

1N Part 1 - TGF

Evaluating the impact of different industry corrections varying reference oil targets and standard deviations

Elisa Santos and Doyle Boese

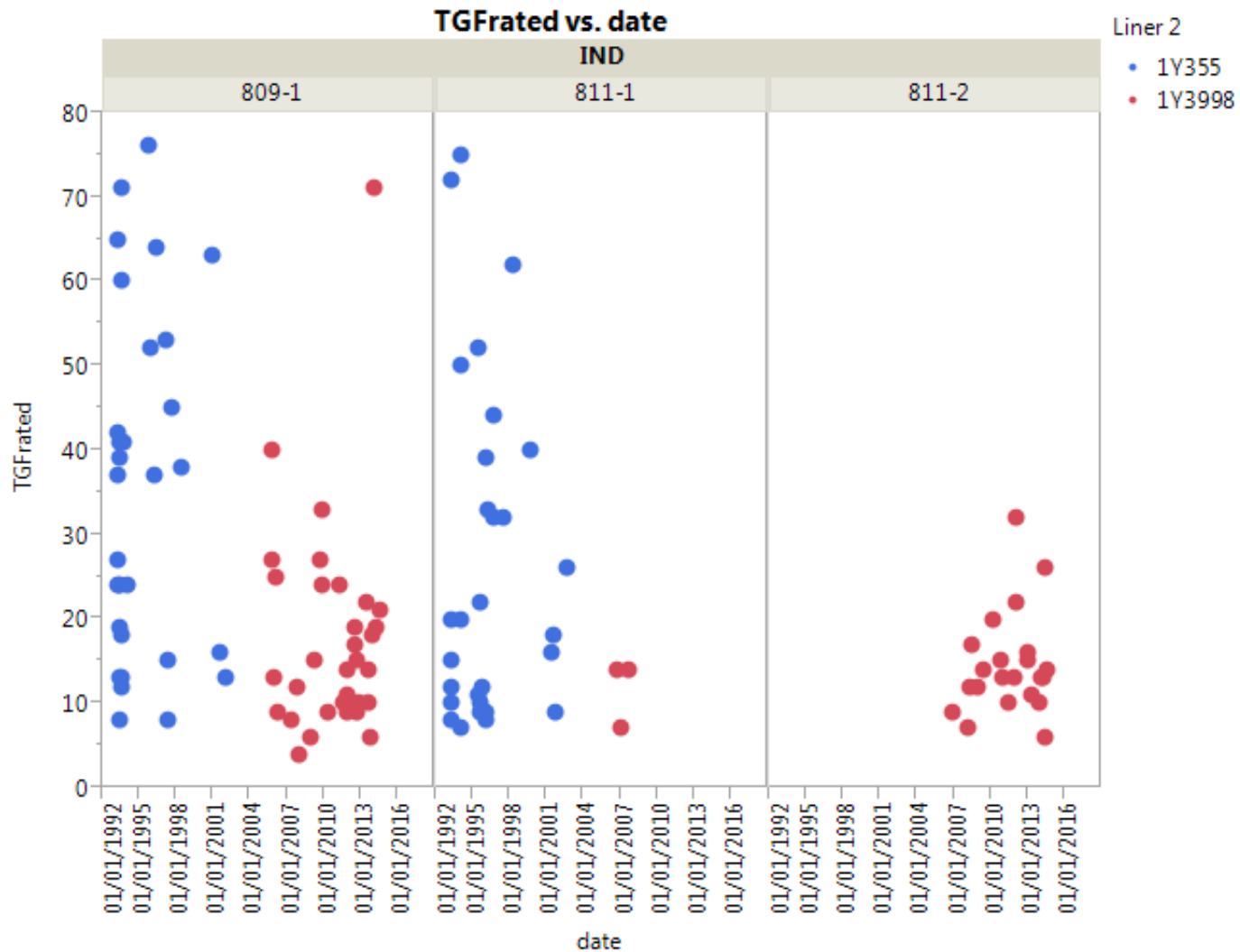
October 21st, 2014

- Describe the problem
- Describe the five scenarios for TGF
- Evaluate the results by scenario
 - Show the data before and after the proposed corrections
 - Show number of failed calibrations by lab
 - Provide the equivalent Pass limit after the adoption of a particular CF and/or SA
 - Comment on obtained results
- Conclusions
- Appendix

Please, note that these calculations are not official and because of rounding they may change slightly

- New liners seem to have turned the 1N into a mild test
- Several correction factors are being considered
- My interpretation from the discussions had at the Surveillance Panel (SP) in May 2014 is that SP believes that the effect of the new liner is confounded with a reduction in variability. The SP wants to establish new standard deviations for the test moving forward and correct the mean to original values.
- My own interpretation based on my experience analyzing data is that there may be a relationship between the mean and standard deviation – after the liner change, the mean changed to a lower area of possible values taken by, for instance, the TGF parameter and because the lower mean, the variability has also decreased. If this is true, it makes sense to log transform the data.
- Plots of the TGF data are provided next

TGF rated by oil and liner type: original data



Mean and standard deviation by oil/liner combination ---



TGF								
Oil	Liner	# of tests	Mean(TGF)	Std Dev(TGF)				
809-1	1Y355	30	35.3	20.5				
811-1	1Y355	29	26.655	20.036	26.2	19.8	Blue is published TMC value	
811-2*	1Y355	20	24.700	21.617				
809/811	1Y355	59	31.05084746	20.27348183				
809-1	1Y3998	32	17.844	12.8116				
811-1	1Y3998	3	11.66666667	4.041451884				
811-2	1Y3998	22	14.54545455	6.045283661	MEAN DIFFERENCE	old -new	14.80523	
809/811	1Y3998	57	16.24561404	10.44238156	MEAN RATIO	old/New	1.911337	
WDN								

LN(TGFrated)							
Oil	Liner	# of tests	Mean(TGF)	Std Dev(TGF)			
809-1	1Y355	30	3.3688081	0.6702206			
811-1	1Y355	29	3.0182802	0.7416768			
811-2*	1Y355	20	2.8940084	0.7819953			
809/811	1Y355	59	3.196514725	0.706225937			
809-1	1Y3998	32	2.695332089	0.604926448			
811-1	1Y3998	3	2.4080083	0.4001887		Model RMSE	0.60014
811-2	1Y3998	22	2.603554304	0.389327474			
809/811	1Y3998	57	2.644786779	0.524358722	pooled Standard dev.		

- 1A:
 1. Add 15 (after rounding 14.8) to all new liner test results
 - 14.8 is obtained by subtracting the weighted mean of all reference oils before (31.05) and after (16.25) liner change
 2. Change standard deviation – std dev of each oil when calculating the TGF y_i according to table 1. These are the current std dev for the new liner by oil.
 3. Calculate the severity adjustment ($-Z_i \cdot 14.6$), i.e. keeping the current std dev as indicated in the LTMS

Table 1: Target Mean and Std deviation for new liner by oil

Oil	Mean	Standard Dev.
809-1	35.3	12.8116
811-1	26.655	4.041452
811-2	24.700	6.045284
1004-3	23.9	9.9

- 1B:
 1. Maintain step 1 from bullet 1A above
 2. Maintain step 2 from bullet 2A above
 3. Calculate the severity adjustment ($-Z_i \cdot 10.4$), i.e. changing the current std dev as indicated in the LTMS by the pooled std dev for the new liner

- 2A:
 1. Use the log transformation to generate the correction factor, i.e. add 0.5814693 to all new liner test transformed TGF results
 2. Adopt the RMSE from the model used in bullet 1 above as the std dev for each oil when calculation the TGF y_i . This common std deviation will represent the current std dev for the new liner by oil. Note that the model is based on old and new liners.
 3. Calculate the severity adjustment by $(-Z_i \cdot \text{RMSE from the model})$
- 2B:
 1. Use the log transformation to generate the correction factor, i.e. add 0.5814693 to all new liner test transformed TGF results
 2. Instead of using the RMSE of the model, adopt the pooled std dev of the new liner transformed test results as the std dev for each oil when calculating the TGF y_i . This common std deviation will represent the current std dev for the new liner by oil.
 3. Calculate the severity adjustment by $(-Z_i \cdot \text{pooled std based on new liner transformed test results})$

- 3:
 1. Multiply TGF by 1.911 – the ratio between the means before and after the new liner
 - 1.911 is the ratio between the weighted mean of all reference oils before (31.05) and after (16.25) liner change
 2. Change standard deviation – new liner std dev of each oil (table 1) when calculating the TGF y_i is also multiplied by 1.911. These are adopted as the std dev for the new liner by oil.
 3. Calculate the severity adjustment ($-Z_i \cdot 14.6$), i.e. keeping the current std dev as indicated in the LTMS

Evaluating scenarios 1A and 1B

- Scenarios 1A and 1B are highlighted below in Table 1a: Lab A and Lab B1 fail calibration in, respectively, 2 and 3 tests.

Table 1a:

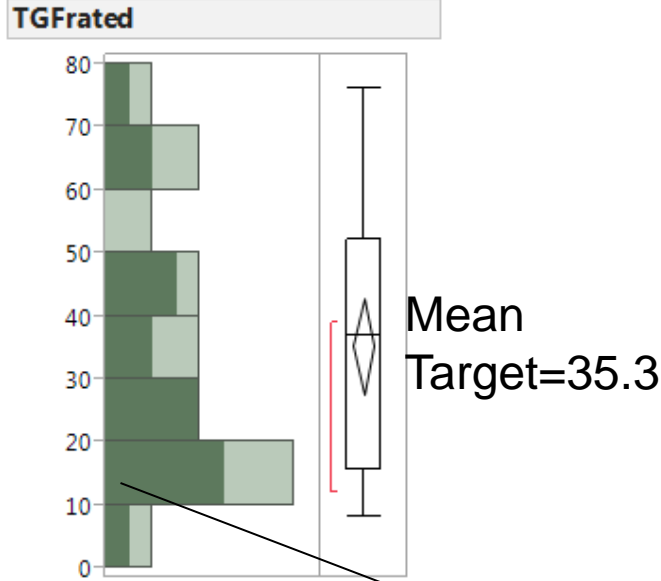
Lab	N new liner	TGF								
		Current state		Scenario 1A		Scenario 1B	Scenario 2A		Scenario 2B	
		Actual Pass/Fail Fail Cal	Actual Pass/Fail limit	Actual Pass/Fail Fail Cal	Actual Pass/Fail limit	Actual Pass/Fail limit	Actual Pass/Fail Fail Cal	Actual Pass/Fail limit	Actual Pass/Fail Fail Cal	Actual Pass/Fail limit
A	22	0	20	3	20	16	2	18	3	18
B1	22	0	7	2	5	5	2	11	4	11
D	8	0	20	0	5	5	0	11	0	11
G	14	0	9	0	5	5	0	11	0	11

- Note how the planned TGF Pass/Fail limit of 20% compares with the actual Pass/Fail limit after the proposed Correction Factor (CF) and the most recent calculated Severity Adjustment (SA) per lab are applied to a future test result.
- If $\text{Test result} + \text{CF} + \text{SA} < \text{Pass/Fail\%} \Rightarrow \text{Test result} < \text{Pass/Fail\%} - \text{CF} - \text{SA}$
- Note that only Lab A has an SA (SA for 1A= -14.76; SA for 1B= -10.51). The other Labs are only affected by the correction factor
- The Pass/Fail for Lab A seems reasonable, but a CF=15 can also result in actual TGF Pass/Fail of 5 for the other labs, which seems unreasonable in practice
- The details about these calibration failures are presented in Table 2

809: before and after liner change; after scenario 1 CF is applied to new liner tests --- OLD SLIDE



Distributions IND= 809-1, Liner2=1Y355

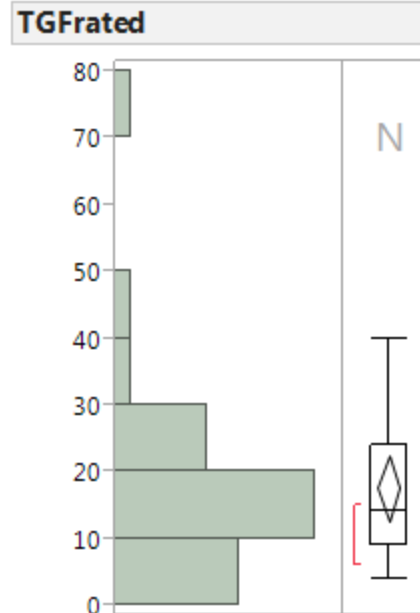


Quantiles		
100.0%	maximum	76
99.5%		76
97.5%		76
90.0%		64.9
75.0%	quartile	52.25
50.0%	median	37
25.0%	quartile	15.75
10.0%		12.1
2.5%		8
0.5%		8
0.0%	minimum	8

Dark green area
TARGET tests

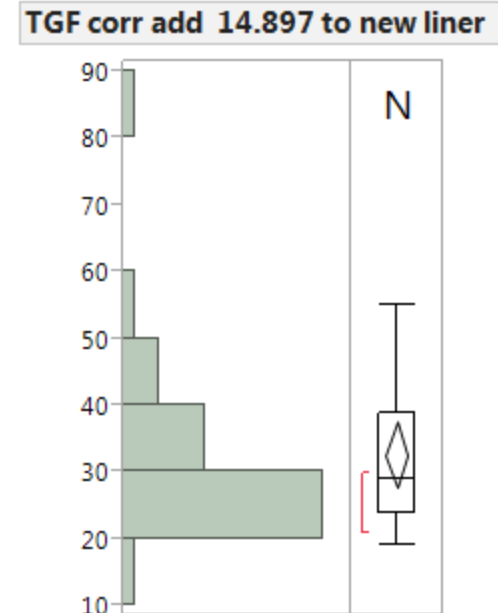
For oil 809, under the new Liner and because of the smaller variability, SP would probably want to identify tests with TGF < 10? and TGF > 60? 70?

