Calibrating The Macropaver

To produce a Slurry Seal mixture to laboratory specifications the Macropaver must be calibrated to work with the specific materials being used on a job. The Macropaver mixing system is built around the aggregate conveyor head pulley. The emulsion pump is a positive displacement pump and is driven from the conveyor head shaft with a fixed ratio. This allows the emulsion to aggregate ratio to be adjusted by changing the aggregate gate opening. The fines filler to aggregate ratio is controlled by changing the speed ratio between the fines feeder and aggregate conveyor. The ratio of fines feeder speed to aggregate conveyor speed is displayed on the Fines / Agg. Ratio Meter. Both water and liquid additive flow rates are controlled by adjusting the corresponding gate valves. A truck scale will be will be required to weigh the truck for aggregate and emulsion calibration and a portable scale will be necessary for weighing the fines. The EZ-OP "CALIBRATE" system will provide step by step instructions as well as allow for input of the calibration data. Its instructions are basically the same as shown on the following pages.

Aggregate Calibration

Aggregate is generally the first material to be calibrated. **(Macropaver MUST have emulsion in emulsion tank as emulsion pump will be operating during this calibration procedure.)** This calibration will develop a graph for the Aggregate Gate Setting versus Emulsion to Agg Ratio. (The aggregate used for calibration must be representative of the aggregate to be used on the job. Aggregate density can vary greatly.) A sheet is provided to record the calibration data. Fill it out as shown below or enter data into EZ-OP controller. 100 head shaft revolutions for each gate setting is the recommended amount.

Proceed as in the example that follows:

1. Load the Macropaver with aggregate - load aggregate from the WATER TANK side of the machine ONLY.

2. Weigh the Macropaver and record this weight as the Heavy Weight for Trial #1. Set the desired number of head shaft revolutions in the EZ-OP "AGGREGATE" calibration screen.

3. Set the aggregate gate opening height and record as the aggregate gate setting. (Start with a small opening and proceed to larger openings.)

4. Drive the Macropaver to a location where the aggregate can be unloaded onto the ground.

5. Start the emulsion pump by turning the "EMULSION PUMP SPEED" control. Set it to about 500 RPM to start - faster speeds are okay.

6. The aggregate counter will reset automatically to read 0.0 counts for each trial during the EZ-OP calibration process.

Calibrating The Macropaver (cont'd)

7. Turn the pugmill on to full speed in the forward direction.

8. Press the Main Start Trigger on the Joystick Control Handle. Watch the aggregate coming out of the pugmill. It will be necessary to move the Macropaver forward to keep aggregate from building up at the back of the machine and plugging the pugmill.

9. The aggregate flow will shut-off when the desired number of Aggregate Conveyor Head Shaft revolutions has been reached. Record this number in the space marked "Head Shaft Revolutions". Stop the pugmill AFTER it has emptied of aggregate.

10. Weigh the Macropaver and record this number as Light Weight under Trial #1.

11. Repeat this procedure at the same gate setting for trials 2 and 3.

Figure #1: Example of Aggregate Calibration with Trial Data and Calculations

Aggregate Calibration

Aggregate Gate Setting	in(cm)	4.5					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		62160	58300	54360		
Light Weight	lbs (Kg)		58300	54360	50440		
Aggregate Unloaded	lbs (Kg)		3860	3940	3920		
Head Shaft Revolutions	Rev counts		50.1	50.1	50.1	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		77.05	78.64	78.24	233.93	77.98

Aggregate Gate Setting	in(cm)	5.5					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		66640	61820	56980		
Light Weight	lbs (Kg)		61820	56980	52180		
Aggregate Unloaded	lbs (Kg)		4820	4840	4800		
Head Shaft Revolutions	Rev counts		50.1	50.1	50.1	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		96.21	96.61	95.81	288.62	96.21

Aggregate Gate Setting	in(cm)	6.5					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		62180	56100	49920		
Light Weight	lbs (Kg)		56100	49920	44020		
Aggregate Unloaded	lbs (Kg)		6080	6180	5900		
Head Shaft Revolutions	Rev counts		50	50	50	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		121.60	123.60	118.00	363.20	121.07

Equations used in above tables:

Aggregate unloaded = Heavy Weight - Light Weight

Calibrating The Macropaver (cont'd)

Sum = (Agg. Weight / Rev Trial #1) + (Agg. Weight / Rev Trial #2) + (Agg. Weight / Rev Trail #3)

Average = Sum / 3

Emulsion Calibration

The emulsion is calibrated to determine the weight of emulsion pumped per revolution of the Aggregate Conveyor Head Shaft. To calibrate the emulsion proceed as follows:

1. Unload any aggregate left in aggregate hopper from the aggregate calibration.

2. Make sure the Macropaver emulsion tank is full with emulsion.

3. Weigh the Macropaver and record this weight as the Heavy Weight for Trial #1. Set the desired number of head shaft revolutions in the EZ-OP "EMULSION" calibration screen.

