Sequence VH O&H Meeting
January 28th, 2025 at 3PM EST via MS Teams

Attendees: Ben Maddock, Al Lopez, Joe Anthony, Dan Engstrom, Rich Grundza, Mike Deegan

Overview:

1. Hardware
2. Operation
3. Fuel
4. February 11th Meeting in San Antonio
5. Other

Notes:

1. Hardware

- Pencool 2000 shortage
    - PenRay discontinued their entire PenCool line (2000, 3000, 4000 and the associated filters). They do not offer an alternative.
    - Alternatives
        - Nalcool NalFleet 2000
        - DELO Extended Life coolant
        - Motorcraft, Dexcool, Peak
    - Labs to check inventory and consult internal experts
        - SwRI, IAR and Afton reported at least 6 months inventory available
        - This topic will be shelved until later in the year

- Runs per camshaft
    - TMC has requested labs to provide camshaft run number values for all reference results
    - Proposal: Complete by March 31st, 2025 to allow labs the time to balance with fuel approval matrix and standard workload

2. Operation

- RO 940 Sludge Formation by fuel batch approval
    - Joe Anthony: “Given that AES was around 7.1 for the two RO940 results, while the RCS left and right results were both in the mid 9’s, it seems that we have sludge here but it may be distributed unevenly across the 9 rated parts.”

Sludge Deposits	
Area	**Merit**
Rocker Arm Cover, Left	RACLSRT
Rocker Arm Cover, Right	RACRSRT
Camshaft Baffle, Left	CAMBLSRT
Camshaft Baffle, Right	CAMBRSRT
Timing Chain Cover	TCCSRT
Oil Pan Baffle	OILPBSRT
Oil Pan	OILPNSRT
Valve Deck Area, Left	VLVDLSRT
Valve Deck Area, Right	VLVDRSRT
Average Engine Sludge	AES

- Divide the rated parts?
  - Lower AES = Oil Pan + Oil Pan Baffle + Timing Chain Cover
  - Upper AES = Left RAC + Right RAC + Left Baffle + Right Baffle + Left VDS + Right VDS
- Evaluate against previous fuel batch approval matrices?
  - DJ is the target distribution of sludge

	A	B	D	G	H	I	J	K	M	N	O	P	Q	R	S	T	U	V	W	X	AA	AH
1	TESTKEY	LTI	LAI	VAL	FUELBTID	IND	DTCOMP	AES_OR	AES	AESyi	RACLSRT	RACRSRT	CAMBLSRT	CAMBRSRT	TCCSRT	OILPBSRT	OILPNSRT	VLVDLSRT	VLVDRSRT	RACS_OF	RACyi	OSCR
37	117503-VH	A	V	NN	DJ0121NX10	940	20160703	6.8	6.8	0.6735	8.11	7.94	5.32	6.94	6.7	8.52	6.2	5.86	5.65	8.02	-1.0283	70
39	109000-VH	G	V	NN	DJ0121NX10	940	20160724	6.88	6.88	0.8367	8.33	8.66	6.71	6.63	6.77	7.79	5.84	5.6	5.6	8.5	-2.2568	98
42	90017-VH	E	V	NN	DJ0121NX10	940	20160902	6.76	6.76	0.5918	8.65	9.13	7.06	5.35	6.44	5.64	6.48	5.9	6.19	8.89	-3.5891	35
43	95499-VH	D1	V	LN	DJ0121NX10	940	20160911	7.25	7.25	1.5918	7.43	8.59	6.02	6.03	6.51	9.12	7.03	7.26	7.26	8.01	-1.006	80
44	109001-VH	G	V	NN	DJ0121NX10	940	20160917	6.5	6.5	0.0612	7.91	7.76	6.11	6.6	6.1	7.84	5.94	3.92	6.36	7.84	-0.6433	97
48	120496-VH	B	V	NN	DJ0121NX10	940	20161020	6.67	6.67	0.4082	7.7	8.06	6.49	5.97	6.57	8.67	6.76	4.94	4.87	7.88	-0.726	100
51	120509-VH	D1	V	NN	DJ0121NX10	940	20161105	6.6	6.6	0.2653	6.67	6.9	5.61	5.3	6.25	8.83	6.59	6.46	6.75	6.78	1.1234	98
54	119149-VH	G	V	NN	DJ0121NX10	940	20170121	6.28	6.28	-0.3878	7.28	7.07	4.61	4.86	6.06	8.66	5.83	5.91	6.2	7.18	0.5364	95
55	119150-VH	G	V	AO	DJ0121NX10	940	20170128	5.88	5.88	-1.2041	7.4	6.73	4.92	4.6	5.76	7.82	5.38	4.85	5.47	7.06	1.1723	98
56	119151-VH	G	V	AO	DJ0121NX10	940	20170129	6.55	6.55	0.1633	7.56	8.01	5.62	5.36	6.31	8.22	6.34	5.89	5.66	7.78	-0.0282	45
