94	94	93	93	93	93	93	93	93
1.42	100	97	95	94	93	93	93	93	93	93	93	93
1.41	100	97	94	94	93	93	93	93	93	93	93	93
1.40	100	97	94	93	93	93	93	93	92	92	92	92
1.39	100	96	94	93	93	93	92	92	92	92	92	92
1.38	100	96	94	93	93	92	92	92	92	92	92	92
1.37	100	96	93	93	92	92	92	92	92	92	92	92
1.36	100	95	93	93	92	92	92	92	92	92	92	92
1.35	100	95	93	92	92	92	92	92	92	92	92	92
1.34	100	95	93	92	92	92	92	92	91	91	91	91
1.33	100	94	93	92	92	92	91	91	91	91	91	91
1.32	100	94	92	92	91	91	91	91	91	91	91	91
1.31	100	94	92	92	91	91	91	91	91	91	91	91
1.30	100	93	92	91	91	91	91	91	91	91	91	91
1.29	100	93	92	91	91	91	91	91	91	90	90	90
1.28	100	93	91	91	91	91	90	90	90	90	90	90
1.27	100	92	91	91	90	90	90	90	90	90	90	90
1.26	100	92	91	90	90	90	90	90	90	90	90	90
1.25	100	92	91	90	90	90	90	90	90	90	90	90
1.24	100	91	90	90	90	90	90	90	90	90	90	89
1.23	100	91	90	90	90	89	89	89	89	89	89	89
1.22	100	91	90	89	89	89	89	89	89	89	89	89
1.21	100	90	90	89	89	89	89	89	89	89	89	89
1.20	100	90	89	89	89	89	89	89	89	89	89	89
1.19	100	90	89	89	89	89	89	89	89	88	88	88
1.18	100	89	89	89	88	88	88	88	88	88	88	88
1.17	100	89	88	88	88	88	88	88	88	88	88	88
1.16	100	89	88	88	88	88	88	88	88	88	88	88
1.15	97	88	88	88	88	88	88	88	88	88	88	88
1.14	95	88	88	88	87	87	87	87	87	87	87	87
1.13	93	88	87	87	87	87	87	87	87	87	87	87
1.12	92	87	87	87	87	87	87	87	87	87	87	87
1.11	91	87	87	87	87	87	87	87	87	87	87	87
1.10	90	87	87	87	87	87	87	87	87	87	86	86
1.09	89	86	86	86	86	86	86	86	86	86	86	86
1.08	88	86	86	86	86	86	86	86	86	86	86	86
1.07	88	86	86	86	86	86	86	86	86	86	86	86
1.06	87	85	85	85	85	86	86	86	86	86	86	86
1.05	86	85	85	85	85	85	85	85	85	85	85	85
1.04	86	85	85	85	85	85	85	85	85	85	85	85
1.03	85	84	85	85	85	85	85	85	85	85	85	85
1.02	84	84	84	84	84	84	85	85	85	85	85	85

