

# 1N: Updated Standard Deviations

*A discussion*

*New Material added – slide 26 forward*

Elisa Santos

08/13/2020

07 23 2020

Performance you can rely on.



- Issue raised with respect to Top Groove Fill data: reference oils have diverged in severity (09/2016)
  - Parts variation was identified as the root cause
- Plots for TGF: RO809 trending down and RO811 moving up
- TGF Updated Standard deviations: 101 tests (1Y3998)
- Plots – Other parameters
- Proposed standard deviations by oil based on liner 1Y3998
- Proposed standard deviation for calculating severity adjustments

# Updating standard deviations



- Lubrizol raised an issue – see power point presentation  
– Caterpillar 1N TGF Dilemma from September 2016

[http://www.astmtmc.cmu.edu/ftp/docs/diesel/CAT/minutes/2016/10.07/1N%20TGF%209\\_21\\_2016.pdf](http://www.astmtmc.cmu.edu/ftp/docs/diesel/CAT/minutes/2016/10.07/1N%20TGF%209_21_2016.pdf) [www.astmtmc.cmu.edu - /ftp/docs/diesel/CAT/minutes/2016/10.07/](http://www.astmtmc.cmu.edu/ftp/docs/diesel/CAT/minutes/2016/10.07/)

---

[\[To Parent Directory\]](#)

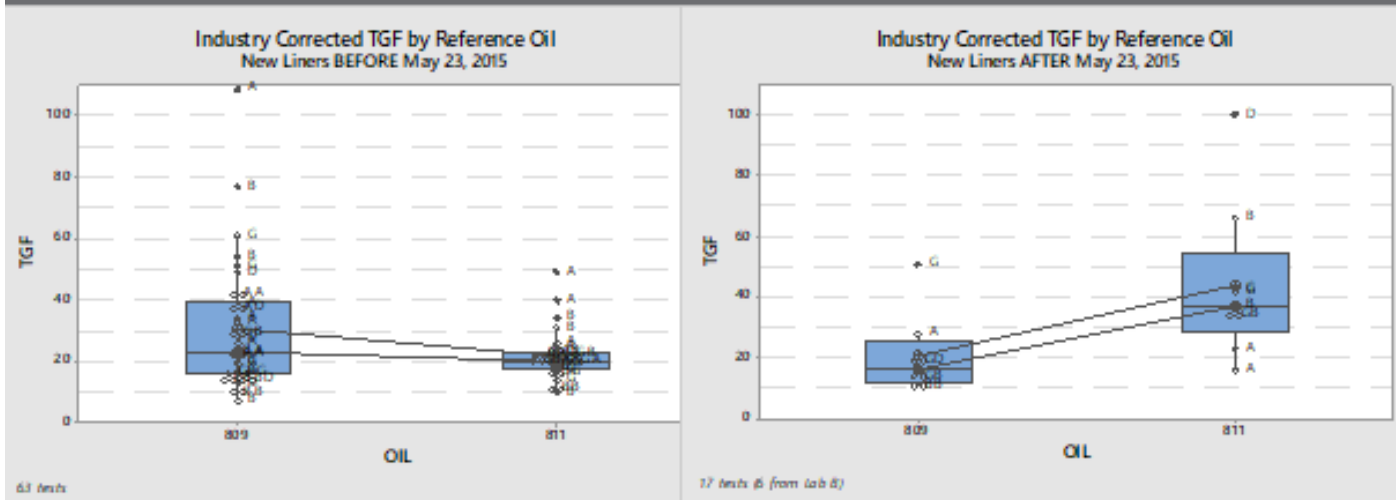
1/10/2017	8:48 AM	410023	<a href="#">1N TGF 9 21 2016.pdf</a>
12/9/2016	6:10 PM	4096875	<a href="#">IR-1808 FilterAnalysis.pdf</a>
1/10/2017	8:49 AM	21178	<a href="#">COAT-Task Force Teleconference 10-7-2016.pdf</a>

---

- Next four slides will tell you that parts variation was identified as the root cause
- I will proceed with the analysis without excluding any data, assuming that parts variability is part of the test variability
- Please let me know if you have any concerns with anything and I will revise it

# Caterpillar 1N TGF Dilemma from September 2016

## Evidence of Issue



- Problem so bad that RO 809 and RO 811 have diverged in TGF severity!
  - Historically, 809 with higher TGF than 811
  - Now 811 way higher than 809
    - This is not due to the correction factor, but another issue

All,

I wanted to inform this group of the result of a recent 1N hardware test that we ran as a part of our continuing investigation into the TGF issues we discussed earlier last year. We ran a reference test on oil 811 in our stand 605. If the group recalls, 811 was supposedly the oil that was trending severe and our stand 605 was also supposedly a severe stand. We ran the recent reference test using a piston, rings, and liner from Southwest who had some older parts on hand and, as you might guess, we drastically shifted our results and went very mild with TGF as you can see in the plot below. Before running the test, we analyzed the Southwest parts and compared them against a set from Lubrizol. We found what we believe to be significant differentiation of the top ring face surface finish, as displayed in the second graphic below (the "Minus Major Asperity" values or those that discount a large valley in the Southwest ring). I believe this new information warrants further discussion and should probably be brought up again at a surveillance panel call. If there are any questions or comments, please let me know.

Andrew D. Stevens

Test Engineer, Mechanical Engineering & Testing

The Lubrizol Corporation

<http://www.astmtmc.cmu.edu/ftp/docs/diesel/CAT/minutes/2017/01.10/1N%20TGF%20findings.pdf>

**[www.astmtmc.cmu.edu - /ftp/docs/diesel/CAT/minutes/2017/01.10/](http://www.astmtmc.cmu.edu - /ftp/docs/diesel/CAT/minutes/2017/01.10/)**

[\[To Parent Directory\]](#)

2/20/2017	2:05 PM	111125	<a href="#">1N TGF findings.pdf</a>
2/20/2017	2:05 PM	24361	<a href="#">CAT surveillance panel minutes 1-10-2017.pdf</a>
2/20/2017	2:05 PM	72326	<a href="#">COAT MM Calibration Procedure Rev1 1-11-2017.pdf</a>
2/20/2017	2:05 PM	64775	<a href="#">Test Numbering Proposed Changes.pdf</a>

## **1N – Hardware effect on TGF (Lubrizol)**

Greg: We sent out data from the last test.

We got old parts from SwRI. Should have been severe. But they went mild. There is a plot that was sent out. (Attached with these minutes)

Greg: Quite a bit difference in the surface profile of the top ring.

- Went back to minutes and found 3/31/2017 CAT O & H Panel Conference Minutes
  - Proper recording of parts data for 1K/1N (specifying serial number, date code, etc and ensuring consistency between labs)
  - Proper recording of parts data will allow for future investigations as needed
  - Example for liners:
    - LINERPN – “Liner part number” (Include dash, dash change level) 1Y-3998-03
    - LINERBDC – “Liner box date code” Date code on box label (14 characters)
    - LINERDC – “Liner date code” day of year - year’s last digit (Ex. 133-6)
    - LINERSN – “Sequence number” - 0-99999
  - It also includes a CAT presentation SCOTE **Hardware Marking** March 31, 2017

### Piston, Ring, Liner Part Numbers

Oil Test Engine Parts					
ASTM Test	D6750 1K	D6750 1N	D6681 1P	D6923 1R	D7549 C13
Arrangement	1Y0540	1Y0540	1Y3700	E455	1Y4100
Liner	1Y3998	1Y3998	1Y3997	1Y3997	1Y4107
Piston	1Y0727	1Y0727	1Y3400	1Y4016	1Y4106
Skirt	na	na	1Y3659	1Y4015	na
Top Ring	1Y3506	1Y3506	1Y3802	1Y4014	1Y4108
2nd Ring	1Y3507	1Y3507	1Y3803	1Y4013	1Y4109
Oil Ring	1Y3508	1Y3508	1Y3804	1Y4012	1Y4110
Ring Kit	1Y0728	1Y0728	na	na	na

From CAT

# The current test database with parts data vs. recommended recording – please follow the recommendations



Liners - an example

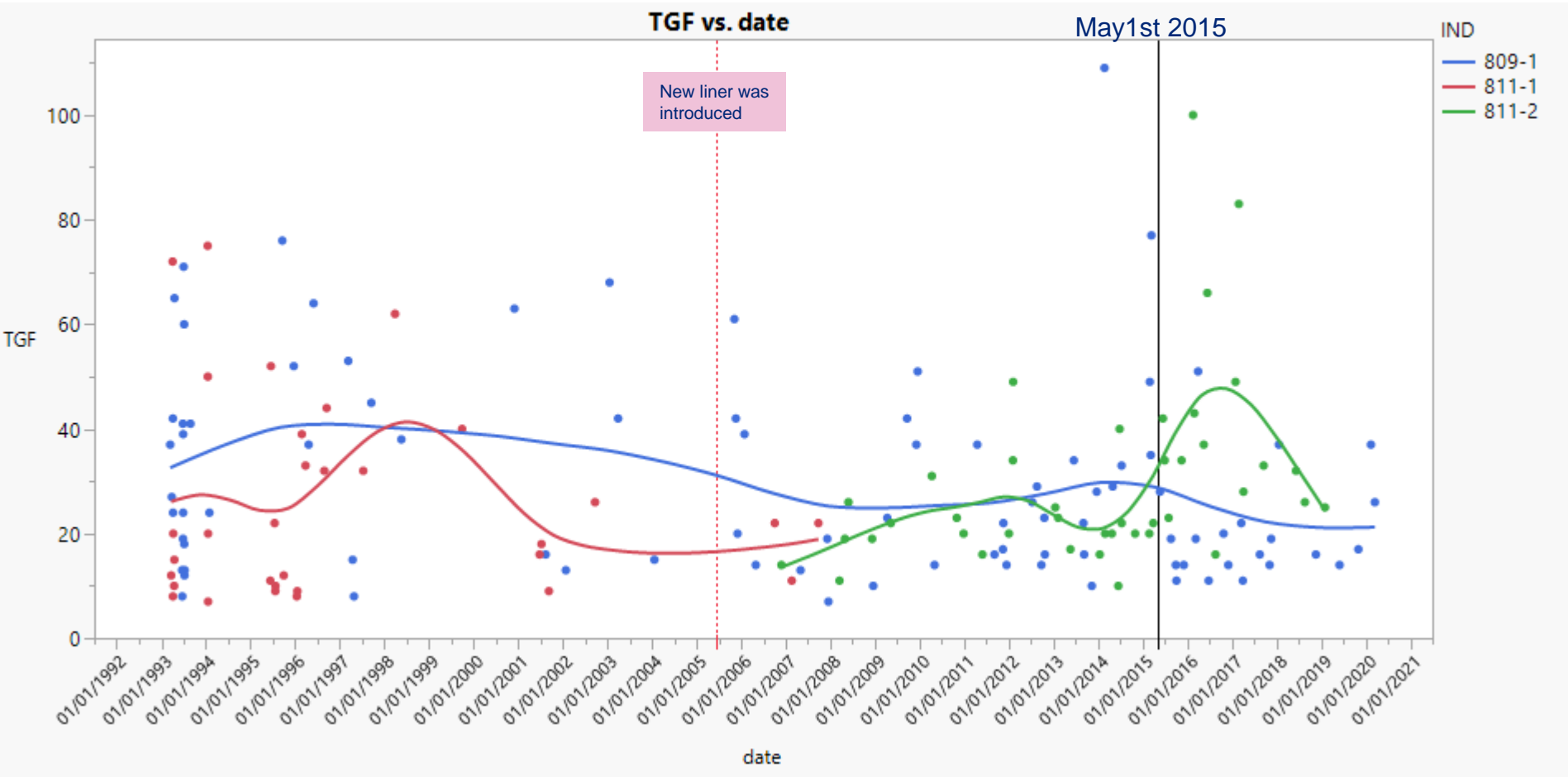
LINERPN – “Liner part number” (Include dash, dash change level) 1Y-3998-03  
 LINERBDC – “Liner box date code” Date code on box label (14 characters)  
 LINERDC – “Liner date code” day of year - year’s last digit (Ex. 133-6)  
 LINERSN – “Sequence number” - 0-99999