58	123887-VH	G	V	AO	DJ0121NX10	940	20170211	6.88	6.88	0.8367	7.82	8.21	6.03	6.39	6.44	7.14	7.21	6.17	6.48	8.02	-0.5171	50
66	121398-VH	D	V	AO	DJ0121NX10	940	20170317	6.87	6.87	0.8163	7.93	7.46	6.07	5.76	6.98	8.33	5.79	6.99	6.51	7.7	0.1231	89
71	108997-VH	A	V	AO	DJ0121NX10	940	20170330	7.16	7.16	1.4082	8.73	8.36	7.44	6.62	7.63	8.6	6.71	3.22	7.16	8.54	-1.8191	80
76	108998-VH	A	V	AO	DJ0121NX10	940	20170413	6.05	6.05	-0.8571	6.87	7.75	5.64	5.71	5.64	7.76	6.18	5.04	3.84	7.31	0.7925	97
79	118698-VH	A	V	AO	DJ0121NX10	940	20170427	6.13	6.13	-0.6939	7.35	8.38	5.06	5.46	5.94	8.38	5.51	5.46	3.64	7.86	-0.185	95
81	129620-VH	E	V	AC	DJ0121NX10	940	20170829	6.47	6.47	0	7.17	7.82	5.84	6.41	6.16	7.26	6.01	6.76	4.81	7.5	0.4794	98
85	129862-VH	A	V	AC	DJ0121NX10	940	20171230	6.5	6.5	0.0612	6.98	7.56	6.05	5.09	6.01	8.06	6.96	6.31	5.48	7.27	0.8556	97
86	132159-VH	B	V	OC	DJ0121NX10	940	20171231	7.37	7.37	1.8367	8.35	8.31	7.03	7.07	7.33	8.81	6.56	6.81	6.08	8.33	-1.2448	94
89	129859-VH	G	V	AC	DJ0121NX10	940	20180128	6.14	6.14	-0.6735	7.84	7.69	5.18	4.78	6.41	7.38	5.99	3.75	6.28	7.76	0.0102	96
117	133492-VH	G	V	AC	DJ0121NX10	940	20180525	6.36	6.36	-0.2245	7.42	8.33	4.8	6.33	6.05	7.23	5.78	5.52	5.74	7.88	-0.2251	65
118	132160-VH	B	V	AC	DJ0121NX10	940	20180601	7.11	7.11	1.3061	7.98	8.51	6.82	6.73	6.25	8.65	6.93	5.8	6.32	8.24	-1.0205	92
121	133513-VH	G	V	AC	DJ0121NX10	940	20180620	5.79	5.79	-1.3878	7.07	6.39	4.6	5.02	5.84	7.66	5.66	4.31	5.6	6.73	1.6269	97
123	121399-VH	D	V	AC	DJ0121NX10	940	20180630	6.4	6.4	-0.1429	7.51	7.21	5.6	4.28	6.8	8.21	5.77	6.93	5.32	7.36	0.7123	97
124	129863-VH	A	V	AC	DJ0121NX10	940	20180706	6.54	6.54	0.1429	7.97	7.08	6.88	5.34	6.58	7.75	6.06	5.62	5.57	7.52	0.4451	95
125	133509-VH	A	V	AC	DJ0121NX10	940	20180730	6.96	6.96	1	8.03	8.16	5.91	6.25	6.56	8.75	7.12	5.8	6.03	8.1	-0.6934	83
126	133514-VH	G	V	AC	DJ0121NX10	940	20180811	5.96	5.96	-1.0408	6.72	7.33	4.34	4.54	6.05	7.41	5.53	6.05	5.63	7.02	1.23	98
128	138240-VH	G	V	AC	DJ0121NX10	940	20180816	6.17	6.17	-0.6122	7.17	6.99	4.64	4.38	5.89	7.81	5.96	6.62	6.05	7.08	1.1431	70
144	136675-VH	B	V	AC	DJ0121NX10	940	20180928	7.19	7.19	1.4694	8.41	8.31	5.82	6.22	7.07	8.57	6.78	6.76	6.76	8.36	-1.3222	88
145	138244-VH	A	V	AC	DJ0121NX10	940	20181003	6.33	6.33	-0.2857	8.27	8.62	4.51	5.84	5.48	7.5	6.46	5.24	5.04	8.44	-1.536	98
249	172586-VH	G	V	NF	N-000010	940	20220730	7.23	7.23	1.551	8.72	9.42	6.73	6.65	7.29	6.45	6.62	6.99	6.22	9.07	-3.7465	40
250	172580-VH	A	V	NF	N-000010	940	20220801	6.08	6.08	-0.7959	7.98	8.91	6.48	6.64	7.04	7.65	6.26	2.61	1.17	8.44	-1.536	96
251	172260-VH	D	V	NF	N-000010	940	20220825	5.91	5.91	-1.1429	7.44	7.7	4.88	4.28	5.75	8.13	5.58	5.13	4.29	7.57	0.3581	94
264	172587-VH	G	V	AF	N-000010-1	940	20221202	6.11	6.11	-0.7347	6.87	7.27	4.58	4.6	5.65	6.84	6.31	7.06	5.83	7.07	1.1577	96
265	172582-VH	A	V	AF	N-000010-1	940	20221207	6.54	6.54	0.1429	8.35	8.81	6.44	6.4	6.62	8.33	7.08	2.86	3.96	8.58	-1.9378	100
275	175643-VH	G	V	AC	N-000010-1	940	20221226	6.7	6.7	0.4694	8.32	8.81	6.22	6.62	6.8	6.47	6.17	5.46	5.41	8.56	-1.878	85
319	176844-VH	G	V	PF	M-000054	940	20250120	7.17	7.17	1.4286	9.07	9.46	6.41	6.52	6.99	8.38	7.22	3.05	7.44	9.26	-4.7231	28
320	Manual Entry	A	V		M-000054	940					9.06	9.27	7.46	7.07	7.97	9.14	6.73	2.61	5.59			