Quality Index (QI) Values- LookUp Table												
Percent Within Limit (PWL) For a Given Sample Size (n)												
Note: This table was developed using the Excel based BetaDistribution function.												
QI	**n=3**	**n=4**	**n=5**	**n=6**	**n=7**	**n=8**	**n=9**	**n=10**	**n=11**	**n=12**	**n=13**	**n=14**
1.01	84	84	84	84	84	84	84	84	84	84	84	84
1.00	83	83	84	84	84	84	84	84	84	84	84	84
0.99	83	83	83	84	84	84	84	84	84	84	84	84
0.98	82	83	83	83	83	83	83	84	84	84	84	84
0.97	82	82	83	83	83	83	83	83	83	83	83	83
0.96	81	82	82	83	83	83	83	83	83	83	83	83
0.95	81	82	82	82	83	83	83	83	83	83	83	83
0.94	80	81	82	82	82	82	82	82	82	82	83	83
0.93	80	81	82	82	82	82	82	82	82	82	82	82
0.92	79	81	81	82	82	82	82	82	82	82	82	82
0.91	79	80	81	81	81	81	82	82	82	82	82	82
0.90	78	80	81	81	81	81	81	81	81	81	81	81
0.89	78	80	80	81	81	81	81	81	81	81	81	81
0.88	78	79	80	80	81	81	81	81	81	81	81	81
0.87	77	79	80	80	80	80	80	80	81	81	81	81
0.86	77	79	79	80	80	80	80	80	80	80	80	80
0.85	76	78	79	79	80	80	80	80	80	80	80	80
0.84	76	78	79	79	79	79	80	80	80	80	80	80
0.83	76	78	78	79	79	79	79	79	79	79	79	79
0.82	75	77	78	79	79	79	79	79	79	79	79	79
0.81	75	77	78	78	78	79	79	79	79	79	79	79
0.80	74	77	77	78	78	78	78	78	78	79	79	79
0.79	74	76	77	78	78	78	78	78	78	78	78	78
0.78	74	76	77	77	77	78	78	78	78	78	78	78
0.77	73	76	77	77	77	77	77	78	78	78	78	78
0.76	73	75	76	77	77	77	77	77	77	77	77	77
0.75	73	75	76	76	77	77	77	77	77	77	77	77
0.74	72	75	76	76	76	76	77	77	77	77	77	77
0.73	72	74	75	76	76	76	76	76	76	76	76	76
0.72	71	74	75	75	76	76	76	76	76	76	76	76
0.71	71	74	75	75	75	75	76	76	76	76	76	76
0.70	71	73	74	75	75	75	75	75	75	75	75	76
0.69	70	73	74	74	75	75	75	75	75	75	75	75
0.68	70	73	74	74	74	74	75	75	75	75	75	75
0.67	70	72	73	74	74	74	74	74	74	74	75	75
0.66	69	72	73	73	74	74	74	74	74	74	74	74
0.65	69	72	73	73	73	74	74	74	74	74	74	74
0.64	69	71	72	73	73	73	73	73	73	74	74	74
0.63	68	71	72	72	73	73	73	73	73	73	73	73
0.62	68	71	72	72	72	73	73	73	73	73	73	73
0.61	68	70	71	72	72	72	72	72	72	73	73	73
0.60	67	70	71	71	72	72	72	72	72	72	72	72
0.59	67	70	71	71	71	72	72	72	72	72	72	72