4. Disconnect the emulsion line from the pugmill inlet hopper and connect it to a line returning to an emulsion storage tank.

5. Start the emulsion pump by turning the "EMULSION PUMP SPEED" control. Set it to about 500 RPM.

6. The emulsion counter will reset automatically to read 0.0 counts for each trial during the EZ-OP calibration process.

7. Press the Main Start Trigger on the Joystick Control Handle. This will start the emulsion pumping from the Macropaver into the emulsion storage tank. (NOTE: Pugmill does not have to be ON for main start to operate during emulsion calibration.)

8. The emulsion flow will shut off when the desired number of Aggregate Conveyor Head Shaft revolutions has been reached. Record this number as Head Shaft Revolutions under Trial #1.

9. Weigh the Macropaver and record this number as Light Weight under Trial #1.

10. Repeat this procedure for trials 2 and 3.

Calibrating The Macropaver (cont'd)

Figure #2. Example of Emulsion Calibration with Trial Data and Calculations

	UNITS	Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)	45640	44137	46206		
Light Weight	lbs (Kg)	44137	42606	44685		
Emulsion Pumped	lbs (Kg)	1503	1531	1521		
Head Shaft Revolutions	Rev counts	100.2	100.7	100.7	SUM	Average
Emulsion / Rev	lbs/Rev (Kg/Rev)	15.00	15.20	15.10	45.31	15.10

Equations used in above table:

Emulsion Pumped = Heavy Load - Light Load

Emulsion / Rev = Emulsion Pumped / Head Shaft Revolutions

Sum = (Emulsion / Rev trial #1) + (Emulsion / Rev trial #2) + (Emulsion / Rev trial #3)

Average = Sum / 3

Emulsion to Aggregate Graph

Figure #3: Example of Percent Emulsion to Aggregate Ratio

	UNITS	Gate Setting		
Agg. Gate Setting	in. (cm)	4.5	5.5	6.5
Ave. Emulsion / Rev	lbs/Rev (Kg/Rev)	15.10	15.10	15.10
Ave Agg. / Rev	lbs/Rev (Kg/Rev)	77.98	96.21	121.07
Emulsion to Agg.		0.1937	0.157	0.1247
% Emulsion to Agg Ratio	%	19.37	15.70	12.47

