AGGREGATES

Section 9 – Practice Problems

Practice Problems

- Aggregate Gradations (T-166)
- JMF
- Correlation of Testing Technicians for Aggregate Gradations
- Aggregate Pay Factor Calculations
- Need LL,PL, and PI. Practice problem on form T-166

SAMPLE I.D.: Maintenance Stockpile (Type A) 1/2" nom. size — SAMPLED BY:

PIT OR QUARRY: — COUNTY:

QUANTITY: — FOR USE AS:

DATE RECEIVED: — DATE TESTED:

	WEIGHT (lbs or kg)	
	COARSE AGG.	FINE AGG.
Sample	31.2 = (E)	325.1 = (F)
After Wash		312.5
Pass No. 200 [75µm]		12.6
Pass No. 200 [75 µm], Pan		11.9
Total Pass No. 200 [75µm]		24.5

	Weight Retained (lbs or kg)	% Retained = (A or B / D) x 100
RETAINED No. 4 [4.75 mm] = (A)	16.10	51.6 = (H)
PASS No. 4 [4.75 mm]= (B)	15.10	48.4 = (I)
TOTAL , A + B = (D)	31.20	

SIEVE SIZE	WT RET =K	% RET = K X 100 / E =L	WT RET =P	% RET = P x 100 / F =R	% RET R x I / 100 =S	COMBINED AGGREGATE =Z	% PASSING 100 - S (Z) to 0.1 %	% PASSING 100 - S (Z) to 1 %	SPEC % PASSING
1 1/2" [37.5 mm]							100.0	100	
1" [25mm]							100.0	100	
3/4" [19 mm]							100.0	100	100
1/2" [12.5 mm]	4.60	14.7				14.7	85.3	85	90-100
3/8" [9.5 mm]	5.30	17.0				17.0	68.3	68	60-90
No. 4 [4.75 mm]	6.20	19.9				19.9	48.4	48	45-60
No. 8 [2.36 mm]			58.7	18.1	8.8	8.8	39.6	40	30-50
No. 16 [1.18 mm]									
No. 30 [600 µm]			70.5	21.7	10.5	10.5	29.1	29	
No. 40 425 [µm]			66.7	20.5	9.9	9.9	19.2	19	
No. 50 [300 µm]									
No. 100 [150 µm]			52.6	16.2	7.8	7.8	11.4	11	
No. 200 [75 µm]			51.8	15.9	7.7	7.7	3.7	3.7	3-12
Pass No. 200 [75 µm], Pan	15.10	48.4	24.5	7.5	3.6				
TOTAL PASSING	31.20	100.0	324.8	99.9					
SHAKER LOSS %			0.1%						
FRACTURED FACES %	One or more		SHAKER LOSS FORMULA						
FLAT & ELONGATED %	1:5 Ratio		or F] - TOTAL PASSING) / [E or F] *						
FINENESS MODULUS: see M.T.M., Sect. 816.0:									

							WET WT (lb or kg)		33.4
							DRY WT (lb or kg)		31.2
							WET - DRY = MOISTURE		2.2
							% MOIST.=(MOIST./ DRY WT)x100		7.1

BLOWS = 31	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE	% MOISTURE (DD / EE) x 100	Corr. Factor	LL*Corr. Factor	PLASTIC INDEX (PI) =LL - PL
LIQUID LIMIT (LL)	A1	52.7	46.5	22.3	6.2	24.2	25.6	1.026	26	12
PLASTIC LIMIT (PL)	b2	48.3	45.2	22.4	3.1	22.8	14			

SAMPLE I.D.: Fine Aggregate for Concrete Table 803.2.1-2 SAMPLED BY:

PIT OR QUARRY: COUNTY:

QUANTITY: FOR USE AS:

DATE RECEIVED: DATE TESTED:

	WEIGHT (lbs or kg)	
	COARSE AGG.	FINE AGG.
Sample	32.80 = (E)	453.6 = (F)
After Wash		444.2
Pass No. 200 [75µm]		9.4
Pass No. 200 [75 µm], Pan		8.3
Total Pass No. 200 [75µm]		17.7

	Weight Retained (lbs or kg)	% Retained = (A or B / D) x 100
RETAINED No. 4 [4.75 mm] = (A)	1.45	4.4 = (H)
PASS No. 4 [4.75 mm]= (B)	31.35	95.6 = (I)
TOTAL , A + B = (D)	32.80	

