



Aggregate Analysis
T-166

- The T-166 form has several important parts.
 - ▶ Project Identification
 - ▶ Initial Moisture Content
 - ▶ Atterberg Limits
 - ▶ Gradation Analysis
- The sheet shows the results of the lab testing.
 - ▶ Coarse Aggregate (Gilson) Test
 - ▶ Fine Aggregate and Wash Sieve Tests

Section 8 – 2

T-166 Example 1

Sieve	WEIGHT (lbs or kg)		WEIGHT RETAINED (lbs or kg)	% RETAINED	WEIGHT PASSED (lbs or kg)	% PASSED	Weight Retained (lbs or kg)	% Retained (lbs or kg)
	COARSE AGG.	FINE AGG.						
Sample	318	421.9						
After Wash			311.1				RETAINED No. 40 (75) and +100	19.90
Pave No. 100 (75) and +100			68.8				PASS No. 40 (75) and +100	40.10
Pave No. 100 (75) and Pass			33.1				TOTAL, 1 + 2 = 100	32.50
Total Pass No. 100 (75) and								

Sieve Size	WT RET.	% RET.	WT RET.	% RET.	COMBINED AGGREGATE	
					% PASSING 100 - 5 (1.2)	SPEC. % PASSING
1 1/2" (37.5 mm)					100.0	
1" (25 mm)	2.10	6.4			93.6	
3/4" (19 mm)	4.30	13.2			86.4	
1/2" (12.5 mm)	3.80	11.7				
3/8" (9.5 mm)	5.10	15.6			84.4	
No. 4 (4.75 mm)	4.20	12.9	77.2	7.4	92.6	40
No. 10 (1.5 mm)					92.6	33
No. 30 (600 µm)			14.7	4.5	95.5	27
No. 60 (250 µm)			55.6	17.0	83.0	22
No. 100 (150 µm)			59.4	18.4	81.6	16
No. 200 (75 µm)			44.0	13.8	86.2	12
No. No. 200 (75 µm) Pass	13.00	39.9	121.9	37.6		
TOTAL PASSING			419.8	99.9		
SHAKE LOSS %		0.2 %	0.6 %			
FLAKY (DUST) %						
FLAT & ELONGATED %						

Section 8 – 3

Aggregate Analysis T-166

WYOMING DEPARTMENT OF TRANSPORTATION T-166 MATERIALS TESTING LABORATORY											
AGGREGATE ANALYSIS				JOB NO. _____				DATE _____			
PROJECT: _____				SHEET NO. _____				TOTAL SHEETS _____			
LOCATION: _____				TESTER: _____				CHECKER: _____			
SPECIFICATION: _____				TEST METHOD: _____				STATION: _____			
W E I G H T (lbs or kg)											
Sample		COLUSE AGG.		FINE AGG.				Weight		% Retained	
		376.2		157.3				Retained No. 4 (75) (mm) = 18.07		50.8	
After Wash								Pass No. 4 (75) (mm) = 15.9		41.8	
Pass No. 100 (150) (µm)								TOTAL = A + B = 15.9		39.6	
Total Pass No. 100 (150) (µm)											

➤ This example tests the gradation against the specification for a 3/4" Superpave Mix.
 ➤ The sieve specification range is written in the right-hand column.
 ➤ After the sieve analysis is completed, the results are compared against the range.
 ➤ Note: This is a complete sheet with water content, Atterberg Limits and Gradations all calculated.

