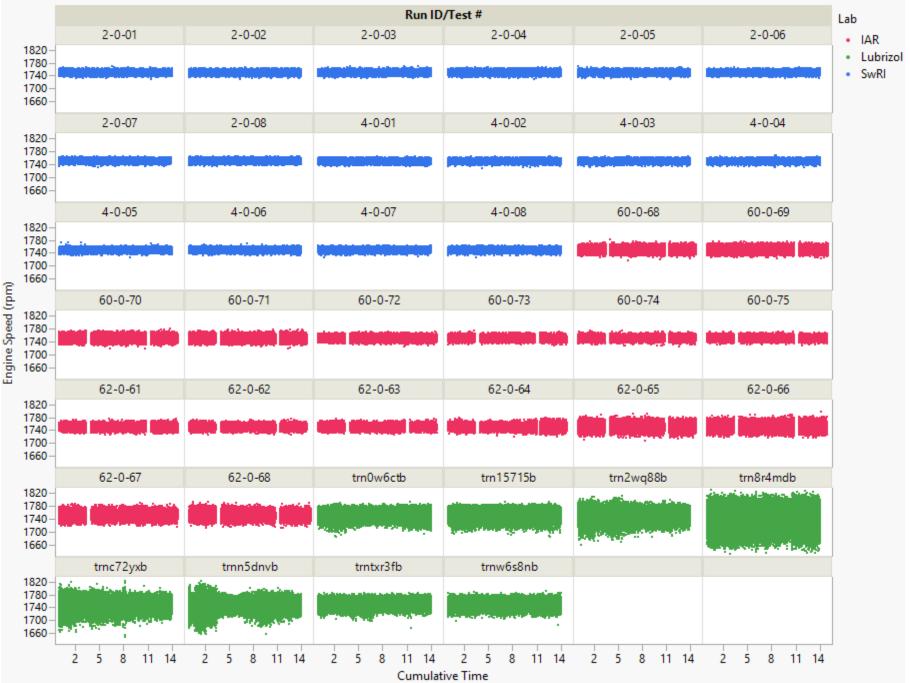
Ford LSPI Prove Out Operational Data Plots

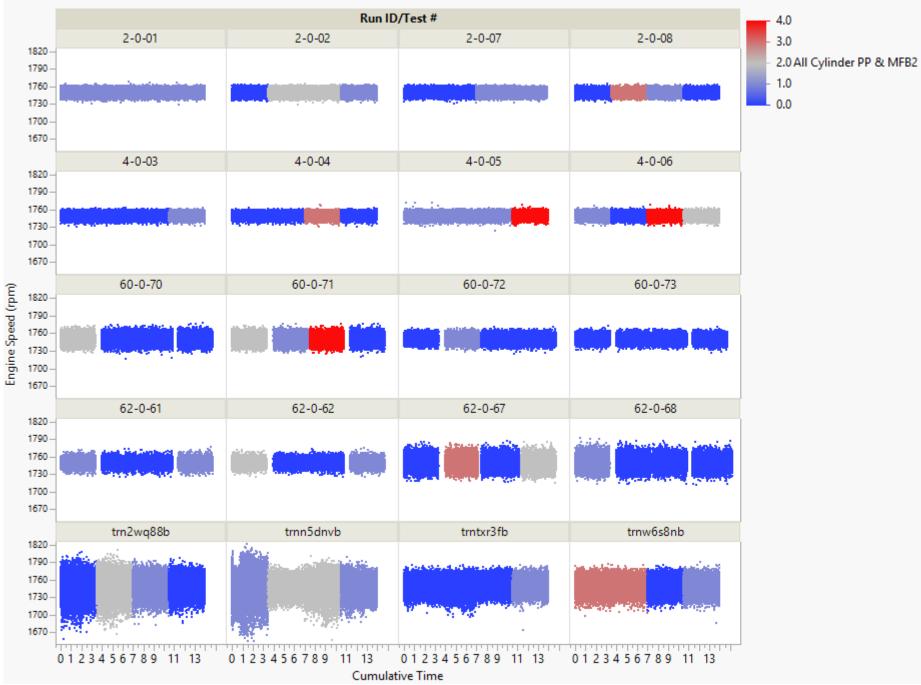
12-10-15 Kevin O'Malley The Lubrizol Corporation

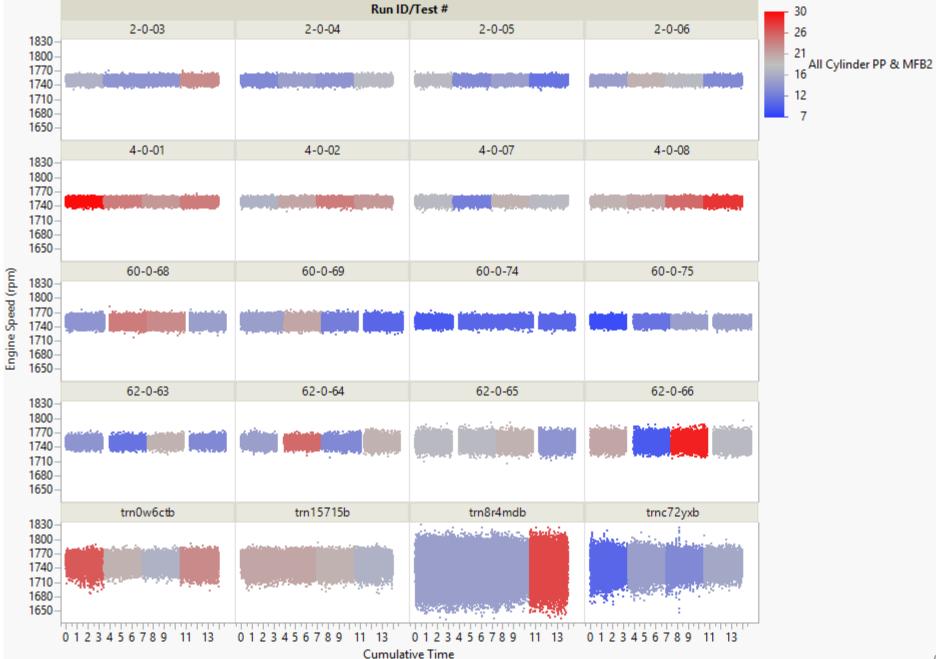
Overview

- 40 tests included
 - 16 IAR (2 stands; 8 tests per stand; 2 engine builds per stand)
 - 16 SwRI (2 stands; 8 tests per stand; 2 engine builds per stand)
 - 8 LZ (1 stand; 2 engine builds)
- 2 oils tested (low event oil and high event oil)
 - Each oil tested in duplicate within each stand-engine build combination
- Operational parameters are plotted versus cumulative time
 - Cumulative time is a combination of time from valid iterations
 A, B, C, and D; time at start of iteration A = 0hrs
- Each RunID/Test # is plotted in a separate pane
- Each parameter has plots with a legend for both lab and number of LSPI events (a.k.a. All Cylinder PP & MFB2)
- CAN data are plotted with and without stand 62

