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Originally Issued: February , 2017

Reply to: Richard Grundza
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Unapproved Minutes of the February 6, 2017
Sequence IV Surveillance Panel Meeting.

The meeting was called to order by Chairman Buscher at 1:00 PM Central Time.

A list of attendees is included as attachment 1.

A copy of the agenda is included as attachment 2.

Minutes from the 3/30/2016 and 11/16/2016 meetings were approved by voice vote.

Action Items from Previous Meeting

A review of the status of action items from the previous meeting was under taken. All action items were addressed, with the exception of action item 2 pertaining to CAN data to be monitored during the test. Completion of this action item is still being pursued by Bill Buscher. The action items and their disposition are included as attachment 3.

IVA Update

The panel discussed the use of an alternate fuel pump, since the Nissan pump may not be easily obtained. The panel approved a motion to use the pump utilized by the Sequence V test. An Information Letter will be issued to update the IVA procedure to include this pump.

Review of IVB Test configuration

The panel discussed a number of hardware items relating to the final hardware configuration for the matrix. There are 130 cams available and in order to meet AOAP requirements for having enough hardware available for at least one reference period, it may be necessary to decrease reference periods to have hardware available for all calibrated stands. An action item was assigned to address redistribution of hardware. Hardware usage is included as Attachment 4.

IVB Operational Review

The panel reviewed a presentation regarding review of proveout data, see attachments 5 and 6. Lab performance of several variables was discussed and some operational limits were discussed. These conversations led into the QI limit review.

IVB QI Limits/Final Approval of QI limits

The panel reviewed a presentation developed by Travis Kosten and members of the stats group, see attachment 7. After considerable review and deliberation the panel agreed to adopt the proposed limits for QI calculations to be performed on the matrix test. Attachment 8 includes QI review for speed.

Vote on Ready for Matrix

After review of prove out data and discussion of AOAP requirements, see attachments 8 and 9, the panel voted to recommend to the AOAP that the IVB test is ready for matrix. This votes was affirmative with three waives and no negative. Also mentioned as part of these discussions was that labs will conduct Keyence measurements utilizing talc and without talc.

The meeting was adjourned at 6:36 PM.

A listing of the motions and action items from this meeting is included as attachment 10.

MEMBERSHIP
SEQUENCE IV SURVEILLANCE PANEL

2/6/17
~~November 16, 2016~~

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SEQUENCE IV SURVEILLANCE PANEL

November 16, 2016

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SEQUENCE IV SURVEILLANCE PANEL

November 16, 2016

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November 16, 2016

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November 16, 2016

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Attachment 2

Sequence IV Surveillance Panel

San Antonio, TX
Intertek
February 6, 2017
1:00 p.m. - 5:00 p.m.

A G E N D A

1. Chairman comments
2. Attendance sign-in sheet distribution
3. Membership changes
4. Motion and action recorder
5. Approval of minutes for 1/21/2016 and 11/16/2016
6. Action item review
7. Sequence IVA update
8. Sequence IVB final test configuration review
9. Sequence IVB prove-out test statistical analysis review
10. Sequence IVB final recommendation for QI set-points and limits review
11. Vote on Sequence IVB precision matrix test validity criteria
12. Vote on recommendation that Sequence IVB is ready to proceed with precision matrix
13. Review scope & objectives
14. Old business
15. New business
16. Motion and action item review
17. Next meeting
18. Adjourn

Sequence IV Surveillance Panel
November 16, 2016
9:00AM – 3:00PM
Southwest Research Institute
San Antonio, TX

Motions and Action Items
As Recorded at the Meeting by Bill Buscher

1. Action Item – Complete and distribute minutes for the 3/30/2016 surveillance panel meeting.
   Completed.

2. Action Item – Revisit OBD2 data acquisition, following up with Toyota to obtain callout information for the Toyota specific OBD2 parameters, and address knock sensor signal concerns.
   Incomplete.

3. Action Item – Distribute all comments received from the negative voters on their negative votes on motion # 5 from 3/30/2016 surveillance panel meeting.
   Completed.

4. Motion – Sequence IV surveillance panel chair to instruct Haltermann to change their blending protocol for the KA24E Green test fuel from blending small batches on demand to blending large batches (size to be determined, but to be at least 50,000 gallons), as they currently do for the EEE and SVGM2 test fuels.
   Bill Buscher / Bob Campbell / Passed Unanimously 15 – 0 – 0
   Completed.

5. Motion – Set the blowby gas temperature to 29ºC for both Stage 1 and Stage 2, for the upcoming test development / prove-out tests. Drop ASTM REO 1006-2, replace it with REO3 (5W-20) and conduct a minimum of six (6) test development / prove-out tests, using Intertek stand 102, SwRI stand 18 and Lubrizol stand 347. One test on each oil will be conducted on each stand. The first row of testing will be conducted on REO3 (5W-20) and the second row of testing will be conducted on ASTM REO 300.
   Teri Kowalski / Kaustav Sinha / Passed 14 – 1 – 0
   Completed.

6. Motion – The Sequence IV Surveillance Panel approves the inclusion the following procedural process improvements into the next six (6) test development / prove-out tests:
   - Will set the engine coolant flow rate control to 80 lpm for both Stage 1 and Stage 2.
   - Will set the rocker cover coolant flow rate control to 120 lpm for both Stage 1 and Stage 2.
   - Will add blowby condenser with cooling and heating circuit, oil separator and blowby collection tank w/ one-way valve to the crankcase ventilation system.
   - Will set the blowby gas temperature to 29ºC for both Stage 1 and Stage 2.
   - Will change intake air pressure from 0.07 kPa to 0.25 kPa.
   - Will change oil gallery temperature from 53ºC to 54ºC for Stage 1 and from 55ºC to 54ºC for Stage 2.
   - Will control exhaust backpressure to 104.5 kPa for Stage 2 and lock the control valve at the controller's output value at the end of Stage 2 for Stage 1.
   - Will relocate the stock Toyota knock sensor to be remote from the test engine. Exact location to be determined.
   - Will add coolant in and out temperature measurement for the blowby condenser.
   - Will use Batch C intake camshafts.

   Bill Buscher / Khaled Rais / Passed Unanimously 15 – 0 – 0
   Completed.

7. Action Item – Relocate the stock Toyota knock sensor to be remote from the test engine. Exact location to be determined by the precision matrix labs.
   Completed.

8. Action Item – Add coolant in and out temperature measurement for the blowby condenser.
   Completed.
9. Action Item – OHT to donate engine test kits, p/n OHTIVB-102-1, with Batch C intake camshafts for the next six test development / prove-out tests.
   Completed.

10. Action Item – Intertek to distribute quantities of REO3 (5W-20) to SwRI and Lubrizol for their test development / prove-out tests.
    Completed.

11. Action Item – The ASTM TMC to start the procurement process of REO3 (5W-20).
    Completed.

12. Motion – The Sequence IVB precision matrix will be conducted on a single batch of KA24E Green test fuel. The intention will be to conduct the first calibration period post precision matrix on the same batch of KA24E Green test fuel, with the exception of any test lab that is under specific legal constraints. A test lab that meets the exception can calibrate on a different fuel batch if they conduct statistically acceptable calibration tests on that fuel batch. A batch size of a minimum of 40,000 gallons will be required.
    Bob Campbell / Mark Overaker / Passed 14 – 0 – 1
    Completed.

Sequence IVB Critical Hardware Usage
Precision Matrix Hardwae Batch

	total	stands	tests	
precision matrix	20	4	5	
referencing non-pm stands	14	7	2	
first reference period	88	11	8	reduced from 15
	122			
OHT inventory	130			
SwRI inventory	20			
Intertek inventory	0			
Lubrizol invenotry	4			
	154			
balance	32			

Attachment 5

IVB Prove-Out Operational Data Summary

Date: February 6, 2017

Presented By: Travis Kostan and Kevin O'Malley
With Additional Support from Other Stat Group Members

Data Overview

- Operational data were collected from 101 to 102 hours of each test.
  - Each test hour contains 120 cycles (each cycle is 30 seconds)
  - Each cycle consists of 4 stages:
    - Stage 1 (7 seconds)
    - Stage 12: the transition from stage 1 to stage 2 (8 seconds)
    - Stage 2 (7 seconds)
    - Stage 21: the transition from stage 2 to stage 1 (8 seconds)

11 Tests included:

Lab	Test
Intertek	IVB102-0-47
	IVB102-0-48
	IVB102-0-49
	IVB165-0-15
	IVB165-0-16
Lubrizol	TRNGGD8BB
	TRNKVVM3B
	TRNT388PB
Southwest	18-0-29
	18-0-30
	20-0-46

Summary

- There are operational differences across the labs observed in some parameters:
  - The profile of the 30 second cycle at LZ is offset (lagged) from the other labs
  - There is a peak within the transition from stage 1 to stage 2 of IAR tests that is more pronounced than the other labs
  - The 30 second cycle profiles differ among the labs
  - Cycles occurring across the hour's worth of data differ between the labs
  - There is a slight difference in ramping during the transitions (mainly from stage 1 to 2)
  - In SwRI tests, it appears some parameters weren't quite stable at the being of the hour's worth of data reported
  - There is a magnitude difference between the labs
  - IAR stands differ

QI Evaluation

From the DACA II:

- The upper and lower limits for the QI calculations are derived statistically from the operating conditions of the test development "Golden" stand. The limits should be adjusted and set during test development to result in a final QI of approximately .80 to .90 for each parameter on the Golden stand. These limits can be calculated from the operational data. This will result in a uniform criteria for assessing the quality of a test.

- Analyses were conducted to target QIs of approximately 0.8 and 0.9. Where available, limits from previous QI evaluations were utilized as a starting point.
  - Window 1 are limits to achieve approx. 0.9
  - Window 2 are limits to achieve approx. 0.8

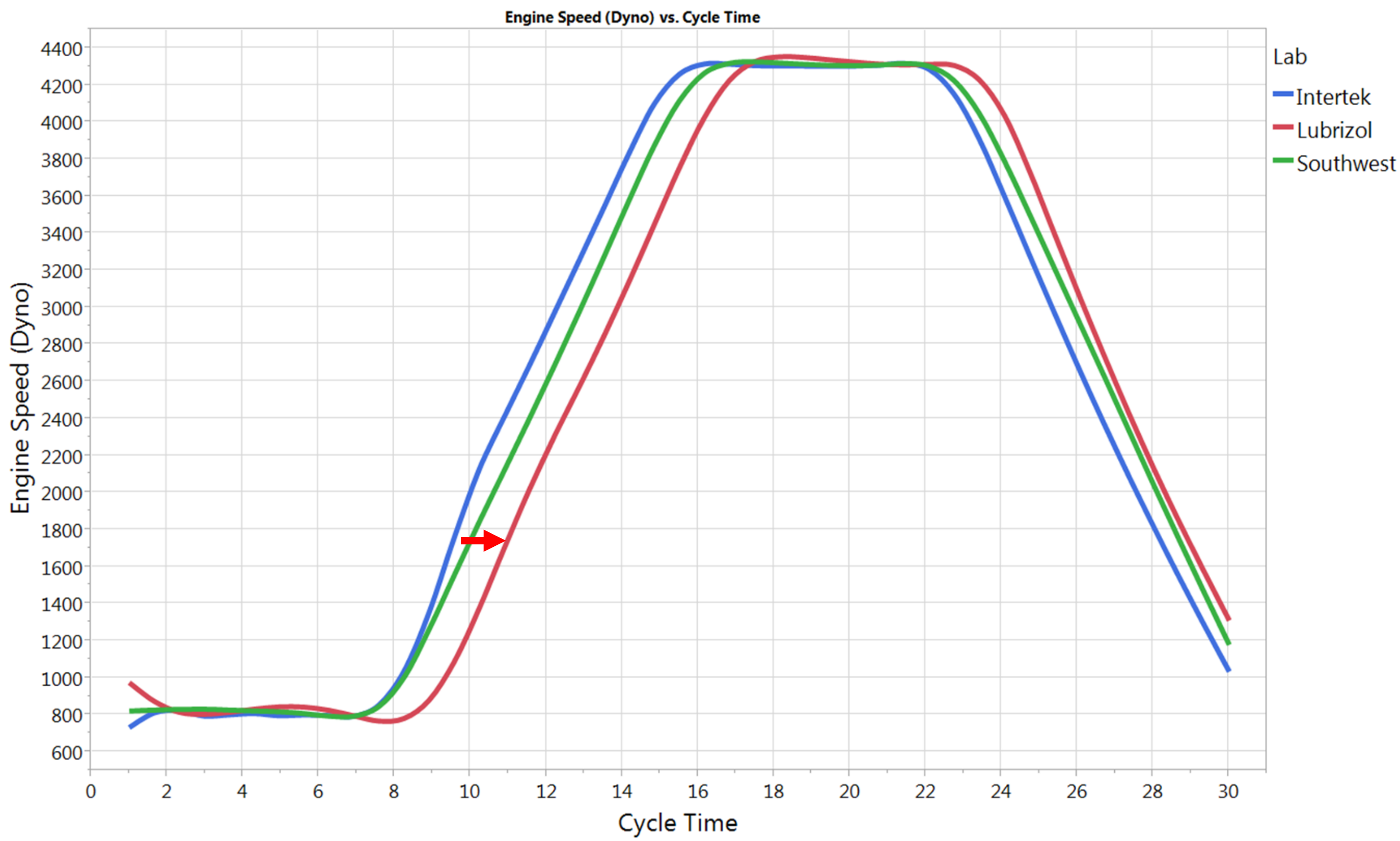
QI Evaluation Summary

Parameter	Agreed Upon Control
Intake Air Humidity	11.5 ± 0.5 g/kg
Engine Coolant In Temp	49 ± 0.75 C
Exhaust Backpressure	104.5 ± 3 kPa
Fuel Rail Temp	24 ± 0.5 C
Intake Air Pressure	0.25 ± 0.25 kPa
Intake Air Temp	32 ± 0.75 C
Oil Gallery Temp	54 ± 4 C
RAC Temp Out	20 ± 0.75 C
Torque	25 ± 1.5 N m
Engine Coolant Flow Rate	80 ± 0.4 L/min
RAC Coolant Flow Rate	120 ± 0.75 L/min
Blowby Gas Temp	29 ± 0.5 C
Engine Speed (Dyno)	TBD today
Load Cell Temperature	TBD today
Engine Coolant Pressure	Minimum 60 kPa Avg.
Fuel Rail Pressure	TBD today

Engine Speed QI

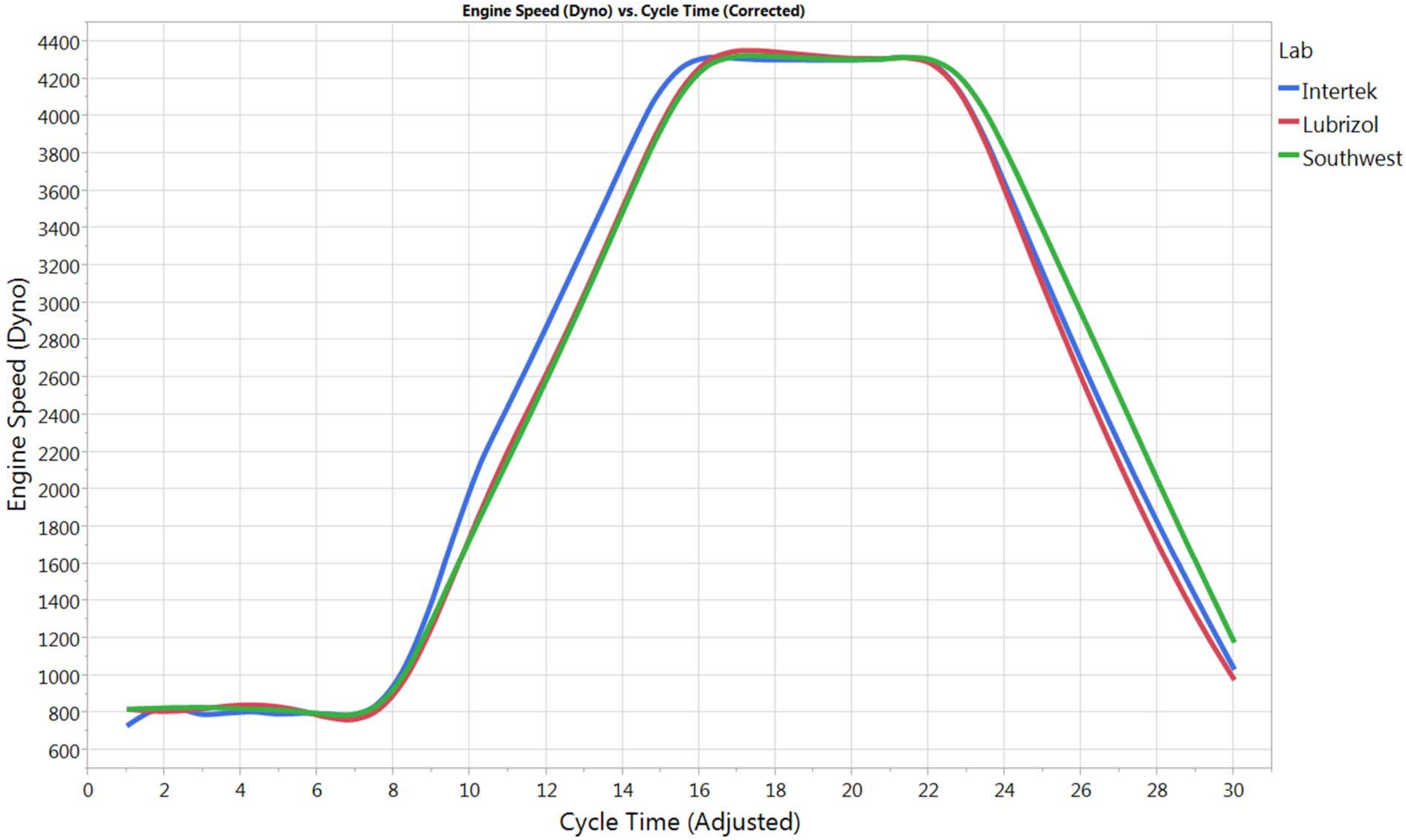
Engine Speed Shift at Lubrizol

It was noted during the operational data review that the engine speed at Lubrizol appeared to lag the other labs by ~ 1 second.



Engine Speed Shift at Lubrizol

Shifting the Lubrizol data by 1 second results in a Stage 1-2 transition that matches SwRI data and a 2-1 transition that matches Intertek. This indicates that Lubrizol spends slightly less time at stage 2 than the other 2 labs.



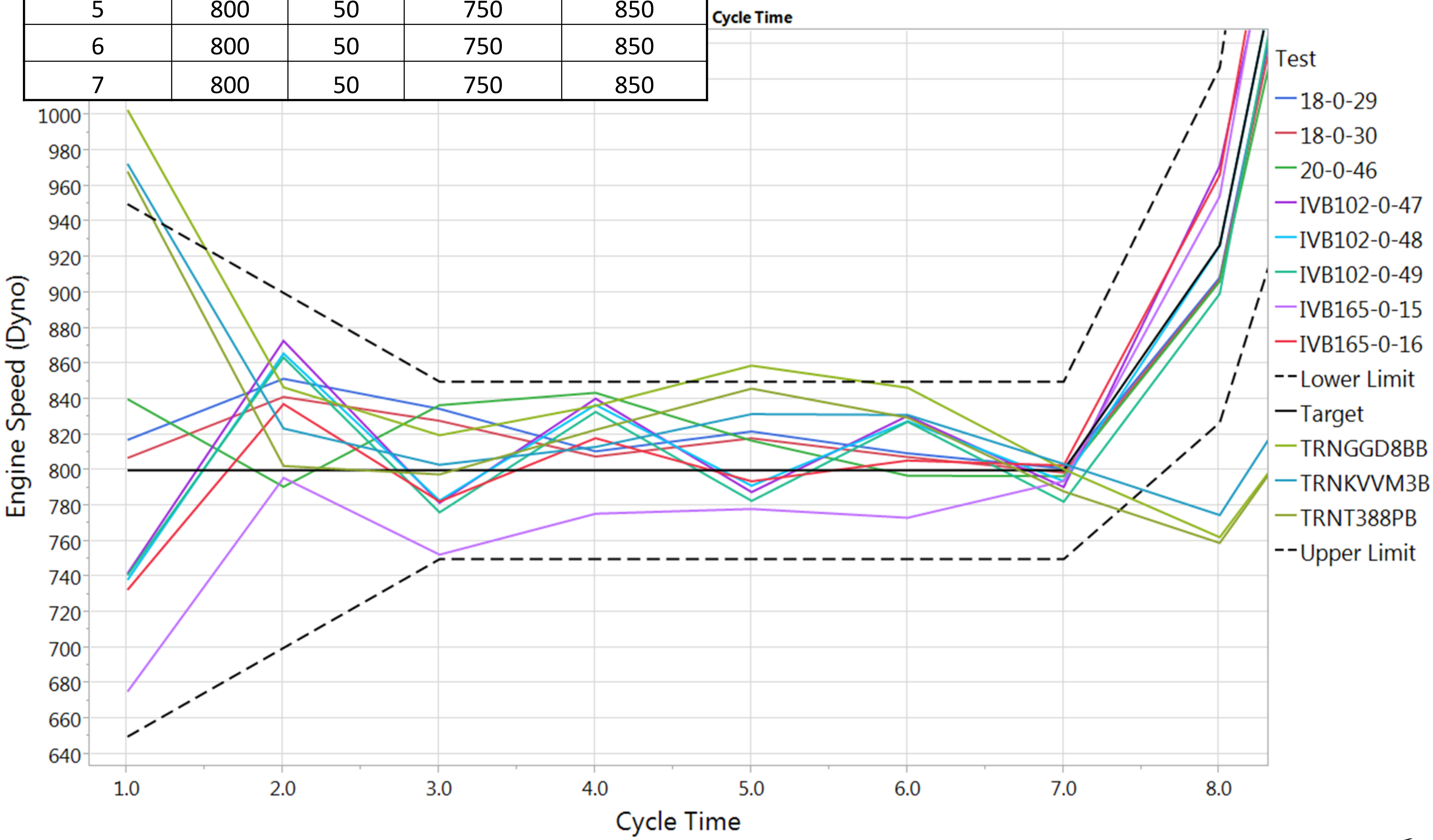
Steady State Targets and Windows

- For steady-state stages 1 and 2, the targets for QI were the same as the actual targets throughout (800 rpm and 4300 rpm, respectively).

