QCP Pay Calculation
Appendix E6

Effective: January 1, 2012
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This document explains the procedure used to determine the pay adjustment for a hot-mix asphalt (HMA) mixture for Quality Control for Performance (QCP) projects.

The following steps are used to determine the pay deduction for each QCP mixture:

1. Determine sublot deviation from target for each pay parameter.
2. Determine the sublot pay factor for each sublot using the Table 1 and the deviation from target.
3. Determine the average sublot Pay Factor for each pay parameter.
4. Calculate a Combined Pay Factor using the average sublot Pay Factors and Equation 1.
5. Determine the QCP pay deduction for the mixture using Equation 2.
6. The Combined Pay Factor shall not exceed 100%.
7. The 103% column only applies when the district conducts testing of all the sublots within a given lot and all of the tests are within the Acceptable Limits. The 103% column also applies to density sublots where no individual density test is less than 90.0% or greater than 98.0% density. The average sublot Pay Factor for each pay parameter shall be capped at 100.0% prior to calculating the Combined Pay Factor.

Table 1

Parameter	Pay Factor			
	103%	100%	95%	90%
Voids[1/ 3/]	± 0.5%	± 1.2%	± 1.6%	± 2.0%
VMA [3/]	0% to +1.0% above minimum specified	-0.7% to +2.0%	-0.8% to +2.5%	-1.0% to +3.0%
Density[2/]	93.5% to 94.5%	92.5% to 96.5%	91.5% to 97.0%	90.0% to 98.0%
SMA	94.0% to 95.0%	93.5% to 96.5%	92.5% to 97.0%	92.0% to 98.0%
IL-9.5FG at < 1.25 in.	93.5% to 94.5%	91.0% to 96.5%	90.0% to 97.0%	89.0% to 98.0%

1/ Ranges based on deviation from the specified design percent Voids.
2/ If no density requirement applies the Contractor will receive 100% for the density pay factor in Equation 1.
3/ If mixture testing is waived for small tonnage, the Contractor will receive 100% for the Voids and VMA pay factors in Equation 1.

Equation 1: $CPF = 0.30(PF_{Voids}) + 0.30(PF_{VMA}) + 0.40(PF_{Density})$

Where: CPF = Combined Pay Factor

PF_{Voids}, PF_{VMA}, and $PF_{Density}$ = Average sublot pay factors for the pay parameters

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The QCP deduction for a given mixture is calculated by multiplying the Mixture Unit Price by the Quantity and the CPF according to Equation 2 below.

Equation 2: QCP Deduction = (Mixture Unit Price x Mixture Quantity x CPF/100) – (Mixture Unit Price x Mixture Quantity)

Example:

Determine the QCP pay deduction for the given N70 HMA IL-12.5 surface mixture being placed at 1.5 inches thick as an overlay. The project consists of 6,900 tons placed over a distance of 12 lane miles.

Note that mix sample lots and density lots are independent of one another.

In this example the first mix lot represents 4,000 tons while the second lot represents 2,900 tons. There are 12 density sublots representing 12 lane miles (N=12, representing 12 miles x 5 cores/mile = 60 cores).

Mix sample: Each sublot represents 1000 tons except for lot 2, sublot 3 which represents 900 ton.

Lot	Sublot	Voids (Target = 4.0%)		VMA (Des. Min = 14.0%)	
		Contractor	District	Contractor	District
1	1	4.1		13.9	
	2	3.9	***3.2***	13.5	***13.3***
	3	2.5		13.0	
	4	3.0		13.8	
2	1	2.3	***2.5***	13.3	***13.4***
	2	2.1	2.2	13.0	13.1
	3	3.8	3.6	13.7	13.6

Note: Bolded and italicized test results denote the sublot split that was randomly selected by the District for testing.

Density: Since this pavement is < 3 inches thick, cores are taken randomly every 0.2 mile which is 5 cores per mile. Each density sublot represents 1 mile. Therefore with cores taken every 0.2 mile, the density sublot will represent the average of 5 density cores.

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Density Sublot	Density Intervals (cores)				
	1	2	3	4	5
1	90.4	90.8	91.6	92.4	92.1
2	93.8	94.1	92.3	92.1	92.6
3	91.8	93.5	93.9	92.8	92.5
4	93.7	94.2	93.5	93.3	92.8
5	92.1	94.1	92.6	93.8	92.3
6	94.1	94.3	93.2	94.5	93.9
7	93.6	93.3	92.5	91.9	92.7
8	92.8	93.3	94.2	93.5	93.7
9	90.0	90.2	91.9	91.8	90.9
⋮	⋮	⋮	⋮	⋮	⋮
12	91.5	93.5	92.7	93.8	92.1

Determine the average sublot pay factor for each parameter:

Voids:

Since the District randomly selected and tested the split from sublot 2 in Lot 1, and the void results were 1) within the 100% pay factor tolerance **and** 2) within Precision Limits of the Contractor's results, the District does not need to test the remaining sublots in Lot 1 and the entire Lot receives a Pay Factor of 100%.

For the second Lot the District randomly selected and tested the split from sublot 1. Since the District void results were not within the 100% pay factor tolerance, the District had to test all of the remaining Sublot splits. (see completed table below):

Calculate the void deviation from target for each of the District sublot split results.