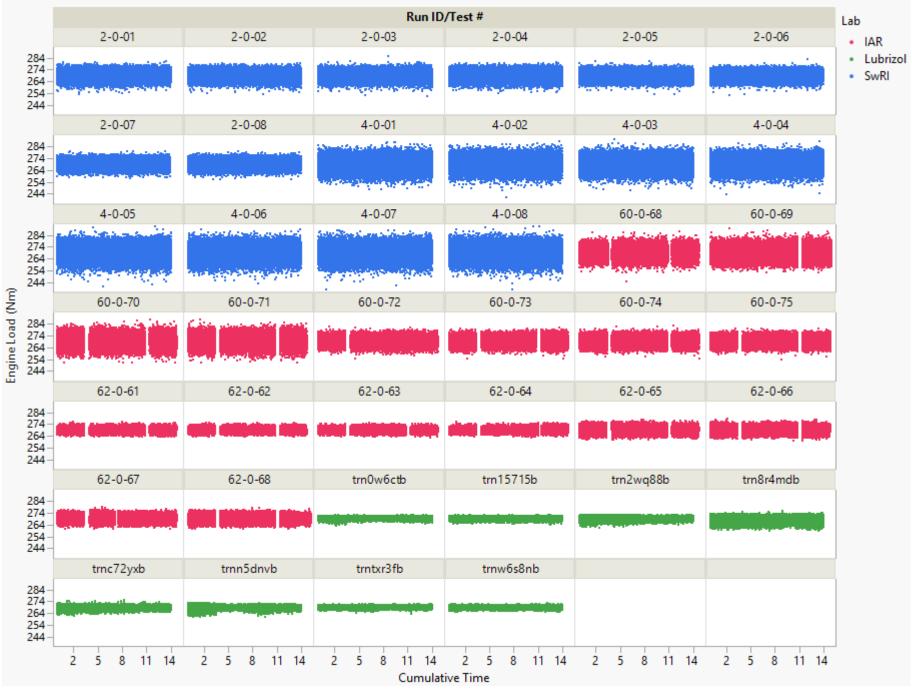
Engine Speed

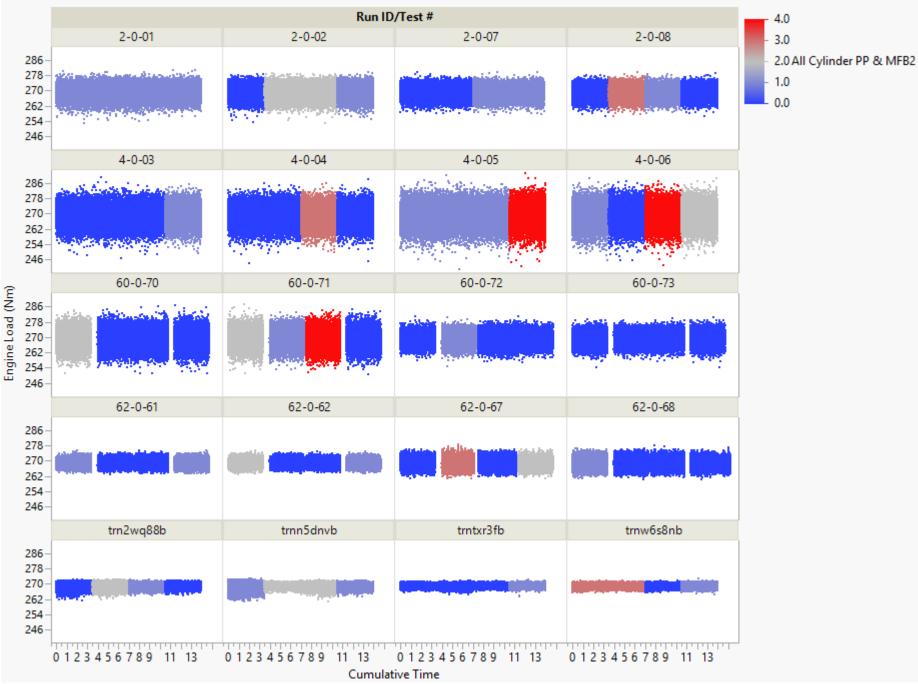


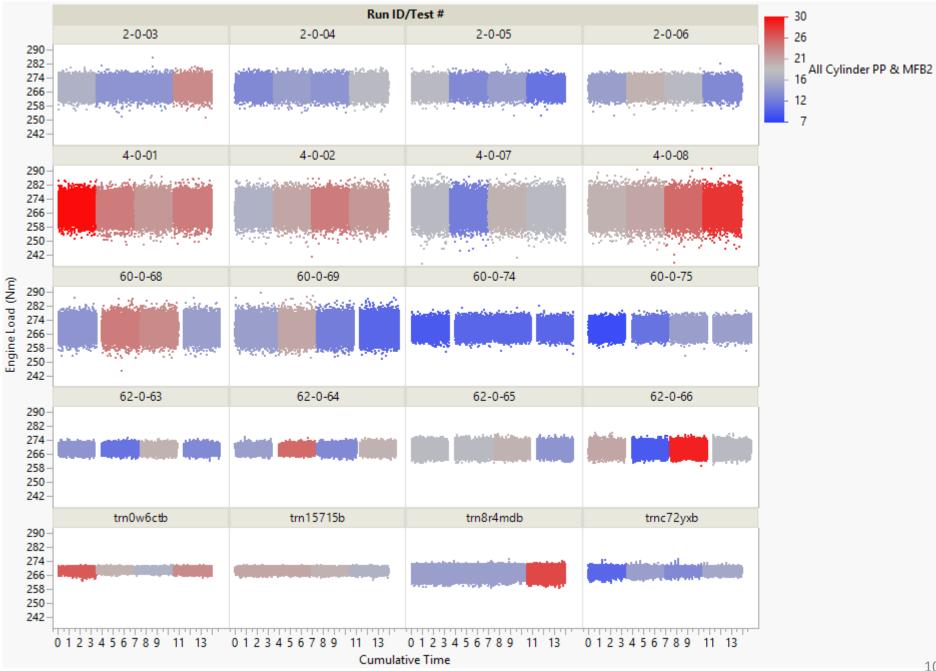




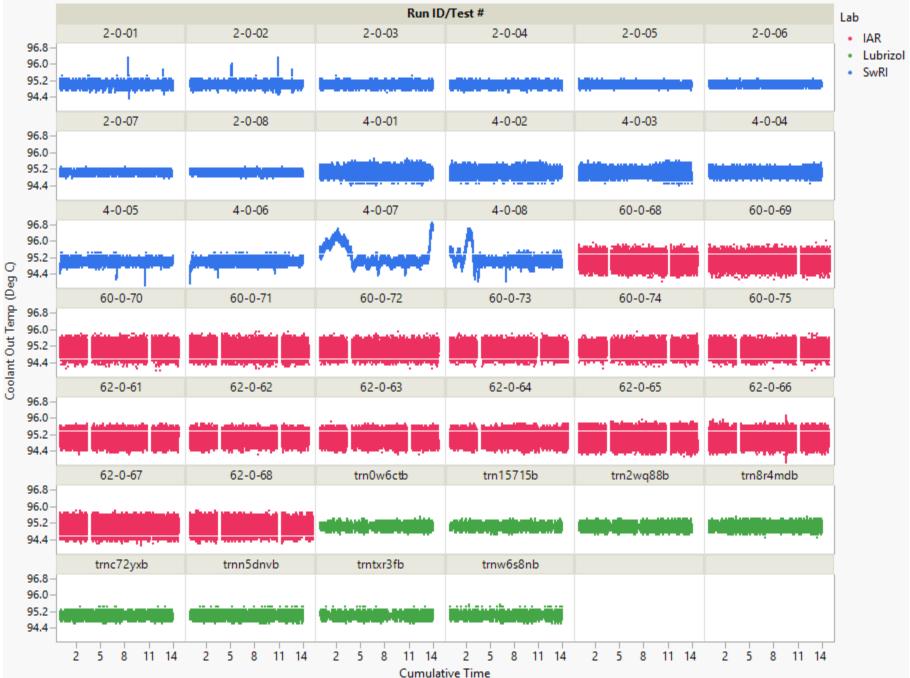
Engine Load

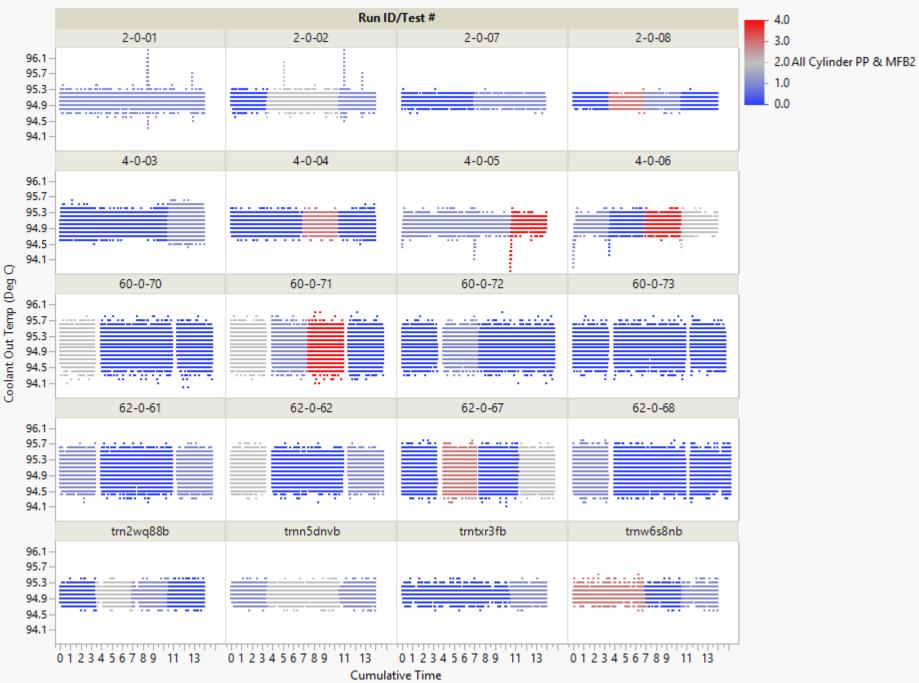


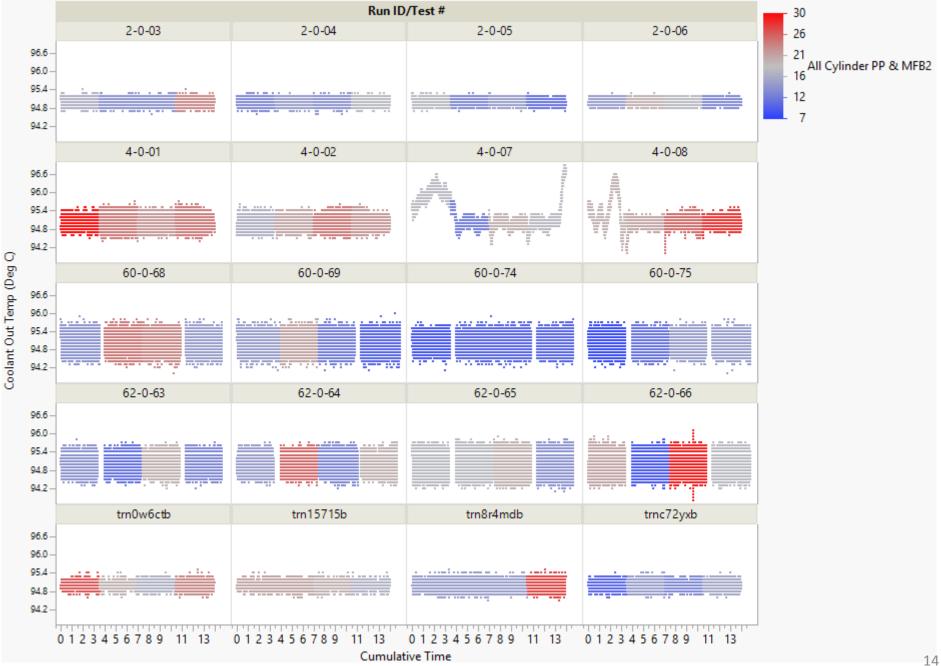




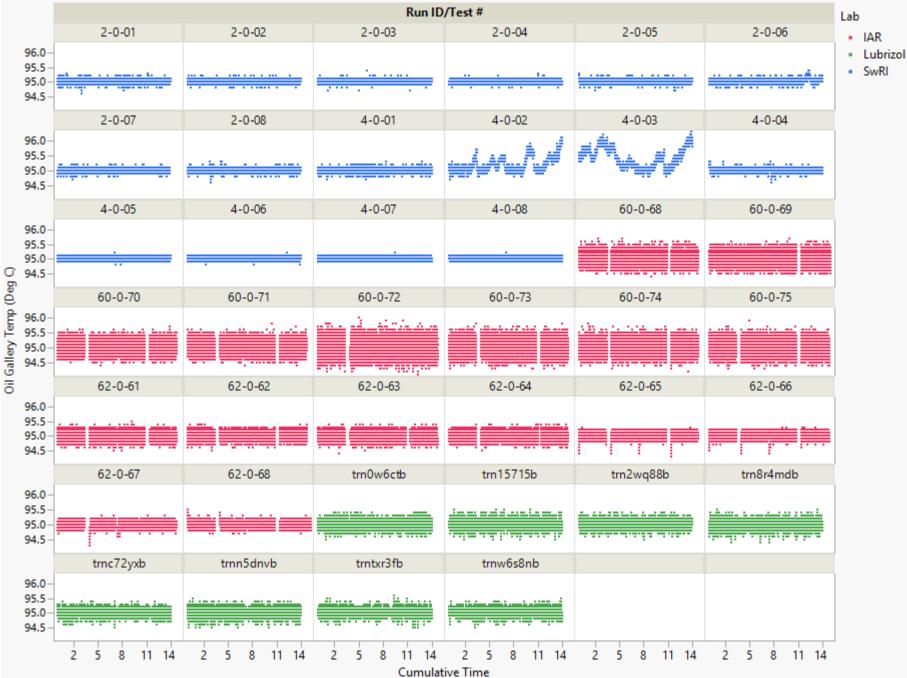
Coolant Out Temperature

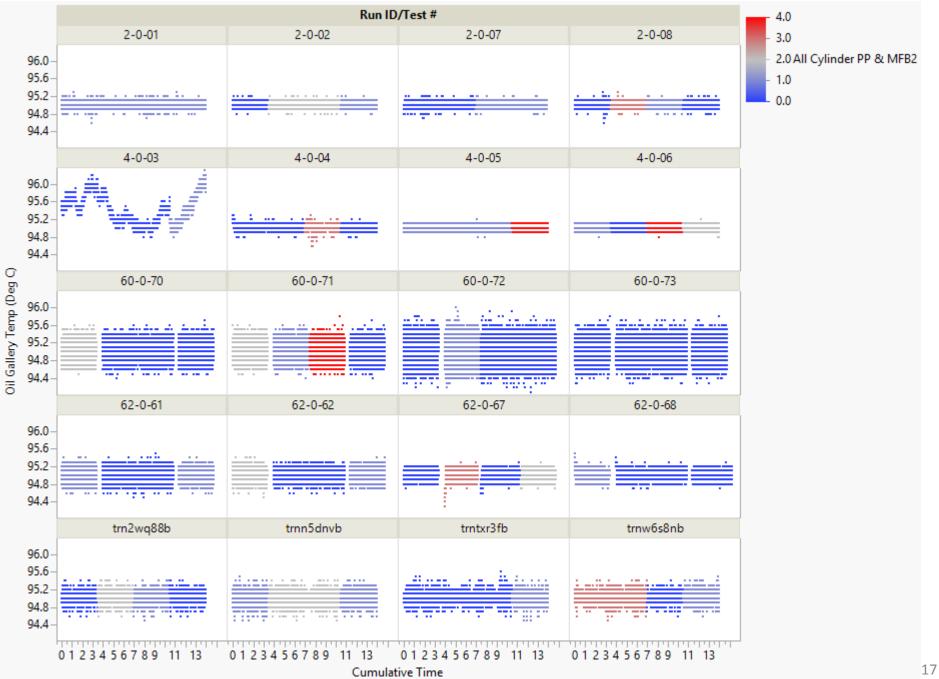


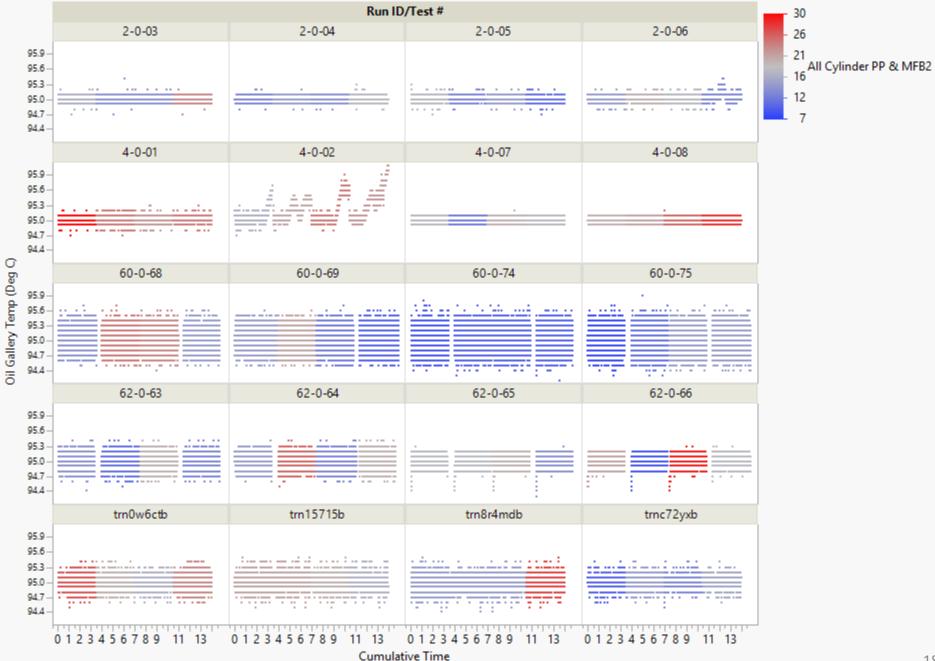




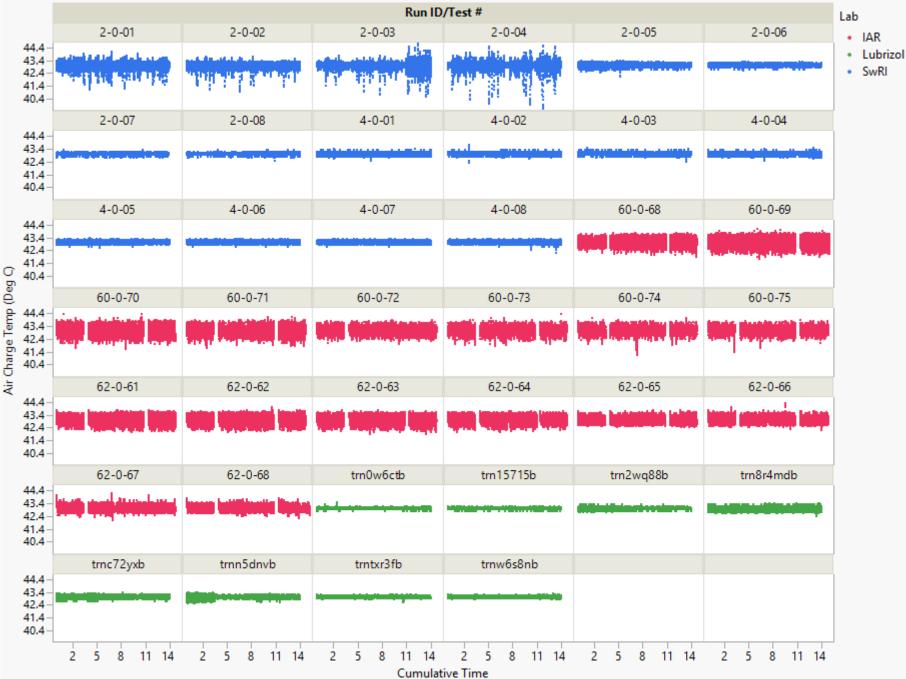
Oil Gallery Temperature

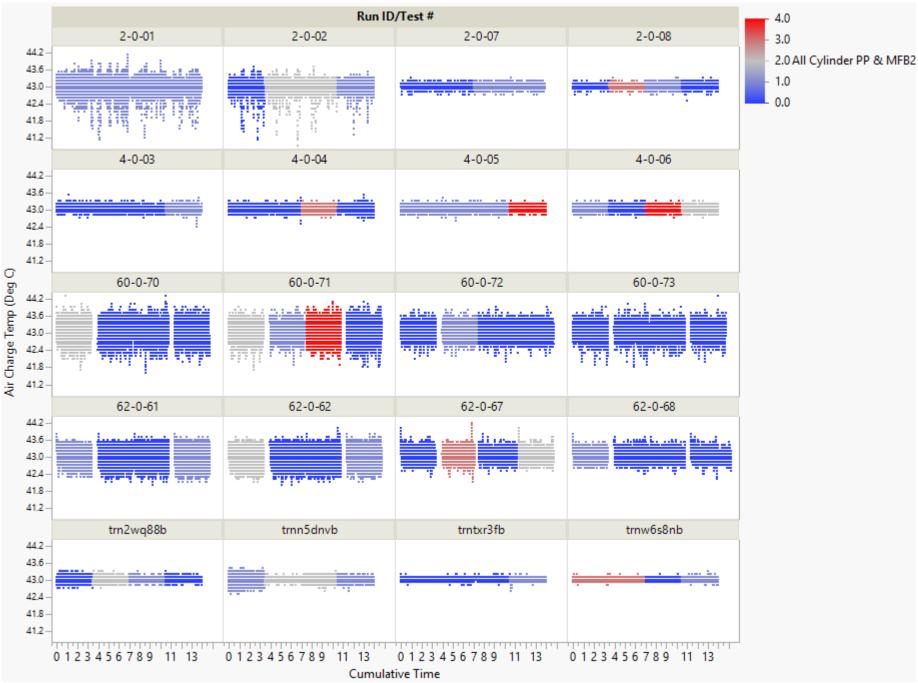


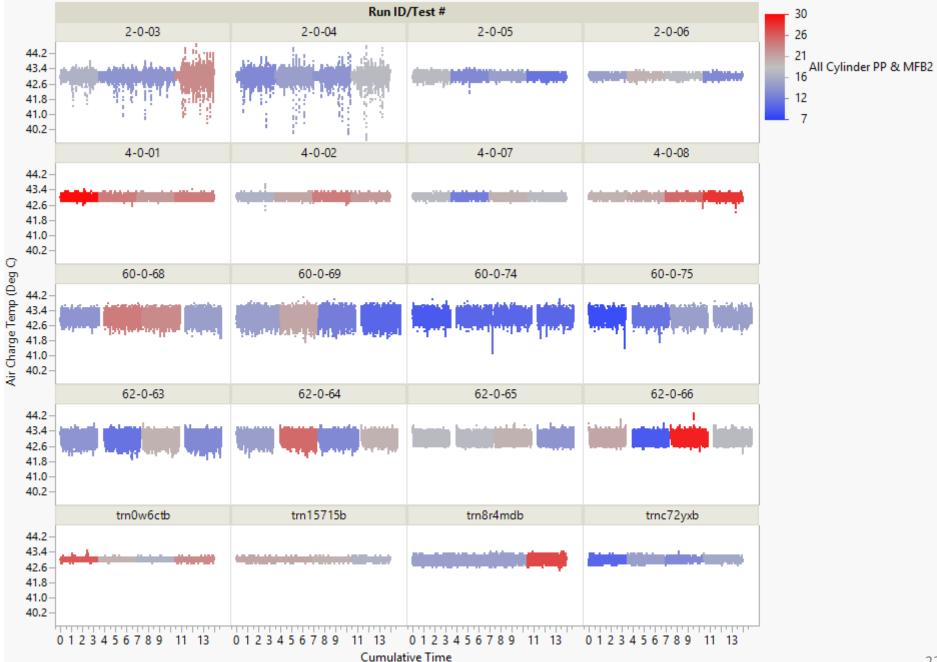




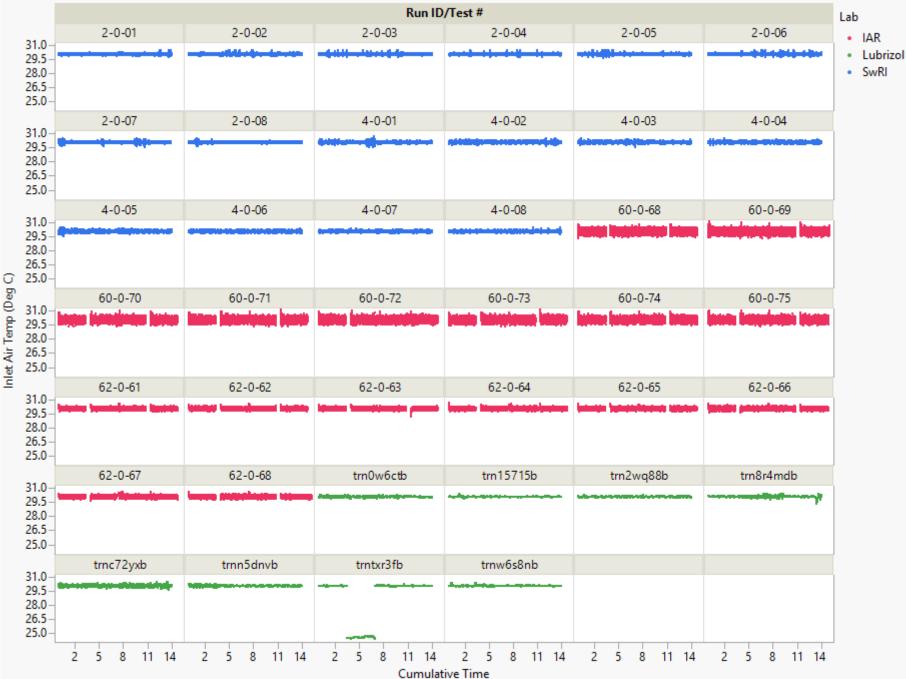
Air Charge Temperature

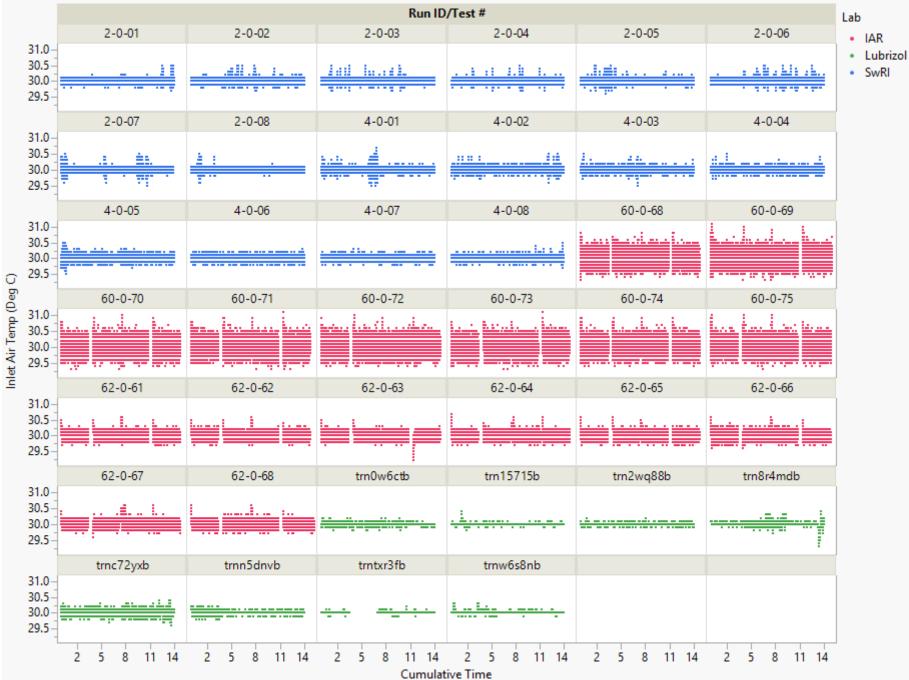




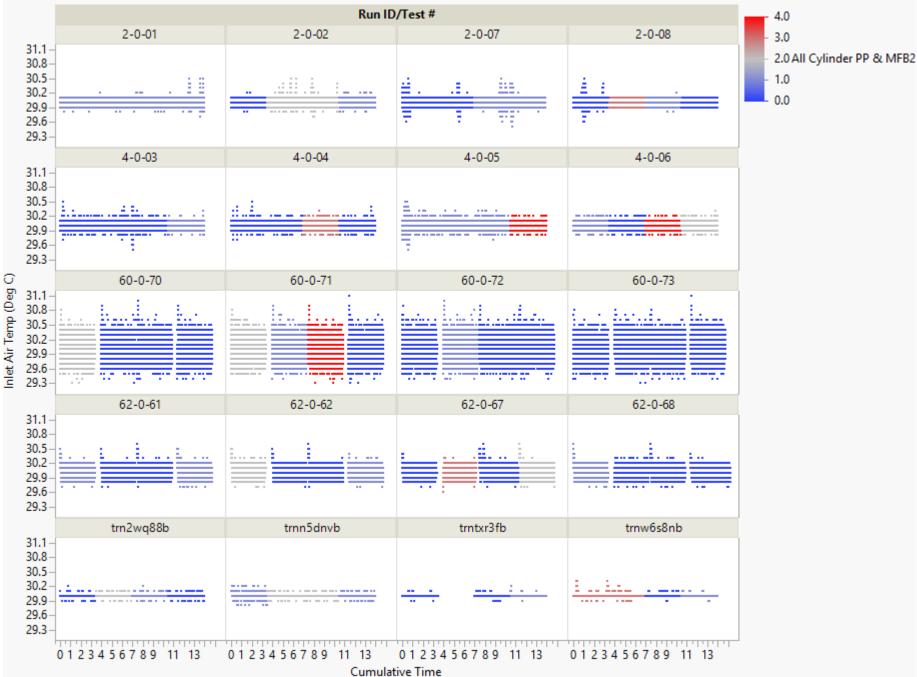


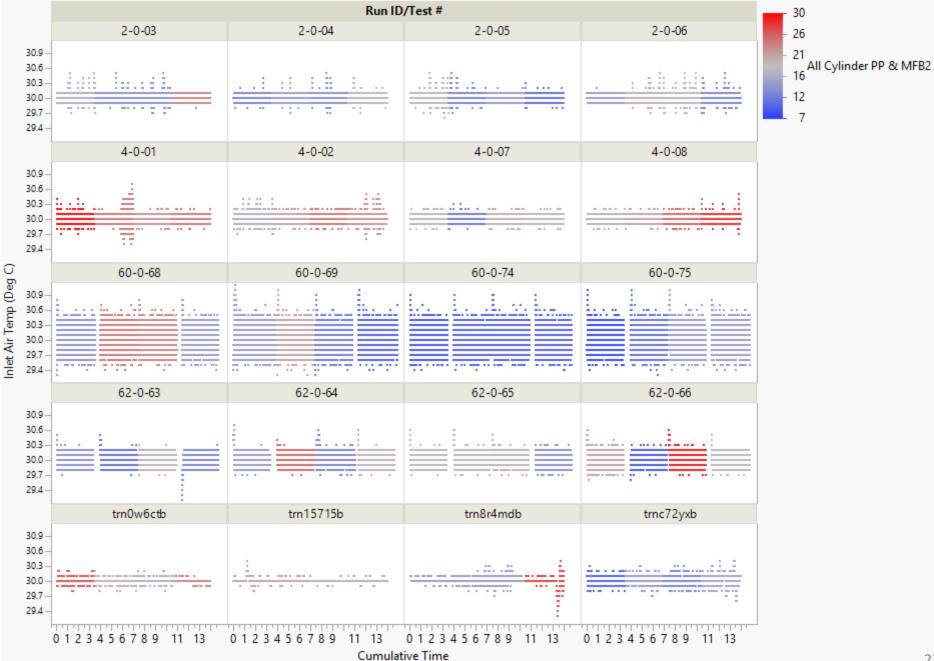
Inlet Air Temperature





ZOOMED IN

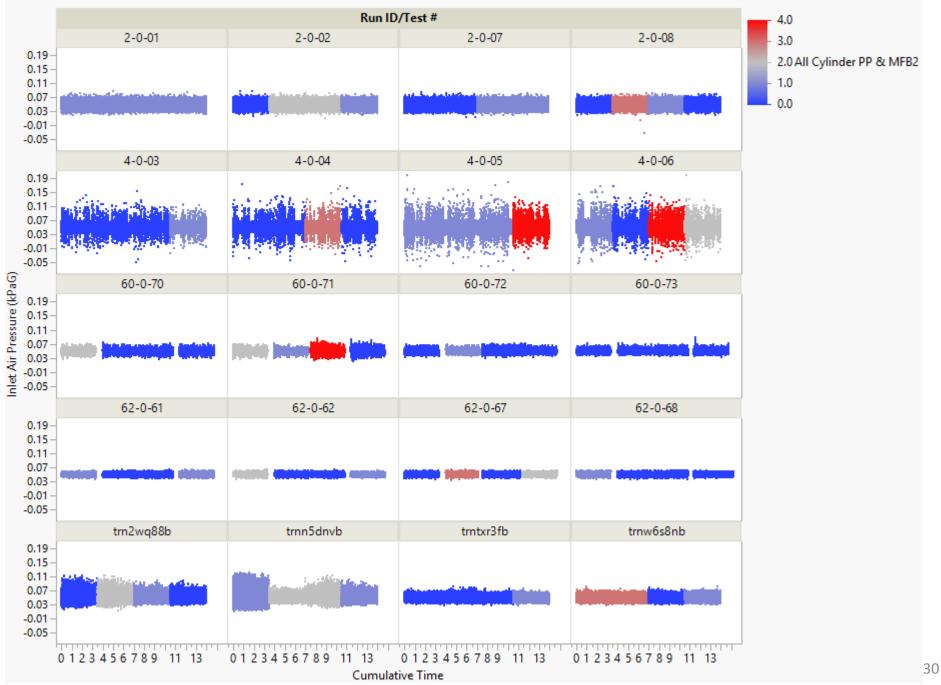


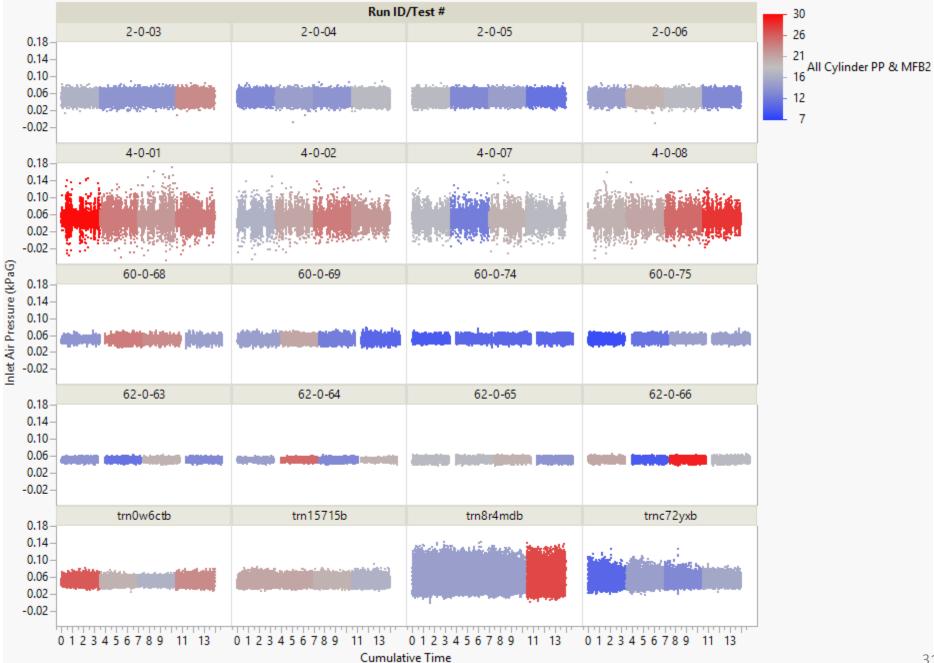


Inlet Air Pressure

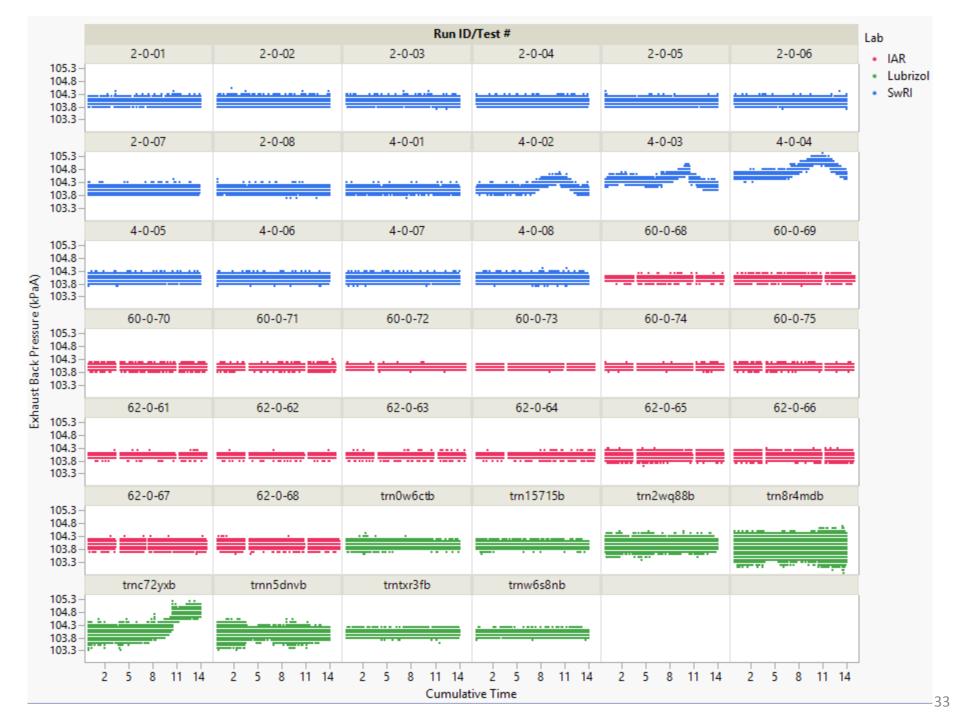
	Run ID/Test #						Lab
0.21 - 0.16 - 0.01 - 0.01 - 0.01 - 0.01 - 0.01 - 0.01 - 0.11 - 0.06 - 0.01 - 0.01 - 0.01 - 0.04 - 0.11 - 0.06 - 0.01 - 0.04 - 0.11 - 0.06 - 0.01 - 0.04 - 0.11 - 0.06 - 0.01 - 0.04 - 0.05 -	2-0-01	2-0-02	2-0-03	2-0-04	2-0-05	2-0-06	• IAR
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	60-0-70	60-0-71	60-0-72	60-0-73	60-0-74	60-0-75	
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	62-0-61	62-0-62	62-0-63	62-0-64	62-0-65	62-0-66	[
	62-0-67	62-0-68	trn0w6ctb	trn15715b	trn2wq88b	trn8r4mdb	
	ander Örjimeiraris-s-ini	ande addition of the second					
	trnc72yxb	trnn5dnvb	trntxr3fb	trnw6s8nb			
			dan myöllik junisjonin				
	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	
Cumulative Time							

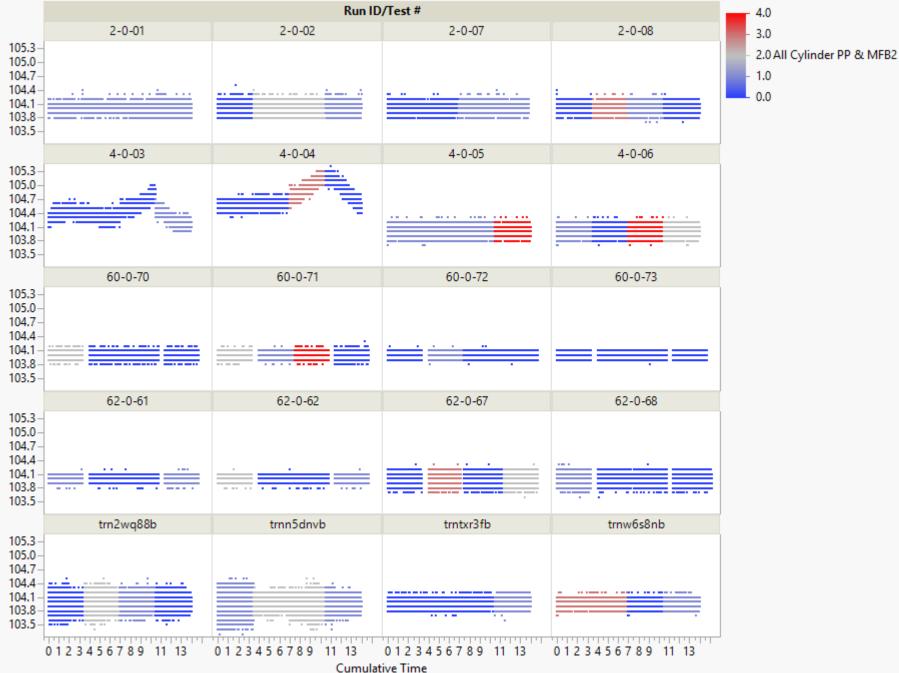
Inlet Air Pressure (kPaG)

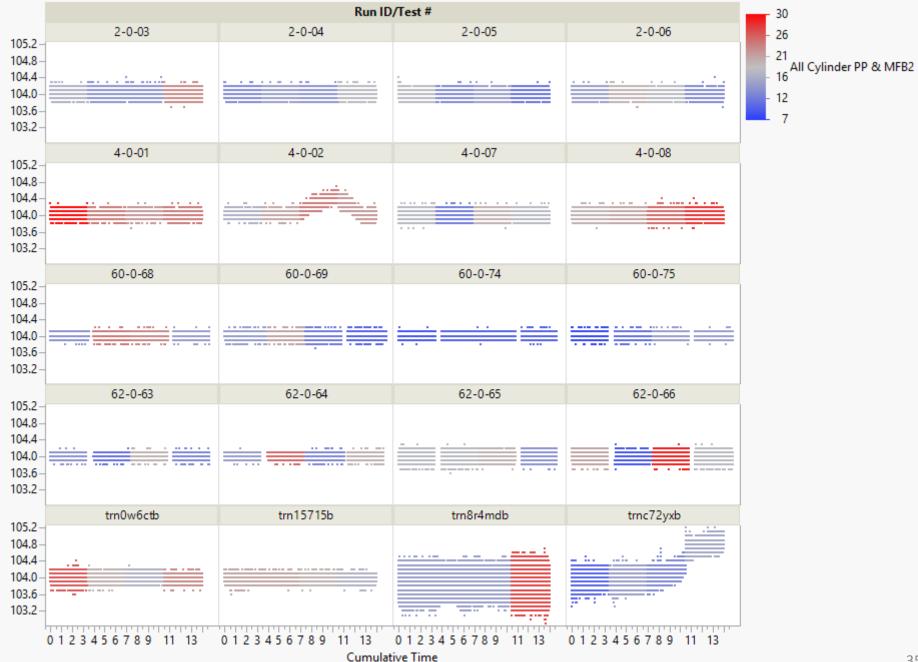




Exhaust Back Pressure

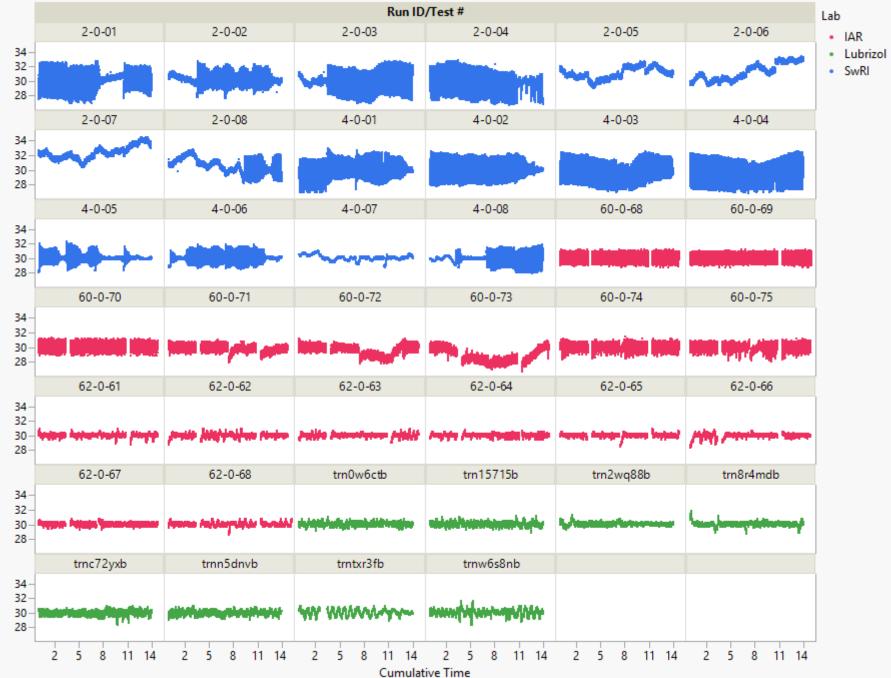


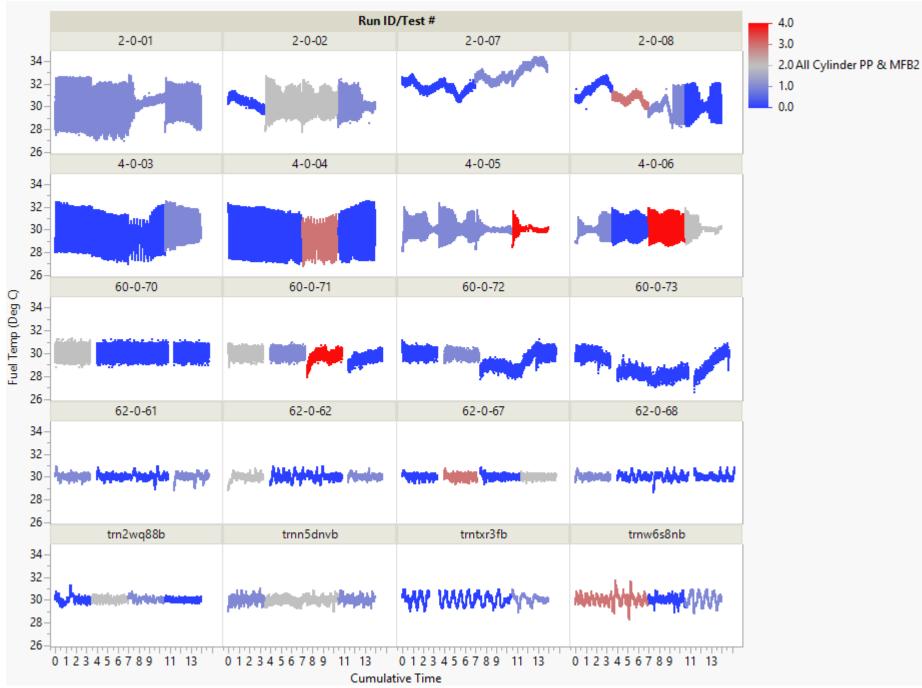


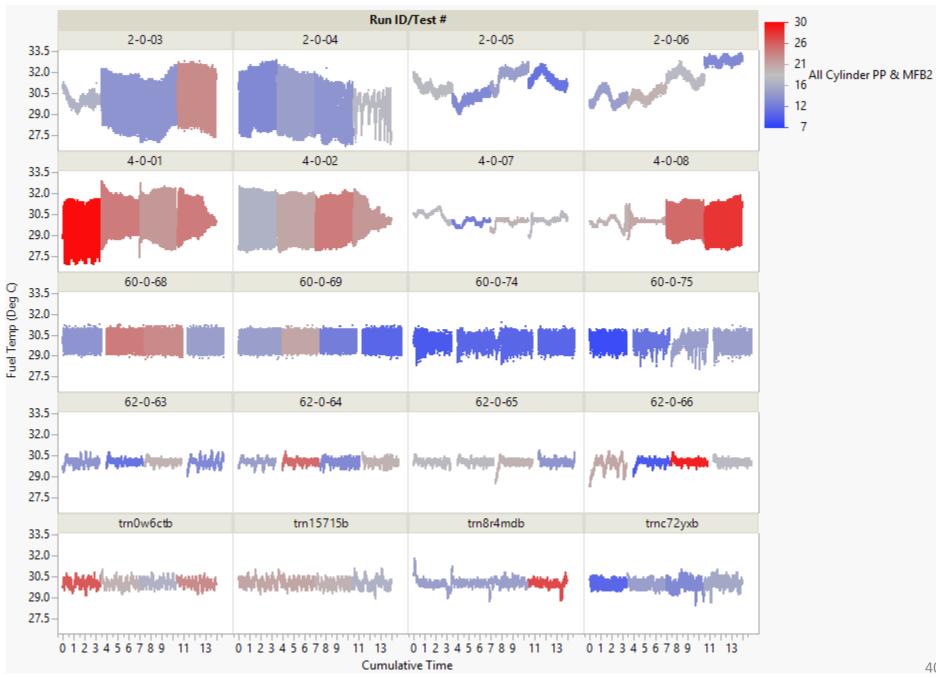


Fuel Temperature

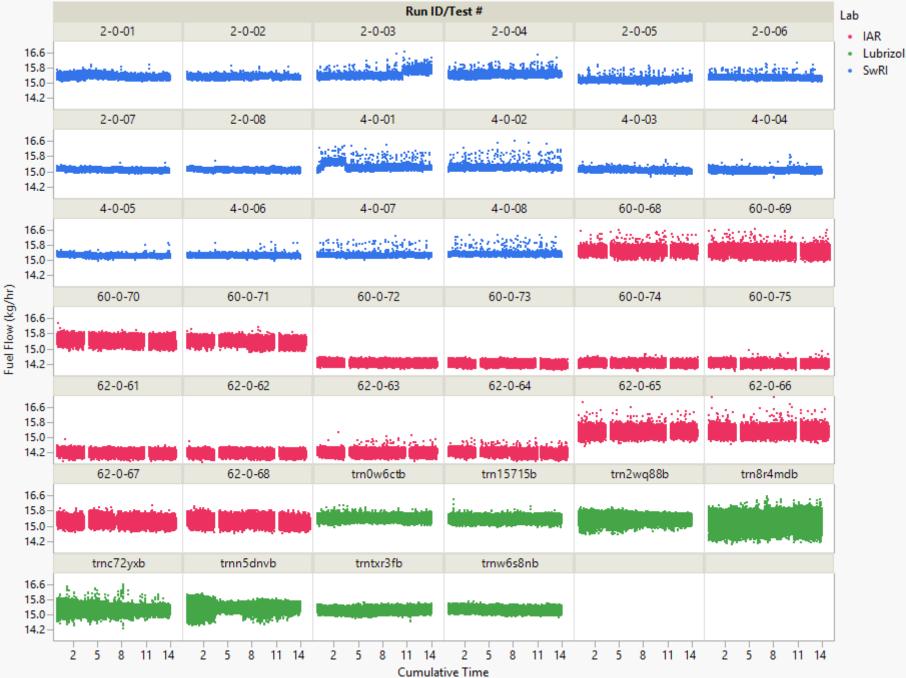
			Run ID	/Test #		
	2-0-01	2-0-02	2-0-03	2-0-04	2-0-05	2-0-06
9.5e+19- 7.5e+19- 5.5e+19- 3.5e+19- 1.5e+19-						
	2-0-07	2-0-08	4-0-01	4-0-02	4-0-03	4-0-04
9.5e+19- 7.5e+19- 5.5e+19- 3.5e+19- 1.5e+19-						
	4-0-05	4-0-06	4-0-07	4-0-08	60-0-68	60-0-69
9.5e+19- 7.5e+19- 5.5e+19- 3.5e+19- 1.5e+19-						
) }	60-0-70	60-0-71	60-0-72	60-0-73	60-0-74	60-0-75
9.5e+19- 2.7.5e+19- 5.5e+19- 3.5e+19- 1.5e+19-						
	62-0-61	62-0-62	62-0-63	62-0-64	62-0-65	62-0-66
9.5e+19- 7.5e+19- 5.5e+19- 3.5e+19- 1.5e+19-						
	62-0-67	62-0-68	trn0w6ctb	trn15715b	trn2wq88b	trn8r4mdb
9.5e+19- 7.5e+19- 5.5e+19- 3.5e+19- 1.5e+19-						
	trnc72yxb	trnn5dnvb	trntxr3fb	trnw6s8nb		
9.5e+19- 7.5e+19- 5.5e+19- 3.5e+19- 1.5e+19-						
	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14

