

CHAPTER 8

QUALITY ACCEPTANCE & DATA PROCESSING

Acceptance

Acceptance will be made under the Department's quality assurance program which includes the testing of production samples by the Contractor and of monitor samples by the Department. Sampling and testing for the determination of grading, asphalt cement content and temperature shall be performed by the Contractor, and the Department will perform independent monitor checks at a laboratory of its discretion. The Contractor shall provide copies of such test results to the Department on forms furnished by the Department. Where the Contractor's test results indicate that the mixture conforms to the gradation, asphalt cement content and mix temperature requirements of the Specifications, the mixture will be acceptable for these properties; however, nothing herein shall be construed as waiving the requirements of Sections 106.06, 200.02 and 200.03, and 315 or relieving the Contractor of the obligation to furnish and install a finished functional product which conforms to the requirements of the Contract.

In the event a statistical comparative analysis of the Contractor's test results and the Department's monitor tests indicate a statistically significant difference in the results and either of the results indicate that the material does not conform to the grading and asphalt cement content requirements of the Specifications, an investigation will be made to determine the reason for the difference. In the event it is determined from the investigation that the material does not conform to the requirements of the Contract, price adjustments will be made in accordance with the requirements of Section 211.09.

Acceptance for gradation and asphalt cement content will be based on the mean of results of eight tests performed on samples taken in a stratified random manner from each 4,000 ton lot (8,000 ton lots may be used when the normal daily production of the source from which the material is being obtained is in excess of 4,000 tons). Unless otherwise approved by the Engineer, samples shall be obtained from the approximate center of the truckload of material. Any statistically acceptable method of randomization may be used to determine when to take the stratified random sample; however, the Department shall be advised of the method to be used prior to beginning production.

A lot will be considered to be acceptable for gradation and asphalt content if the mean of the test results obtained is within the tolerance allowed for the job-mix formula as specified in Table II-15.

TABLE II-15 PROCESS TOLERANCE

Tolerance on Each Laboratory Sieve and Asphalt Content – Percent Plus and Minus

No. Tests	Top Size ¹	1 1/2 in	1 in	3/4 in	1/2 in	3/8 in	No. 4	No. 8	No. 30	No. 50	No. 200	AC
1	0.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	6.0	5.0	2.0	0.60
2	0.0	5.7	5.7	5.7	5.7	5.7	5.7	5.7	4.3	3.6	1.4	0.43
3	0.0	4.4	4.4	4.4	4.4	4.4	4.4	4.4	3.3	2.8	1.1	0.33
4	0.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	2.5	1.0	0.30
5	0.0	3.6	3.6	3.6	3.6	3.6	3.6	3.6	2.7	2.2	0.9	0.27
6	0.0	3.3	3.3	3.3	3.3	3.3	3.3	3.3	2.4	2.0	0.8	0.24
7	0.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.3	1.9	0.8	0.23
8	0.0	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.1	1.8	0.7	0.21
12	0.0	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.7	1.4	0.6	0.17

¹ Defined as the sieve that has 100% passing as defined in Table II-13

Figure 8-1

If the job mix formula is modified within a lot, the mean test results of samples taken will be compared to the applicable process tolerance shown in Figure 8-1. Should visual examination by the Engineer reveal that the material in any load or portion of the paved roadway is obviously contaminated or segregated, that load or portion of the paved roadway will be rejected without additional sampling or testing of the lot. In the event it is necessary to determine the gradation or asphalt content of the material in any load or portion of the paved roadway, samples will be taken, tested, and the results compared to the requirements of the approved job-mix formula. The results obtained in the testing will apply only to the material in question.