Section 8 - 4

T-166 Example 2

W E I G H T (lbs or kg)											
Sample		COLUSE AGG.		FINE AGG.				Weight		% Retained	
		376.2		157.3				Retained No. 4 (75) (mm) = 18.07		50.8	
After Wash								Pass No. 4 (75) (mm) = 15.9		41.8	
Pass No. 100 (150) (µm)								TOTAL = A + B = 15.9		39.6	
Total Pass No. 100 (150) (µm)											

COMBINED AGGREGATE					
SIEVE SIZE	WT RET	% RET	SPEC	% PASSING	
				100 - S (1.75) (mm)	200 - S (2) (mm)
1.18 (17.7 mm)				100.0	100
75 (3.0 mm)					100
300 (12.5 mm)	3.28	91		91	90-100
475 (18.7 mm)	5.83	16.4		16.4	74.5-90
600 (24.0 mm)	4.68				45-85
No. 10 (2.0 mm)	4.31			8.8	30-65
No. 16 (1.18 mm)		67.3	17.0	8.8	20-50
No. 30 (600 µm)		59.3	15.6	7.8	
No. 40 (400 µm)		52.6		29.8	26
No. 60 (250 µm)		49.5			5-30
No. 100 (150 µm)		53.3	7.0		
No. 200 (75 µm)		52.1		6.8	5.5
No. 300 (125 µm)	17.53	4.6	5.5		2-7
TOTAL PASSING				99.9	100.0
SHRINKER LOSS %				0.8 %	0.8 %
FLAT & ELONGATED %				[Blank]	

Section 8 - 5

➤ Note: This is a complete sheet with water content, Atterberg Limits and Gradations all calculated.

W E I G H T (lbs or kg)											
Sample		COLUSE AGG.		FINE AGG.				Weight		% Retained	
		376.2		157.3				Retained No. 4 (75) (mm) = 18.07		50.8	
After Wash								Pass No. 4 (75) (mm) = 15.9		41.8	
Pass No. 100 (150) (µm)								TOTAL = A + B = 15.9		39.6	
Total Pass No. 100 (150) (µm)											

COMBINED AGGREGATE					
SIEVE SIZE	WT RET	% RET	SPEC	% PASSING	
				100 - S (1.75) (mm)	200 - S (2) (mm)
1.18 (17.7 mm)				100.0	100
75 (3.0 mm)					100
300 (12.5 mm)	3.28	91		91	90-100
475 (18.7 mm)	5.83	16.4		16.4	74.5-90
600 (24.0 mm)	4.68				45-85
No. 10 (2.0 mm)	4.31			8.8	30-65
No. 16 (1.18 mm)		67.3	17.0	8.8	20-50
No. 30 (600 µm)		59.3	15.6	7.8	
No. 40 (400 µm)		52.6		29.8	26
No. 60 (250 µm)		49.5			5-30
No. 100 (150 µm)		53.3	7.0		
No. 200 (75 µm)		52.1		6.8	5.5
No. 300 (125 µm)	17.53	4.6	5.5		2-7
TOTAL PASSING				99.9	100.0
SHRINKER LOSS %				0.8 %	0.8 %
FLAT & ELONGATED %				[Blank]	

Section 8 - 6

Correlation of Testing Technicians for Gradation

The actual calculations of the correlation will not be on the exam but you would need to have an appreciation to the process. In addition, you would need to be able to answer general questions about the process.

Section 8 - 7

Correlation of Testing Technicians for Gradation

(WYDOT MTM 126.0)

➤ General

- ▶ Compares aggregate gradations obtained by WYDOT field laboratory and Contractor's laboratory.
- ▶ The paired t-test is used.
- ▶ If difference is significant, then the dispute resolution procedure will start.
- ▶ Re-correlate if either tester is changed.
- ▶ Can be done during aggregate production.

Section 8 - 8

Correlation of Testing Technicians for Gradation

➤ Procedure

- ▶ Obtain 15 aggregate samples
 - ◆ Groups of 3
 - ◆ Sample according to WYDOT MTM 804
 - ◆ 5 samples for WYDOT, 5 for contractor, and 5 for referee
 - ◆ When sampling from a belt, the middle sample should be the referee sample
- ▶ Test samples
 - ◆ WYDOT MTM 814.0

Section 8 - 9

Procedural Steps on Form

- Determine percent passing each sieve size
- Perform t-test separately for each sieve size
- Calculate the difference between % passing
- Determine the mean and the Standard Deviation (s) of the differences

Section 8 - 10

Procedure (continued)

- Compare s to the minimum and maximum values in Table 1.
- Calculate
$$t = \frac{|\bar{x}|}{\sqrt{\frac{s^2}{n}}}$$
- If $t < 4.604$; No significant difference
- If $t > 4.604$; Significant difference
- Check for Sign Error – Do the Differences all have the same sign? Indicates Bias.