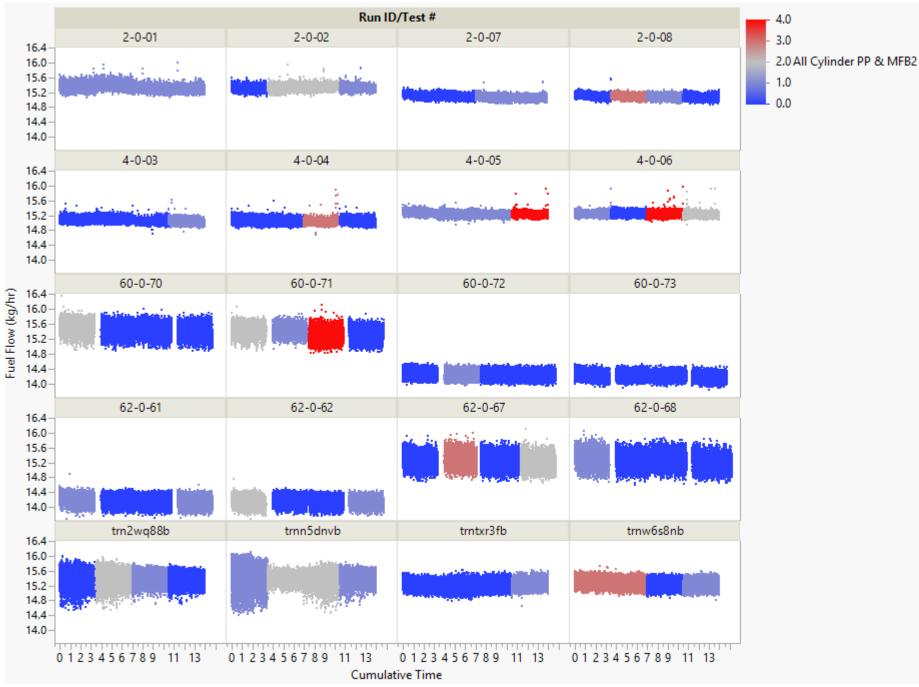


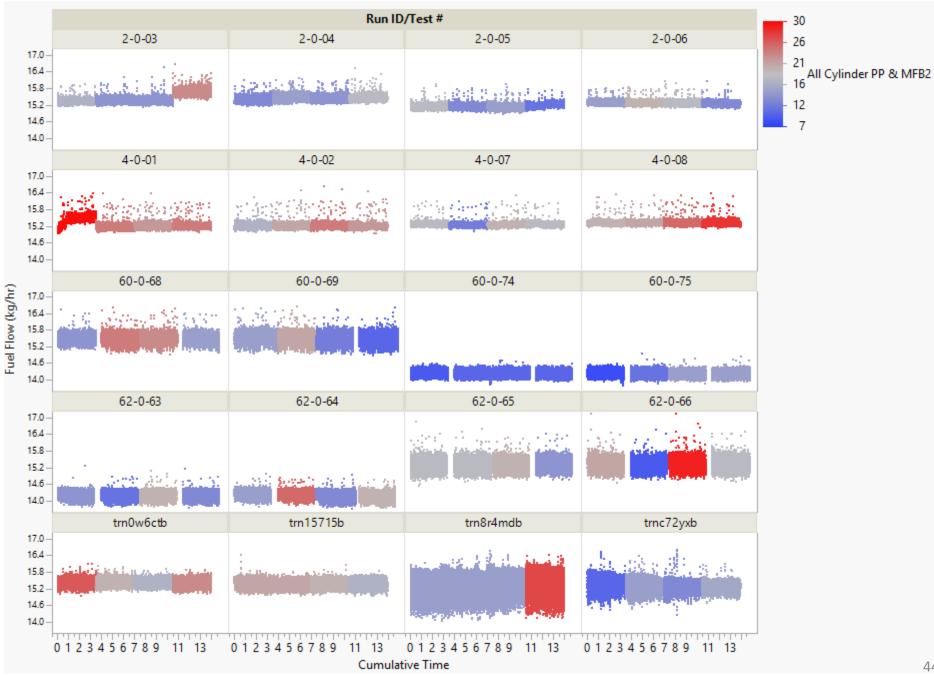




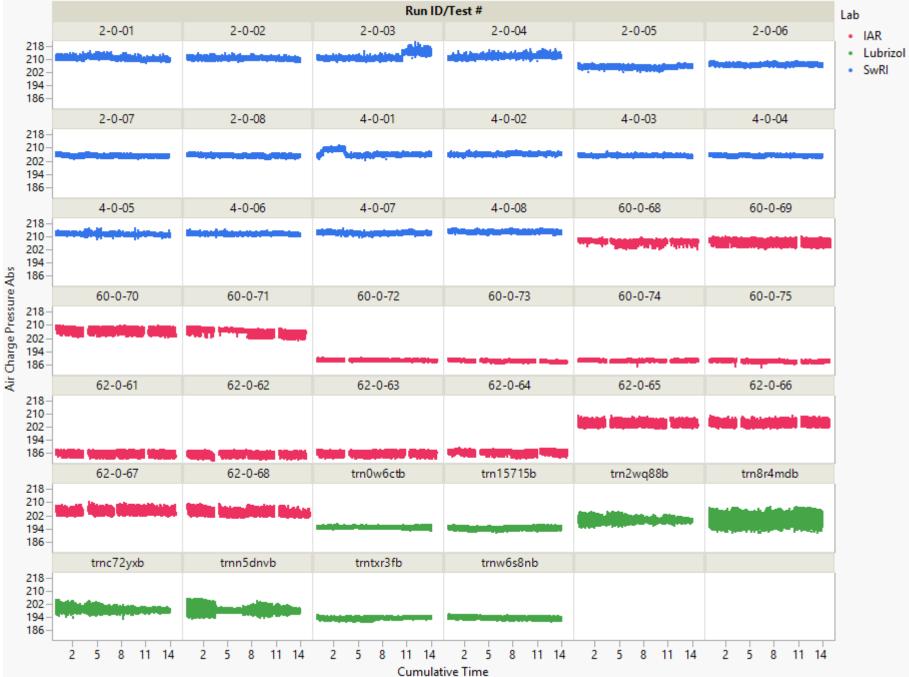
Fuel Flow

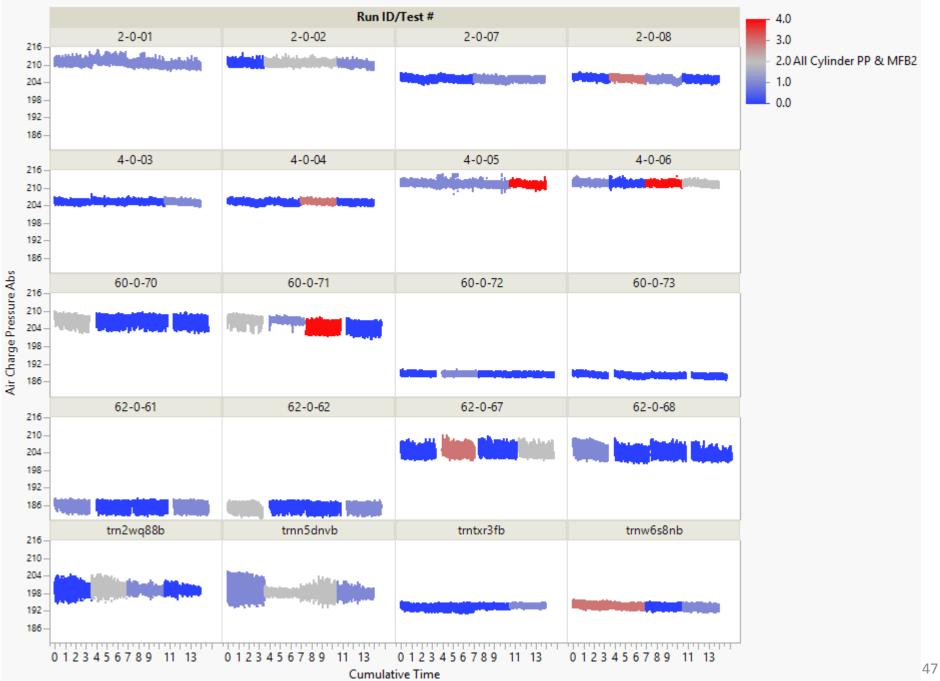


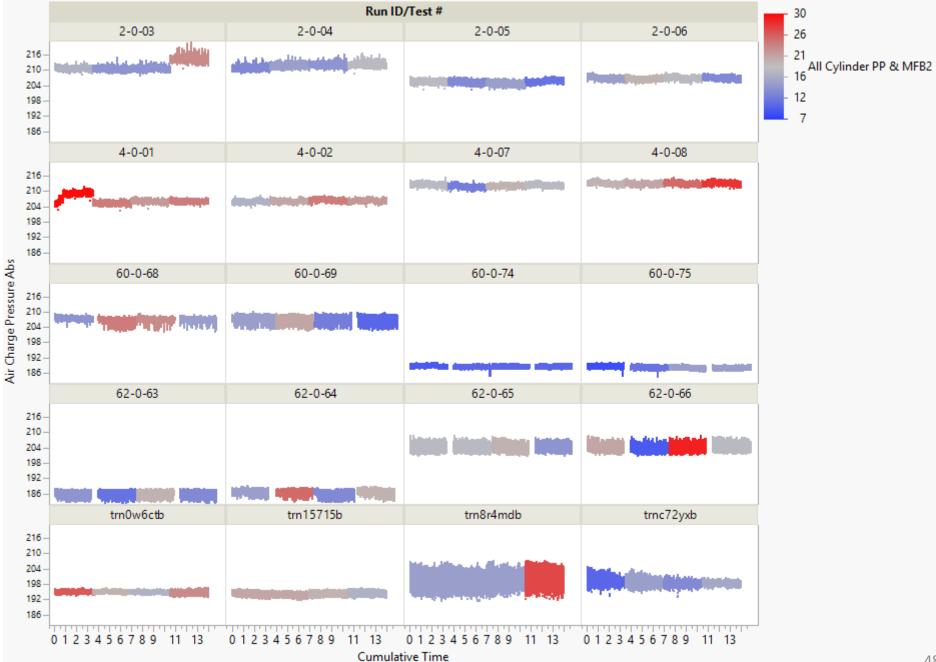




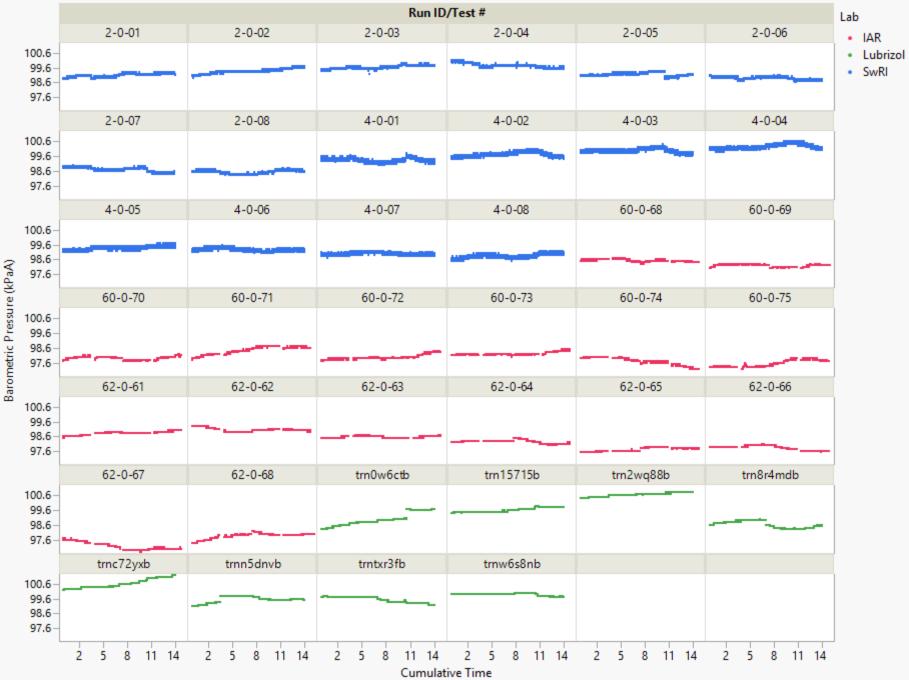
Air Charge Pressure

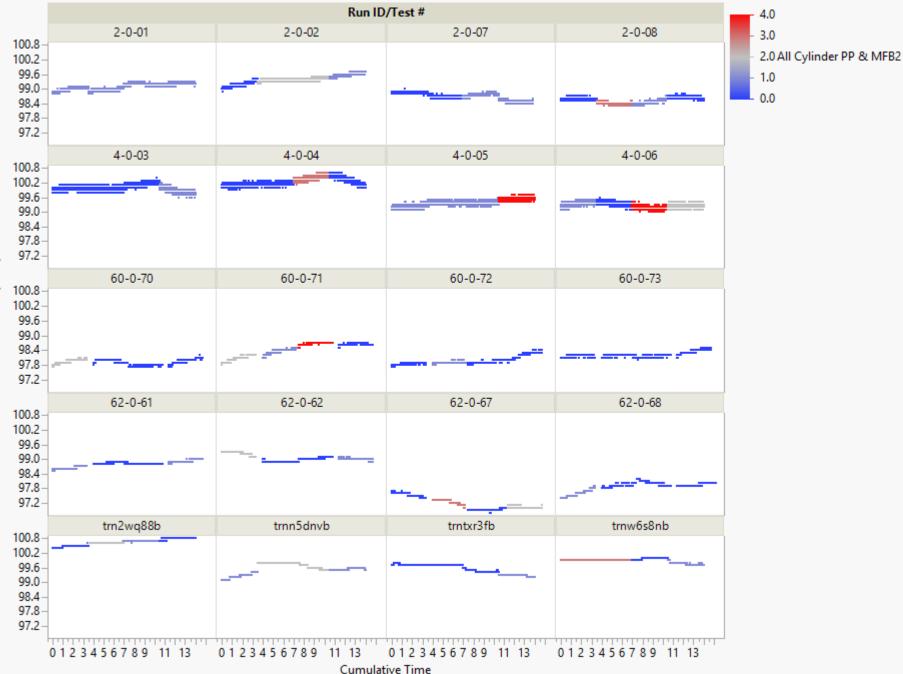


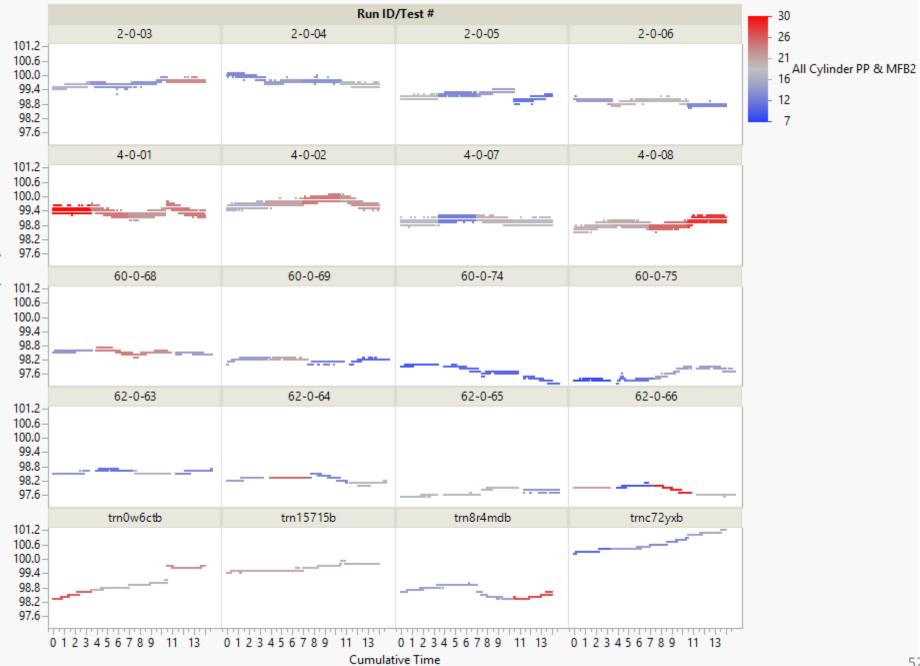




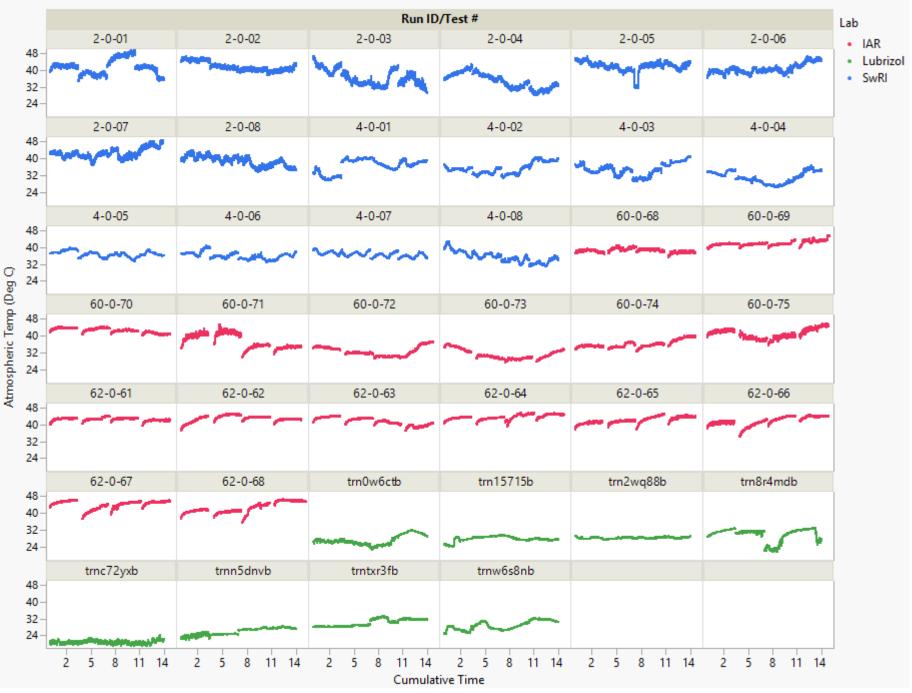
Barometric Pressure

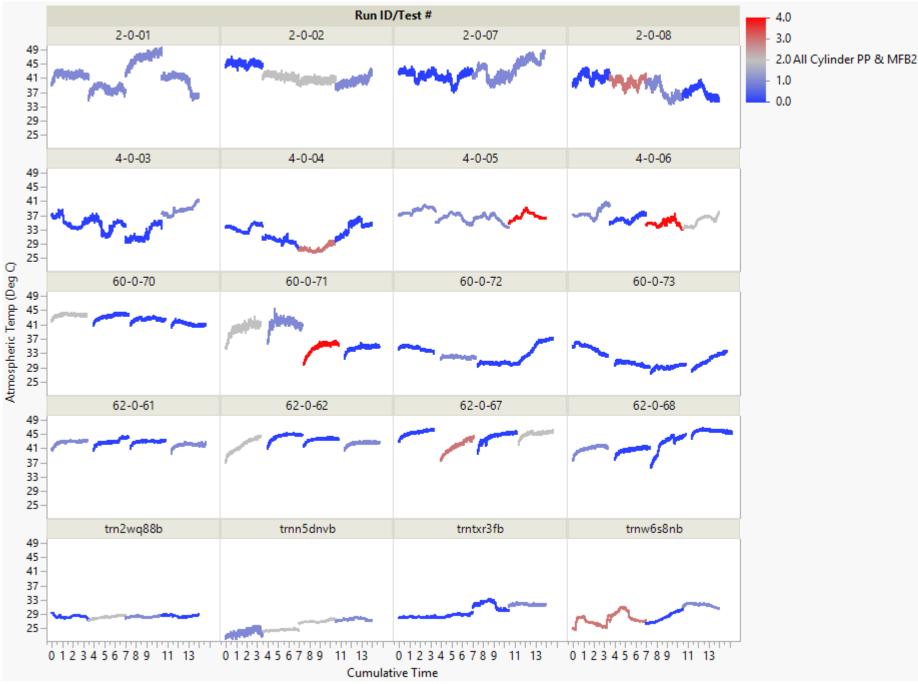




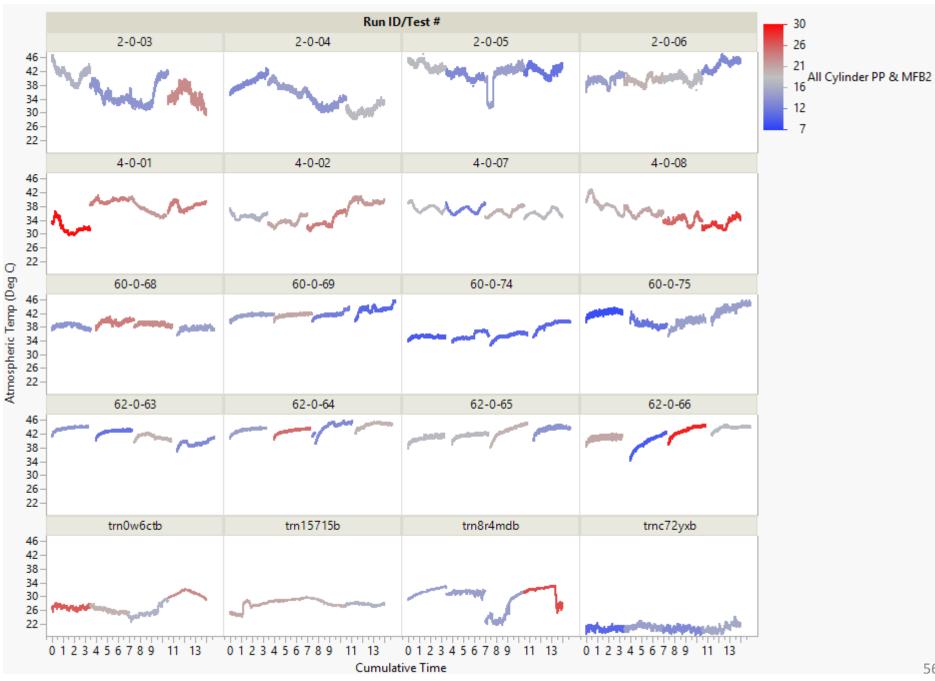


Atmospheric Temp

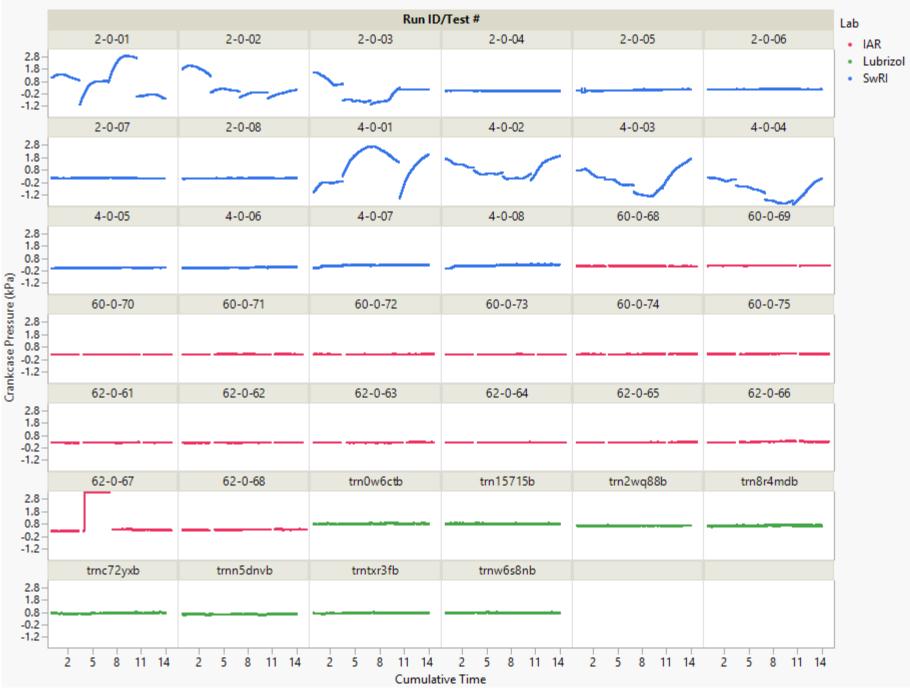


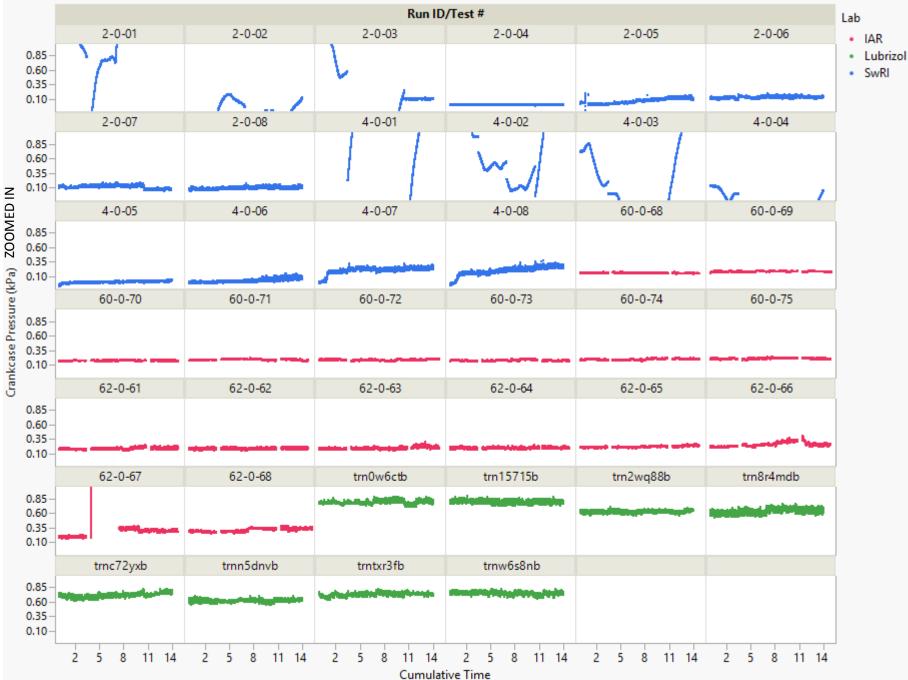


High Event Oil

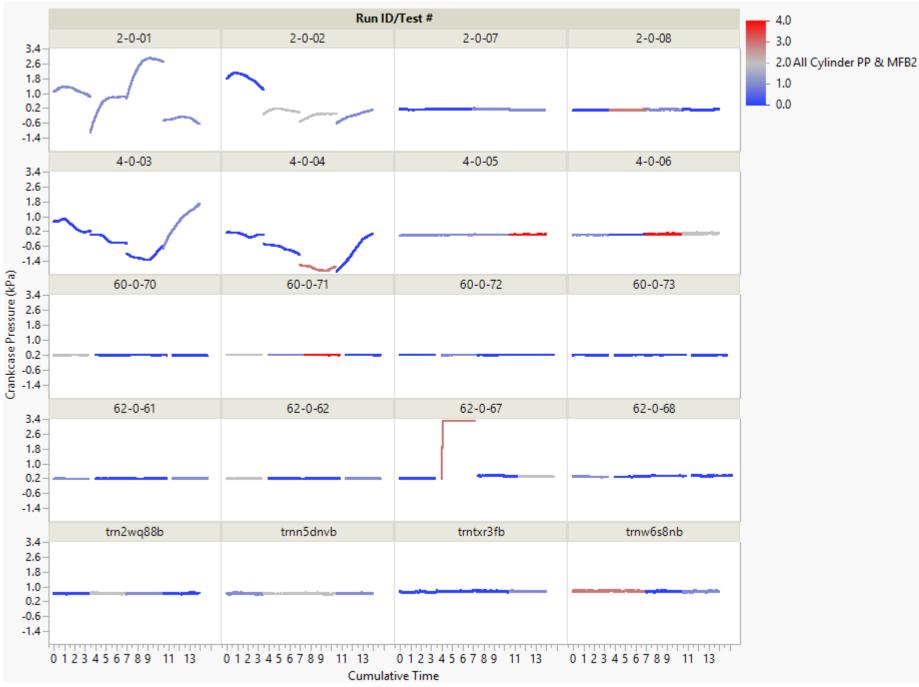


Crankcase Pressure



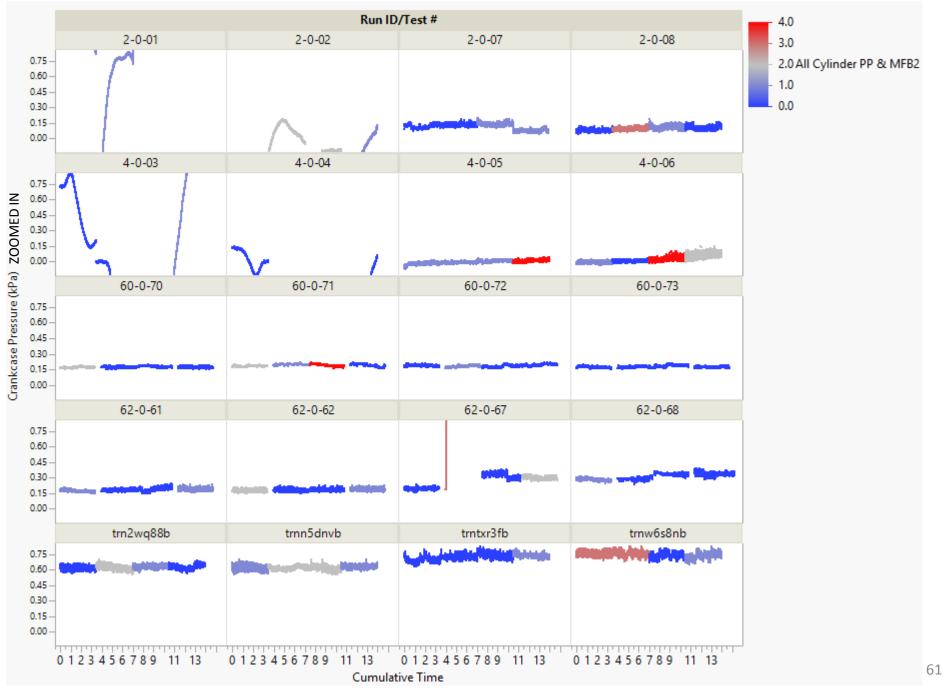


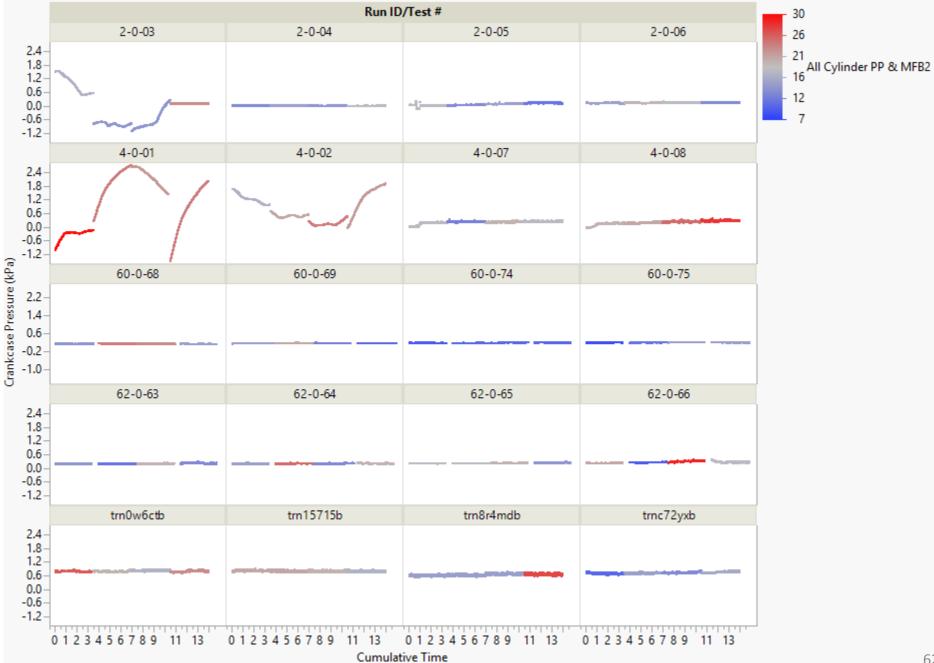
Crankcase Pressure (kPa)