ISOCyi	LINERPN	LINERSN	LINERDC	LINERBDC	PISTPN	PISTSNBDC	PISTDC	PISTIC	RINGPN	RINGSN	RINGBDC	RINGSC	DWNOCR	
440	0.0577	1Y3998	D05M09Y14P47	N/A	1Y0727		1444	1225	1Y0728				0	
441	1.7885	1Y3998	65861	DYM06Y15P47	1Y0727		733	1225	1Y0728				4	
442	0.2971	1Y3998	D04M06Y15P47	N/A	1Y0727		256	1225	1Y0728				1	
443	0.8457	1Y3998	566017	D09M12Y15P47	1Y0727		310714	1225	1Y0728				5	
444	0.8269	1Y-3998	N/A	D04M06Y15P47	1Y-0727		615	1225	1Y-0728				0	
445	0.8269	1Y-3998	N/A	D24M08Y15P47	1Y-0727		615	1225	1Y-0728				3	
446	0.9029	1Y-3998	N/A	D09M12Y15P47	1Y-0727		615	1225	1Y-0728				0	
447	1.4808	1Y3998	D13M06Y14P47	N/A	1Y0727		1225M2561202	N/A	1Y0728				2	
448	0.2743	1Y-3998	D13M06Y14P47	N/A	1Y-0727		1225M3191300	N/A	1Y-0728				6	
449	0.7886	1Y3998	6-65171	D09M06Y16P47	1Y0727		10515	1225	1Y0728				3	
450	-1.76	1Y-3998	N/A	D09M12Y15P47	1Y-0727		615	1225	1Y-0728				0	
451	1.0192	1Y-3555G	N/A	D13M06Y14P47	1Y-0727		114	1225	1Y-0728				0	
452	1.5962	1Y-3998	N/A	D04M06Y15P47	1Y-0727		615	1225	1Y-0728				0	
453	0.3269	1Y3998	D09M06Y16P47	3	1Y0727		2136	1225	1Y0728				2	
454	0.3886	1Y3998	D09M06Y16P47	1396	1Y0727		2133	1225	1Y0728				2	
455	0.7886	1Y-3998	N/A	D09M06Y16P47	1Y-0727		615	1225	1Y-0728				0	
456	0.1029	1Y-3998	N/A	D09M12Y15P47	1Y-0727		1016	1225	1Y-0728				0	
457	1.2115	1Y3998	5-65913	D04M06Y12P47	1Y0727		D07M10Y16P47	1225	1Y0728				2	
458	0.3886	1Y3998	55581	2235	1Y0727		1225M3191307	N/A	1Y0728				7	
459	0.9038	1Y3998	55974	223 5	1Y0727		1225M3491302	N/A	1Y0728				3	
460	0.5029	1Y-3998	65983	223 5	1Y-0727		1225M2161620	N/A	1Y-0728				2	
461	-0.56	1Y3998	D09M06Y16P47	6-66145	1Y0727		D07M10Y16P47	1225	1Y0728	N/A		N/A	1	
462	0.7314	1Y3998	66236	235-6	D31M08Y16P47	1Y0727	D25M08Y17P47	0016-185-17	1225	1Y0728	N/A	271216A8871L	N/A	0
463	1.4038	1Y3998	86990	033-6	D09M06Y17P47	1Y-0727	D07M10Y16P47	1857-216-16	1225	1Y-3508-04	B659	N/A	T	2
464	0.6346	1Y-3998	65690	1624	D28M11Y16	1Y-0727	D07M10Y16	M21616	1225	1Y-3508-04	B802	271216	A8871	1
465	0.9029	1Y3998	6-66202	03-301	D02M11Y16P47	1Y0727	D25M08Y17P47	220412417	1225	1Y0728	N/A	240816A8871L	N/A	2
466	1.5962	1Y3998	6-66206	03-235	D31M08Y16P47	1Y0727	D25M08Y17P47	231212417	1225	1Y0728	N/A	271216A8871L	N/A	2
467	0.7314	1Y-3998	66244	235 6	D31M08Y16P47	1Y-0727	D25M08Y17P47	1225M1841723	1225	1Y-0728	B866	271216A8871L	B866	3
468	4.2885	1Y-3998	66232	235-6	D31M08Y16P47	1Y-0727-02	D25M08Y17P47	1225M1941721	1225	1Y-0728	B843	271216A8871L	B843	1
469	0.8457	1Y-3998	66115	133-6	D09M06Y16	1Y-0727-02	D25M08Y17P47	0037-185-17	1225	1Y-0728	B753	240816A8871L	B357	1
470	0.8457	1Y-3998-03	62239	235-6	D31M08Y16P47	1Y-0727-02	D25M08Y17P47	2325-184-17	1225	1Y-0728-04	B714	271216A8871L	T	4
471	0.8457	1Y3998-03	66316	301-6	D02M11Y16P47	1Y0727	D25M08Y17P45	184178303	1225	1Y0728		D13M01Y17P47	B607	2



# Plots – Top Groove Fill (TGF) original unit

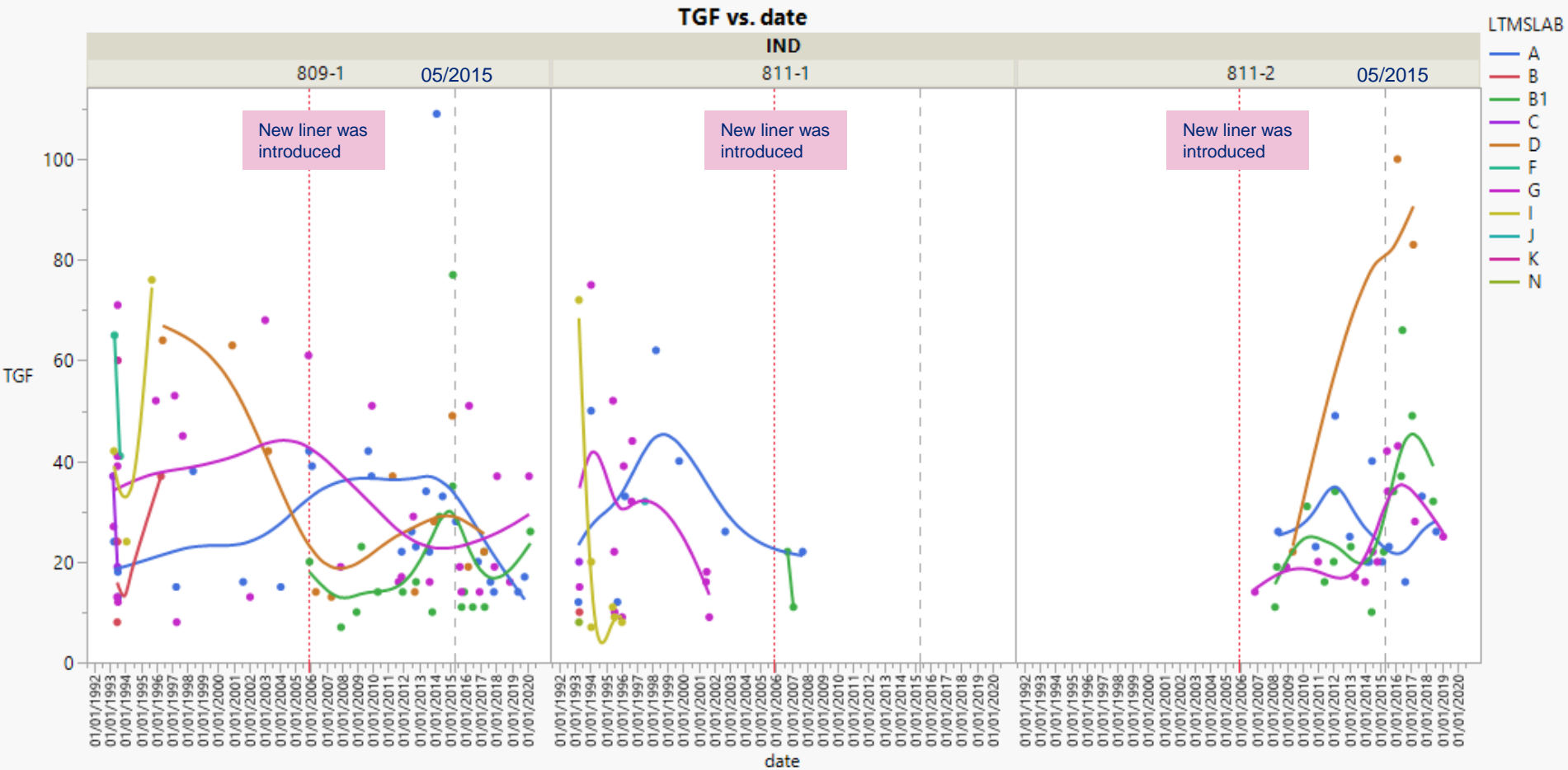
# TGF Overall trend: 809 trending down and 811 moving up



TGF (after CF is applied)

# TGF by oil and Lab: 809 trending down and 811 moving up

## Only Labs A, B1, D and G have data for new liners – 1Y3998



TGF (after CF is applied)

# TGF by Lab and Oil: 809 trending down and 811 moving up (current oils highlighted)

Labs are affected differently depending on the parts they get and how the test is run



TGF vs. date

LTMSLAB

IND

- 809-1
- 811-1
- 811-2
- 1004
- 1004-1
- 1004-2
- 1004-3

New liner was introduced

May 1st 2015

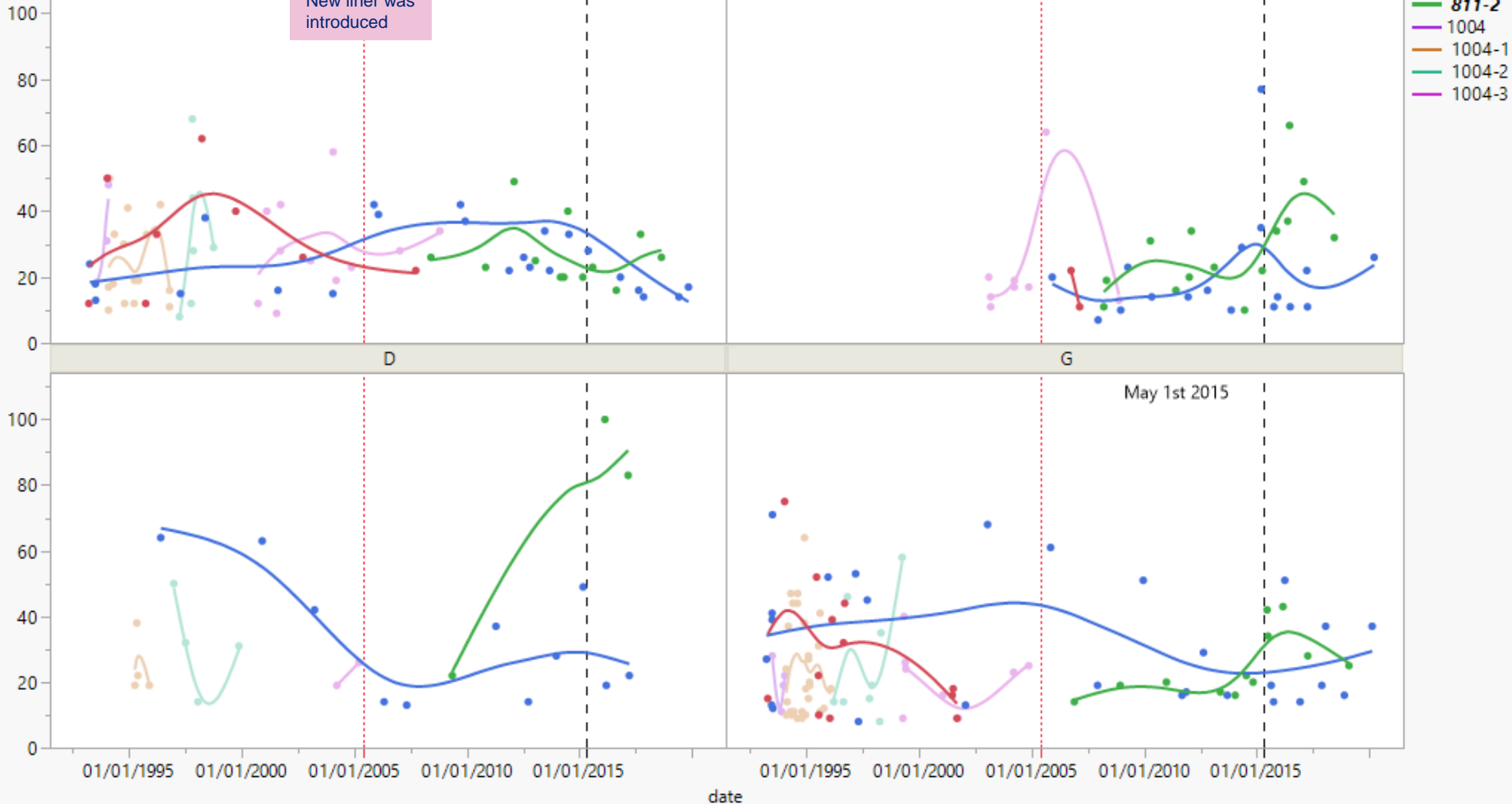
May 1st 2015

A

B1

D

G



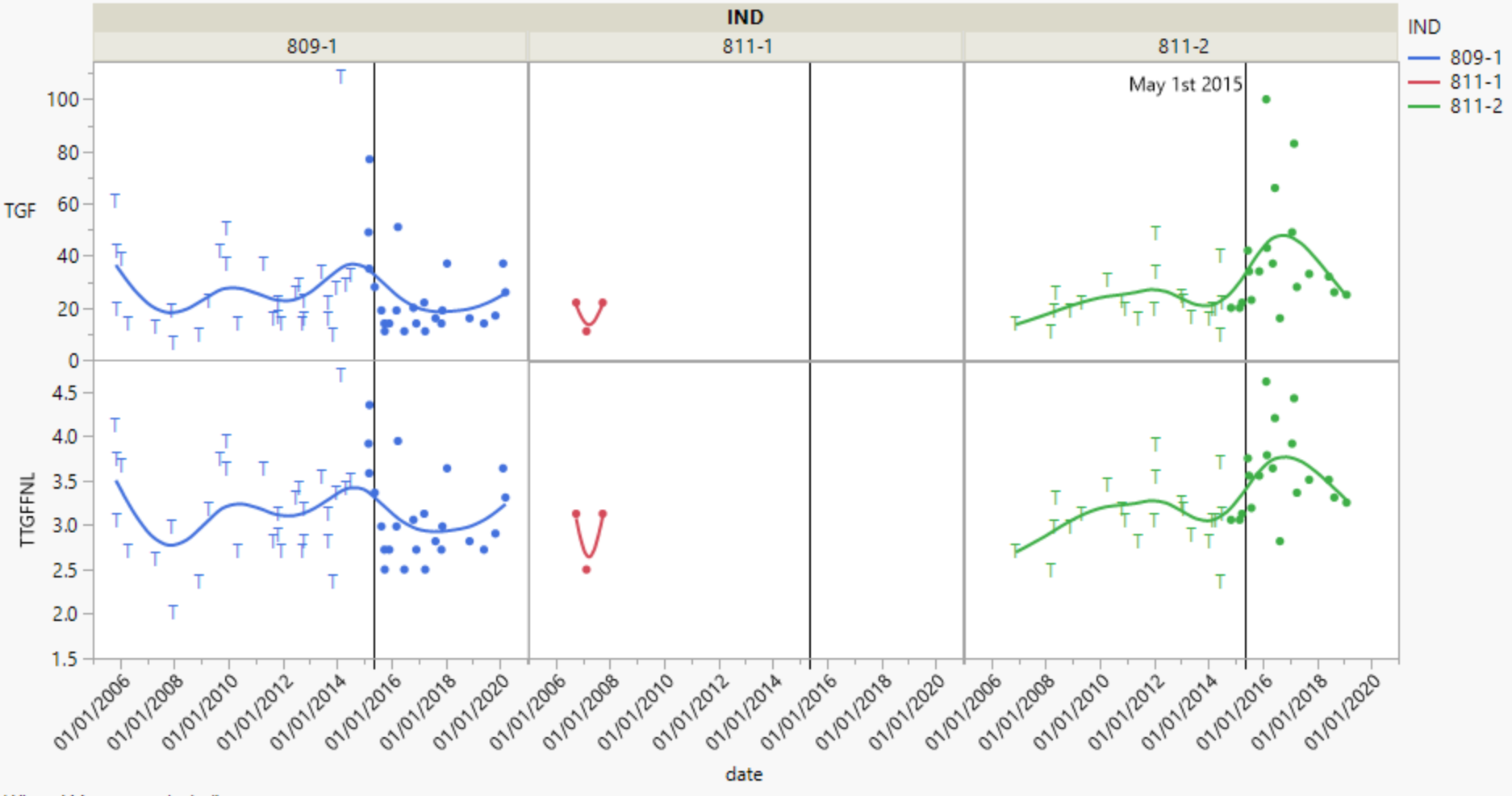
TGF (after CF is applied)