- The windows (+/- values) for each second were adjusted accordingly in an attempt to meet the QI goals given in the DACA II for golden stands.

Stage 1 Targets and Windows

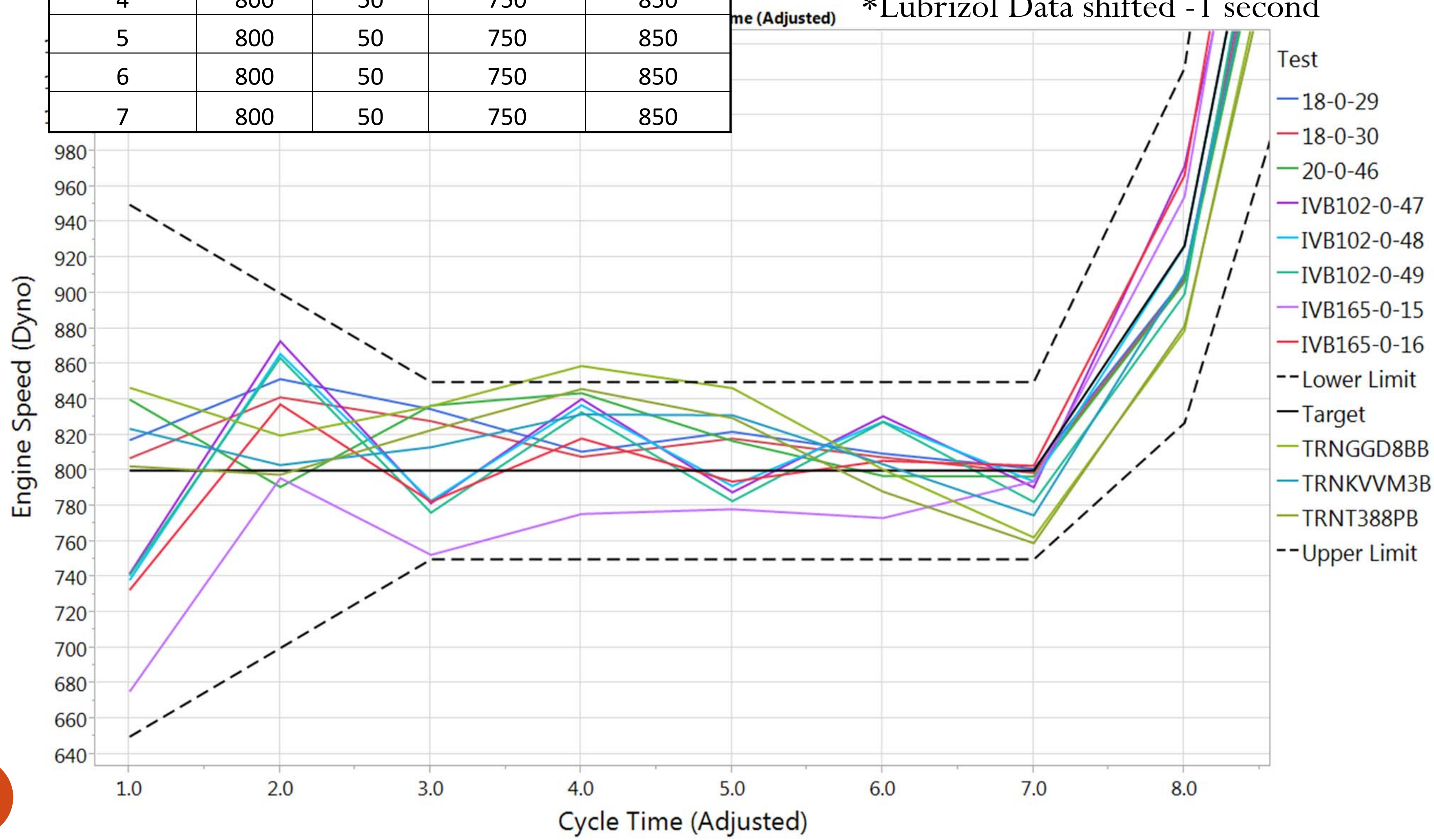
Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
1	800	150	650	950
2	800	100	700	900
3	800	50	750	850
4	800	50	750	850
5	800	50	750	850
6	800	50	750	850
7	800	50	750	850



Stage 1 Targets and Windows

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
1	800	150	650	950
2	800	100	700	900
3	800	50	750	850
4	800	50	750	850
5	800	50	750	850
6	800	50	750	850
7	800	50	750	850

*Lubrizol Data shifted -1 second



Ramp Target Calculation

The target for each second was based on an average of the lab averages. An example using cycle second 8 (1^{st} second of Stage 1 to Stage 2 ramp) is shown below. Due to the lag observed in Lubrizol data, it was agreed during the call on 02-02-2016 that the ramp targets would be calculated based on just the SwRI and Intertek data. A target using a 3 lab average could be added, though not included in this presentation.

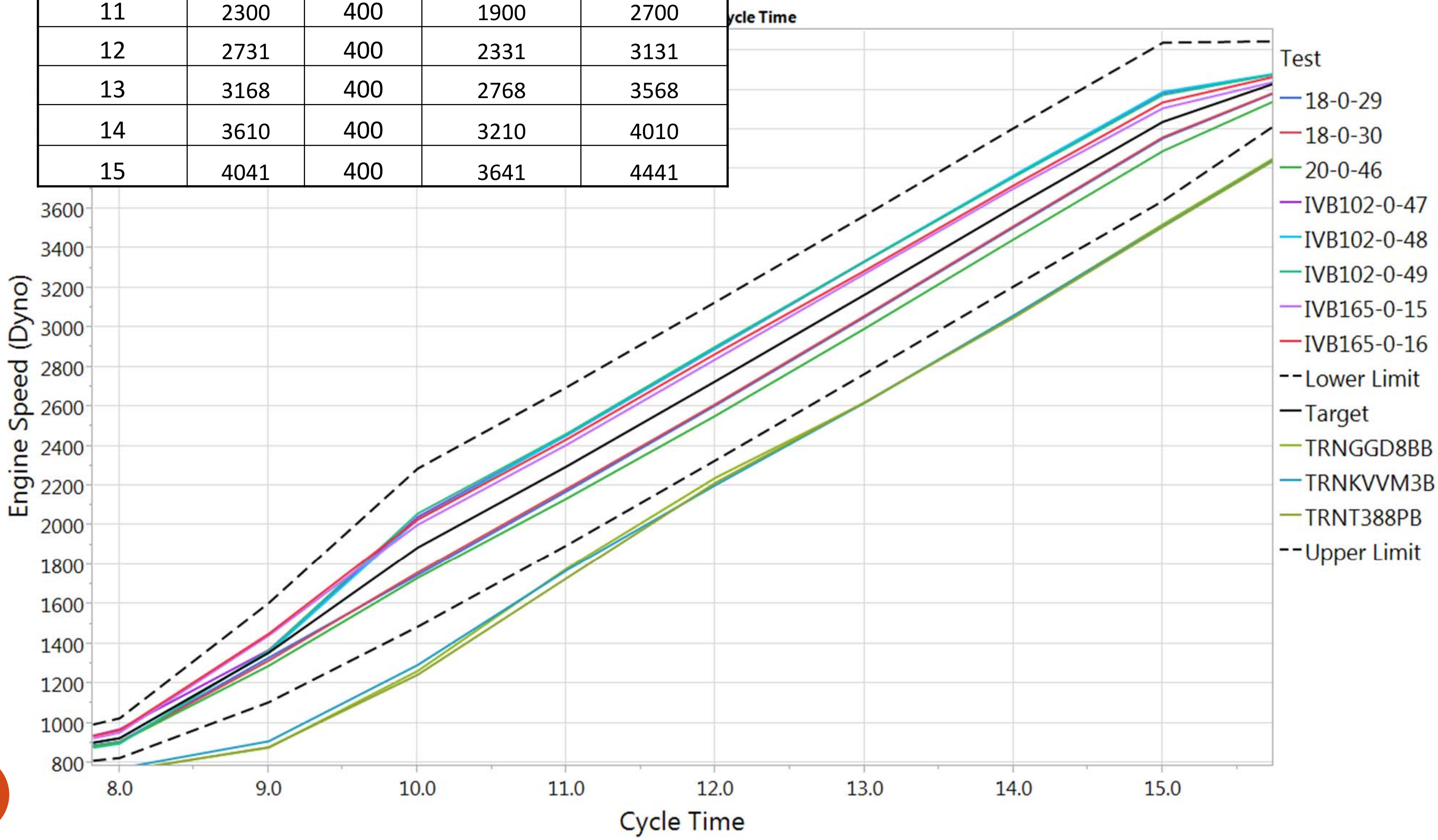
Lab	Stand	Test	Cycle Time	Test Average	Stand Avg.	Lab Avg.
SwRI	18	18-0-29	8	908.7	908.1	907.3
SwRI	18	18-0-30	8	907.4		
SwRI	20	20-0-46	8	906.5	906.5	
Intertek	102	102-0-47	8	971.7	932.5	946.5
Intertek	102	102-0-48	8	926.5		
Intertek	102	102-0-49	8	899.5		
Intertek	165	165-0-15	8	954.4	960.5	
Intertek	165	165-0-16	8	966.5		
Lubrizol	LZ1	TRNGGD8BB	8	762.3	765.4	765.4
Lubrizol	LZ1	TRNKVVM3B	8	774.8		
Lubrizol	LZ1	TRNT388PB	8	759.1		

Ex) $\frac{907.3 + 946.5}{2} \approx 927\ (Target\ for\ second\ 8\ using\ 2\ labs)$

Stage 1-2 Ramp Targets and Windows

-Using Average of SwRI and IAR data

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
8	927	100	827	1027
9	1357	250	1107	1607
10	1888	400	1488	2288
11	2300	400	1900	2700
12	2731	400	2331	3131
13	3168	400	2768	3568
14	3610	400	3210	4010
15	4041	400	3641	4441

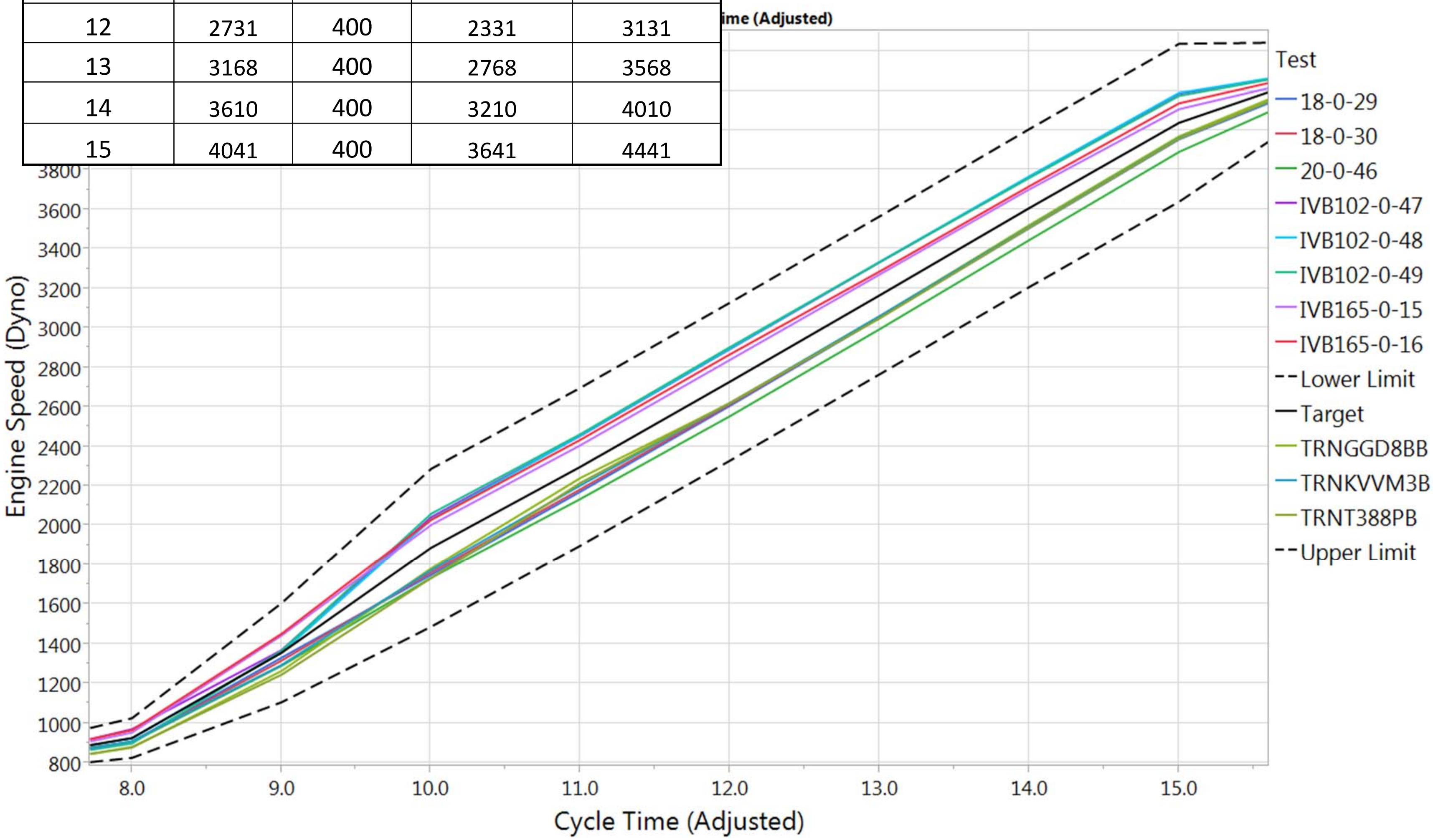


Stage 1-2 Ramp Targets and Windows

-Using Average of SwRI and IAR data

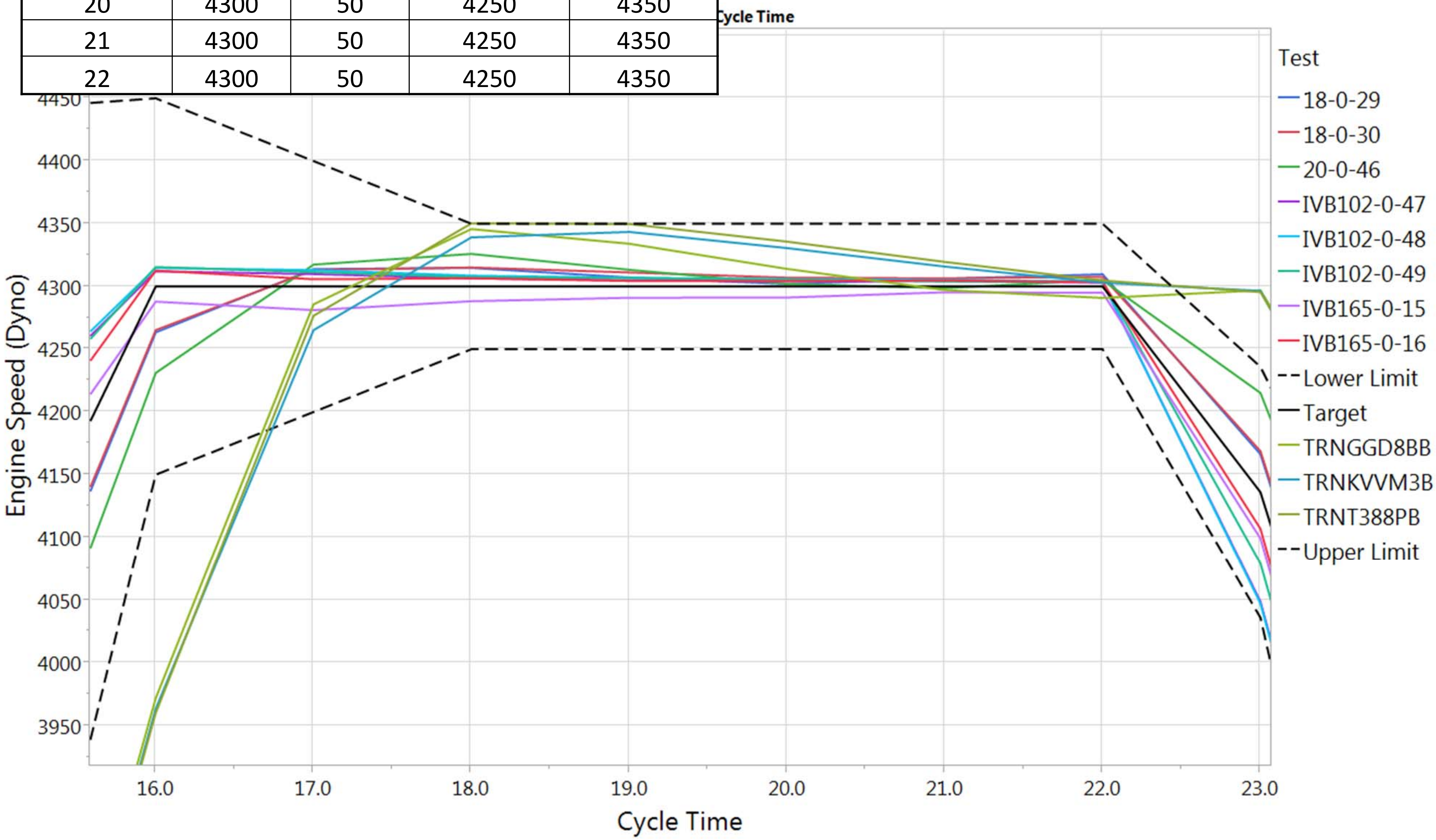
Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
8	927	100	827	1027
9	1357	250	1107	1607
10	1888	400	1488	2288
11	2300	400	1900	2700
12	2731	400	2331	3131
13	3168	400	2768	3568
14	3610	400	3210	4010
15	4041	400	3641	4441

*Lubrizol Data shifted -1 second



Stage 2 Targets and Windows

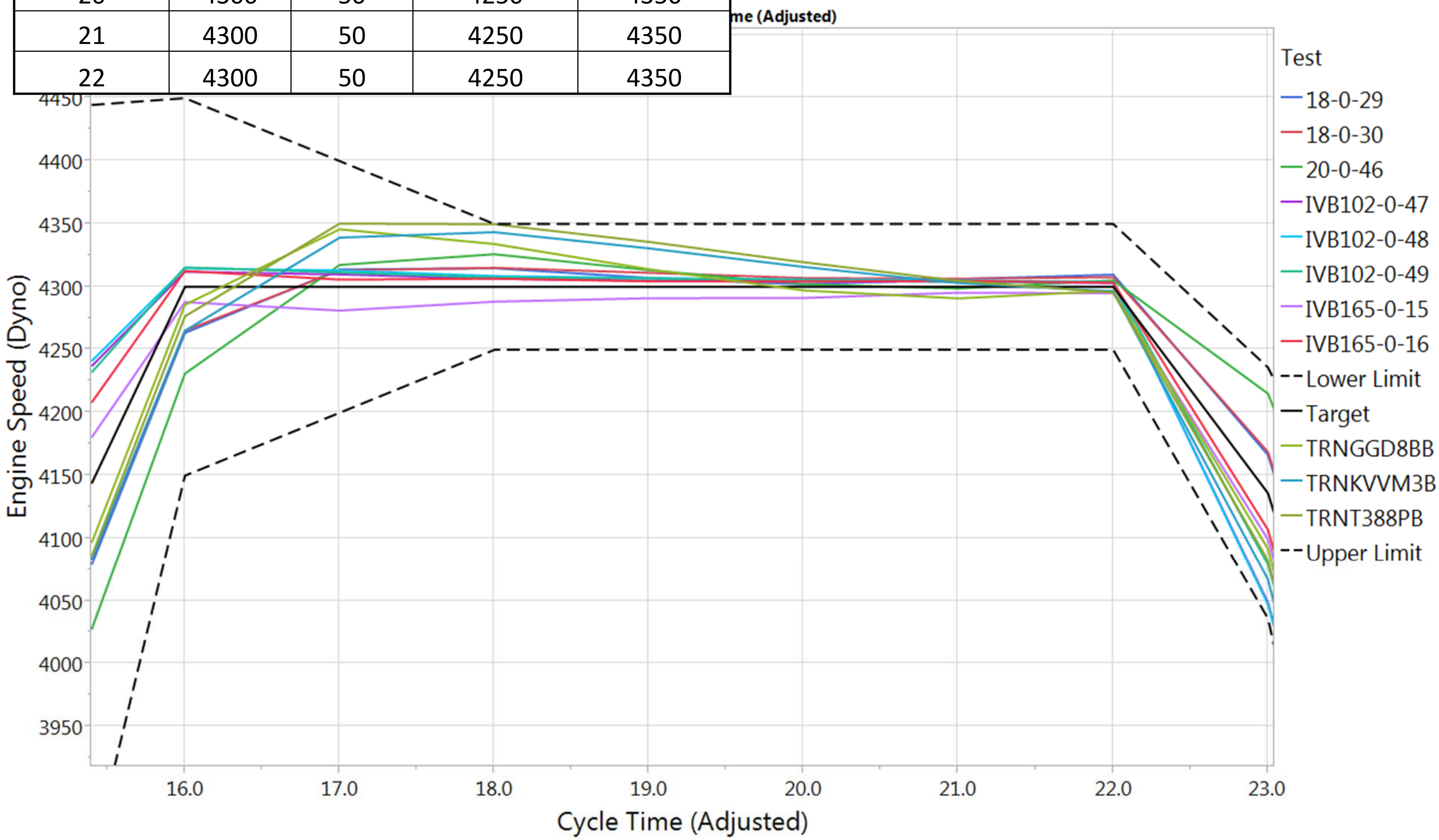
Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
16	4300	150	4150	4450
17	4300	100	4200	4400
18	4300	50	4250	4350
19	4300	50	4250	4350
20	4300	50	4250	4350
21	4300	50	4250	4350
22	4300	50	4250	4350