Distributions IND= 809-1, Liner2=1Y3998



Quantiles		
100.0%	maximum	71
99.5%		71
97.5%		71
90.0%		32.4
75.0%	quartile	24
50.0%	median	14
25.0%	quartile	9
10.0%		6.2
2.5%		4
0.5%		4
0.0%	minimum	4

Distributions 809-1 New liner



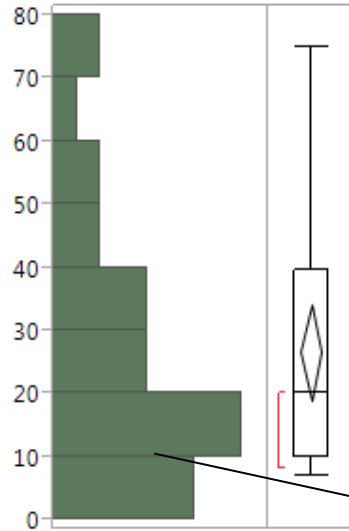
Quantiles		
100.0%	maximum	85.897
99.5%		85.897
97.5%		85.897
90.0%		47.297
75.0%	quartile	38.897
50.0%	median	28.897
25.0%	quartile	23.897
10.0%		21.097
2.5%		18.897
0.5%		18.897
0.0%	minimum	18.897

811: before and after liner change; after scenario 1 CF is applied to new liner tests ---- OLD SLIDE



Distributions Liner2 = 1Y355

TGFrated



Mean
Target=24.7

Dark green area
TARGET tests

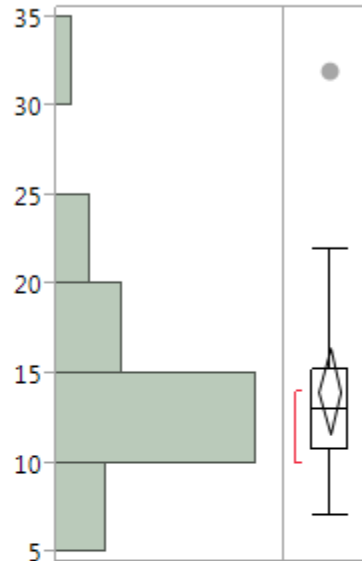
Quantiles

100.0%	maximum	75
99.5%		75
97.5%		75
90.0%		62
75.0%	quartile	39.5
50.0%	median	20
25.0%	quartile	10
10.0%		8
2.5%		7
0.5%		7
0.0%	minimum	7

For 811 oil, under the new Liner and because of the smaller variability, SP would probably want to identify tests with TGF < 20? and TGF > 40? 50?

Distributions Liner2 = 1Y3998

TGFrated

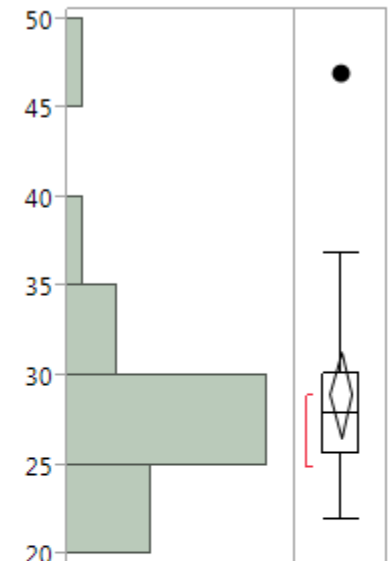


Quantiles

100.0%	maximum	32
99.5%		32
97.5%		32
90.0%		21.4
75.0%	quartile	15.25
50.0%	median	13
25.0%	quartile	10.75
10.0%		7.6
2.5%		7
0.5%		7
0.0%	minimum	7

Distributions 811-1 and 811-2 New liner

TGF corr add 14.897 to new liner



Quantiles

100.0%	maximum	46.897
99.5%		46.897
97.5%		46.897
90.0%		36.297
75.0%	quartile	30.147
50.0%	median	27.897
25.0%	quartile	25.647
10.0%		22.497
2.5%		21.897
0.5%		21.897
0.0%	minimum	21.897

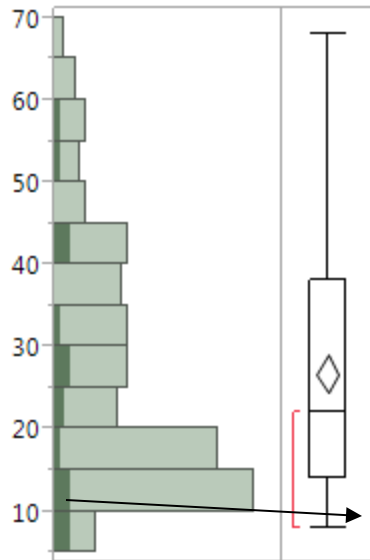
1004-3: before and after liner change; after scenario

1 CF is applied to new liner tests --- OLD SLIDE



Distributions 1004-3 Liner= 1Y355

TGFrated

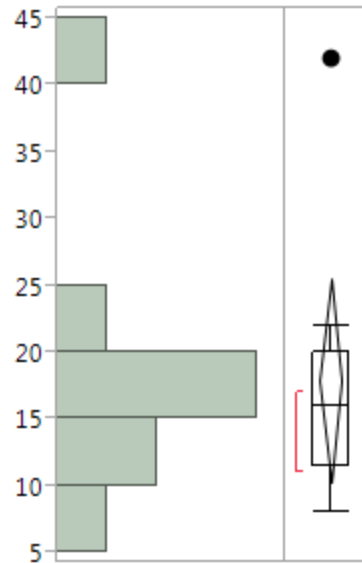


Dark green area = TARGET tests

Quantiles		
100.0%	maximum	68
99.5%		68
97.5%		61.8
90.0%		50
75.0%	quartile	38
50.0%	median	22
25.0%	quartile	14
10.0%		10
2.5%		9
0.5%		8
0.0%	minimum	8

Distributions 1004-3 Liner= 1Y3998

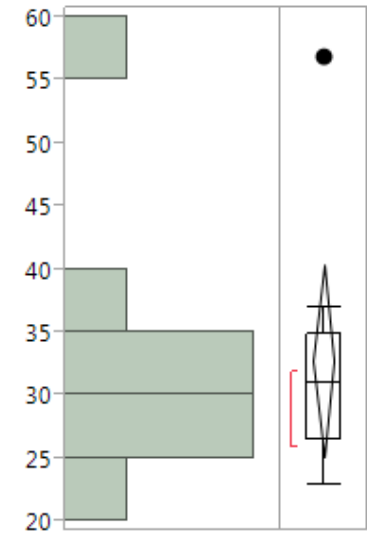
TGFrated



Quantiles		
100.0%	maximum	42
99.5%		42
97.5%		42
90.0%		42
75.0%	quartile	20
50.0%	median	16
25.0%	quartile	11.5
10.0%		8
2.5%		8
0.5%		8
0.0%	minimum	8

Distributions 1004-3 Liner2=1Y3998

TGF corr add 14.897 to new liner



Quantiles		
100.0%	maximum	56.897
99.5%		56.897
97.5%		56.897
90.0%		56.897
75.0%	quartile	34.897
50.0%	median	30.897
25.0%	quartile	26.397
10.0%		22.897
2.5%		22.897
0.5%		22.897
0.0%	minimum	22.897

Are options 1A and 1B doing a sensible job in flagging tests that will result in failing stand calibration?



- The first three tests were flagged by all scenarios examined here: 1A, 1B, 2A, 2B and 3.
- For scenario 1, TGF rated results of 32%, 71% and 42% become 47%, 86% and 57% after the CF is applied and should be flagged. Look at Table 2 for more details for each flagged test. Refer to slides 9, 10 and 11 for plots of the new liner data before and after CF is applied
- Tests 99441 and 77659 were also flagged by option 1. TGF= 26% (41% after CF is applied) or 22% (37% after CF is applied) for oil 811-1 targeted at 24.7 is flagged because of the small std deviation for 811-1 (equal to 6 for the new liner), making yi large. These tests may not be the tests we are trying to flag.
- Scenario 1 did well flagging the first three tests, but adding 14.9 to TGF rated and adopting the new liner standard deviation by oil may flag tests that one would not expect to flag. The SP needs to confirm that this is the case.

Table 2:

1A and 1B scenarios				n=116									
Lab	Testkey	Oil	TGFrated	TGF Industry corrected adding 15	TGF target	Current TGF Standard Deviation	Correction factor	TGF Standard Deviation for new liner	Current TGF Standard Deviation for SA	Original TGFyi	Scenario1A TGFyi	Scenario1B TGFyi	
A	86123	811-2	32	47	24.7	21.617	15	6.045	14.6	0.338	3.72	3.72	
A	96565	809-1	71	86	35.3	20.5	15	13.2	14.6	1.7415	3.96	3.96	
B1	51111	1004-3	42	57	23.9	14.6	15	9.9	14.6	1.7192	3.343	3.343	
B1	99441	811-2	26	41	24.7	21.617	15	6.045	14.6	-0.0602	2.720	2.720	
B1	77659	811-2	22	37	24.7	21.617	15	6.045	14.6	-0.125	2.050	2.050	

Evaluating scenarios 2A and 2B

- Scenarios 2A and 2B are highlighted below in Table 3. Lab A fails calibration in, respectively, 2 and 3 tests; Lab B fails calibration in, respectively, 2 and 4 tests. The details about these failures are presented in Table 4
- Compare TGF Pass/Fail limit of 20% with the actual Pass/ Fail after the proposed CF and the most recent calculated Severity Adjustment - SA per lab are applied to a future test result.
- If **Test result + CF +SA < Pass/Fail% => Test result < Pass/Fail% - CF - SA**
- Scenarios 2A and 2B result in a Pass/Fail =18 (with SA)for Lab A and Pass/Fail =11 for the other labs (no SA).

Table 3:

Lab	N new liner	TGF									
		Current state		Scenario 1A		Scenario 1B	Scenario 2A		Scenario 2B		
		Fail	Cal	Actual Pass/Fail	Actual Pass/Fail	Actual Pass/Fail	Fail	Cal	Actual Pass/Fail	Actual Pass/Fail	
				limit	limit	limit			limit	limit	
A	22	0	20	3	20	16	2	18	3	18	
B1	22	0	7.4	2	5	5	2	11	4	11	
D	8	0	20	0	5	5	0	11	0	11	
G	14	0	9.4	0	5	5	0	11	0	11	

Are options 2A and 2B doing a sensible job in flagging tests?



- For scenario 2, TGF test results of 32%, 71% and 42% become 57%, 127% and 75% and should be flagged. Look at Table 4 for more details for each flagged test.
- Note that corrected TGF may reach values greater than 100%
- Tests 62205, 66788 and 95830 are also flagged by scenario 2B. TGF= 4% and 6% for oil 809-1 targeted at 35.3 should be flagged. Scenario 2A detects TGF= 4% (7 % after CF applied) but not 6% (11% after CF applied).
- If TGF = 7 the test won't be flagged by scenario 2B.
- Scenarios 2A and 2B flagged high and low values of TGF rated. Scenario 2B flagged more tests than Scenario 2A. Both options indicate a Pass/Fail =11 if no SA is applied.

Table 4:

2A and 2B scenarios		n=116											
Lab	Testkey	Oil	TGFrated	TGF Industry corrected adding 0.5814693 to transf TGF	TGF target	Current TGF Standard Deviation	Multiplicative Correction factor: add 0.5814693 on the LN scale	TGF Standard Deviation for new liner	Current TGF Standard Deviation for SA	Original TGFyi	Scenario2A TGFyi	Scenario2B TGFyi	
A	86123	811-2	32	57.2	24.7	21.6	1.789	6.0453	14.6	0.34	1.922	2.199	
A	96565	809-1	71	127.0	35.3	20.5	1.789	12.8116	14.6	1.74	2.458	2.814	
B1	51111	1004-3	42	75.1	23.9	14.6	1.789	9.9	14.6	1.72	2.193	2.510	
B1	62205	809-1	4	7.2	35.3	20.5	1.789	12.8116	14.6	-1.53	-2.335	-2.672	
B1	66788	809-1	6	10.7	35.3	20.5	1.789	12.8116	14.6	-1.43	-1.659	-1.899	
B1	95830	809-1	6	10.7	35.3	20.5	1.789	12.8116	14.6	-1.43	-1.659	-1.899	
A	99441	811-2	26	46.5	24.7	21.6	1.789	6.0453	14.6	0.06	1.576	1.803	
											red cells TGFyi>1.75		
											additional calibration test		

Evaluating scenario 3

- Scenario 3 is highlighted below in Table 5: Lab A and Lab B1 fail calibration in, respectively, 2 tests and 1 test. The details about these failures are presented in Table 6
- Also here, compare TGF Pass/Fail limit of 20% with the actual Pass/ Fail after CF and SA per lab are applied to a future test result. Refer to Table 5 for “actual Pass/ Fail” under Scenario 3.
- If

$$\text{Test result} * \text{CF} + \text{SA} < \text{Pass/Fail\%} \Rightarrow \text{Test result} < (\text{Pass/Fail\%} - \text{SA})/\text{CF}$$
- Note that Lab A has an SA = -11.9

Table 5:

Lab	N new liner	TGF										
		Current state		Scenario 1A		Scenario 1B	Scenario 2A		Scenario 2B		Scenario 3	
		Fail Cal	Actual Pass/Fail limit	Fail Cal	Actual Pass/Fail limit	Actual Pass/Fail limit	Fail Cal	Actual Pass/Fail limit	Fail Cal	Actual Pass/Fail limit	Fail Cal	Actual Pass/Fail limit
A	22	0	20	3	20	16	2	18	3	18	2	17
B1	22	0	7.4	2	5	5	2	11	4	11	1	10
D	8	0	20	0	5	5	0	11	0	11	0	10
G	14	0	9.4	0	5	5	0	11	0	11	0	10

Is option 3 doing a sensible job in flagging tests that will result in failing stand calibration?

- As pointed earlier, the first three tests are properly flagged by option 3. TGF test results of 32%, 71% and 42% become 61%, 136% and 80% and should be flagged. Look at Table 6 for more details for each flagged test. Refer to Appendix for plots of the new liner data before and after CF is applied
- Note that corrected TGF may reach values greater than 100%
- Scenario 3 fails to flag low values of TGF identified by scenarios 2A and 2B. The larger standard deviation (equal to 14.6) contributes to it.

Table 6:

Scenario 3 CF also increases the standard deviation of the new liner, which is now given by TGF std dev for new liner * 1.911

3	n=116											
Lab	Testkey	Oil	TGFrated	TGF Industry corrected multiplying TGF by 1.911	TGF target	Current TGF Standard Deviation	Multiplicative Correction factor	TGF Standard Deviation for new liner *1.911	Current TGF Standard Deviation for SA	Original TGFyi	Scenario 3 TGFyi	
A	86123	811-2	32	61.2	24.7	21.6	1.911	11.55	14.6	0.34	3.142	
A	96565	809-1	71	135.7	35.3	20.5	1.911	24.48	14.6	1.74	4.097	
B1	51111	1004-3	42	80.3	23.9	14.6	1.911	18.92	14.6	1.72	2.982	

- The CF=15 for scenarios 1A and 1B seem excessive, producing unreasonable Pass/Fail limits after CF and SA are applied. Scenarios 1A and 1B did well flagging the first three tests. Scenarios 1A and 1B also flagged tests with TGF= 26% (plus 15 = 41%) or 22% (plus 15 = 37%) for oils 811-2, but misses the low TGF values for oil 809.
- Scenario 3 only flags the first three tests missing the low TGF values for oil 809. Pass/Fail =10 if no SA is applied.
- Scenarios 2A and 2B flagged high and low values of TGF rated. Scenario 2B flagged more tests than Scenario 2A. Both options indicate a Pass/Fail =11 if no SA is applied.
- Scenarios 2 A and 2B indicate
 - Pass/Fail =18 for lab A with an SA
 - Pass/Fail = 11 for the other three labsFrom the options investigated so far these seem capable of detecting low TGF values and have a higher Pass/Fail limit.