Acceptance Calculations for Gradation and Asphalt Content

As previously stated, acceptance for gradation and asphalt content will be based upon a mean (average) of the results of tests performed on samples taken in a stratified random manner from each lot. The procedure for calculating the acceptance or failure for gradation and asphalt content is as follows:

Obtain the job-mix formula. The job-mix formula is found on Form TL-127 (see Chapter 5) as submitted by the Contractor/Technician for the type mixture being produced. Each approved job-mix formula shall remain in effect, provided the results of tests performed on material currently being produced consistently meet the requirements of the job-mix for grading, asphalt content, temperature, SUPERPAVE compaction results, and the requirements of Section 315.

Determine the number of tests performed on the quantity of material tested for acceptance. Usually the quantity of material tested for acceptance is a lot (4000 or 8000 tons), which requires 8 tests (one for every 500 or 1000 tons).

Example: Lot = 4000 or 8000 tons = 8 Tests

Calculate the Acceptance Range. To calculate the acceptance range, the process tolerance for the number of tests performed is applied to the job-mix.

$$\text{Acceptance Range} = \text{Job-Mix Process Tolerance}$$

Example: (8 Tests) Type Mix: IM-I9.0A

Job-Mix Sieves	Job-Mix Formula Total % Passing	Process Tolerance for 8 Tests	Acceptance Range
1 in.	100.0	± 0.0	100
3/4 in.	98.0	± 2.8	95.2 – 100
1/2 in.	78.0	± 2.8	75.2 – 80.8
No. 8	47.0	± 2.8	44.2 – 49.8
No. 200	4.0	± 0.7	3.3 – 4.7
Asphalt	5.4	± 0.21	5.19 – 5.61

Calculate the mean (Average) of the Test results. This is done for each job-mix sieve, and asphalt content.

$$\text{Mean (average)} = \frac{\text{Sum of Test Results}}{\text{Number of Tests}}$$

Sample No.	1	2	3	4	5	6	7	8	Aver.	Acc. Range		Job-Mix
										Lower	Upper	
1 in.	100	100	100	100	100	100	100	100	100	100	100	100
3/4 in.	97	96	98	97	95	99	98	97	97.1	95.2	100	98
1/2 in.	76	74	77	80	75	79	75	78	76.8	75.2	80.8	78
No. 8	45	44	49	47	46	43	50	46	46.3	44.2	49.8	47
No. 200	3	5	4	4	3	4	5	4	4	3.3	4.7	4
Asphalt	5	5.2	5.41	5.29	5.31	5.1	5.4	5.1	5.23	5.19	5.61	5.4

Compare the mean (Average) of the Test results to the acceptance range

Example: The averages of the above lot are within the acceptance range.

This lot passes.

Adjustment System

In the event a lot of material does not conform to the acceptance requirements, adjustment points will be determined as follows:

<u>Sieve No.</u>	Adjustment Points For Each 1% That The Gradation Is Outside The Process Tolerance Permitted In Table II-15 (Applied in 0.1 increments)
2 in	1
1 ½ in	1
1 in	1
¾ in	1
½ in	1
⅜ in	1
No. 4	1
No. 8	1
No. 30	2
No. 50	2
No. 200	3
Asphalt Content	10

One adjustment point will be applied for each 0.1% that the material is out of the process tolerance for asphalt content. This statement means that 10 adjustment points will be applied for each 1% that the material is out.

In the event the total adjustment for a lot is greater than twenty-five (25) points, the failing material shall be removed from the road. In the event the total adjustment is twenty-five (25) points or less and the Contractor does not elect to remove and replace the material, the unit price paid for the material will be reduced 1% of the unit price bid for each adjustment point. The adjustment will be applied to the tonnage represented by the sample or samples. In the event adjustment points are applied against 2 successive lots, plant adjustment shall be made prior to continuing production.