SIEVE SIZE	WT RET =K	% RET = K X 100 / E =L	WT RET =P	% RET = P x 100 / F =R	% RET R x I / 100 =S	COMBINED AGGREGATE =Z	% PASSING 100 - S (Z) to 0.1 %	% PASSING 100 - S (Z) to 1 %	SPEC % PASSING
1 1/2" [37.5 mm]							100.0	100	
1" [25mm]							100.0	100	
3/4" [19 mm]									
1/2" [12.5 mm]									
3/8" [9.5 mm]	0.00					0.0	100.0	100	100
No. 4 [4.75 mm]	1.45	4.4				4.4	95.6	96	95-100
No. 8 [2.36 mm]			59.8	13.2	12.6	12.6	83.0	83	
No. 16 [1.18 mm]			76.0	16.8	16.1	16.1	66.9	67	45-80
No. 30 [600 µm]			92.1	20.3	19.4	19.4	47.5	47	
No. 40 425 [µm]									
No. 50 [300 µm]			120.2	26.5	25.3	25.3	22.2	22	10-30
No. 100 [150 µm]			64.1	14.1	13.5	13.5	8.7	9	2-10
No. 200 [75 µm]			23.3	5.1	4.9	4.9	3.8	3.8	0-4
Pass No. 200 [75 µm], Pan	31.35	95.6	17.7	3.9	3.7				
TOTAL PASSING	32.80	100.0	453.2	99.9					
SHAKER LOSS %		0.0%	0.1%						
FRACTURED FACES %	One or more		SHAKER LOSS FORMULA						
FLAT & ELONGATED %	1:5 Ratio		or F] - TOTAL PASSING) / [E or F] *						
☑ FINENESS MODULUS: see M.T.M., Sect. 816.0:									

							% MOISTURE			
BLOWS = 20	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE	(DD / EE) x 100	Corr. Factor	LL*Corr. Factor	PLASTIC INDEX (PI) =LL - PL
LIQUID LIMIT (LL)	a2	48.3	40.6	21.4	7.7	19.2	40.1	0.973	39	28
PLASTIC LIMIT (PL)	B4	43.2	41.0	21.6	2.2	19.4	11			

WET WT (lb or kg)	33.6
DRY WT (lb or kg)	32.8
WET - DRY = MOISTURE	0.8
% MOIST.=(MOIST./ DRY WT)x100	2.4

Practice Problem 1

Material	Crushed Gravel #1		Crushed Sand #2		Fine Sand #3		Filler		Combined Gradation	Target Value	Specification Limits
Percent Used		50%		25%		25%					
U.S. Sieves	Percent Passing	Percent Batch	Percent Passing	Percent Batch	Percent Passing	Percent Batch	Percent Passing	Percent Batch			
2"	100	50	100	25	100	25			100	100	100
1.5"	100	50	100	25	100	25			100	100	100
1"	100	50	100	25	100	25			100	100	100
3/4"	100	50	100	25	100	25			100	100	100
1/2"	100	50	100	25	100	25			100	100	100
3/8"	90	45	100	25	100	25			95	95	90-100
No. 4	42	21	100	25	100	25			71	71	60-75
No. 8	6	3	99	24.75	100	25			52.75	53	40-55
No. 16											
No. 30	1	0.5	20	12.5	93	23.25			36.25	36	20-35
No. 50			3	0.7	64	16			16.7	17	12-22
No. 100											
No. 200			1.0	0.25	28	7			7.25	7.3	4-10

Practice Problem 2

Material	Bin #1		Bin #0		Bin #3		Filler		Combined Gradation	Target Value	Specification Limits
Percent Used		15%		40%		42%		3%			
U.S. Sieves	Percent Passing	Percent Batch	Percent Passing	Percent Batch	Percent Passing	Percent Batch	Percent Passing	Percent Batch			
2"											
1.5"	100	15		40		42		3	100	100	100
1"	90	13.5		40		42		3	99	99	90-100
3/4"	59	8.9	100	40		42		3	93.9	94	75-100
1/2"	4	0.6	67	18.0	100	42		3	63.6	64	55-90
3/8"											
No. 4			4	1.6	98	41.2		3	45.8	46	35-60
No. 8					75	31.5		3	34.5	35	20-45
No. 16											
No. 30											
No. 50					40	16.8	100	3	19.8	20	10-30
No. 100					21	8.8	96	2.9	11.7	12	5-18
No. 200					8.0	3.4	80	2.4	5.8	5.8	2-10

Practice Problem 3

This is one solution but not the only one.