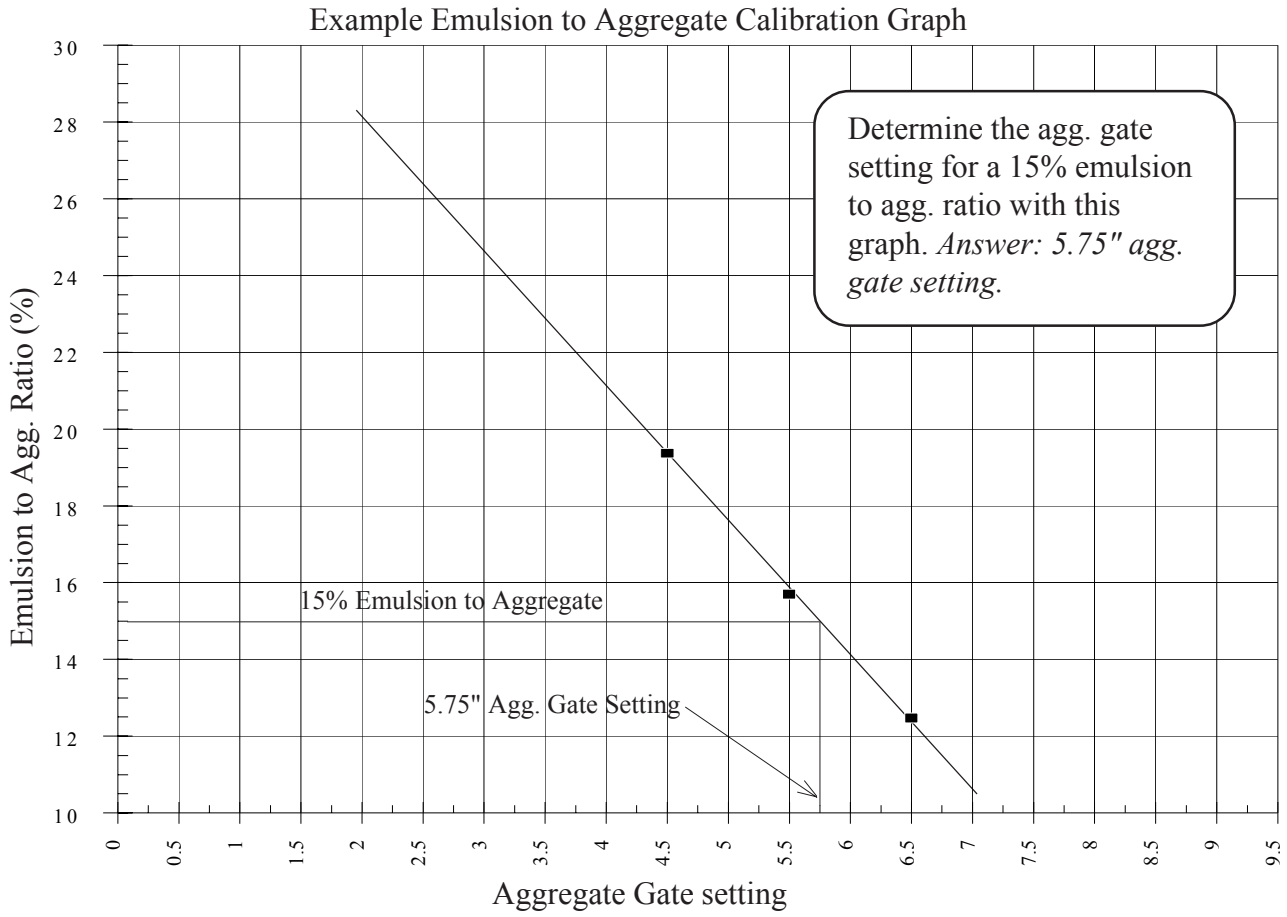
Equations used in above table:

Emulsion to Agg = (Ave. Emulsion Weight / Rev) / (Ave. Aggregate Weight / Rev)

% Emulsion to Aggregate Ratio = Emulsion to Agg x 100

Plot the values of percent emulsion to aggregate versus aggregate gate setting on a graph as shown on the following page. This is used to determine the aggregate gate setting to achieve a given percent emulsion to agg ratio. Enter the graph at the desired percent emulsion to agg ratio. Draw a horizontal line to the right until it intersects the calibration line. Then draw a vertical line down from that point to determine the agg gate setting.

Calibrating The Macropaver (cont'd)



Fines Filler Calibration

The fines to aggregate ratio displays the ratio of fines being fed to aggregate being fed.

The Macropaver must be calibrated before this becomes useful information to the operator. In other words, we must determine the weight of the product per shaft revolution for both the fines and the aggregate. The aggregate calibration shown previously should have been completed at this point. The fines feeder must now be calibrated to determine the weight of fines discharged per auger revolution. This procedure is similar to the emulsion and aggregate calibration measurements, and is shown in the following example.

1. Unload any aggregate left from calibration.

2. With the Macropaver engine off, remove the pugmill inlet hopper and find a suitable container to place under the fines feeder discharge. **CAUTION:** Place pugmill cover back over pugmill.

Calibrating The Macropaver (cont'd)

3. Load the fines feeder hopper with cement representative of that to be used on the job.

4. Weigh the empty container on a suitable scale that will weigh up to approximately 200 lbs. (100 Kg). Record this weight as the Empty Weight for Trail #1. Set the desired number of shaft revolutions in the EZ-OP "FINES" calibration screen.

5. Set the "FINES RATIO" control to a middle range and turn the "FINES" switch on.

6. The fines counter will reset automatically to read 0.0 counts for each trial during the EZ-OP calibration process.

7. Press the Main Start Trigger on the Joystick Control Handle to start feeding fines out of the hopper. (NOTE: Pugmill does not have to be ON for main start to operate during fines calibration.)

8. The fines flow will shut off when the desired number of Fines Auger Shaft revolutions has been reached. Record this as Fines Auger Revolutions under Trial #1.