Stage 2 Targets and Windows

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
16	4300	150	4150	4450
17	4300	100	4200	4400
18	4300	50	4250	4350
19	4300	50	4250	4350
20	4300	50	4250	4350
21	4300	50	4250	4350
22	4300	50	4250	4350

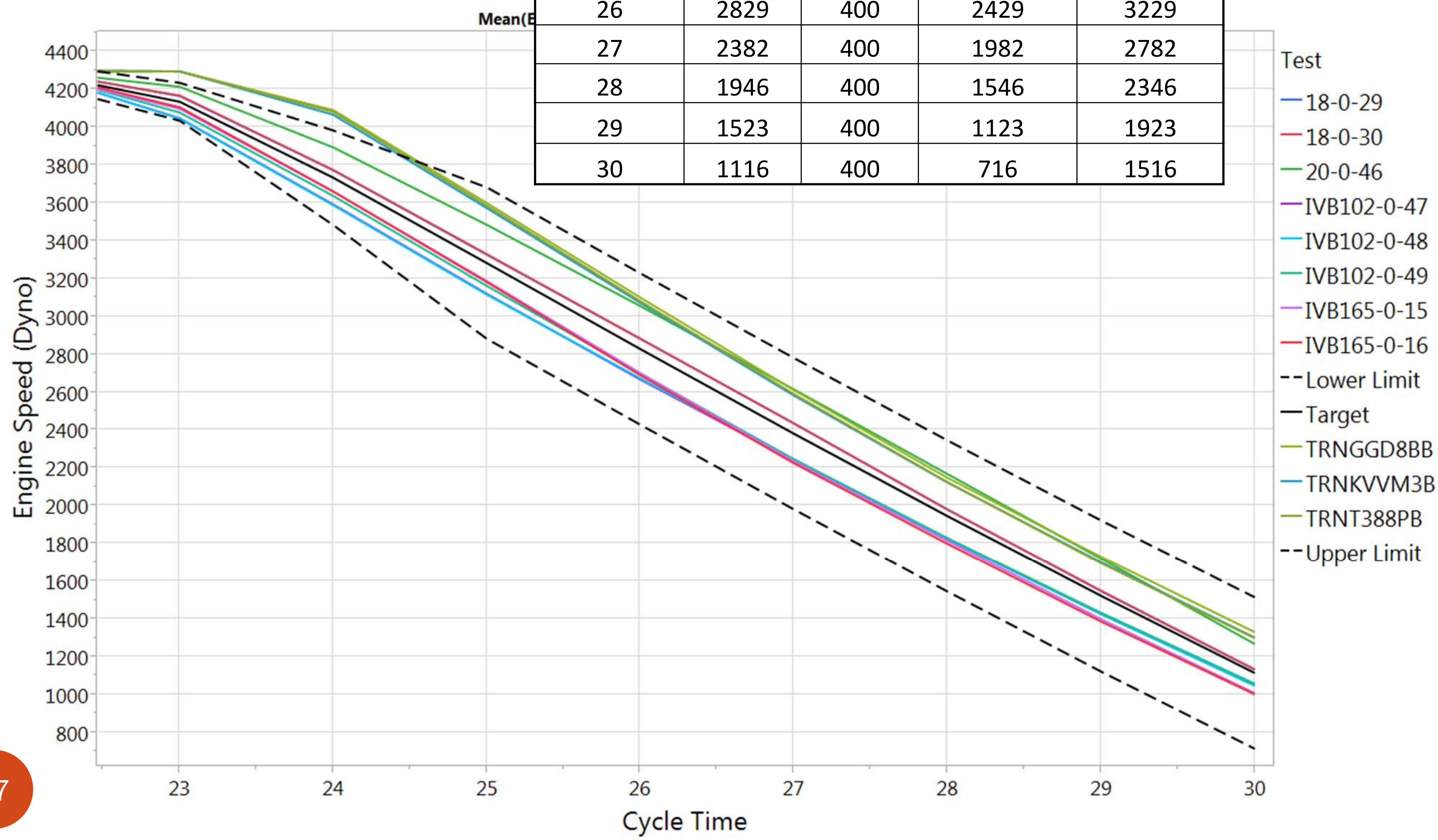
*Lubrizol Data shifted -1 second



Stage 2-1 Ramp Targets and Windows

-Using Average of SwRI and IAR data

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
23	4136	100	4036	4236
24	3734	250	3484	3984
25	3283	400	2883	3683
26	2829	400	2429	3229
27	2382	400	1982	2782
28	1946	400	1546	2346
29	1523	400	1123	1923
30	1116	400	716	1516

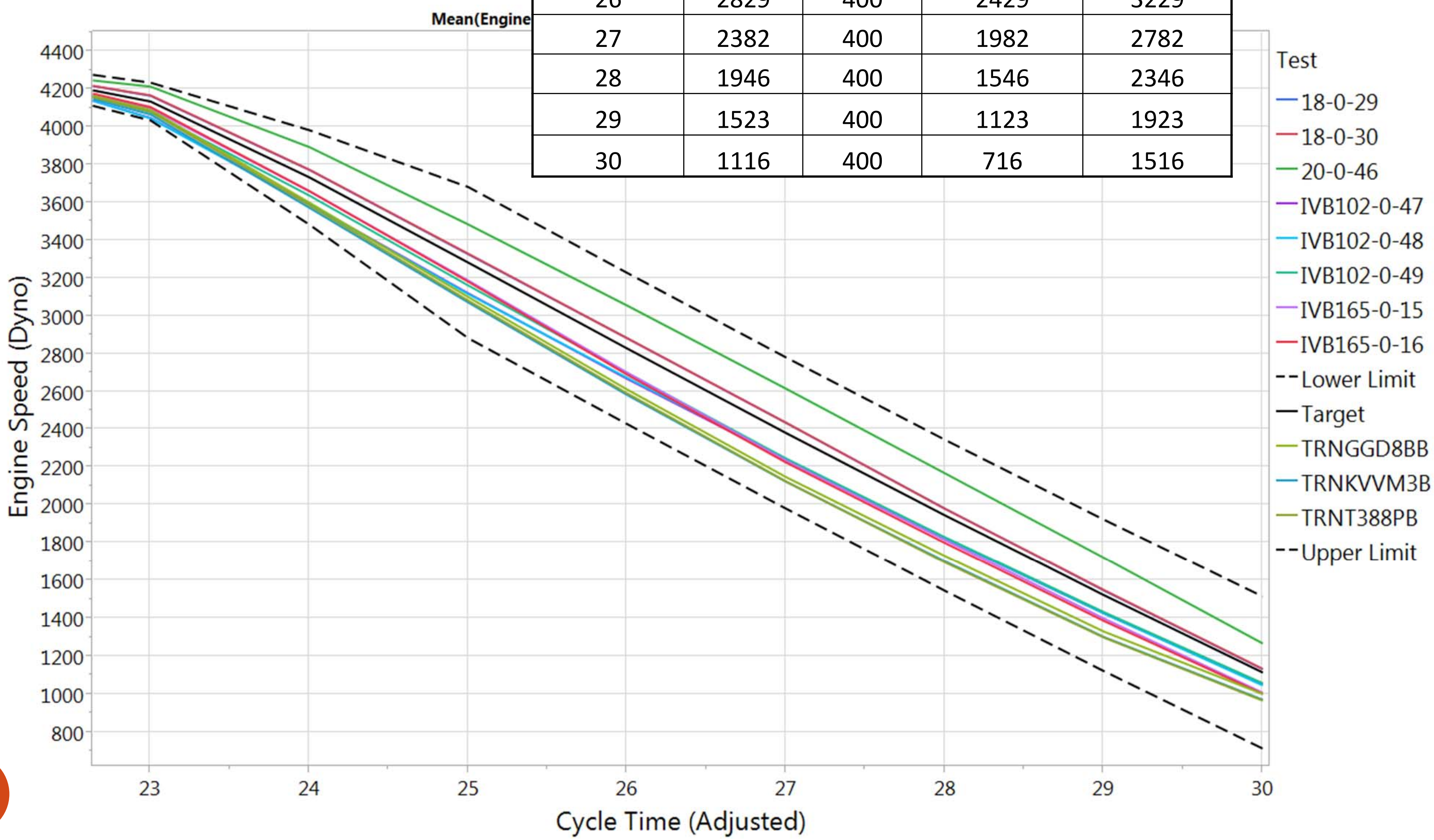


Stage 2-1 Ramp Targets and Windows

-Using Average of SwRI and IAR data

*Lubrizol Data shifted -1 second

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
23	4136	100	4036	4236
24	3734	250	3484	3984
25	3283	400	2883	3683
26	2829	400	2429	3229
27	2382	400	1982	2782
28	1946	400	1546	2346
29	1523	400	1123	1923
30	1116	400	716	1516



QI Summary by Stage

Test	QI Stage 1	QI Stage 1-2	QI Stage 2	QI Stage 2-1	QI Final
18-0-29	0.83	0.93	0.96	0.98	0.92
18-0-30	0.89	0.94	0.95	0.97	0.94
20-0-46	0.77	0.86	0.91	0.67	0.80
102-0-47	0.72	0.85	0.98	0.78	0.83
102-0-48	0.76	0.88	0.98	0.78	0.85
102-0-49	0.74	0.87	0.98	0.88	0.87
165-0-15	0.64	0.91	0.96	0.90	0.86
165-0-16	0.90	0.87	0.97	0.89	0.91
Average	**0.78**	**0.89**	**0.96**	**0.86**	**0.87**

Lubrizol QIs (shifted data QI in parentheses)

Test	QI Stage 1	QI Stage 1-2	QI Stage 2	QI Stage 2-1	QI Final
TRNGGD8BB	0.21 (0.51)	-1.18 (0.82)	0.05 (0.84)	0.13 (0.75)	-0.22 (0.73)
TRNKVVM3B	0.61 (0.80)	-1.09 (0.89)	-0.05 (0.76)	0.33 (0.65)	-0.10 (0.77)
TRNT388PB	0.54 (0.71)	-1.28 (0.79)	-0.17 (0.69)	0.20 (0.68)	-0.20 (0.72)
Average	**0.45 (0.68)**	**-1.18 (0.83)**	**-0.06 (0.76)**	**0.22 (0.69)**	**-0.17 (0.74)**

Question

Should we keep window sizes the same for steady state stages or adjust based on stage 2 having better control than stage 1?

Stage 1

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
1	800	150	650	950
2	800	100	700	900
3	800	50	750	850
4	800	50	750	850
5	800	50	750	850
6	800	50	750	850
7	800	50	750	850

Stage 2

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
16	4300	150	4150	4450
17	4300	100	4200	4400
18	4300	50	4250	4350
19	4300	50	4250	4350
20	4300	50	4250	4350
21	4300	50	4250	4350
22	4300	50	4250	4350

OR

Stage 1

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
1	800	150	650	950
2	800	100	700	900
3	800	75	725	875
4	800	50	750	850
5	800	50	750	850
6	800	50	750	850
7	800	50	750	850

Stage 2

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
16	4300	100	4200	4400
17	4300	75	4225	4375
18	4300	50	4250	4350
19	4300	25	4275	4325
20	4300	25	4275	4325
21	4300	25	4275	4325
22	4300	25	4275	4325

QI Summary by Stage

Using Different Windows for Stage 1 vs. Stage 2

Test	QI Stage 1	QI Stage 1-2	QI Stage 2	QI Stage 2-1	QI Final
18-0-29	0.87	0.93	0.89	0.98	0.92
18-0-30	0.92	0.94	0.86	0.97	0.93
20-0-46	0.81	0.86	0.81	0.67	0.79
102-0-47	0.73	0.85	0.94	0.78	0.83
102-0-48	0.77	0.88	0.93	0.78	0.84
102-0-49	0.76	0.87	0.94	0.88	0.86
165-0-15	0.72	0.91	0.89	0.90	0.86
165-0-16	0.91	0.87	0.90	0.89	0.89
Average	**0.81**	**0.89**	**0.90**	**0.86**	**0.87**

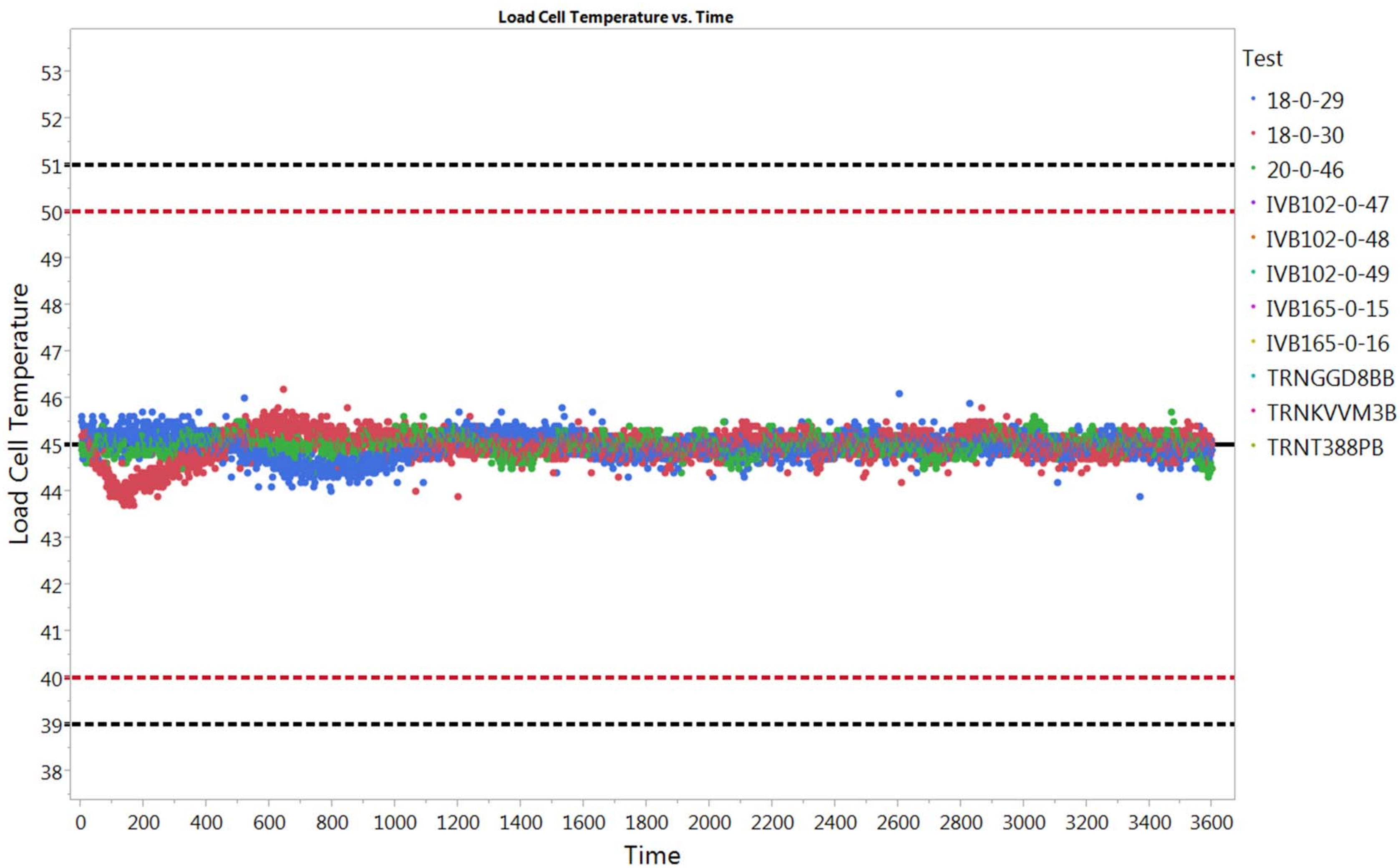
Lubrizol QIs (shifted data QI in parentheses)

Test	QI Stage 1	QI Stage 1-2	QI Stage 2	QI Stage 2-1	QI Final
TRNGGD8BB	0.33 (0.56)	-1.18 (0.82)	-1.15 (0.70)	0.13 (0.75)	-0.49 (0.70)
TRNKVVM3B	0.62 (0.81)	-1.09 (0.89)	-1.56 (0.47)	0.33 (0.65)	-0.45 (0.70)
TRNT388PB	0.55 (0.74)	-1.28 (0.79)	-1.88 (0.32)	0.20 (0.68)	-0.60 (0.63)
Average	**0.50 (0.70)**	**-1.18 (0.83)**	**-1.53 (0.50)**	**0.22 (0.69)**	**-0.51 (0.68)**