- Column N and AA show AES Yi and RAC Yi, respectively. Green is milder, red is severe
- Columns O through W represent the nine rated parts, red is severe

- The group reached a consensus that the M-000054 fuel is too mild and the lack of sludge in the rocker arm covers needs to be addressed.

3. <u>Fuel</u>

- M-000054 Fuel Batch Approval
  - Pilot batch vs full tank adjustment?
- This topic was tabled due to 1/30 SP meeting

4. <u>February 11th</u>

- In-person lab meeting to discuss VH / VJ

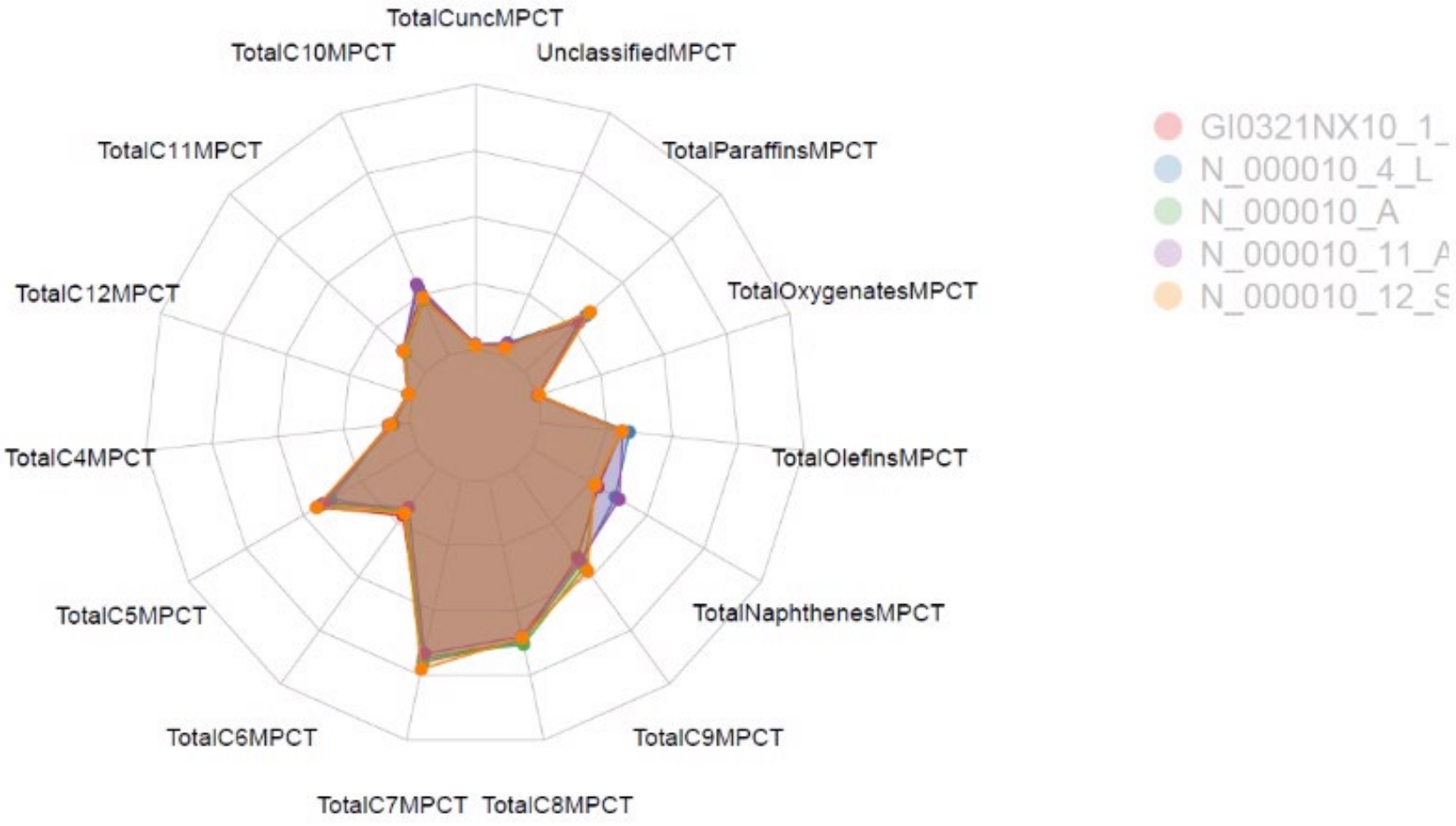
5. **<u>Other</u>**
    a. FCS Order through TEI
        i. "The Pistons and Rings were ordered on November 1st. The lead time for the rings is 69 days and 127 days for the pistons."
        ii. Rings expected January 9th, 2025
            1. Arrived early but missing some from one size.
        iii. Pistons expected March 8th, 2025

Historical Logbook

Date	Topic	Description	Comments
2/12/24	-	O&H formed.	
2/29/24	Hardware	Cam cap anaerobic sealant	IL24-1
3/5/24	Hardware	Cam bearings resolved with King Bearing supply to TEI.	Incl. SwRI bearing analysis
3/12/24	Fuel	N-000010-1+ CofA data integrity review.	Included lab samples to Saybolt
3/26/24	Fuel	Quarterly samples now from test cell	
4/9/24	Hardware	Piston oil hole size differences by piston size not statistically significant to APV	
4/16/24	Operation	Build Workshop conducted	IL24-3 and IL24-4
5/21/24	Fuel	AO content depletion in transit	
5/21/24	Operation	Honing data analysis uninterpretable due to measurement differences	This will be revisited after 2025 fuel approval matrix
6/4/24	Hardware	OHT3G-096-1 brushes explained	IIIG efforts
7/9/24	Operation	OSCR raters group imprecision reviewed	
8/27/24	Hardware	FCS order placed on pistons and rings	
8/27/24	Operation	N-10-1 approval vs PM statistical analysis	
1/7/25	Fuel	RVP adjustments vs fuel dilution	

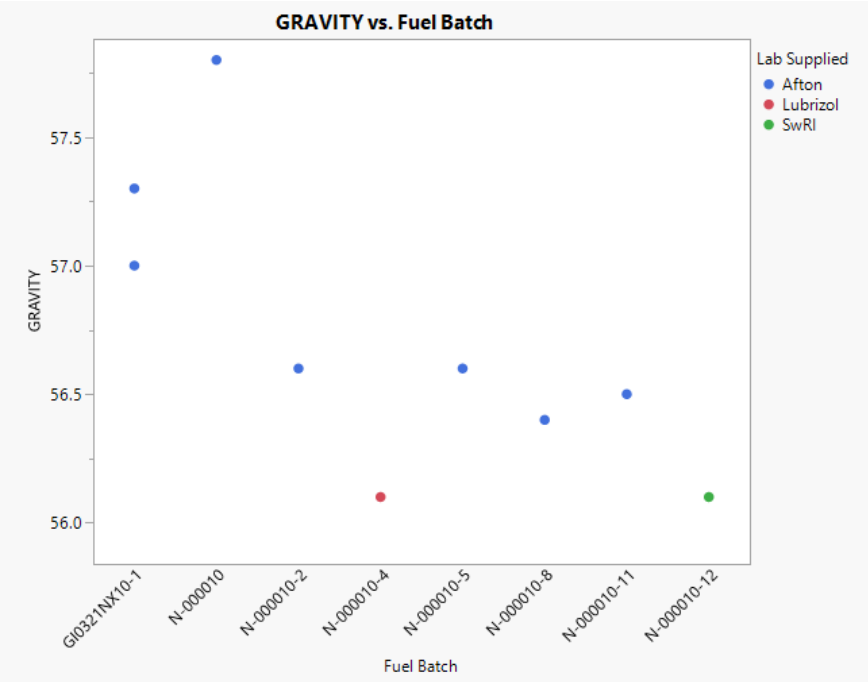
VH Fuel Batch Analysis

DHA Analysis



Gravity and Density

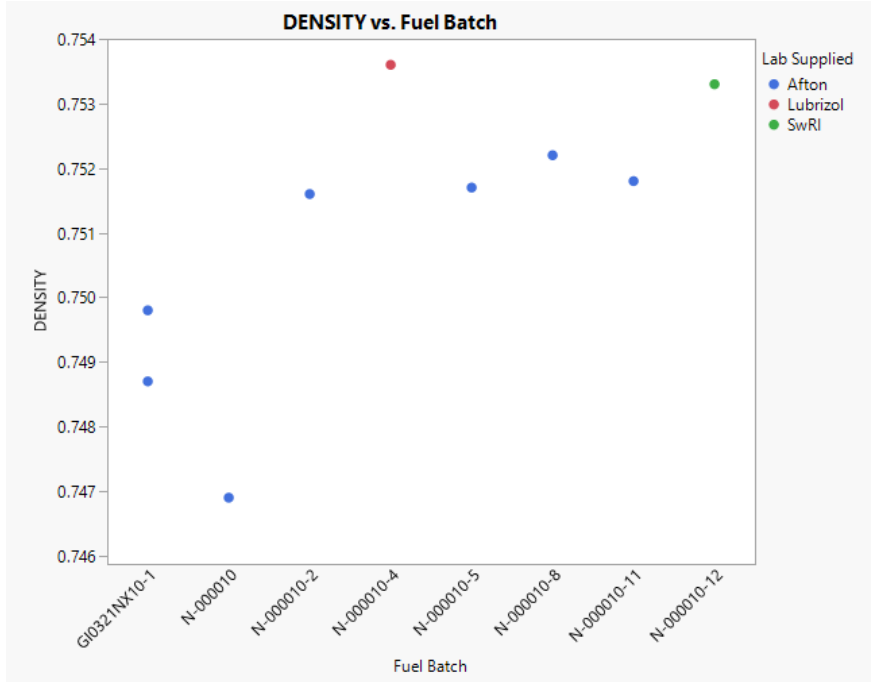
- GI Batch and original N-10 batch higher for gravity and lower for density
- N-10-1+ batches grouped lower for gravity and higher for density



Connecting Letters Report

Level		Mean
N-000010	A	57.800000
GI0321NX10-1	A	57.150000
N-000010-1+	B	56.383333

Levels not connected by same letter are significantly different.



