



MRPA

MICHIGAN ROAD PRESERVATION ASSOCIATION

Micro Surfacing Calibration Summary

Excerpt from ISSA Calibration Guidelines used with Permission

Determination of Gate Setting using the JMF

Once the emulsified asphalt, mineral filler and aggregate feeds have been calibrated, the application equipment must be set to produce a mixture that matches the target JMF from the mix design. The residual binder content of the emulsified asphalt used in the mix design process may not be the same as the residual binder content of the emulsified asphalt used on the project. For this reason, it is preferable to calculate the gate setting using Method A.

Method A: Gate setting calculation using percent residual binder content in the mix **(preferred)**

1. Record the average lbs./count of emulsified asphalt from the Emulsified Asphalt Calibration worksheet in the appropriate cell on the Calibration Summary worksheet on page 34. From the example on page 28, this value is 4.0 lbs./count of emulsified asphalt.
2. Record the residual binder content of the emulsified asphalt (in decimal form) on the Calibration Summary worksheet. This value can be found on the manufacturer's Certificate of Analysis (CoA) for the material delivered to the project. From the example CoA on page 28, the value is 64.5%.
3. Record the target JMF residual binder content of the mixture (in decimal form) on the Calibration Summary worksheet. This value can be found on the mix design. From the example mix design on page 108, the value is 7.7%.
4. Multiply the average lbs./count of emulsified asphalt by the percent residual binder content of the emulsified asphalt (in decimal form) and divide by the target JMF percent residual binder content of the mixture (in decimal form) to calculate the dry aggregate lbs./count required to match the target JMF residual binder content of the mixture from the mix design. In the example below, the value is 33.5 dry aggregate lbs./count.
5. On the Aggregate Graph on page 35, find the dry aggregate lbs./count calculated in Step 4 on the y axis and follow that line horizontally until it intersects the line drawn on the graph. Then, follow the line down vertically to the x axis to determine the gate setting required to deliver the dry aggregate lbs./count required to match the target JMF residual binder content. In the example below, the gate setting is 3.75”.

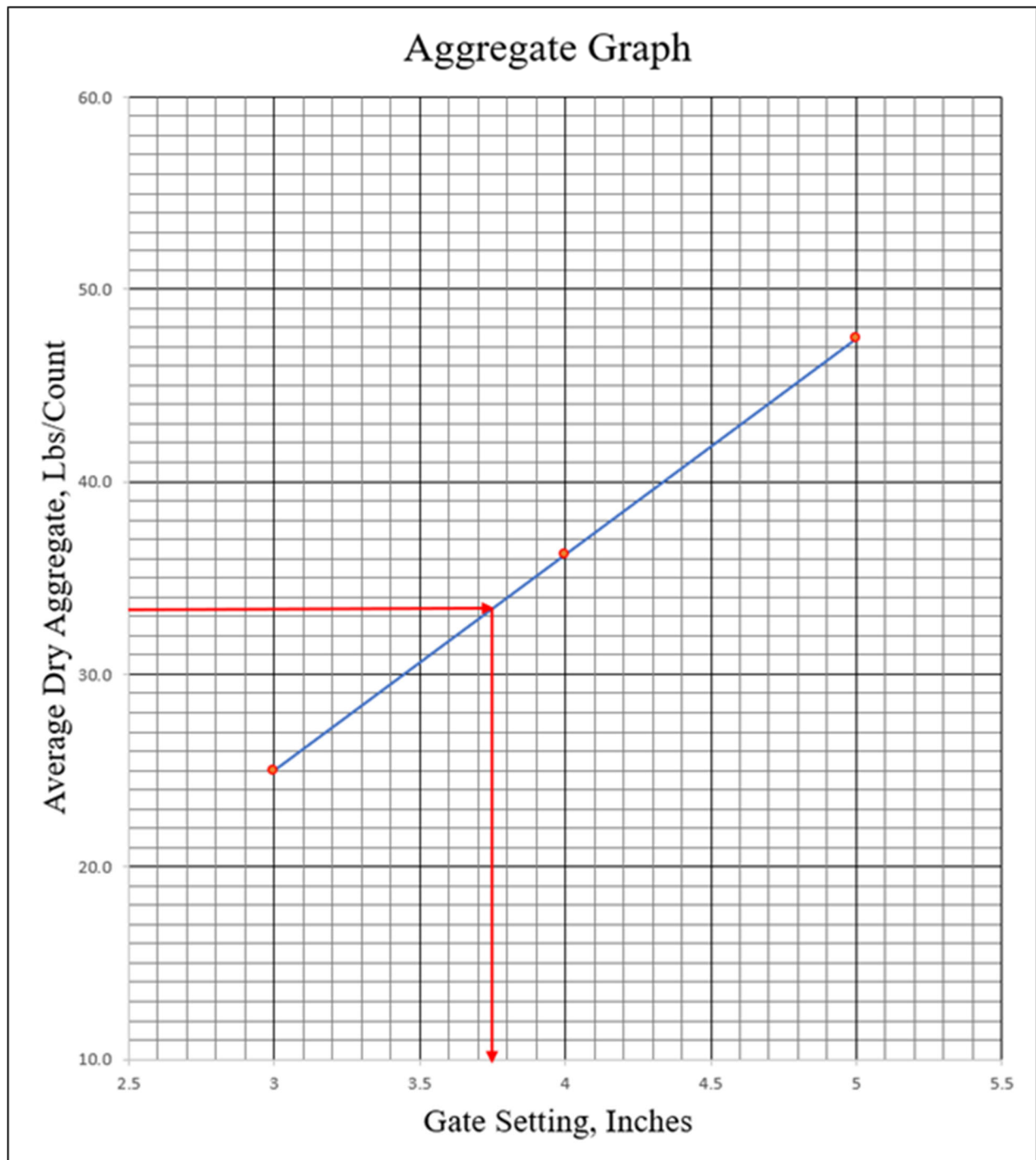
Method B: Gate setting calculation using percent emulsified asphalt content in the mix