Other Parameters

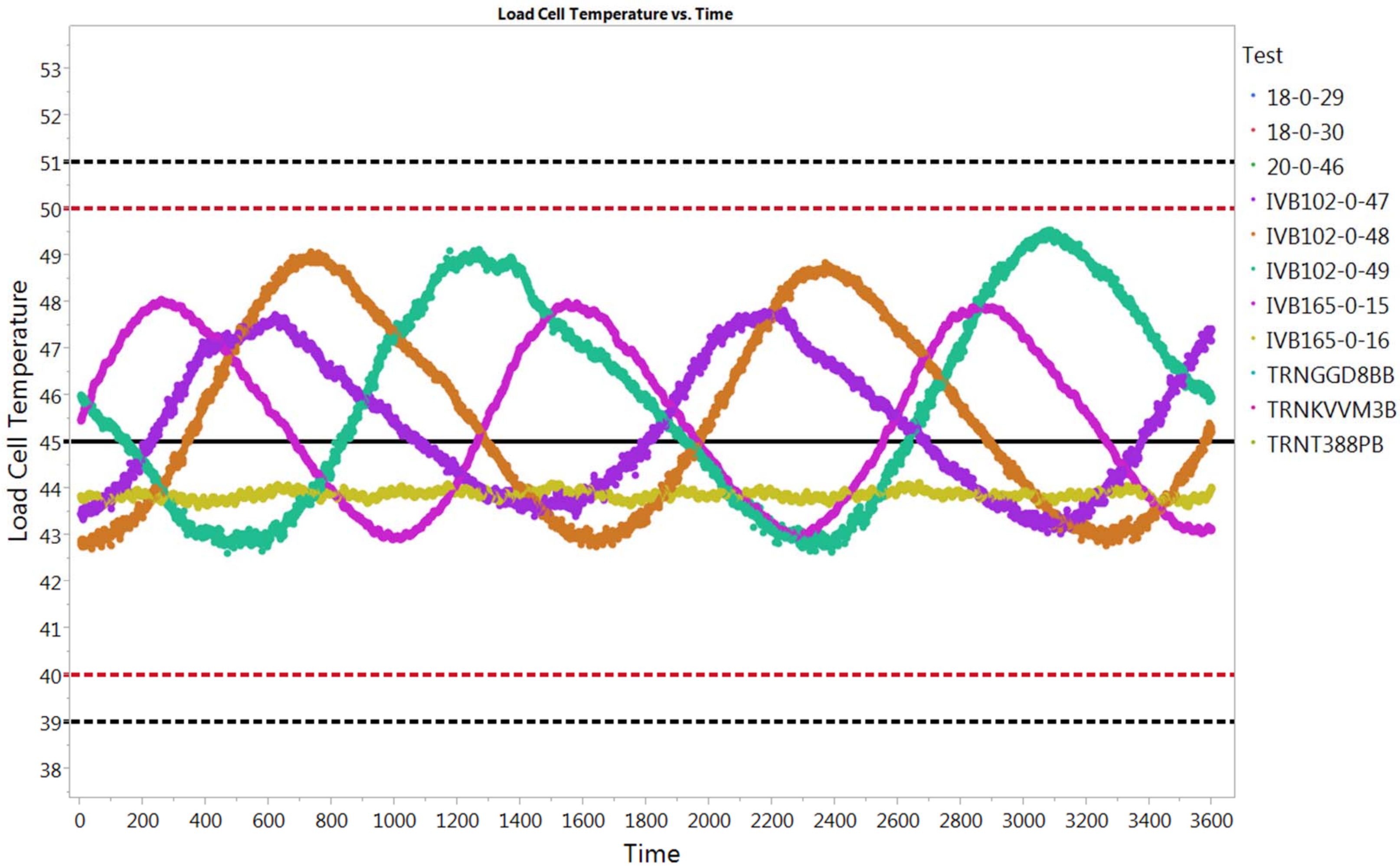
Load Cell Temp QI
Lab = SwRI

- Target : 45 C
- Window size 1: +/- 6 C
- Window size 2: +/- 5 C



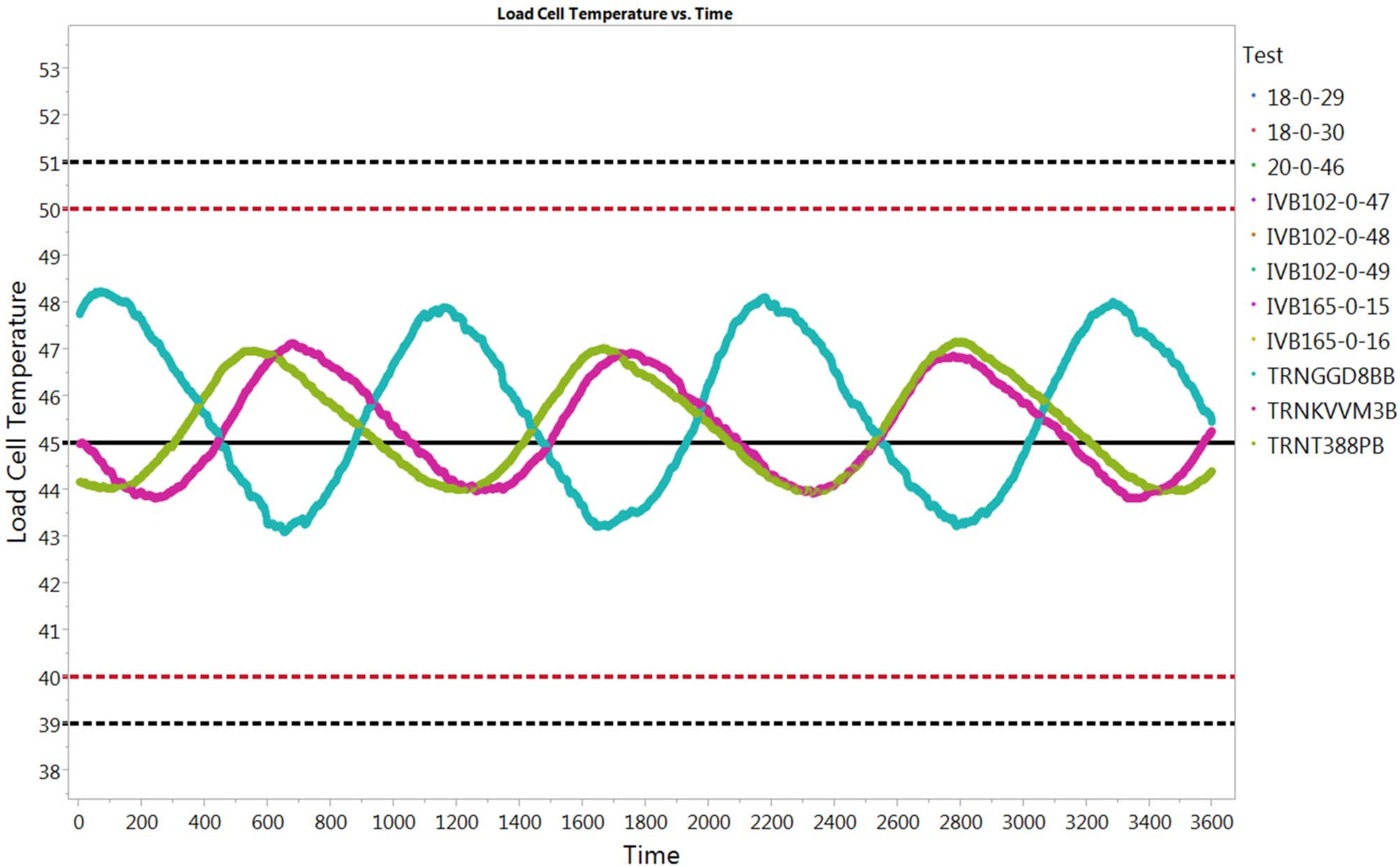
Load Cell Temp QI
Lab = IAR

- Target : 45 C
- Window size 1: +/- 6 C
- Window size 2: +/- 5 C



Load Cell Temp QI
Lab = LZ

- Target : 45 C
- Window size 1: +/- 6 C
- Window size 2: +/- 5 C



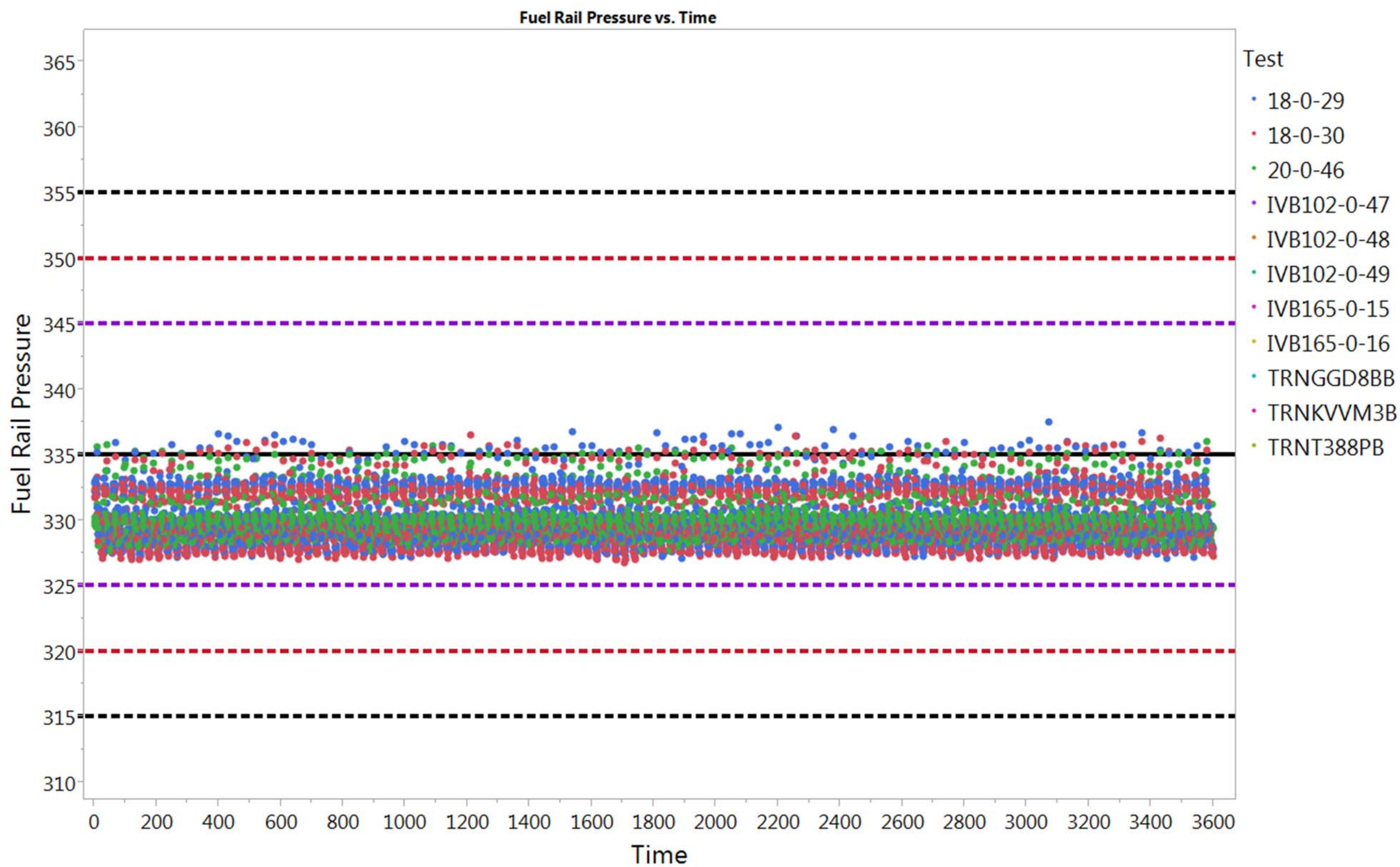
Load Cell Temp QI Summary

- Target : 45 C
- Window size 1: +/- 6 C
- Window size 2: +/- 5 C

Test no.	QI Window 1	QI Window 2
18-0-29	1.00	1.00
18-0-30	1.00	1.00
20-0-46	1.00	1.00
102-0-47	0.94	0.91
102-0-48	0.88	0.83
102-0-49	0.85	0.78
165-0-15	0.91	0.87
165-0-16	0.96	0.95
TRNGGD8BB	0.91	0.87
TRNKVVM3B	0.97	0.95
TRNT388PB	0.97	0.95
Average	**0.94**	**0.92**

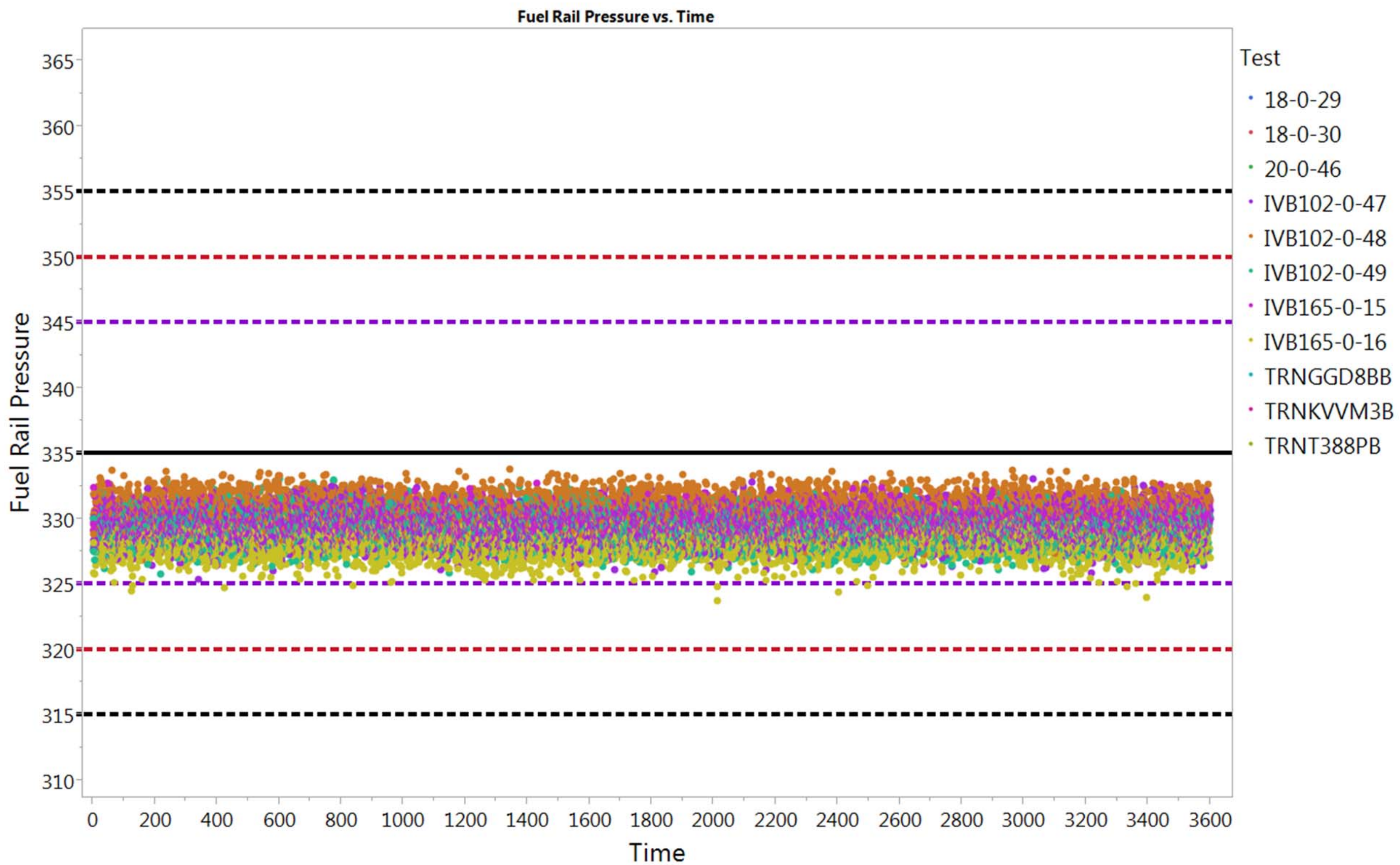
Fuel Rail Pressure QI
Lab = SwRI

- Target : 335 kPa
- Window size 1: +/- 20 kPa
- Window size 2: +/- 15 kPa
- Window size 3: +/- 10 kPa



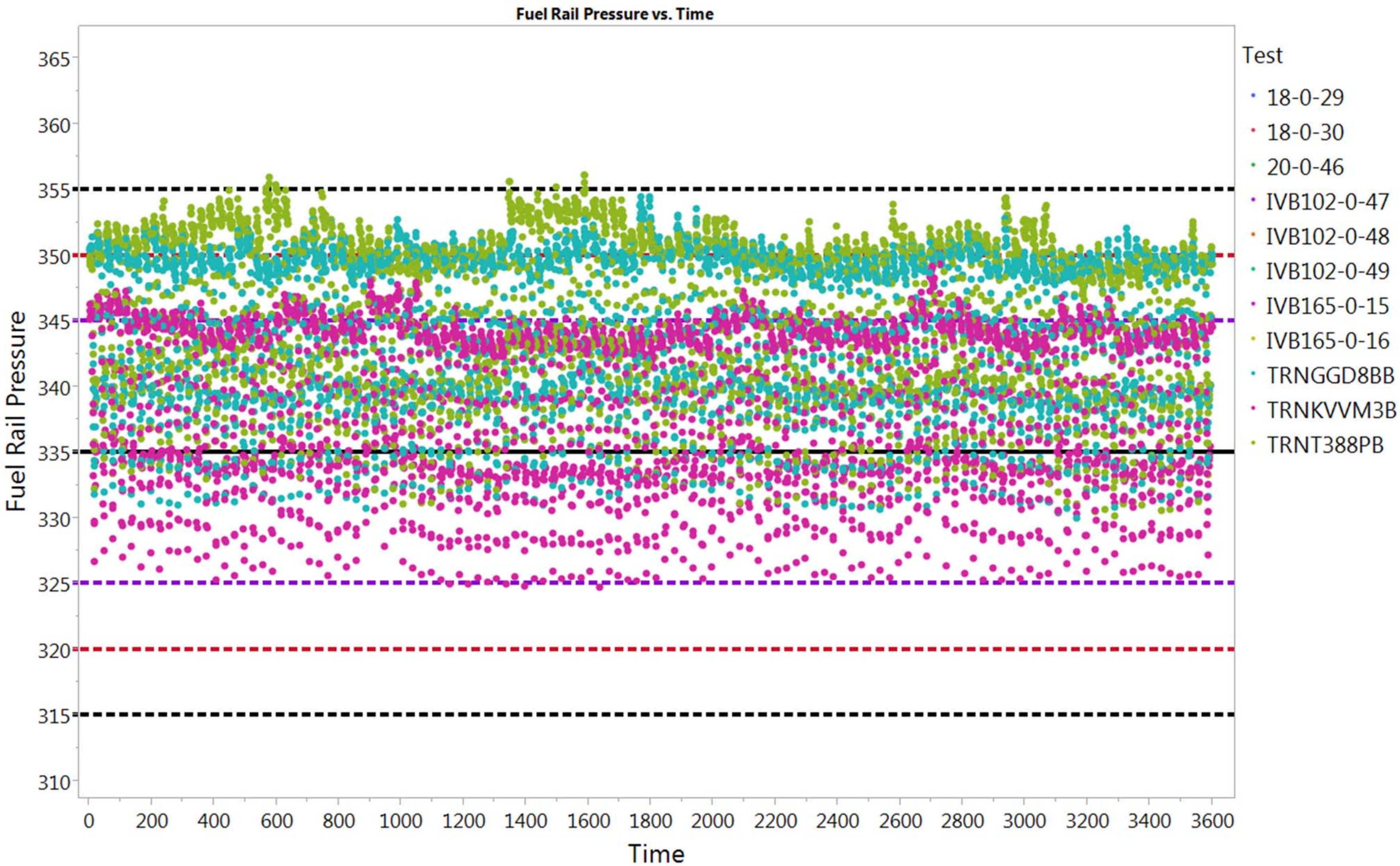
Fuel Rail Pressure QI
Lab = IAR

- Target : 335 kPa
- Window size 1: +/- 20 kPa
- Window size 2: +/- 15 kPa
- Window size 3: +/- 10 kPa



Fuel Rail Pressure QI
Lab = LZ

- Target : 335 kPa
- Window size 1: +/- 20 kPa
- Window size 2: +/- 15 kPa
- Window size 3: +/- 10 kPa



Fuel Rail Pressure QI Summary

- Target : 335 kPa
- Window size 1: +/- 20 kPa
- Window size 2: +/- 15 kPa
- Window size 3: +/- 10 kPa

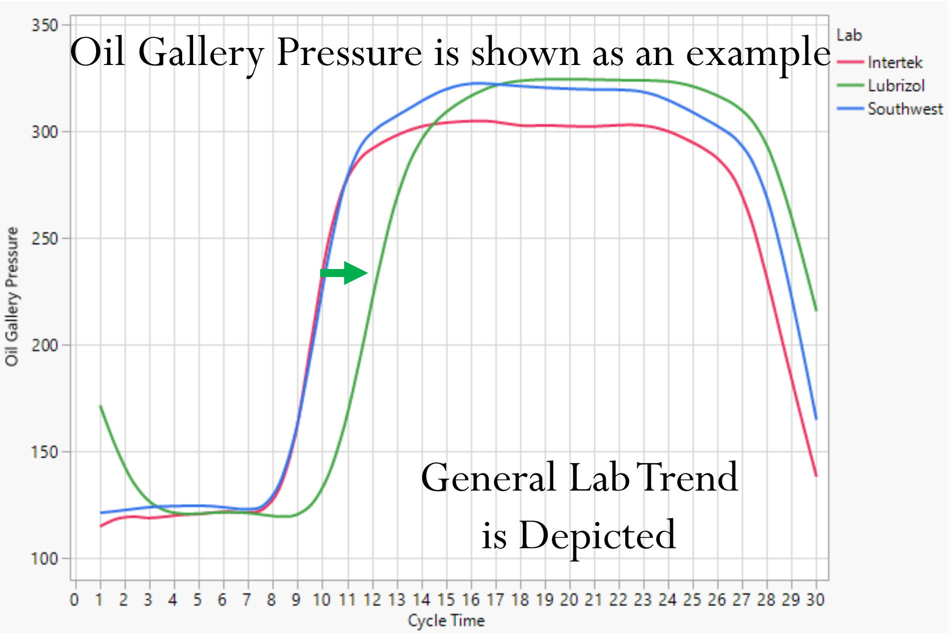
Test no.	QI Window 1	QI Window 2	QI Window 3
18-0-29	0.93	0.88	0.72
18-0-30	0.93	0.87	0.70
20-0-46	0.93	0.87	0.71
102-0-47	0.92	0.85	0.67
102-0-48	0.95	0.91	0.80
102-0-49	0.91	0.85	0.66
165-0-15	0.93	0.88	0.73
165-0-16	0.88	0.78	0.51
TRNGGD8BB	0.69	0.45	-0.25
TRNKVVM3B	0.87	0.77	0.49
TRNT388PB	0.63	0.34	-0.49
Average	**0.87**	**0.77**	**0.48**

Appendix

Summary - Lab Cycle Profile Offset

There are many parameters in which the cycle profiles are offset between the various labs (mainly LZ):

1. Parameters in which LZ's cycle profile is offset by a lag of ~1 second:
   1. Absolute Throttle Position
   2. Absolute Load
   3. Bank 1 STFT (~1 second offset from SwRI)
2. Parameters in which LZ's cycle profile is offset by a lag of ~1 to ~2 seconds:
   1. Engine Power
   2. Engine Speed (Dyno)
   3. Engine Speed (OBD)
   4. Ignition Timing Advance
3. Parameters in which LZ's cycle profile is offset by a lag of ~2 seconds:
   1. Blowby Flow Rate
   2. Crankcase Gas Pressure
   3. Coolant Delta
   4. Coolant Temperature Out of Engine
   5. Exhaust Pressure
   6. Exhaust Gas Temperature
   7. Intake Manifold Pressure
   8. Oil Gallery Pressure
   9. Engine Oil Gallery Temperature
4. LZ's Engine Oil Sump Temp cycle profile is offset by a lag of ~4 to ~5 seconds
5. The Fuel Flow Rate cycle at SwRI is offset from IAR by a lag of 1 second; LZ is offset from IAR by a lag of 1 second