Quality Index (QI) Values- LookUp Table												
Percent Within Limit (PWL) For a Given Sample Size (n)												
Note: This table was developed using the Excel based BetaDistribution function.												
QI	**n=3**	**n=4**	**n=5**	**n=6**	**n=7**	**n=8**	**n=9**	**n=10**	**n=11**	**n=12**	**n=13**	**n=14**
0.58	67	69	70	71	71	71	71	71	71	72	72	72
0.57	66	69	70	70	71	71	71	71	71	71	71	71
0.56	66	69	70	70	70	71	71	71	71	71	71	71
0.55	66	68	69	70	70	70	70	70	70	70	71	71
0.54	65	68	69	69	70	70	70	70	70	70	70	70
0.53	65	68	69	69	69	69	70	70	70	70	70	70
0.52	65	67	68	69	69	69	69	69	69	69	69	70
0.51	65	67	68	68	69	69	69	69	69	69	69	69
0.50	64	67	68	68	68	68	69	69	69	69	69	69
0.49	64	66	67	68	68	68	68	68	68	68	68	68
0.48	64	66	67	67	68	68	68	68	68	68	68	68
0.47	63	66	67	67	67	67	67	68	68	68	68	68
0.46	63	65	66	67	67	67	67	67	67	67	67	67
0.45	63	65	66	66	67	67	67	67	67	67	67	67
0.44	62	65	65	66	66	66	66	67	67	67	67	67
0.43	62	64	65	66	66	66	66	66	66	66	66	66
0.42	62	64	65	65	65	66	66	66	66	66	66	66
0.41	62	64	64	65	65	65	65	65	65	66	66	66
0.40	61	63	64	65	65	65	65	65	65	65	65	65
0.39	61	63	64	64	64	65	65	65	65	65	65	65
0.38	61	63	63	64	64	64	64	64	64	64	64	65
0.37	60	62	63	63	64	64	64	64	64	64	64	64
0.36	60	62	63	63	63	63	64	64	64	64	64	64
0.35	60	62	62	63	63	63	63	63	63	63	63	63
0.34	60	61	62	62	63	63	63	63	63	63	63	63
0.33	59	61	62	62	62	62	62	63	63	63	63	63
0.32	59	61	61	62	62	62	62	62	62	62	62	62
0.31	59	60	61	61	61	62	62	62	62	62	62	62
0.30	58	60	61	61	61	61	61	61	61	61	62	62
0.29	58	60	60	61	61	61	61	61	61	61	61	61
0.28	58	59	60	60	60	61	61	61	61	61	61	61
0.27	58	59	60	60	60	60	60	60	60	60	60	60
0.26	57	59	59	60	60	60	60	60	60	60	60	60
0.25	57	58	59	59	59	59	59	60	60	60	60	60
0.24	57	58	59	59	59	59	59	59	59	59	59	59
0.23	56	58	58	58	59	59	59	59	59	59	59	59
0.22	56	57	58	58	58	58	58	58	58	58	58	59
0.21	56	57	57	58	58	58	58	58	58	58	58	58
0.20	56	57	57	57	57	58	58	58	58	58	58	58
0.19	55	56	57	57	57	57	57	57	57	57	57	57
0.18	55	56	56	57	57	57	57	57	57	57	57	57
0.17	55	56	56	56	56	56	56	57	57	57	57	57
0.16	54	55	56	56	56	56	56	56	56	56	56	56

Quality Index (QI) Values- LookUp Table												
Percent Within Limit (PWL) For a Given Sample Size (n)												
Note: This table was developed using the Excel based BetaDistribution function.												
QI	**n=3**	**n=4**	**n=5**	**n=6**	**n=7**	**n=8**	**n=9**	**n=10**	**n=11**	**n=12**	**n=13**	**n=14**
0.15	54	55	55	56	56	56	56	56	56	56	56	56
0.14	54	55	55	55	55	55	55	55	55	55	55	55
0.13	54	54	55	55	55	55	55	55	55	55	55	55
0.12	53	54	54	54	54	55	55	55	55	55	55	55
0.11	53	54	54	54	54	54	54	54	54	54	54	54
0.10	53	53	54	54	54	54	54	54	54	54	54	54
0.09	52	53	53	53	53	53	53	53	53	53	53	54
0.08	52	53	53	53	53	53	53	53	53	53	53	53
0.07	52	52	52	53	53	53	53	53	53	53	53	53
0.06	52	52	52	52	52	52	52	52	52	52	52	52
0.05	51	52	52	52	52	52	52	52	52	52	52	52
0.04	51	51	51	51	51	52	52	52	52	52	52	52
0.03	51	51	51	51	51	51	51	51	51	51	51	51
0.02	51	51	51	51	51	51	51	51	51	51	51	51
0.01	50	50	50	50	50	50	50	50	50	50	50	50
0.00	50	50	50	50	50	50	50	50	50	50	50	50
-0.01	50	50	50	50	50	50	50	50	50	50	50	50
-0.02	49	49	49	49	49	49	49	49	49	49	49	49
-0.03	49	49	49	49	49	49	49	49	49	49	49	49
-0.04	49	49	49	49	49	48	48	48	48	48	48	48
-0.05	49	48	48	48	48	48	48	48	48	48	48	48
-0.06	48	48	48	48	48	48	48	48	48	48	48	48
-0.07	48	48	48	47	47	47	47	47	47	47	47	47
-0.08	48	47	47	47	47	47	47	47	47	47	47	47
-0.09	48	47	47	47	47	47	47	47	47	47	47	46
-0.10	47	47	46	46	46	46	46	46	46	46	46	46
-0.11	47	46	46	46	46	46	46	46	46	46	46	46
-0.12	47	46	46	46	46	45	45	45	45	45	45	45
-0.13	46	46	45	45	45	45	45	45	45	45	45	45
-0.14	46	45	45	45	45	45	45	45	45	45	45	45
-0.15	46	45	45	44	44	44	44	44	44	44	44	44
-0.16	46	45	44	44	44	44	44	44	44	44	44	44
-0.17	45	44	44	44	44	44	44	43	43	43	43	43
-0.18	45	44	44	43	43	43	43	43	43	43	43	43
-0.19	45	44	43	43	43	43	43	43	43	43	43	43
-0.20	44	43	43	43	43	42	42	42	42	42	42	42
-0.21	44	43	43	42	42	42	42	42	42	42	42	42
-0.22	44	43	42	42	42	42	42	42	42	42	42	
-0.23	44	42	42	42								
-0.24	43	42										
-0.25	43	42										
-0.26	43											
-0.27	42											