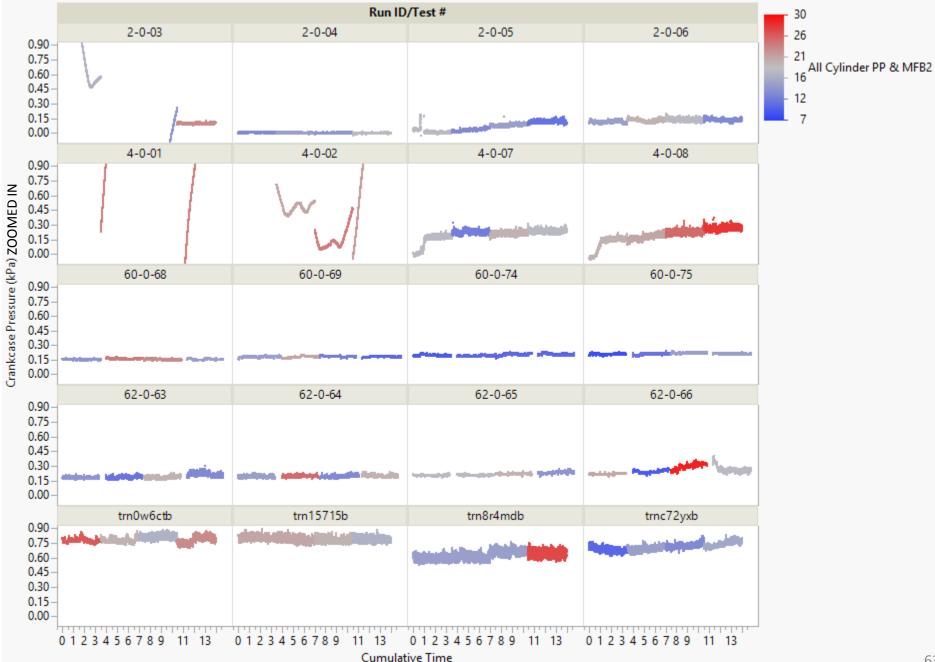


60

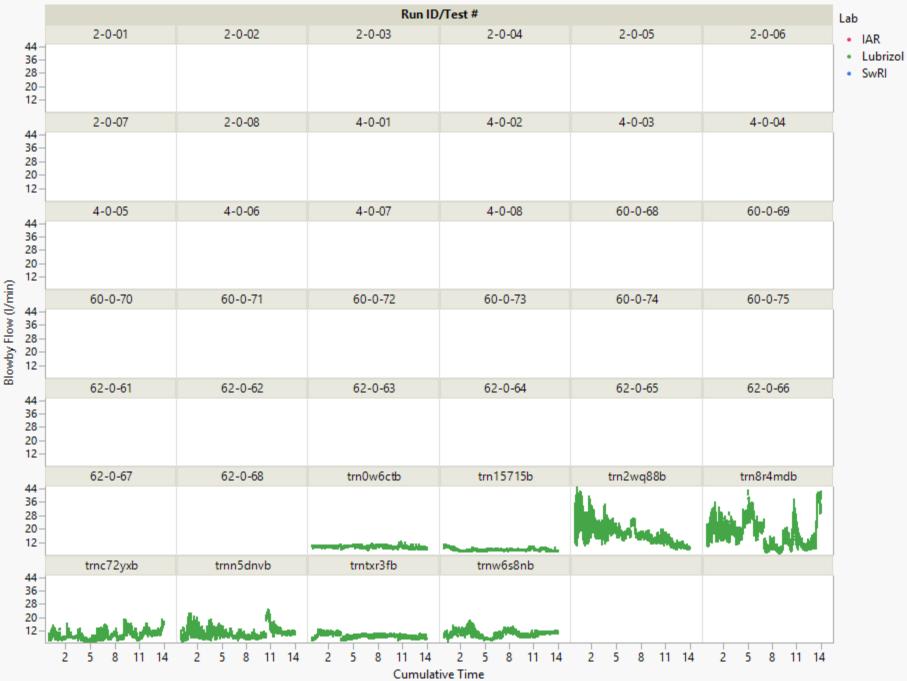
Low Event Oil

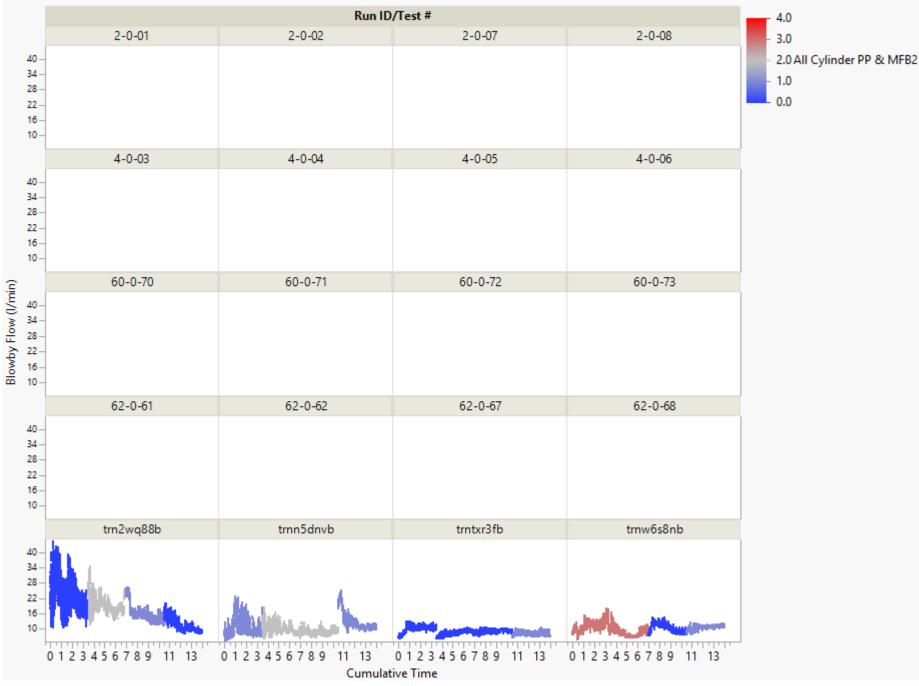


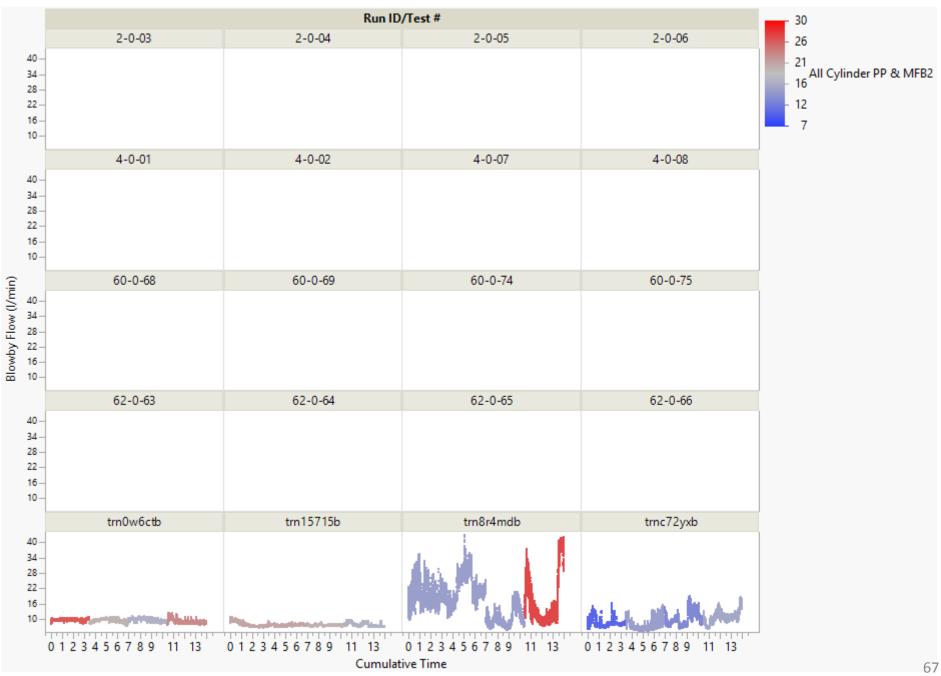




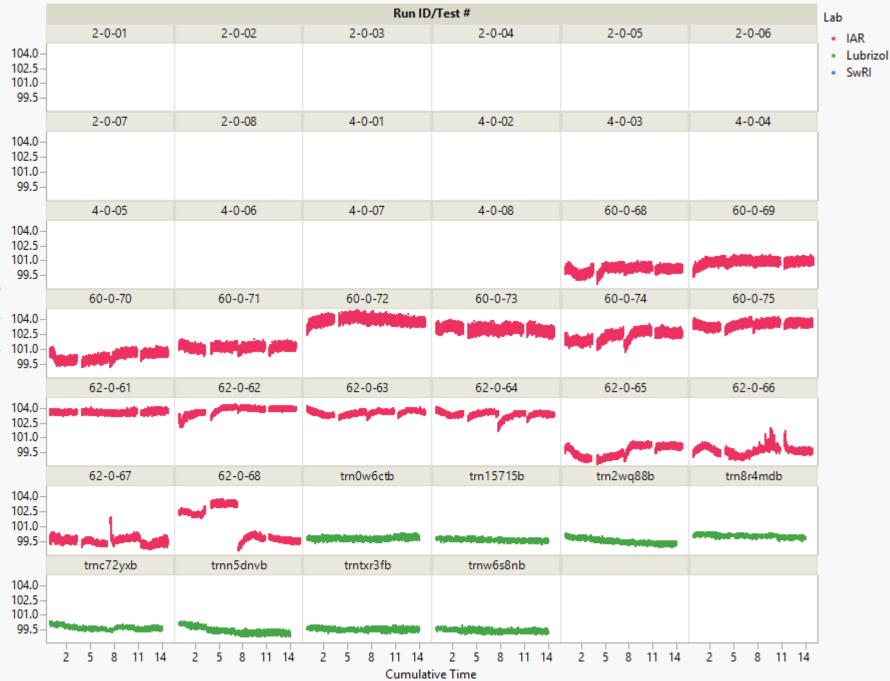
Blowby Flow



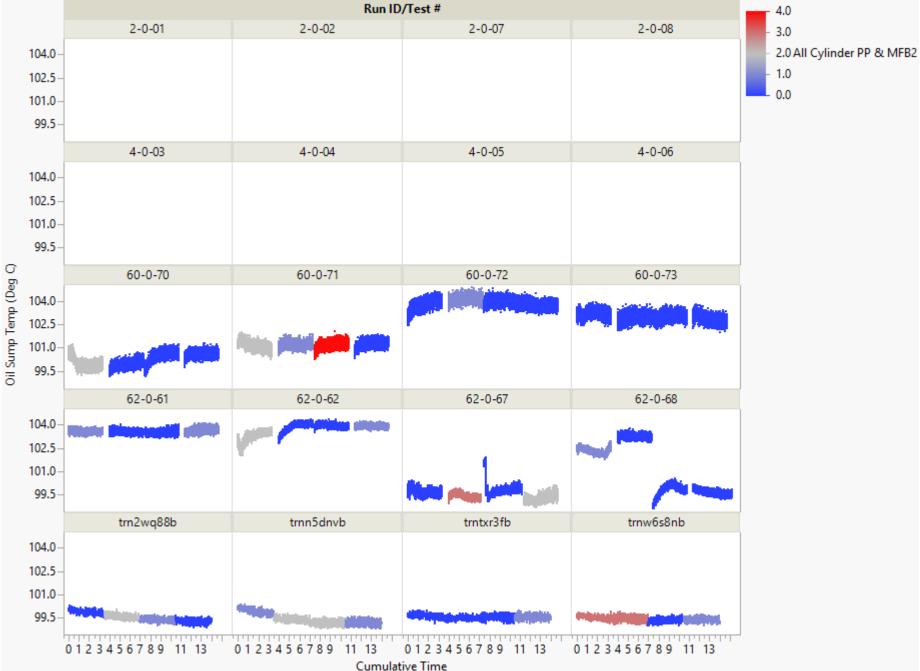


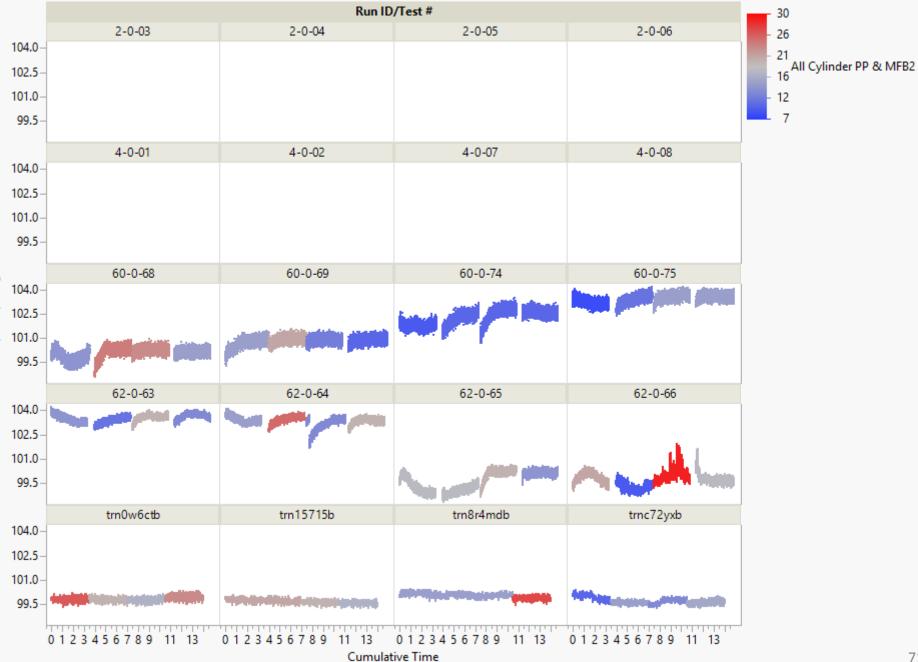


Oil Sump Temp



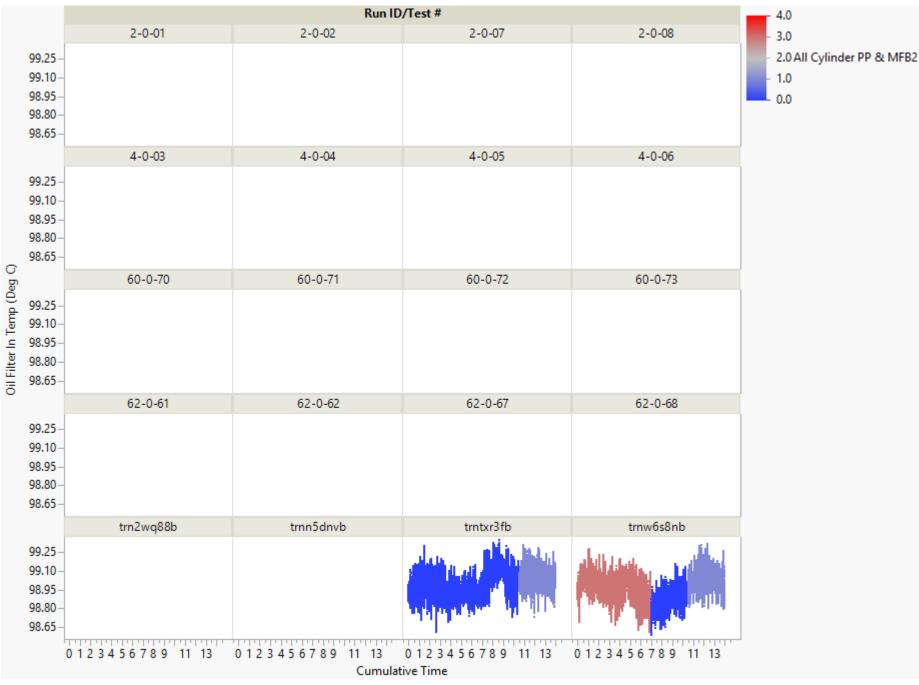
Oil Sump Temp (Deg C)

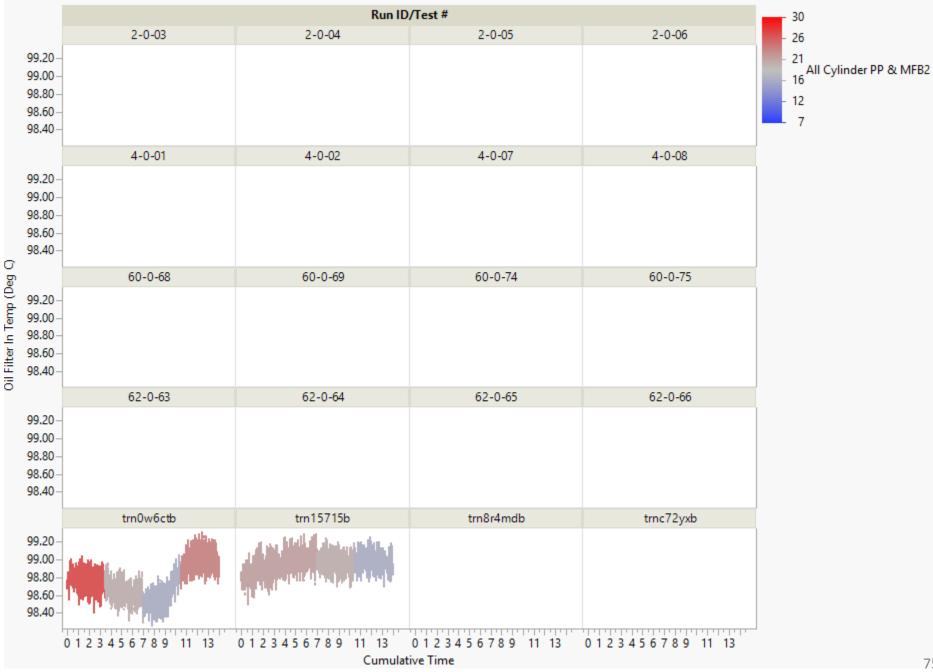




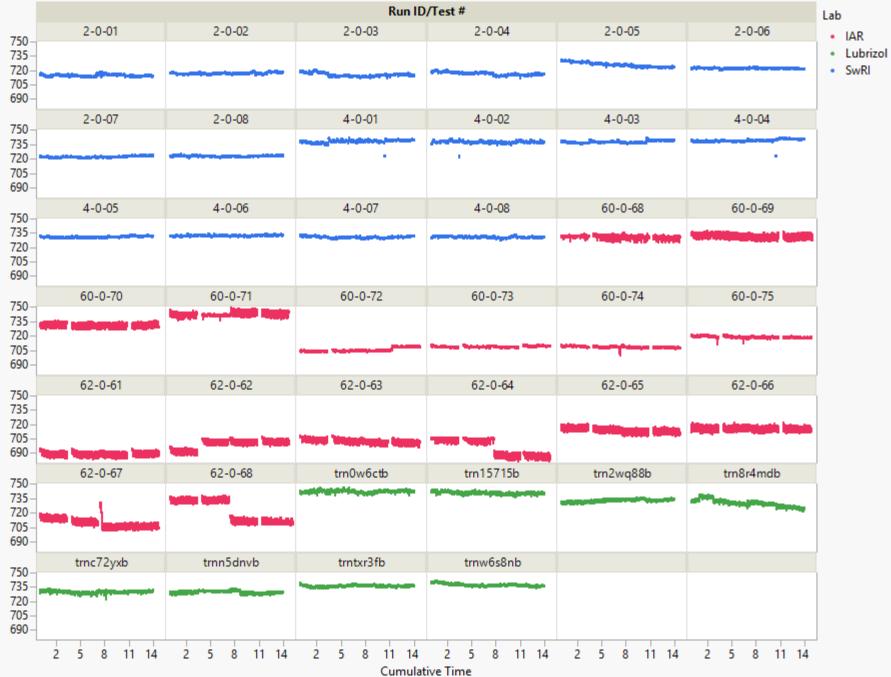
Oil Fiter In Temp

			Run ID)/Test #			La
	2-0-01	2-0-02	2-0-03	2-0-04	2-0-05	2-0-06	
99.20- 99.00- 98.80- 98.60- 98.40-							:
	2-0-07	2-0-08	4-0-01	4-0-02	4-0-03	4-0-04	
9.20 - 8.95 - 8.70 - 8.45 -							
	4-0-05	4-0-06	4-0-07	4-0-08	60-0-68	60-0-69	
99.20 99.00 98.80 98.60 98.60 98.40							
	60-0-70	60-0-71	60-0-72	60-0-73	60-0-74	60-0-75	
99.20 99.00 98.80 98.60 98.60 98.40							
	62-0-61	62-0-62	62-0-63	62-0-64	62-0-65	62-0-66	
99.20 99.00 98.80 98.60 98.60 98.40							
	62-0-67	62-0-68	trn0w6ctb	trn15715b	trn2wq88b	trn8r4mdb	
99.20 98.95 98.70 98.45							
	trnc72yxb	trnn5dnvb	trntxr3fb	trnw6s8nb			
99.20 99.00 98.80 98.60 98.60 98.40							
	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14 Cumulat	2 5 8 11 14 tive Time	2 5 8 11 14	2 5 8 11 14	

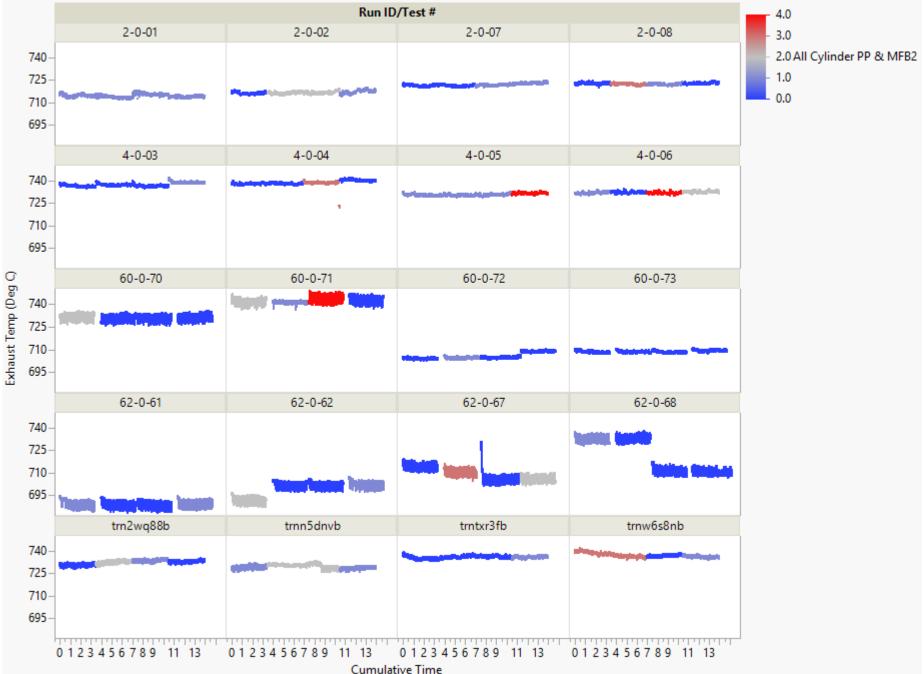


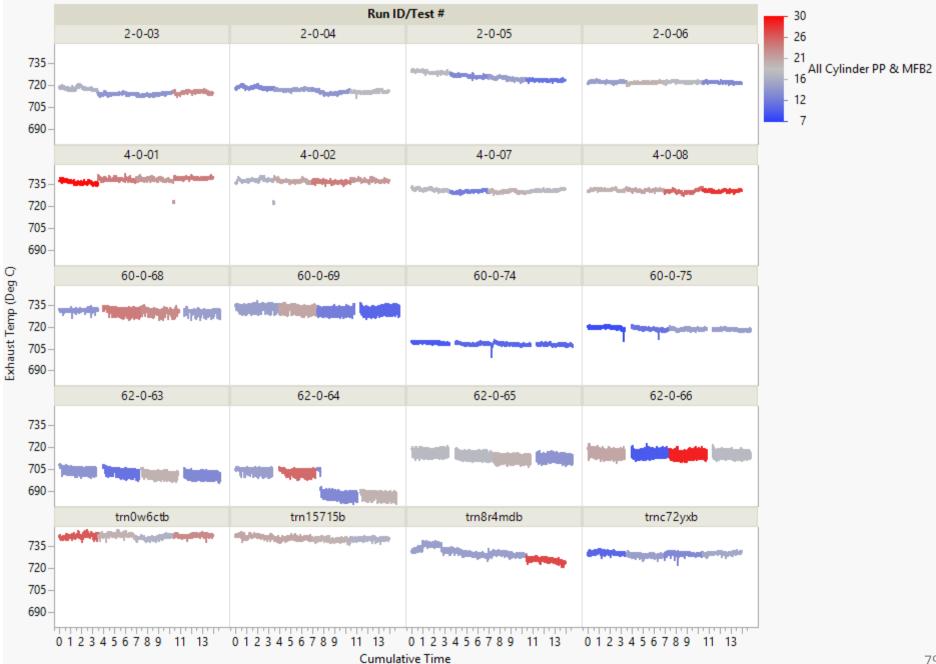


Exhaust Temp

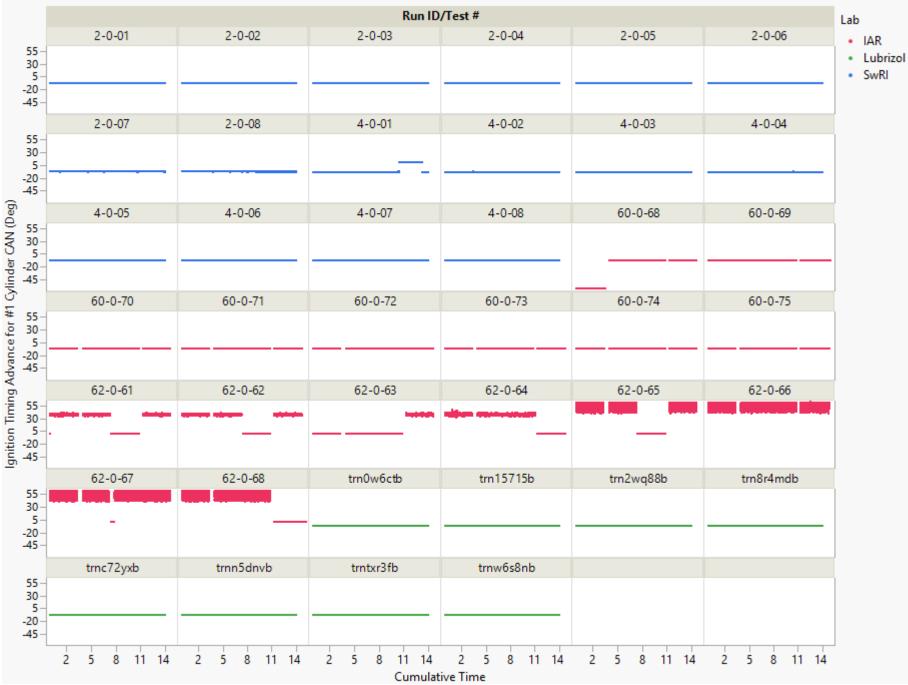


Exhaust Temp (Deg C)

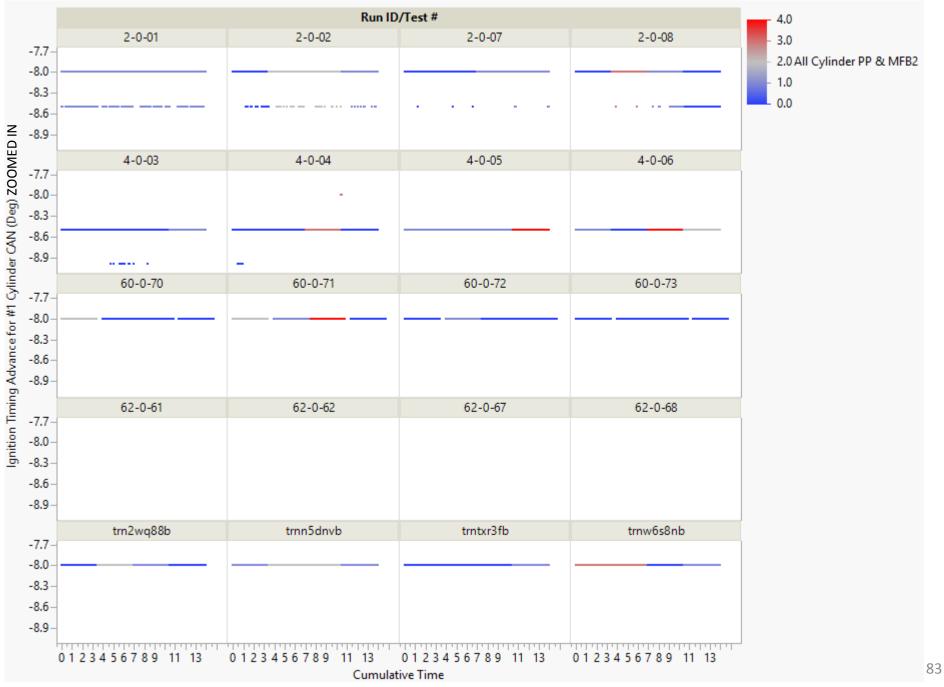


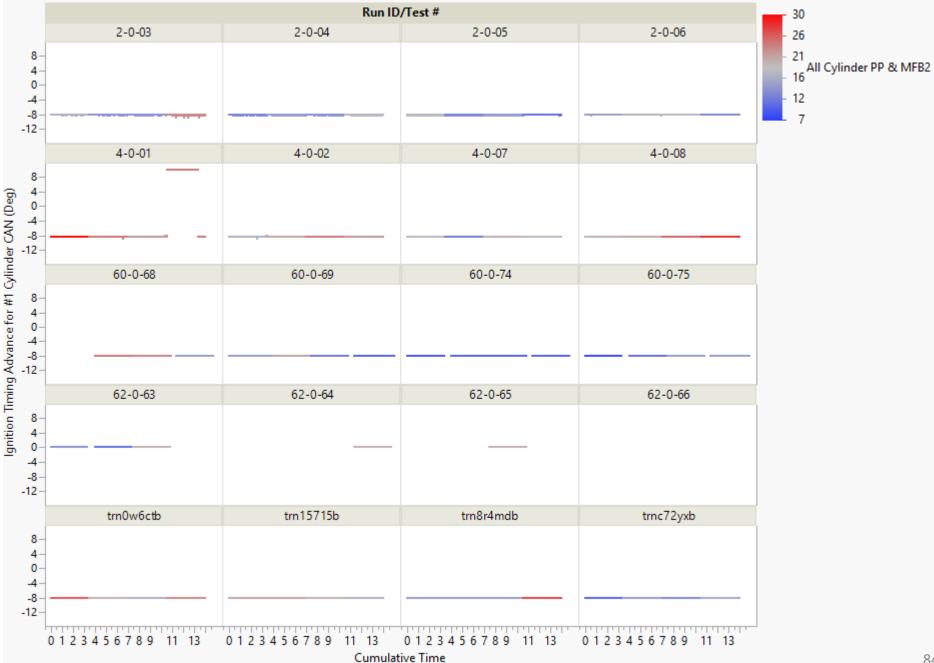


Ignition Timing Advance for #1 Cylinder CAN

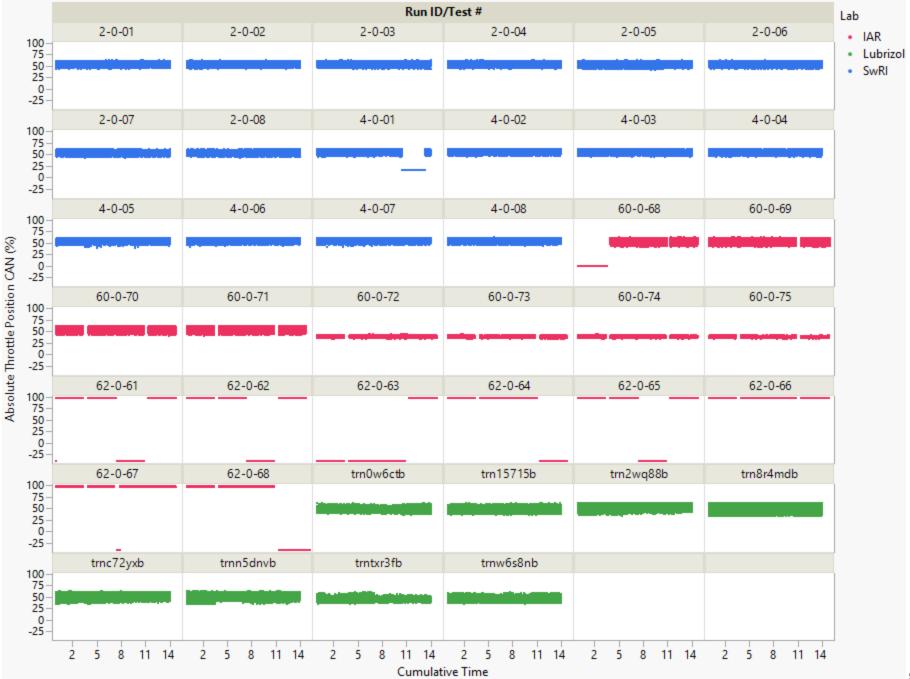


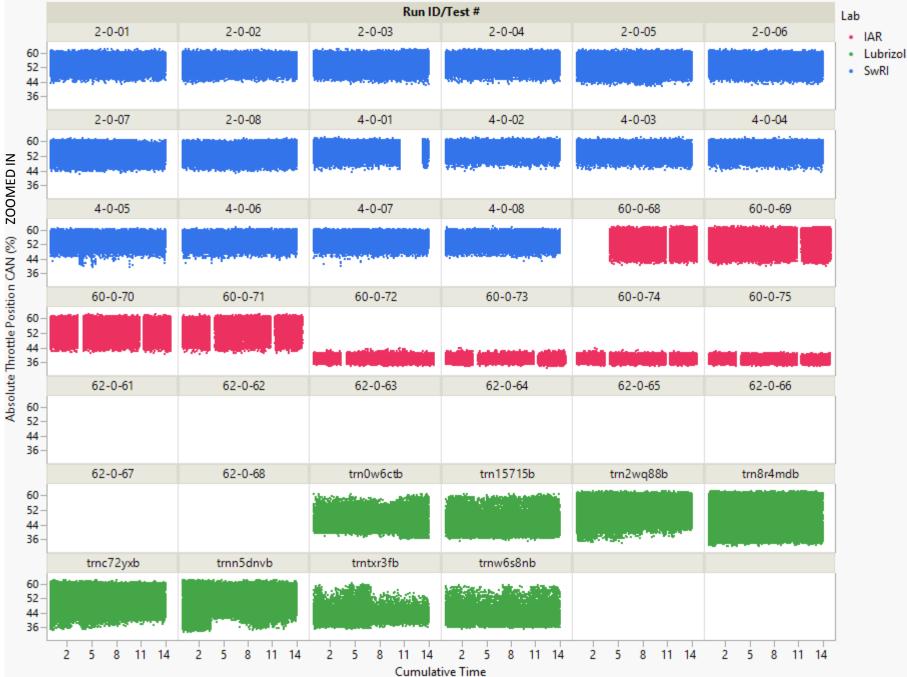
2-0-01 2-0-02 2-0-03 2-0-04 2-0-05 2-0-06 IAR				Run ID	/Test #			Lab
3.1			2-0-02	2-0-03	2-0-04	2-0-05	2-0-06	
0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 <th0< td=""><td>-8.1</td><td></td><td></td><td></td><td></td><td></td><td></td><td>Lubrizol</td></th0<>	-8.1							Lubrizol
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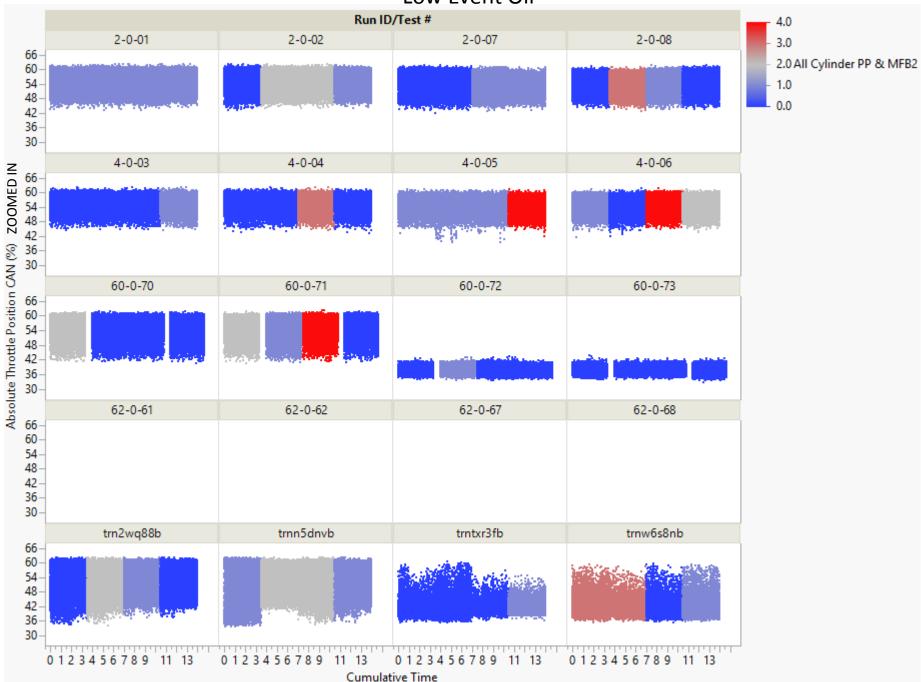