Adjustment Calculations on Material Failing Gradation and Asphalt Content

Assume: Sample No.	Type 1	Mix 2	SM -12.5A 3	Acc. Average	Range Lower	Range Upper	Job-mix	P/F
¾ in	100	100	100	100	100	100	100	
½ in	100	98	97.0	98.3	94.6	100	99	
⅜ in	85	87	83.0	85.0	81.6	90.4	86	
No. 8	49	53	52.0	51.3	52.6	61.4	57	F
No. 200	3.6	4.3	4.1	4.0	4.9	7.1	6	F
Asphalt	5.3	5.22	5.23	5.25	5.37	6.03	5.7	F

Compute the adjustment on the No. 8 (2.36mm) sieve. Refer to the adjustment point table for gradation and note that, for the No. 8 (2.36mm) sieve, a point adjustment each 1% that the gradation is outside the acceptance range is applied.

52.6 Lower Acc. Range	1.0 Adjustment for Each 1%
<u>-51.3</u> Average #8 (2.36mm) Sieve	<u>x1.3%</u> Outside Acc. Range
1.3% Outside Acc. Range	1.3% Adjustment #8 (2.36mm) Sieve

Compute the Adjustment on the No. 200 (75 µm) Sieve. Refer to the adjustment point table for gradation and note that for the No. 200 (75 µm) sieve, a 3 point adjustment for each 1% that the gradation is outside the acceptance range is applied.

4.9 Lower Acc. Range	3.0 Adjustment for Each 1%
<u>-4.0</u> Average #200 (75 µm) Sieve	<u>x 0.9%</u> Outside Acc. Range
0.9% Outside Acc. Range	2.7% Adjustment #200 (75 µm) Sieve

Compute the Adjustment on Asphalt Content. Refer to the specifications and note that one adjustment point will be applied for each 0.10% that the material is outside of the acceptance range. This statement means that 10 adjustment points will be applied for each 1% that the material is out.

5.37 Lower Acc. Range	10 Adjustment for Each 1%
<u>-5.25</u> Average Asphalt Content	<u>x 0.12%</u> Outside Acc. Range
0.12% Outside Acc. Range	1.2% Adjustment Asph. Content

Compute the Total Adjustment. The total adjustment is the sum of the adjustments for gradation and asphalt content.

1.3 %	Adjustment #8 (2.36 mm) Sieve
2.7 %	Adjustment#200 (75 µm)
<u>+1.2 %</u>	Adjustment Asphalt Content
5.2 %	Total Adjustment for Gradation and Asphalt Content

5.2 Adjustment Points Applied To This Lot.

Standard Deviation (Calculation of Variability)

The Contractor shall control the variability of his product in order to furnish a uniform mix. When the quantity of any one type material furnished a project exceeds 4000 tons, the variability of the total quantity furnished will be measured by calculating the standard deviation for each sieve size and the asphalt content. A separate standard deviation will be determined by VDOT for each calendar's year production of each mix type produced by a plant. In the event the standard deviation is within the limits shown in the Standard Deviation Table, Table II-16 (Figure 7-2), the unit bid price for the material will be adjusted as indicated hereinafter. Standard deviation computations will not be made separately on more than two job-mixes for the same type material, unless a change is requested by VDOT.

**TABLE II-16
STANDARD DEVIATION
(Determination of Variability)**

Sieve No. & A.C.	1 adjustment point for each sieve size and asphalt content	2 adjustment points for each sieve size and asphalt content	3 adjustment points for each sieve size and asphalt content
1/2 in	3.8 - 4.7	4.8 - 5.7	5.8 - 6.7
3/8 in	3.8 - 4.7	4.8 - 5.7	5.8 - 6.7
No. 4	3.8 - 4.7	4.8 - 5.7	5.8 - 6.7
No. 8	3.0 - 3.9	4.0 - 4.9	5.0 - 5.9
No. 30	2.2 - 3.1	3.2 - 4.1	4.2 - 5.1
No. 50	1.5 - 2.4	2.5 - 3.4	3.5 - 4.4
No. 200	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0
A.C.	0.27 - 0.36	0.37 - 0.46	0.47 - 0.56

**Standard Deviation Chart
Figure 7-2**

The unit bid price will be reduced by 0.5% for each adjustment point applied.