1. Record the average lbs./count of emulsified asphalt from the Emulsified Asphalt Calibration worksheet in the appropriate cell on the Calibration Summary worksheet. From the example on page 28, this value is 4.0 lbs./count of emulsified asphalt.

- Record the target JMF emulsified asphalt content in the mixture (in decimal form) on the Calibration Summary worksheet. This value can be found on the mix design. From the example mix design on page 108, the value is 11.9%.
- Divide the average lbs./count of emulsified asphalt by the target JMF percent emulsified asphalt content of the mixture (in decimal form) to calculate the dry aggregate lbs./count required to match the target JMF emulsified asphalt content of the mixture from the mix design. In the example below, the value is 33.6 dry aggregate lbs./count.
- Determine the gate setting using the dry aggregate pounds/count just calculated in Step 3 as described in Step 5 of Method A, above. In this example, the gate setting is 3.75”.

Over the course of the job, occasionally verify that the gate setting matches what was determined during calibration.

Calibration Summary Worksheet				
Unit Number: <u>1</u>		Date: <u>07/01/20</u>		
Determination of Gate Setting				
Choose the calculation procedure (below) based on the information provided on the mix design.				
A. GATE SETTING CALCULATION USING PERCENT RESIDUAL BINDER CONTENT IN THE MIX (PREFERRED)				
1. Average lbs./count of emulsified asphalt from Emulsified Asphalt Calibration worksheet				4.0
2. Percent residual binder content of the emulsified asphalt (provided on the supplier CoA with the load)				64.5
3. Percent residual binder content of the mixture (from the JMF on the mix design)				7.7
Average lbs./count emulsified asphalt	Residual binder content of the emulsified asphalt (in decimal form)	Target JMF residual binder content of the mixture (in decimal form)	Dry aggregate lbs./count required to match target JMF residual of the mix	
4. 4.0	X 0.645	÷ 0.077	= 33.5	
5. Gate setting required to provide dry aggregate lbs./count calculated in Step 4			= 3.75 inches	
B. GATE SETTING CALCULATION USING PERCENT EMULSION CONTENT IN THE MIX				
1. Average lbs./count of emulsified asphalt from Emulsified Asphalt Calibration worksheet				4.0
2. Percent emulsified asphalt content (from the JMF on the mix design)				11.9
Average lbs./count emulsified asphalt	Percent emulsified asphalt content in the mixture (in decimal form)	Dry aggregate lbs./count required to match target JMF emulsion content of the mix		
3. 4.0	÷ 0.119	= 33.6		
4. Gate setting required to provide lbs aggregate/count calculated in Step 2			= 3.75 inches	
Input data in colored/shaded cells. Calculate data in white cells.				