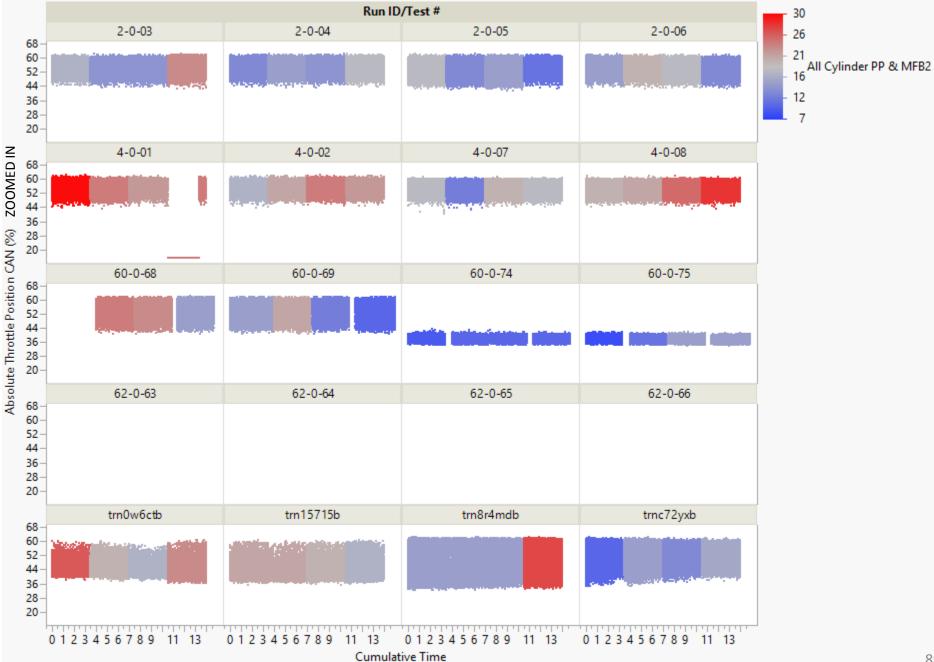


Absolute Throttle Position CAN





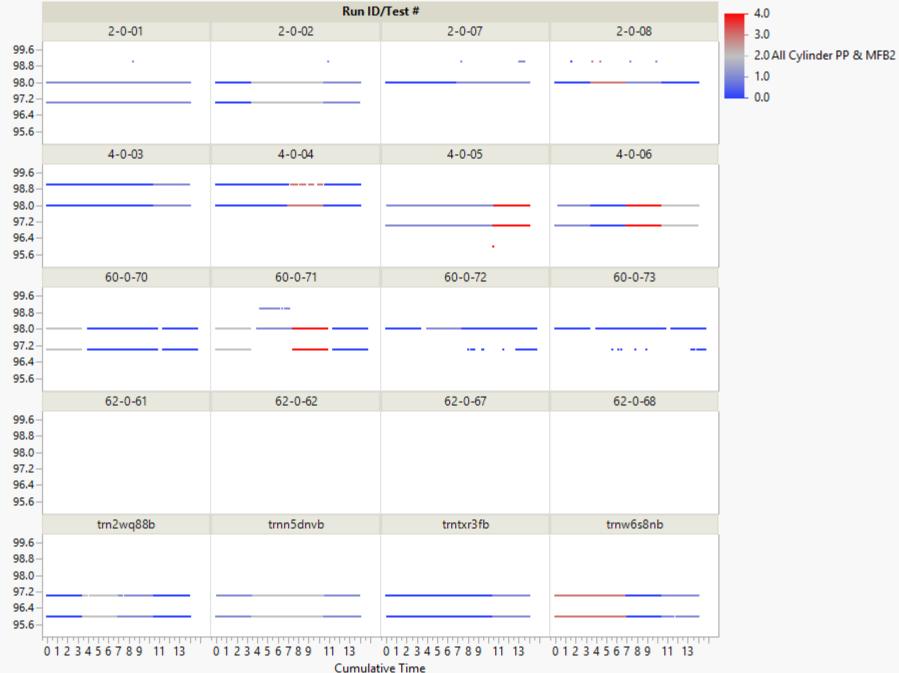


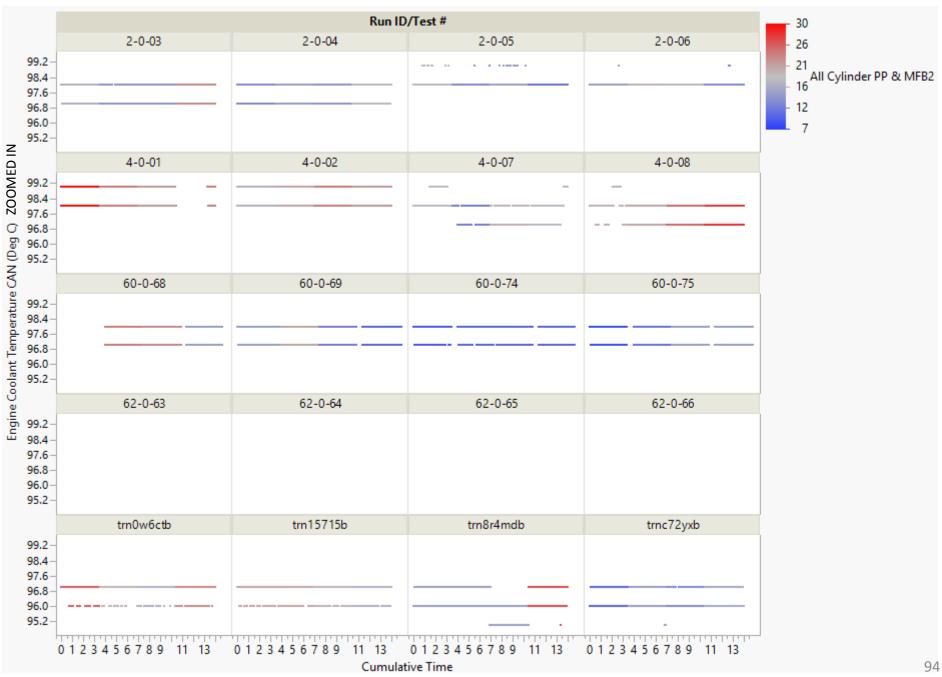


Engine Coolant Temperature CAN

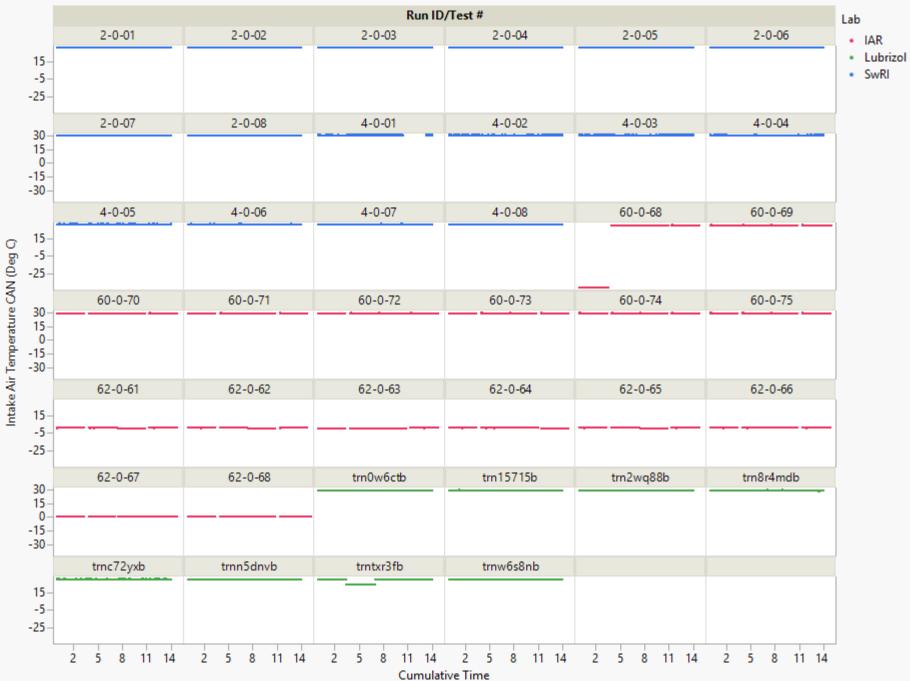


			Run ID	/Test #			Lab
	2-0-01	2-0-02	2-0-03	2-0-04	2-0-05	2-0-06	• IAI
98.8-	•					10 C 10 C 10 C	l Lu
98.0- 97.2-							• Sv
96.4 -							
95.6-	2-0-07	2-0-08	4-0-01	4-0-02	4-0-03	4-0-04	
	2-0-07	2-0-08	4-0-01	4-0-02	4-0-05	4-0-04	
98.8- 98.0-							
97.2 - 96.4 -							
95.6-							
	4-0-05	4-0-06	4-0-07	4-0-08	60-0-68	60-0-69	Í
98.8-				-			
98.0- 97.2-							
96.4							
95.0-	60-0-70	60-0-71	60-0-72	60-0-73	60-0-74	60-0-75	
	00-0-70	00-0-71	00-0-72	00-0-73	00-0-74	00-0-75	
98.0-							
97.2- 96.4-							
98.8- 98.0- 96.4- 95.6- 98.8- 97.2- 96.4- 95.6- 95.6- 98.8- 98.0- 97.2- 98.8- 98.0- 97.2-							
	62-0-61	62-0-62	62-0-63	62-0-64	62-0-65	62-0-66	
98.8-							
98.0 - 97.2 -							
96.4 - 95.6 -							
55.0	62-0-67	62-0-68	trn0w6ctb	trn15715b	trn2wq88b	trn8r4mdb	
98.8-							
98.0-							
97.2 - 96.4 -							
95.6-							J
	trnc72yxb	trnn5dnvb	trntxr3fb	trnw6s8nb			
98.8- 98.0-							
97.2-							
96.4- 95.6-							
			2 5 0 11 14	2 5 0 11 14			
	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14 ive Time	2 5 8 11 14	2 5 8 11 14	

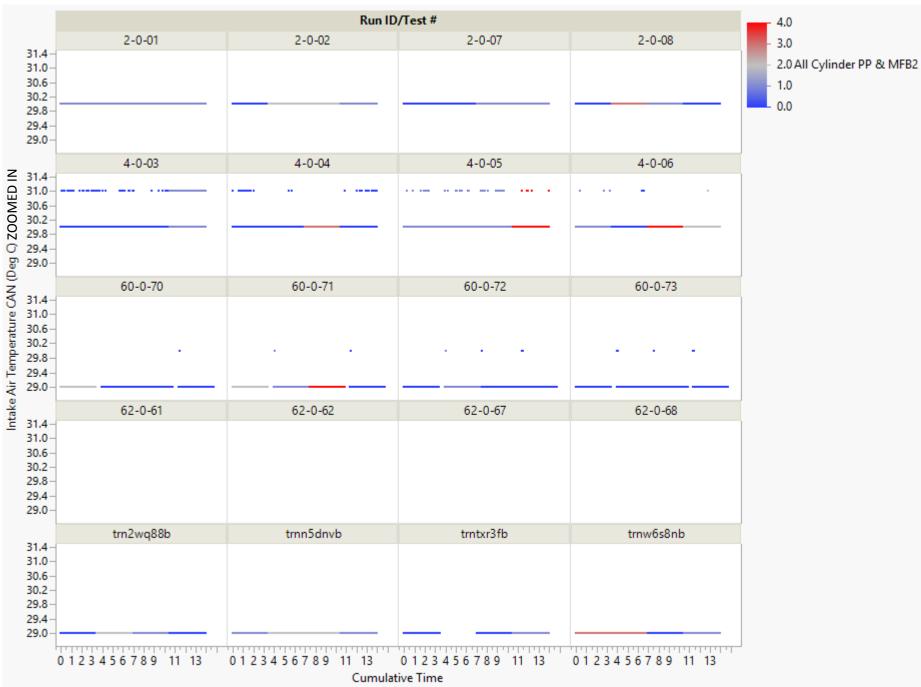




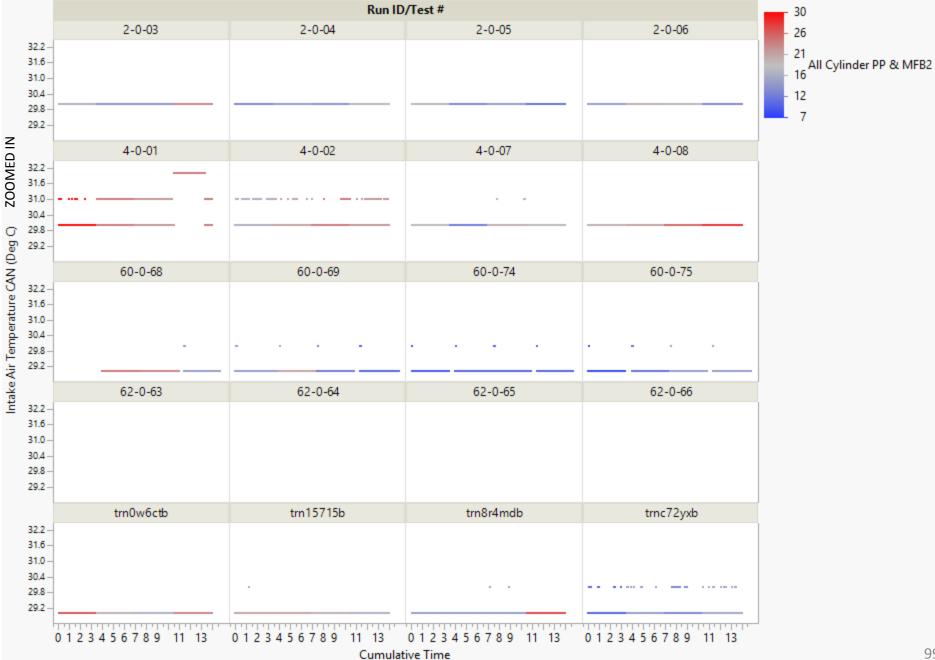
Intake Air Temperature CAN







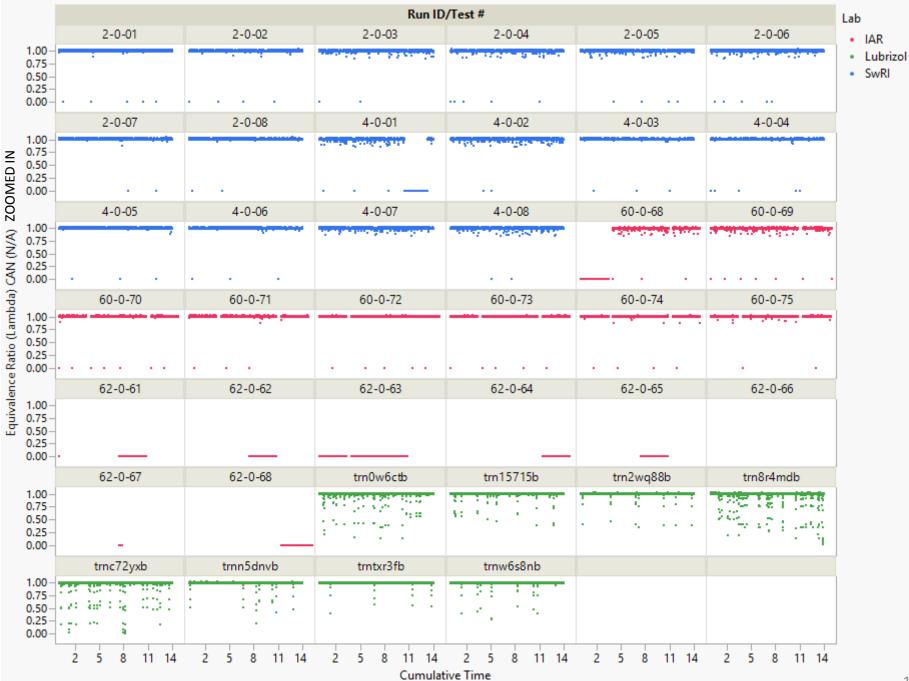
High Event Oil

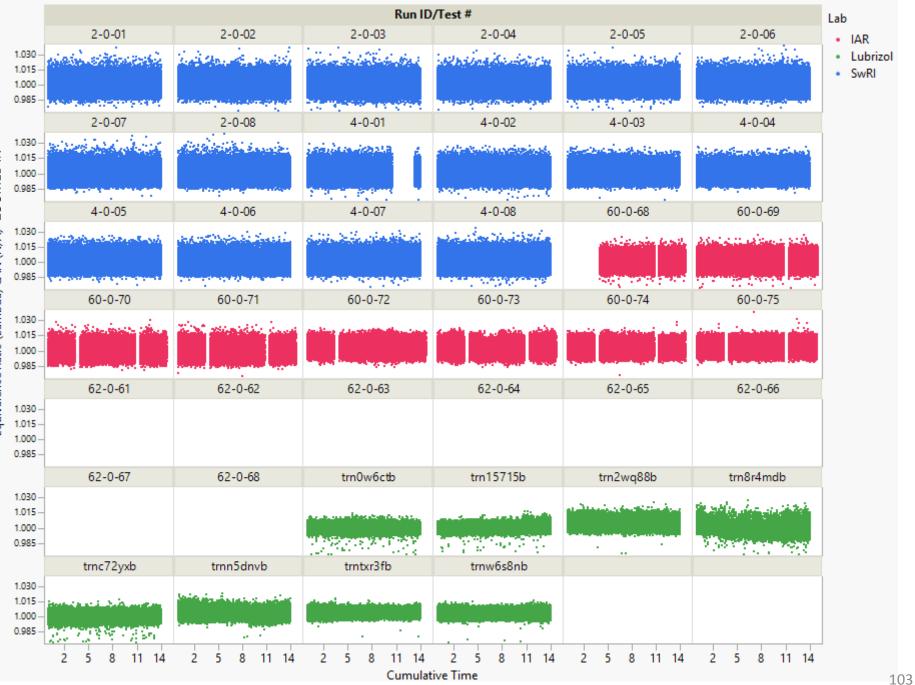


Equivalence Ratio (Lambda) CAN

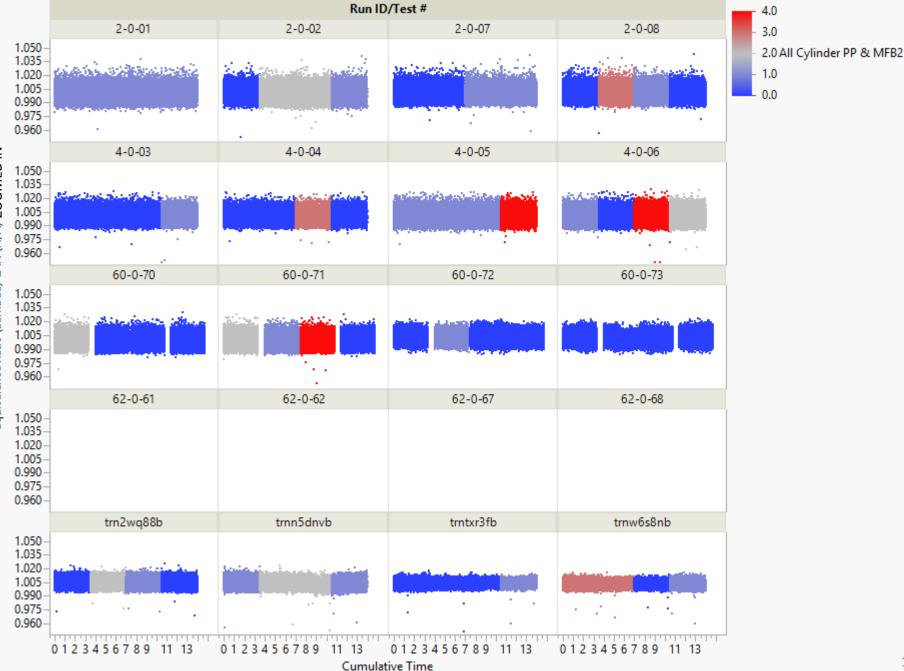


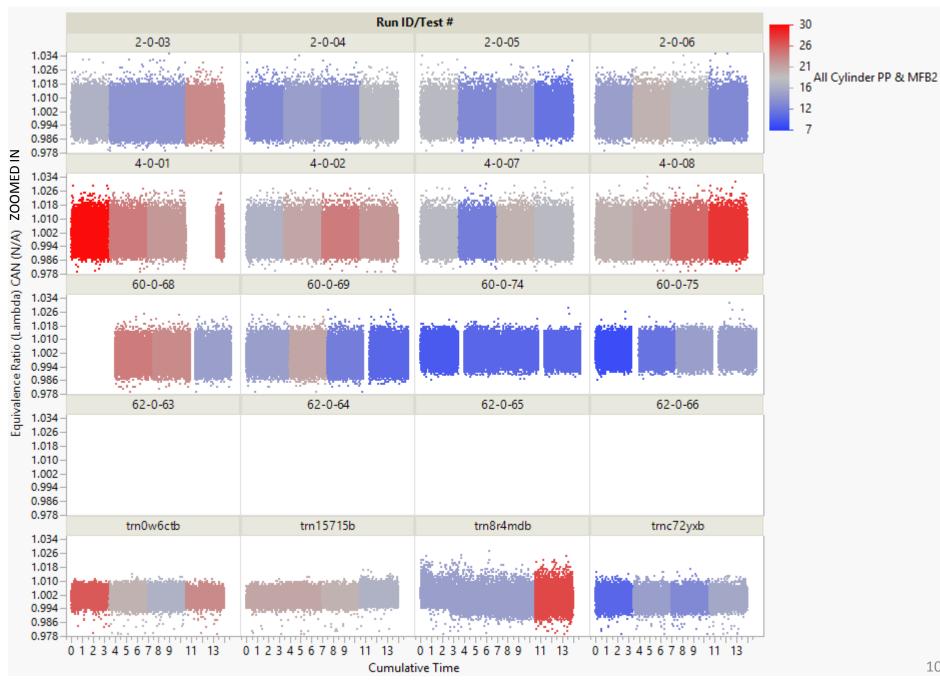
Equivalence Ratio (Lambda) CAN (N/A)



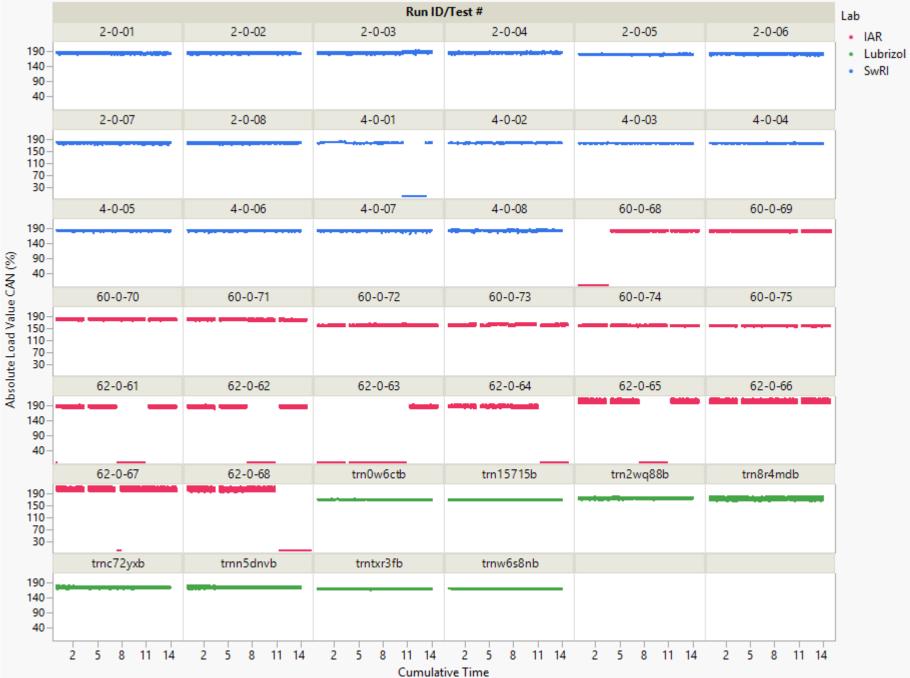


Equivalence Ratio (Lambda) CAN (N/A) ZOOMED IN

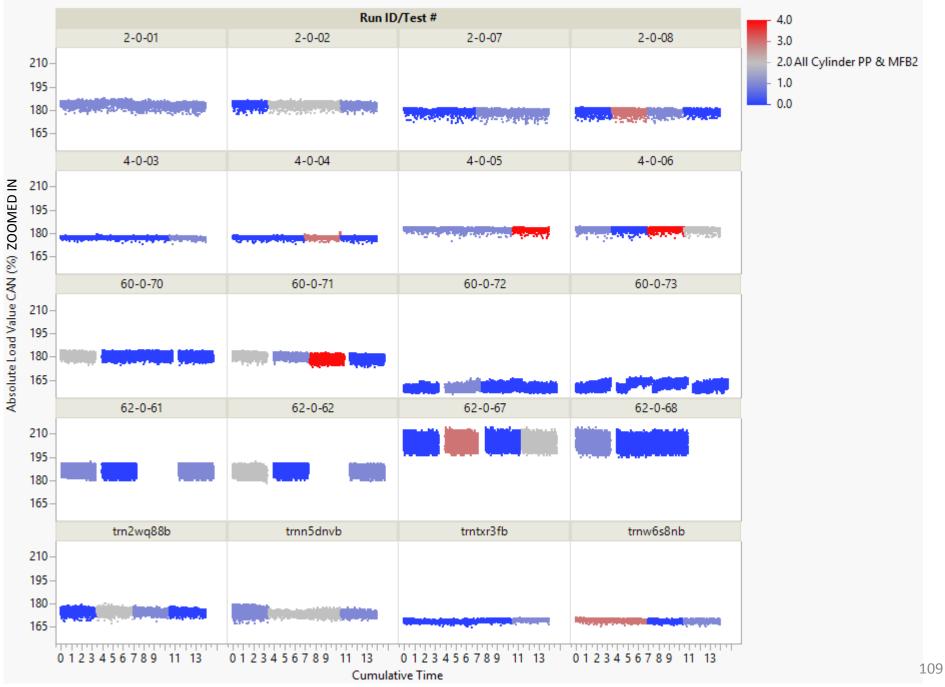


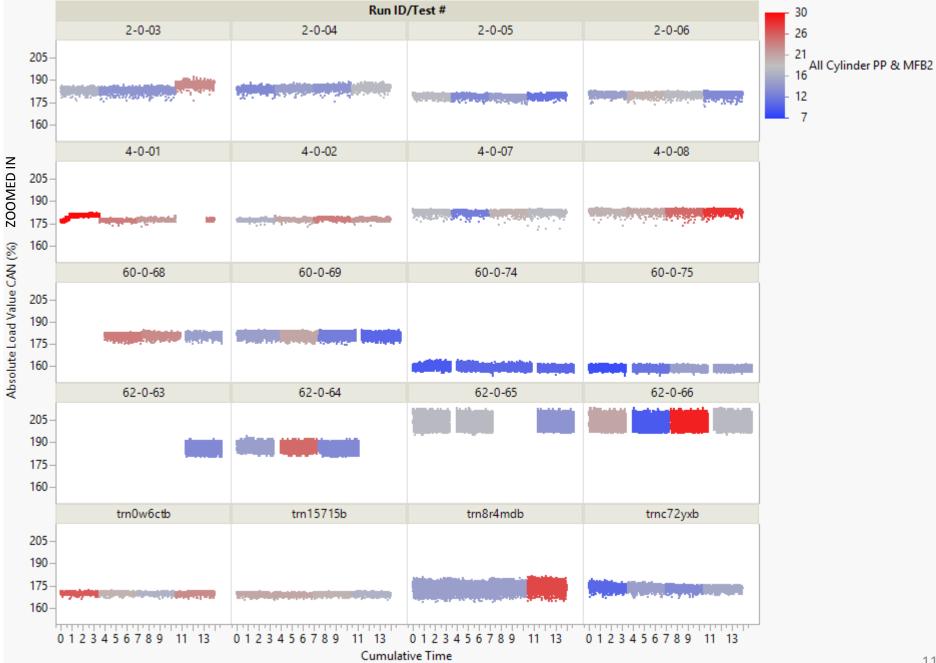


Absolute Load Value CAN

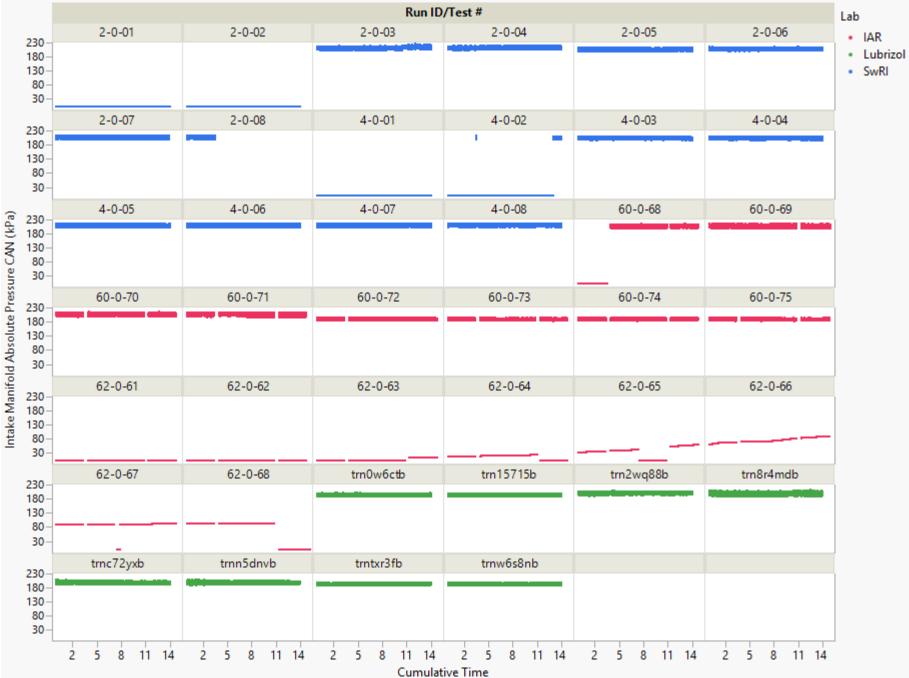


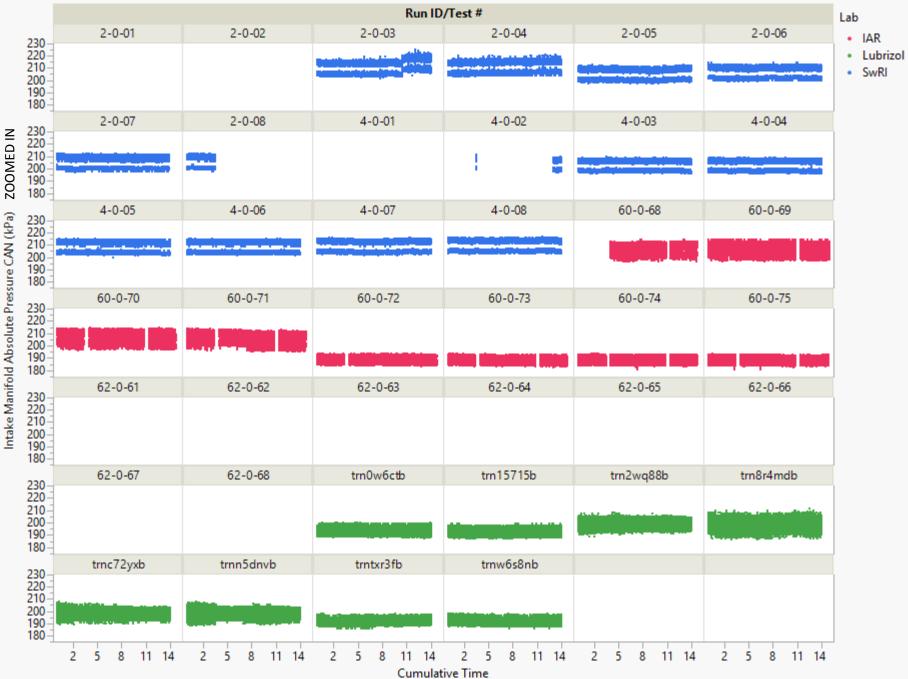
	Run ID/Test #							
220-	2-0-01	2-0-02	2-0-03	2-0-04	2-0-05	2-0-06	• IAR	
220 200 190 190 190 190 190	and the state of the		a transferitur (a finale	a <mark>lintestelet soniejestelje</mark>			 Lubrize SwRI 	
	2-0-07	2-0-08	4-0-01	4-0-02	4-0-03	4-0-04		
220 200 198 180 170 150								
	4-0-05	4-0-06	4-0-07	4-0-08	60-0-68	60-0-69		
220 200 190 190 190 190 190					maggetistere Spereg	Manual Contraction of the second		
	60-0-70	60-0-71	60-0-72	60-0-73	60-0-74	60-0-75		
220 200 190 180 170 150	anadis padaginginan kalany	and the summary produces and the	andas spillininifficient	والكند البادي ماحي أكلاك	سينيد والباديوسانا والقرد	مادده فلمبطقتك المعاد		
220-	62-0-61	62-0-62	62-0-63	62-0-64	62-0-65	62-0-66		
220 210 190 190 190 190 190		andaj angel i kajin		aline anterimete	jijana kiljina kinak			
220-	62-0-67	62-0-68	trn0w6ctb	trn15715b	trn2wq88b	trn8r4mdb		
220 - 210 - 200 - 190 - 180 - 170 - 150 -	nin järk tirjainis				Other Report of the second s			
	trnc72yxb	trnn5dnvb	trntxr3fb	trnw6s8nb				
220 200 190 190 190 190 190								
	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14 Cumulat	2 5 8 11 14 tive Time	2 5 8 11 14	2 5 8 11 14		



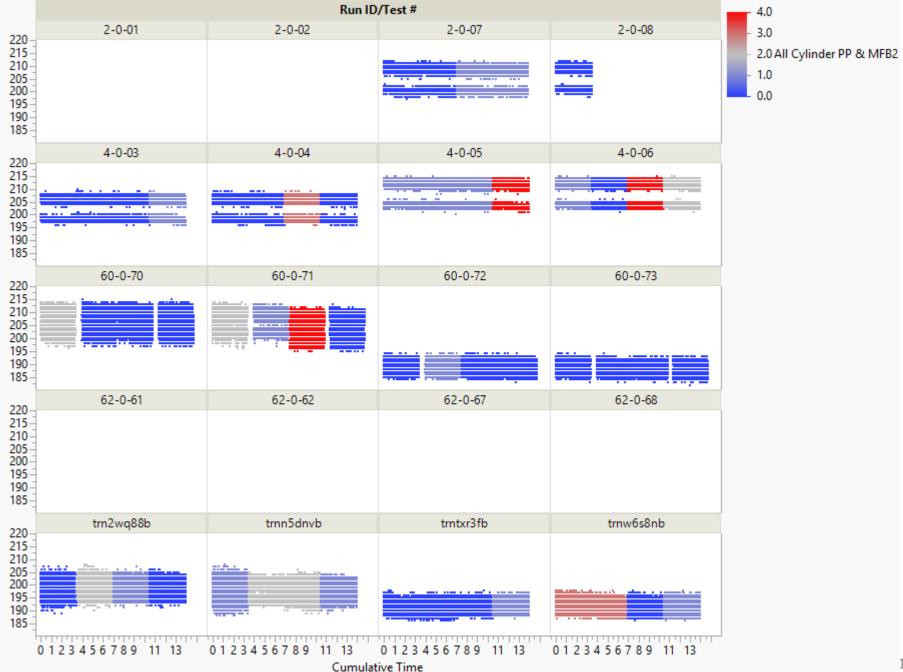


Intake Manifold Absolute Pressure CAN

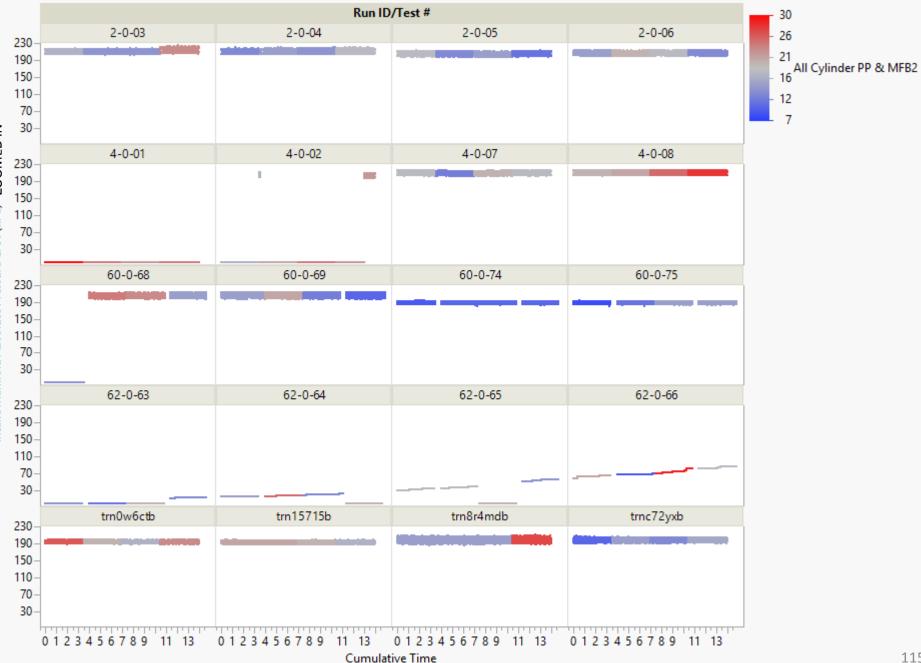




Intake Manifold Absolute Pressure CAN (kPa)