# Plots – TGF (original unit) & transformed unit

# TGF by oil: original unit and transformed unit



TGF & TTGFFNL vs. date



# Updated Standard deviations: 101 tests (1Y3998)



2013/2014 – 57 tests

Present – 101 tests (1Y3998)

LN (TGF plus one)				
Oil	Liner	# of tests	Mean(LN (TGF +1))	Std Dev(LN (TGF +1))
809-1	1Y355	30	3.410591	0.64212
811-1	1Y355	29	3.077855	0.705547
811-2*	1Y355	20	2.961267	0.744084
809/811	1Y355	59	3.247043	0.674023
809-1	1Y3998	32	2.771324	0.56397
811-1	1Y3998	3	2.498514	0.362927
811-2	1Y3998	22	2.679636	0.361554
809/811	1Y3998	57	2.721577	0.488165

Current target (1Y355)  
Current standard deviation (1Y3998)

Updated Standard deviations- transformed scale; after current CF

oil	# of tests	Mean	standard deviation
809-1	57	3.154255	0.532380
811-2	41	3.3134	0.474121

pooled Standard dev.

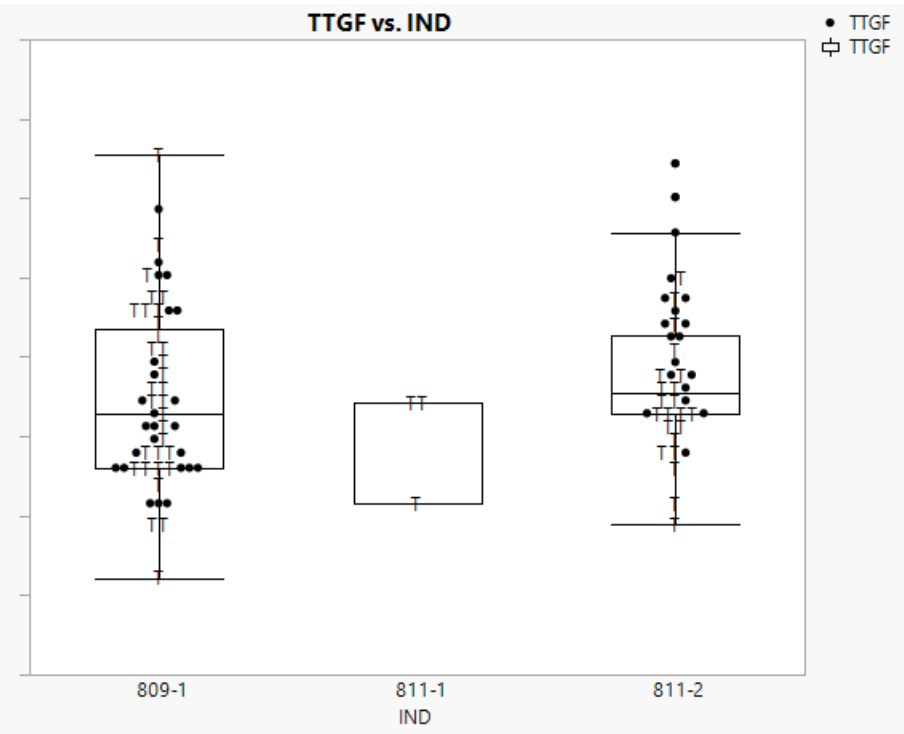
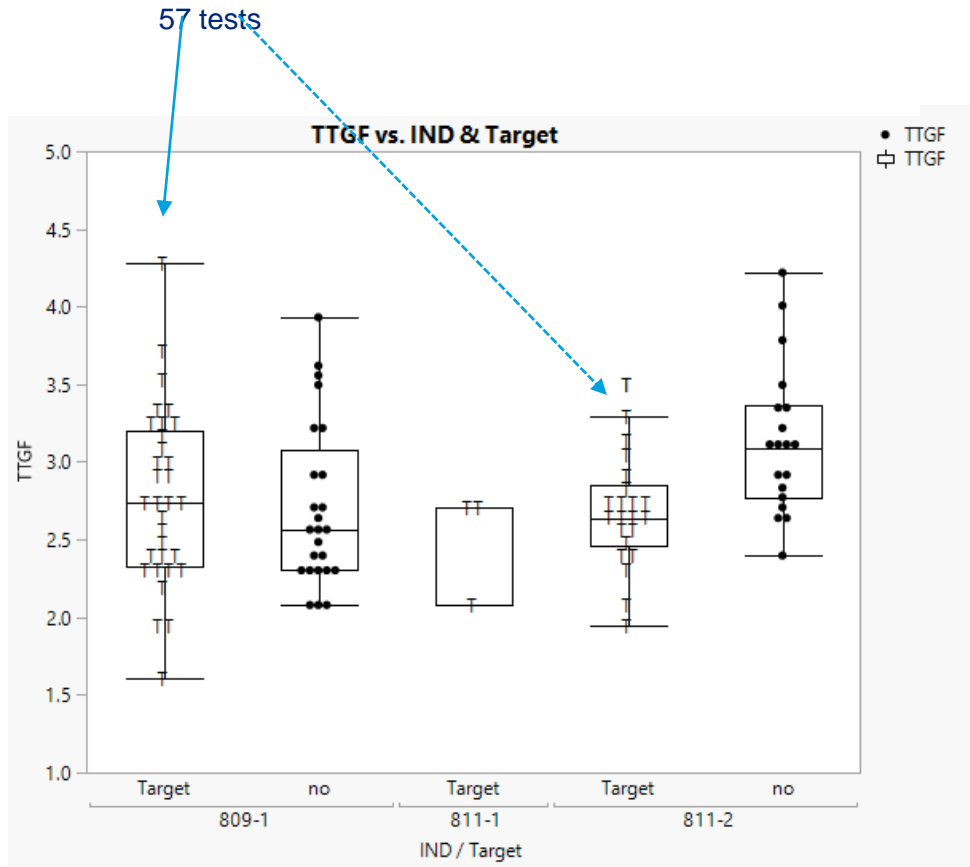
0.506358

Summary of Fit		Model: Oil
RSquare		0.033469
RSquare Adj		0.013744
Root Mean Square Error		0.506358
Mean of Response		3.211855
Observations (or Sum Wgts)		101

811-1 => 3 tests

Previous data set (57 tests/ 1Y3998 liner) used for calculating **current standard deviation** – Transformed unit

Combined data set (101 tests/ 1Y3998 liner) used for calculating **proposed standard deviation** - Transformed unit