Section 8 - 11

Table 1. Allowable Range of Standard Deviation

Percent Retained	Grading			
	Coarse		Fine	
	Maximum	Minimum	Maximum	Minimum
< 3%	3.00	0.39	0.60	0.21
3% - 10%	3.00	1.06	1.60	0.57
10% - 20%	4.70	1.66	2.70	0.95
20% - 30%	5.70	2.01	3.50	1.24
30% - 40%	6.90	2.44	4.00	1.41
>40%	9.00	3.18	5.20	1.41

- Use the coarse values unless the nominal maximum aggregate size is #4 or less, in which case use the fine values

Section 8 - 12

Correlation of Testing Technicians for Gradation

Example - #1:

Sampler: _____ Contractor: _____
 Project: _____ Location: _____
 Test Sieve Size: #4 Date: _____
 Average % Passing 1/2" is 57.2%
 Grading W - Coarse Gradation

% Retained =

Sample	WYDOT (A)	Contractor (B)	Difference (A) - (B)
A	49.2	48.8	
B	50.6	46.9	
C	49.6	51.2	
D	51.2	48.3	
E	50.9	48.2	

Average Passing = **49.53**

Mean -x: _____
 Std Dev - s: _____
 Min SD: _____
 Max SD: _____
 SD Used: _____

t: _____
 t > (t_{crit}=4.604): _____

If t > t_{crit} then the data sets are **Significantly Different**
 If t ≤ t_{crit} then the data sets are **Not Significantly Different**
 Is there a significant? _____

Section 8 - 13

Correlation of Testing Technicians for Gradation

Example - #2:

Sampler: _____ Contractor: _____
 Project: _____ Location: _____
 Test Sieve Size: #4 Date: _____
 Average % Passing 1/2" is 57.2%
 Grading W - Coarse Gradation

% Retained =

Sample	WYDOT (A)	Contractor (B)	Difference (A) - (B)
A	49.2	46.7	
B	50.6	47.3	
C	49.6	47.3	
D	51.2	48.3	
E	50.9	48.2	

Average Passing = **48.93**

Mean -x: _____
 Std Dev - s: _____
 Min SD: _____
 Max SD: _____
 SD Used: _____

t: _____
 t > (t_{crit}=4.604): _____

If t > t_{crit} then the data sets are **Significantly Different**
 If t ≤ t_{crit} then the data sets are **Not Significantly Different**
 Is there a significant? _____

Section 8 - 14

Correlation of Testing Technicians for Gradation

Example - #3:

Sampler: _____ Contractor: _____
 Project: _____ Location: _____
 Test Sieve Size: #200 Date: _____
 Average % Passing #30 is 14.5%
 Grading W - Coarse Gradation

% Retained =

Sample	WYDOT (A)	Contractor (B)	Difference (A) - (B)
A	2.75	2.64	
B	2.60	2.81	
C	3.12	3.59	
D	3.05	3.69	
E	2.88	3.01	

Average Passing = **3.01**

Mean -x: _____
 Std Dev - s: _____
 Min SD: _____
 Max SD: _____
 SD Used: _____

t: _____
 t > (t_{crit}=4.604): _____

If t > t_{crit} then the data sets are **Significantly Different**
 If t ≤ t_{crit} then the data sets are **Not Significantly Different**
 Is there a significant? _____