Quality Index (QI) Values- LookUp Table												
Percent Within Limit (PWL) For a Given Sample Size (n)												
Note: This table was developed using the Excel based BetaDistribution function.												
QI	**n=3**	**n=4**	**n=5**	**n=6**	**n=7**	**n=8**	**n=9**	**n=10**	**n=11**	**n=12**	**n=13**	**n=14**
-0.28	42											
-0.29	42											
-0.30	42											

(c) Smoothness

When the pavement smoothness is tested with a profilograph, payment will be based on a zero blanking band on the final profile index in accordance with the following table. A Quality Assurance Pay Factor (PF_s) for smoothness will apply to the planned typical section including the aggregate base, and the HMA base, intermediate, and surface courses. The quality assurance adjustment for each section will include the total area of each pavement lane excluding shoulders for 0.1 mi. (0.16 km) long section represented by the profile index calculated by the following formula:

$$q_s = (PF_s - 1.00)\sum_{i=1}^{n}\left(A \times \frac{S}{T} \times U\right)$$

where:

q_s = quality assurance adjustment for smoothness for one section
PF_s = pay factor for smoothness
n = number of layers
A = area of the section, syd (m^2)
S = planned spread rate for material, lb/syd (kg/m^2)
T = conversion factor: 2000 lb/ton (1000 kg/Mg)
U = unit price for the material, \$/ton (\$/Mg)

The quality assurance adjustment for smoothness, Q_S, for the contract will be the total of the quality assurance adjustments for smoothness, q_s, on each section by the following formula:

$$Q_s = \Sigma\, q_s$$

ADJUSTMENT FOR SMOOTHNESS ($PI_{0.0}$) ZERO BLANKING BAND	
Design Speed Greater Than 45 mph (70 km/hr)	
Profile Index in./0.1 mi. (mm per 0.16 km)	Pay Factor
Over 0.00 to 1.20in. (Over 0 to 30 mm)	1.06
Over 1.20to 1.40in. (Over 30to 35mm)	1.05
Over 1.40to 1.60in. (Over 35to 40mm)	1.04

Over 1.60 to 1.80in. (Over 40to 45mm)	1.03
Over 1.80to 2.00in. (Over 45to 50mm)	1.02
Over 2.00 to 2.40in. (Over 50to 60mm)	1.01
Over 2.40 to 3.20 in. (Over 60to 80mm)	1.00
Over 3.20 to 3.40 in. (Over 80to 85mm)	0.96
All pavement with a profile index ($PI_{0.0}$) greater than 3.40 in. (85 mm) shall be corrected to 3.40 in. (85 mm).	