Emulsified Asphalt Calibration Procedure

For Positive Displacement Pumps:

1. Fill the application equipment with emulsified asphalt.
2. Connect one end of a hose to the emulsified asphalt pump outlet and connect the other to a container sufficiently sized to hold the emulsified asphalt used during calibration. Run the emulsified asphalt pump long enough to fill the connecting hose to ensure that all calibration checks are consistent.
3. Note the identity of the unit for which calibration is being completed as well as the date on the Emulsified Asphalt Calibration worksheet.

4. There are 2 options for determining the sample weights of the emulsified asphalt. Pick the option that will be used to determine how to complete the worksheet.
Option 1: The application equipment is filled with emulsified asphalt and weighed on a certified truck scale before and after each sample run in order to calculate the sample size. For this option, note the start weight in the “Weight A” column and the end weight in the “Weight B” column on the worksheet. This is the Option displayed in the Emulsified Asphalt Calibration worksheet example.
Option 2: A container, into which the emulsified asphalt is pumped, is weighed on a certified platform scale before and after each sample run in order to calculate the sample size. For this option, note the start weight in the “Weight B” column and the end weight in the “Weight A” column on the worksheet.
5. Zero the aggregate counter before each sample run.
6. Note the start weight in the appropriate space on the worksheet. Pump the emulsified asphalt for a minimum of 50 counts of the aggregate counter. The resulting sample size should be large enough to ensure greater than 2% accuracy. Minimum sample size is calculated by dividing scale accuracy by 2%.

Examples of minimum sample size include: 50 lbs. of emulsified asphalt if the scale accuracy is ± 1 lb., 100 lbs. for ± 2 lb. accuracy, 250 lbs. for ± 5 lb. accuracy, or 1000 lbs. for ± 20 lb. accuracy.

7. Once pumping is complete, remove the connecting hose from the container and note the end weight in the appropriate space on the worksheet.
8. Determine the net weight (weight A minus weight B) for the first sample of emulsified asphalt pumped. Divide the net weight by the number of counts of the aggregate belt and record the lbs./count for the first sample.
9. Repeat Steps 5-8 for two additional sample runs, recording the results on the worksheet. It is important to run three calibration samples and then to average the lbs./count of the three samples as illustrated in the completed Emulsifier Asphalt Calibration worksheet.

For Variable Speed Constant Displacement Pumps:

1. Set the emulsified asphalt pump to the factory recommended setting and lock in place.
2. Follow Steps 1-9 above for calibrating the variable speed constant displacement pump.
3. Once calibration is completed, the pump should be locked in place to avoid accidental changes to the flow rate setting.

All emulsified asphalt pumps, regardless of type, should deliver consistent weights so that, once the three runs are averaged, any individual weight should be within $\pm 2\%$ of the average.

Example: The average emulsified asphalt lbs./count is 4.0. 2% of 4.0 is 0.1, so each individual run should be between 3.9 to 4.1 lbs./count.

If the pump is variable speed constant displacement, over the course of the job, occasionally verify that the pump setting still matches what was used during calibration.



Inspector's Note: If the variation is too great and the calibration process must be repeated, emulsified asphalt used in the initial calibration runs should not be used again. Emulsified asphalt that has been pumped back and forth between the container and truck will contain entrained air which will lead to incorrect weights.

Emulsified Asphalt Calibration Worksheet					
Minimum of 50 counts of the rock/aggregate belt counter per sample					
Unit Number: <u>1</u>			Date: <u>07/01/20</u>		
Emulsified Asphalt	Weight A (Lbs)	Weight B (Lbs)	Net Weight (Lbs) (=A-B)	Number of Counts	Lbs / Count (= Net Wt/Counts)
Sample 1	58640	56940	1700	425	4.0
Sample 2	56940	55197	1743	425	4.1
Sample 3	55197	53507	1690	425	4.0
Average lbs / count of Emulsified Asphalt					4.0