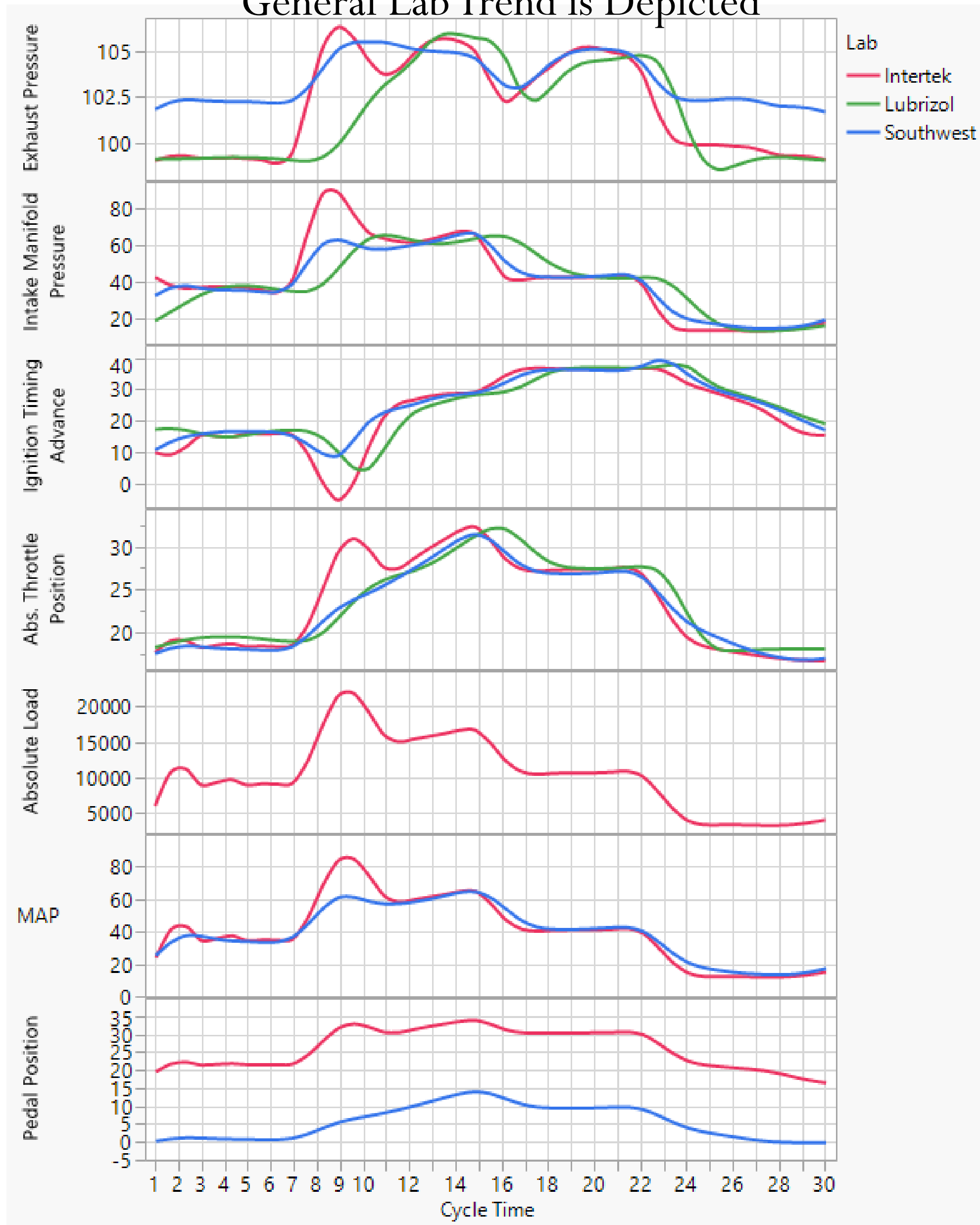


Summary – IAR Stage 1 to 2 Ramp Peak

There is a peak (or valley) in the transition from stage 1 to stage 2 that is more pronounced at IAR than the other labs. This is observed in the following parameters:

1. Exhaust Pressure
2. Intake Manifold Pressure
3. Ignition Timing Advance (OBD)
4. Absolute Throttle Position (OBD)
5. MAP (OBD)
6. Pedal Position (OBD)

General Lab Trend is Depicted

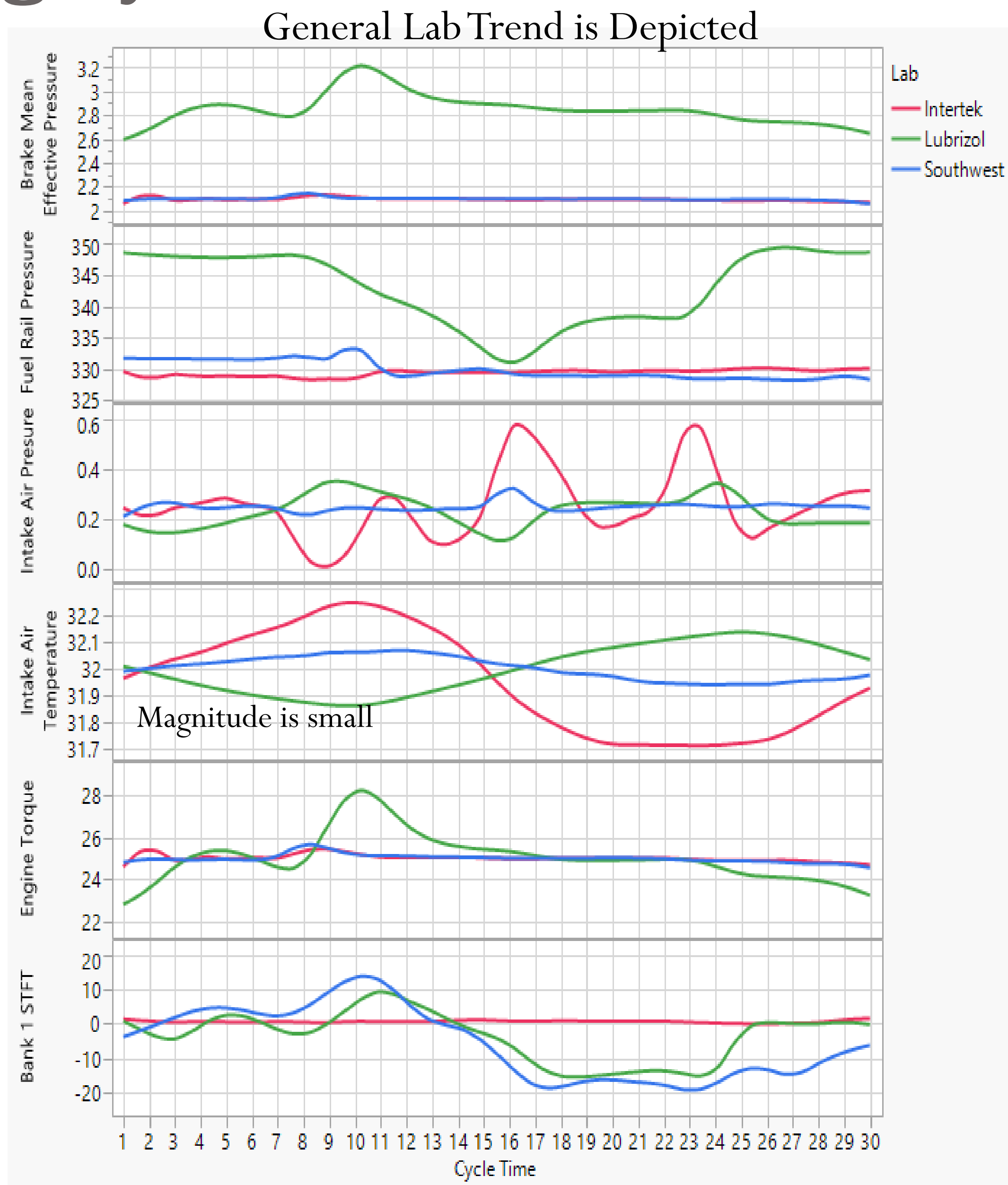


Summary – Differing Cycle Profiles

The cycle profiles of some parameters are not consistent across the labs.

These include:

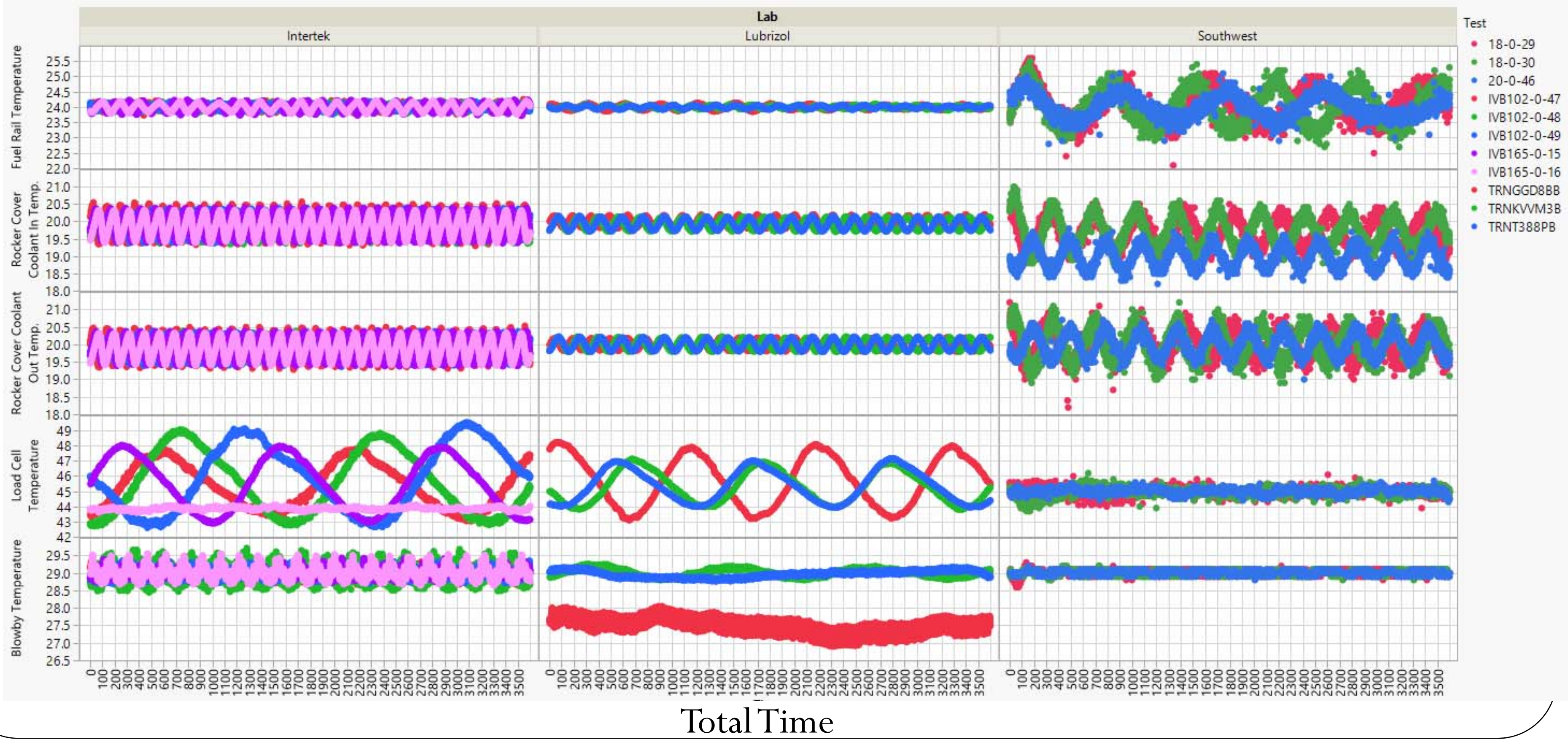
1. Brake Mean Effective Pressure
2. Fuel Rail Pressure
3. Intake Air Pressure
4. Intake Air Temperature
5. Engine Torque (OBD)
6. Bank 1 STFT (OBD)



Summary–Cycling Differences Over Total Time

Some labs fluctuate over the hour of data differently in some parameters. These include:

1. Fuel Rail Temperature
2. Rocker Cover Coolant In & Out Temperatures
3. Load Cell Temperature
4. Blowby Temperature



Summary – Ramping Differences

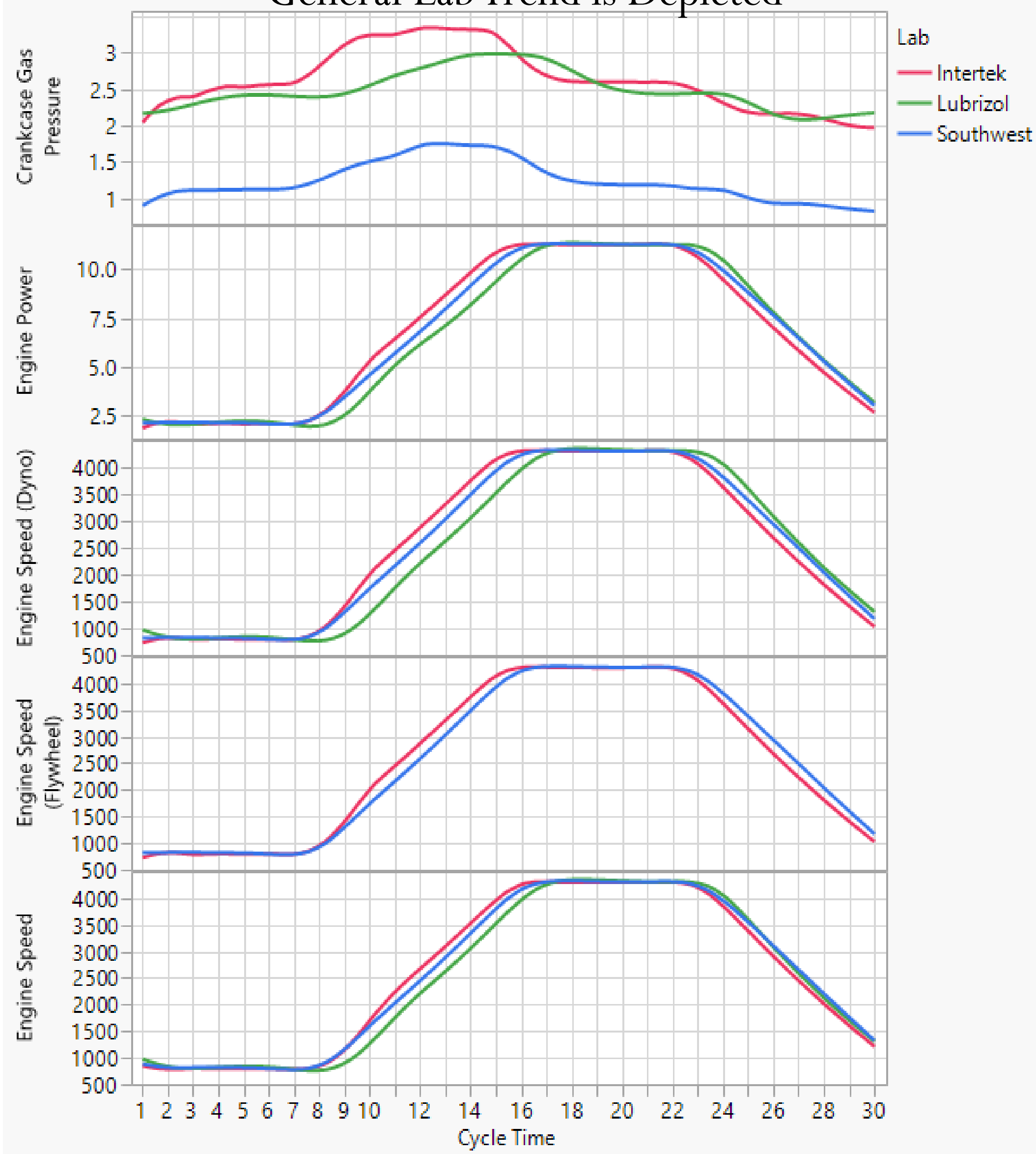
The rate at which some parameters ramp is not consistent across the labs.

These include:

1. Crankcase Gas Pressure
2. Engine Power
3. Engine Speed
   (Dyno, Flywheel and OBD)

In particular, IAR is steepest during the first part of the transition from stage 1 to stage 2

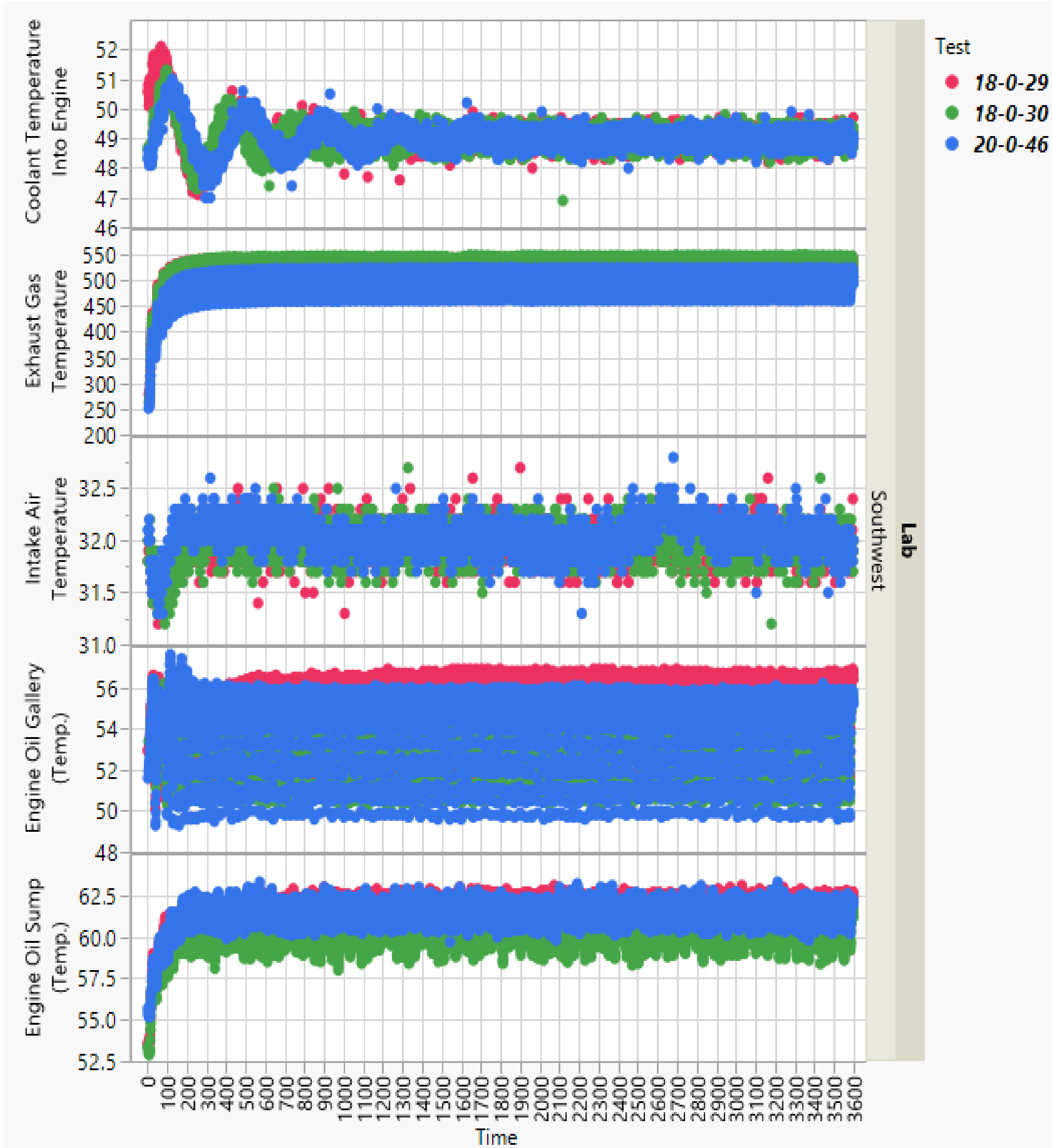
General Lab Trend is Depicted



Summary – SwRI Stabilization

In SwRI tests, it appears some parameters weren't quite stable at the being of the data reported. These include:

1. Coolant Temperature into the Engine
2. Exhaust Gas Temperature
3. Intake Air Temperature
4. Engine Oil Gallery Temperature
5. Engine Oil Sump Temperature

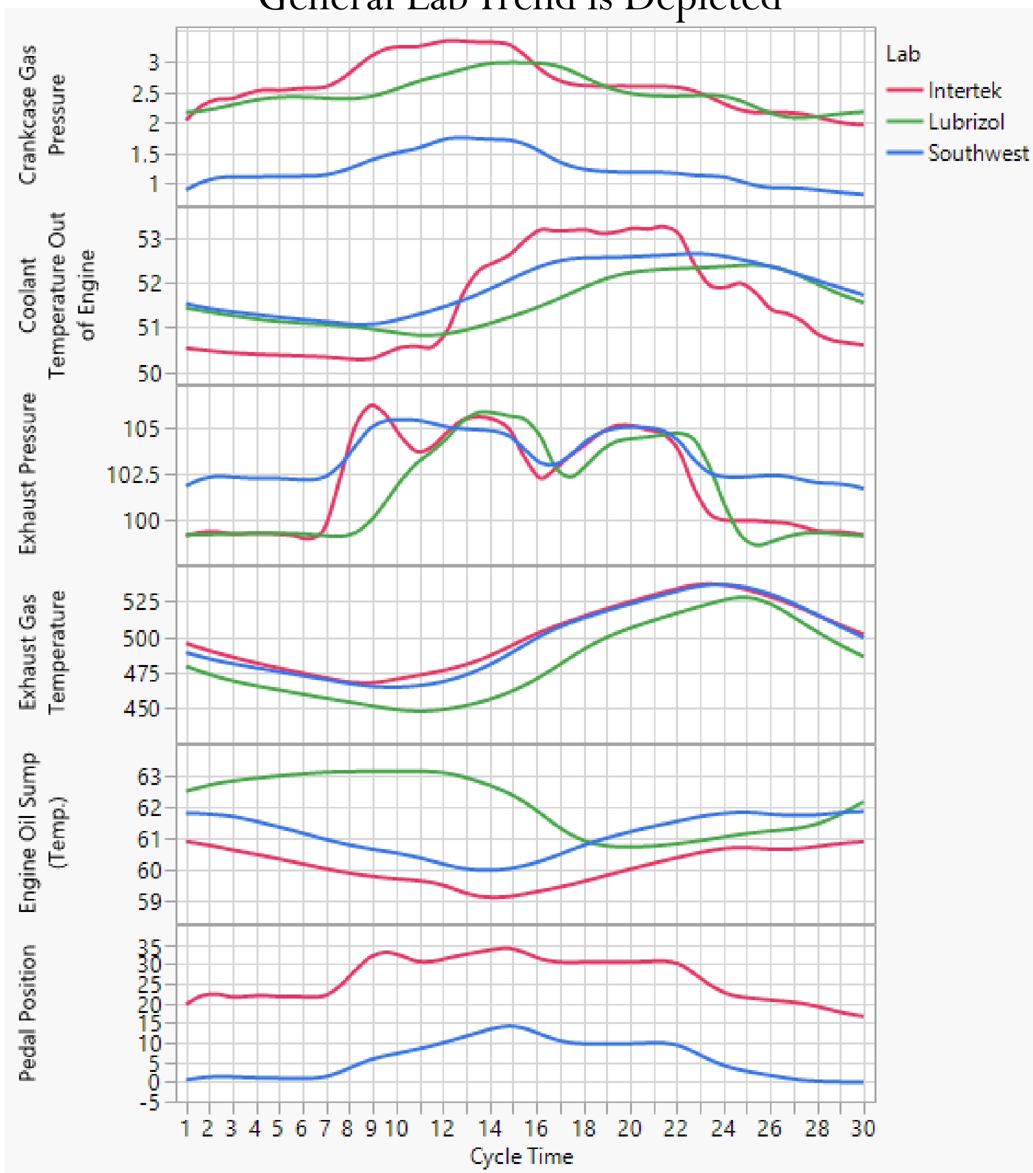


Summary–Lab Offset

Labs differ in some parameters:

1. Crankcase Gas Pressure (SwRI lower)
2. Coolant Temperature Out of Engine (IAR has largest swing in temp)
3. Exhaust Pressure (SwRI least swing in pressure)
4. Exhaust Gas Temperature (LZ lower)
5. Engine Oil Sump Temperature (LZ > SwRI > IAR)
6. Pedal Position (IAR > SwRI)

General Lab Trend is Depicted

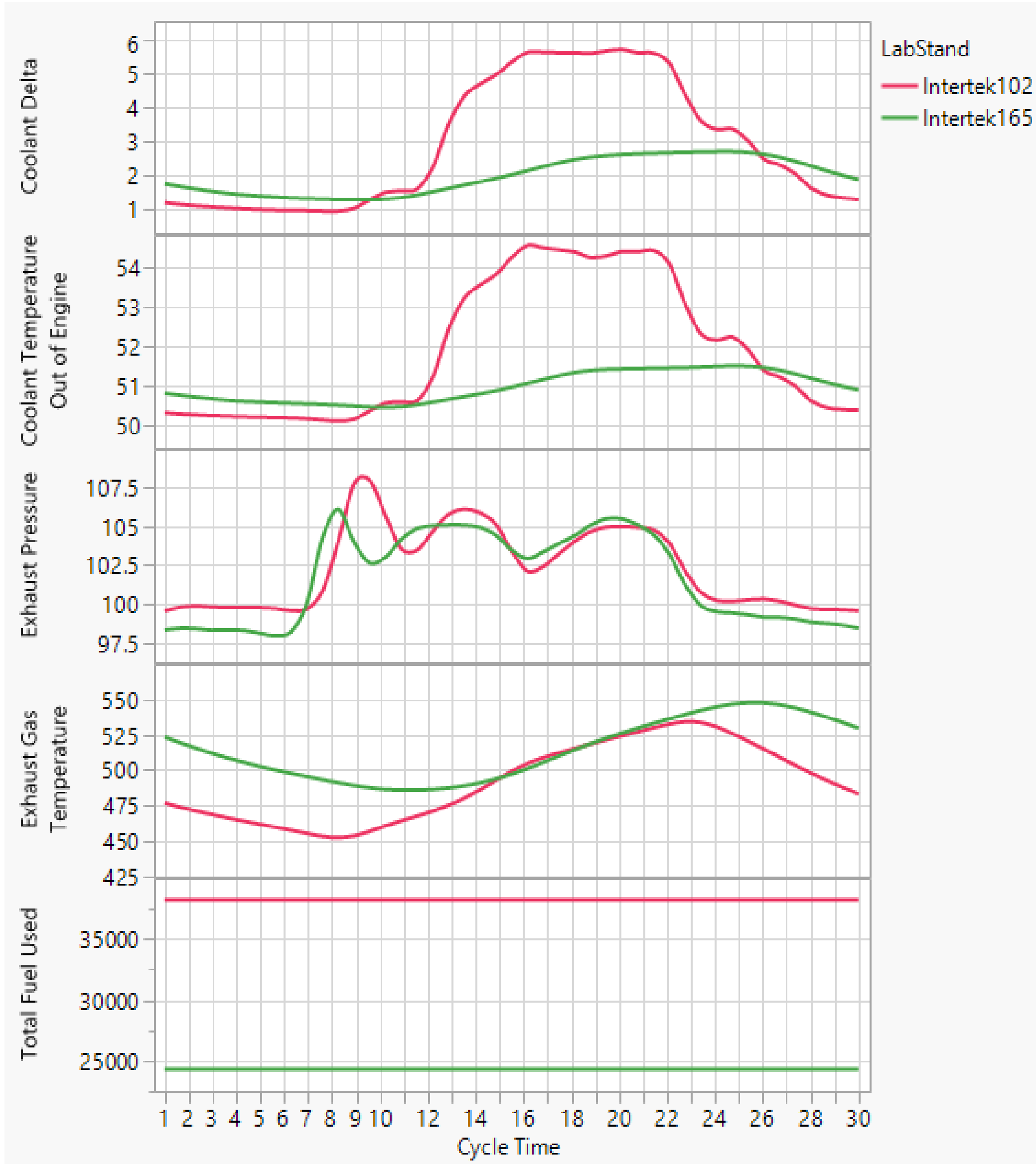


Summary–IAR Stand Differences

IAR stands exhibit differences in the following parameters:

1. Coolant Delta & Coolant Temperature Out of Engine
   1. Stand 102 higher in stage 2 and transition from stage 1 to stage 2
2. Exhaust Pressure
   1. Stand 165 peak is sooner in transition from stage 1 to 2
3. Exhaust Gas Temperature (165 higher)
4. Total Fuel Used (102 higher)

General Stand Trend is Depicted

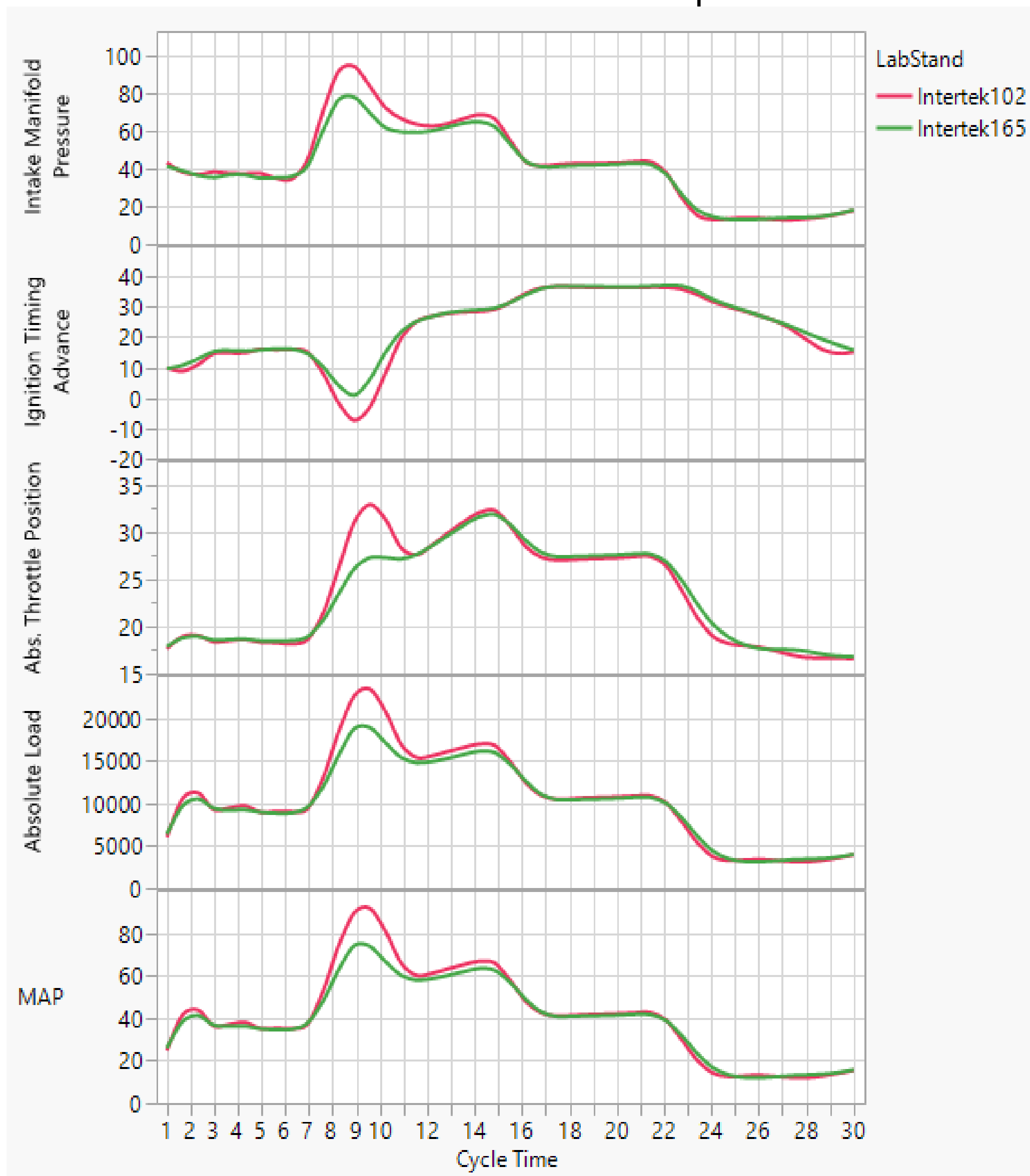


Summary–IAR Stand Differences

The peak (or valley) in the transition from stage 1 to stage 2 is less pronounced in stand 165 than 102 in the following parameters:

1. Intake Manifold Pressure
2. Ignition Timing Advance
3. Absolute Throttle Position
4. Absolute Load
5. MAP

General Stand Trend is Depicted

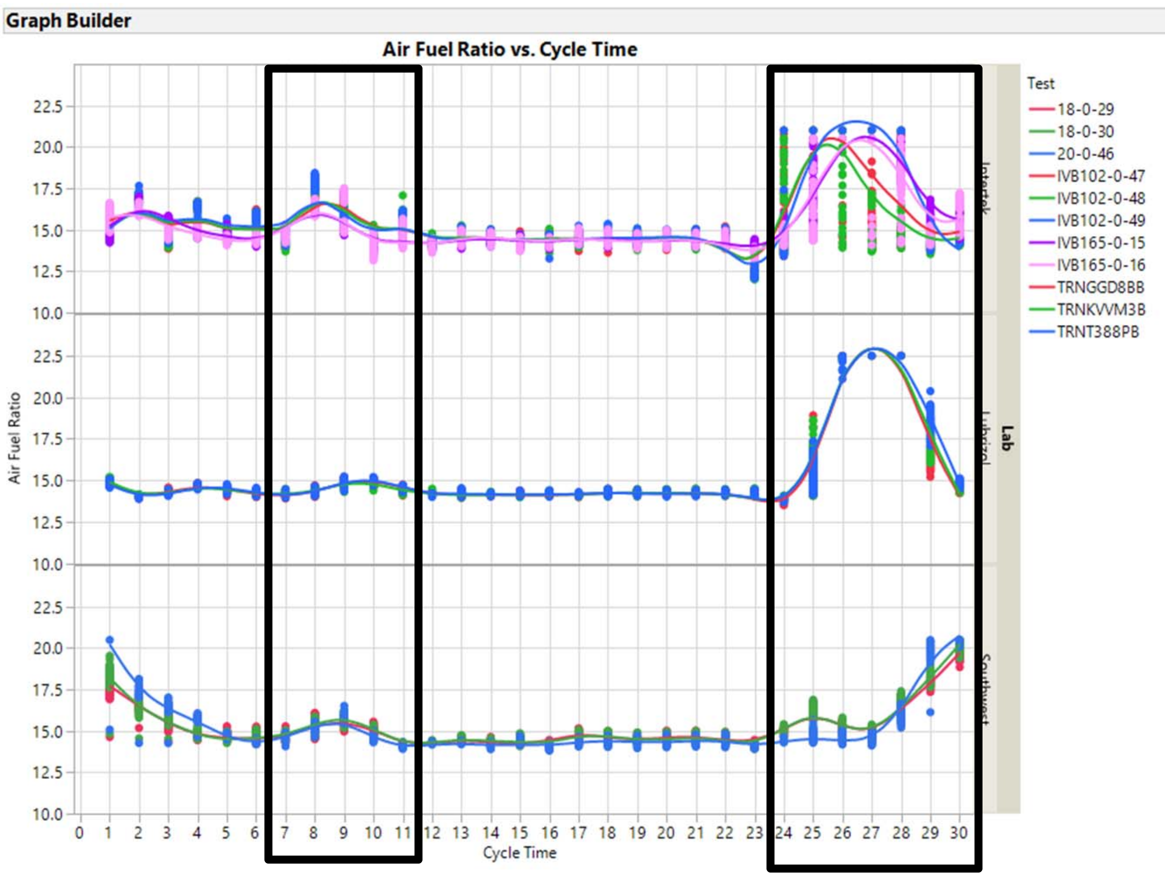


Summary – Air Fuel Ratio Peaks

The spike in air fuel ratio at the beginning of the transition from stage 1 to stage 2 happens at slightly different times at the labs (IAR first, then SwRI followed by LZ). The magnitude of the peak is also different.

At LZ and IAR the air fuel ratio generally spikes up and then back down in the transition from stage 2 to stage 1 while at SwRI the air fuel ratio spikes up at the end of the transition and then spikes down at the beginning of stage 1.

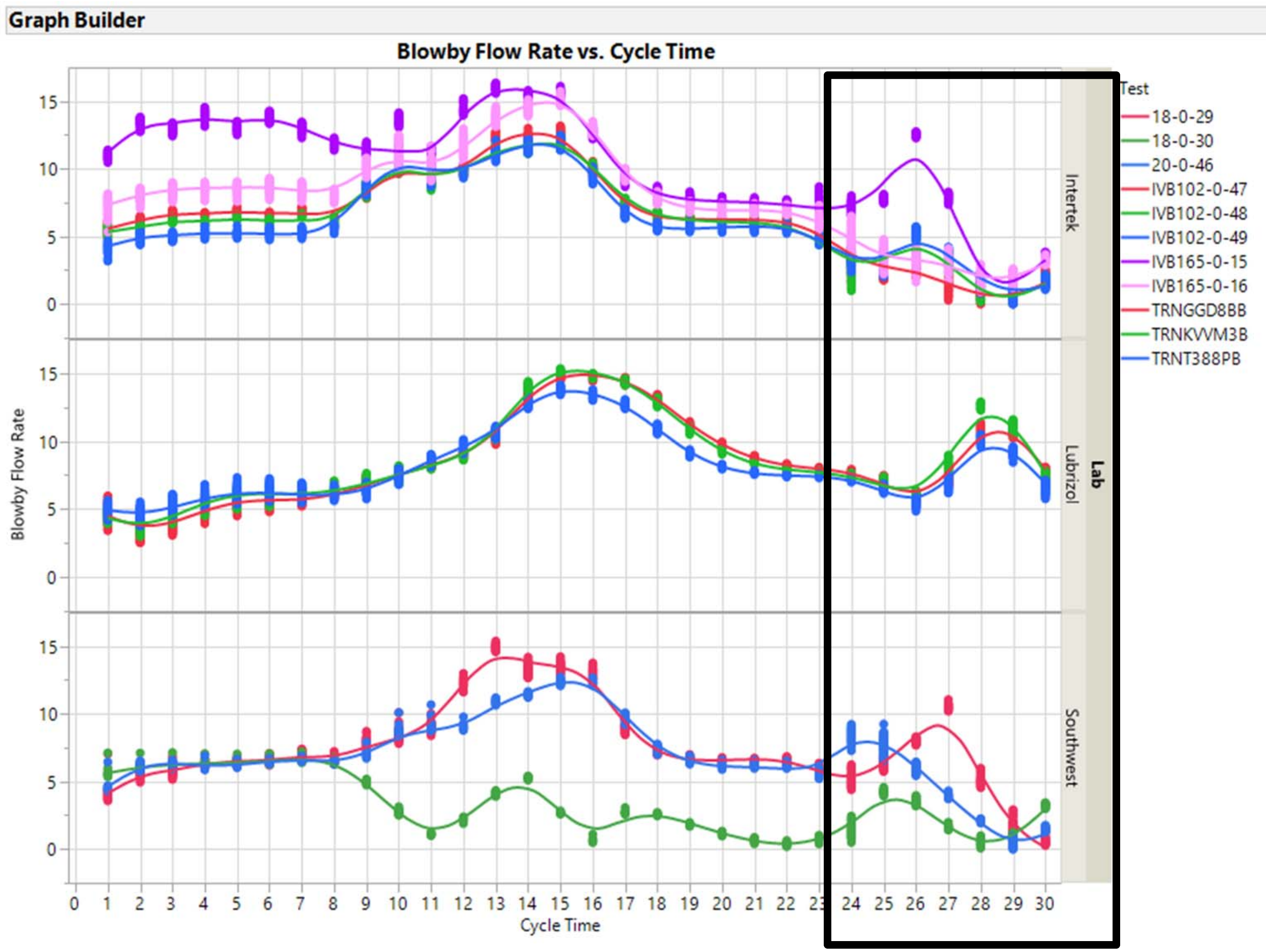
Also, the peak is higher at LZ than the other labs



Summary – Stage 2 to 1 Blowby Ramp Peak

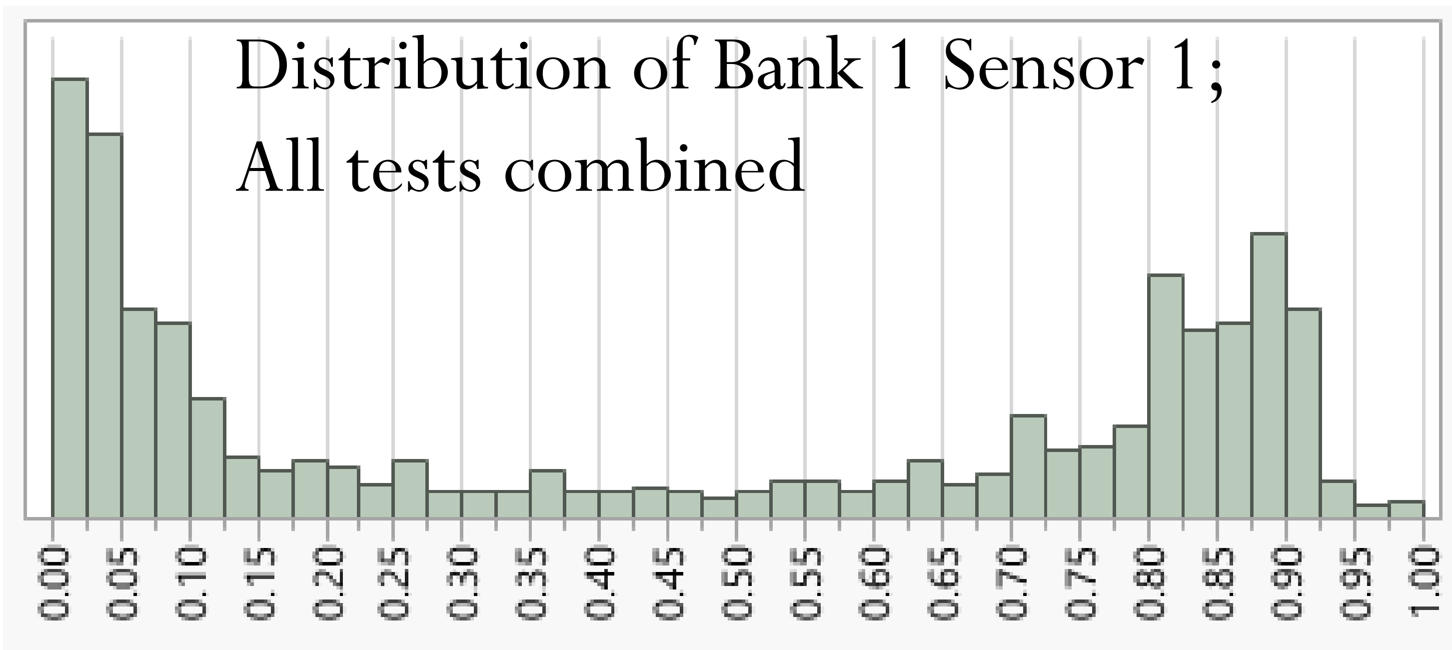
In the transition from stage 2 to stage 1:

1. IAR doesn't exhibit much of a peak
2. LZ's peak occurs later in the transition
3. SwRI isn't consistent from test to test



Summary – Bank 1 Sensor 1

Bank 1 Sensor 1 values generally fall close to 0 and close to 1.