1. Mean and standard deviation by oil/liner combination
2. Plot of TGF rated and all proposed corrections by oil and liner type with comments about the variability in each scenario
3. Additional plots of TGF by oil and liner type before and after CF for scenarios 2 and 3 are applied to new liner tests

APPENDIX

1. Mean and standard deviation by oil/liner combination ---

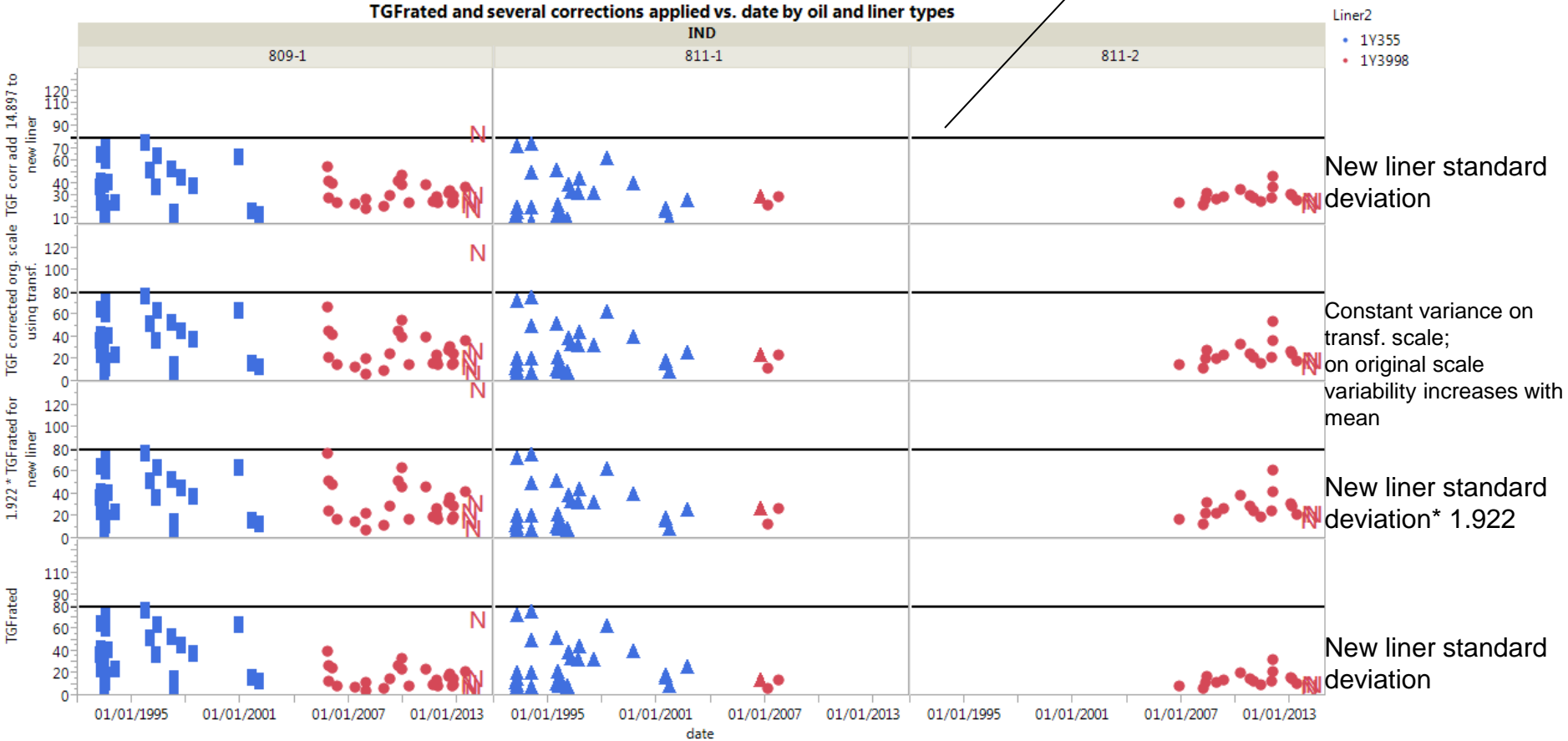
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WDN								

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811-2	1Y3998	22	2.603554304	0.389327474			
809/811	1Y3998	57	2.644786779	0.524358722	pooled Standard dev.		

2. TGF rated and all proposed corrections by oil and liner type with comments about the variability in each scenario --- OLD SLIDE



TGF = 80 is just a reference line to guide the eye



LN TGF Model details



TGF rated	transformed	LN TGFrated		
n=116	111+ 5 extra tests			
RMSE				
Oil				
Level	Least Sq Mean	Std Error	Mean	
809-1	3.034142	0.130545	3.02121	
811-1	2.7721206	0.16823	2.96107	
811-2	2.9729888	0.182064	2.60355	
Liner2				
Least Squares Means Table				
Level	Least Sq Mean	Std Error	Mean	
1Y355	3.2171518	0.133902	3.19651	
1Y3998	2.6356825	0.165282	2.64479	
difference	0.5814693			
1.788664586 multiplicative correction factor				
Summary of Fit				
LAB, IND, Liner2				
RSquare	0.322201			
RSquare Adj	0.235815			
Root Mean Square Error	0.60014			
Mean of Response	2.925407			
Observations (or Sum Wgts)	116			

3. Additional plots of TGF by oil and liner type before and after CF for scenarios 2 and 3 are applied to new liner tests

809: before and after liner change; after CF for scenarios 2 and 3 are applied to new liner tests



OLD SLIDE

Old Liner

New Liner original data

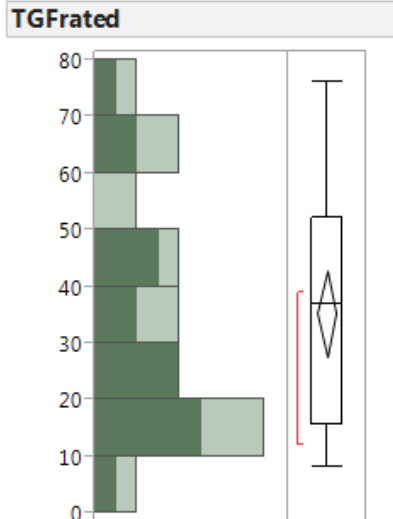
CF using Log transf

CF Multiply TGF by 1.922

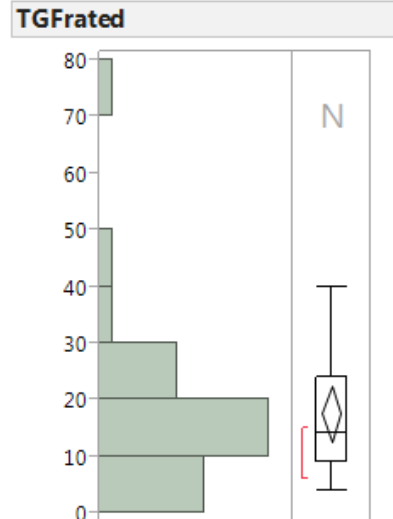
Distributions IND= 809-1, Liner2=1Y355

Distributions IND= 809-1, Liner2=1Y3998

Distributions oil= 809 Liner = 1Y3998

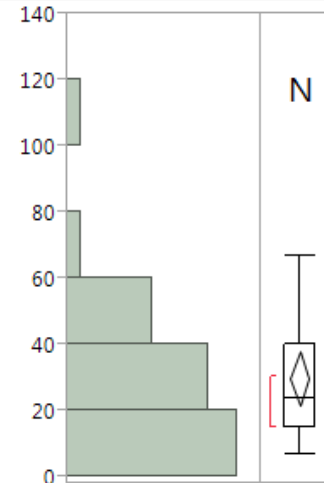


Quantiles		
100.0%	maximum	76
99.5%		76
97.5%		76
90.0%		64.9
75.0%	quartile	52.25
50.0%	median	37
25.0%	quartile	15.75
10.0%		12.1
2.5%		8
0.5%		8
0.0%	minimum	8



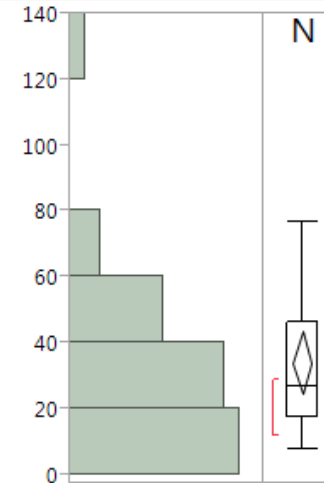
Quantiles		
100.0%	maximum	71
99.5%		71
97.5%		71
90.0%		32.4
75.0%	quartile	24
50.0%	median	14
25.0%	quartile	9
10.0%		6.2
2.5%		4
0.5%		4
0.0%	minimum	4

TGF corrected org. scale using transf.



Quantiles		
100.0%	maximum	118.451
99.5%		118.451
97.5%		118.451
90.0%		54.0536
75.0%	quartile	40.0397
50.0%	median	23.3565
25.0%	quartile	15.0149
10.0%		10.3436
2.5%		6.67328
0.5%		6.67328
0.0%	minimum	6.67328

1.922 * TGFrated for new liner



Quantiles		
100.0%	maximum	136.462
99.5%		136.462
97.5%		136.462
90.0%		62.2728
75.0%	quartile	46.128
50.0%	median	26.908
25.0%	quartile	17.298
10.0%		11.9164
2.5%		7.688
0.5%		7.688
0.0%	minimum	7.688

811: before and after liner change; after CF for scenarios 2 and 3 are applied to new liner tests



OLD SLIDE

Old Liner

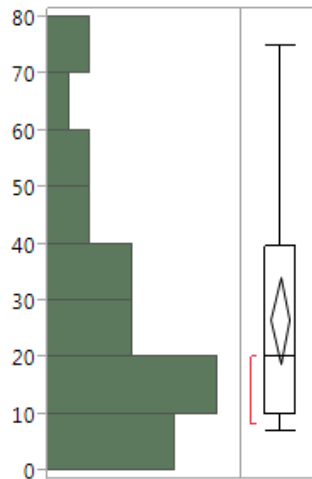
New Liner original data

CF using Log transf

CF Multiply TGF by 1.922

Distributions Liner2=1Y355

TGFrated

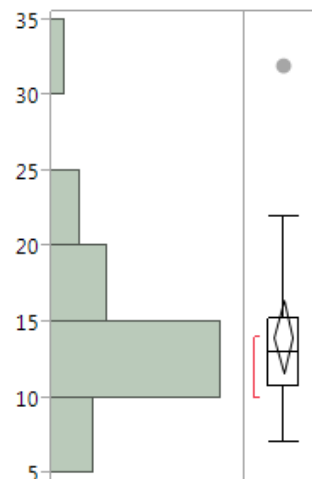


Quantiles

100.0%	maximum	75
99.5%		75
97.5%		75
90.0%		62
75.0%	quartile	39.5
50.0%	median	20
25.0%	quartile	10
10.0%		8
2.5%		7
0.5%		7
0.0%	minimum	7

Distributions Liner2=1Y3998

TGFrated

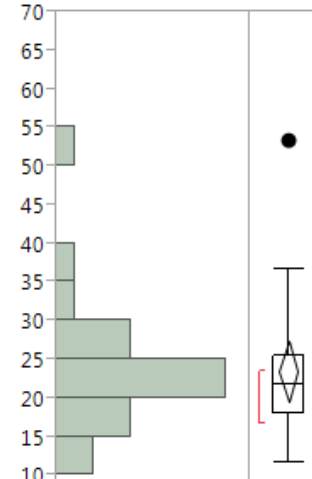


Quantiles

100.0%	maximum	32
99.5%		32
97.5%		32
90.0%		21.4
75.0%	quartile	15.25
50.0%	median	13
25.0%	quartile	10.75
10.0%		7.6
2.5%		7
0.5%		7
0.0%	minimum	7

Distributions oil 811 Liner = 1Y3998

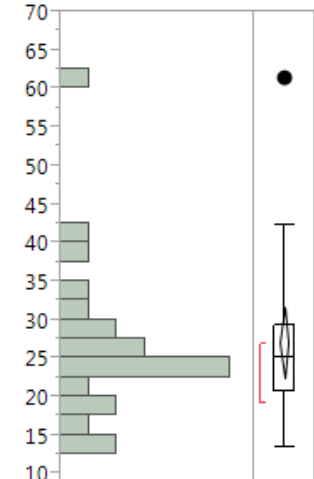
TGF corrected org. scale using transf.



Quantiles

100.0%	maximum	53.3862
99.5%		53.3862
97.5%		53.3862
90.0%		35.702
75.0%	quartile	25.4419
50.0%	median	21.6882
25.0%	quartile	17.9344
10.0%		12.6792
2.5%		11.6782
0.5%		11.6782
0.0%	minimum	11.6782

1.922 * TGFrated for new liner



Quantiles

100.0%	maximum	61.504
99.5%		61.504
97.5%		61.504
90.0%		41.1308
75.0%	quartile	29.3105
50.0%	median	24.986
25.0%	quartile	20.6615
10.0%		14.6072
2.5%		13.454
0.5%		13.454
0.0%	minimum	13.454

1004-3: before and after liner change; after CF for scenarios 2 and 3 are applied to new liner tests



OLD SLIDE

Old Liner

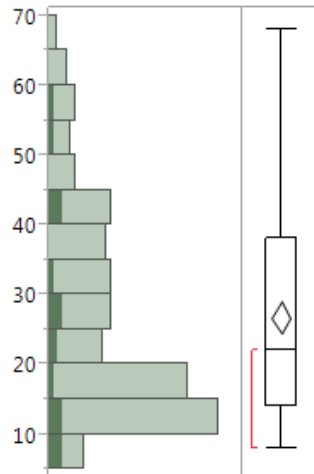
New Liner original data

CF using Log transf

CF Multiply TGF by 1.922

Distributions 1004-3 Liner= 1Y355

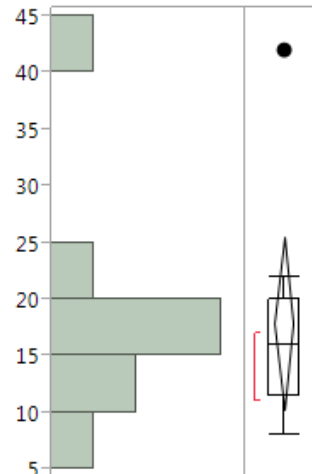
TGFrated



Quantiles		
100.0%	maximum	68
99.5%		68
97.5%		61.8
90.0%		50
75.0%	quartile	38
50.0%	median	22
25.0%	quartile	14
10.0%		10
2.5%		9
0.5%		8
0.0%	minimum	8

Distributions 1004-3 Liner= 1Y3998

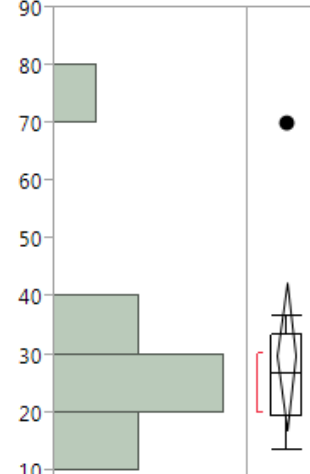
TGFrated



Quantiles		
100.0%	maximum	42
99.5%		42
97.5%		42
90.0%		42
75.0%	quartile	20
50.0%	median	16
25.0%	quartile	11.5
10.0%		8
2.5%		8
0.5%		8
0.0%	minimum	8

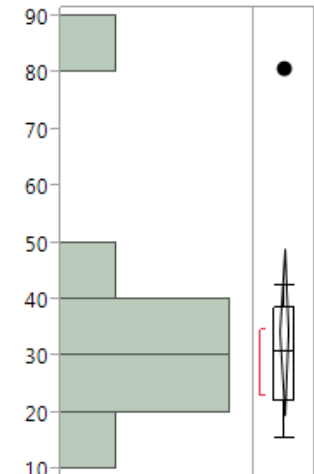
Distributions oil 1004-3 Liner= 1Y3998

TGF corrected org. scale using transf.