9. Weigh the full container and record this number as Full Weight under Trail #1.

10. Repeat this procedure for trials 2 and 3.

Figure 4. Example of Fines Calibration Data and Calculations

Fines Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Full Weight	lbs (Kg)	105.7	108.4	106.7		
Empty Weight	lbs (Kg)	4	4	4		
Fines Unloaded	lbs (Kg)	101.7	104.4	102.7		
Auger Shaft Revolutions	Rev counts	50.1	50.3	50.1	SUM	Average
Fines / Rev	lbs/Rev (Kg/Rev)	2.03	2.08	2.05	6.16	2.05

Equations used in above table:

Fines Unloaded = Full Weight - Empty Weight

Fines / Rev = Fines Unloaded / Auger Shaft Revolutions

Sum = (Fines / Rev Trial #1) + (Fines / Rev Trial #2) + (Fines / Rev Trial #3)

Average = Sum / 3

Calibrating The Macropaver (cont'd)

Fines to Aggregate Ratio Calibration

Plot the values of aggregate weight per conveyor head shaft revolution versus aggregate gate setting found in figure 1 on a graph as shown below. Enter the graph at the aggregate gate setting determined from the emulsion and aggregate calibration, draw a vertical line up until it intersects the calibration line. Then draw a line to the left from that point to determine the weight of aggregate per revolution. This will be used to calculate the fines to aggregate ratio to match the laboratory design mix.

Example Aggregate Gate Setting versus Weight of Aggregate per Revolution Calibration Graph