Engine Speed QI

Cycle Time	Target	Window
1	800	150
2	800	100
3	800	75
4	800	50
5	800	50
6	800	50
7	800	50
8	927	150
9	1357	250
10	1888	400
11	2300	400
12	2731	400
13	3168	400
14	3610	400
15	4041	400
16	4300	100
17	4300	75
18	4300	50
19	4300	25
20	4300	25
21	4300	25
22	4300	25
23	4136	100
24	3734	250
25	3283	400
26	2829	400
27	2382	400
28	1946	400
29	1523	400
30	1116	400

IVB ASTM REO 300

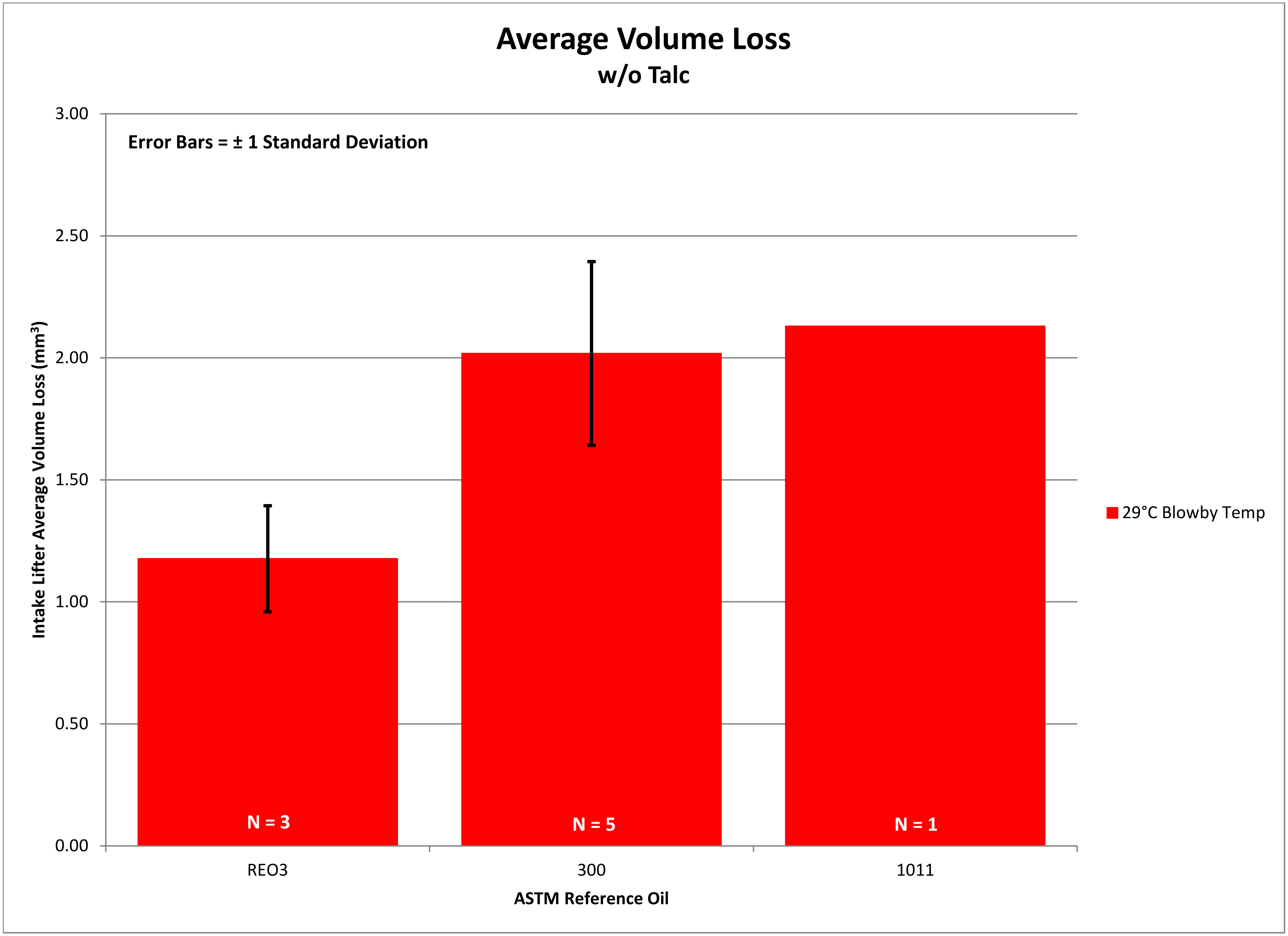
Lab	IAR	SwRI	SwRI	SwRI	IAR	IAR	SwRI	SwRI	IAR	Lubrizol	Average and Std Dev of DOE Matrix tests.		Average and Std Dev of final prove-out tests.		Lab
Stand	I-101	S-18	S-20	S-20	I-165	I-102	S-18	S-20	I-101	347					Stand
Oil	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300	300	300	300	Oil
Purpose	DOE Matrix	DOE Matrix	DOE Matrix	DOE Matrix	Coolant Flow 80 lpm + Blowby Temp 29°C Prove-out	Coolant Flow 80 lpm + Blowby Temp 29°C Prove-out	Coolant Flow 80 lpm + Blowby Temp 29°C Prove-out	Coolant Flow 80 lpm + Blowby Temp 29°C Prove-out	Coolant Flow 80 lpm + Blowby Temp 29°C Prove-out	Coolant Flow 80 lpm + Blowby Temp 29°C Prove-out	AVERAGE (1)	STD DEV (1)	AVERAGE (2)	STD DEV (2)	Purpose
Test Number	IVB101-0-5	18-0-6	20-0-26	20-0-27	165-0-15	102-0-48	18-0-30	20-0-46	101-0-50	TRN					Test Number
Fe Content @ 200 hours, ppm	227	245	332	323	263	248	255	260	381		282	53.46	281	55.97	Fe Content @ 200 hours, ppm
Intake Bucket Lifters Average Area Loss, μm^2	239274	301518	244467	286161	181144	178950	222566	236590	249017		267855	30725.49	213653	32082.93	Intake Bucket Lifters Average Area Loss, μm^2
Intake Bucket Lifters Average Volume Loss, mm^3	2.59	2.93	2.38	2.73	1.59	1.71	2.05	2.23	2.51		2.66	0.231	2.02	0.376	Intake Bucket Lifters Average Volume Loss, mm^3
Yi (Area Loss)	-0.93	1.10	-0.76	0.60	-1.01	-1.08	0.28	0.71	1.10	-6.66	RED = Calculated using the mean and stand deviation derived from the 4 test development DOE matrix tests.				Yi (Area Loss)
Yi (Volume Loss)	-0.28	1.17	-1.20	0.31	-1.14	-0.82	0.09	0.56	1.31	-5.36	BLUE = Calculated using the mean and stand deviation derived from the final prove-out tests.				Yi (Volume Loss)
					w/ Talc	w/ Talc	w/ Talc	w/ Talc	w/ Talc	w/ Talc			w/ Talc	w/ Talc	
Intake Bucket Lifters Average Volume Loss, mm^3					1.73	1.85	2.28	2.54	2.75				2.23	0.437	Intake Bucket Lifters Average Volume Loss, mm^3

IVB REO3 (5W-20)

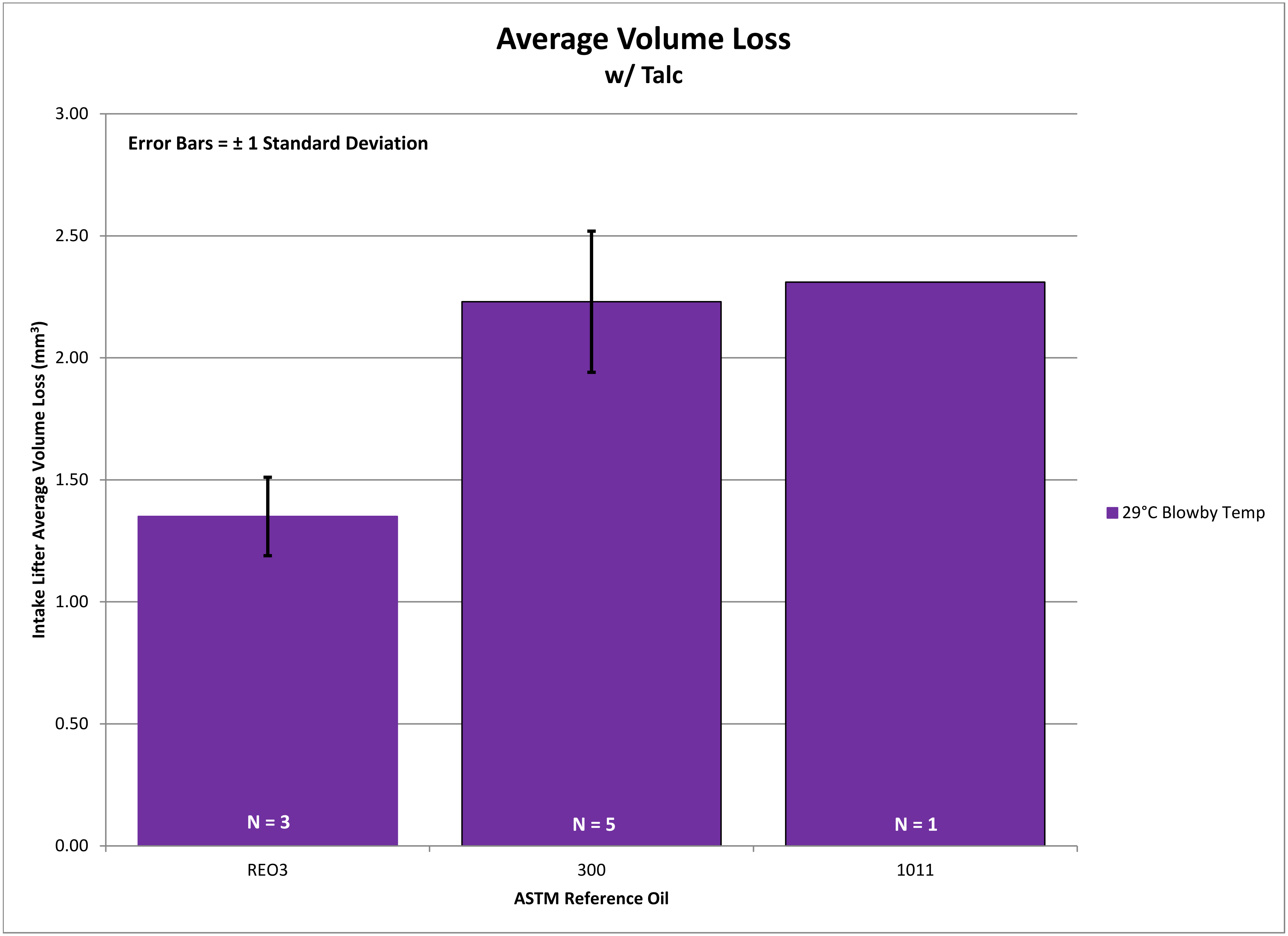
Lab	IAR	IAR	Lubrizol	Lubrizol	IAR	SwRI	IAR	Lubrizol	Average and Std Dev of initial dev. tests.		Average and Std Dev of final prove-out tests.	
Stand	I-100	I-101	347	347	I-102	S-18	I-165	347				
Oil	REO3 (5W-20)	REO3 (5W-20)	REO3 (5W-20)	REO3 (5W-20)	REO3 (5W-20)	REO3 (5W-20)	REO3 (5W-20)	REO3 (5W-20)	REO3	REO3	REO3	REO3
Purpose	Test Development Support	Test Development Support	Prove-out	Prove-out	Prove-out	Prove-out	Prove-out	Prove-out	AVERAGE (1)	STD DEV (1)	AVERAGE (2)	STD DEV (2)
Test Number	IVB100-0-6	IVB101-0-8	TRNWVQKSC	TRN	IVB102-0-47	18-0-29	IVB165-0-16	TRN				
Fe Content @ 200 hours, ppm	90	115	627	207	277	155	214		103	17.68	215	61.01
Intake Bucket Lifters Average Area Loss, μm^2	102011	116375	365539	197344	127524	124277	159639		109193	10157.22	137146	19546.48
Intake Bucket Lifters Average Volume Loss, mm^3	0.70	0.98	3.88	2.09	1.14	0.98	1.41		0.84	0.197	1.17	0.216
Yi (Area Loss)	-0.71	0.71	25.24	8.68	-0.49	-0.66	1.15	-7.02	RED = Calculated using the mean and stand deviation derived from the 2 test development support tests.			
Yi (Volume Loss)	-0.71	0.71	15.45	6.34	-0.17	-0.90	1.08	-5.44	BLUE = Calculated using the mean and stand deviation derived from the final prove-out tests.			
w/ Talc												
Intake Bucket Lifters Average Volume Loss, mm^3					1.28	1.23	1.53				1.35	0.161

IVB ASTM REO 1011 **ASTM REO 1011 = Tech 1 (0W-16)**

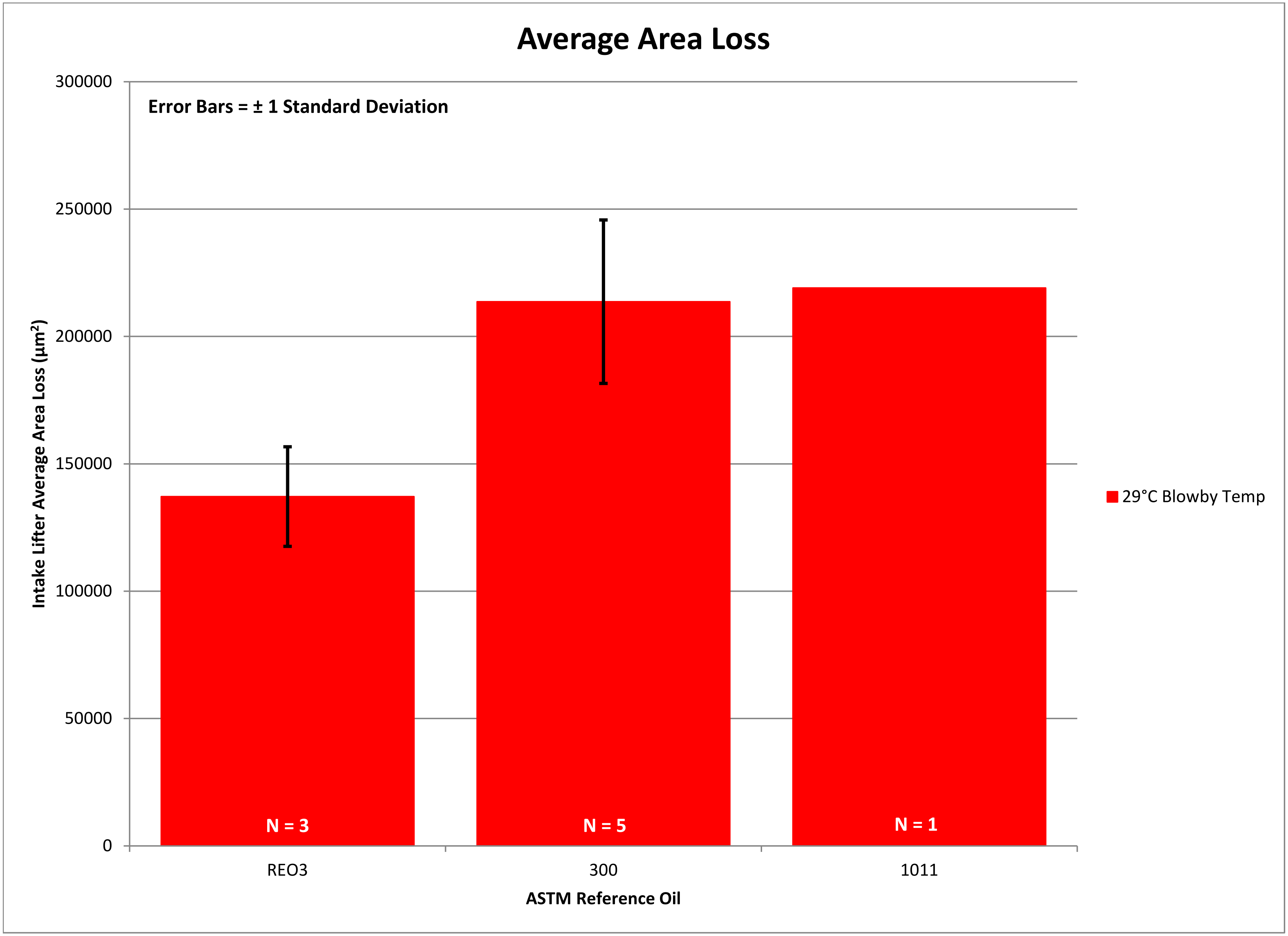
Lab	IAR	IAR				Average and Std Dev of initial dev. tests.		Average and Std Dev of final prove-out tests.	
Stand	I-101	I-102							
Oil	1011	1011				1011	1011	1011	1011
Purpose	Test Development Support	Prove-out				AVERAGE (1)	STD DEV (1)	AVERAGE (2)	STD DEV (2)
Test Number	IVB101-0-6	IVB102-0-49							
Fe Content @ 200 hours, ppm	225	727				225	#DIV/0!	727	#DIV/0!
Intake Bucket Lifters Average Area Loss, μm^2	204657	219025				204657	#DIV/0!	219025	#DIV/0!
Intake Bucket Lifters Average Volume Loss, mm^3	1.96	2.13				1.96	#DIV/0!	2.13	#DIV/0!
Yi (Area Loss)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	RED = Calculated using the mean and stand deviation derived from the test development support tests.			
Yi (Volume Loss)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	BLUE = Calculated using the mean and stand deviation derived from the final prove-out tests.			
w/ Talc									
Intake Bucket Lifters Average Volume Loss, mm^3		2.31						2.31	#DIV/0!



Average Volume Loss
w/o Talc
Error Bars = ± 1 Standard Deviation
Intake Lifter Average Volume Loss (mm³)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
N = 3
N = 5
N = 1
REO3
300
1011
ASTM Reference Oil
29°C Blowby Temp



Average Volume Loss
w/ Talc
Error Bars = ± 1 Standard Deviation
Intake Lifter Average Volume Loss (mm³)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
N = 3
N = 5
N = 1
REO3
300
1011
ASTM Reference Oil
29°C Blowby Temp



Average Area Loss
Error Bars = ± 1 Standard Deviation
Intake Lifter Average Area Loss (µm²)
300000
250000
200000
150000
100000
50000
0
N = 3
N = 5
N = 1
REO3
300
1011
ASTM Reference Oil
29°C Blowby Temp

Attachment 8

Sequence IVB Prove-Out Data Analysis

Statistics Group

Feb. 6, 2017

Statistics Group

- Arthur Andrews, ExxonMobil
- Doyle Boese, Infineum
- Jo Martinez, Chevron Oronite
- Kevin O'Malley, Lubrizol
- Martin Chadwick, Intertek
- Richard Grundza, TMC
- Lisa Dingwell, Afton
- Todd Dvorak, Afton
- Travis Kostan, SwRI

Summary

- 9 Prove-out data with final configuration (Coolant Flow 80 lpm + Blowby Temp 29°C)
- Labs
  - IAR: 3 stands
  - SwRI: 2 stands
- Oils
  - REO3 (5W-20): 3 tests
  - 300 (5W-30): 5 tests
  - 1011 (0W-16): 1 test
- Given limited data on Area Loss and Volume Loss (with or without talc), the test appears to discriminate oils
- Planned testing

Stand	REO3	300	1011
I-102	1	1	1
I-165	1	1	
S-18	1	1	
S-20		1	
L-347	1	1	
I-101*		1	
I-100*		1	

*non-PM stand (camshaft Batch A)

Planned

Prove-out Data

Lab	Stand	Oil	Test Number	Fe Content @ 200 hours, ppm	Intake Bucket Lifters Average Area Loss, µm^2	Intake Bucket Lifters Average Volume Loss, mm^3 w/o talc	Intake Bucket Lifters Average Volume Loss, mm3 w/talc
IAR	I-165	300 (5W-30)	165-0-15	263	181144	1.59	1.73
IAR	I-102	300 (5W-30)	102-0-48	248	178950	1.71	1.85
IAR	I-101	300 (5W-30)	101-0-50	381	249017	2.51	2.75
SwRI	S-18	300 (5W-30)	18-0-30	255	222566	2.05	2.28
SwRI	S-20	300 (5W-30)	20-0-46	260	236590	2.23*	2.54*
IAR	I-102	REO3 (5W-20)	IVB102-0-47	277	127524	1.14	1.28
IAR	I-165	REO3 (5W-20)	IVB165-0-16	214	159639	1.41	1.53
SwRI	S-18	REO3 (5W-20)	18-0-29	155	124277	0.98	1.23
IAR	I-102	1011 (0W-16)	IVB102-0-49	727	219025	2.13	2.31

*Pre-test volume measurements for lifters I5 and I8 were estimated for this test. Analysis without this test result did not change the conclusion on test discrimination.

