

Sequence IV Surveillance Panel | MINUTES

REVISION DATE: 12/6/2017 9:59:00 AM

Relevant Test:	Sequence IVA and IVB
Note Taker:	Chris Miletì
Meeting Date:	11-07-2017
Comments:	Conference call to review the status of the 2 nd Sequence IVB Precision Matrix.

1. REVIEW OF PRECISION MATRIX:

1.1. Test Results:

1.1.1. Available test results from 2nd Prove-Out Matrix:

- 1.1.1.1. REO1012: 8 results
- 1.1.1.2. REO1011: 2 results
- 1.1.1.3. REO300: 9 results

1.1.2. Available test results from 2nd Precision Matrix:

- 1.1.2.1. REO1012: 4 results
- 1.1.2.2. REO1011: 2 results
- 1.1.2.3. REO300: 2 results

1.2. General Comments:

1.2.1. REO300 is experiencing the most variation in test results.

1.2.2. REO1012 has experienced significant variation during both the 1st and 2nd Precision Matrices.

1.2.3. Southwest's Comments:

- 1.2.3.1. The "mild" Southwest stand (SWRI-18) appears to have shifted "severe" and is now performing more similarly to the Intertek stands.
- 1.2.3.2. They believe that the increase in severity may be due to changes in oil temperature control.

1.2.4. Lubrizol's Comments:

- 1.2.4.1. Lubrizol's original prove-out test (with REO300) delivered an unexpectedly mild result.
 - 1.2.4.1.1. This mild result was like the earlier results on SWRI-18.
- 1.2.4.2. Lubrizol's second prove-out test (with REO1012) delivered a result that was almost identical to the REO1012 results at Intertek.
 - 1.2.4.2.1. The increase in severity of LZ-347 may have been the result of modifications to the oil temperature control strategy.

1.2.5. Intertek's Comments:

- 1.2.5.1. IAR-101 and IAR-102 have produced different results on REO1012 (even though the stands were run side-by-side).
- 1.2.5.2. IAR-101 is significantly more severe than IAR-102.
- 1.2.5.3. The difference in severity is currently unexplained.
- 1.2.5.4. Both stands are generating positive QI values.

1.2.6. The Surveillance Panel has an action item to review the QI strategy for the oil gallery temperature after the Precision Matrix is complete.

1.2.6.1. Ashland noted that the Sequence III Surveillance Panel tightened the QI limits for fuel temperature after the IIIH Precision Matrix completed.

1.3. Lessons Learned:

1.3.1. Affon's Comments:

1.3.1.1. Affon would like the Surveillance Panel to thoroughly document everything learned about the impact of oil temperature on test severity.

1.3.1.2. This includes compiling a table of test results versus oil gallery temperature statistics.

1.3.1.3. The Surveillance Panel also needs to document "how we got here" by creating a timeline that shows changes to operational parameters with the corresponding test results.

1.3.2. Toyota's Comments:

1.3.2.1. [This Surveillance Panel] needs to build a knowledge database that can be shared with the industry.

1.3.2.2. This can effectively be done with software applications.

1.3.3. Buscher responded to Affon's request by creating the following action items:

1.3.3.1. Identify controlled parameters that are critical to test severity and review their QI strategies.

1.3.3.2. Capture lessons learned by creating a master data table (with a statistical summary).

1.3.4. Southwest's Comments:

1.3.4.1. Kostan has already been maintaining a table of temperature statistics.

1.3.4.2. He will continue to maintain this table.

1.3.5. Lubrizol's Comments:

1.3.5.1. It appears that oil gallery temperature may be a significant driver of test severity.

1.3.5.2. Subtle changes to oil temperature control may not necessarily be captured by the current QI calculations.

1.3.5.3. A histogram may be needed instead.

1.3.6. Ashland's Comments:

1.3.6.1. Ashland supports Lubrizol's assertion that a quality index may not be ideal for monitoring oil temperature control.