The disposition of material having standard deviations larger than those shown in Table II-16 will be determined by the Engineer.

Computing Standard Deviations

STANDARD DEVIATION IS A MEASURE OF VARIABILITY. It is usually designated by the Greek symbol σ and in mathematical equation form is equal to:

$$\sigma = \sqrt{\frac{\sum (X - \bar{X})^2}{n - 1}}$$

Where:

Σ = sum of

X = the individual test results

\bar{X} = the average of all test results

n = the number of test results

While the formula may look complicated, the actual computing of the standard deviation is simple. The following example shows the procedure which should be used.

Example: Given the following four test results for the No.8 (2.36mm) sieve, SM-9.5A mix.

Test #1 - 59.3%, Test #2 - 53.1%, Test #3 - 64.7%, Test #4 - 55.7%.

Find:

A table should be set up as follows:

n	X	\bar{X}	$X - \bar{X}$	$(X - \bar{X})^2$
---	---	-----------	---------------	-------------------

- In the column headed n, list 1, 2, 3, 4, since there were four tests.

n
1
2
3
4

- In the column headed X, list the individual test results in the problem.

n	X
1	59.3
2	53.1
3	64.7
4	55.7

- Add the results in the X column. This gives 232.8. Divide this total by the number of tests which in this case is 4. This gives an average % passing the No.8 (2.36mm) sieve of 58.20. Show this value in the column headed \bar{X} . The average should always be shown to the nearest one-hundredth of a percent (two decimal places).

n	X	\bar{X}
1	59.3	58.20
2	53.1	58.20
3	64.7	58.20
4	<u>55.7</u>	58.20
	232.8	

4. Subtract the values in the \bar{X} column from those in the X column.

$$59.3 - 58.20 = +1.10$$

$$53.1 - 58.20 = -5.10$$

$$64.7 - 58.20 = +6.50$$

$$55.7 - 58.20 = -2.50$$

Record these values in the $X - \bar{X}$ column. As a check, the values in this column can be added algebraically and should equal zero, except in cases where the average is not exact and has been rounded off to two decimal places.

	X	\bar{X}	$X - \bar{X}$
1	59.3	58.20	+1.10
2	53.1	58.20	-5.10
3	64.7	58.20	+6.50
4	<u>55.7</u>	58.20	<u>-2.50</u>
	232.8		0.00

5. Square the values in the $X - \bar{X}$ column and record in the $(X - \bar{X})^2$ column.

$$1.10 \times 1.10 = 1.2100$$

$$5.10 \times 5.10 = 26.0100$$

$$6.50 \times 6.50 = 42.2500$$

$$2.50 \times 2.50 = 6.2500$$

6. Add the $(X - \bar{X})^2$ column. This gives a value of 75.7200.
7. Divide this value by the number of samples minus 1. In this case there are 4 samples, $4 - 1 = 3$.

$$75.7200 / 3 = 25.2400.$$

8. The only step left is to take the square root of 25.2400.

$$\sqrt{25.2400} = 5.02$$

$$\sigma = 5.02$$

This is the standard deviation of the four test results:

n	X	\bar{X}	$X - \bar{X}$	$(X - \bar{X})^2$
1	59.3	58.20	+1.10	1.2100
2	53.1	58.20	-5.10	26.0100
3	64.7	58.20	+6.50	42.2500
4	55.7	58.20	-2.50	6.2500
Totals	232.8		0.00	75.7200

$$\Sigma = (X - \bar{X})^2 = 75.7200$$

$$\Sigma = \frac{(X - \bar{X})^2}{n-1} = \frac{75.7200}{4-1} = \frac{75.7200}{3} = 25.2400$$

$$\sqrt{25.2400} = 5.02$$

Therefore: $\sigma = 5.02$

The standard deviation can be computed at any time and for any number of samples*; however, each time a sample is run, the average will probably change, making it necessary to recalculate each column. From this it can be seen that, after very many samples have been taken, it will be quite a long process to determine the standard deviation. For this reason, the Department is not furnishing the Contractor or Producer with standard deviations until the end of the project.