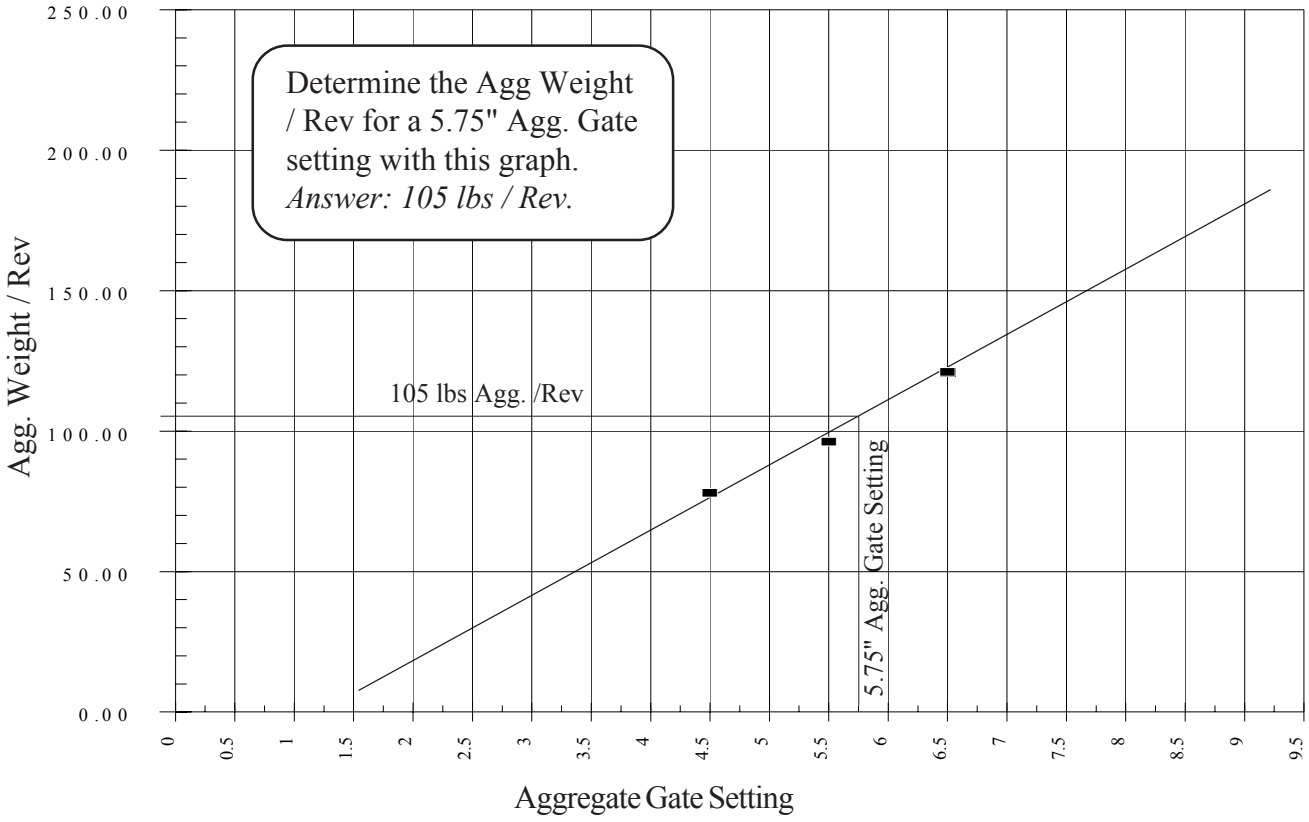


Figure 5. Example of Fines to Aggregate Ratio

% Fines to Aggregate Ratio

	UNITS	
Desired Fines to Agg. Ratio	%	0.75
Aggregate / Rev	lbs/Rev (Kg/Rev)	105
Ave. Fines / Rev	lbs/Rev (Kg/Rev)	2.05
Fines / Agg.	lbs/Rev (Kg/Rev)	0.7875

Equations used in above table:

$$\text{Fines / Agg.} = \frac{(\text{Desired Fines to Agg Ratio}) \times (\text{Aggregate / Rev})}{100}$$

Calibrating The Macropaver (cont'd)

Liquid Additive Flow Calculation

If liquid additive is required, the mix design will specify the amount by a percentage of the dry aggregate. Once calibration is complete and the mix design data is entered, the EZ-OP controller will calculate the requred liquid additive flow rate as well as water flow rate. But, if it is desired to also calculate this manually this percentage can be converted into a flow rate based upon the emulsion pump RPM. The emulsion pump speed is indicated on the EZ-OP "OPERATE" screen and from this the aggregate conveyor speed can be calculated. So, for a known aggregate conveyor speed and aggregate gate setting, we can determine the pounds (or kg.) of aggregate / minute the machine is producing. From this aggregate output rate, we can calculate the additive flow reguired:

The gearbox that drives the conveyor has a 15:1 ratio, so at emulsion pump speed of about 450 RPM, the conveyor will be turning about 30 RPM.

At a gate setting of 5.75", the aggregate output is 105 lbs./ rev. x 30 RPM = 3150 lbs./min.

With an additive requirement of 1%, the flow rate required is .01 x 3150 = 31.50 lbs./min. Assuming the additive specific gravity is 1.335 (or approx. 11.15 lbs./gal.), then the flow rate is 31.50 ÷ 11.15 = 2.8 GPM.

If the mix design recommends an approximate water flow rate, this can be calculated using the same method (using 8.34 lbs./gal.).

Aggregate Calibration Charts

Job:________________________ Date:________________________

Machine No:________________________ Measured By:________________________

Aggregate Type:____

Aggregate Moisture%:____________________

Aggregate Calibration

Aggregate Gate Setting	in(cm)						
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)						
Light Weight	lbs (Kg)						
Aggregate Unloaded	lbs (Kg)						
Head Shaft Revolutions	Rev counts					SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)						

Aggregate Gate Setting	in(cm)						
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)						
Light Weight	lbs (Kg)						
Aggregate Unloaded	lbs (Kg)						
Head Shaft Revolutions	Rev counts					SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)						

Aggregate Gate Setting	in(cm)						
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)						
Light Weight	lbs (Kg)						
Aggregate Unloaded	lbs (Kg)						
Head Shaft Revolutions	Rev counts					SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)						

Emulsion Calibration Charts

Job:_____ Date:_____

Machine No:_____ Measured By:_____

Emulsion Type: _____

Emulsion Temperature:_____

Emulsion Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)					
Light Weight	lbs (Kg)					
Emulsion Pumped	lbs (Kg)					
Head Shaft Revolutions	Rev counts				SUM	Average
Emulsion / Rev	lbs/Rev (Kg/Rev)					

% Emulsion to Aggregate Ratio

	UNITS		Gate Setting	
Agg. Gate Setting	in. (cm)			
Ave. Emulsion / Rev	lbs/Rev (Kg/Rev)			
Ave Agg. / Rev	lbs/Rev (Kg/Rev)			
Emulsion to Agg.				
% Emulsion to Agg Ratio	%			

Fines Calibration Charts

Job:_____ Date:_____

Machine No:_____ Measured By:_____

Fines Type:_____

Fines Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Full Weight	lbs (Kg)					
Empty Weight	lbs (Kg)					
Fines Unloaded	lbs (Kg)					
Auger Shaft Revolutions	Rev counts				SUM	Average
Fines / Rev	lbs/Rev (Kg/Rev)					