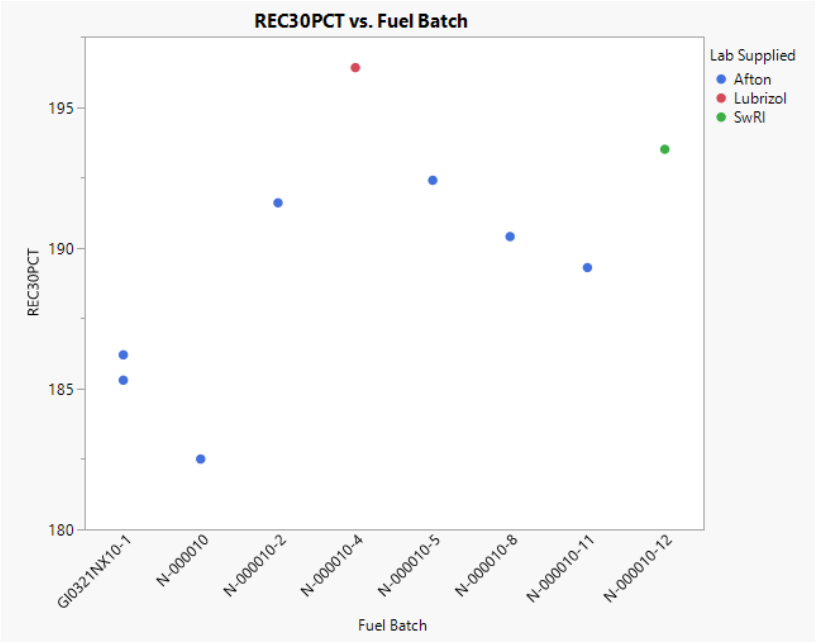
Connecting Letters Report

Level		Mean
N-000010-1+	A	0.75236667
GI0321NX10-1	B	0.74925000
N-000010	B	0.74690000

Levels not connected by same letter are significantly different.

Distillation 30%, 40%, 50%

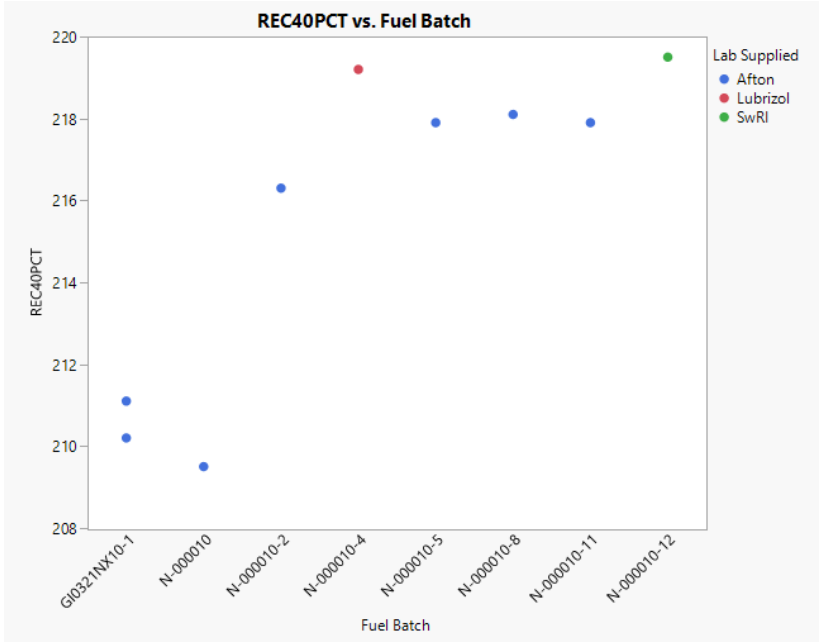
- GI Batch and original N-10 batch lower
- N-10-1+ batches grouped higher



Connecting Letters Report

Level		Mean
N-000010-1+	A	192.26667
GI0321NX10-1	B	185.75000
N-000010	B	182.50000

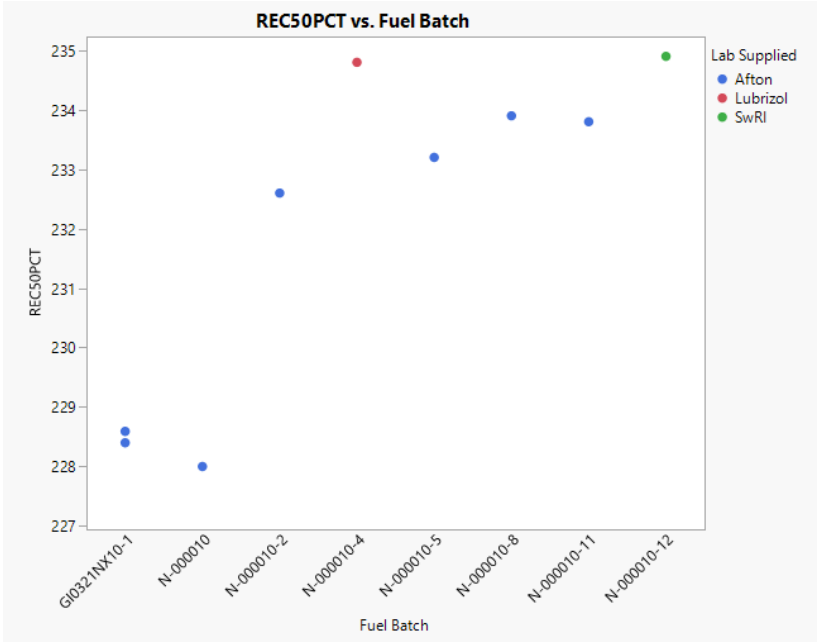
Levels not connected by same letter are significantly different.