Intake Manifold Absolute Pressure CAN (kPa)

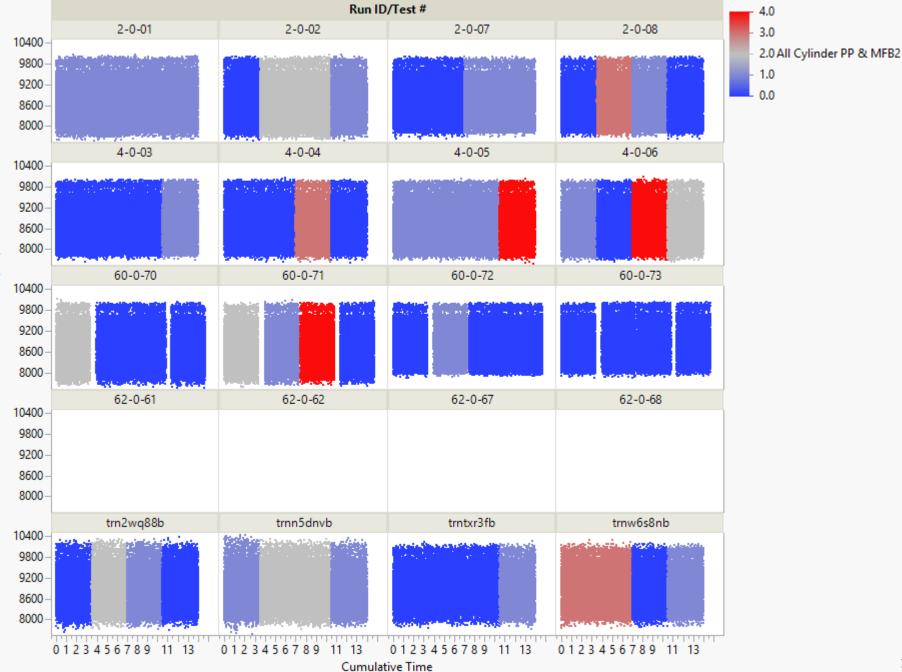


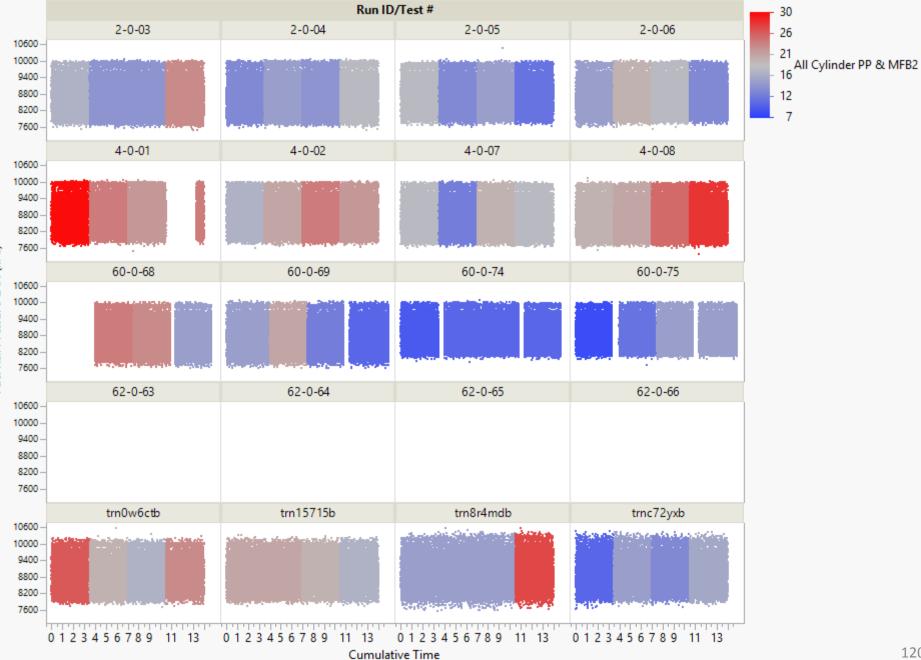
Fuel Rail Pressure CAN



Fuel Rail Pressure CAN (kPa)

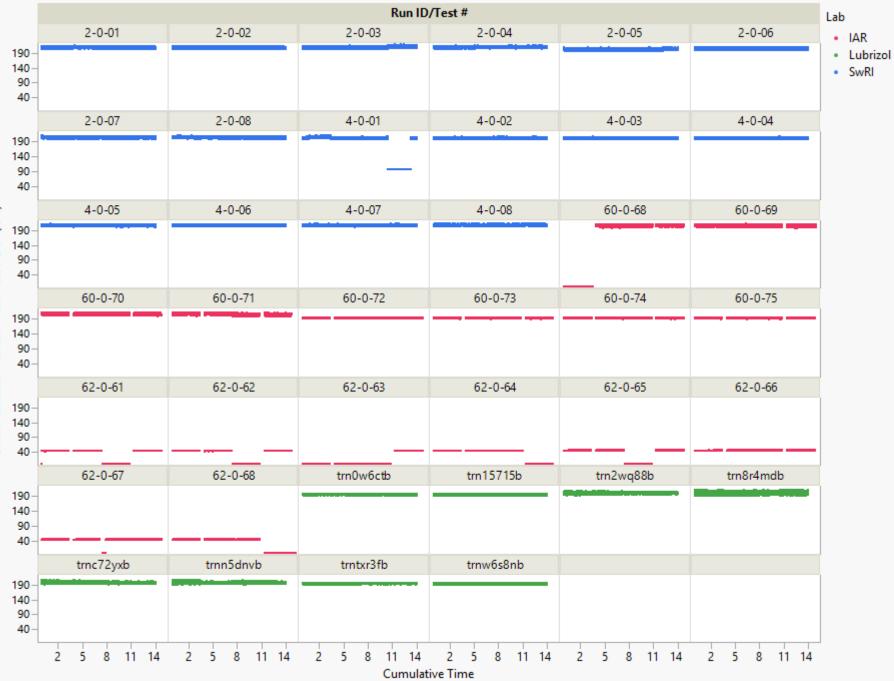




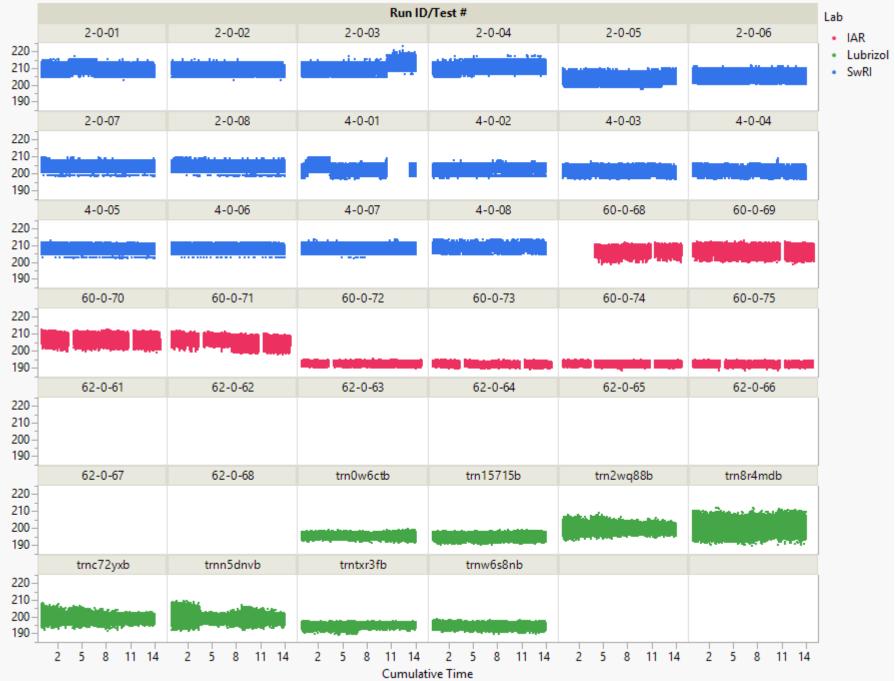


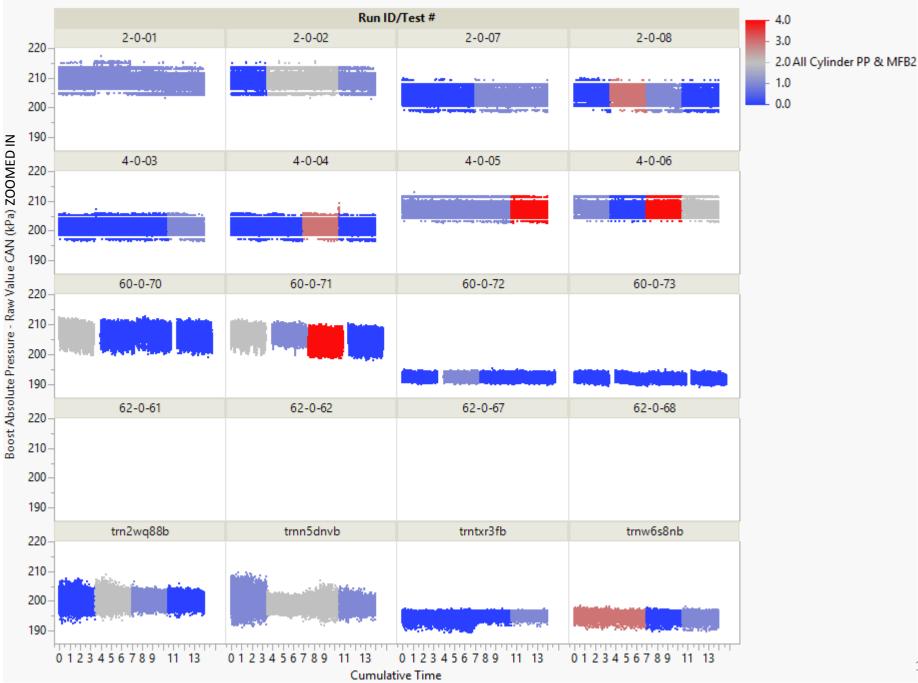
120

Boost Absolute Pressure - Raw Value CAN

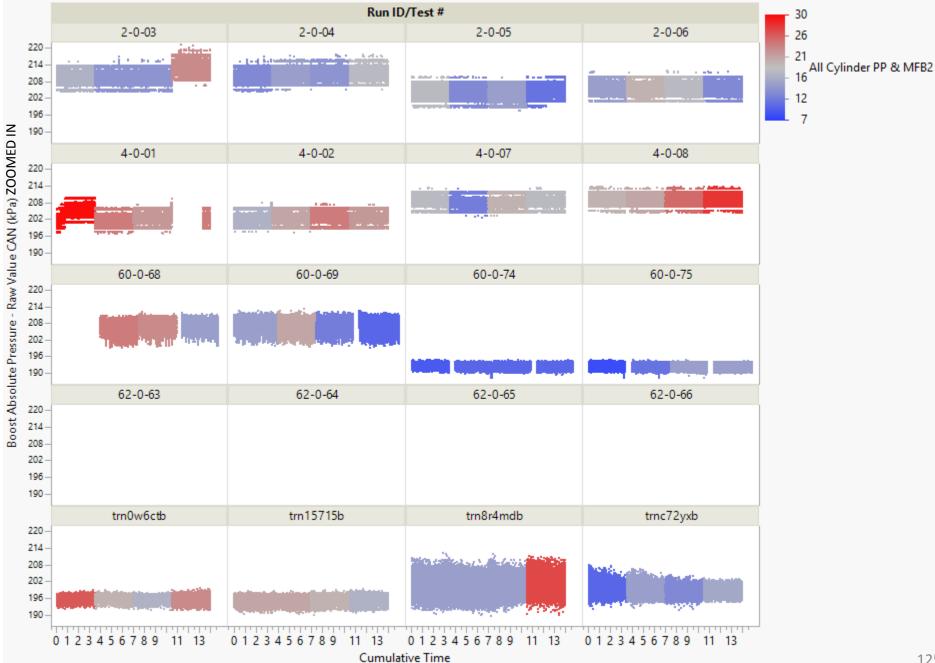


Boost Absolute Pressure - Raw Value CAN (kPa)

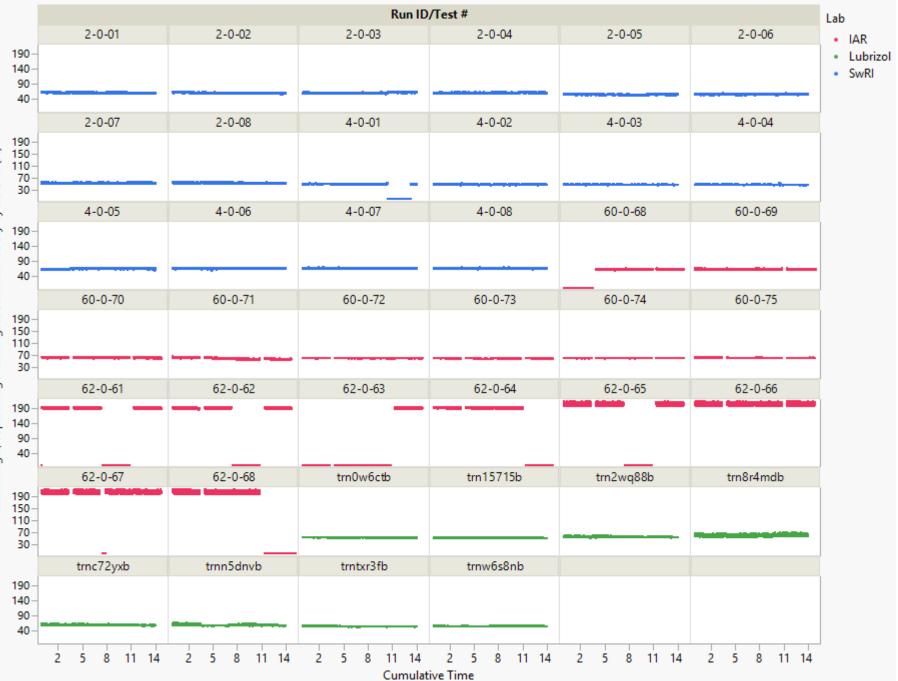




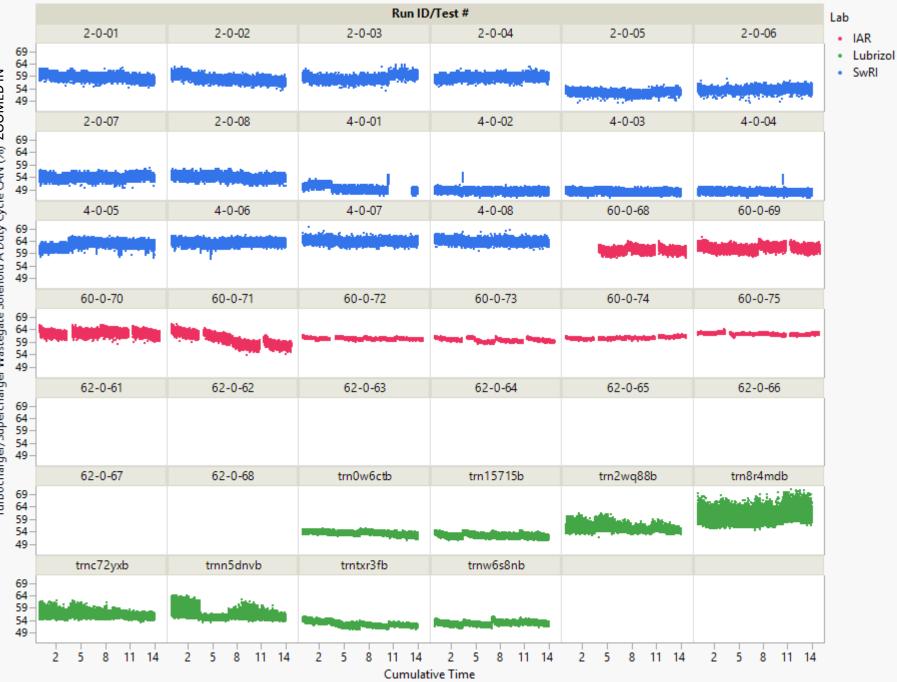
124

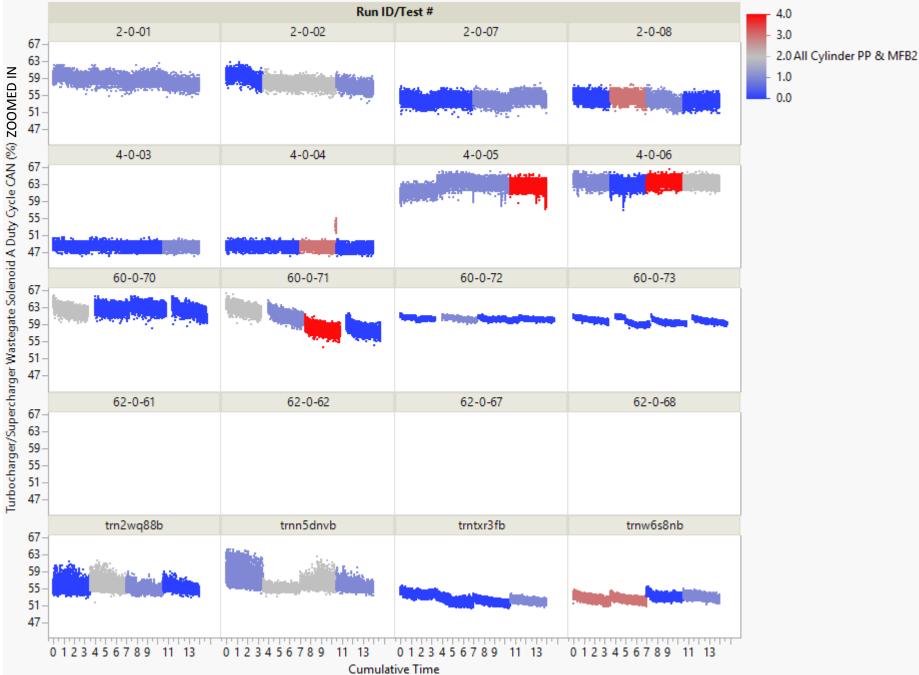


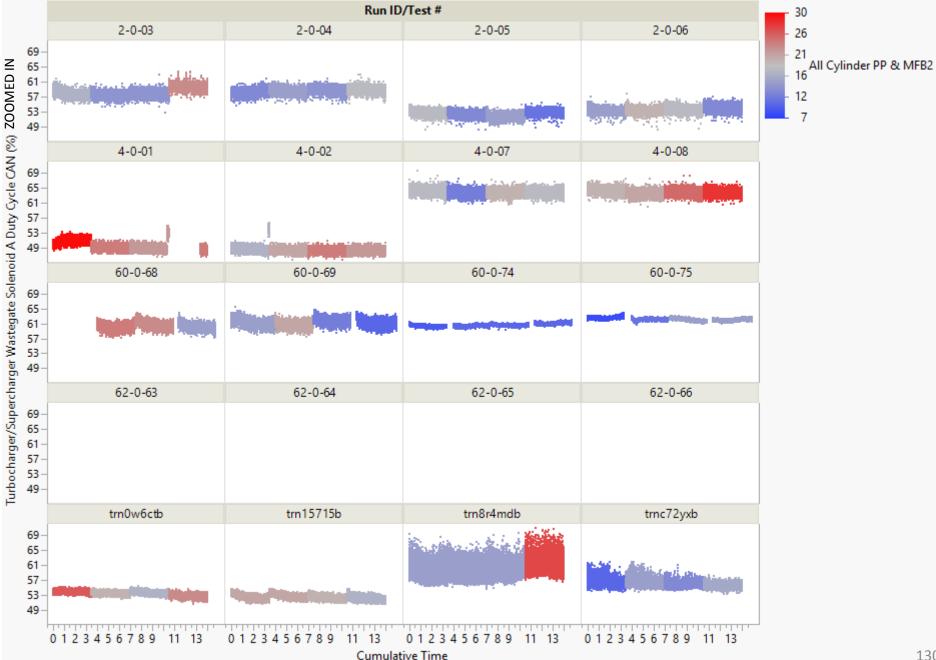
Turbocharger/Supercharger Wastegate Solenoid A Duty Cycle CAN



Turbocharger/Supercharger Wastegate Solenoid A Duty Cycle CAN (%)





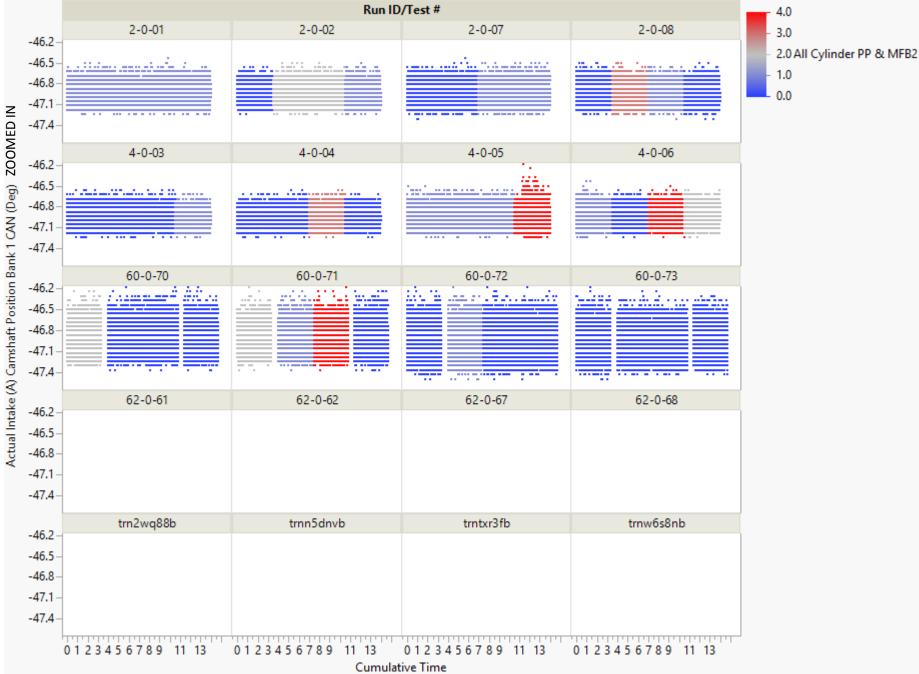


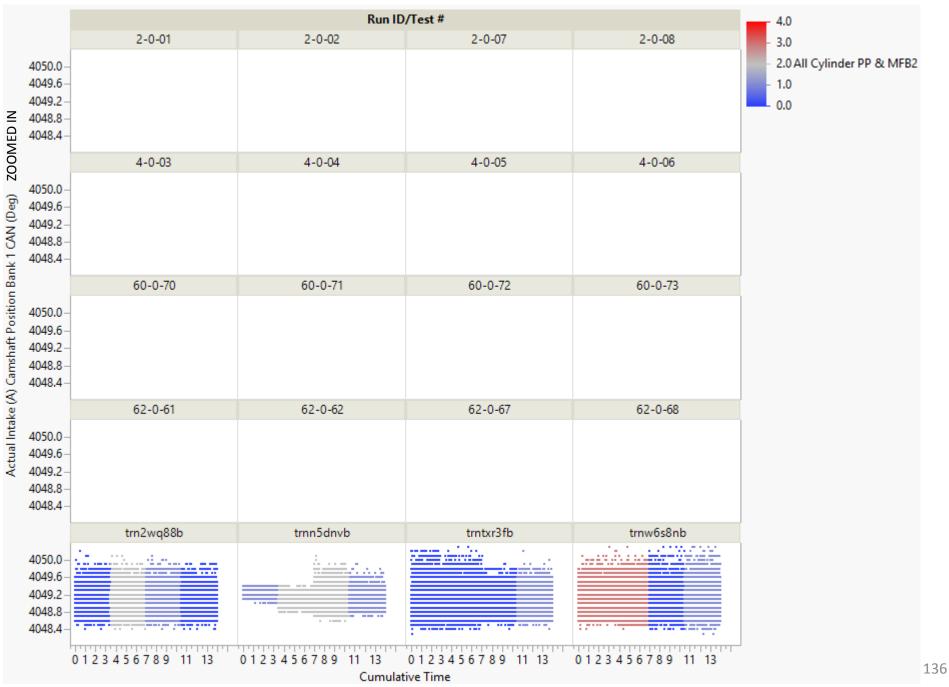
Actual Intake (A) Camshaft Position Bank 1 CAN

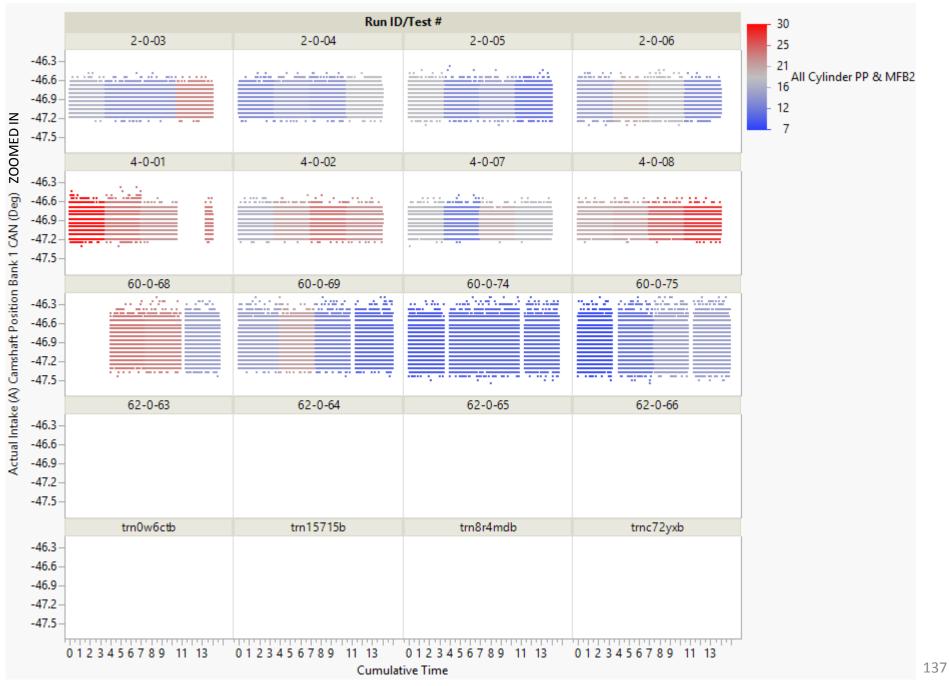
	Run ID/Test #										
	2-0-01	2-0-02	2-0-03	2-0-04	2-0-05	2-0-06	Lab • IAR				
3800 3000 2200 1400 600							 Lubrizol SwRI 				
	2-0-07	2-0-08	4-0-01	4-0-02	4-0-03	4-0-04	Í				
3800 - 3000 - 2200 - 1400 - 600 -											
	4-0-05	4-0-06	4-0-07	4-0-08	60-0-68	60-0-69					
3800 - 3000 - 2200 - 1400 - 600 -											
	60-0-70	60-0-71	60-0-72	60-0-73	60-0-74	60-0-75	í l				
3800 3000 2200 1400 600											
2	62-0-61	62-0-62	62-0-63	62-0-64	62-0-65	62-0-66					
3800- 3000- 2200- 1400- 600-											
	62-0-67	62-0-68	trn0w6ctb	trn15715b	trn2wq88b	trn8r4mdb					
3800 3000 2200 1400 600											
	trnc72yxb	trnn5dnvb	trntxr3fb	trnw6s8nb							
3800 3000 2200 1400 600											
	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14	2 5 8 11 14					
			Cumulati	ive Time							

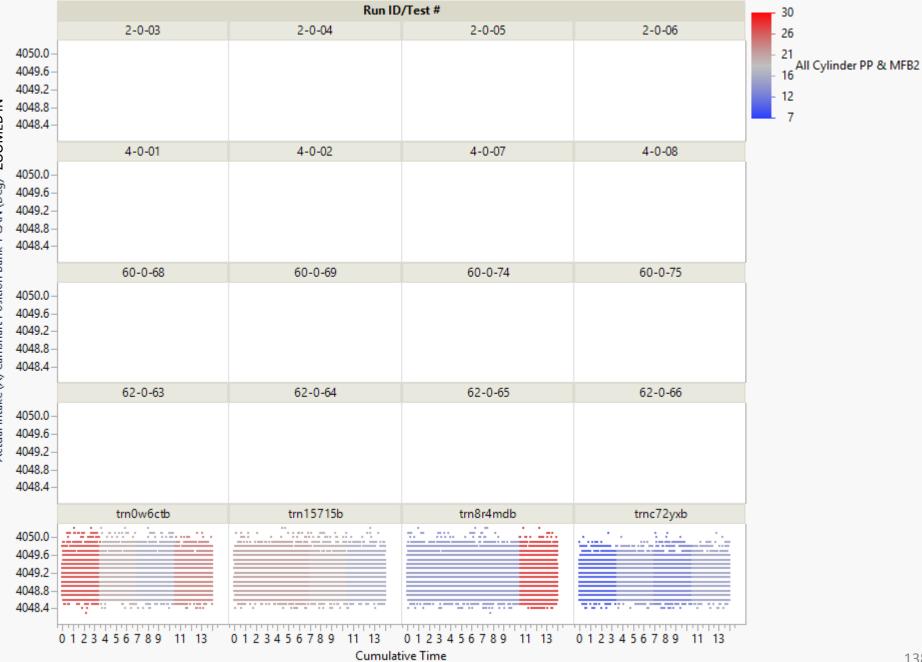


	Run ID/Test #										
	2-0-01	2-0-02	2-0-03	2-0-04	2-0-05	2-0-06	• IAR				
4050.4 - 4049.9 - 4049.4 - 4048.9 - 4048.4 -							 Lubrizol SwRl 				
	2-0-07	2-0-08	4-0-01	4-0-02	4-0-03	4-0-04					
4050.4 – 4049.9 – 4049.4 – 4048.9 –											
4040.4- 5	4-0-05	4-0-06	4-0-07	4-0-08	60-0-68	60-0-69	(
4050.4 – 4049.9 – 4049.4 – 4048.9 – 4048.9 – 4048.4 –											
	60-0-70	60-0-71	60-0-72	60-0-73	60-0-74	60-0-75	[
6 4050.4 – 4049.9 – 4049.4 – 4048.9 – 4048.9 –											
ξ	62-0-61	62-0-62	62-0-63	62-0-64	62-0-65	62-0-66	(
4050.4 – 4049.9 – 4049.4 – 4048.9 – 4048.9 –											
-	62-0-67	62-0-68	trn0w6ctb	trn15715b	trn2wq88b	trn8r4mdb					
4050.4 4049.9 4049.4 4048.9 4048.4			dinina na ina.	nia - Program - Ap		in an stàit ta th					
	trnc72yxb	trnn5dnvb	trntxr3fb	trnw6s8nb							
4050.4 4049.9 4049.4 4048.9 4048.4											
2 5 8 11 14 2 5 8 11 14 2 5 8 11 14 2 5 8 11 14 2 5 8 11 14 2 5 8 11 14 2 5 8 11 14											
			Cumulat	ive fime							