1.3.6.2. They took Affon's suggestion one step further by suggesting that the detailed meeting minutes be compiled into a comprehensive summary.

1.4. Detailed Review of Existing Data Set (Buscher):

1.4.1. The procedure is the same for the data in the existing [Prove-Out and Precision Matrix] data set.

1.4.2. However, some of the data points may have been generated with different engine batches.

1.4.3. Test Stand Review:

1.4.3.1. IAR-101 has demonstrated almost no discrimination between REO1011 and REO1012.

1.4.3.2. IAR-102 shows discrimination between all three reference oils.

1.4.3.3. IAR-165 is a non-Precision Matrix stand that has only completed one test.

1.4.3.4. SWRI-18 demonstrates good discrimination if its (2) "mild" results are removed.

1.5. Update on Laboratory Status:

1.5.1. Lubrizol will start its 1st Precision Matrix test tomorrow.

1.5.2. Exxon will start its 1st Precision Matrix test on Friday.

- 1.5.3. Afton is preparing to start their first prove-out test.
 - 1.5.3.1. They are not sure if they will be able to supply any supplemental data to the Precision Matrix.
- 1.5.4. Intertek experienced a negative QI with their 3rd Precision Matrix test.
 - 1.5.4.1. The consensus within the Surveillance Panel is that the test is valid.
 - 1.5.4.2. The TMC instructed Intertek to use a weighted QI.

2. OPERATIONAL DATA REVIEW (O'MALLEY):

2.1. Background:

- 2.1.1. O'Malley emailed a PowerPoint file to the Surveillance Panel on 11-06-2017 summarizing his analysis of the operational data.
- 2.1.2. However, he used his statistical software to present the data during this meeting.

2.2. Absolute Throttle Position (CAN):

- 2.2.1. The Southwest data is much smoother than the data at Intertek or Lubrizol.

2.3. Absolute Load (CAN):

- 2.3.1. It is obvious that the three original laboratories are not pulling the same channel for this parameter.
- 2.3.2. Exxon will connect the OBD-II parameters to their data acquisition system before the Precision Matrix.

2.4. AFR:

- 2.4.1. There are clear differences between the labs.
- 2.4.2. Exxon is the only lab that is not experiencing "saturated" AFR measurements.
 - 2.4.2.1. *Could this be because their AFR sensors are new?*
- 2.4.3. Intertek has not recently replaced the AFR sensors on their test stands.
 - 2.4.3.1. They believe that the age of the sensors can impact the AFR measurements.

2.5. Bank 1, Sensor 1 (CAN):

- 2.5.1. Lubrizol and Intertek exhibit very similar data trends.

2.6. STFT:

- 2.6.1. It is obvious that the three original laboratories are not pulling the same channel for this parameter.
- 2.6.2. The labs will need to compare their CAN-Bus parameters and data filters.

2.7. Blowby Coolant Temperature at Heat Exchanger Outlet:

- 2.7.1. The scale of the graph is skewed by an open thermocouple in one of the Southwest tests.

2.7.2. Afton's Comments:

- 2.7.2.1. Some of these coolant temperatures are below the dew point of the blowby gas.
- 2.7.2.2. This can result in condensation on the walls inside of the blowby heat exchanger.
- 2.7.2.3. *Could this condensation correlate to test severity?*
- 2.7.2.4. Intertek suggested checking the Karl Fisher water content data to try and answer Afton's question.

2.8. Blowby Flow Rate:

2.8.1. Exxon's Comments:

- 2.8.1.1. They are having problems with this parameter.
 - 2.8.1.2. Their flow meter is registering a negative flow rate.
 - 2.8.1.3. They replaced the flow meter and one-way check valve with no improvement.
- 2.8.2. The other three labs have not experienced negative blowby flow rates on their test stands.