Lot 1:
Sublot 2: Deviation = 3.2% - 4.0% = -0.8%

Lot 2:
Sublot 1: Deviation = 2.5% - 4.0% = -1.5%
Sublot 2: Deviation = 2.2% - 4.0% = -1.8%
Sublot 3: Deviation = 3.6% - 4.0% = -0.4%

Using Table 1 and the deviation from Target, determine the corresponding Void sublot Pay Factor for each District test result.

Lot 1:
Sublot 2: Pay Factor associated with -0.8% in Table 1 is 100%

Lot 2:

Sublot 1: Pay Factor associated with -1.5% in Table 1 is 95%
Sublot 2: Pay Factor associated with -1.8% in Table 1 is 90%
Sublot 3: Pay Factor associated with -0.4% in Table 1 is 103%

Target Voids = 4.0%					
Lot	Sublot	Contractor	District	Deviation	Sublot PF
1	1	4.1			
	2	3.9	***3.2***	***-0.8***	***100.0***
	3	2.8			
	4	3.0			
2	1	2.3	***2.5***	***-1.5***	***95***
	2	2.1	2.2	-1.8	90
	3	3.8	3.6	-0.4	103

Note: Bolded and italicized test results denote the sublot split that was randomly selected by the District for testing.

Calculate the average sublot Pay Factor for Voids. (Note: The 100% in Lot 1 represents four sublots and therefore is multiplied by four)

Ave Sublot Pay Factor (PF_{Voids}) = ((100% X 4) + 95% + 90% + 103%) / 7 sublots = **98.3%**

VMA:

Since the District randomly selected and tested the split from Sublot 2 in Lot 1, and the VMA results were 1) within the 100% pay factor tolerance **and** 2) within Precision Limits of the Contractor's results, the District does not need to test the remaining sublots in Lot 1 and the entire Lot receives a Pay Factor of 100%.

For the second Lot the District randomly selected and tested the split from Sublot 1. Since the District results were not within the 100% pay factor tolerance **for Voids**, the District had to test all of the remaining sublot splits. (see completed table below):

Calculate the VMA deviation from target for each of the District sublot split results.

Lot 1:

Sublot 2: Deviation = 13.3% - 14.0% = -0.7%

Lot 2:

Sublot 1: Deviation = 13.4% - 14.0% = -0.6%
Sublot 2: Deviation = 13.1% - 14.0% = -0.9%
Sublot 3: Deviation = 13.6% - 14.0% = -0.4%

Using Table 1 and the deviation from Target, determine the corresponding VMA sublot pay factor for each District test result.

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Lot 1:
Sublot 2: Pay Factor associated with -0.7% in Table 1 is 100%

Lot 2:
Sublot 1: Pay Factor associated with -0.6% in Table 1 is 100%
Sublot 2: Pay Factor associated with -0.9% in Table 1 is 90%
Sublot 3: Pay Factor associated with -0.4% in Table 1 is 100%

Minimum VMA = 14.0%					
Lot	Sublot	Contractor	District	Deviation	Sublot PF
1	1	13.9	***13.3***	***-0.7***	***100***
	2	13.5			
	3	13.4			
	4	13.8			
2	1	13.3	***13.4***	***-0.6***	***100***
	2	13.0	13.1	-0.9	90
	3	13.7	13.6	-0.4	100

Note: Bolded and italicized test results denote the sublot split that was randomly selected by the District for testing.

Calculate the average sublot pay factor for VMA. (Note: The 100% in Lot 1 represents four sublots and therefore is multiplied by four)

Ave Sublot Pay Factor (PF_{VMA}) = ((100% X 4) + 100% + 90% + 100%) / 7 sublots = **98.6%**

Density:

Determine the average density for each sublot.

Determine the sublot pay factor using the average sublot density and Table 1 (see completed table below).

Determine the Density pay factor by averaging the sublot pay factors.

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Density Sublot	Density Intervals (cores) 1	2	3	4	5	Sublot Ave	Sublot PF
1	90.4	90.8	91.6	92.4	92.1	91.5	95
2	93.8	94.1	92.3	92.1	92.6	93.0	100
3	91.8	93.5	93.9	92.8	92.5	92.9	100
4	93.7	94.2	93.5	93.3	92.8	93.5	103
5	92.1	94.1	92.6	93.8	92.3	93.0	100
6	94.1	94.3	93.2	94.5	93.9	94.0	103
7	93.6	93.3	92.5	91.9	92.7	92.8	100
8	92.8	93.3	94.2	93.5	93.7	93.5	103
9	90.0	90.2	91.9	91.8	90.9	91.0	95
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
12	91.5	93.5	92.7	93.8	92.1	92.7	100
						Average Density Sublot PF =	99.9

Combined Pay Factor:

Determine the Combined Pay Factor using Equation 1.

$$CPF = 0.30(PF_{Voids}) + 0.30(PF_{VMA}) + 0.40(PF_{Density})$$

$$= 0.30(98.3) + 0.30(98.6) + 0.4(99.9)$$

$$CPF = 99.1\%$$

QCP Deduction:

Determine the QCP deduction pay for the given mixture using Equation 2.

QCP Deduction = (Mixture Unit Price x Mixture Quantity x CPF/100) – (Mixture Unit Price x Mixture Quantity)

Where: Mixture Unit Price = $65.00

Mixture Quantity = 6,900 tons placed.

QCP Deduction = ($65.00/ton x 6,900 tons x 99.1 / 100) – ($65.00/ton x 6,900 tons)
= - $4,036.50

In this case a $4,036.50 disincentive would be paid as per Construction Memorandum 10-4.