Intake Bucket Lifters Average Area Loss

Summary of Fit

RSquare	0.911304
RSquare Adj	0.645216
Root Mean Square Error	27366.63
Mean of Response	188748
Observations (or Sum Wgts)	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	6	1.539e+10	2.565e+9	3.4248
Error	2	1497864944	748932472	Prob > F
C. Total	8	1.6888e+10		0.2432

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	207982.85	14720.9	14.13	0.0050*
Oil[1011 (0W-16)]	43858.667	22344.76	1.96	0.1887
Oil[300 (5W-30)]	6607.3333	15800.13	0.42	0.7164
Lab[IAR]:Stand[I-101]	39110.722	21715.2	1.80	0.2135
Lab[IAR]:Stand[I-102]	-28132.61	17467.7	-1.61	0.2486
Lab[SwRI]:Stand[S-18]	-17315.92	17665.08	-0.98	0.4303
Lab[IAR]	-4683.903	10615.39	-0.44	0.7022

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Oil	2	2	7771422029	5.1883	0.1616
Stand[Lab]	3	3	3190581033	1.4201	0.4386
Lab	1	1	145809605	0.1947	0.7022

Summary of Fit

RSquare	0.710946
RSquare Adj	0.614595
Root Mean Square Error	28523.16
Mean of Response	188748
Observations (or Sum Wgts)	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	1.2006e+10	6.0031e+9	7.3787
Error	6	4881422416	813570403	Prob > F
C. Total	8	1.6888e+10		0.0242*

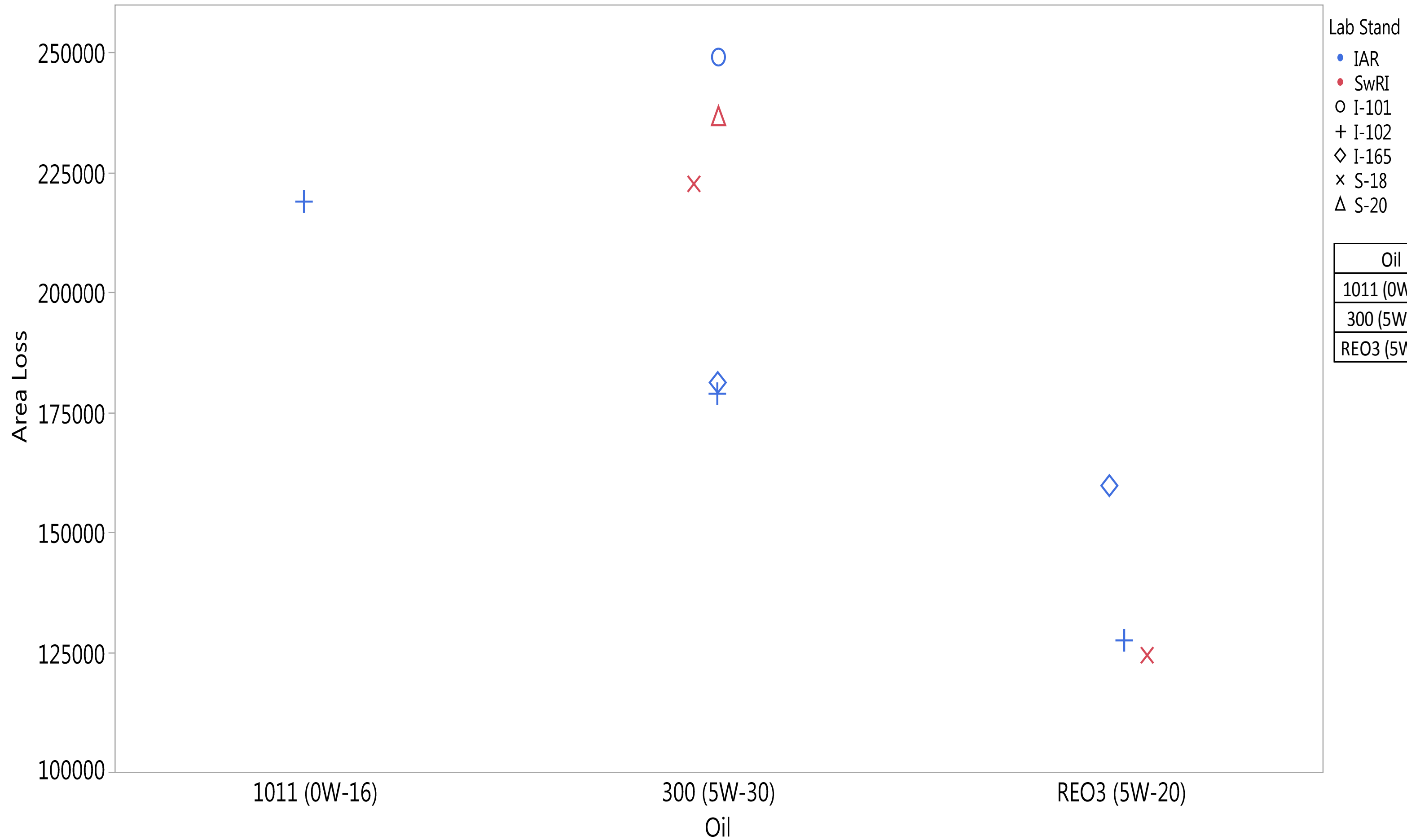
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	189941.69	11773.2	16.13	<.0001*
Oil[1011 (0W-16)]	29083.311	20243.48	1.44	0.2008
Oil[300 (5W-30)]	23711.711	13886.91	1.71	0.1386

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Oil	2	2	1.2006e+10	7.3787	0.0242*

Intake Bucket Lifters Average Area Loss



Oil	Area Loss
1011 (0W-16)	219025
300 (5W-30)	213653
REO3 (5W-20)	137147

1011, 300 > REO3 (p=0.10, 0.02)

Intake Bucket Lifters Average Volume Loss w/o talc

Summary of Fit

RSquare	0.868647
RSquare Adj	0.540265
Root Mean Square Error	0.314315
Mean of Response	1.654224
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	1.3066649	0.261333	2.6452
Error	2	0.1975877	0.098794	Prob > F
C. Total	7	1.5042526		0.2968

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.8259963	0.157157	11.62	0.0073*
Oil[1011 (0W-16)]	0.4705871	0.256637	1.83	0.2081
Oil[300 (5W-30)]	0.0690037	0.18147	0.38	0.7403
Lab[IAR]:Stand[I-102]	-0.037361	0.157157	-0.24	0.8342
Lab[SwRI]:Stand[S-18]	-0.205351	0.202889	-1.01	0.4180
Lab[IAR]	-0.129649	0.128319	-1.01	0.4187

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Oil	2	2	0.88775915	4.4930	0.1821
Stand[Lab]	2	2	0.10678932	0.5405	0.6492
Lab	1	1	0.10085259	1.0208	0.4187

Summary of Fit

RSquare	0.69411
RSquare Adj	0.592146
Root Mean Square Error	0.331478
Mean of Response	1.74931
Observations (or Sum Wgts)	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	1.4959684	0.747984	6.8074
Error	6	0.6592645	0.109877	Prob > F
C. Total	8	2.1552329		0.0286*

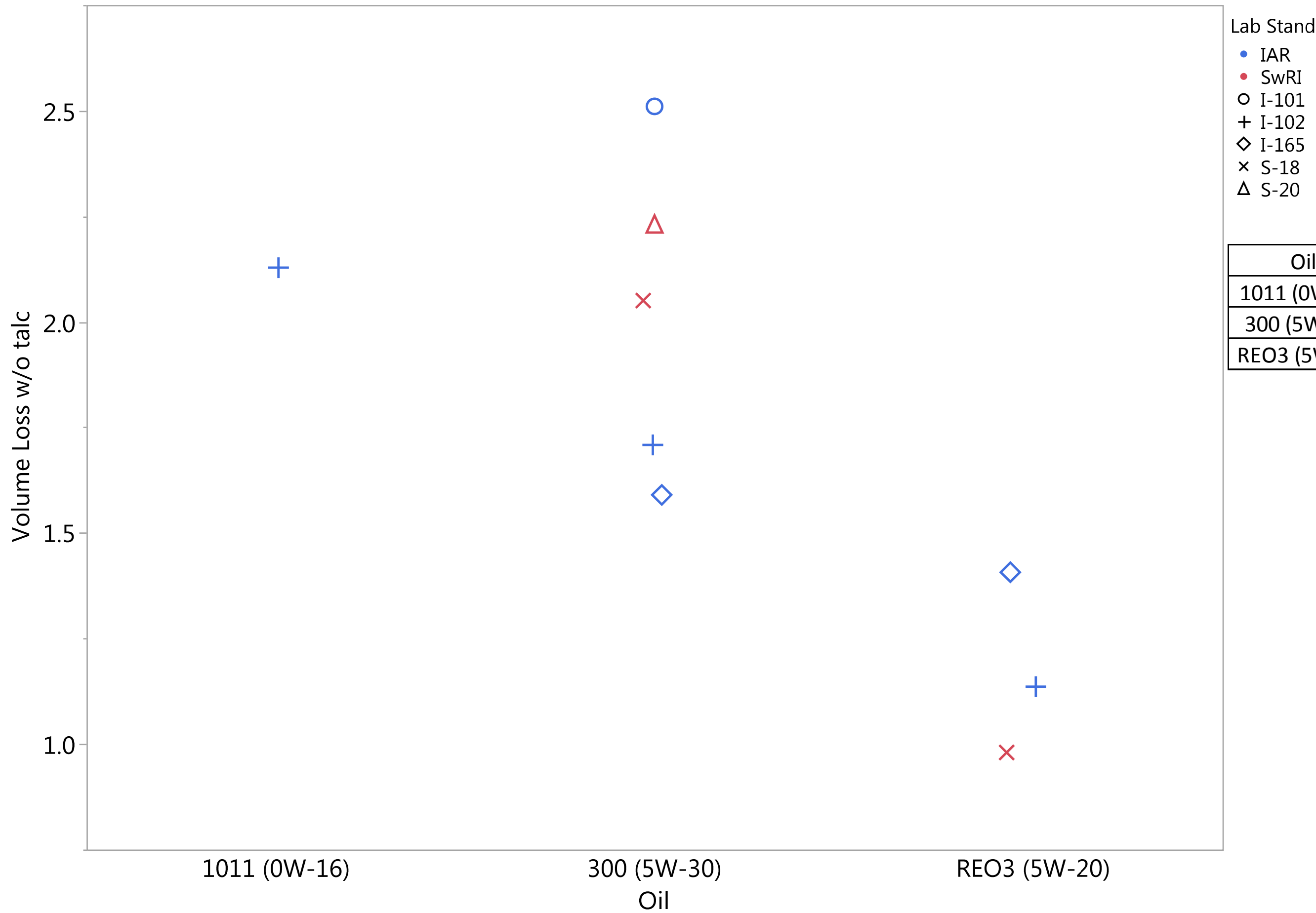
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.7741043	0.136821	12.97	<.0001*
Oil[1011 (0W-16)]	0.3554698	0.235257	1.51	0.1815
Oil[300 (5W-30)]	0.2438957	0.161385	1.51	0.1815

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Oil	2	2	1.4959684	6.8074	0.0286*

Intake Bucket Lifters Average Volume Loss w/o talc



Oil	Volume Loss w/o talc
1011 (0W-16)	2.13
300 (5W-30)	2.02
REO3 (5W-20)	1.17

1011, 300 > REO3 (p=0.10,0.03)

Intake Bucket Lifters Average Volume Loss w/ talc

Summary of Fit

RSquare	0.893055
RSquare Adj	0.625694
Root Mean Square Error	0.301358
Mean of Response	1.84375
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	1.5167542	0.303351	3.3403
Error	2	0.1816333	0.090817	Prob > F
C. Total	7	1.6983875		0.2463

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	2.045	0.150679	13.57	0.0054*
Oil[1011 (0W-16)]	0.4966667	0.246058	2.02	0.1810
Oil[300 (5W-30)]	0.055	0.173989	0.32	0.7819
Lab[IAR]:Stand[I-102]	-0.0325	0.150679	-0.22	0.8492
Lab[SwRI]:Stand[S-18]	-0.240833	0.194526	-1.24	0.3413
Lab[IAR]	-0.199167	0.123029	-1.62	0.2469

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Oil	2	2	0.92208333	5.0766	0.1646
Stand[Lab]	2	2	0.14342667	0.7896	0.5588
Lab	1	1	0.23800417	2.6207	0.2469

Summary of Fit

RSquare	0.664364
RSquare Adj	0.552485
Root Mean Square Error	0.368571
Mean of Response	1.944444
Observations (or Sum Wgts)	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	1.6133556	0.806678	5.9382
Error	6	0.8150667	0.135844	Prob > F
C. Total	8	2.4284222		0.0378*

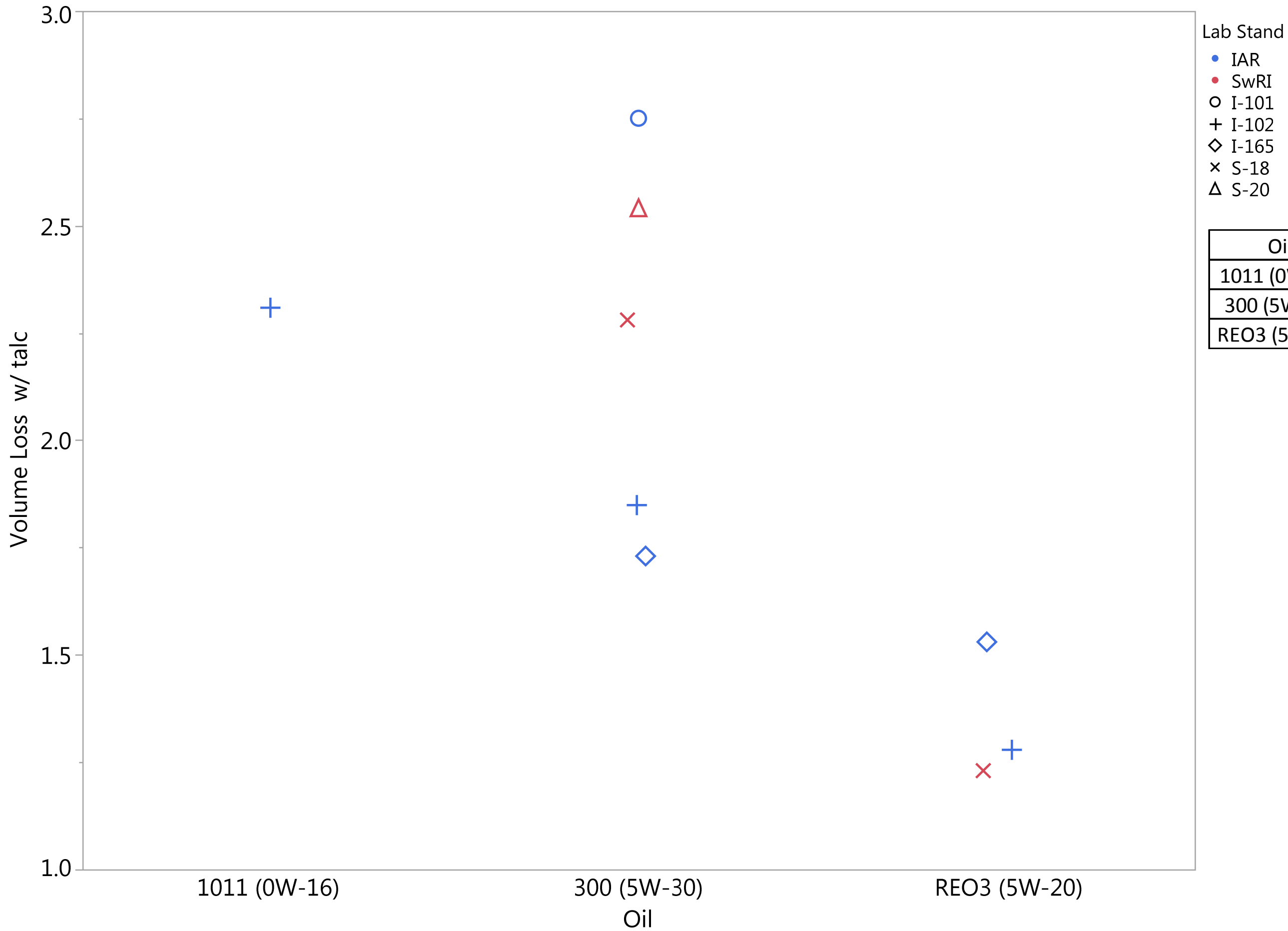
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.9622222	0.152131	12.90	<.0001*
Oil[1011 (0W-16)]	0.3477778	0.261582	1.33	0.2320
Oil[300 (5W-30)]	0.2677778	0.179444	1.49	0.1862

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Oil	2	2	1.6133556	5.9382	0.0378*

Intake Bucket Lifters Average Volume Loss w/ talc



Oil	Volume Loss w/ talc
1011 (0W-16)	2.31
300 (5W-30)	2.23
REO3 (5W-20)	1.35

1011, 300 > REO3 (p=0.14,0.04)

Attachment 9

Sequence IVB

MOA Checklist

and

Final Precision Matrix Design

William Buscher
Teri Kowalski
February 6, 2017

Readiness

- Meet validity requirements of the MOA
- All three oils are at TMC
  - TMC1011 - Tech 1 (0W-16)
  - TMC300 - (5W-30) – Failing reference oil
  - TMC1012 - REO3 (5W-20) – Low wear reference oil
- Test Procedure – ASTM format in progress. Draft on TMC website, complete enough to run PM
- Test Forms – On TMC website. Beta test complete. Data transfer from Intertek and SWRI complete.
- Reference period – will have to shorten 1st referencing period.

MOA Requirements

Each oil used to demonstrate discrimination has a minimum of two valid test results in the documented Test Matrix procedure. The Test Development Task Force must approve these results.

Has been successfully met. We have 5 tests on 300 (HWO) and 3 tests on 1012 - REO3 (LWO). We have one test on 1011 - Tech 1 0W-16 but that's not an oil that will be used to demonstrate discrimination.

Each Matrix Lab has run at least two operationally valid tests (shakedown runs are eligible) using the Test Matrix procedure. Shakedown runs are full-length, operationally valid runs on oils such as potential candidate or research oils. The Test Development Task Force will determine if these test results are satisfactory.

Has been successfully met at Intertek and SwRI. Task force agreed and voted that these tests are operationally valid. This has not been successfully met at Lubrizol, but their lab has been dropped from the precision matrix.

The Test Development Task Force has visited each Matrix Lab and filed a report with the ASTM Test Monitoring Center regarding the Matrix Lab's conformance to specifications that include, at a minimum, completed lab inspection checklists.

All labs have been visited multiple times, visit summaries were reviewed by the test development team and task force, lab visit summaries are posted on the TMC website and necessary lab changes were completed.

Matrix Lab readiness, as summarized by the lab inspection team reports, is deemed satisfactory by a majority of the members of the Test Development Task Force.

Task force reviewed the lab inspection reports and voted this test was ready for matrix.

The current batch supply of critical test parts used in the Test Matrix is sufficient to use in post-Matrix Testing beyond one reference cycle.

Current inventory is sufficient for the precision matrix, plus a shortened first reference period. Shortened reference period will be necessary to accommodate all 11 industry stands.

MOA Requirements

A matrix ready report packet has been approved by the Task Force and implemented by all Matrix Labs. At least one successful data transmission to the ASTM TMC is required before matrix oils will be assigned.

Report forms, version 20161012, are complete, are located on the TMC website, have gone through Beta testing and became active on October 12, 2016.

The Task Force has approved and posted on the ASTM TMC website operational control parameter ‘for matrix use’ Quality Index U & L values so that End of Test (EOT) Quality Index values can be reported in the matrix approved test report packet. If Quality Index is not anticipated to be pursued by the Task Force, operational control ± limits are to be established for all control parameters. The intent is that control parameters are to be centered on the control target, and the average is to be within the ± limits if Quality Index is not pursued.

Control parameter limits were approved by the Sequence IV surveillance panel on February 6, 2017 and are in the process of being added to the test procedure draft.

The Matrix Test oils are available at the Matrix Test Labs.

All three oils are at TMC
TMC1011 - Tech 1 (0W-16)
TMC300 - (5W-30) – Failing reference oil
TMC1012 - REO3 (5W-20) – Low wear reference oil

The Task Force should define the validity criteria before the start of the Matrix.

Sequence IV surveillance panel completed definition of the validity criteria on February 6, 2017.

4-Stand Precision Matrix Design

Run Order	IAR Stand 1	IAR Stand 2	SwRI Stand 1	SwRI Stand 2
1	300	1012	300	1011
2	1011	1011	1012	1011
3	1011	300	1012	1012
4	1012	300	1011	300
5	300	1012	1011	300

Attachment 10

Sequence IV Surveillance Panel
February 6, 2017
1:00PM – 5:00PM
Intertek
San Antonio, TX

Motions and Action Items
As Recorded at the Meeting by Bill Buscher

1. Motion – Revise the Sequence IVA test procedure to allow Ford fuel pump, p/n E7TZ-9C407-BA, as an acceptable alternative to the Nissan fuel pump.
   Charlie Leverett / Jerry Brys / Passed Unanimously

2. Action Item – Address the distribution of current batch supply of critical hardware for the precision matrix plus the first reference period post precision matrix.

3. Action Item – Add critical part serial numbers to the Sequence IVB test report package.

4. Action Item – OHT to report any available information on timing for next batch of critical hardware.

5. Motion – Set the Sequence IVB operational data QI targets and windows as per the recommendations included in the op data statistical presentation dated 2/6/17, the engine speed QI target and window table generated in today's meeting, Load Cell Temperature Qi target of 45°C and window of ± 4°C, Fuel Rail Pressure Qi target of 335 kPa and window of ± 10 kPa and Engine Coolant Pressure Qi target of 70 kPa and window of ± 10 kPa. These Qi calculations will be utilized as part of the precision matrix test validity criteria.
   Bill Buscher / Teri Kowalski / Passed 13 – 0 – 2

6. Motion – Sequence IV surveillance panel recommends to the PCEOCP and AOAP that the Sequence IVB is ready to proceed with precision matrix, pending update of the draft procedure to the finalized test configuration.
   Bill Buscher / Teri Kowalski / Passed 11 – 0 – 3

7. Action Item – Create one common document, incorporating all of the revisions for the finalized test configuration, as the latest draft test procedure for the Sequence IVB test.

8. Action Item – Prior to starting the precision matrix, SwRI and Intertek will perform one final lab visitation of both labs to inspect their precision matrix stands.