Connecting Letters Report

Level		Mean
N-000010-1+	A	218.15000
GI0321NX10-1	B	210.65000
N-000010	B	209.50000

Levels not connected by same letter are significantly different.



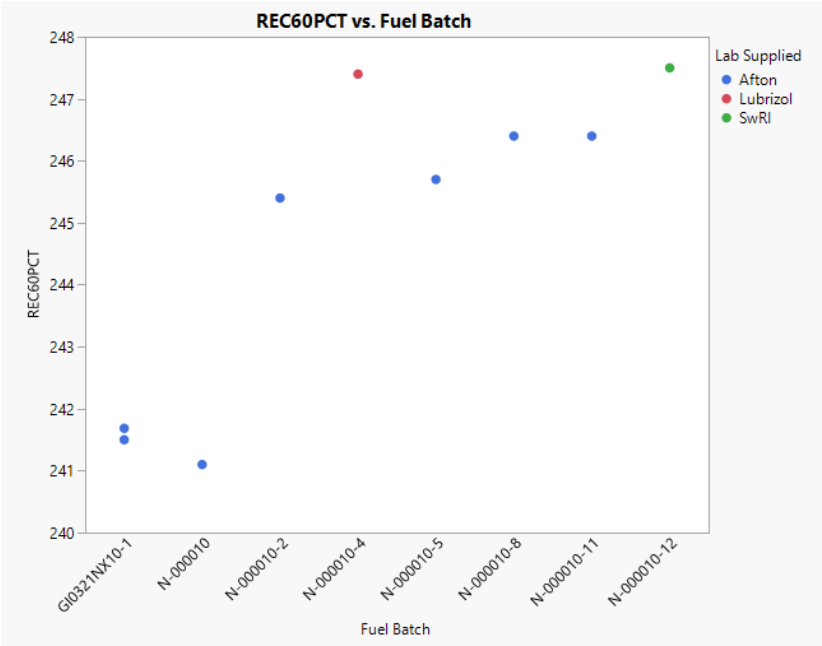
Connecting Letters Report

Level		Mean
N-000010-1+	A	233.86667
GI0321NX10-1	B	228.45000
N-000010	B	228.00000

Levels not connected by same letter are significantly different.

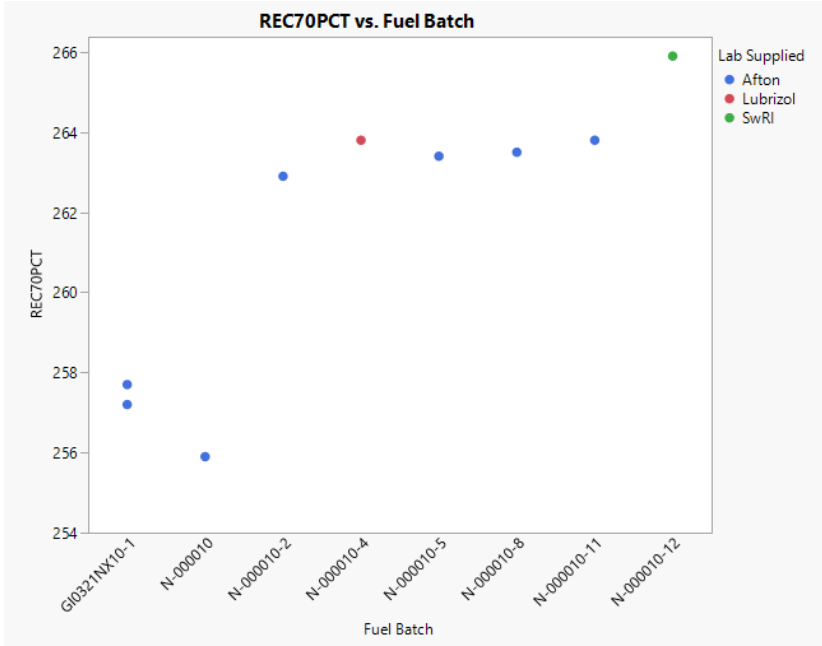
Distillation 60%, 70%, 80%

- GI Batch and original N-10 batch lower
- N-10-1+ batches grouped higher



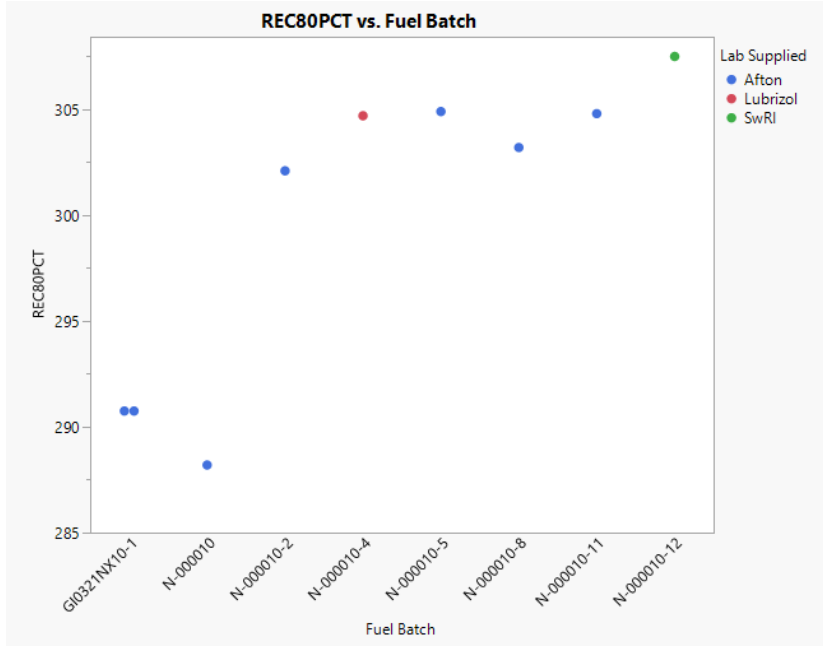
Connecting Letters Report		
Level		Mean
N-000010-1+	A	246.46667
GI0321NX10-1	B	241.55000
N-000010	B	241.10000

Levels not connected by same letter are significantly different.



Connecting Letters Report		
Level		Mean
N-000010-1+	A	263.88333
GI0321NX10-1	B	257.45000
N-000010	B	255.90000

Levels not connected by same letter are significantly different.