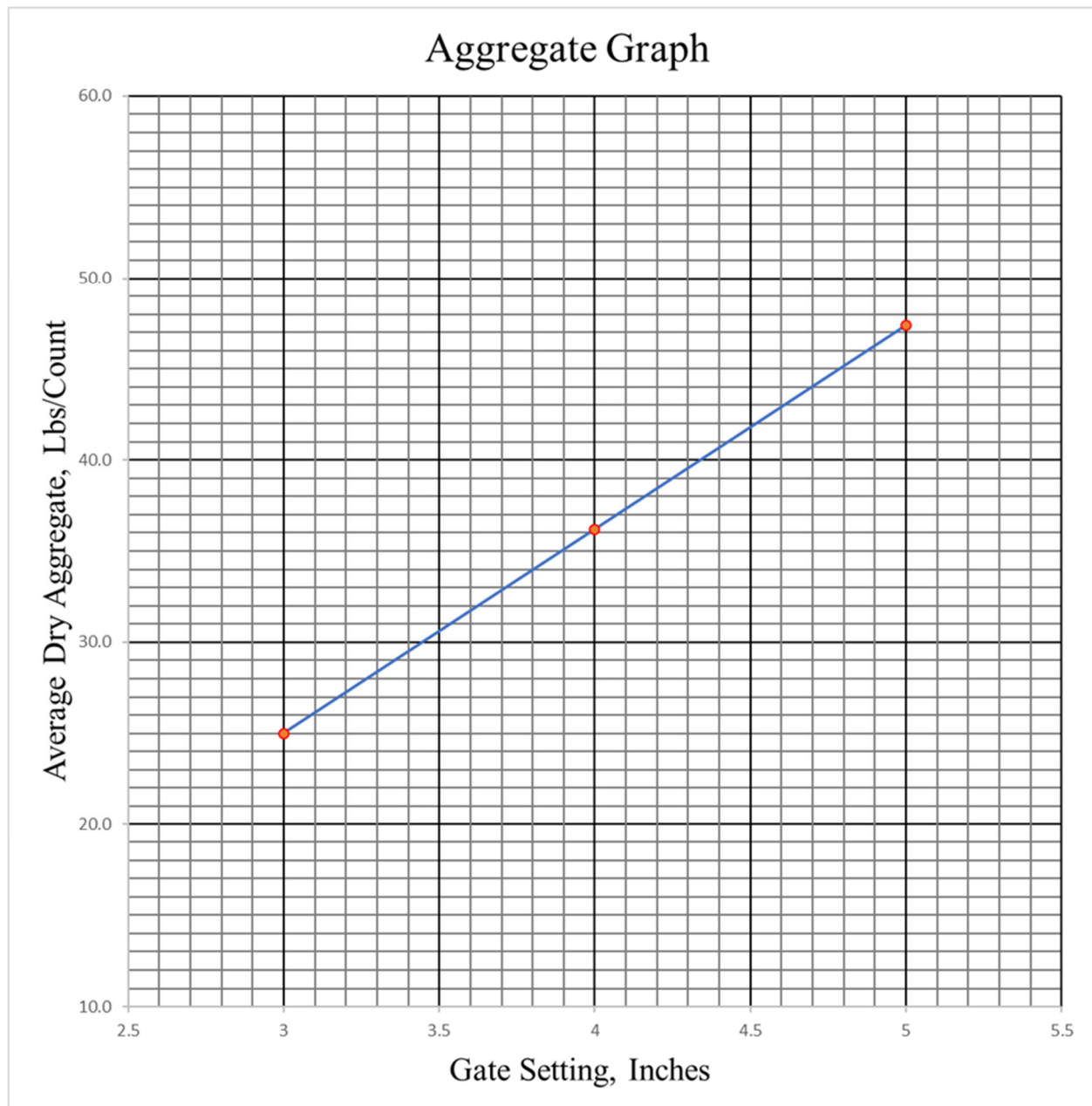
Inspector's Note: Emulsified asphalt pumps vary among manufacturers. Pumps are either a positive displacement type or a variable speed constant displacement type which can be mechanically set to various rates of flow. Since a variable speed constant displacement pump will not normally be changed during the project, a calibration is necessary only for the setting that the contractor intends to use. Variable speed constant displacement pumps should be equipped with a lock. Calibrate emulsified asphalt to the head pulley revolutions which are displayed on the aggregate counter.