*** Except one, since one sample has no variability.**

Automated Data Processing of Asphalt Concrete

The purpose of the data system for which these instructions were prepared is to provide descriptive information about the materials used in highway work. Basically, the system is designed for coding test reports. For instance, in lieu of recording the Contractor's name and location, only a 4-digit code will be required. The printout will show the Contractor's name and location. The codes may be obtained from the District Materials Section.

It is very important for the success of the computer program that all data entered on the Data Processing Forms be correct, in the proper blanks, and, most of all, legible. As a rule, numeric characters are recorded from the right to left and alphabetic from the left to right. Please adhere to these standards.

When the coding input forms have been completed by the Contractor/Technician, they should be submitted to the District Materials Section for review and processing. After processing, the forms will be retained by the District Materials Section for the duration of the project.

Form TL-100A - Asphalt Test Results Input Form

The records input data are self-explanatory; you only enter the codes and/or test data. Note that there are eight data records, which allow for the entry of the test data for eight tests, which is the normal lot size (see revised Rd& Bridge Spec. 211.09 Adjustment System) The codes for the contracts will be put on the forms by the Department. (See next page.)

ASPHALT CONCRETE - TEST RESULTS INPUT FORM

INPUT SUBMITTED BY: J. D. Harris DATE SUBMITTED: 8/26/2010 PHONE NUMBER: 512-6712
 PLANT ID: 1048

JOB MIX NUMBER:	201004	PROJECT #:	
LOT:	201001	TONS:	4000
MIX TYPE:	SM12-5A	PROJECT #:	
MIX CODE:	150	PROJECT #:	

REPORT #	51-1048-1685																				
SAMPLE #	TON	DATE MMDDYY	TIME HHMM	2 in	1.5 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	#4	#8	#30	#50	#200	A.C.	TEMP	C F	M I L	ASPH CEM.	LOD	
1	193	8/23/2010	9:10	100%	100%	100%	100%	98%	89%		35%			7.0%	5.78%	310	F	27	1	x	
2	699	8/23/2010	13:50	100%	100%	100%	100%	98%	92%		38%			5.9%	6.30%	320	F	27	1		
3	1390	8/24/2010	8:41	100%	100%	100%	100%	100%	92%		40%			7.2%	6.05%	320	F	27	1	x	
4	1830	8/24/2010	13:18	100%	100%	100%	100%	99%	92%		40%			6.6%	5.81%	310	F	27	1		
5	2361	8/24/2010	15:25	100%	100%	100%	100%	99%	91%		38%			6.5%	5.96%	315	F	27	1		
6	2640	8/25/2010	8:25	100%	100%	100%	100%	99%	89%		38%			6.3%	6.12%	317	F	27	1	x	
7	3290	8/25/2010	11:00	100%	100%	100%	100%	100%	93%		37%			5.7%	6.08%	320	F	27	1		
8	3794	8/25/2010	13:49	100%	100%	100%	100%	98%	91%		37%			6.4%	6.02%	315	F	27	1	x	
Volumetric Data	VTM	VMA	VFA	F/be	Gmm	VCmix (SMA Only)															Comments
1	3.51%	15.8%	77.8%	1.11	2.503																
2																					
3	2.90%	15.5%	81.3%	1.20	2.501																
4																					
5	4.02%	16.4%	75.5%	1.10	2.507																
6																					
7	3.89%	16.4%	76.3%	1.14	2.500																
8																					