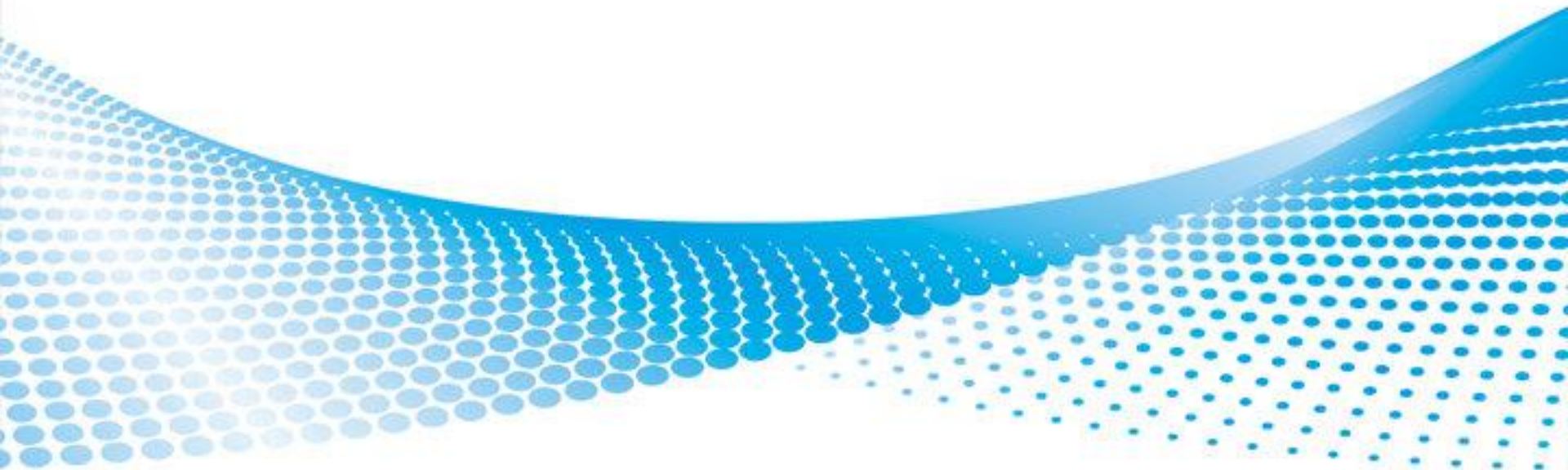


Quantiles		
100.0%	maximum	70.0694
99.5%		70.0694
97.5%		70.0694
90.0%		70.0694
75.0%	quartile	33.3664
50.0%	median	26.6931
25.0%	quartile	19.1857
10.0%		13.3466
2.5%		13.3466
0.5%		13.3466
0.0%	minimum	13.3466

1.922 * TGFrated for new liner



Quantiles		
100.0%	maximum	80.724
99.5%		80.724
97.5%		80.724
90.0%		80.724
75.0%	quartile	38.44
50.0%	median	30.752
25.0%	quartile	22.103
10.0%		15.376
2.5%		15.376
0.5%		15.376
0.0%	minimum	15.376



1N: Part 2

TLHC, WDN, BSOC

Infineum Confidential Information

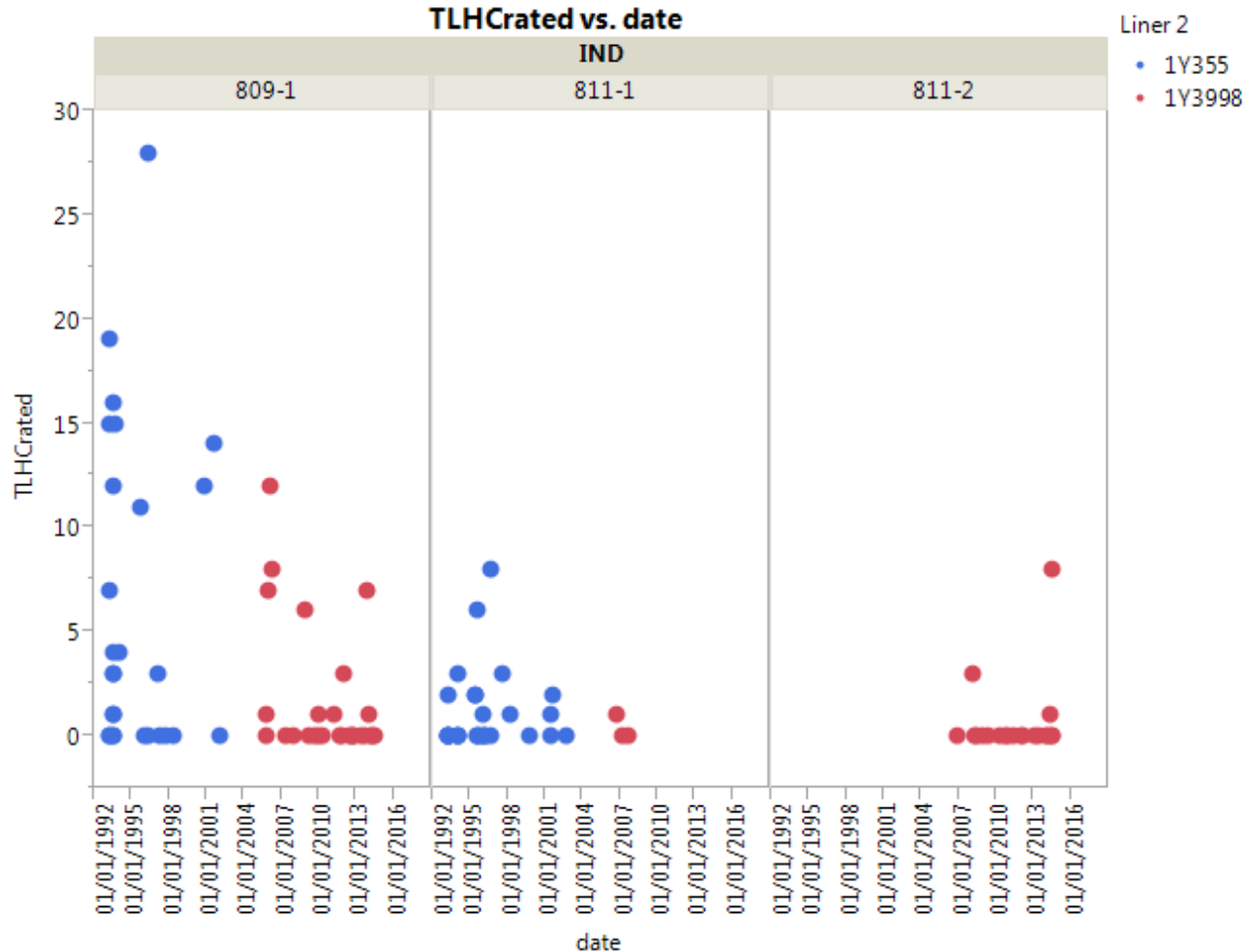
Performance you can rely on.



Top Land Heavy Carbon



Observe how the number of zeroes has increased after the adoption of the new liner



Mean and Standard Deviation for LN(TLHC rated +1)



*based on 811-1

LN(TLHC rated plus one)

Oil	Liner	# of tests	Mean(LN(TLHC rated plus one))	Std Dev(LN(TLHC rated plus one))			
809-1	1Y355	30	1.243135454	1.192089561	1.197	1.213	Blue is published TMC value
811-1	1Y355	29	0.461710833	0.669355	0.454	0.659	Blue is published TMC value
811-2*	1Y355	20	0.3660594	0.6125739			
809/811	1Y355	59	0.859045386	0.984214998			
809-1	1Y3998	32	0.46956	0.81576		Model RMSE	0.84437
811-1	1Y3998	3	0.23105	0.4002			
811-2	1Y3998	22	0.194393915	0.551996508	MEAN DIFFERENCE	old -new	0.508244
809/811	1Y3998	57	0.350801115	0.711656977	MEAN RATIO	old/New	2.44881

Working with LN(TLHCrated+1)



		Scenarios for TLHC									
		Current state		1A CF=0.50824	1A Std= 0.9 is the current std	1B CF=0.50824 std= 0.7116 pooled std	0A NO CF		2A CF=0.79222	2A Std= 0.84437 RMSE	2B CF=0.79222 std= 0.7116 pooled std
Lab	N new liner	Fail Cal	Actual Pass/Fail limit	Fail Cal	Actual Pass/Fail limit %	Actual Pass/Fail limit %	Fail Cal	Actual Pass/Fail limit %	Fail Cal	Actual Pass/Fail limit %	Actual Pass/Fail limit %
A	22	1	5	3	1	1	1	3	3	1	1
B1	22	2	2	4	1	1	2	3	3	1	1
D	8	1	2	2	1	1	0	3	2	1	1
G	14	0	1	0	1	1	0	1	0	0	0