Material	Bin #1		Bin #2		Bin #3		Filler		Combined Gradation	Target Value	Specification Limits
Percent Used		10%		57%		30%		3%			
U.S. Sieves	Percent Passing	Percent Batch	Percent Passing	Percent Batch	Percent Passing	Percent Batch	Percent Passing	Percent Batch			
2"											
1.5"	100	10		57		30	100	3	100		100
1"	79	7.9	100	57		30	100	3	98		90-100
3/4"											
1/2"	6	0.6	83	47.3		30	100	3	81		60-80
3/8"											
No. 4	2	0.2	4	2.3	100	30	100	3	36	43	25-60
No. 8			1	0.6	88	26.4	100	3	30	30	15-45
No. 16											
No. 30											
No. 50					27	8.1	100	3	11	11	3-18
No. 100											
No. 200					4.0	1.2	80	2.4	4	4.0	1-7

Table 1. Allowable Range of Standard Deviation for Tester Correlation

	Grading			
	Coarse		Fine	
Percent Retained	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
No. 200 [75 microm]	0-15	4-15	3-15	3-15

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

Correlation Of Testing Technicians for Gradation

Example - #4:

Sampler: _____ **Contractor:** _____

Project: _____ **Location:** _____

Test Sieve Size: #200 **Date:** _____

Average % Passing #30 is 14.5%

Grading W - Coarse Gradation

$$t = \frac{|\bar{x}|}{\sqrt{\frac{s^2}{n}}}$$

#30	14.5
#200	3.00
Ret'd	11.50

	Percent Passing Test Sieve		
Sample	WYDOT (A)	Contractor (B)	Difference (A) - (B)
A	3.20	3.17	0.03
B	2.65	2.73	-0.08
C	3.16	2.95	0.21
D	3.05	3.10	-0.05
E	2.98	3.02	-0.04
		Mean -$\bar{x}$:	0.014
Average Passing =	3.00	Std Dev - s:	0.117
		Min SD:	1.66
		Max SD:	4.70
		SD Used:	1.66
		t :	0.019
		t > (t_{crit}=4.604):	No

No Significant Difference

If $t > t_{crit}$, then the data sets are Significantly Different

If $t \leq t_{crit}$, then the data sets are Not Significantly Different

Is there a sign error? _____

Correlation Of Testing Technicians for Gradation

Example - #5:

Sampler: _____ Contractor: _____

Project: _____ Location: _____

Test Sieve Size: #200 Date: _____

Average % Passing #30 is 11.5%

Grading W - Coarse Gradation

$$t = \frac{|\bar{x}|}{\sqrt{\frac{s^2}{n}}}$$

		Sample	Percent Passing Test Sieve WYDOT (A)	Contractor (B)	Difference (A) - (B)
#30	11.5	A	3.30	2.70	0.6
#200	3.14	B	3.60	2.82	0.78
Ret'd	8.36	C	3.53	2.79	0.74
		D	3.38	2.73	0.65
		E	3.63	2.89	0.74
				Mean - $\bar{x}$:	0.702
Average Passing =			3.14	Std Dev - s:	0.074
				Min SD:	1.06
				Max SD:	3.00
				SD Used:	1.06
				t :	1.481
				t > (t_{crit}=4.604):	No

No Significant Difference

If $t > t_{crit}$, then the data sets are Significantly Different

If $t \leq t_{crit}$, then the data sets are Not Significantly Different

Is there a sign error? _____ yes

Correlation Of Testing Technicians for Gradation

Example - #6:

Sampler: _____ **Contractor:** _____

Project: _____ **Location:** _____

Test Sieve Size: 3/8" **Date:** _____

Average % Passing 1/2" is 74.2%

Grading W - Coarse Gradation

$$t = \frac{|\bar{x}|}{\sqrt{\frac{s^2}{n}}}$$

		Sample	Percent Passing Test Sieve WYDOT (A)	Contractor (B)	Difference (A) - (B)
1/2"	74.2	A	52.8	47.3	5.5
3/8"	49.46	B	51.7	45.5	6.2
	24.74	C	53.6	46.3	7.3
		D	50.4	48.9	1.5
		E	52.2	45.9	6.3
				Mean -$\bar{x}$:	5.36
	Average Passing =		49.5	Std Dev - s:	2.251
				Min SD:	2.01
				Max SD:	5.70
				SD Used:	2.25
				t :	5.324
				t > (t_{crit}=4.604):	Yes