Section 8 - 15

Correlation of Aggregate Gradations

WYOMING DEPARTMENT OF TRANSPORTATION 1 102 AG
REV (4-2004)
CORRELATION OF AGGREGATE GRADATIONS

Contractor: _____ Consultant: _____ Project No(s): _____
WYDOT: _____ Resident Engineer: _____ Test to Correlate (Check One)
Testing Date: _____ Testers: A
QC Supervisor: _____ Mechanical Sampler: _____ B

Control Slave Slave #	Tester	Percent Passing					Avg	Std Dev	Max SD	Min SD	LC50 to	Pass/Fail
		Pair A	Pair B	Pair C	Pair D	Pair E						
C1	Contractor	80.0	80.0	80.0	80.0	80.0						
	WYDOT	80.0	80.0	80.0	80.0	80.0						
	Difference											
C2	Contractor	85.0	85.0	85.0	85.0	85.0						
	WYDOT	85.0	85.0	85.0	85.0	85.0						
	Difference											
C3	Contractor	90.0	90.0	90.0	90.0	90.0						
	WYDOT	90.0	90.0	90.0	90.0	90.0						
	Difference											
C4	Contractor	95.0	95.0	95.0	95.0	95.0						
	WYDOT	95.0	95.0	95.0	95.0	95.0						
	Difference											

Directional Bias on Any Slave? _____ Which One(s)? _____
Comments: _____
Signature of Tester A: _____ Signature of Tester B: _____ Date: _____

Section 8 - 16

Correlation of Aggregate Gradations

WYOMING DEPARTMENT OF TRANSPORTATION 1 102 AG
REV (4-2004)
CORRELATION OF AGGREGATE GRADATIONS

Contractor: Curly Quose Consultant: Beehesters Project No(s): 13-34(88)
WYDOT: Max Thome Resident Engineer: Larry Stapp Test to Correlate (Check One)
Testing Date: 3/28/09 Testers: A, B
QC Supervisor: B. Maggo Mechanical Sampler: _____

Control Slave Slave #	Tester	Percent Passing					Avg	Std Dev	Max SD	Min SD	LC50 to	Pass/Fail
		Pair A	Pair B	Pair C	Pair D	Pair E						
C1	Contractor	80.0	85.0	85.0	87.5	80.0	80.0					
	WYDOT	81.0	84.0	84.0	82.0	80.0	80.0	2.50	4.7	1.66	0.240	Pass
	Difference	-1.1	-1.0	-1.0	-2.0	-2.0						
C2	Contractor	78.0	78.0	77.0	81.0	81.0	78.0					
	WYDOT	78.0	78.0	75.0	79.0	80.0	78.0					
	Difference	0.0	0.0	2.0	2.0	1.0		0.71	4.7	1.66	0.539	Pass
C3	Contractor	88.0	88.0	88.0	86.0	88.0	88.0					
	WYDOT	88.0	88.0	88.0	86.0	88.0	88.0					
	Difference	0.0	0.0	0.0	0.0	0.0		1.00	5.0	2.00	1.57	Pass
C4	Contractor	84.0	84.0	87.0	87.0	84.0	84.0					
	WYDOT	85.0	85.0	84.0	81.0	82.0	82.0					
	Difference	-1.0	-1.0	3.0	6.0	2.0		3.18	4.8	2.44	0.120	Fail
C5	Contractor	11.0	12.0	12.0	14.0	11.0	11.0					
	WYDOT	13.0	13.0	13.0	13.0	11.0	11.0					
	Difference	-2.0	-1.0	-1.0	1.0	0.0		0.80	4.7	1.66	1.77	Pass
C6	Contractor	6.0	6.0	7.0	7.0	6.0	6.0					
	WYDOT	7.0	6.0	7.0	7.0	7.0	6.0					
	Difference	-1.0	0.0	0.0	0.0	-1.0		0.80	3	1.00	0.240	Pass

Directional Bias on Any Slave? Yes Which One(s)? #4, #50
Comments: There appears to be a significant problem on the #4.

Signature of Tester A: Curly Quose Signature of Tester B: Max Thome Date: 3/28/09

Section 8 - 17