TLHC Detailed Summary

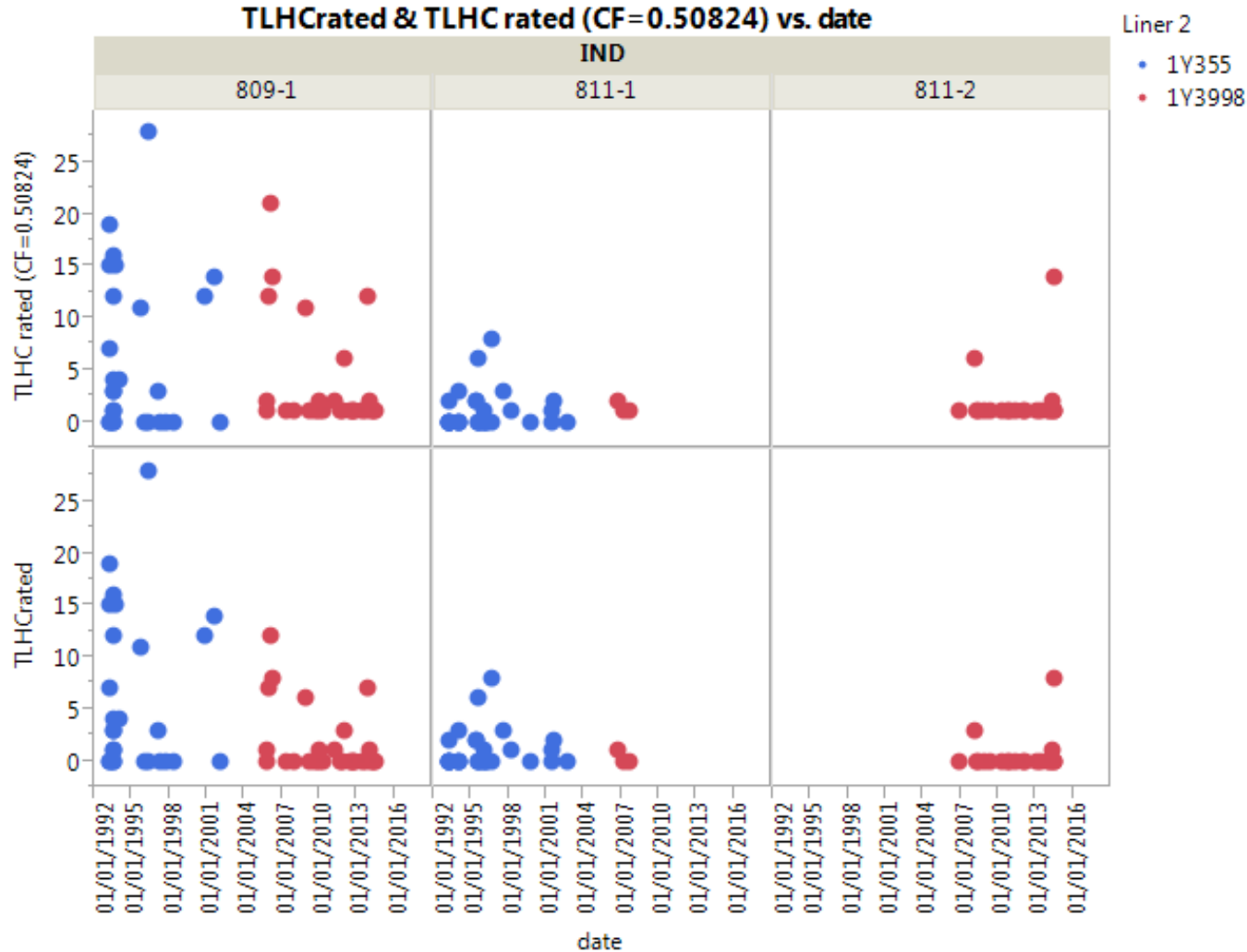


TESTKEY	LTMSLAB	IND	TLHCrated	LN(TLHC rated+1)	LN(TLHC rated+1) plus 1A					LN(TLHC rated+1) plus 1B				
					1A CF	TLHCyi	TLHCZi	1A TLHC SA	1A TLHC Sev	1B CF	1B TLHCyi	1B TLHC Zi	1B TLH SA	1B TLH Sev
50759-1N	A	1004-3	4	1.609438	2.117677912	2.105047	-0.18866		Fail	2.117677912	2.10504698	-0.1886559		Fail
50760-1N	A	809-1	12	2.564949	3.073189357	2.243362	0.31974		Fail	3.073189357	2.24336181	0.3197443		Fail
99441-1N	A	811-2	8	2.197225	2.705464577	4.23808	0.83746	-0.7537	Fail	2.705464577	4.23807967	0.83746169	-0.59599	Fail
99439-1N	A	809-1	0	0	0.50824	-0.90087	0.4898		Pass	0.50824	-0.9008677	0.48979582		Pass
51111-1N	B1	1004-3	5	1.791759	2.299999469	2.303183	0.38879		Fail	2.299999469	2.30318305	0.38879194		Fail
24232-1N	B1	809-1	7	2.079442	2.587681542	1.648205	0.64067		Pass	2.587681542	1.64820465	0.64067448		Pass
24229-1N	B1	811-1	1	0.693147	1.201387181	1.848319	0.8822	-0.794	Fail	1.201387181	1.84831887	0.88220336	-0.62783	Fail
65648-1N	B1	811-2	3	1.386294	1.894534361	2.768994	0.87623	-0.7886	Fail	1.894534361	2.7689939	0.87623039	-0.62358	Fail
51112-1N	B1	1004-3	9	2.302585	2.810825093	2.858318	1.17366	-1.0563	Fail	2.810825093	2.85831751	1.17366298	-0.83525	Fail
66788-1N	B1	809-1	6	1.94591	2.454150149	1.484516	1.23583	-1.1123	Pass	2.454150149	1.4845159	1.23583356	-0.87949	Pass
95830-1N	B1	809-1	7	2.079442	2.587681542	1.648205	0.44823		Pass	2.587681542	1.64820465	0.44822571		Pass
100712-1N	B1	811-2	0	0	0.50824	0.257575	0.19424		Pass	0.50824	0.25757518	0.19424066		Pass
51070-1N	D	1004-3	3	1.386294	1.894534361	1.862548	0.0015		Fail	1.894534361	1.86254804	0.00150467		Fail
59544-1N	D	809-1	8	2.197225	2.705464577	1.792588	0.41644		Fail	2.705464577	1.79258835	0.41644178		Fail
97769-1N	D	809-1	1	0.693147	1.201387181	-0.05118	-0.07189		Pass	1.201387181	-0.0511769	-0.0718886		Pass
102357-1N	G	811-2	0	0	0.50824	0.257575	-0.20724		Pass	0.50824	0.25757518	-0.2072352		Pass

TESTKEY	LTMSLAB	IND	TLHCrated	LN(TLHC rated+1)	LN(TLHC rated+1) plus 0A					LN(TLHC rated+1) plus 2A					2B TLH SA	Liner2
					0 CF	TLHCyi	0A TLH Zi	0A TLH SA	0A TLH Sev	2A CF	2A TLHCyi	2A TLH Zi	2A TLH SA	2A TLH Sev		
50759-1N	A	1004-3	4	1.609438	1.609437912	1.552722	-0.29912		Pass	2.401657912	2.63037497	-0.0835903		Fail	1Y3998	
50760-1N	A	809-1	12	2.564949	2.564949357	1.620339	0.02476		Pass	3.357169357	2.50368192	0.49313919		Fail	1Y3998	
99441-1N	A	811-2	8	2.197225	2.197224577	3.317349	0.04156		Fail	2.989444577	3.10691424	0.78389127		Fail	1Y3998	
99439-1N	A	809-1	0	0	0	-1.52389	-0.27153		Pass	0.79222	-0.5340259	0.52030784		Pass	1Y3998	
51111-1N	B1	1004-3	5	1.791759	1.791759469	-0.6095	-0.34823		Pass	2.583979469	2.84630111	0.55634142		Fail	1Y3998	
24232-1N	B1	809-1	7	2.079442	2.079441542	-0.6095	-0.40048		Pass	2.871661542	1.92868776	0.83081068		Fail	1Y3998	
24229-1N	B1	811-1	1	0.693147	0.693147181	-1.5655	-0.63348		Pass	1.485367181	1.2123315	0.90711485		Pass	1Y3998	
65648-1N	B1	811-2	3	1.386294	1.386294361	1.848263	-0.04518		Fail	2.178514361	2.14651748	0.8584048		Fail	1Y3998	
51112-1N	B1	1004-3	9	2.302585	2.302585093	2.305993	0.32618		Fail	3.094805093	3.45127953	1.32038832		Fail	1Y3998	
66788-1N	B1	809-1	6	1.94591	1.945910149	0.861493	0.43324		Pass	2.738130149	1.77054454	1.41041956		Fail	1Y3998	
95830-1N	B1	809-1	7	2.079442	2.079441542	1.025181	-0.32218		Pass	2.871661542	1.92868776	0.72186839		Fail	1Y3998	
100712-1N	B1	811-2	0	0	0	-0.66316	-0.58265		Pass	0.79222	0.50470836	0.47749329		Pass	1Y3998	
51070-1N	D	1004-3	3	1.386294	1.386294361	1.310223	-0.10896		Pass	2.178514361	2.36610273	0.10221561		Fail	1Y3998	
59544-1N	D	809-1	8	2.197225	2.197224577	1.169565	0.13277		Pass	2.989444577	2.06817997	0.59494096		Fail	1Y3998	
97769-1N	D	809-1	1	0.693147	0.693147181	-0.6742	-0.6142		Pass	1.485367181	0.28687865	0.21153704		Pass	1Y3998	
102357-1N	G	811-2	0	0	0	-0.66316	-0.96533	0.8688	Pass	0.79222	0.50470836	0.07858807	0.815098	Pass	0.6869659 1Y3998	

TLHC rated and TLHC rated corrected

Using $\text{LN}(\text{TLHC rated} + 1)$ and $\text{CF} = 0.50824$



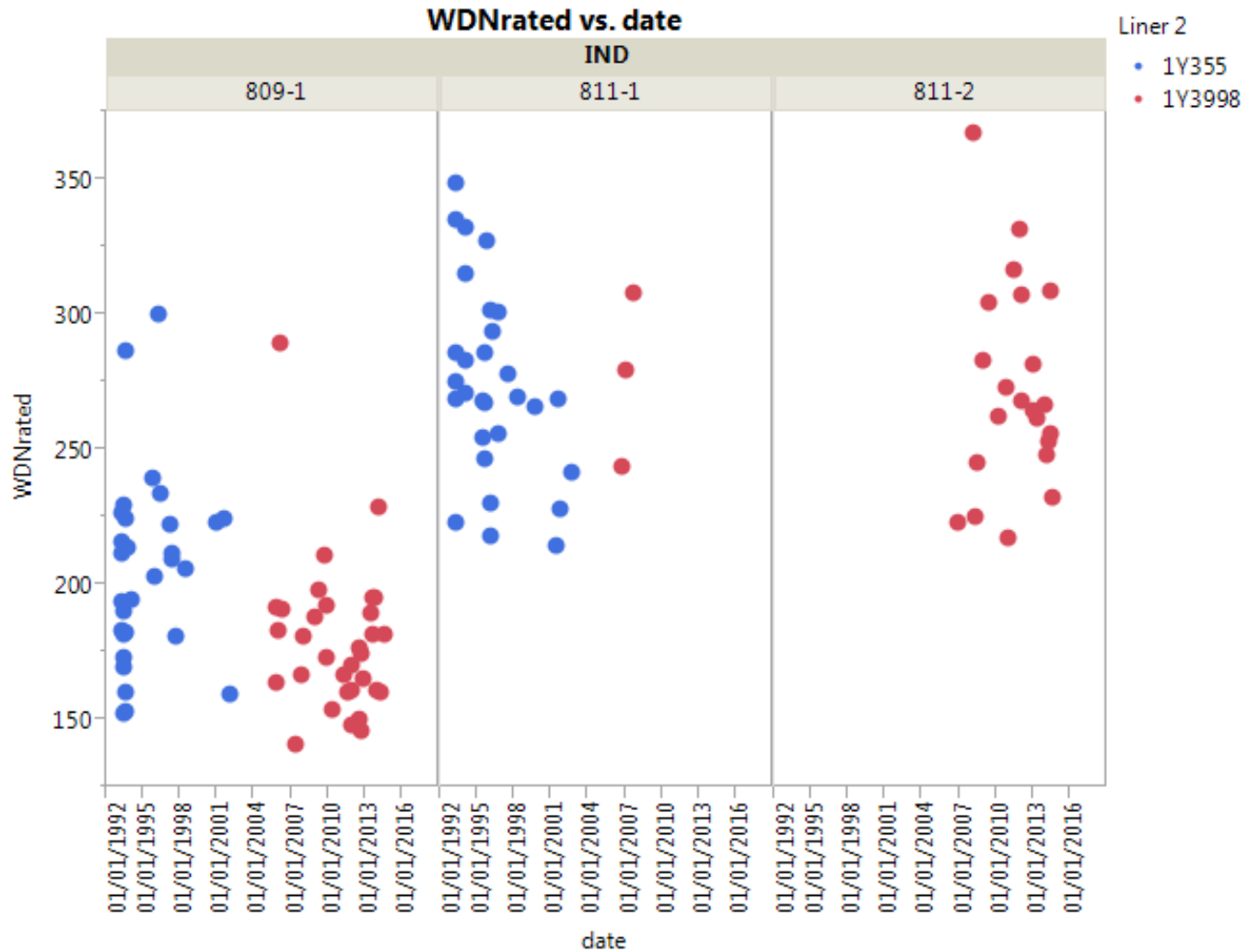
LN(TLHC rated +1): Model details



Summary of Fit				
RSquare		0.262681		
RSquare Adj		0.168709		
Root Mean Square Error		0.84437		
Mean of Response		0.609305		
Observations (or Sum Wgts)		116		
Analysis of Variance				
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	13	25.90831	1.99295	2.7953
Error	102	72.72202	0.71296	Prob > F
C. Total	115	98.63033		0.0019

Least Squares Means Table			
Level	Least Sq Mean	Std Error	Mean
1Y355	1.080761	0.188394	0.859045
1Y3998	0.288541	0.232544	0.350801
difference	0.79222		

Weighted demerits: WDN



WDNrated: Mean and Standard Deviation



WDN								
Oil	Liner	# of tests	Mean(WDN)	Std Dev(WDN)				
809-1	1Y355	30	205	34.6				
811-1	1Y355	29	274.2448276	35.65532004	273.2	35.5	Blue is published TMC value	
811-2*	1Y355	20	281.52	37.419128				
809/811	1Y355	59	239.0355932	35.12236548				
809-1	1Y3998	32	179.065625	28.08544118				
811-1	1Y3998	3	276.9	32.40108023				
811-2	1Y3998	22	272.3863636	37.66442423	MEAN DIFFERENCE	old -new	18.80226	
809/811	1Y3998	57	220.2333333	32.30153021	MEAN RATIO	old/New	1.085374	

Current state versus another possible correction



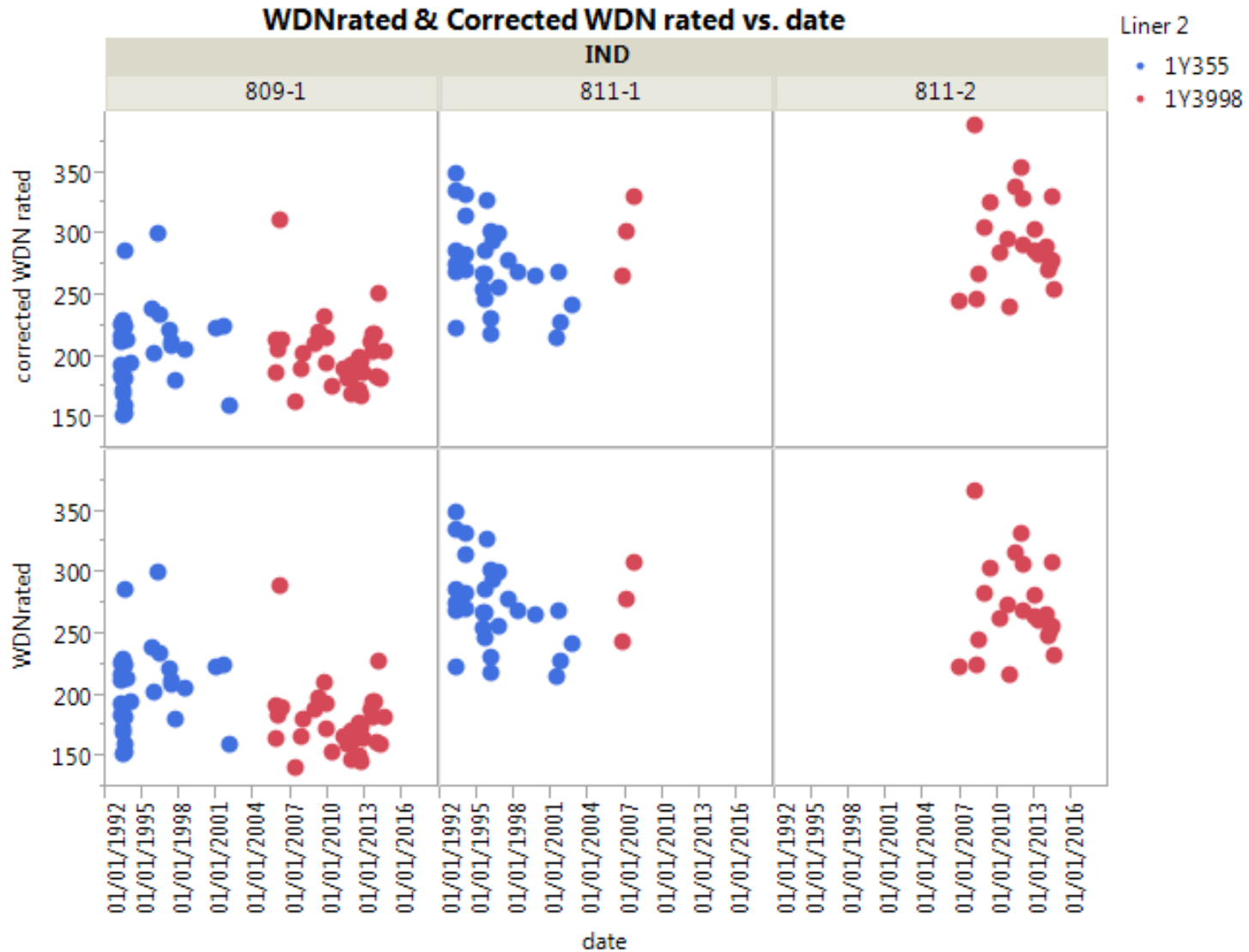
		WDN			
		Current state		CF=22.31815	1A Std= 27.1 is the current std
Lab	N new liner	Fail Cal	Actual Pass/Fail limit	Fail Cal	Actual Pass/Fail limit %
A	22	1	286.2	1	263.9
B1	22	1	286.2	4	263.9
D	8	0	260.1	0	263.9
G	14	0	261.3	0	263.9