Significant Difference

If $t > t_{crit}$, then the data sets are Significantly Different

If $t \leq t_{crit}$, then the data sets are Not Significantly Different

Is there a sign error? _____ Yes

Correlation Of Testing Technicians for Gradation

Example:

Sampler: _____ **Contractor:** _____

Project: _____ **Location:** _____

Test Sieve Size: _____ **Date:** _____

Average % Passing ____ is ____%

Grading ___ - _____ Gradation

$$t = \frac{|\bar{x}|}{\sqrt{\frac{s^2}{n}}}$$

Sample	Percent Passing Test Sieve WYDOT (A)	Contractor (B)	Difference (A) - (B)
A			
B			
C			
D			
E			
		Mean -$\bar{x}$:	
		Std Dev - s:	
		Min SD:	
		Max SD:	
		SD Used:	
		t :	
		t > (t_{crit}=4.604):	

If $t > t_{crit}$, then the data sets are <u>Significantly Different</u>

If $t \leq t_{crit}$, then the data sets are <u>Not Significantly Different</u>

Is there a sign error? _____

Table 113.1-1
Quality Level Analysis by the Standard Deviation Method

P_U or P_L percent Within Limits for Positive Values of Q_U or Q_L	Upper Quality Index Q_U or Lower Quality Index Q_L				
	n = 3	n = 4	n = 5	n = 6	n = 7
100	1.16	1.50	1.79	2.03	2.23
99		1.47	1.67	1.80	1.89
98	1.15	1.44	1.60	1.70	1.76
97		1.41	1.54	1.62	1.67
96	1.14	1.38	1.49	1.55	1.59
95		1.35	1.44	1.49	1.52
94	1.13	1.32	1.39	1.43	1.46
93		1.29	1.35	1.38	1.40
92	1.12	1.26	1.31	1.33	1.35
91	1.11	1.23	1.27	1.29	1.30
90	1.10	1.20	1.23	1.24	1.25
89	1.09	1.17	1.19	1.20	1.20
88	1.07	1.14	1.15	1.16	1.16
87	1.06	1.11	1.12	1.12	1.12
86	1.04	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.04	1.04
84	1.01	1.02	1.01	1.01	1.00
83	1.00	0.99	0.98	0.97	0.97
82	0.97	0.96	0.95	0.94	0.93
81	0.96	0.93	0.91	0.90	0.90
80	0.93	0.90	0.88	0.87	0.86
79	0.91	0.87	0.85	0.84	0.83
78	0.89	0.84	0.82	0.80	0.80
77	0.87	0.81	0.78	0.77	0.76
76	0.84	0.78	0.75	0.74	0.73
75	0.82	0.75	0.72	0.71	0.70
74	0.79	0.72	0.69	0.68	0.67
73	0.76	0.69	0.66	0.65	0.64
72	0.74	0.66	0.63	0.62	0.61
71	0.71	0.63	0.60	0.59	0.58
70	0.68	0.60	0.57	0.56	0.55
69	0.65	0.57	0.54	0.53	0.52
68	0.62	0.54	0.51	0.50	0.49
67	0.59	0.51	0.47	0.47	0.46
66	0.56	0.48	0.45	0.44	0.44

P_U or P_L percent Within Limits for Positive Values of Q_U or Q_L	Upper Quality Index Q_U or Lower Quality Index Q_L				
	n = 3	n = 4	n = 5	n = 6	n = 7
65	0.52	0.45	0.43	0.41	0.41
64	0.49	0.42	0.40	0.39	0.38
63	0.46	0.39	0.37	0.36	0.35
62	0.43	0.36	0.34	0.33	0.32
61	0.39	0.33	0.31	0.30	0.30
60	0.36	0.30	0.28	0.27	0.27
59	0.32	0.27	0.25	0.25	0.24
58	0.29	0.24	0.23	0.22	0.21
57	0.25	0.21	0.20	0.19	0.19
56	0.22	0.18	0.17	0.16	0.16
55	0.18	0.15	0.14	0.13	0.13
54	0.14	0.12	0.11	0.11	0.11
53	0.11	0.09	0.08	0.08	0.08
52	0.07	0.06	0.06	0.05	0.05
51	0.04	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00