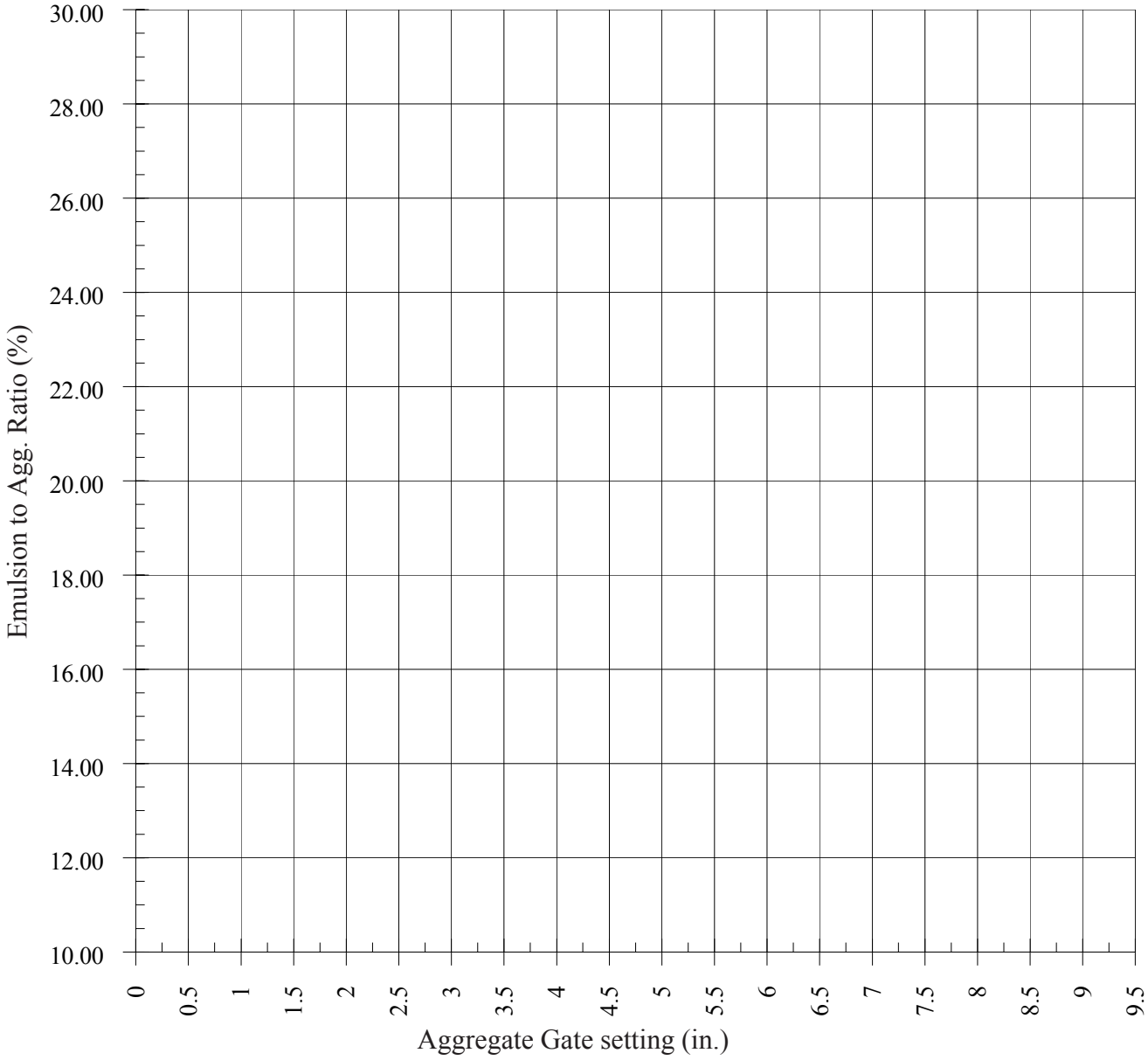
% Fines to Aggregate Ratio

	UNITS	
Desired Fines to Agg. Ratio	%	
Aggregate / Rev	lbs/Rev (Kg/Rev)	
Ave. Fines / Rev	lbs/Rev (Kg/Rev)	
Fines / Agg.	lbs/Rev (Kg/Rev)	

Emulsion To Aggregate Calibration Graph

Job:_____ Date:_____

Machine No:_____ Measured By:_____



Aggregate Weight Per Revolution Calibration Graph

Job:_____ Date:_____

Machine No:_____ Measured By:_____