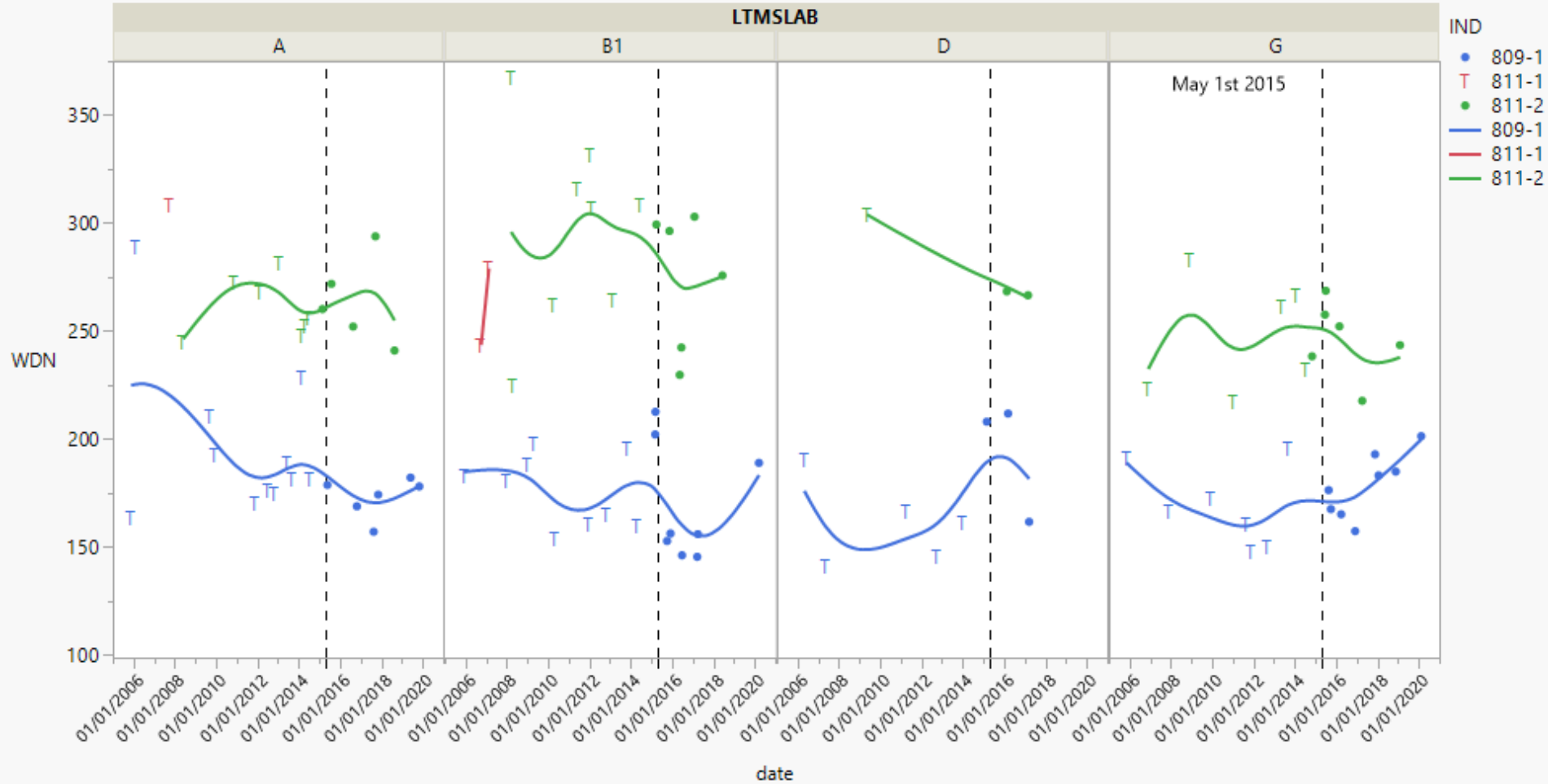
# Plots – Other parameters

# Weighted demerits (1Y3998 liner) over time by Lab and Oil

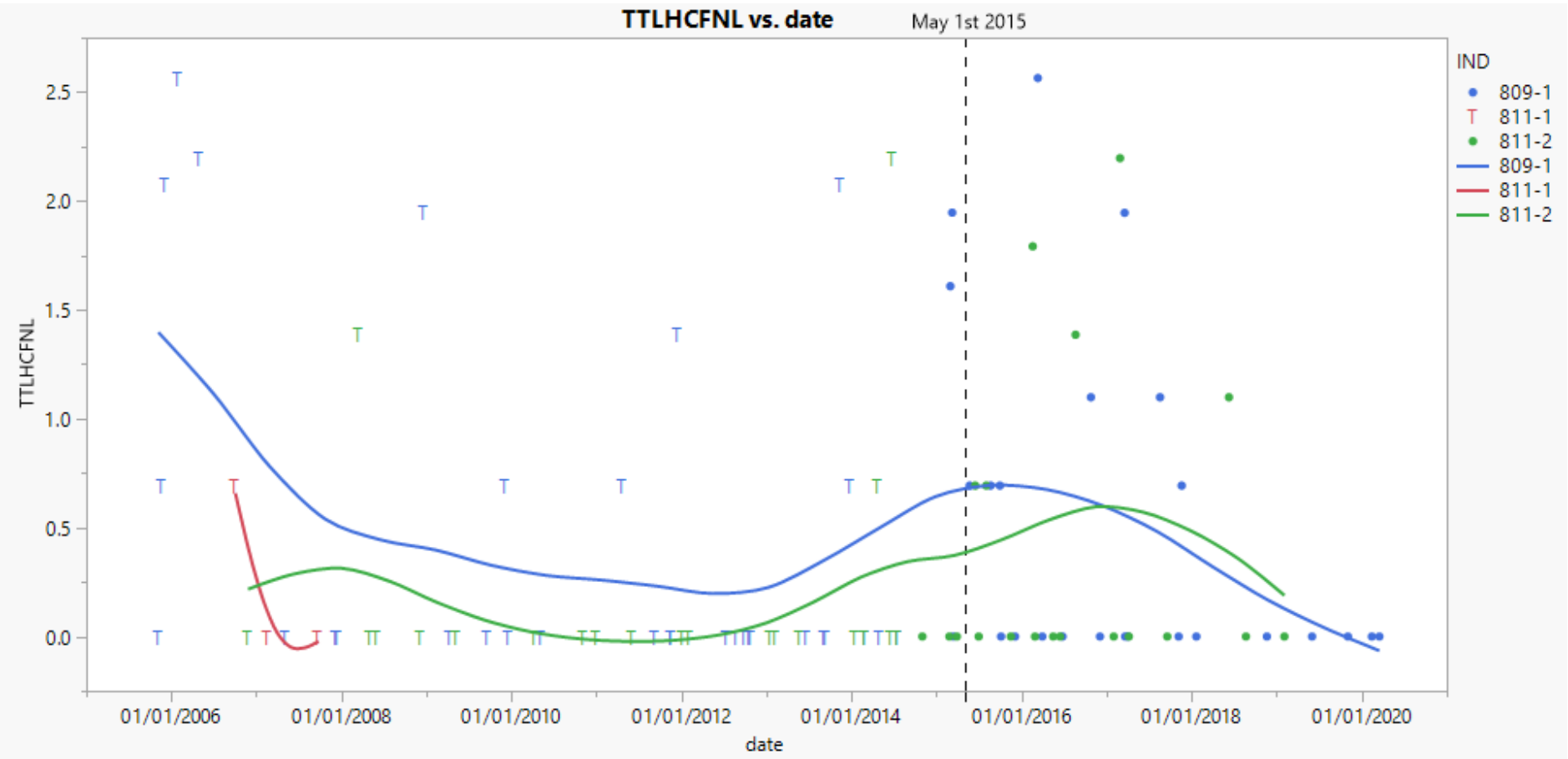


WDN vs. date

LTMSLAB

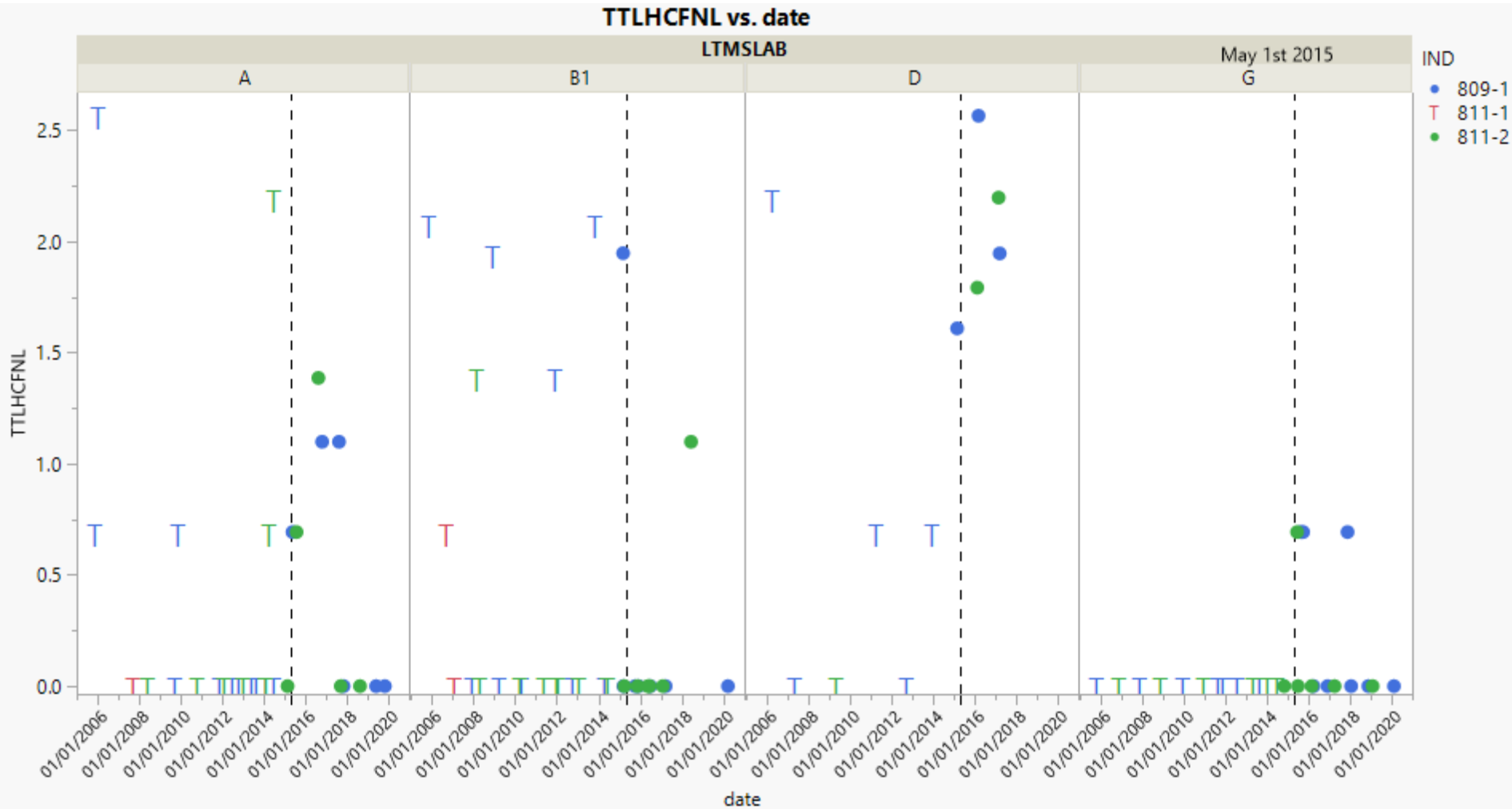


# Top Land Heavy Carbon (1Y3998 liner) over time by Oil (transformed unit)

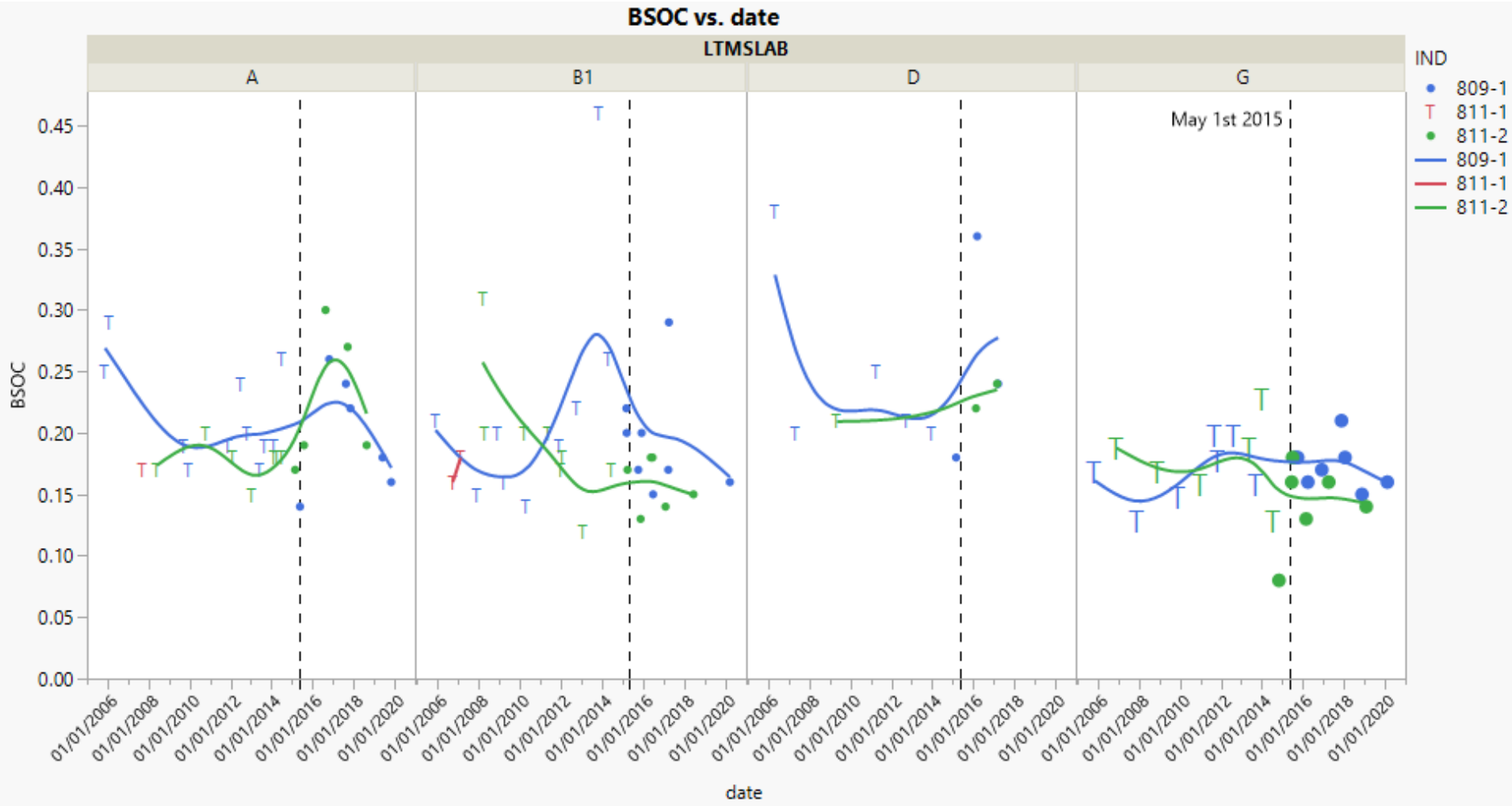


# Top Land Heavy Carbon (1Y3998 liner) over time by Lab and Oil

Labs: A, B1, D and G



# Average Oil Consumption g/kW-h (1Y3998 liner) over time by Lab and Oil



# Proposed standard deviations by oil



IND	Liner2	N Rows	Mean(TTGFFNL)	Std Dev(TTGFFNL)
809-1	New	57	3.154254754	0.532380411
811-1	New	3	2.918468	0.362926998
811-2	New	41	3.313400415	0.474120965
IND	Liner2	N Rows	Mean(WDN)	Std Dev(WDN)
809-1	New	57	177.8263158	24.81789048
811-1	New	3	276.9	32.40108023
811-2	New	41	267.5463415	32.22211273
IND	Liner2	N Rows	Mean(TTLHCFNL)	Std Dev(TTLHCFNL)
809-1	New	57	0.492298246	0.789975948
811-1	New	3	0.231	0.400103737
811-2	New	41	0.296	0.627757238
IND	Liner2	N Rows	Mean(BSOC)	Std Dev(BSOC)
809-1	New	57	0.205087719	0.060122577
811-1	New	3	0.17	0.01
811-2	New	41	0.181707317	0.044096623

# Proposed standard deviation for calculating severity adjustments

- Exceed EWMA laboratory chart action limit for severity (all parameters noted below)
  - Calculate laboratory Severity Adjustment (SA) for each parameter that exceeds action limit, using the current laboratory EWMA ( $Z_i$ ) as follows:

Weighted Demerits:	$SA = (-Z_i) \times (27.1)^1$
Top Groove Fill:	$SA = (-Z_i) \times (0.488165)^2$
Top Land Heavy Carbon:	$SA = (-Z_i) \times (0.9)^1$



Based on 101 tests on liner 1Y3998, updated to 0.5064

<sup>1</sup> s based on reference oil 1004-1

<sup>2</sup> s based on reference oil 811-1 and 811-2 on 1Y-3998 liners

The other two parameters are based on oil 1004-1. Guidance from the SP is needed if there is need to update them.