Table 113.1-2 Pay Factors

Pay Factor	Required Quality Level for a Given Sample Size n and Pay Factor				
	n = 3	n = 4	n = 5	n = 6	n = 7
1.05	100	100	100	100	100
1.04	90	91	92	93	93
1.03	80	85	87	88	89
1.02	75	80	83	85	86
1.01	71	77	80	82	84
1.00	68	74	78	80	81
0.99	66	72	75	77	79
0.98	64	70	73	75	77
0.97	62	68	71	74	75
0.96	60	66	69	72	73
0.95	59	64	68	70	72
0.94	57	63	66	68	70
0.93	56	61	65	67	69
0.92	55	60	63	65	67
0.91	53	58	62	64	66
0.90	52	57	60	63	64
0.89	51	55	59	61	63
0.88	50	54	57	60	62
0.87	48	53	56	58	60
0.86	47	51	55	57	59
0.85	46	50	53	56	58
0.84	45	49	52	55	56
0.83	44	48	51	53	55
0.82	42	46	50	52	54
0.81	41	45	48	51	53
0.80	40	44	47	50	52
0.79	38	43	46	48	50
0.78	37	41	45	47	49
0.77	36	40	43	46	48
0.76	34	39	42	45	47
0.75	33	38	41	44	46

- **Maximum Pay Factor**
  - **Base and Subbase – 1.00**
  - **Treated Base – 1.00**
  - **Plant Mix Pavement – 1.05**
  - **Plant Mix Wearing Course – 1.05**
  - **Seal Coat Aggregate – 1.05**
  - **PCCP – 1.00**

Pay Factor Worksheet #4

Aggregate Specification: Crushed Base Grading W **Test Value:** #4

Test Results: n = 5

Test Values: 44 45 58 65 66

Average Value: $\bar{x}$ = 55.6 **Standard Deviation:** s = 10.60 (σ_{n-1})

Upper Specification Limit, SL_U = 65

Lower Specification Limit, SL_L = 45

Upper Quality Index, $Q_U = \frac{SL_U - \bar{x}}{s} = \frac{65 - 55.6}{10.60} =$ 0.89

Percent Material Within SL_U P_U = 81 (From Table 113.1-1)

(If SL_U is not specified, P_U = 100)

Lower Quality Index, $Q_L = \frac{\bar{x} - SL_L}{s} = \frac{55.6 - 45}{10.60} =$ 1.00

Percent Material Within SL_L P_L = 84 (From Table 113.1-1)

(If SL_L is not specified, P_L = 100)

Quality Level = Percent Within Specification Limits

QL = (P_U + P_L) -100 = 81 + 84 -100 = 65

Pay Factor = PF = 0.93 (From Table 113.1-2)

Minimum Pay Factor = 0.93

Max Pay Factor= 1.00

Pay Adjustment Factor = PAF

= Min Pay Factor - 1.00 = 0.93 -1.00 = -0.07

Pay Factor Worksheet #5

Aggregate Specification: PMP (1") **Test Value:** #30

Test Results: **n =** 5

Test Values: 13 18 15 22 16

Average Value: $\bar{x}$ = 16.8 **Standard Deviation:** s = 3.42 (σ_{n-1})

Upper Specification Limit, SL_U = 25

Lower Specification Limit, SL_L = 5

Upper Quality Index, $Q_U = \frac{SL_U - \bar{x}}{s} = \frac{25-16.8}{3.42} =$ 2.40

Percent Material Within SL_U $P_U =$ 100 (From Table 113.1-1)

(If SL_U is not specified, P_U = 100)

Lower Quality Index, $Q_L = \frac{\bar{x} - SL_L}{s} = \frac{16.8 - 5}{3.42} =$ 3.45

Percent Material Within SL_L $P_L =$ 100 (From Table 113.1-1)

(If SL_L is not specified, P_L = 100)

Quality Level = Percent Within Specification Limits

$QL = (P_U + P_L) - 100 =$ 100 **+** 100 **-100 =** 100

Pay Factor = PF = 1.05 (From Table 113.1-2)