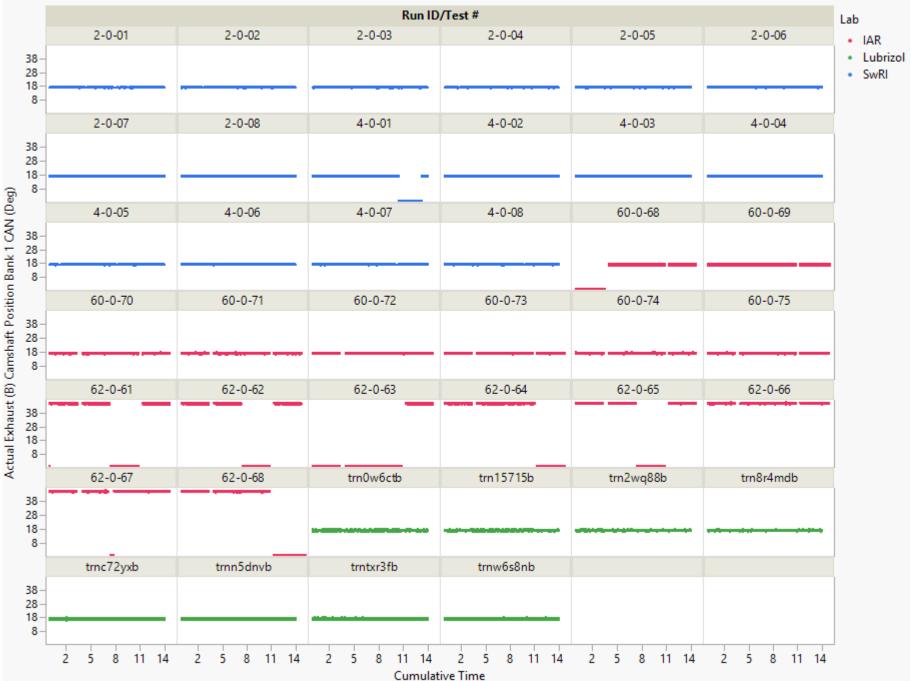


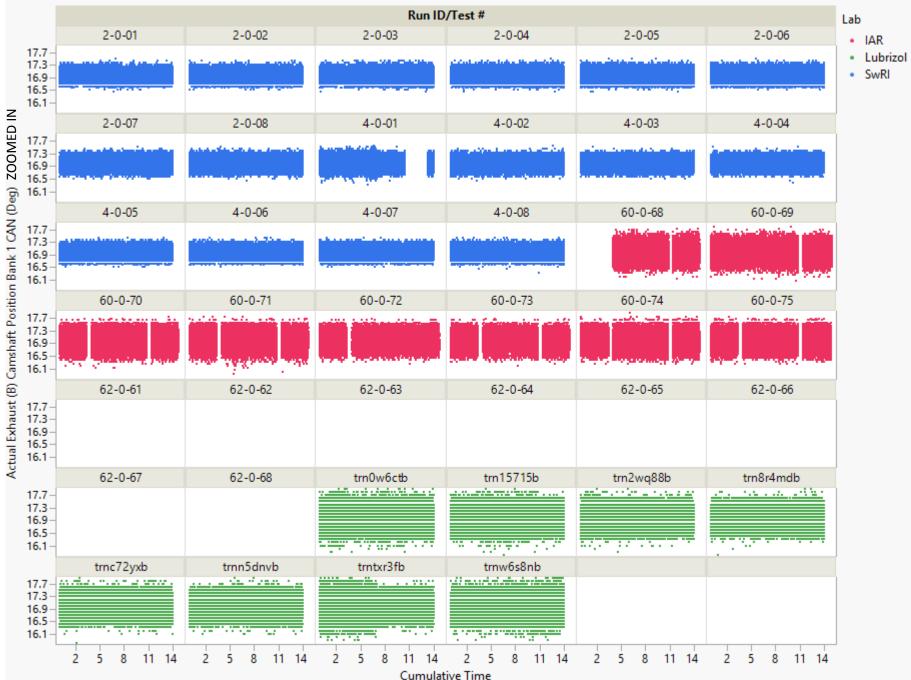


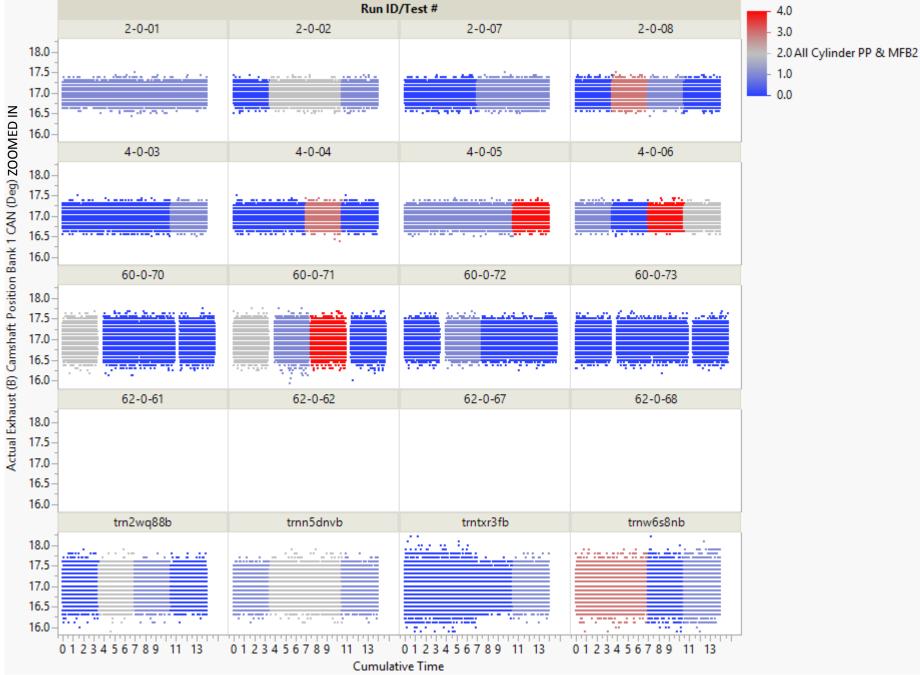


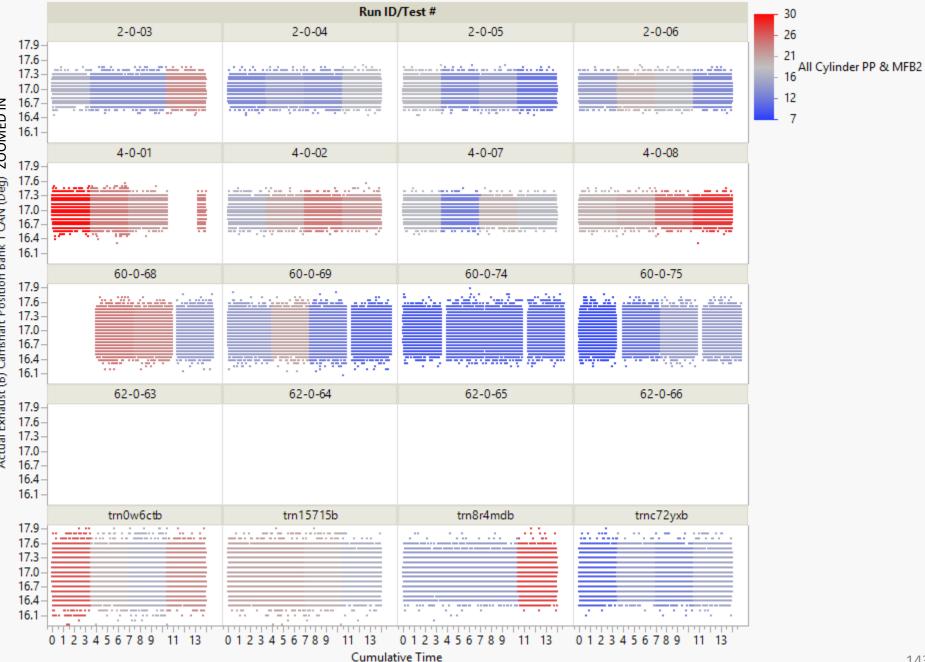


Actual Exhaust (B) Camshaft Position Bank 1 CAN

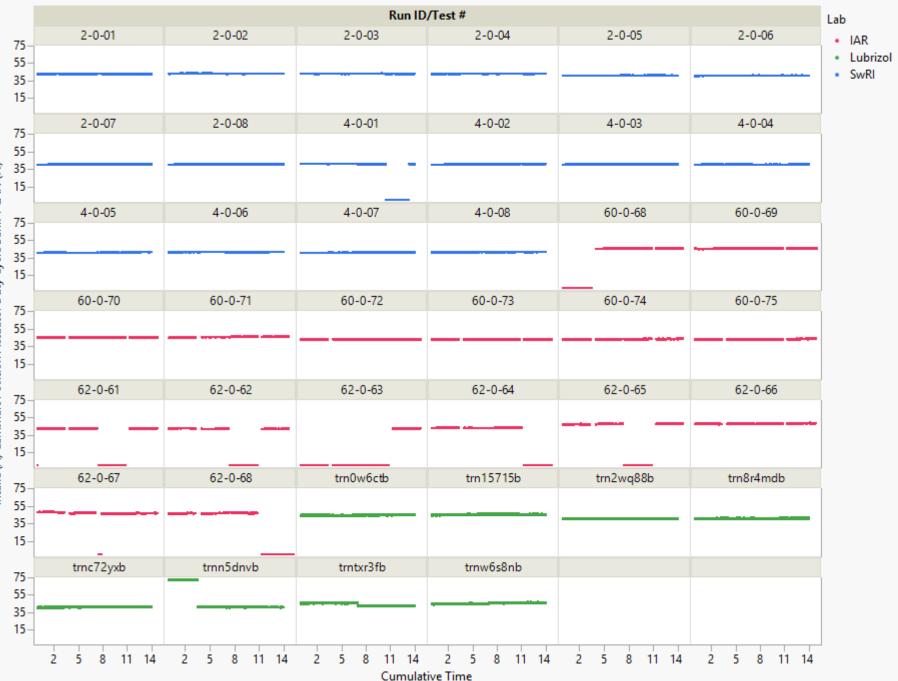


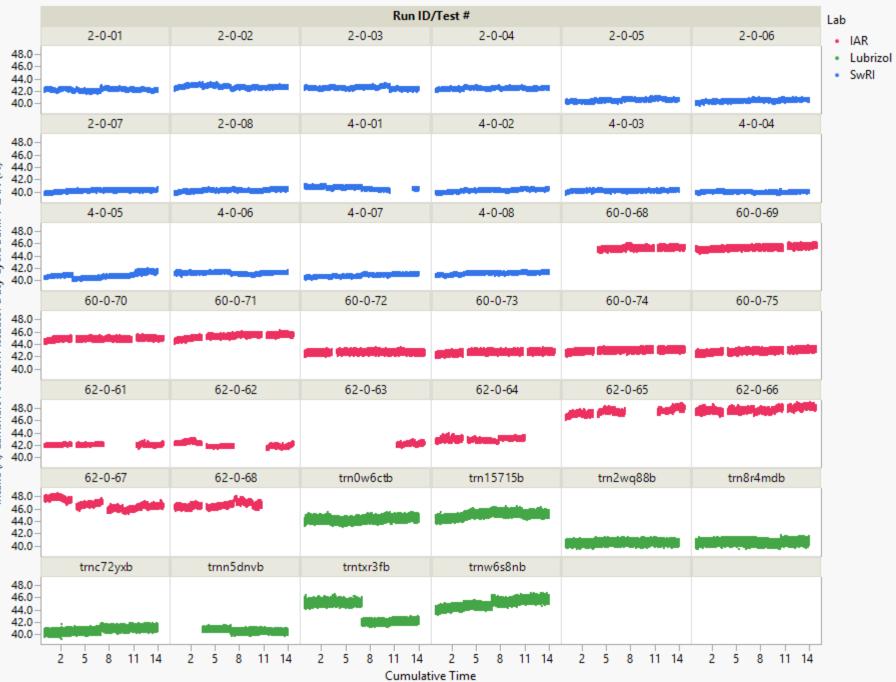




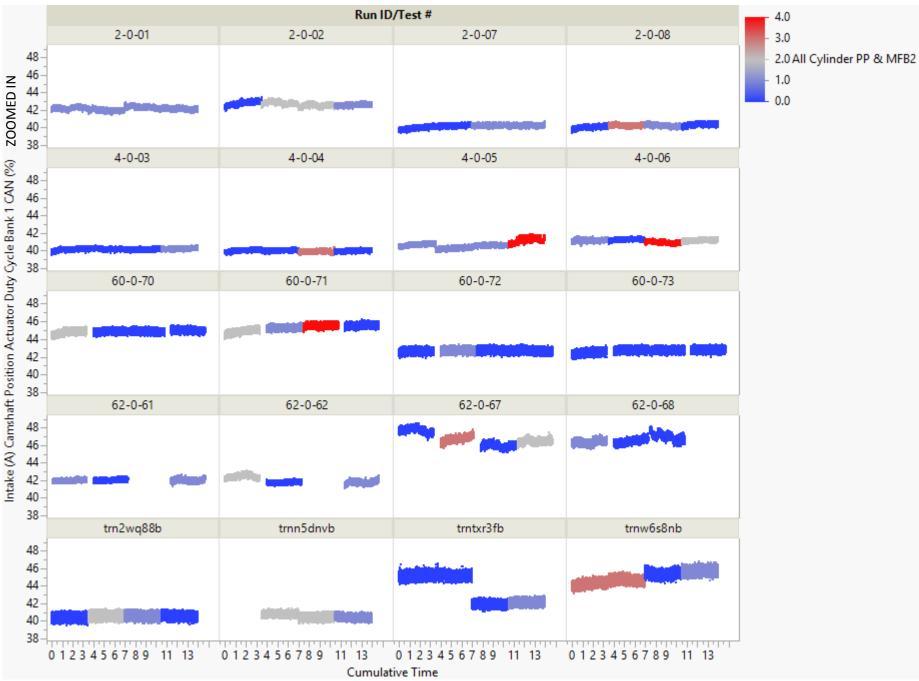


Intake (A) Camshaft **Position Actuator** Duty Cycle Bank 1 CAN

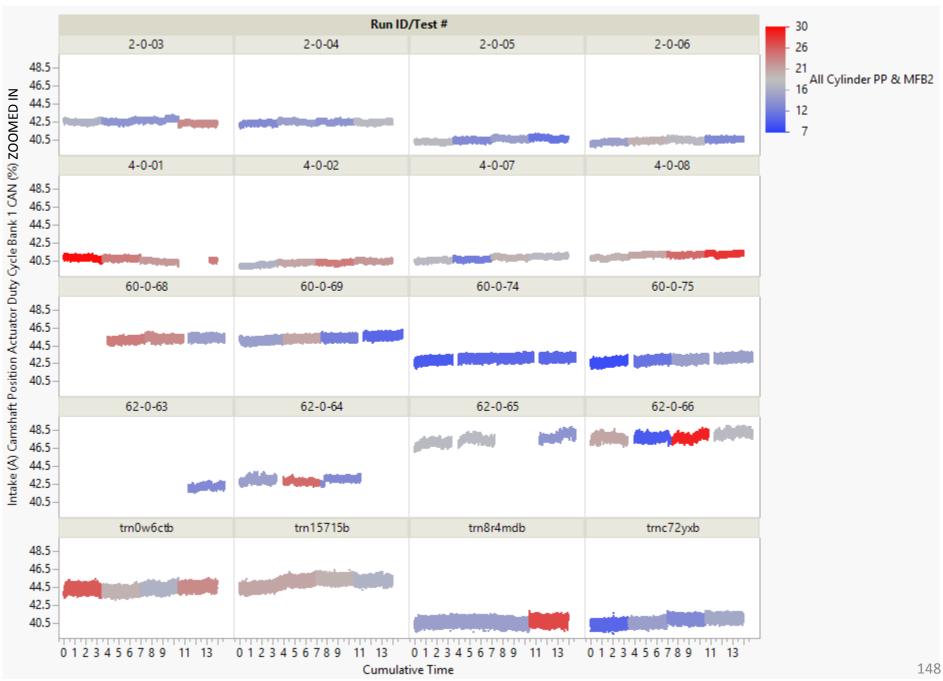




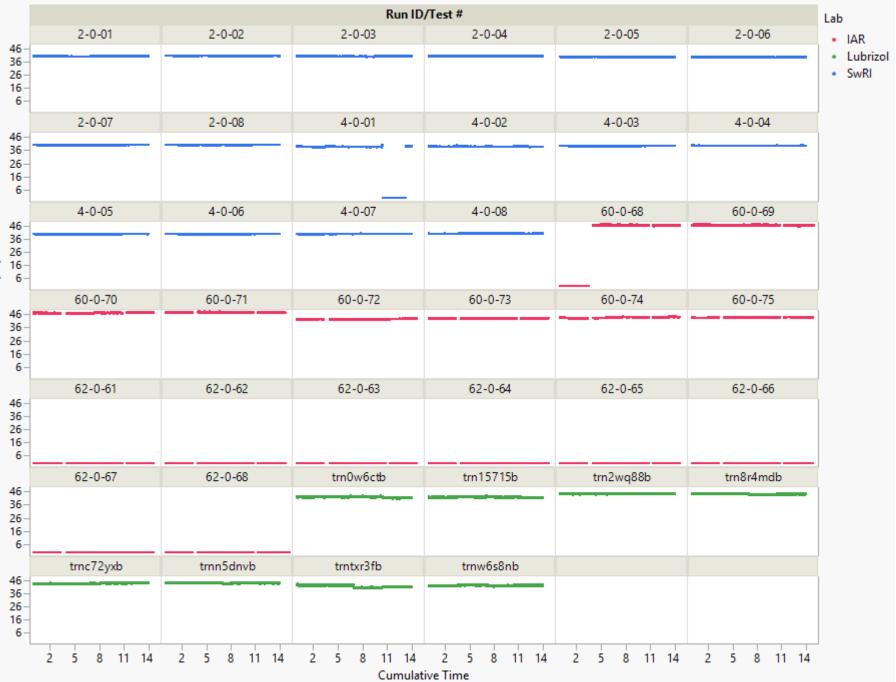
Low Event Oil

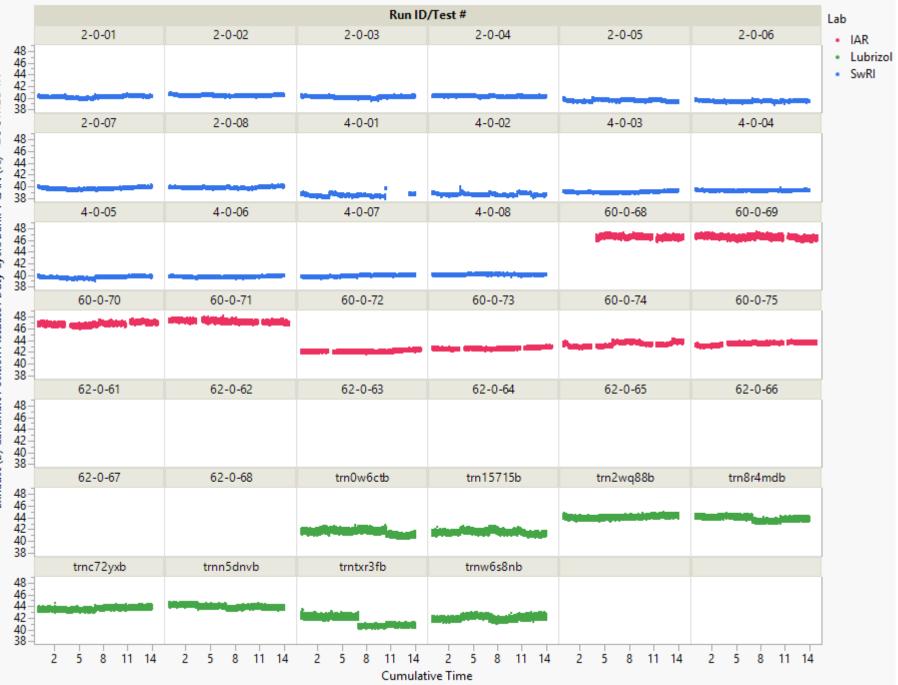


High Event Oil

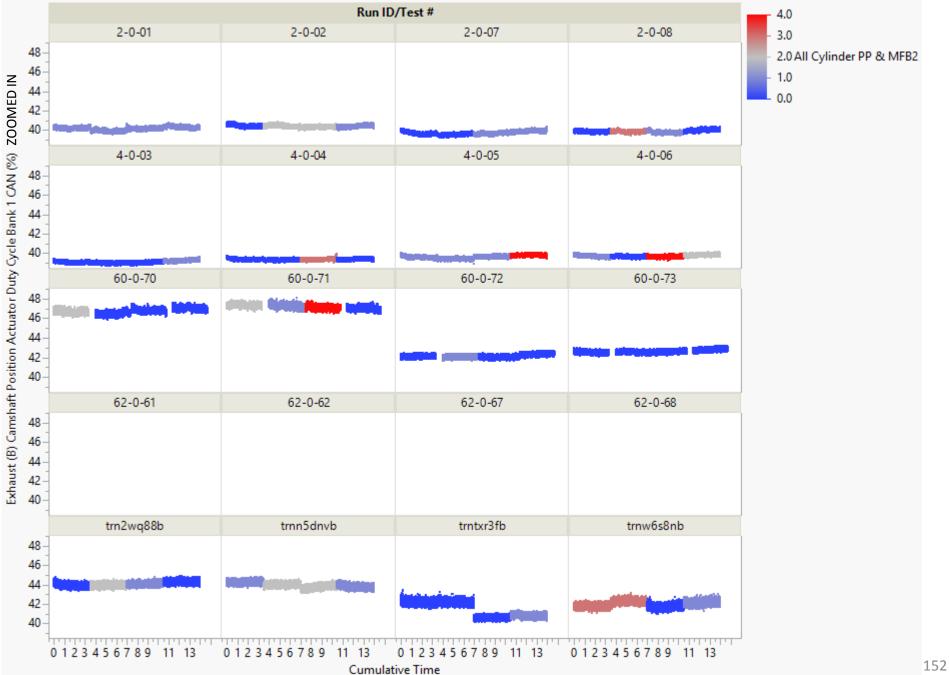


Exhaust (B) Camshaft **Position Actuator** Duty Cycle Bank 1 CAN

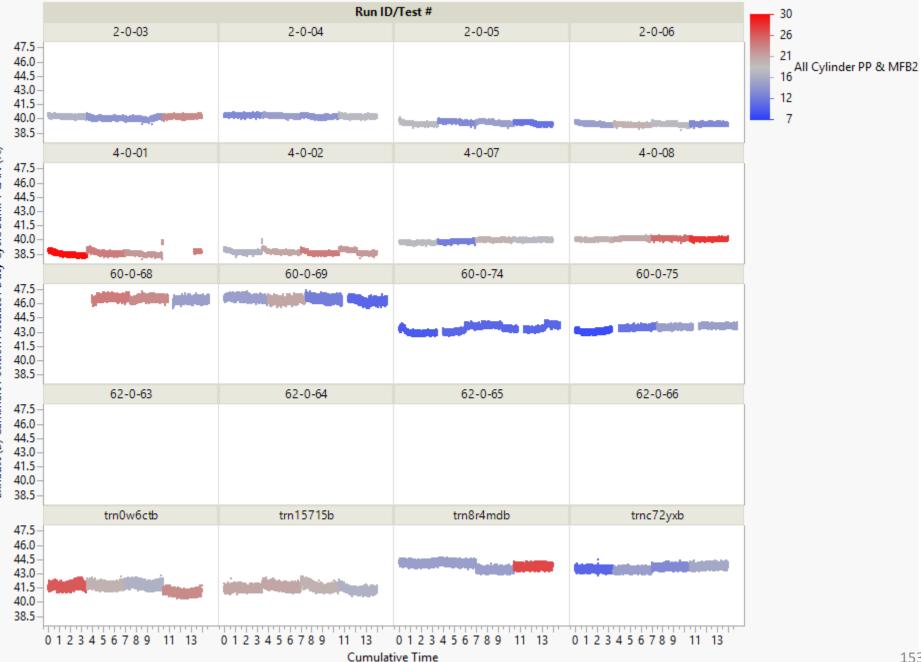




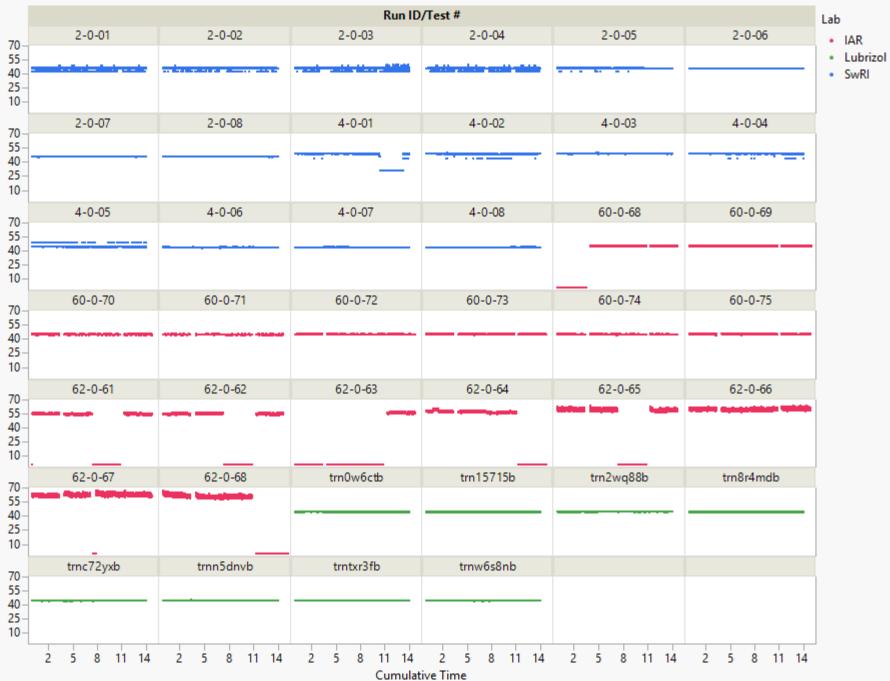
Low Event Oil



High Event Oil

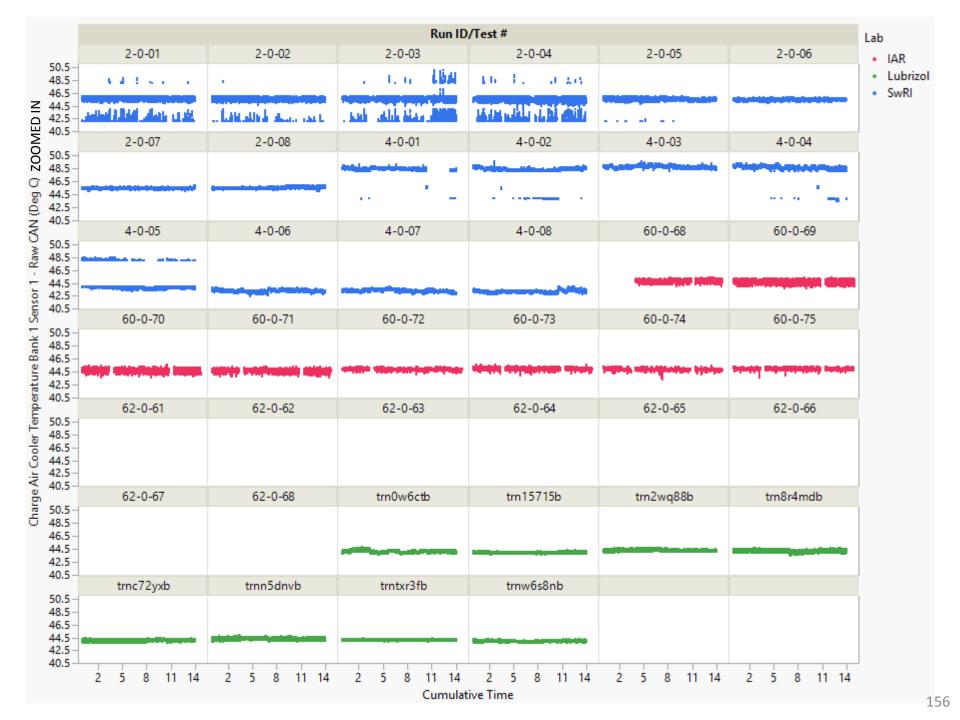


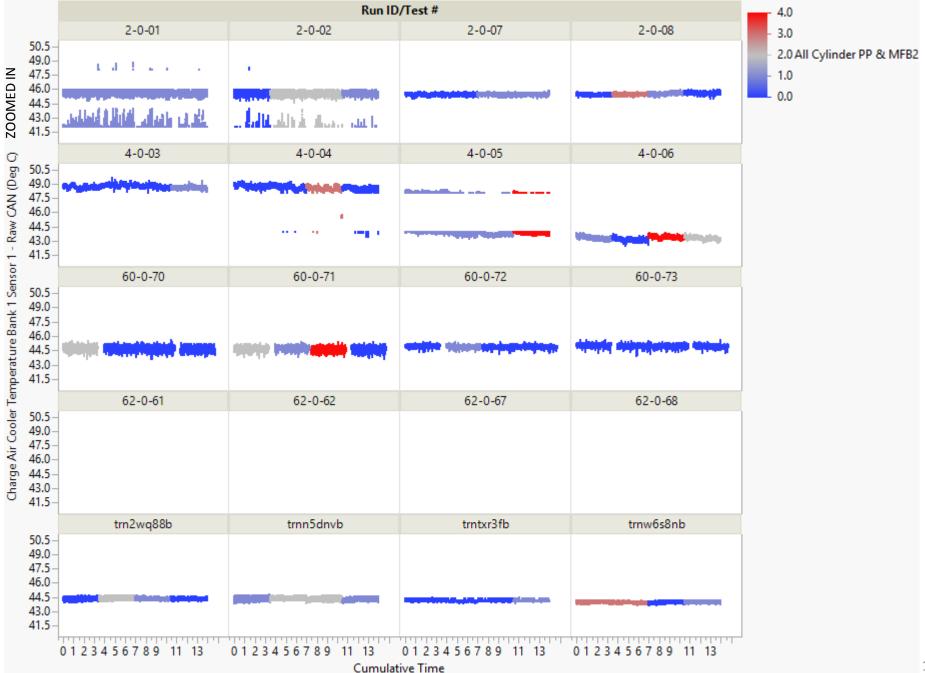
Charge Air Cooler **Temperature Bank** 1 Sensor 1 - Raw CAN



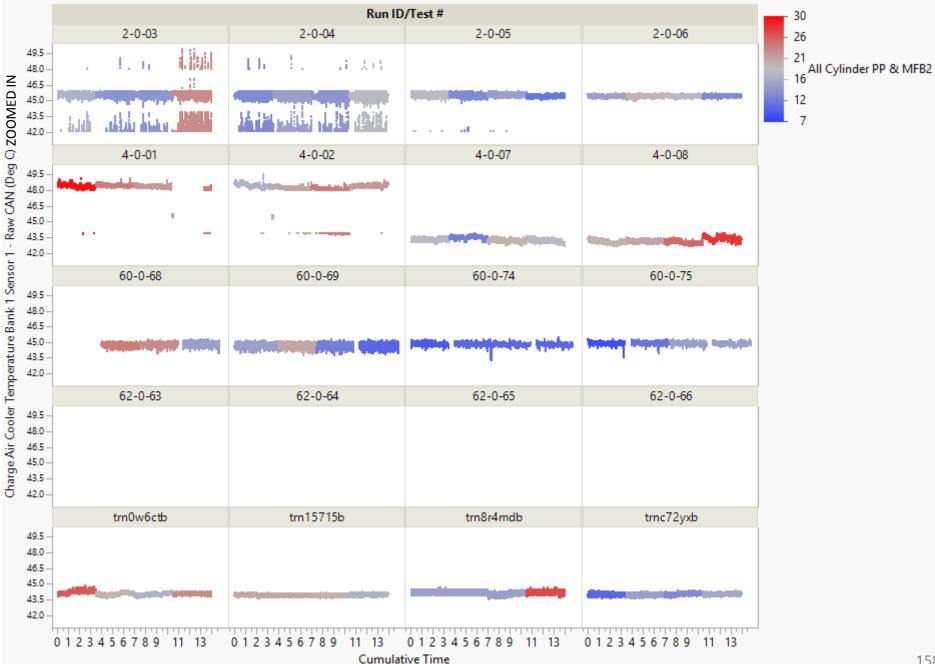
Charge Air Cooler Temperature Bank 1 Sensor 1 - Raw CAN (Deg C)