**Table II -13
ASPHALT CONCRETE MIXTURES-DESIGN RANGE**

Mix Type	Percentage By Mass Passing Square Mesh Sieves										
	2 in.	1 ½ in.	1 in.	¾ in.	½ in.	3/8 in.	No. 4	No. 8	No. 30	No. 50	No. 200
SM-9.0 A,D,E					100	90-100	90 max	47-67			2-10
SM-9.5 A,D,E					100	90-100	80 max	38-67			2-10
SM-12.5 A,D,E				100	95 -100	90 max		34-50			2-10
IM-19.0 A,D,E		100	90-100	90 max				28-49			2-8
BM-25.0	100	90-100	90 max					19-38			1-7
C (curb mix)					100	92-100	70-75	50-60	28-36	15-20	7-9

Legend

SM = Surface Mixture; IM = Intermediate Mixture, BM = Base Mixture, C = Curb Mixture

* A production tolerance of 1% will be applied to this sieve, regardless of the number of tests in the lot.

Figure 8-3

Alphabetic Characters Capital Letters Only

A	Squared top not acceptable	Q	Loop added at top to avoid confusion with numeric zero.
B	Overhang top and bottom to avoid confusion with numerals 8 or 13. Center division required to avoid similarity with letter D.	P	Overhang at top added for consistency with letters B, D, and R
C	Deep curves to avoid similarity with letter D.	Q	No special convention
D	Overhang top and bottom to reduce confusion with numeral zero.	R	Overhang at top added for consistency with letters B, P and P
E	Straight leg	S	Serif added at top only to distinguish from numeral 5.
F	Straight leg	T	No special convention
G	Emphasized serif reduces confusion with letter or numerals 6 or zero.	U	Parallel sides to distinguish from letter V.
H	Parallel sides	V	No special convention.
I	Serifs top and bottom are required.	W	Center division extends to top of letter. Rounded bottom should be avoided.
J	Top serif reduces confusion with letter U	X	No special convention
K	Slanting legs are joined at the center.	Y	Vertical leg bisects angle framed by top legs to avoid confusion with numeral 4
L	No special convention	Z	Horizontal bar is standard.
M	Legs spread at bottom, center division extends to bottom of letter. Rounded tops should be avoided.		
N	Parallel sides		

Numeric Characters

0	Closed circle	6	Looped closed at bottom to avoid confusion with zero or lower case b.
1	Single vertical bar.	7	Crossbar considered confusing with letter Z.
2	No loop at bottom	8	Made with two circles adjoining vertically to avoid confusion with special character ampersand and dollar sign.
3	Curved lines, no straight top line	9	Straight leg
4	Open top to reduce confusion with 9		
5	Vertical and top lines joined at right angle.		

**Coding of Characters for Data Processing Input Data
Figure 8-4**

CHAPTER 8
QUALITY ACCEPTANCE AND DATA PROCESSING
Study Questions

1. A mathematical analysis of accumulated data is called:
 - A. design range
 - B. statistics
 - C. viscosity
 - D. process tolerance

2. The job-mix formula with the tolerance applied is the:
 - A. reference guide
 - B. acceptance range
 - C. control guide
 - D. process tolerance

3. The quantity of material to be checked for compliance with specifications is called:
 - A. gradation
 - B. a lot
 - C. the referee system
 - D. the design range

4. The job-mix formula is chosen from the:
 - A. standard deviation range
 - B. design range
 - C. process tolerance range
 - D. acceptance range

5. A reduction in the unit bid price of material is known as:
 - A. the standard deviation
 - B. a control guide
 - C. a price adjustment
 - D. the design range adjustment.