Minimum Pay Factor = 1.05

Max Pay Factor= 1.05

Pay Adjustment Factor = PAF

= Min Pay Factor - 1.00 = 1.05 **-1.00 =** 0.05

Pay Factor Worksheet #6

Aggregate Specification: PMP(3/4") **Test Value:** #4

Test Results: n = 5

Test Values: 58 41 48 68 65

Average Value: $\bar{x}$ = 56.0 **Standard Deviation:** s = 11.38 (σ_{n-1})

Upper Specification Limit, SL_U = 65

Lower Specification Limit, SL_L = 30

Upper Quality Index, $Q_U = \frac{SL_U - \bar{x}}{s} = \frac{(65-56.0)}{11.38} =$ 0.79

Percent Material Within SL_U P_U = 78 (From Table 113.1-1)

(If SL_U is not specified, P_U = 100)

Lower Quality Index, $Q_L = \frac{\bar{x} - SL_L}{s} = \frac{(56.0-30)}{11.38} =$ 2.28

Percent Material Within SL_L P_L = 100 (From Table 113.1-1)

(If SL_L is not specified, P_L = 100)

Quality Level = Percent Within Specification Limits

QL = (P_U + P_L) -100 = 78 + 100 **-100 =** 78

Pay Factor = PF = 1.00 (From Table 113.1-2)

Minimum Pay Factor = 1.00

Max Pay Factor= 1.05

Pay Adjustment Factor = PAF

= Min Pay Factor - 1.00 = 1.00 **-1.00 =** 0.00

Pay Factor Worksheet #7

Aggregate Specification: PMWC **Test Value:** #4

Test Results: n = 6

Test Values: 25 51 34 57 29 42

Average Value: $\bar{x}$ = 39.7 **Standard Deviation:** s = 12.61 (σ_{n-1})

Upper Specification Limit, SL_U = 45

Lower Specification Limit, SL_L = 25

Upper Quality Index, $Q_U = \frac{SL_U - \bar{x}}{s} = \frac{45-39.7}{12.61} =$ 0.42

Percent Material Within SL_U P_U = 66 (From Table 113.1-1)

(If SL_U is not specified, P_U = 100)

Lower Quality Index, $Q_L = \frac{\bar{x} - SL_L}{s} = \frac{39.7 - 25}{12.61} =$ 1.17

Percent Material Within SL_L P_L = 89 (From Table 113.1-1)

(If SL_L is not specified, P_L = 100)

Quality Level = Percent Within Specification Limits

$QL = (P_U + P_L) - 100 =$ 66 + 89 -100 = 55

Pay Factor = PF = 0.84 (From Table 113.1-2)

Minimum Pay Factor = 0.84

Max Pay Factor= 1.05

Pay Adjustment Factor = PAF

= Min Pay Factor - 1.00 = 0.84 -1.00 = -0.16

Pay Factor Worksheet #8

Aggregate Specification: PMP (1") **Test Value:** #4

Test Results: n = 5

Test Values: 48 59 52 46 58

Average Value: $\bar{x}$ = 52.6 **Standard Deviation:** s = 5.81 (σ_{n-1})

Upper Specification Limit, SL_U = 60

Lower Specification Limit, SL_L = 30

Upper Quality Index, $Q_U = \frac{SL_U - \bar{x}}{s} = \frac{60 - 52.6}{5.81} =$ 1.27

Percent Material Within SL_U P_U = 91 (From Table 113.1-1)

(If SL_U is not specified, P_U = 100)

Lower Quality Index, $Q_L = \frac{\bar{x} - SL_L}{s} = \frac{52.6 - 30}{5.81} =$ 3.89

Percent Material Within SL_L P_L = 100 (From Table 113.1-1)

(If SL_L is not specified, P_L = 100)

Quality Level = Percent Within Specification Limits

QL = (P_U + P_L) -100 = 91 + 100 **-100 =** 91

Pay Factor = PF = 1.03 (From Table 113.1-2)

Minimum Pay Factor = 1.03

Max Pay Factor= 1.05

Pay Adjustment Factor = PAF

= Min Pay Factor - 1.00 = 1.03 **-1.00 =** 0.03

Pay Factor Worksheet

Aggregate Specification: _____ **Test Value:** _____

Test Results: **n =** _____

Test Values: _____

Average Value: $\bar{x}$ = _____ **Standard Deviation:** **s =** _____ (σ_{n-1})