WDN Detailed Summary

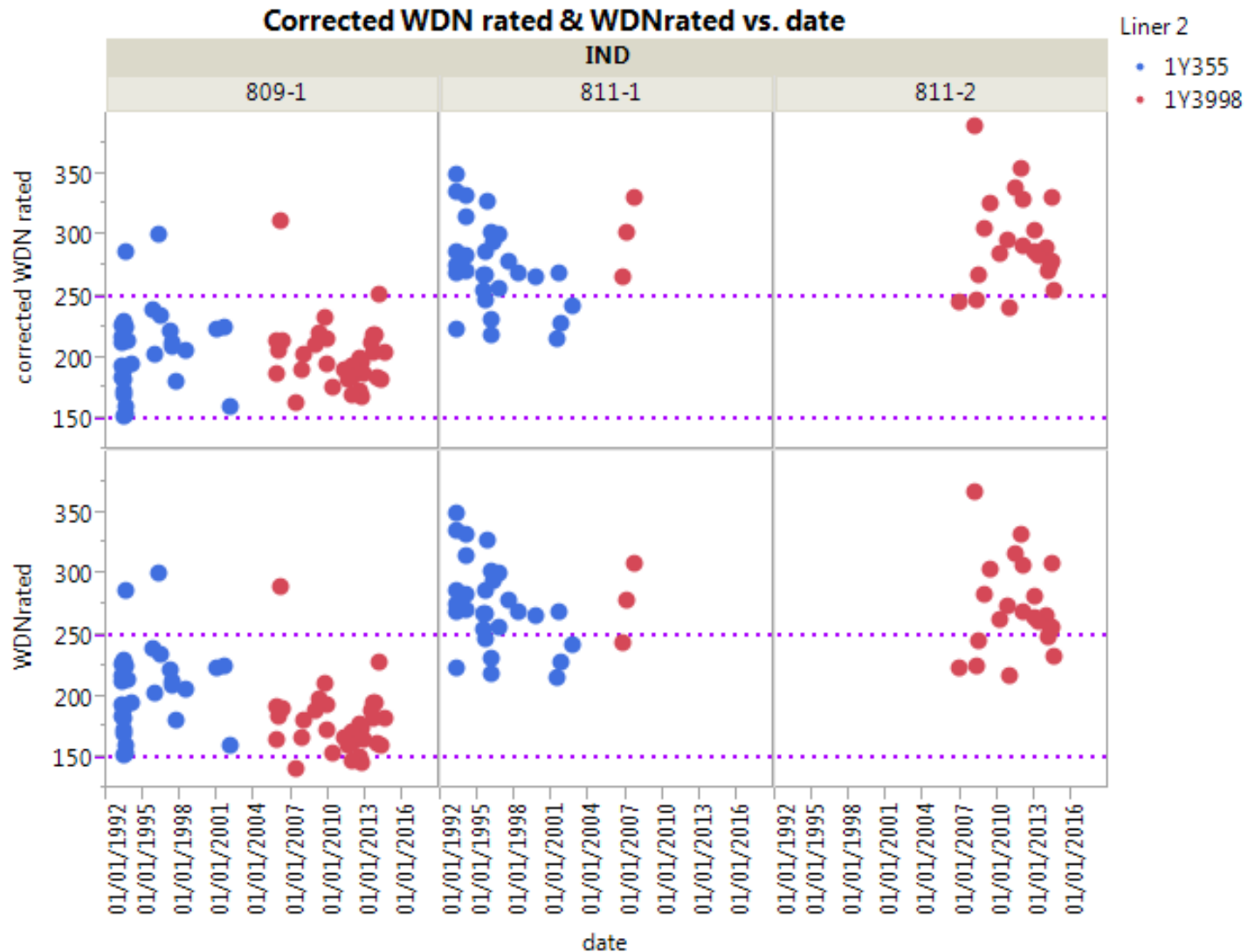


TESTKEY	LTMSLAB	IND	WDNrated	WDN	WDN plus 22.31815	WDNyi	WDN Zi	WDN SA	WDN Sev	Liner2
50760-1N	A	809-1	289.3	289.3	311.6182	3.796207	0.535589		Fail	1Y3998
99439-1N	A	809-1	181.6	181.6	203.9182	-0.03852	0.118724		Pass	1Y3998
51110-1N	B1	1004-3	201.1	201.1	223.4182	1.913055	0.750141	-20.3288	Fail	1Y3998
51111-1N	B1	1004-3	218.5	218.5	240.8182	2.929669	1.186047	-32.1419	Fail	1Y3998
65648-1N	B1	811-2	367.2	367.2	389.5182	2.867378	1.033509	-28.0081	Fail	1Y3998
77658-1N	B1	811-2	331.4	331.4	353.7182	1.916879	0.542255		Fail	1Y3998
100712-1N	B1	811-2	308.5	308.5	330.8182	1.308878	0.376169		Pass	1Y3998
97769-1N	D	809-1	160.9	160.9	183.2182	-0.77556	-0.53616		Pass	1Y3998
102357-1N	G	811-2	232	232	254.3182	-0.72222	-0.35785		Pass	1Y3998

WDN rated and WDN rated corrected



Added a few lines to guide the eye

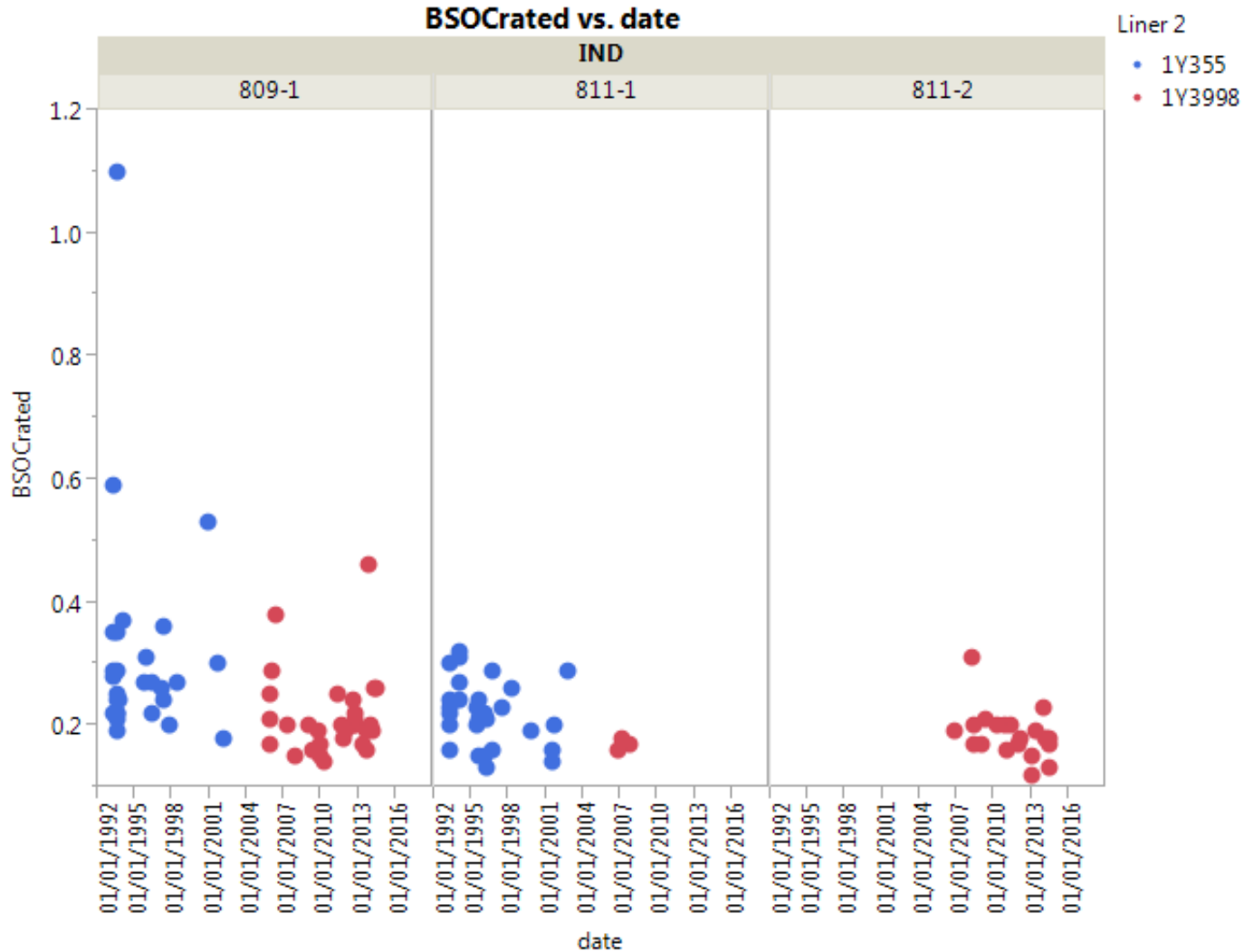


WDN rated Model details

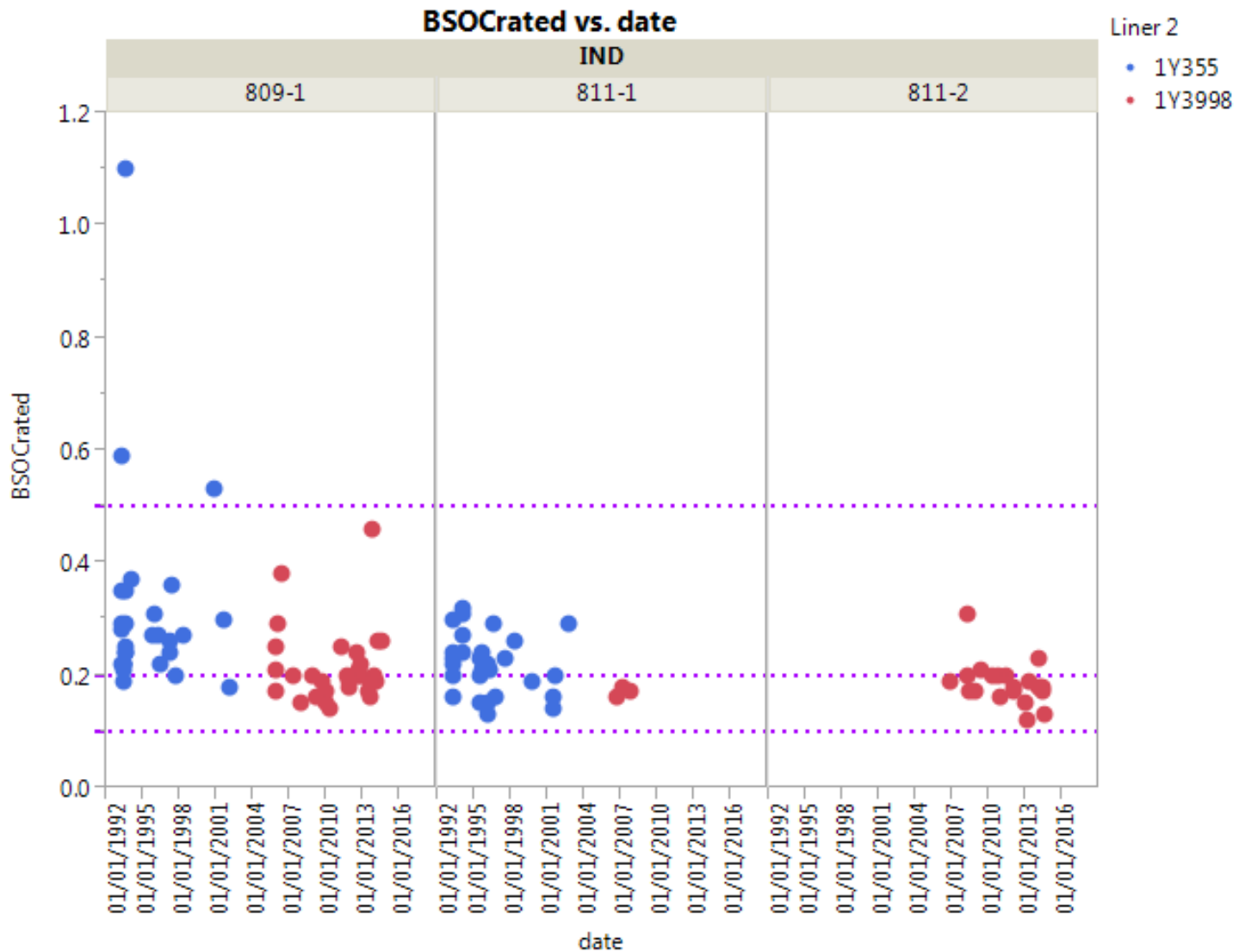


Summary of Fit		Least Squares Means Table			
RSquare	0.64633				
RSquare Adj	0.60512	Level	Least Sq Mean	Std Error	Mean
Root Mean Square Error	33.735	1Y355	240.4233	6.758453	239.029
Mean of Response	229.793	1Y3998	218.1052	8.89433	220.233
Observations (or Sum Wgts)	116	differenca	22.31815		
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Ratio	
Model	12	214215.5	17851.3	15.6859	
Error	103	117218.8	1138		Prob > F
C. Total	115	331434.3		<.0001	
Effect Tests					
Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	10	10	13471.79	1.1931	0.3044
IND2*	2	2	181007.8	80.1521	<.0001
Liner 2	1	1	10607.69	9.3944	0.0028
* combining 3 obs from 811-1 with 811-2					
	811-1	1Y3998	3		
	811-2	1Y3998	22		

Oil Consumption (BSOC g/k W-h)



Added a few lines to guide the eye



BSOC g/k W-h: Mean and Standard Deviation



Average Oil Consumption								
Oil	Liner	# of tests	Mean(BSOC)	Std Dev(BSOC)				
809-1	1Y355	30	0.308	0.175				
811-1	1Y355	29	0.219655172	0.052541328	0.218	0.053	Blue is published TMC value	
811-2*	1Y355	20	0.2225	0.051695				
809/811	1Y355	59	0.264576271	0.130143076				
809-1	1Y3998	32	0.21188	0.06621				
811-1	1Y3998	3	0.17	0.01				
811-2	1Y3998	22	0.18500	0.0374	MEAN DIFFERENCE	old -new	0.065278	
809/811	1Y3998	57	0.199298246	0.055350315	MEAN RATIO	old/New	1.327539	