# Appendices





### IN Reference Oil Targets

Oil	n	Effective Dates		WDN		TGF <sup>3</sup>		TLHC <sup>4</sup>		BSOC	
		From <sup>1</sup>	To <sup>2</sup>	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s
809-1	18	3-14-93	12-7-95	196.6	33.3	32.1	18.8	1.386	1.1	0.325	0.215
	20	12-8-95	12-6-07	198.1	33.1	33.9	20.5	1.363	1.1	0.322	0.204
	30	12-7-07	1-31-04	205.0	34.6	35.3	20.5	1.197	1.213	0.308	0.175
	30 <sup>9</sup>	2-1-04	***	205.0	34.6	3.410591	0.563970	1.197	1.213	0.308	0.175
810-2	8 <sup>6</sup>	2-1-98	12-31-99	270.5	39.3	73.6	11.8	2.632	1.2	0.500	0.407
	4	1-1-00	***	273.3	45.5	70.8	11.0	2.548	1.3	0.540	0.410
811-1	10	3-22-93	3-28-96	293.8	38.6	28.9	26.5	0.262	0.5	0.249	0.051
	20	3-29-96	12-6-07	281.5	37.4	24.7	21.6	0.366	0.6	0.223	0.052
	30	12-7-07	1-31-04	273.2	35.5	26.2	19.8	0.454	0.659	0.218	0.053
	30 <sup>9</sup>	2-1-04	***	273.2	35.5	3.077855	0.362927	0.454	0.659	0.218	0.053
811-2 <sup>8</sup>	20	11-26-06	1-31-04	281.5	37.4	24.7	21.6	0.366	0.6	0.223	0.052
	20 <sup>9</sup>	2-1-04	***	281.5	37.4	2.961267	0.361554	0.366	0.6	0.223	0.052
1004	16	6-29-93	***	224.7	37.5	24.8	13.8	0.588	0.8	0.192	0.048
1004-1	30	2-6-94	***	212.4	27.1	24.7	14.6	0.693	0.9	0.201	0.045
1004-2 <sup>5</sup>	--	8-11-95	12-10-96	212.3	27.1	24.7	14.6	0.693	0.9	0.201	0.045
	12	12-11-96	12-21-97	205.9	28.9	31.7	14.8	0.552	0.904	0.206	0.093
	22	12-22-97	***	204.0	25.7	30.4	16.8	0.490	0.804	0.206	0.075
1004-3 <sup>7</sup>	--	4-17-99	3-13-04	204.0	25.7	30.4	16.8	0.490	0.804	0.206	0.075
	16	3-14-04	1-31-04	190.7	24.7	23.9	14.6	0.1806	0.3977	0.148	0.038
	16 <sup>9</sup>	2-1-04	***	190.7	24.7	3.059337	0.581279	0.1806	0.3977	0.148	0.038

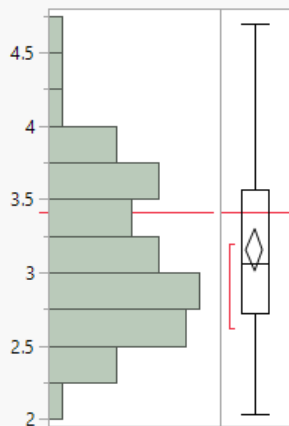
- 1 Effective for all tests completed on or after this date.
- 2 \*\*\* = currently in effect.
- 3 Transformation for TGF is  $\ln(\text{TGF}+1)$ .
- 4 Transformation for TLHC is  $\ln(\text{TLHC}+1)$ .
- 5 Initial targets based on 1004-1.
- 6 Three runs on 810-1 and five runs on 810-2.

- 7 Initial targets based on 1004-2.
- 8 Initial targets based on 811-1
- 9 Targets valid for 1Y3998 liners only

# New Material: to be discussed at SP meeting 8/13/2020

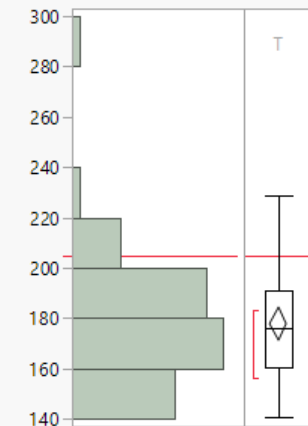
Distributions IND= 809-1

TTGFFNL



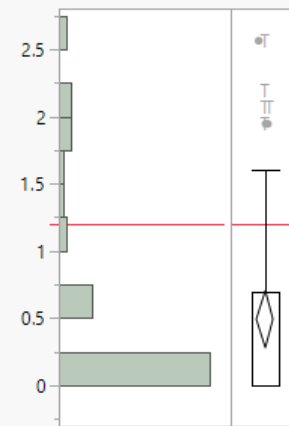
Summary Statistics	
Mean	3.1542548
Std Dev	0.5323804
Std Err Mean	0.0705155
Upper 95% Mean	3.2955143
Lower 95% Mean	3.0129952
N	57

WDN



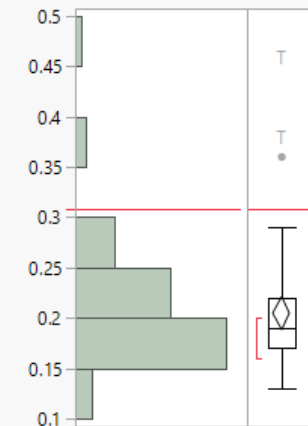
Summary Statistics	
Mean	177.82632
Std Dev	24.81789
Std Err Mean	3.2872099
Upper 95% Mean	184.41139
Lower 95% Mean	171.24124
N	57

TTLHCFNL



Summary Statistics	
Mean	0.4922982
Std Dev	0.7899759
Std Err Mean	0.1046349
Upper 95% Mean	0.7019071
Lower 95% Mean	0.2826894
N	57

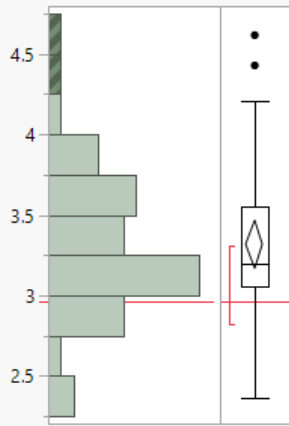
BSOC



Summary Statistics	
Mean	0.2050877
Std Dev	0.0601226
Std Err Mean	0.0079634
Upper 95% Mean	0.2210404
Lower 95% Mean	0.1891351
N	57

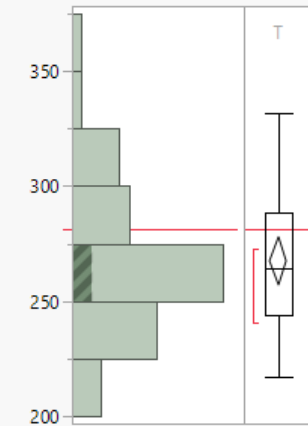
Distributions IND= 811-2

TTGFFNL



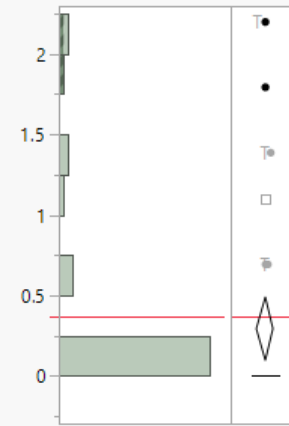
Summary Statistics	
Mean	3.3134004
Std Dev	0.474121
Std Err Mean	0.0740453
Upper 95% Mean	3.4630515
Lower 95% Mean	3.1637494
N	41

WDN



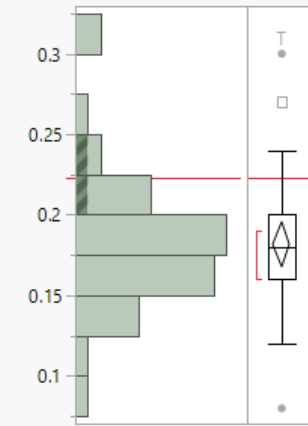
Summary Statistics	
Mean	267.54634
Std Dev	32.222113
Std Err Mean	5.0322486
Upper 95% Mean	277.7169
Lower 95% Mean	257.37579
N	41

TTLHCFNL



Summary Statistics	
Mean	0.296
Std Dev	0.6277572
Std Err Mean	0.0980392
Upper 95% Mean	0.4941446
Lower 95% Mean	0.0978554
N	41

BSOC



Summary Statistics	
Mean	0.1817073
Std Dev	0.0440966
Std Err Mean	0.0068867
Upper 95% Mean	0.1956259
Lower 95% Mean	0.1677887
N	41

New liner data

Horizontal **RED LINE** is the current target

Each plot shows the distribution by parameter and oil

The plots shows how far the current target is from the actual mean

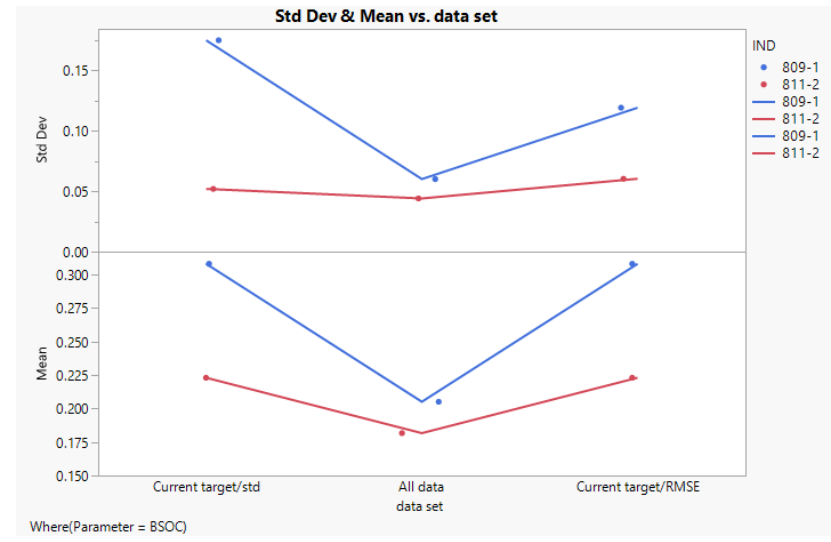
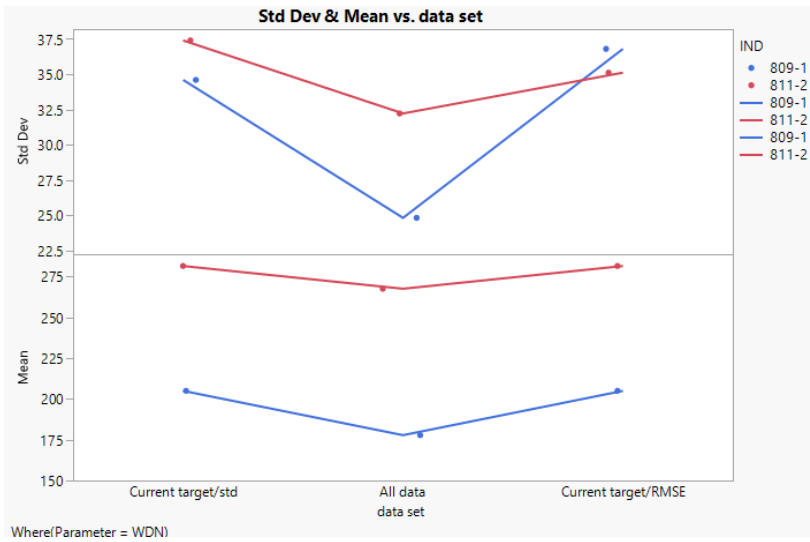
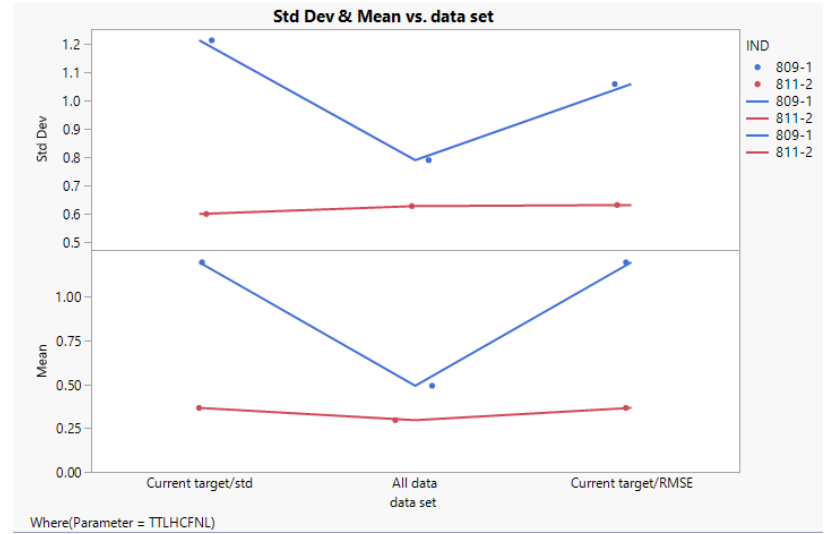
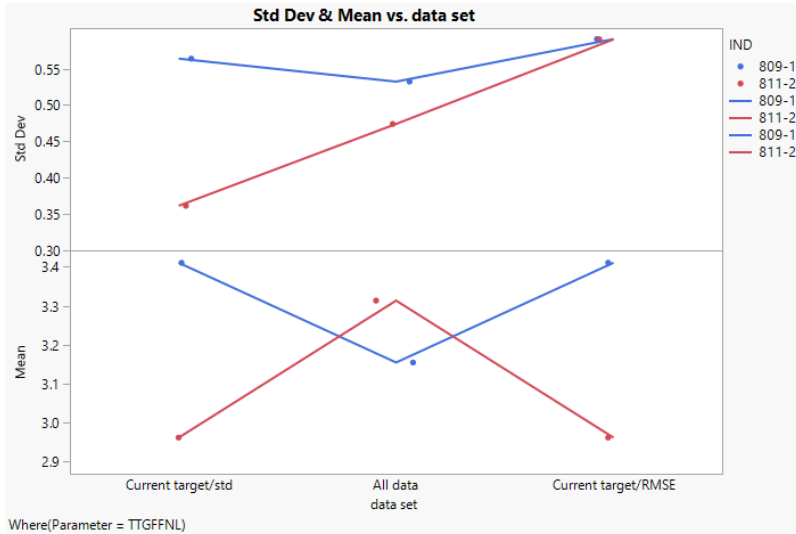
809	All data Mean(TTGFFNL)	811-2	All data Mean(TTGFFNL)
Target	3.410591	Target	2.961267
Mean	3.154255	Mean	3.313400
<b>Std dev</b>	<b>0.532380</b>	<b>Std dev</b>	<b>0.474121</b>
S2	0.283429	S2	0.224791
Mean square error	0.349137	Mean square error	0.348789
<b>RMSE</b>	<b>0.590878</b>	<b>RMSE</b>	<b>0.590583</b>