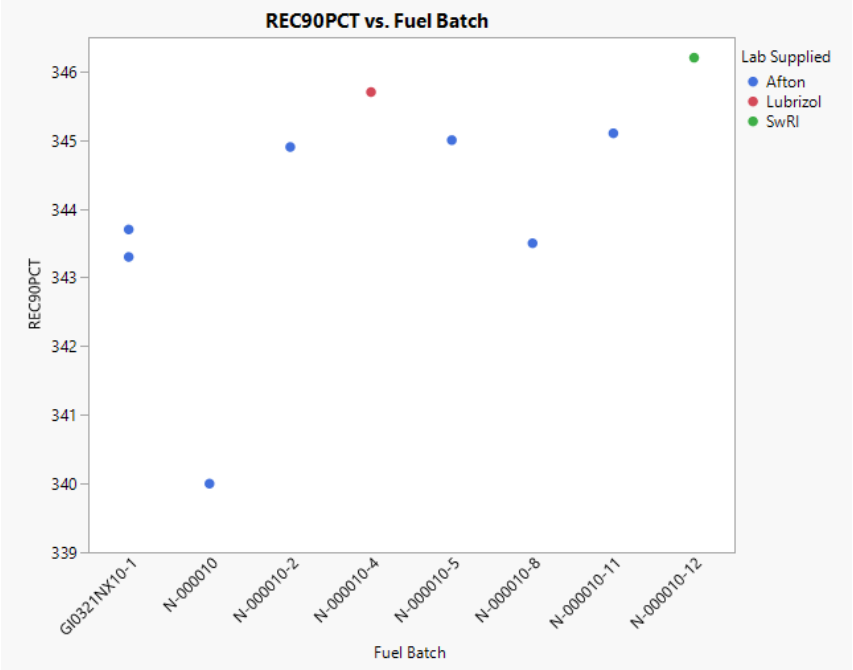


Connecting Letters Report		
Level		Mean
N-000010-1+	A	304.53333
GI0321NX10-1	B	290.75000
N-000010	B	288.20000

Levels not connected by same letter are significantly different.

Distillation 90%, 95%

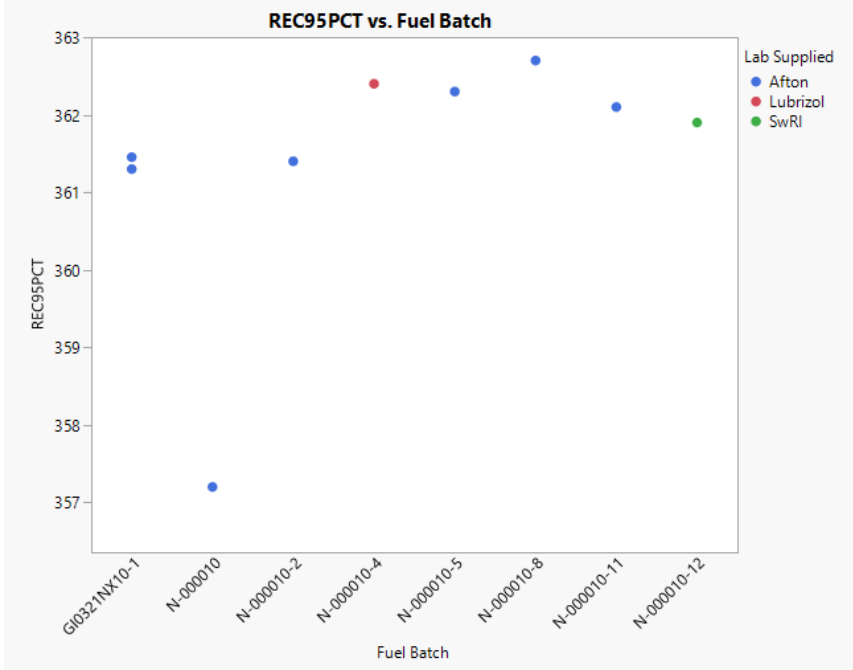
- GI and N-10-1+ batches grouped higher
- Original N-10 batch lower



Connecting Letters Report

Level		Mean
N-000010-1+	A	345.06667
GI0321NX10-1	A	343.50000
N-000010	B	340.00000

Levels not connected by same letter are significantly different.



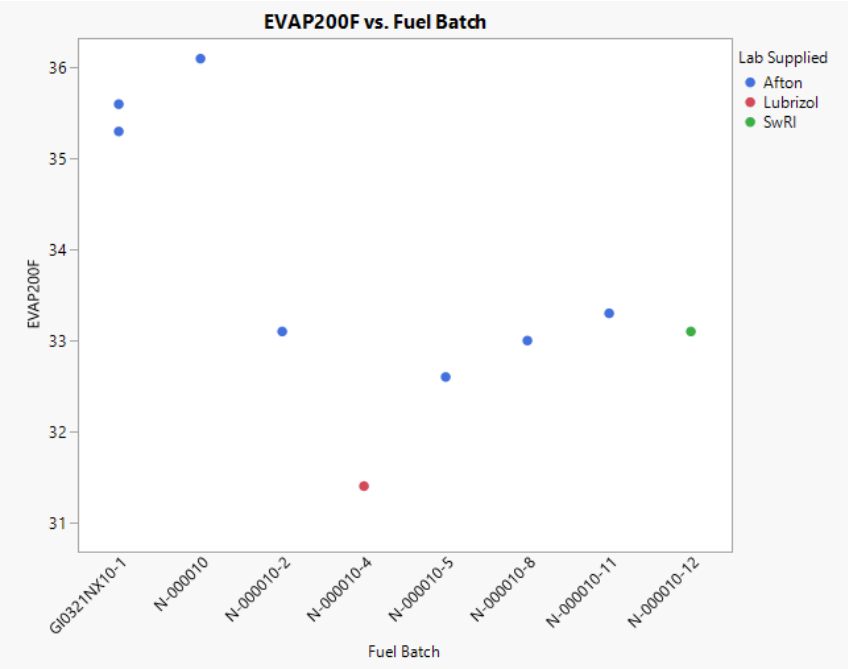
Connecting Letters Report

Level		Mean
N-000010-1+	A	362.13333
GI0321NX10-1	A	361.35000
N-000010	B	357.20000

Levels not connected by same letter are significantly different.