155

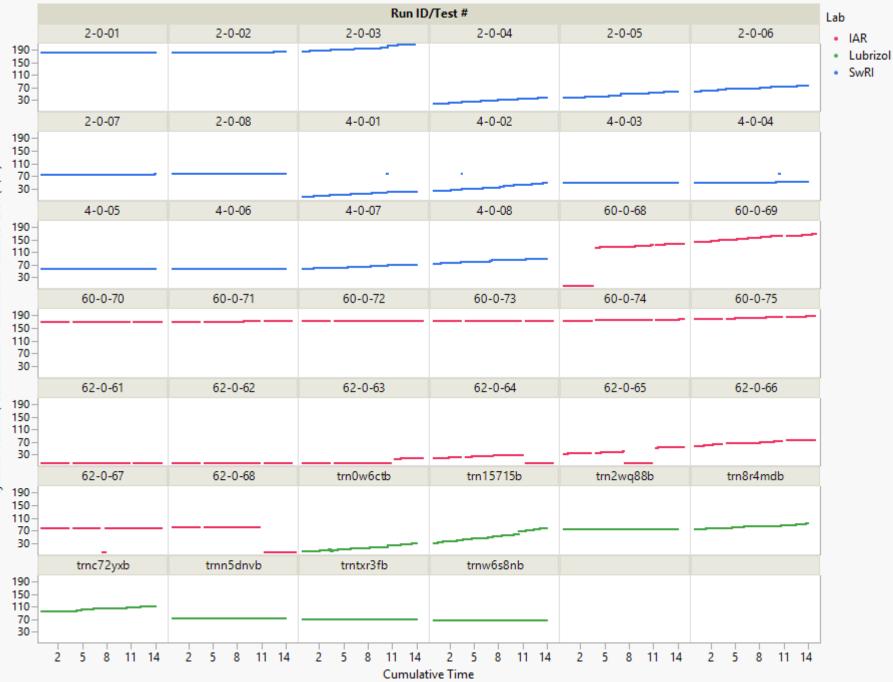




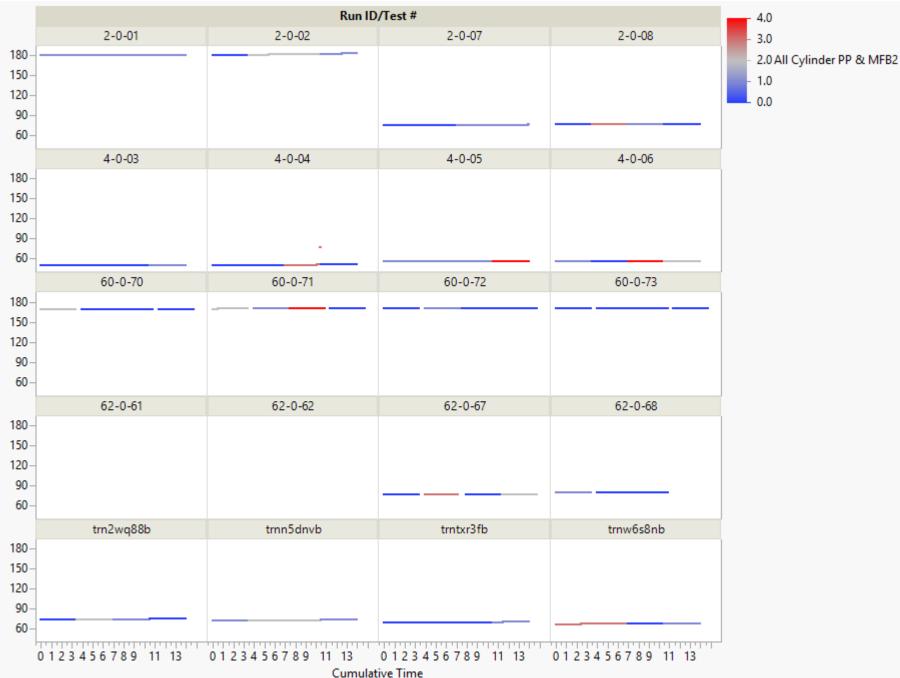
High Event Oil



Cylinder 1 **Knock/Combustion** Performance Counter CAN

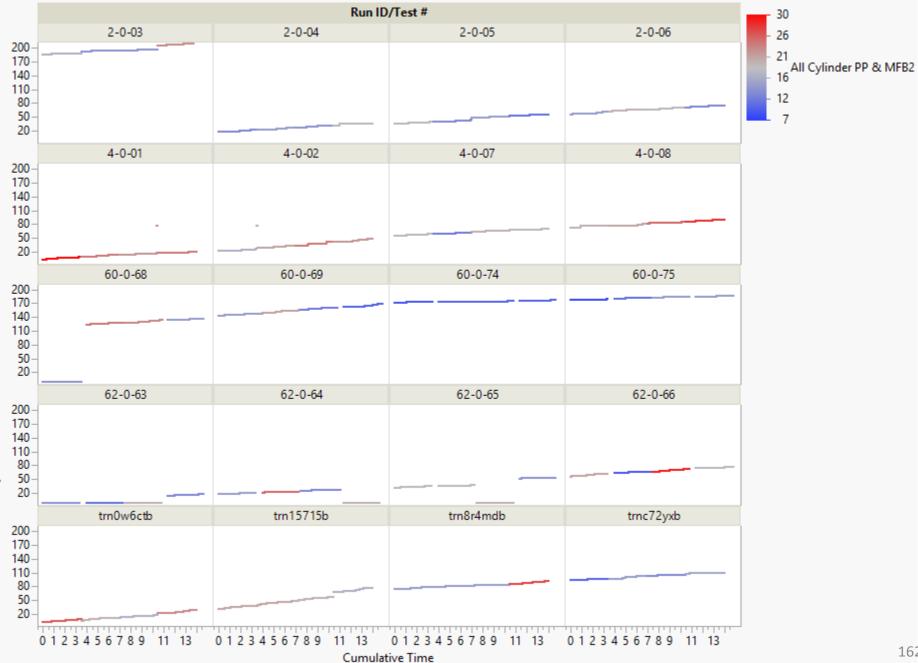


Cylinder 1 Knock/Combustion Performance Counter CAN (N/A)

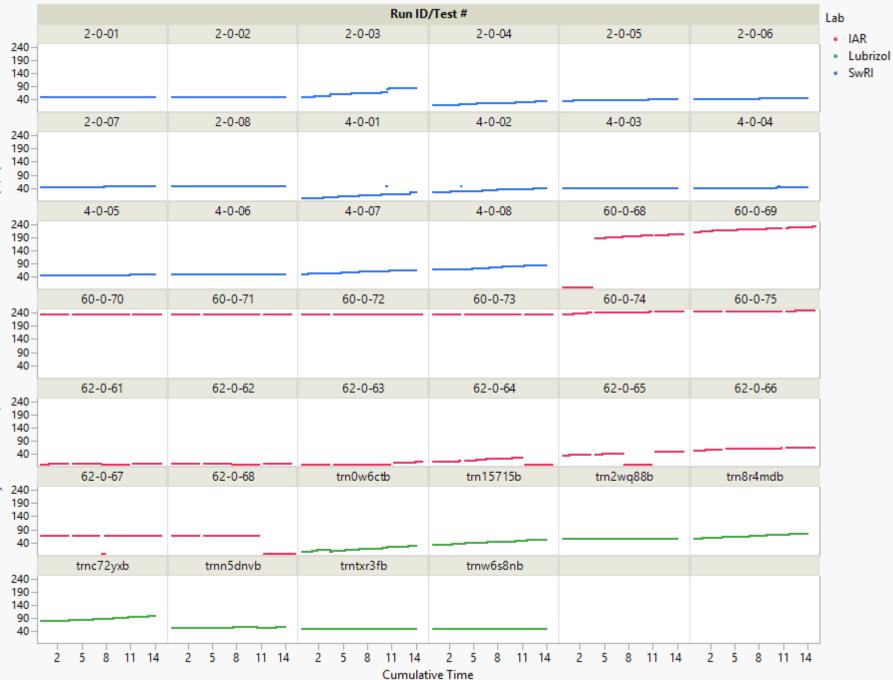


Cylinder 1 Knock/Combustion Performance Counter CAN (N/A)

High Event Oil

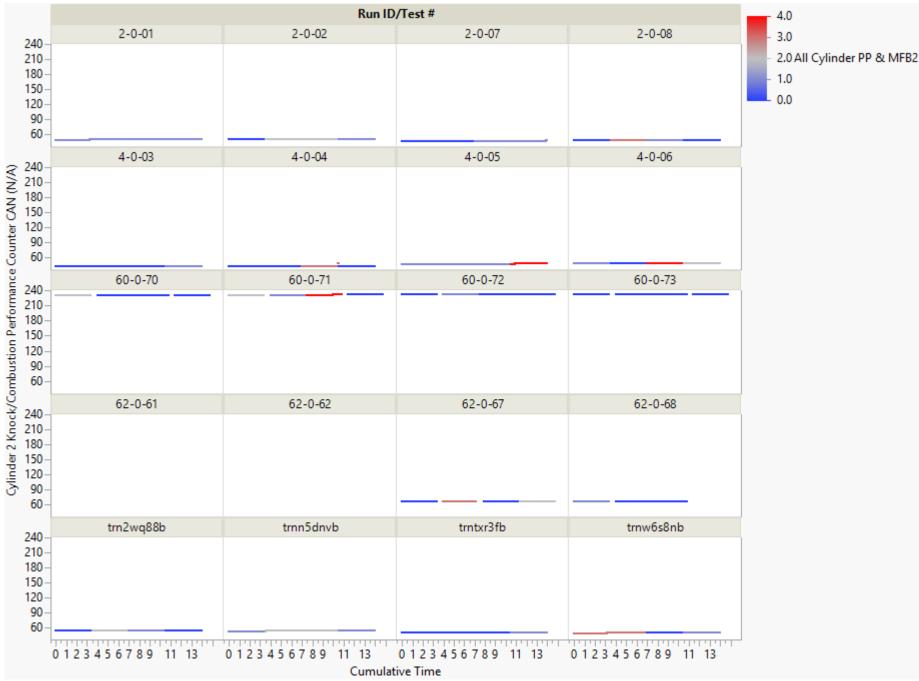


Cylinder 2 **Knock/Combustion** Performance Counter CAN

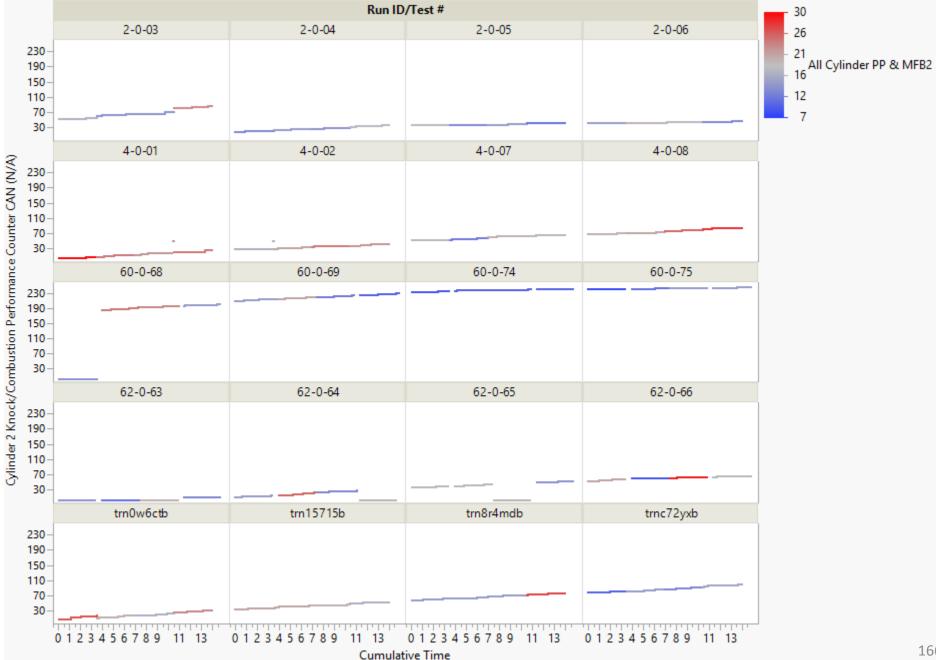


Cylinder 2 Knock/Combustion Performance Counter CAN (N/A)

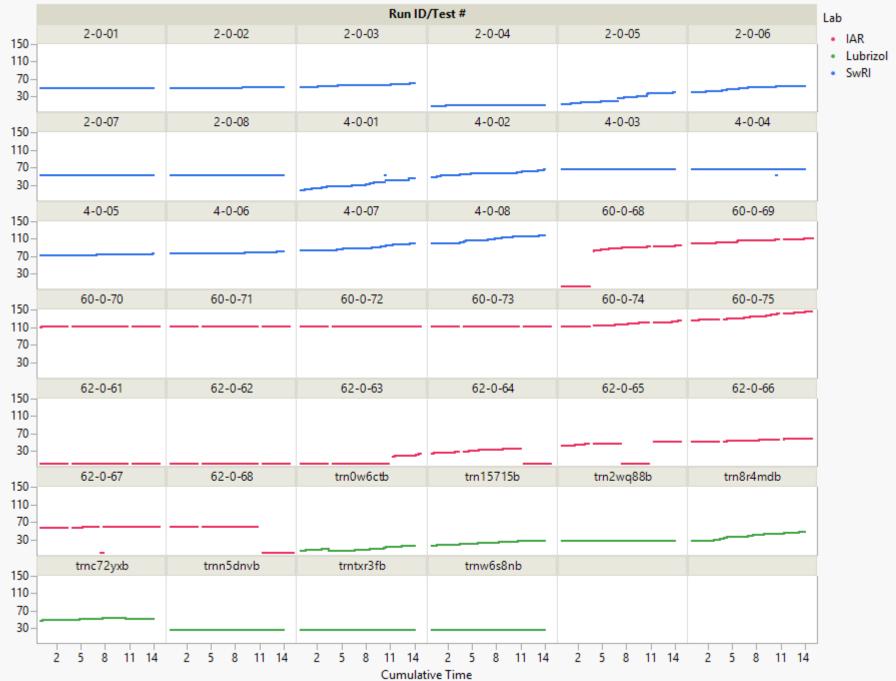
Low Event Oil



High Event Oil

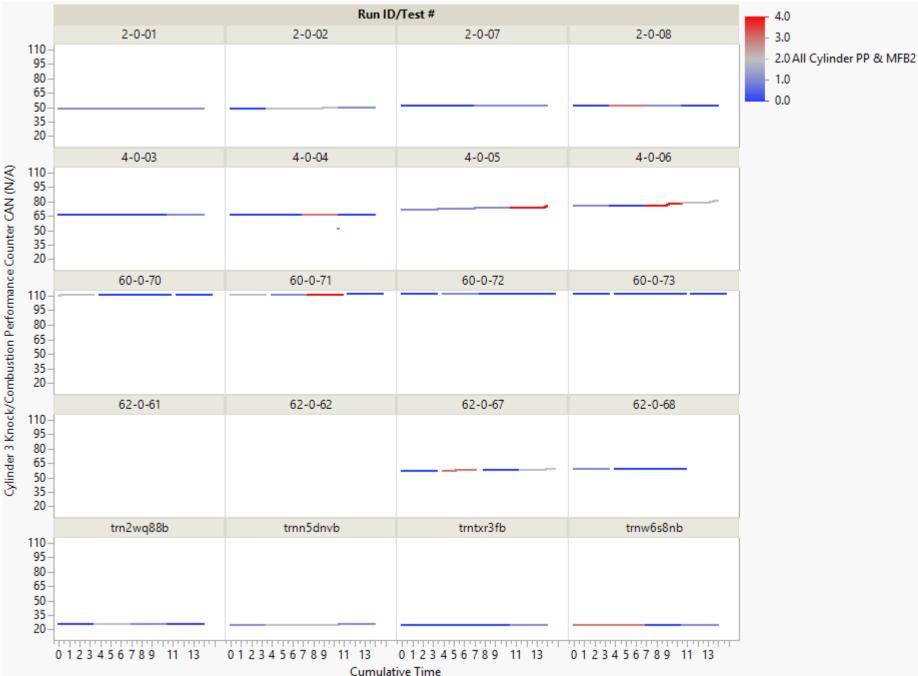


Cylinder 3 **Knock/Combustion** Performance Counter CAN

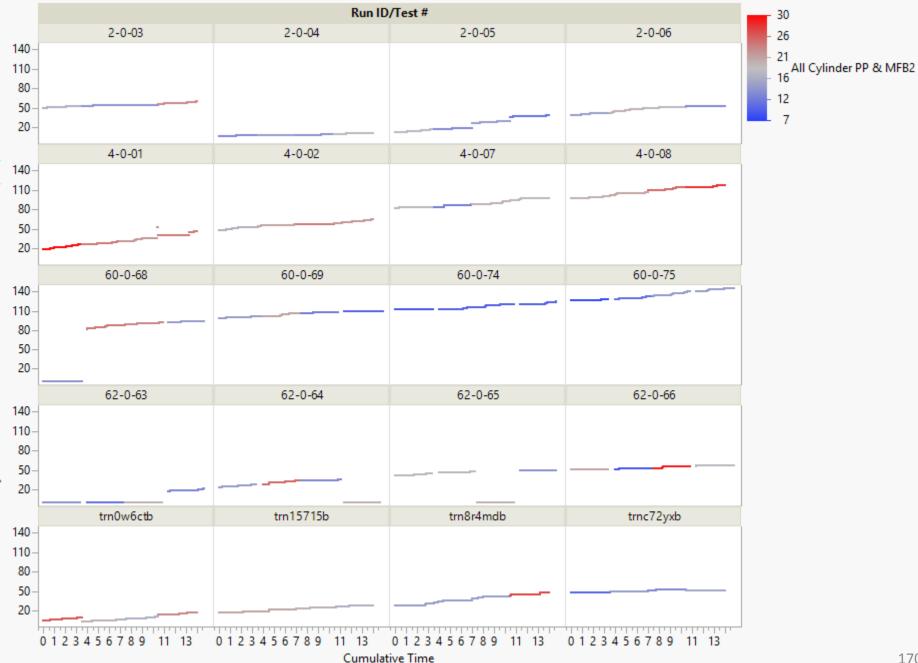


Cylinder 3 Knock/Combustion Performance Counter CAN (N/A)

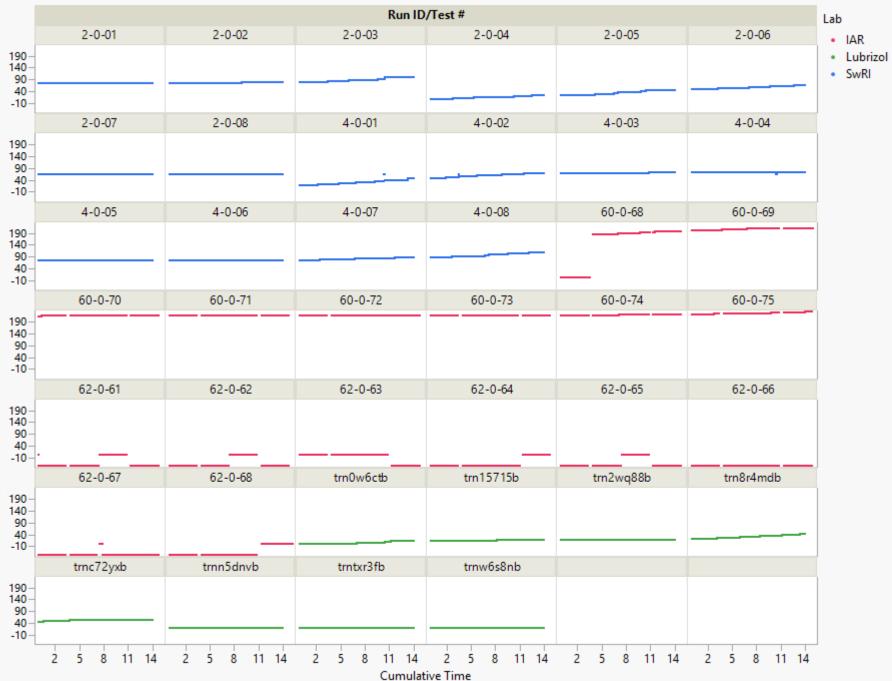
Low Event Oil

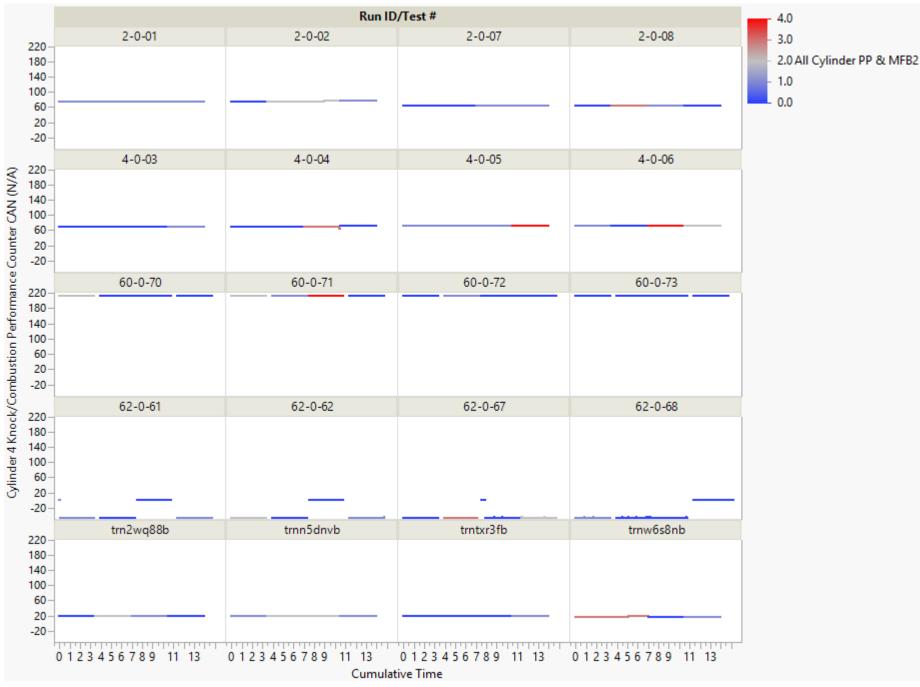


High Event Oil

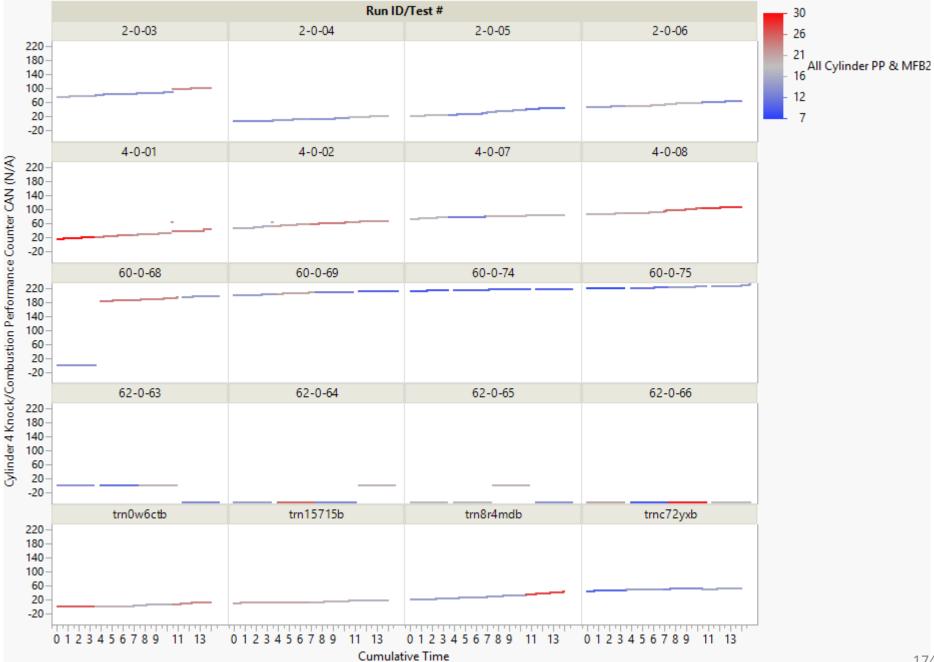


Cylinder 4 **Knock/Combustion** Performance Counter CAN

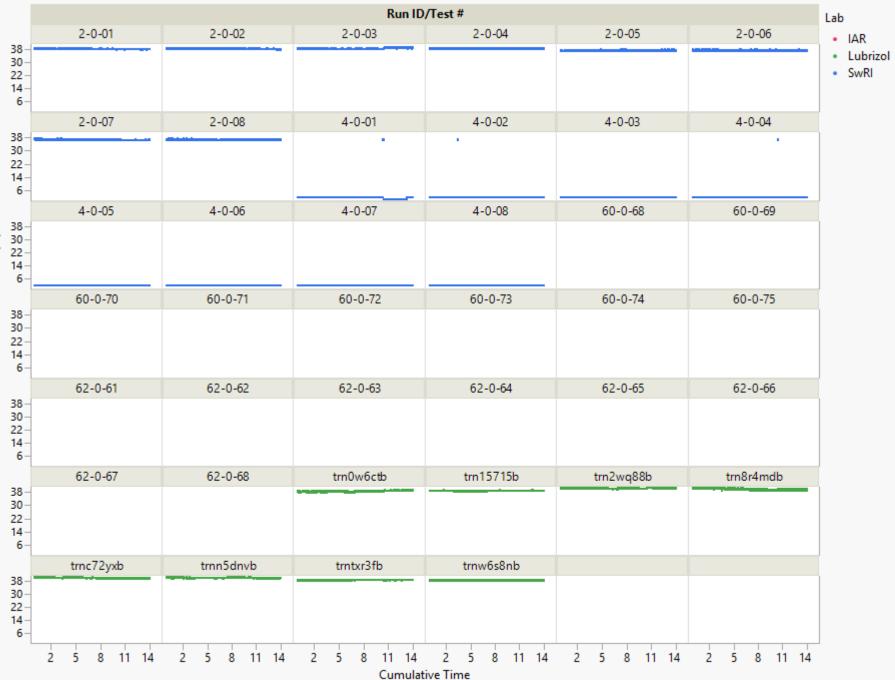




High Event Oil

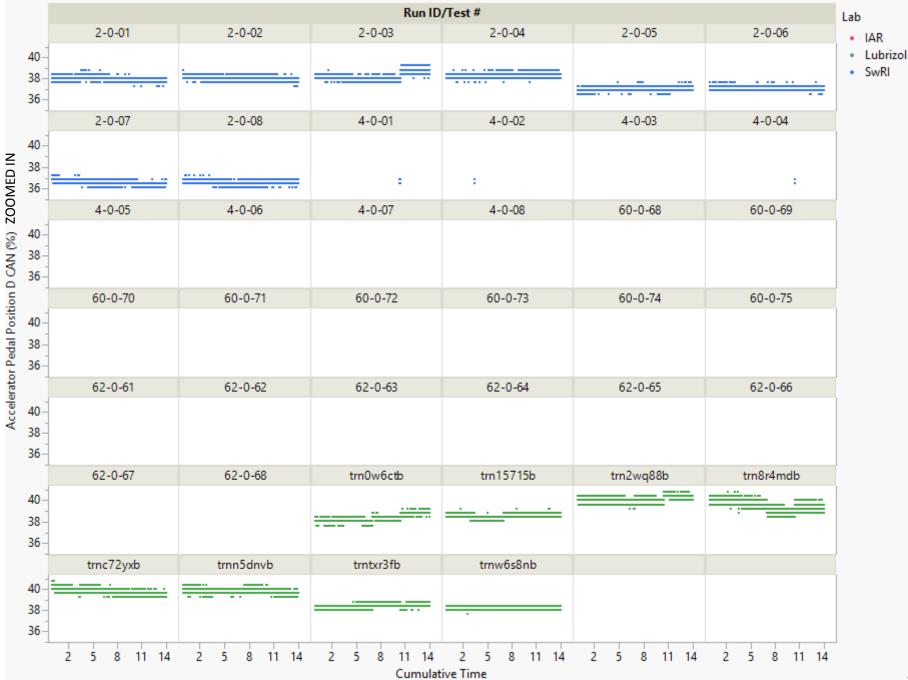


Accelerator Pedal Position D CAN



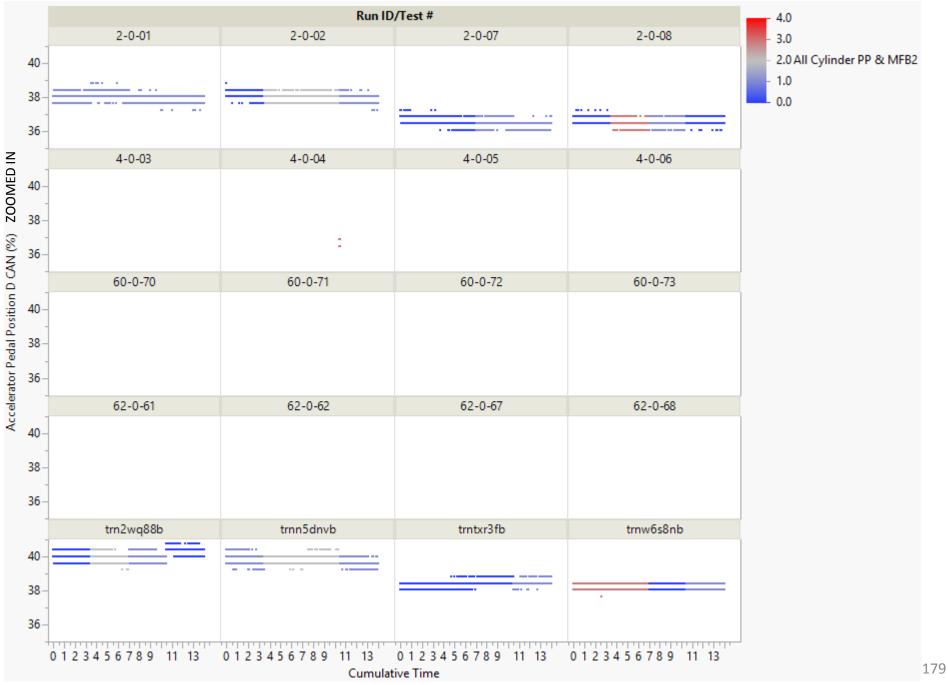
Accelerator Pedal Position D CAN (%)

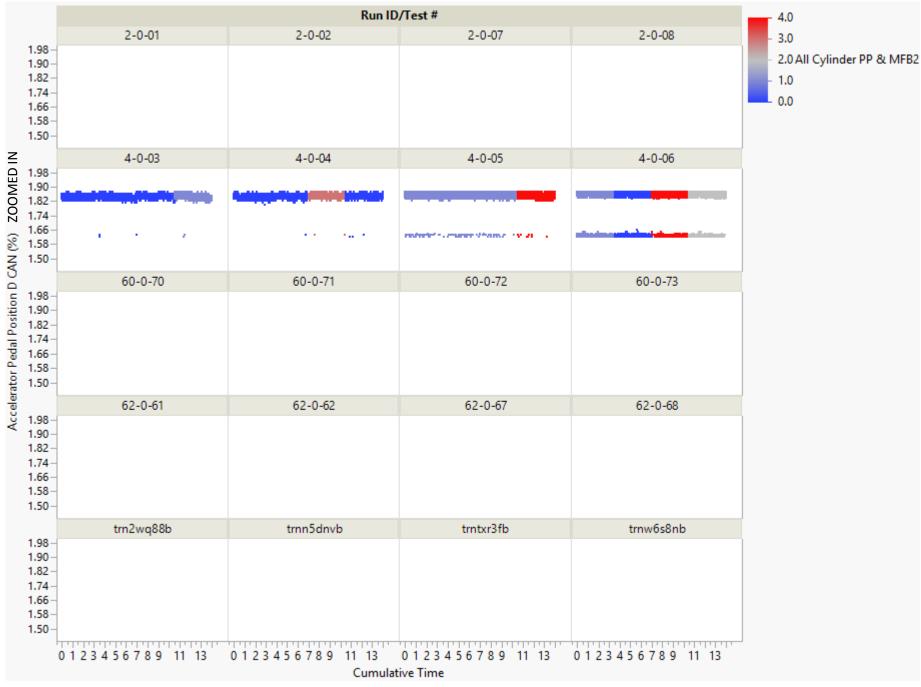
176



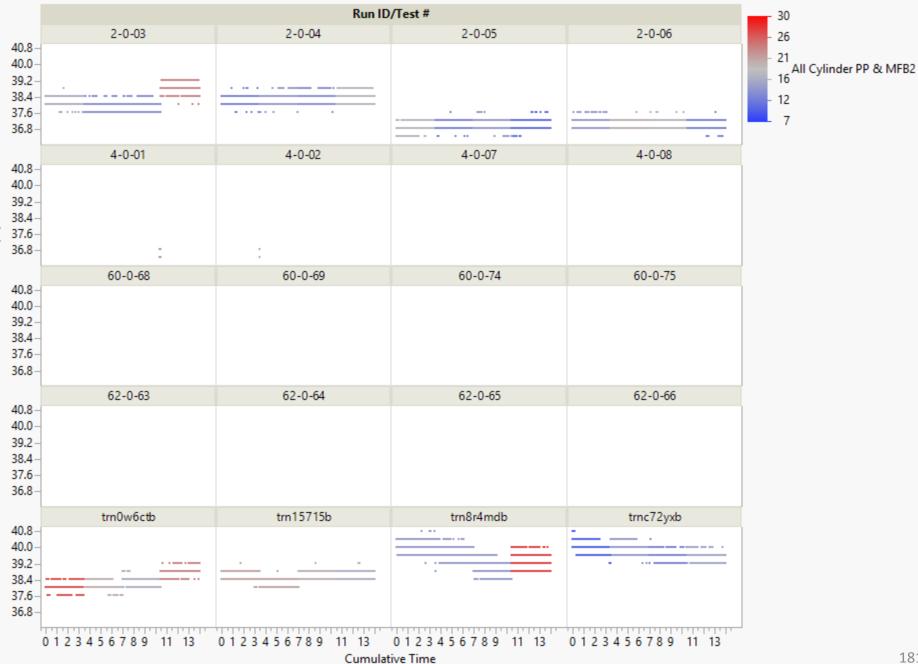


Low Event Oil





High Event Oil



High Event Oil