809	All data Mean(TTLHCFNL)	811-2	All data Mean(TTLHCFNL)
Target	1.197	Target	0.366
Mean	0.492298	Mean	0.296
<b>Std dev</b>	<b>0.789976</b>	<b>Std dev</b>	<b>0.627757</b>
S2	0.624062	S2	0.394079
Mean square error	1.120667	Mean square error	0.398979
<b>RMSE</b>	<b>1.058615</b>	<b>RMSE</b>	<b>0.631648</b>

809	All data Mean(WDN)	811-2	All data Mean(WDN)
Target	205	Target	281.5
Mean	177.826316	Mean	267.546341
<b>Std dev</b>	<b>24.817890</b>	<b>Std dev</b>	<b>32.222113</b>
S2	615.927688	S2	1038.264549
Mean square error	1354.336802	Mean square error	1232.969135
<b>RMSE</b>	<b>36.801315</b>	<b>RMSE</b>	<b>35.113660</b>

809	All data Mean(BSOC)	811-2	All data Mean(BSOC)
Target	0.308	Target	0.223
Mean	0.205088	Mean	0.181707
<b>Std dev</b>	<b>0.060123</b>	<b>Std dev</b>	<b>0.044097</b>
S2	0.003615	S2	0.001945
Mean square error	0.014206	Mean square error	0.003650
<b>RMSE</b>	<b>0.119188</b>	<b>RMSE</b>	<b>0.060412</b>

# Comparing Current Target/ Std Deviation with Updated values with “All Data” and RMSE



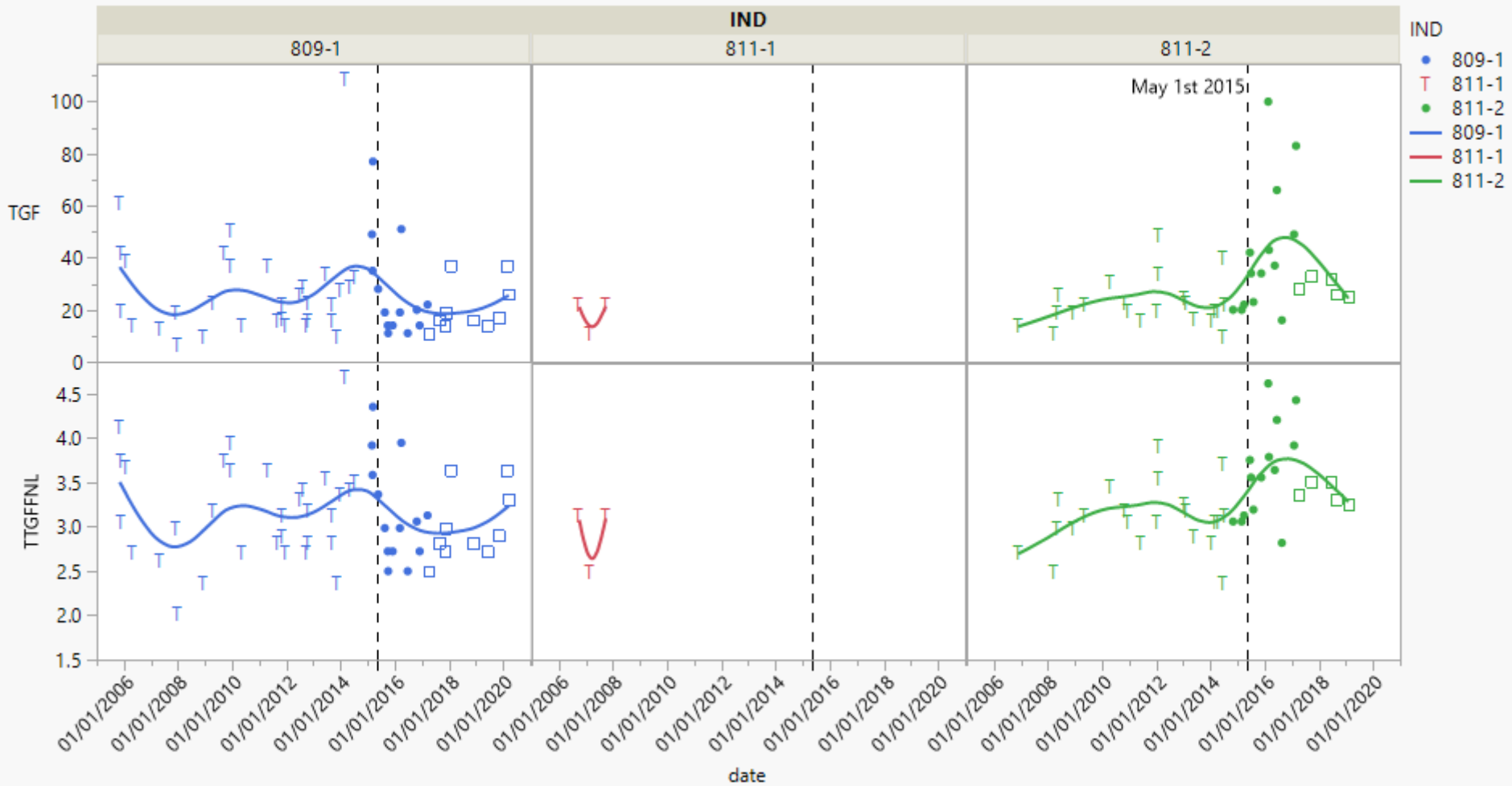
## Mean and Standard Deviation By Oil for different subsets of data

IND	Liner2	N Rows all data	All data Mean(TTGFNL)	All data Std Dev(TTGFNL)	N Rows target	Current target	Current Std Dev	N Rows 04/2017 forward	04/2017 forward Mean	04/2017 forward Std Dev	N Rows 2018 frw	2018 forward Mean	2018 forward Std Dev	N Rows excl D1 811-2	excl D1 811-2 Mean	excl D1 811-2 Std Dev
809-1	New	57	3.154254754	0.532380411	30	3.410591	0.56397	10	3.005792	0.393331	6	3.172206	0.41323	57	3.154254754	0.532380411
811-1	New	3	2.918468	0.362926998												
811-2	New	41	3.313400415	0.474120965	20	2.961267	0.361554	5	3.389976	0.117268	3	3.358163	0.135408	39	3.251461769	0.394261078
IND	Liner2	N Rows all data	Mean(WDN)	Std Dev(WDN)	N Rows target			N Rows 04/2017 forward			N Rows 2018 frw			N Rows excl D1 811-2		
809-1	New	57	177.8263158	24.81789048	30	205	34.6	10	179.73	14.47028	6	186.2833333	8.129555133	57	177.8263158	24.81789048
811-1	New	3	276.9	32.40108023												
811-2	New	41	267.5463415	32.22211273	20	281.5	37.4	5	254.28	30.263295	3	253.3333333	19.41039241	39	267.5538462	33.05852741
IND	Liner2	N Rows all data	Mean(TTLHCFNL)	Std Dev(TTLHCFNL)	N Rows target			N Rows 04/2017 forward			N Rows 2018 frw			N Rows excl D1 811-2		
809-1	New	57	0.492298246	0.789975948	30	1.197	1.213	10	0.1792	0.389718	6	0	0	57	0.492298246	0.789975948
811-1	New	3	0.231	0.400103737												
811-2	New	41	0.296	0.627757238	20	0.366	0.6	5	0.2198	0.491488	3	0.366333333	0.634507946	39	0.208897436	0.503029286
IND	Liner2	N Rows all data	Mean(BSOC)	Std Dev(BSOC)	N Rows target			N Rows 04/2017 forward			N Rows 2018 frw			N Rows excl D1 811-2		
809-1	New	57	0.205087719	0.060122577	30	0.308	0.175	10	0.195	0.044783	6	0.165	0.012247449	57	0.205087719	0.060122577
811-1	New	3	0.17	0.01												
811-2	New	41	0.181707317	0.044096623	20	0.223	0.052	5	0.182	0.052631	3	0.16	0.026457513	39	0.179230769	0.043732718

04/2017 forward: symbol □



TGF & TTGFFNL vs. date



# TTGFFNL: Mean standard deviation for different datasets



Clear Favorites

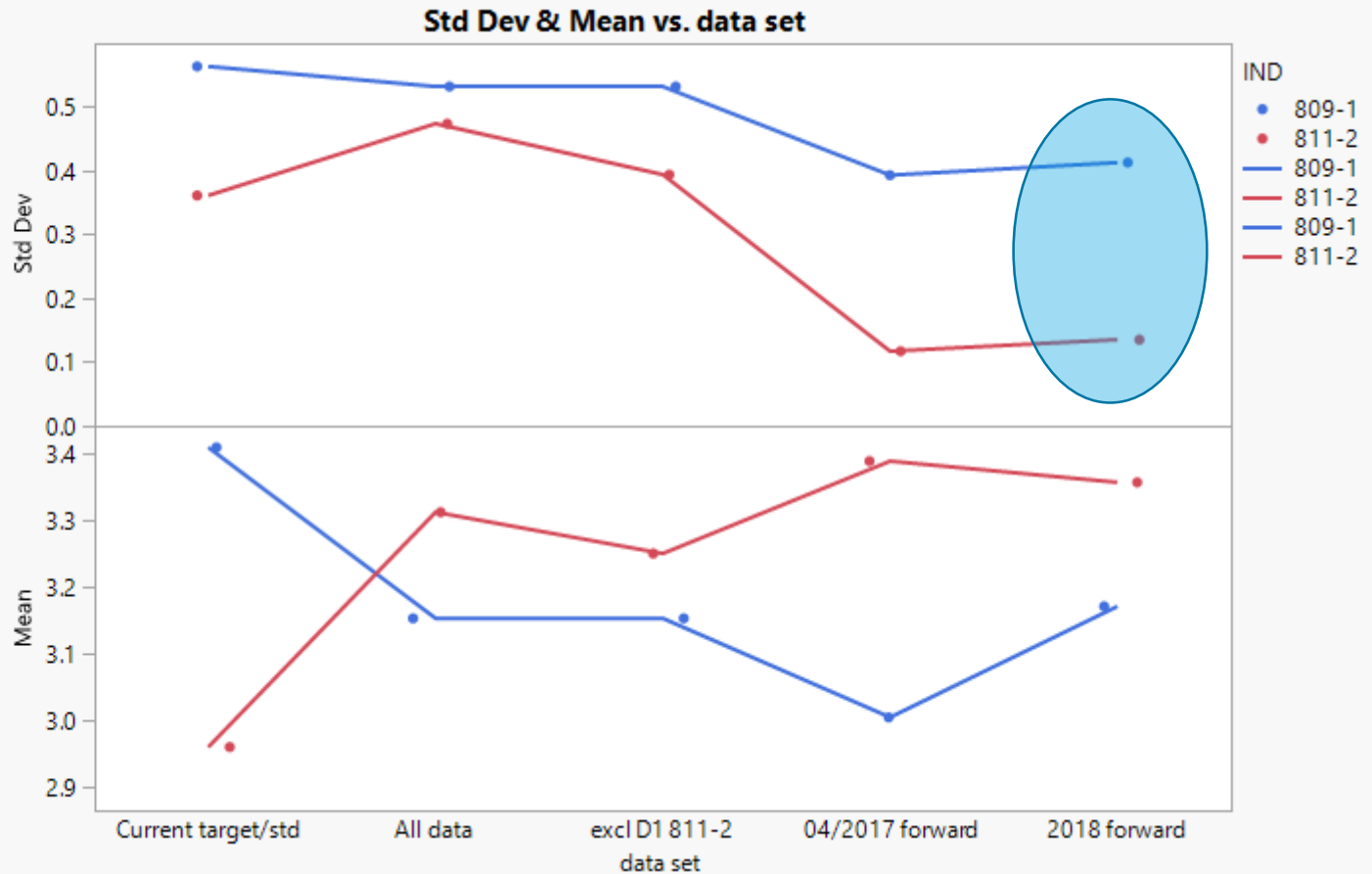
Show  Include  
10 matching rows

Inverse

Parameter (4)