CHAPTER 8
QUALITY ACCEPTANCE AND DATA PROCESSING
Study Questions (continued)

6. When the normal daily production of the source from which asphalt concrete is being obtained is in excess of 4,000 tons, the lot size may be increased to:
 - A. 2000 tons
 - B. 3000 tons
 - C. 8000 tons
 - D. 5000 tons

7. Standard deviation computations are not normally made on more than two job mixes for the same type material on a single project.
 - A. True
 - B. False

8. The amount of deviation allowed from the job mix formula is known as the:
 - A. design range
 - B. process tolerance
 - C. weigh tolerance.
 - D. standard deviation

9. How many adjustment points may a material have and still remain in the road?
 - A. more than 30
 - B. more than 25
 - C. 25 or less
 - D. none of the above

10. Variability can be computed on any number of samples except:
 - A. one
 - B. two
 - C. three
 - D. none of the above

11. Would the process tolerance be the same for three tests as a lot with eight tests?
 - A. Yes
 - B. No

CHAPTER87
QUALITY ACCEPTANCE AND DATA PROCESSING
Study Questions (continued)

12. After running analysis on a sample, how is it checked for conformity with specifications?
13. On a failing lot, who is responsible for applying the adjustment points?
14. If a job mix is in the design range, can it be disapproved?
15. Where are the standard deviation limits found for asphalt concrete?
16. What number of adjustment points constitutes the removal of the material from the road?
17. Why is it important that a Producer know what the product variability is at all times?
18. Calculations for the gradation of aggregate in the mixture are shown to what percent? What percent is the asphalt content ?
19. What, if any adjustment points would be applied to a mix if the standard deviation for the No.200 material is 2.3?

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CHAPTER 8
Problem No.1

Using the information given below, complete the Form TL-100A on the next page.

Producer - Flatt Top Paving Company - code 1048

Wet Mixing Time - 27 seconds

Asphalt Cement Supplier - Alright Asphalt Products - code 23.

Lot 7 - 2000 tons

The material is being shipped to PM-1L-05.

Job Mix Information: Type SM-12.5A mix code number - 15

Job Mix Number - 201003

Test Results	#1	#2	#3	#4
Date	8-27-10	8-27-10	8-28-10	8-28-10
Time	10:00	13:30	8:17	11:05
Ton	210	710	1224	1820
Mix Temp.	310 °F	310 °F	305 °F	308 °F
3/4 in	100	100	100	100
1/2 in	98.4	99.4	98.5	99.2
3/8 in	87.1	83.5	81.1	87.3
No. 8	48.7	46.7	44.2	50.2
No. 200	5.3	4.7	5.7	5.5
A.C.	5.63	5.57	5.06	5.15
VTM	4.40		3.61	
VMA	16.2		15.3	
VFA	72.8		76.4	
F/Pbe	1.0		1.2	
Gmm	2.479		2.494	

VIRGINIA DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION
ASPHALT CONCRETE - TEST RESULTS INPUT FORM

TL-100A
REV: 03/2010

INPUT SUBMITTED BY: DATE SUBMITTED: PHONE NUMBER:

JOB MIX NUMBER:	PROJECT #:	TONS:	PROJECT #:	TONS:
LOT:				
MIX TYPE:				
MIX CODE:				

REPORT #	TON	DATE M/M/D/Y	TIME H/H/M	2 in	1.5 in	1 in.	3/4 in.	1/2 in.	3/8 in.	#4	#8	#30	#50	#200	A.C.	TEMP	C F	TIME	ASPH CEM.	VDOT
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
Volumetric Data				VTM	VMA	VFA	Gmm	Comments												
1																				
2																				
3																				
4																				
5																				
6																				
7																				

CHAPTER 8
Problem No. 2
Failure and Adjustment

Using the information given below, calculate the failure and adjustment.