Quality assurance pay factors greater than 1.00 will be applicable only to the initial measured profile index, prior to any corrective work. Quality assurance pay factors of 1.00 or less will be applied to pavement sections where corrective work has been completed.

(d) Total Quality Assurance Adjustment

The total quality assurance adjustments is to be calculated as follows:

$$Q = Q_S + (\sum q)$$

where:

Q = total quality assurance adjustment
Q_S = quality assurance adjustment for smoothness
q = sublot quality assurance adjustment

PWL.20 Appeals

If the QC test results do not agree with the acceptance test results, a request, along with the QC test results, may be made in writing for additional testing. The appeal sample will be analyzed in a lab different than the lab that analyzed the original sample when requested by the Contractor. Additional testing may be requested for one or more of the following tests: MSG, BSG of the gyratory specimens, binder content, or BSG of the density cores(s). The request for the appeal for MSG, BSG of gyratory specimens, binder content or BSG of the density cores shall be submitted within seven calendar days of receipt of the Department's written results for that lot. The sublot(s) and specific test(s) shall be specified at the time of the appeal request. Only one appeal request per lot is permitted. Upon approval of the appeal, the Engineer will perform additional testing as follows:

The backup or new sample(s) will be tested in accordance with the applicable test method for the test requested.

(a) MSG.

The backup MSG sample will be dried in accordance with ITM 572 and tested in accordance with AASHTO T 209, Section 9.5.1.

(b) BSG of the Gyratory Specimen

New gyratory specimens will be prepared and tested in accordance with AASHTO T 312 from the backup sample.

(c) Binder Content

The backup binder content sample will be prepared and tested in accordance with the test method that was used for acceptance.

(d) BSG of the Density Core(s)

Additional core(s) shall be taken within seven calendar days unless otherwise directed. Additional core(s) locations will be determined by adding 1.0 ft (0.3 m) longitudinally of the core(s) tested using the same transverse offset. The appeal density core(s) will be tested in accordance with AASHTO T 166 from samples prepared in accordance with ITM 572.

The appeal results will replace all previous test result(s) for acceptance of mixture in accordance with PWL.09 and density in accordance with PWL.16. The results will be furnished to the Contractor.

PWL.21 Method of Measurement

HMA mixtures will be measured by the ton (megagram) of the type specified, in accordance with 109.01(b). The measured quantity will be divided by the MAF to determine the pay quantity.

Milled shoulder corrugations will be measured in accordance with 606.02.

PWL.22 Basis of Payment

The accepted quantities for this work will be paid for at the contract unit price per ton (megagram) for QC/QA-HMA, PWL of the type specified, complete in place.

Payment for furnishing, calibrating, and operating the profilograph, and furnishing profile information will be made at the contract lump sum price for profilograph, HMA.

Adjustments to the contract payment with respect to mixture, density, and smoothness for mixture produced will be included in a quality assurance adjustment pay item in accordance with 109.05.1.

Milled shoulder corrugations will be paid for in accordance with 606.03.

Payment will be made under:

Pay Item	Pay Unit Symbol

Profilograph, HMA ..... LS
QC/QA HMA, _____, _____, _____, _____ mm-PWL ..... TON (Mg)
(ESAL[1]) (PG[2]) (Course[3]) (Mix[4])

(1) ESAL Category as defined in PWL.04
(2) Number represents the high temperature binder grade. Low temperature grades are –22.
(3) Surface, Intermediate, or Base
(4) Mixture Designation

Preparation of surfaces to be overlaid shall be included in the cost of other pay items.

Coring and refilling of the core holes shall be included in the cost of other pay items within this section.

No payment will be made for additional anti-stripping additives, appeal coring or traffic control expenditures related to coring operations.

Corrections for pavement smoothness shall be included in the cost of other pay items within this section.

The price for Profilograph, HMA, will be full compensation regardless of how often the profilograph is used or how many profilograms are produced.