EVAP200F and EVAP300F

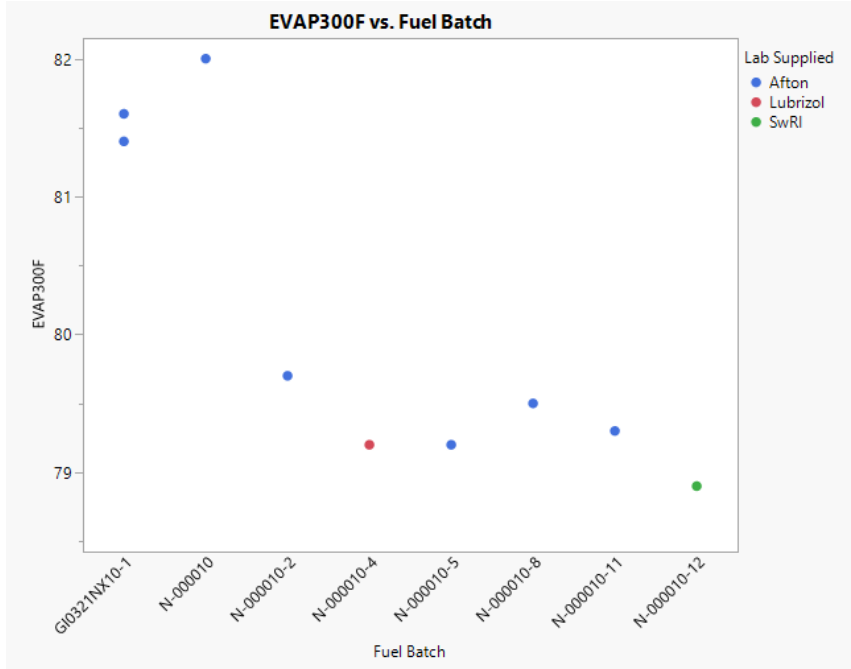
- GI Batch and original N-10 batch higher
- N-10-1+ batches grouped lower



Connecting Letters Report

Level		Mean
N-000010	A	36.100000
GI0321NX10-1	A	35.450000
N-000010-1+	B	32.750000

Levels not connected by same letter are significantly different.



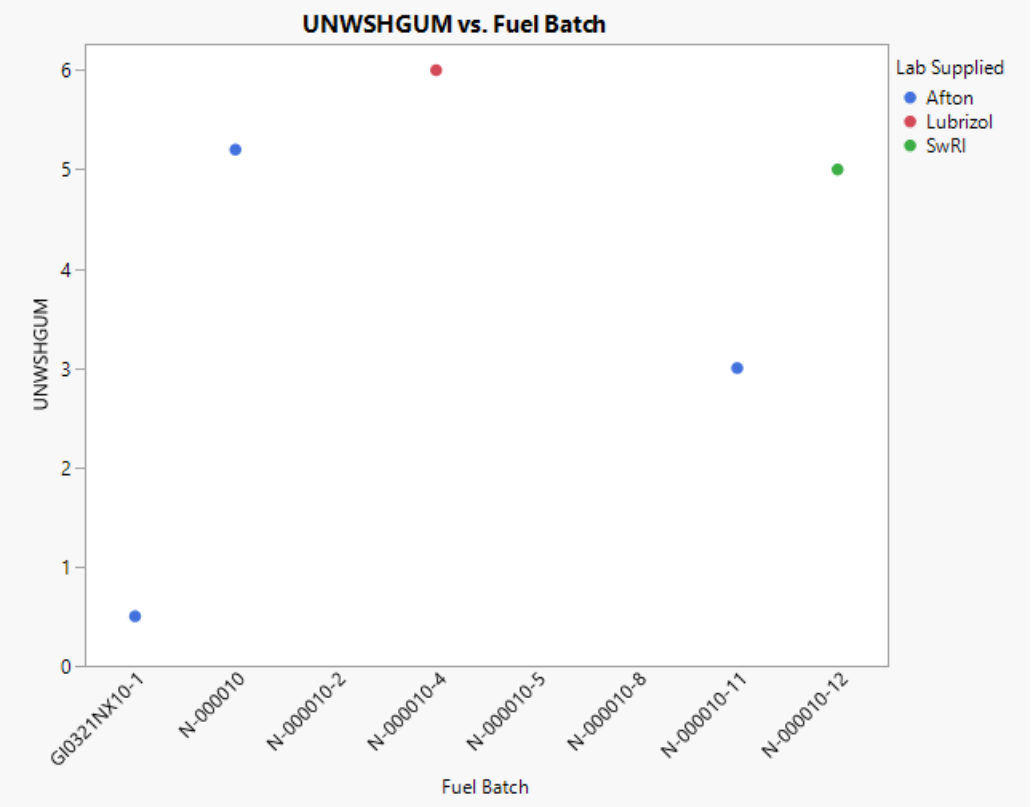
Connecting Letters Report

Level		Mean
N-000010	A	82.000000
GI0321NX10-1	A	81.500000
N-000010-1+	B	79.300000

Levels not connected by same letter are significantly different.