Example of an Emulsified Asphalt Certificate of Analysis (CoA)

Certificate of Analysis			
Date	3/19/2021		
Product	CSS-1HP		
State	Your State		
Facility Location	Your City		
TEST	MIN	MAX	RESULT
Saybolt Viscosity, 25°C, SSF	20	100	33
Storage Stability, 24 Hr, %	-----	1	0.4
Particle Charge Test Pass fail Mv min	pos	-----	pass
Sieve Test, %	-----	0.1	.04
Residue by Distillation, 177°C, 15 min hold	62	-----	64.5
Penetration, 25°C, 100g, 5 sec, dmm	40	90	80
Softening Point, °F	135.0	-----	136.4
Elastic Recovery, 10°C, HG, 5 cm/min, 20 cm elongation, 5 min hold, %	50	-----	58

Graphing Aggregate Calibration Data

1. Find the average dry aggregate lbs./count for the smallest gate setting on the Aggregate Calibration worksheet. The value in the example is 25.0 lbs./count for the 3" gate setting.
2. On the Aggregate Graph on page 32, mark the data point at the intersection of 3 inches on the x axis (Gate Setting) and 25.0 lbs./count on the y axis (Average Dry Aggregate).
3. Find the average dry aggregate lbs./count for the second and third gate settings on the Aggregate Calibration worksheet. The values in the example are 36.2 lbs./count for the 4" gate setting and 47.4 lbs./count for the 5" gate setting.
4. On the Aggregate Graph, mark the data points at the intersection of 4 inches on the x axis (Gate Setting) and 36.2 lbs./count on the y axis (Average Dry Aggregate) and at the intersection of 5 inches on the x axis (Gate Setting) and 47.4 lbs./count on the y axis.
5. Use a ruler or straightedge to draw a line connecting the individual data points. This line should be reasonably straight.



Aggregate Calibration Procedure

1. If oversized material is present in the stockpile, screen the aggregate prior to loading and calibrating the application equipment.
2. Choose three gate settings (3", 4", and 5" are typical examples) at which to calibrate the aggregate and record them on the Aggregate Calibration worksheet. Also, note the unit for which the calibration is being completed as well as the date on the worksheet.
3. Determine the moisture content of the aggregate and calculate the moisture factor which is used to convert the wet aggregate weight into dry aggregate weight. The moisture factor equals the moisture in the aggregate (in decimal form) plus 1.00. For each gate setting on the worksheet, record the moisture factor in the spaces provided.

Example: If the moisture is 5%, the moisture factor is 1.05.

Calculation: $0.05 + 1.00 = 1.05$



Designer's Note: A proven moisture content test method such as AASHTO T 255, Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying, or a mutually agreed upon test method for aggregate moisture content determination, should be utilized.

4. To ensure consistent calibration, ensure the aggregate belt is charged with rock/aggregate.
5. Set the gate to the smallest opening chosen for calibration. (In the case of the typical examples given in Step 2 above, that would be the 3" setting).
6. There are 2 options for determining the sample weights of the aggregate. Pick the option that will be used to determine how to complete the worksheet.

Option 1: The application equipment is filled with aggregate and weighed on a certified truck scale before and after each sample run in order to calculate the sample size. For this option, note the start weight in the "Weight A" column and the end weight in the "Weight B" column on the worksheet. This is the option displayed in the Aggregate Calibration worksheet example.

Option 2: A container, into which the aggregate is delivered, is weighed on a certified platform scale before and after each sample run in order to calculate the sample size. For this option, note the start weight in the "Weight B" column and the end weight in the "Weight A" column on the worksheet.

7. Zero the aggregate counter before each sample run.
8. Run a minimum of 50 counts of the aggregate belt. The resulting sample size should be large enough to ensure greater than 2% accuracy. Minimum sample size is calculated by dividing scale accuracy by 2%.

Examples of minimum sample size include: 50 lbs. of aggregate for a platform scale with ± 1 lb. accuracy or 1000 lbs. for a truck scale with ± 20 lb. accuracy.

9. After delivery of the aggregate is complete, note the end weight in the appropriate space on the worksheet.
10. Determine the net weight (weight A minus weight B) for the first sample. Divide the net weight of the aggregate by the number of counts of the aggregate belt and record the lbs./count of the wet aggregate for the first sample.
11. Repeat Steps 7-10 for two additional sample runs at the same gate opening and record the results on the worksheet. It is important to run three calibration samples at each gate opening and then to average the lbs./count of wet aggregate for the three samples as illustrated in the completed worksheet example.
12. Calculate the average dry aggregate lbs./count for the gate opening by dividing the average wet aggregate lbs./count by the moisture factor determined in Step 3. Record the average dry aggregate lbs./count in the appropriate space on the worksheet for the gate setting.
13. Set the gate to the second gate opening and repeat Steps 7-12, then set the gate to the third gate opening and repeat Steps 7-12 again. To ensure consistent calibration ensure the aggregate belt is recharged after resetting the gate each time.