1A BSOC scenario:
add 0.065278 to the
new liner test results

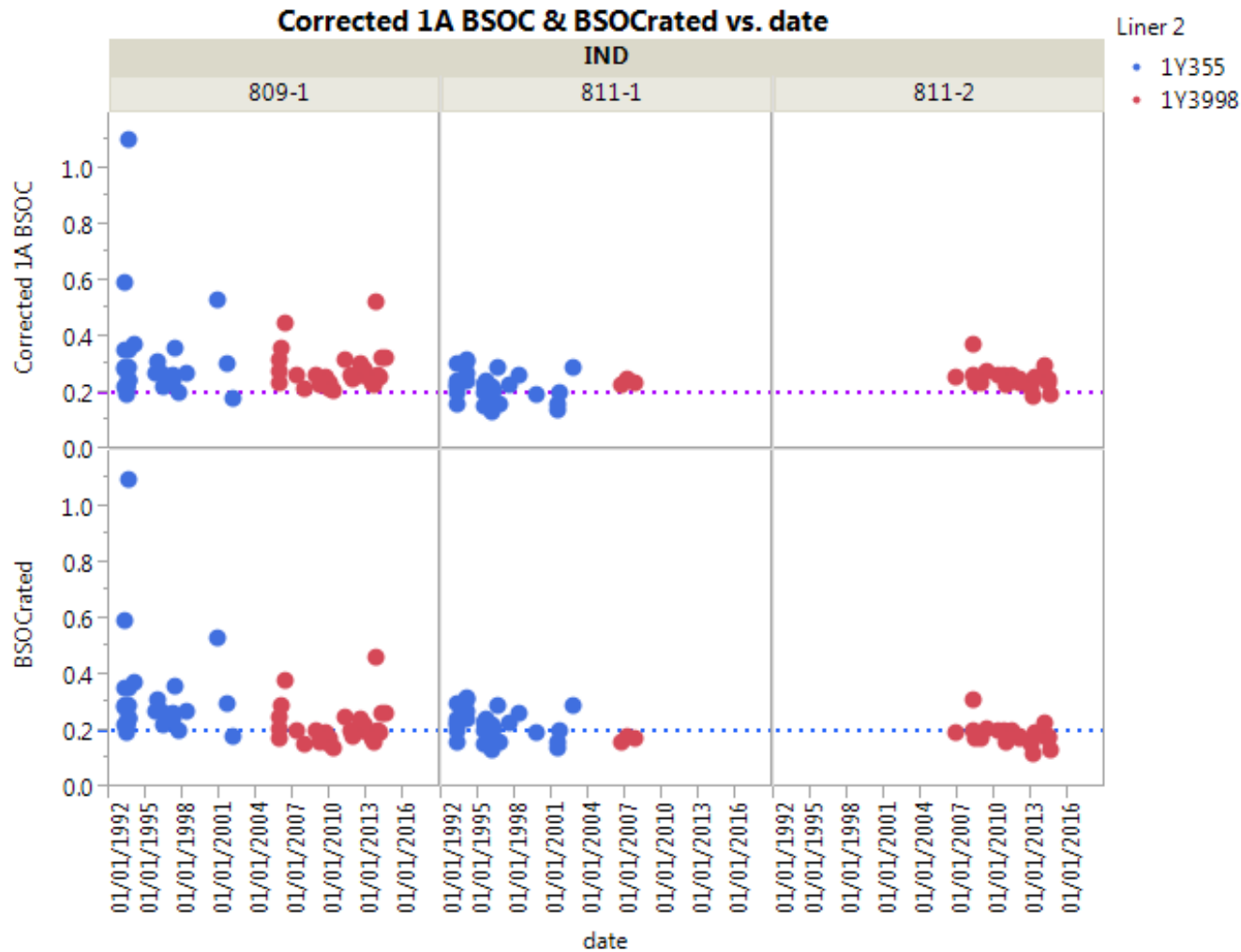
1A		BSOC			
		Current state		CF=0.06528	NO SA
Lab	N new liner	Fail Cal	Actual Pass/Fail limit	Fail Cal	Actual Pass/Fail limit %
A	22	0	0.5	1	0.43
B1	22	2	0.5	5	0.43
D	8	2	0.5	2	0.43
G	14	1	0.5	1	0.43

1A BSOC: BSOC + 0.065278



TESTKEY	LTMSLAB	IND	BSOCrated	BSOC	1A BSOC	BSOCyi	BSOC Zi	BSOC Sev	Liner2
50759-1N	A	1004-3	0.26	0.2	0.26528	1.949509	-0.06379	Fail	1Y3998
51110-1N	B1	1004-3	0.32	0.26	0.32528	2.942637	0.780589	Fail	1Y3998
24234-1N	B1	811-1	0.18	0.18	0.24528	2.562483	0.939949	Fail	1Y3998
65648-1N	B1	811-2	0.31	0.31	0.37528	4.086694	1.194836	Fail	1Y3998
51112-1N	B1	1004-3	0.21	0.21	0.27528	2.115031	1.370792	Fail	1Y3998
95830-1N	B1	809-1	0.46	0.46	0.52528	3.28179	0.595028	Fail	1Y3998
51070-1N	D	1004-3	0.23	0.23	0.29528	2.446073	0.535782	Fail	1Y3998
59544-1N	D	809-1	0.38	0.38	0.44528	2.073473	0.698749	Fail	1Y3998
90771-1N	G	811-2	0.23	0.23	0.29528	1.946783	0.007464	Fail	1Y3998

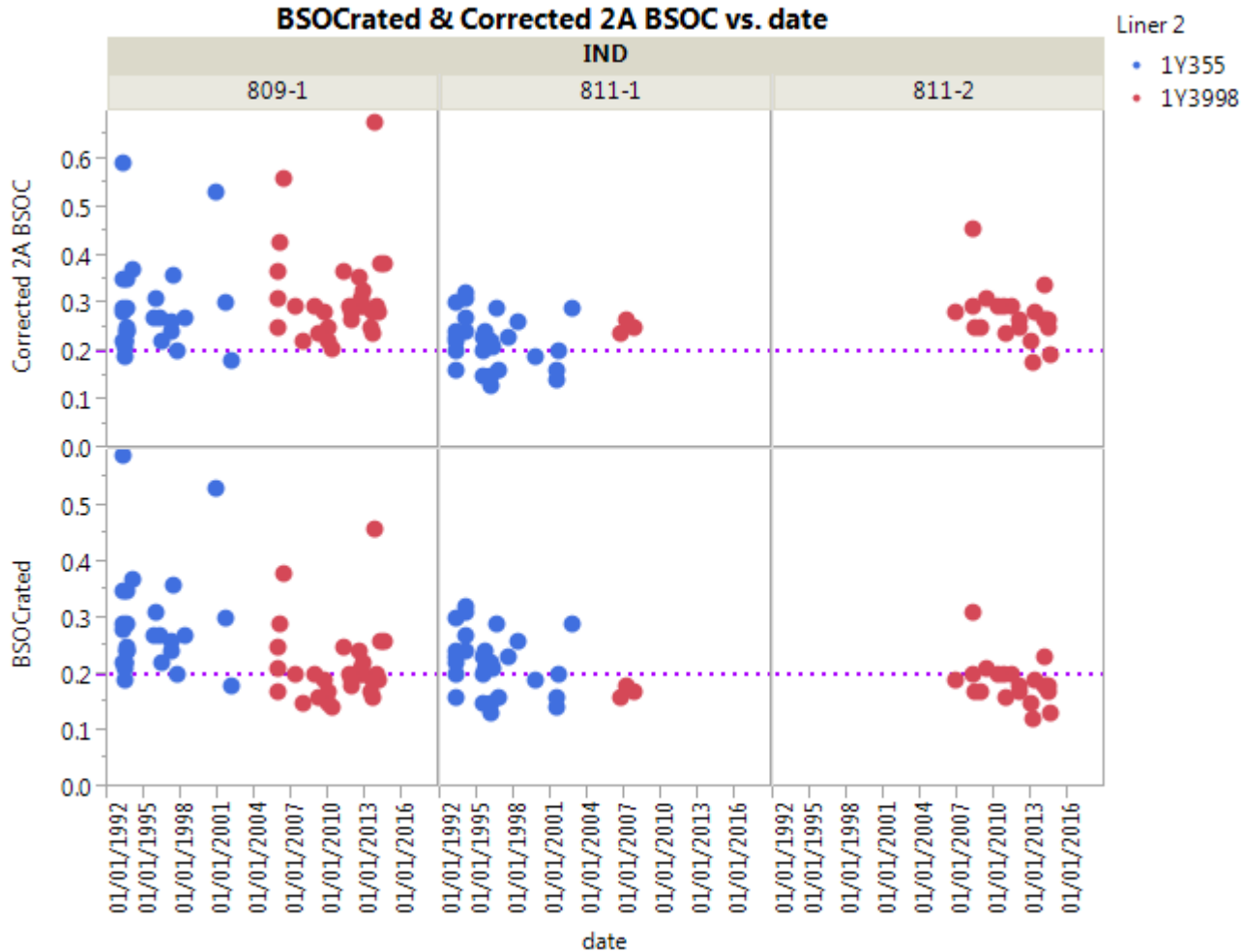
1A BSOC before and after the correction is applied (n=116)



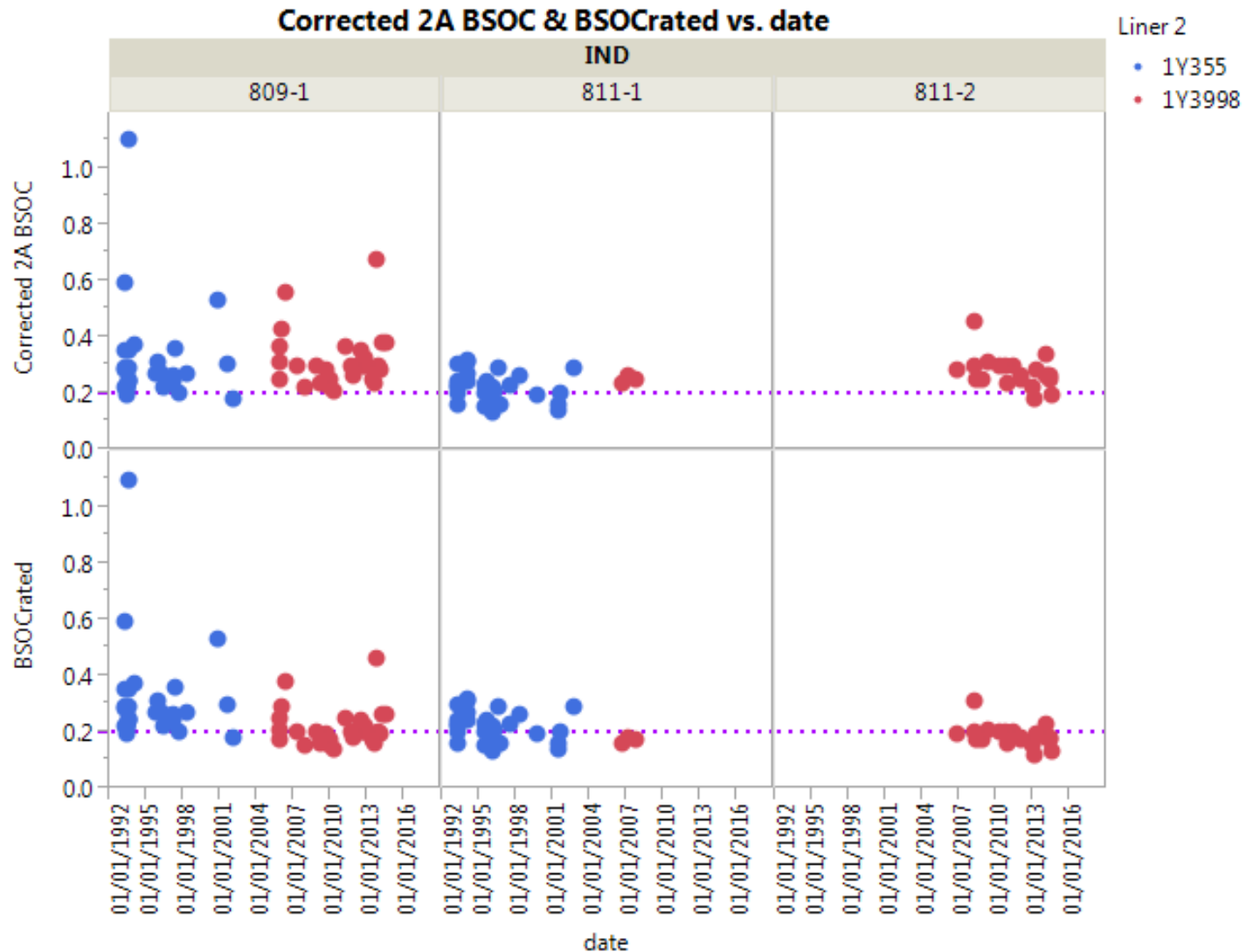
After

Before

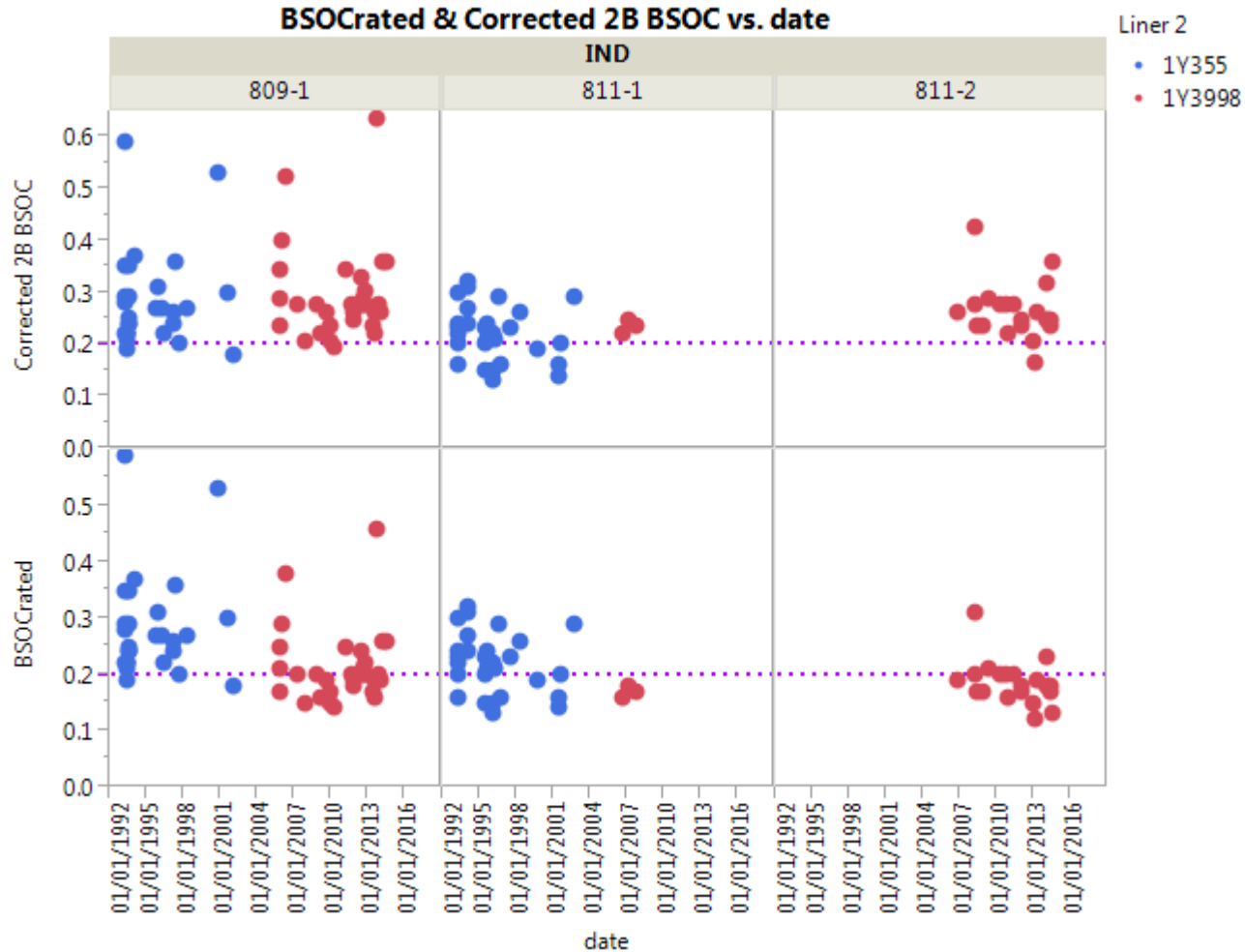
2A BSOC before and after the correction is applied (n=115) – removing the high value allows for better visualization of the CF applied to medium size BSOC