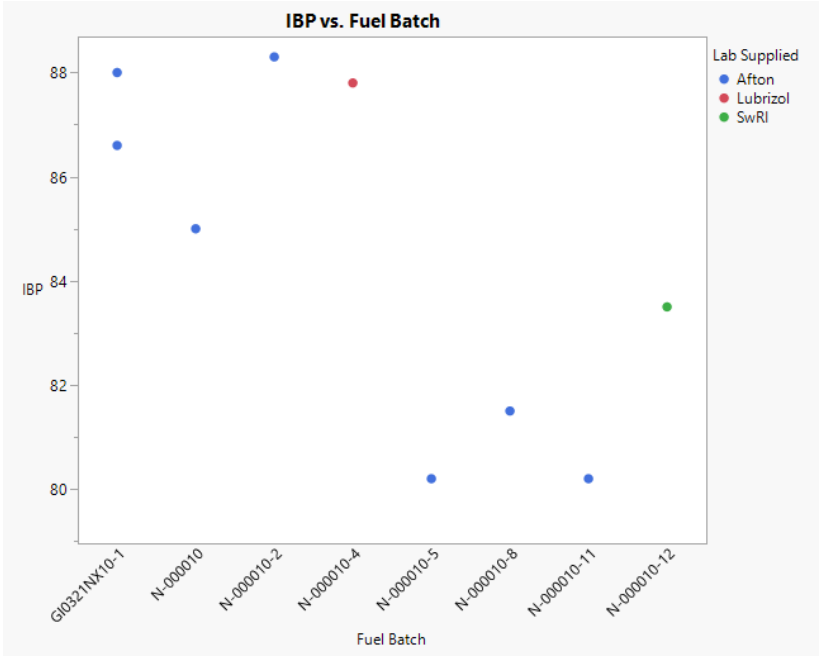
Unwashed Gum

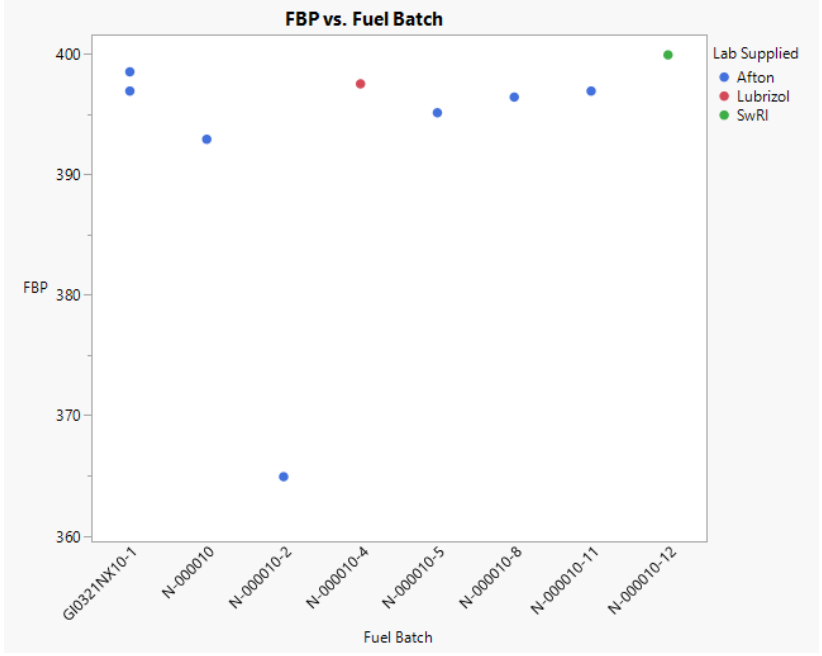
- N-10 batches have much higher unwashed gums, compared to GI batches having <0.5

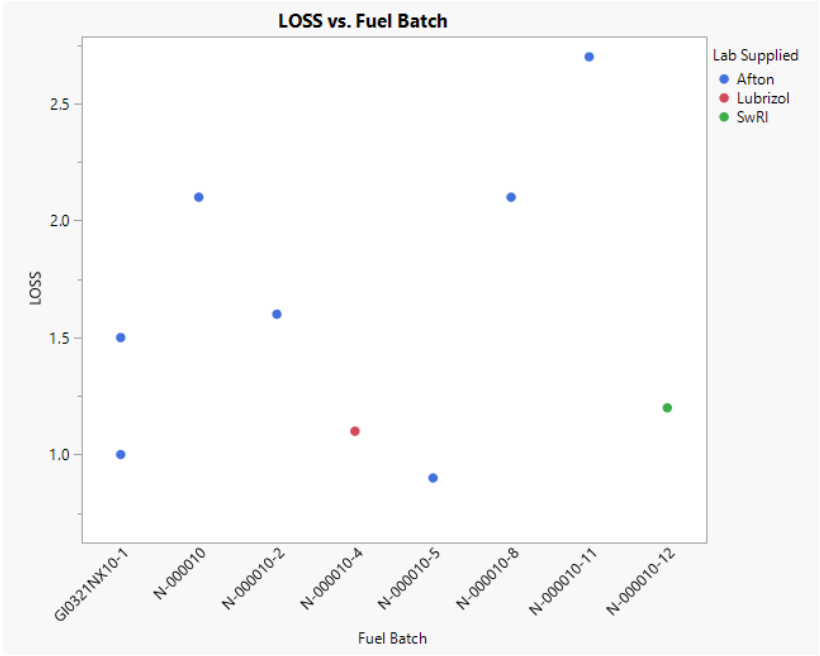


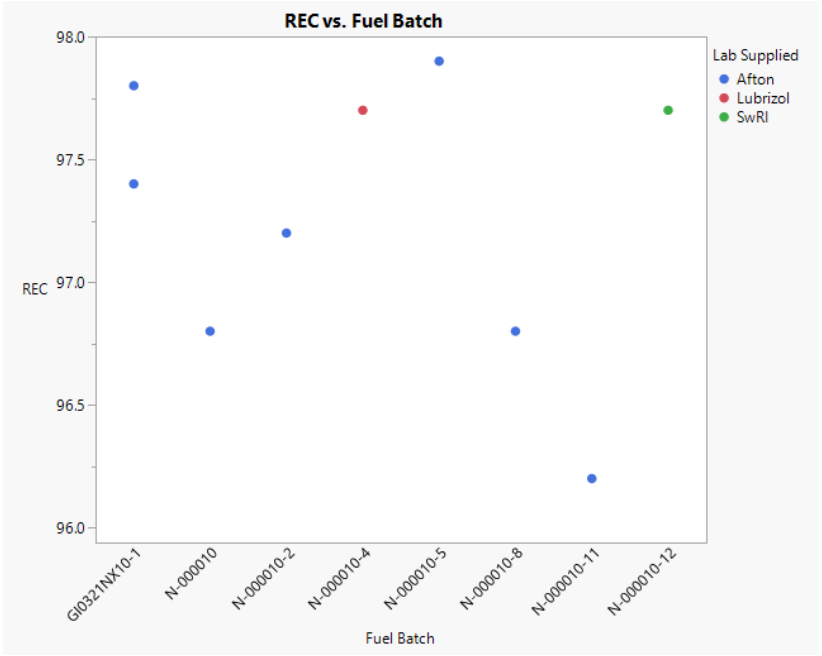
Appendix

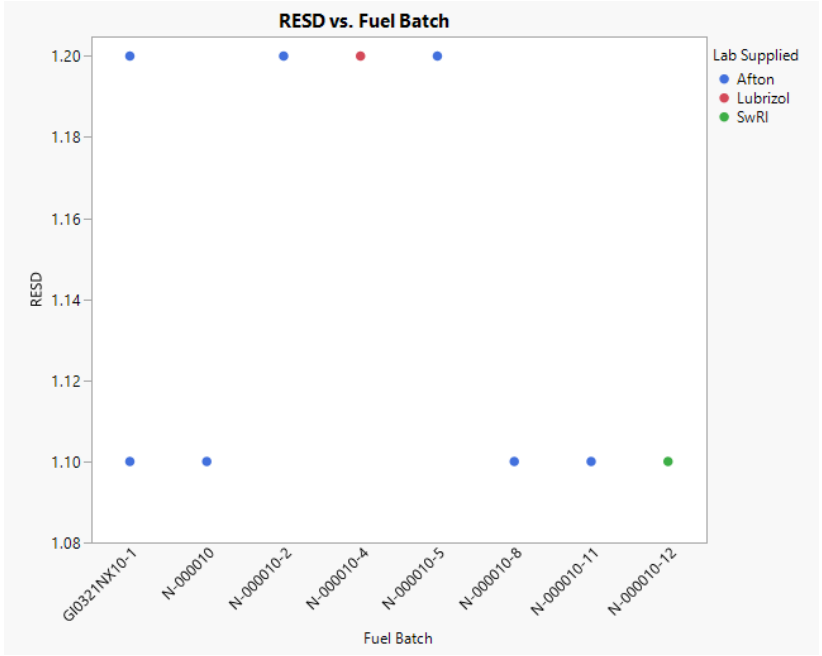
Additional Plots with no significant differences.











Additional Plots with no significant differences.