Upper Specification Limit, SL_U = _____

Lower Specification Limit, SL_L = _____

Upper Quality Index, $Q_U = \frac{SL_U - \bar{x}}{s}$ = _____ = _____

Percent Material Within SL_U **P_U =** _____ (From Table 113.1-1)

(If SL_U is not specified, P_U = 100)

Lower Quality Index, $Q_L = \frac{\bar{x} - SL_L}{s}$ = _____ = _____

Percent Material Within SL_L **P_L =** _____ (From Table 113.1-1)

(If SL_L is not specified, P_L = 100)

Quality Level = Percent Within Specification Limits

QL = (P_U + P_L) -100 = _____ **+** _____ **-100 =** _____

Pay Factor = PF = _____ (From Table 113.1-2)

Minimum Pay Factor = _____

Max Pay Factor= _____

Pay Adjustment Factor = PAF

= Min Pay Factor - 1.00 = _____ **-1.00 =** _____

Atterberg Limits

TOTAL							WET WT (lbs or kg)			
FRACTURED FACES %	One or more		Two or more				DRY WT (lbs or kg)			
FLAT & ELONGATED %	1:5 Ratio						WET - DRY = MOISTURE			
FINENESS MODULUS: see M.T.M., Sect. 602.0:							% MOISTURE=(MOISTURE/ DRY WT)x100			

BLOWS = 28	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE	% MOISTURE (DD / EE) x 100	x Corr. Factor = 1.014		PLASTIC INDEX (PI) =LL - PL
LIQUID LIMIT (LL)	jvt	148.38	142.38	121.46	6.00	20.92	28.7	29.1	29	13
PLASTIC LIMIT (PL)	x38	141.21	138.74	123.57	2.47	15.17	16.3%		16	

TOTAL							WET WT (lbs or kg)			
FRACTURED FACES %	One or more		Two or more				DRY WT (lbs or kg)			
FLAT & ELONGATED %	1:5 Ratio						WET - DRY = MOISTURE			
FINENESS MODULUS: see M.T.M., Sect. 602.0:							% MOISTURE=(MOISTURE/ DRY WT)x100			

BLOWS = 23	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE	% MOISTURE (DD / EE) x 100	x Corr. Factor = = 0.990		PLASTIC INDEX (PI) =LL - PL
LIQUID LIMIT (LL)	r33	160.34	154.21	122.62	6.13	31.59	19.4%	19.2	19	3
PLASTIC LIMIT (PL)	44S	150.90	147.25	123.84	3.65	23.41	15.6%		16	

Atterberg Limits

TOTAL							WET WT (lbs or kg)		
FRACTURED FACES %	One or more		Two or more				DRY WT (lbs or kg)		
FLAT & ELONGATED %	1:5 Ratio						WET - DRY = MOISTURE		
FINENESS MODULUS: see M.T.M., Sect. 602.0:							% MOISTURE=(MOISTURE/ DRY WT)x100		

BLOWS = 20	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE	% MOISTURE (DD / EE) x 100	x Corr. Factor = 0.973		PLASTIC INDEX (PI) =LL - PL
LIQUID LIMIT (LL)	5x3	155.56	149.66	123.65	5.90	26.01	22.7%	22.1	22	5
PLASTIC LIMIT (PL)	8-3	140.16	137.88	124.75	2.28	13.13	17.4%		17	

TOTAL							WET WT (lbs or kg)		
FRACTURED FACES %	One or more		Two or more				DRY WT (lbs or kg)		
FLAT & ELONGATED %	1:5 Ratio						WET - DRY = MOISTURE		
FINENESS MODULUS: see M.T.M., Sect. 602.0:							% MOISTURE=(MOISTURE/ DRY WT)x100		

BLOWS = 31	Tin No.	Wet+Tare= AA	Dry + Tare= BB	Tare = CC	Moisture = AA - BB = DD	Dry Wt = BB - CC = EE	% MOISTURE (DD / EE) x 100	x Corr. Factor = = 1.026		PLASTIC INDEX (PI) =LL - PL
LIQUID LIMIT (LL)	A-2	181.08	162.76	122.62	18.32	40.14	45.6%	46.8	47	27
PLASTIC LIMIT (PL)	8-1	190.46	179.68	124.38	10.78	55.30	19.5%		20	