Job Mix Information: Type SM-12.5A mix

Job Mix

3/4 in	100.0
1/2 in	97.0
3/8 in	88.0
No. 8	55.0
No. 200	5.5
A.C.	5.50

Test Results:	Sample #1	Sample #2	Sample #3	Sample # 4	Avg.	Acc. Range
Date	8-27-10	8-27-10	8-28-10	8-28-10		
Time	10:00	13:30	8:17	11:05		
Ton	210	710	1224	1820		
Mix Temp.	310 °F	310 °F	305 °F	308 °F		
3/4 in	100.0	100.0	100.0	100.0	_____	_____
1/2 in	98.4	99.4	98.5	99.2	_____	_____
3/8 in	87.1	83.5	81.1	87.3	_____	_____
No. 8	48.7	46.7	44.2	50.2	_____	_____
No. 200	5.3	4.7	5.7	5.5	_____	_____
A.C.	5.63	5.57	5.06	5.15	_____	_____

CHAPTER 8
Problem No. 3
COMPUTING STANDARD DEVIATION

Using the information given below, determine the variability of the # 200 sieve.

Test Results: 4	Sample #1	Sample #2	Sample #3	Sample #
Date	8-27-10	8-27-10	8-28-10	8-28-10
Time	10:00	13:30	8:17	11:05
Ton	210	710	1224	1820
Mix Temp.	310°F	310°F	305°F	308°F
3/4 in	100.0	100.0	100.0	100.0
1/2 in	98.4	99.4	98.5	99.2
3/8 in	87.1	83.5	81.1	87.3
No. 8	48.7	46.7	44.2	50.2
No. 200	5.3	4.7	5.7	5.5

$$\sigma = \sqrt{\frac{\sum (X - \bar{X})^2}{n-1}}$$

N	X	\bar{X}	$X - \bar{X}$	$(X - \bar{X})^2$
Sum =				

CHAPTER 8
Problem No. 4
Computing Price Adjustment For Variability
As measured by Standard Deviation

- A . Complete the following test report and if the material fails, indicate area(s) of failure. If the material can be accepted with adjustment, calculate the percent of adjustment.

Sample #	1	2	3	4	Aver.	Accept. Range		Job-Mix	P/F
						Lower	Upper		
1 1/2 in	100.0	100.0	100.0	100.0				100.0	
1 in	97.2	100.0	98.4	99.3				98.0	
3/4 in	73.1	78.2	79.2	75.1				76.0	
No. 8	29.2	32.1	28.3	36.2				33.0	
No. 200	3.2	5.6	4.7	3.9				4.0	
A.C.	4.68	4.83	5.00	5.27				4.40	

CHAPTER 8
Problem No. 4 (continued)
Computing Price Adjustment For Variability
As measured by Standard Deviation

B. Using the test report on the previous page, determine the variability of the No. 8 (2.36mm) sieve by calculating the standard deviation. Determine if the variability meets the specification requirements. If not, how many adjustment points would be applied?

$$\sigma = \sqrt{\frac{\sum (X - \bar{X})^2}{n-1}}$$

N	X	\bar{X}	$X - \bar{X}$	$(X - \bar{X})^2$
Sum =				

CHAPTER 8
Problem No. 5
Computing Price Adjustment For Variability
As measured by Standard Deviation

A. Complete the following test report and if the material fails, indicate area(s) of failure. If the material can be accepted with adjustment, calculate the percent of adjustment.

Sample #	1	2	3	Aver.	Accept. Range		Job-Mix	P/F
					Lower	Upper		
1 1/2 in	100.0	100.0	100.0				100.0	
1 in	94.3	97.7	99.1				98.0	
3/4 in	73.5	76.1	78.9				76.0	
No. 8	28.5	35.1	30.7				33.0	
No. 200	3.6	4.9	4.3				4.0	
A.C.	4.67	4.82	4.91				4.40	

CHAPTER 8
Problem No. 5 (continued)
Computing Price Adjustment For Variability
As measured by Standard Deviation

B. Using the test report on the previous page, determine the variability of the No. 8 (2.36mm) sieve by calculating the standard deviation. Determine if the variability meets the specification requirements. If not, how many adjustment points would be applied?

$$\sigma = \sqrt{\frac{\sum (X - \bar{X})^2}{n-1}}$$

N	X	\bar{X}	$X - \bar{X}$	$(X - \bar{X})^2$
Sum =				