The aggregate belt should deliver consistent weights so that the deviation for any individual sample run should not exceed 2% of the mathematical average of the three runs.

Example: The average wet aggregate lbs./count at the 3" gate setting is 26.2. 2% of 26.2 is 0.5, so each individual run at the 3" gate setting should be between 25.7 and 26.7 lbs./count.

Aggregate Calibration Worksheet

Minimum of 50 counts of the rock/aggregate lbs counter per sample

Unit Number: 1
Date: 07/01/20

Gate Setting (inches)	Weight A (Lbs)	Weight B (Lbs)	Net Weight (Lbs) (=A-B)	Number of Counts	Lbs / Count Wet Aggregate (=Net Wt/Counts)
3					
Sample 1	57300	56000	1300	50	26.0
Sample 2	56000	54690	1310	50	26.2
Sample 3	54690	53370	1320	50	26.4
Avg Wet Agg lbs/count	26.2	+ Moisture Factor	1.05	= Avg Dry Agg lbs/count	25.0
4					
Sample 1	52835	50945	1890	50	37.8
Sample 2	50945	49045	1900	50	38.0
Sample 3	49045	47135	1910	50	38.2
Avg Wet Agg lbs/count	38.0	+ Moisture Factor	1.05	= Avg Dry Agg lbs/count	36.2
5					
Sample 1	46650	44150	2500	50	50.0
Sample 2	44150	41680	2470	50	49.4
Sample 3	41680	39190	2490	50	49.8
Avg Wet Agg lbs/count	49.7	+ Moisture Factor	1.05	= Avg Dry Agg lbs/count	47.4

Input data in blue shaded cells. Calculate data in white cells.

Mineral Filler Calibration Procedure

1. Fill the fines feeder with the mineral filler to be used on the project.
2. Engage and run the mineral filler auger for a long enough period to ensure that the auger is full and a consistent feed of material is achieved.
3. Note the identity of the unit for which the calibration is being completed as well as the date on the Mineral Filler Calibration worksheet.
4. Zero the mineral filler counter before each sample run.
5. Weigh an empty container on a certified scale and note the empty weight on the worksheet. Place the container under the mineral filler delivery port.

- Engage the mineral filler auger and run a minimum of 10 counts of the fines feeder. The resulting sample size should be large enough to ensure greater than 2% accuracy. Minimum sample size is calculated by dividing scale accuracy by 2%.

Example: Minimum sample size would be 5 lbs. of mineral filler if the scale accuracy is ± 0.1 lb.

- After delivery of the mineral filler is complete, note the full weight on the worksheet. Determine the net weight (full minus empty) of the first sample. Divide the net weight of the mineral filler by the number of counts of the fines feeder and record the lbs./count for the first sample.
- Empty the container and repeat Steps 4-7 for two additional sample runs and record the results on the worksheet. It is important to run three calibration samples and average the lbs./count of the three samples as illustrated in the completed worksheet below.

The fines feeder should deliver consistent weights so that, once the three runs are averaged, any individual weight should be within + 2% of the average

Example: The average mineral filler is 0.25 lbs./count. 2% of 0.25 is 0.01, so each individual run should be between 0.24 to 0.26 lbs./count.

Over the course of the job, occasionally verify that the machine setting for the mineral filler still matches what was used during calibration.



Inspector's Note: Various types of application equipment use different methods of supplying mineral filler. Some equipment is mechanically connected to the head pulley while most others are hydraulically matched through a ratio meter. Mechanical feeders have a gate setting similar to that of the aggregate belt. Hydraulic units have a hydraulic flow adjustment.

Mineral Filler Calibration Worksheet					
Minimum of 10 counts of the fines feeder counter per sample					
Unit Number: <u>1</u>			Date: <u>07/01/20</u>		
Emulsified Asphalt	Full Weight (Lbs)	Empty Weight (Lbs)	Net Weight (Lbs) (= Full-Empty)	Number of Counts	Lbs / Count (= Net Wt/Counts)
Sample 1	6.0	1.0	5.0	20	0.25
Sample 2	6.1	1.0	5.1	20	0.26
Sample 3	6.0	1.0	5.0	20	0.25
Input data in blue shaded cells. Calculate data in white cells.					
Average lbs / count of Mineral Filler					0.25