2A BSOC before and after the correction is applied (n=116)



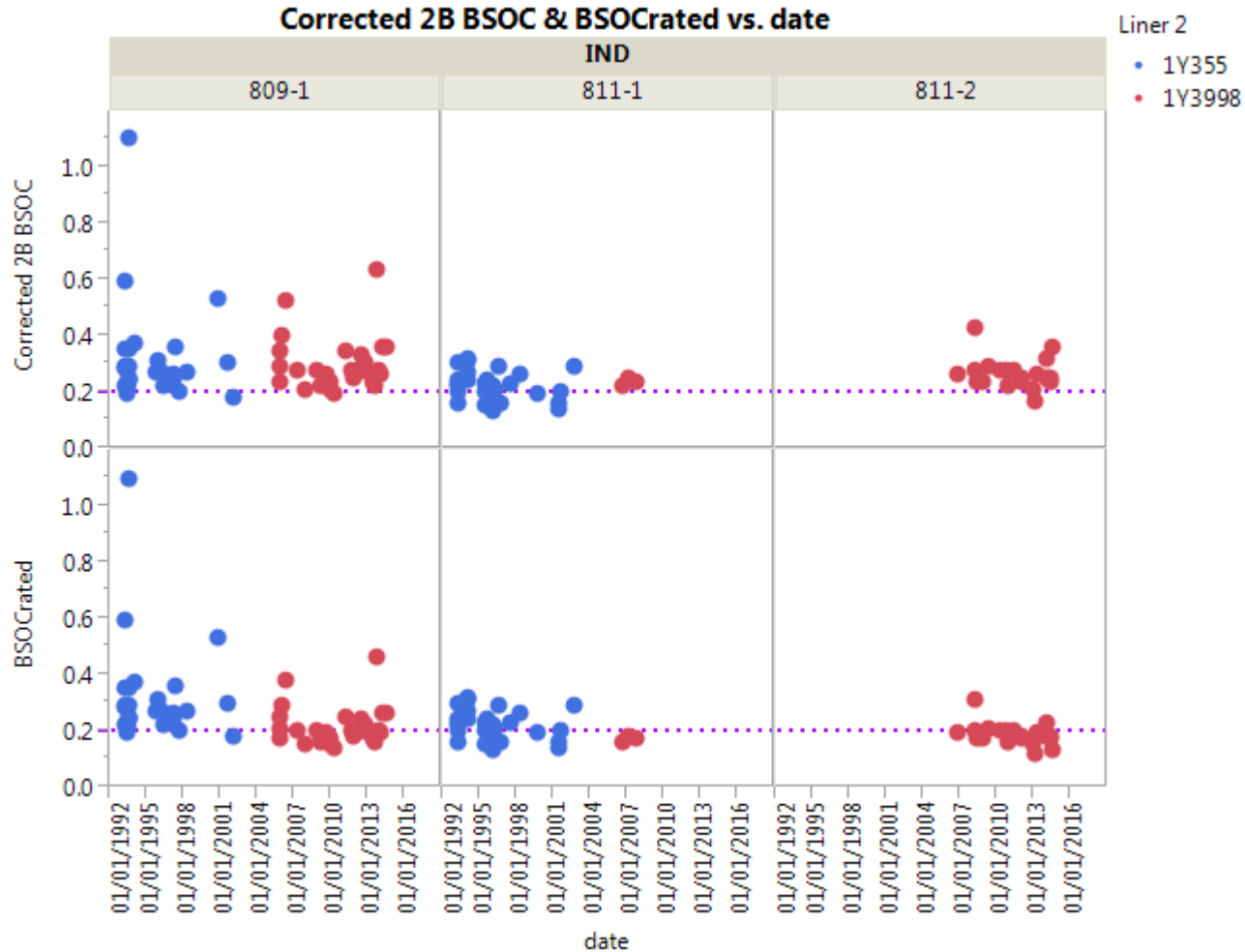
2B BSOC before and after the correction is applied (n = 115)



After

Before

2B BSOC before and after the correction is applied (n = 116)



2A & 2B BSOC: Correction derived from the model for LN BSOC with La, Oil and Liner



2A BSOC: LN(BSOC rated) + 0.386656 (n=116)

2B BSOC: LN(BSOC rated) + 0.320098 (n=115)

- Evaluation of the 2A & 2B BSOC

2A		LN BSOC				
		Current state		CF=0.386656	NO SA	
Lab	N new liner	Fail Cal	Actual Pass/Fail limit	Fail Cal	Actual Pass/Fail limit %	# of BSOC corrected >0.5
A	22	0	0.5	3	0.34	0
B1	22	2	0.5	6	0.34	1
D	8	2	0.5	3	0.34	1
G	14	1	0.5	2	0.34	0
* the model for LN(BSOC) is based on 116 tests (all data available)						
2B		Current state		CF*=0.320098	NO SA	
Lab	N new liner	Fail Cal	Actual Pass/Fail limit	Fail Cal	Actual Pass/Fail limit %	# of BSOC corrected >0.5
A	22	0	0.5	2	0.36	0
B1	22	2	0.5	6	0.36	1
D	8	2	0.5	2	0.36	1
G	14	1	0.5	1	0.36	0
* the model for LN(BSOC) is based on 115 tests it eliminates a test with BSOC = 1.1 (testkey 18077)						

2A BSOC: LN(BSOC rated) + 0.386656 (n=116)

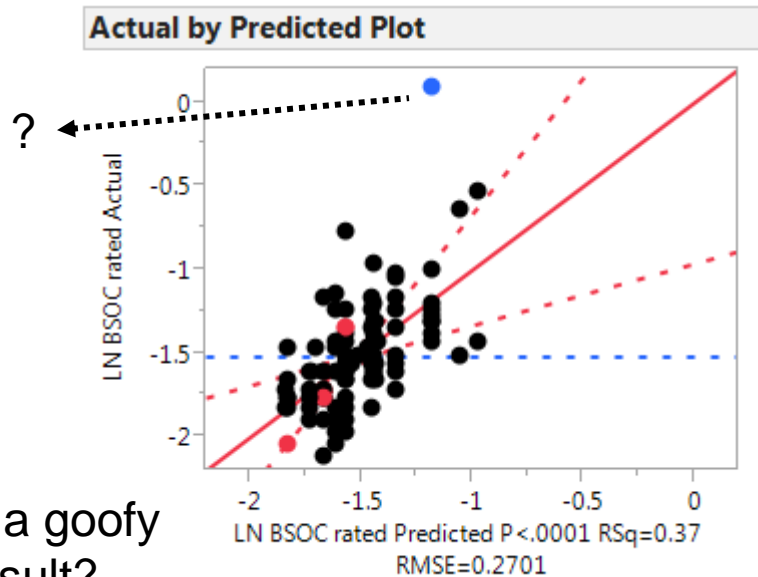


- 0.386656 is the estimated difference between the two liners, obtained from the model to LN(BSOC rated) with Lab, Oil and Liner
- This transformation is not perfect, but I was trying to use the log that I think it has been used for OC in other tests... (this transform may make more sense to you than the best Box Cox transformation)
- BSOC is a non critical parameter. There is no SA for BSOC. Is this ok? This is my interpretation of the LTMS

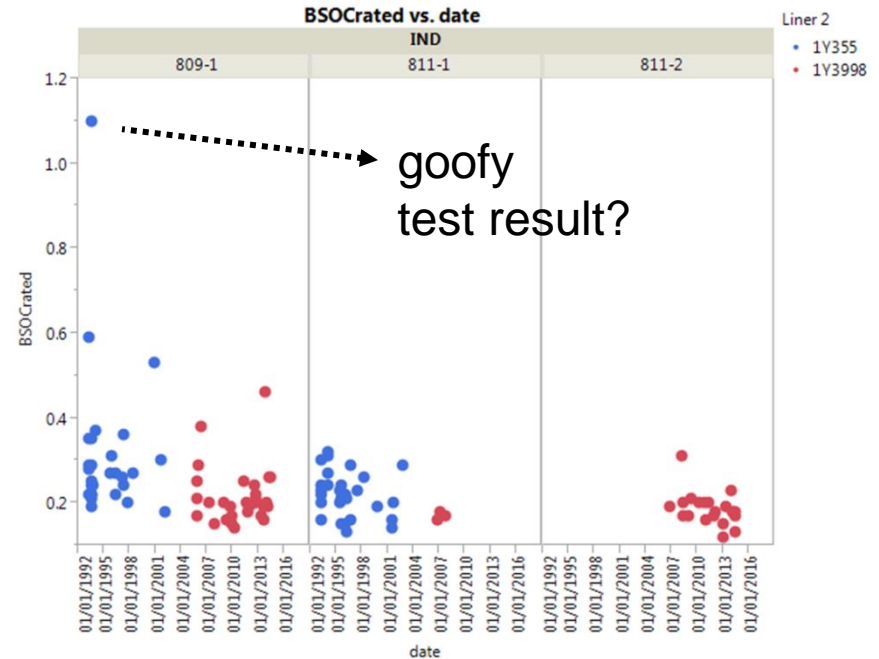
Details about 2A BSOC and 2B BSOC

TESTKEY	LTMSLAB	IND	BSOCrated	BSOC	LN BSOCrated	LN BSOC rated + CF	2A BSOCyi	BSOC Zi	BSOC Sev	Liner2	BSOC corrected >0.5
50759-1N	A	1004-3	0.26	0.2	-1.347073648	-0.96042	3.338046401	0.21392183	Fail	1Y3998	Pass
51072-1N	A	1004-3	0.18	0.18	-1.714798428	-1.32814	2.087020148	0.91162617	Fail	1Y3998	Pass
31595-1N	A	811-1	0.17	0.17	-1.771956842	-1.3853	2.701496741	1.26960029	Fail	1Y3998	Pass
51110-1N	B1	1004-3	0.32	0.26	-1.139434283	-0.75278	4.044450512	1.00095134	Fail	1Y3998	Pass
51111-1N	B1	1004-3	0.19	0.13	-1.660731207	-1.27408	2.270960739	1.25495322	Fail	1Y3998	Pass
24234-1N	B1	811-1	0.18	0.18	-1.714798428	-1.32814	3.671928216	1.68892476	Fail	1Y3998	Pass
65648-1N	B1	811-2	0.31	0.31	-1.171182982	-0.78453	3.922176381	1.71368788	Fail	1Y3998	Pass
51112-1N	B1	1004-3	0.21	0.21	-1.560647748	-1.17399	2.611451891	1.87752745	Fail	1Y3998	Pass
95830-1N	B1	809-1	0.46	0.46	-0.776528789	-0.38987	3.365426216	0.97109655	Fail	1Y3998	Fail
51070-1N	D	1004-3	0.23	0.23	-1.46967597	-1.08302	2.920944449	0.63075585	Fail	1Y3998	Pass
59544-1N	D	809-1	0.38	0.38	-0.967584026	-0.58093	2.630030575	1.04290563	Fail	1Y3998	Fail
65631-1N	D	811-2	0.21	0.21	-1.560647748	-1.17399	1.872280689	1.06742842	Fail	1Y3998	Pass
42645-1N	G	1004-3	0.17	0.11	-1.771956842	-1.3853	1.892563098	-0.1100814	Fail	1Y3998	Pass
90771-1N	G	811-2	0.23	0.23	-1.46967597	-1.08302	2.351098472	0.53389643	Fail	1Y3998	Pass

BSOC: Model details



Is this a goofy test result?



Scenario BSOC 2A takes into account all 116 tests results to generate a correction factor based on the model for LN(BSOC rated) with Lab, Oil and Liner

Scenario BSOC 2B, eliminates the “goofy test result” before generating a correction factor based on the model for LN(BSOC rated) with Lab, Oil and Liner

2A		n=116				
Least Squares Means Table						
Summary of Fit						
RSquare	0.366336	Level	Least Sq Mean	Std Error	Mean	
RSquare Adj	0.285575	1Y355	-1.36586	0.060262	-1.4019	
Root Mean Square Error	0.270091	1Y3998	-1.75251	0.074385	-1.6431	
Mean of Response	-1.52044	difference	0.386656			
Observations (or Sum Wgts)	116	Exp of the CF	0.386656	1.47205		
Analysis of Variance						
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F	
Model	13	4.301721	0.330902	4.536		
Error	102	7.440829	0.072949			
C. Total	115	11.74255		<.0001		

2B							
Summary of Fit				n=115			
				Least Squares Means Table			
RSquare	0.374424						
RSquare Adj	0.293904			Level	Least Sq Mean	Std Error	Mean
Root Mean Square Error	0.237531			1Y355	-1.38645	0.053127	-1.4278
Mean of Response	-1.53449			1Y3998	-1.70655	0.065938	-1.6431
Observations (or Sum Wgts)	115			difference	0.320098		
				exp(diff)	1.377263		
Analysis of Variance							
Source	DF	Sum of Squares	Mean	F Ratio			
Model	13	3.410696	0.3	4.6501			
Error	101	5.698497	0.1		Prob > F		
C. Total	114	9.109192		<.0001			