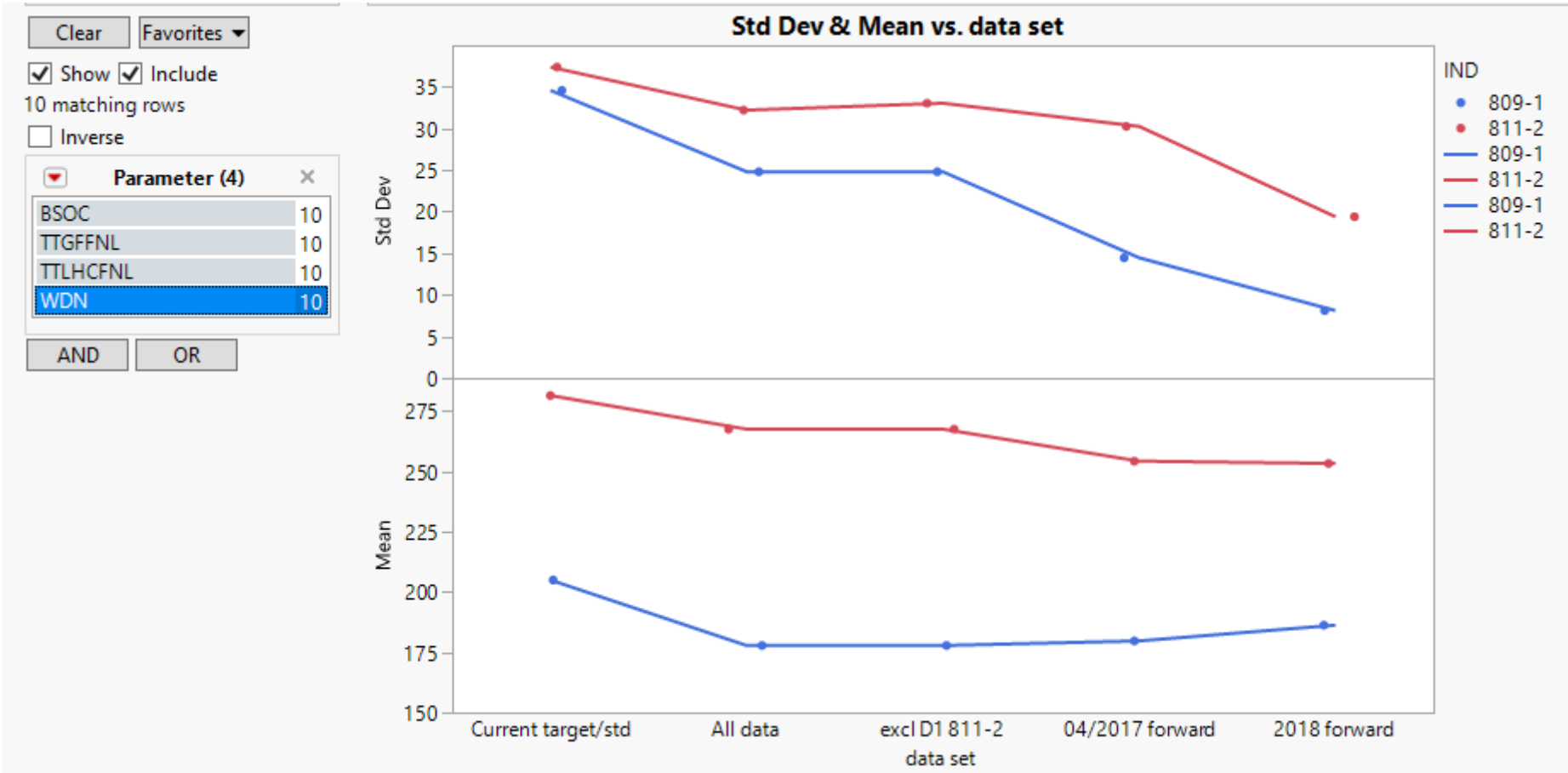
BSOC	10
TTGFFNL	10
TTLHCFNL	10
WDN	10

AND OR

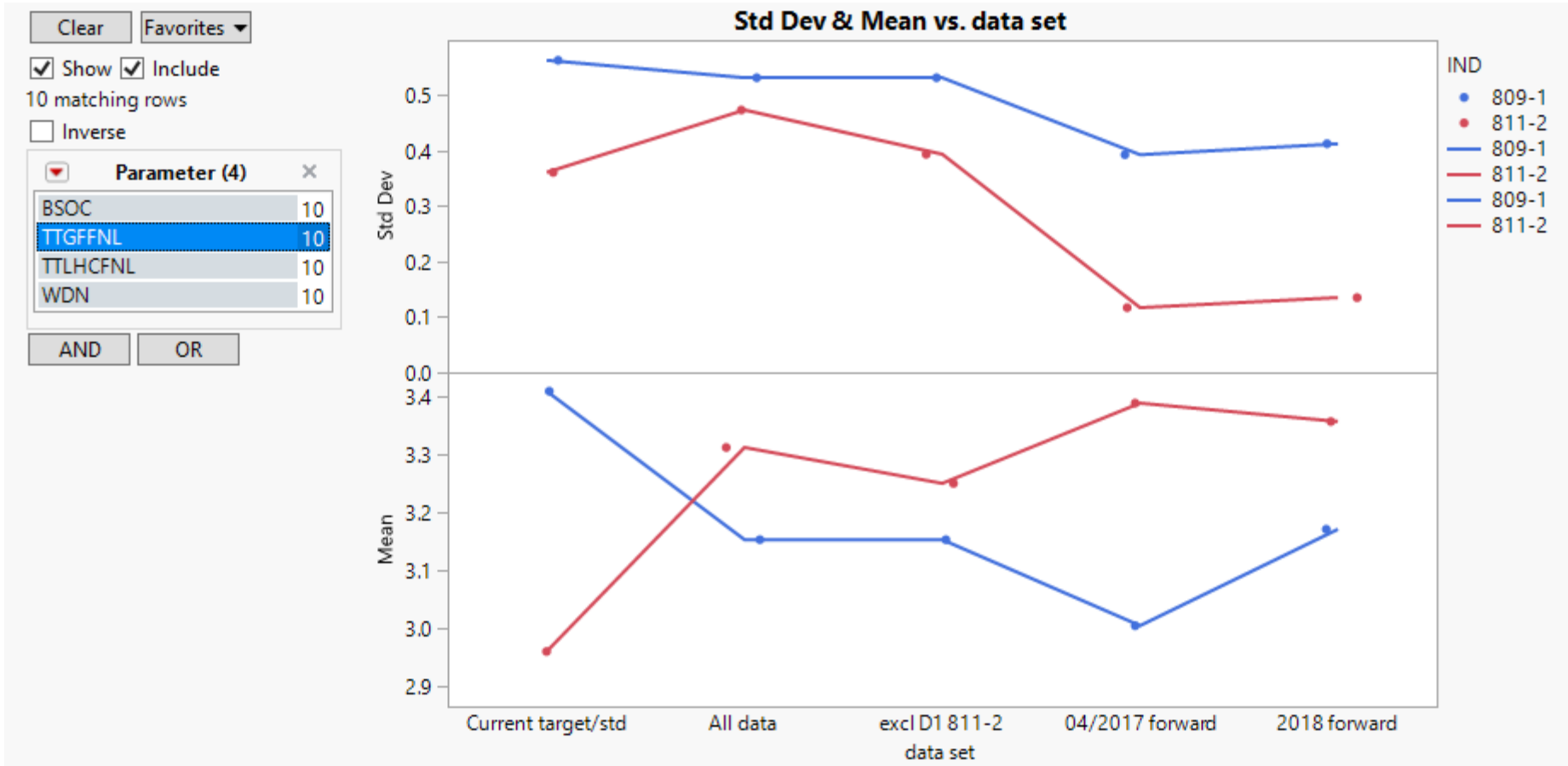




# WDN: Mean standard deviation for different datasets



# TTLHCFNL: Mean standard deviation for different datasets

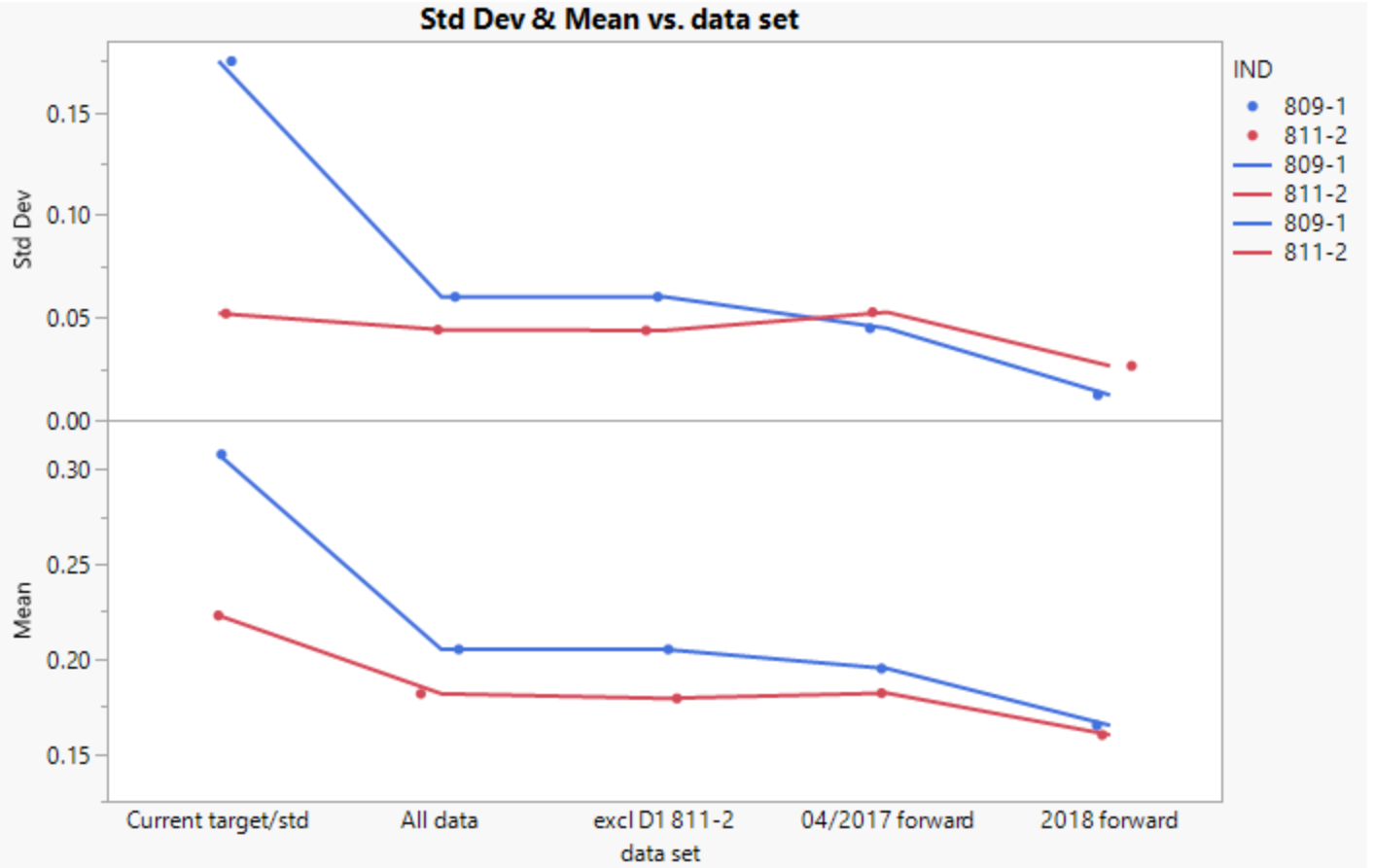


# BSOC: Mean standard deviation for different datasets



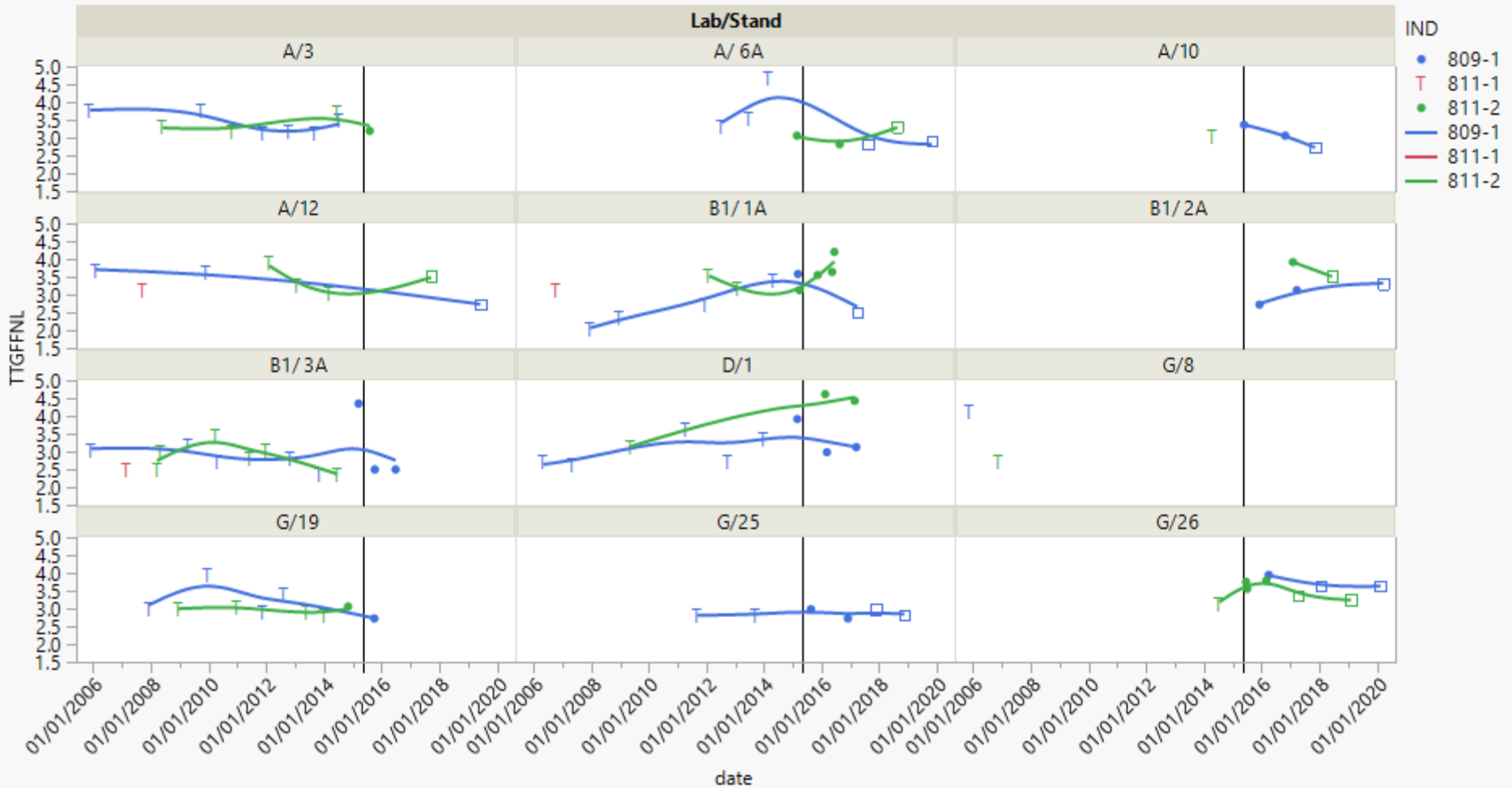
Show
  Include  
 10 matching rows  
 Inverse

Parameter (4)	
BSOC	10
TTGFFNL	10
TTLHCFNL	10
WDN	10

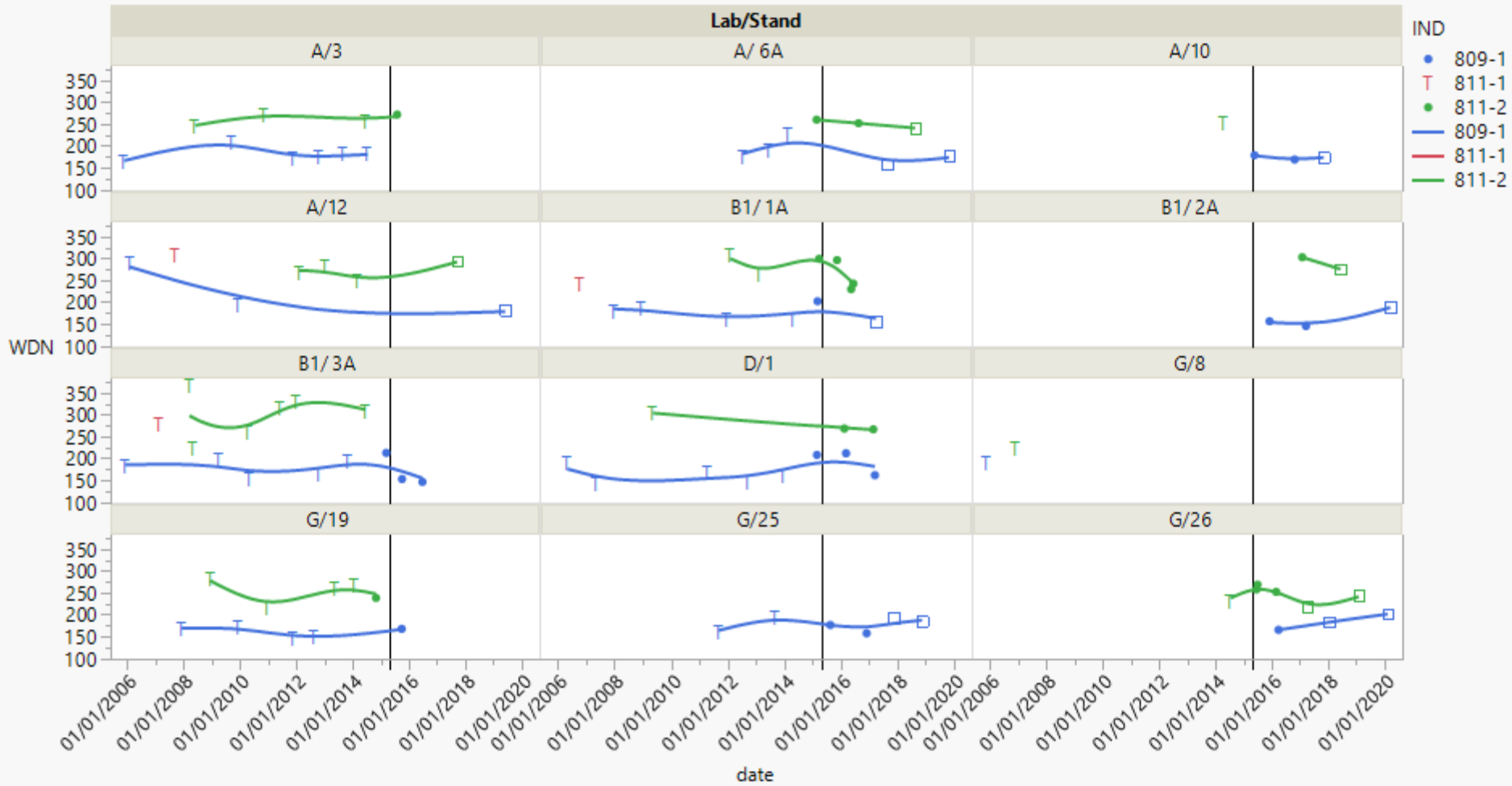


# Additional plots by Lab

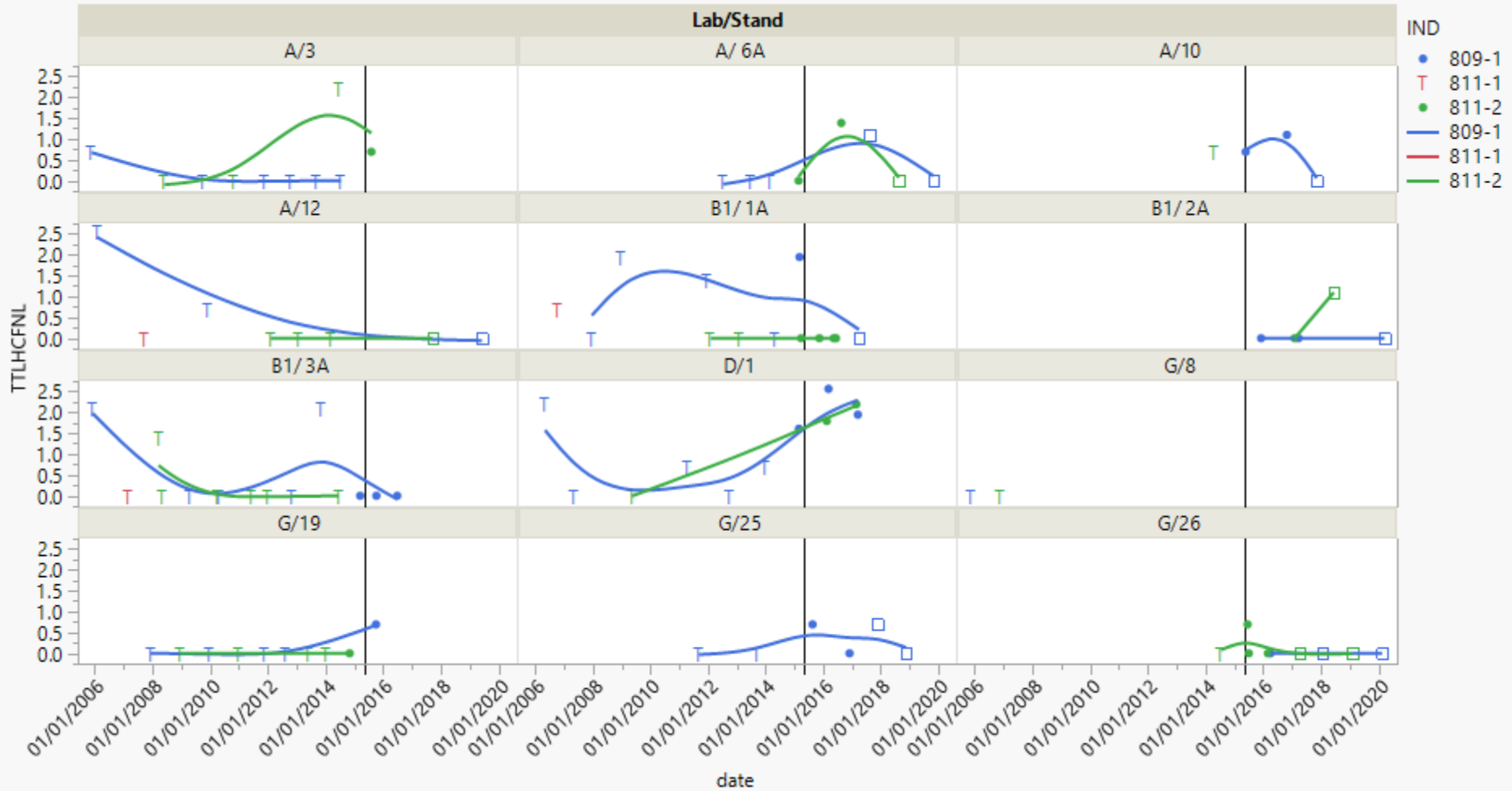
TTGFFNL vs. date



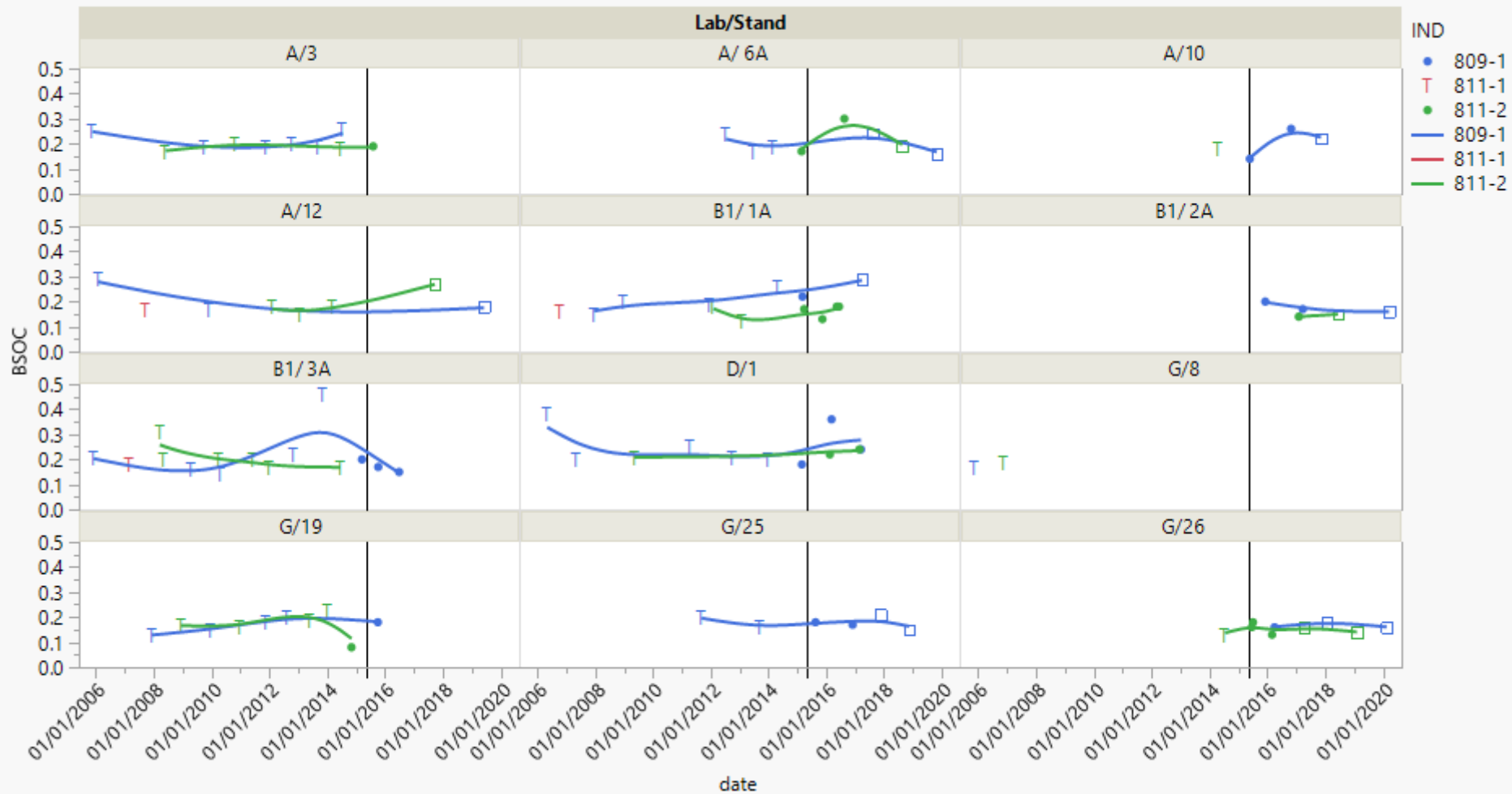
### WDN vs. date



### TTLHCFNL vs. date



### BSOC vs. date





Permission is given for storage of one copy in electronic means for reference purposes. Further reproduction of any material is prohibited without prior written consent of Infineum International Limited.

The information contained in this document is based upon data believed to be reliable at the time of going to press and relates only to the matters specifically mentioned in this document. Although Infineum has used reasonable skill and care in the preparation of this information, in the absence of any overriding obligations arising under a specific contract, no representation, warranty (express or implied), or guarantee is made as to the suitability, accuracy, reliability or completeness of the information; nothing in this document shall reduce the user's responsibility to satisfy itself as to the suitability, accuracy, reliability, and completeness of such information for its particular use; there is no warranty against intellectual property infringement; and Infineum shall not be liable for any loss, damage or injury that may occur from the use of this information other than death or personal injury caused by its negligence. No statement shall be construed as an endorsement of any product or process. For greater certainty, before use of information contained in this document, particularly if the product is used for a purpose or under conditions which are abnormal or not reasonably foreseeable, this information must be reviewed with the supplier of such information.

Links to third party websites from this document are provided solely for your convenience. Infineum does not control and is not responsible for the content of those third party websites. If you decide to access any of those websites, you do so entirely at your own risk. Please also refer to our Privacy Policy.

'INFINEUM', the interlocking Ripple Device, the corporate mark comprising INFINEUM and the interlocking Ripple Device and 润英联 are trademarks of Infineum International Limited.

© 2020 Infineum International Limited. All rights reserved.