2.8.3. Cleaning the Blowby Flow Meter:

- 2.8.3.1. Intertek and Lubrizol are both seeing oil mist collect inside of their blowby flow meters.
 - 2.8.3.2. Afton suggested placing an absorbent pad inside of the surge tank to collect the water, fuel and oil moisture.
 - 2.8.3.3. Intertek is using a MAF cleaner to clean their blowby flow meters after every two tests.
 - 2.8.3.3.1. They will draft a cleaning procedure that can be shared with the Industry.
 - 2.8.3.4. Southwest cleans their blowby flow meter with solvent after every 4-5 tests.
 - 2.8.3.5. The Sequence IVB may be the only GF test to take continual blowby flow rate measurements.
- 2.8.4. Lubrizol, Intertek and Southwest use a Sierra meter "standard" to calibrate the blowby flow meters on their Golden Stands.
- 2.8.4.1. Any flow meters found to be out-of-calibration are replaced.

2.9. Blowby Gas Temperature Inside of Oil Separator:

- 2.9.1. The Southwest data for this parameter was taken at the tee underneath the separator and not inside of the separator itself.
- 2.9.2. The Intertek data was taken inside of the separator.
- 2.9.3. Southwest will investigate the anomalous data from test 19-0-66.

2.10. Coolant Temperature Differential:

- 2.10.1. The coolant temperature differentials are very similar across all the labs.

2.11. Coolant Pressure:

- 2.11.1. Coolant pressure is currently a manually controlled parameter.
- 2.11.2. Golden Stands could be updated to automatically control this parameter in the future.

2.12. Crankcase Pressure:

- 2.12.1. Intertek test 102-0-62 experienced a malfunctioning crankcase pressure transducer during this time.
- 2.12.2. Exxon saw a shift in crankcase pressure between their 1st and 2nd tests.
 - 2.12.2.1. Their crankcase pressure curves are also much flatter than those at the other labs.
 - 2.12.2.2. The quick disconnect at the engine may be becoming fouled (cleaning did seem to improve the measurement).
 - 2.12.2.3. They plan to remove the quick disconnect at the engine.

2.13. Main Engine Coolant Flow:

- 2.13.1. Exxon continues to have difficulty controlling this parameter.
 - 2.13.1.1. Lubrizol recommended that they confirm that their stand is not being "starved" for instrument air pressure.

2.14. Oil Gallery Temperature:

- 2.14.1. The average oil gallery temperature for Lubrizol's 2nd prove-out test shifted downward by approximately 1°C with the new control strategy.
- 2.14.2. The oil gallery temperature for IAR-165 is different than the other test stands during Stage 1 and the Stage 1→2 transition.

2.15. Engine Speed:

- 2.15.1. Lubrizol has a small "bump" in its speed ramp that occurs about 3-seconds into the Stage 1→2 transition that is not present at the other labs.

2.16. Engine Torque:

- 2.16.1. All labs experience a small "bump" in engine torque around 9-seconds.

2.17. Exhaust Temperature:

- 2.17.1. Lubrizol ran an exhaust thermocouple experiment during its recent prove-out test.
 - 2.17.1.1. The existing thermocouple (which had over 1000-hours of operating time) was replaced at 150HRS.
 - 2.17.1.2. There was no significant change in the exhaust temperature measurement.
 - 2.17.1.3. Lubrizol still believes that the stand-to-stand differences in exhaust temperature are significant.
- 2.17.2. Lubrizol and Exxon exhibit very similar exhaust temperature curves.

2.18. Exhaust Backpressure:

- 2.18.1. The backpressure data between Intertek and Southwest is very similar.
- 2.18.2. Lubrizol still is still struggling to improve the control of this parameter.

2.19. Fuel Pressure:

- 2.19.1. This parameter is still controlled by manual adjustments.

2.20. Ignition Timing Advance:

- 2.20.1. The timing advance on the Southwest stands never drops below zero.
- 2.20.2. However, the timing advance at Intertek and Lubrizol can routinely drop to around -10°.

2.21. Intake Manifold Pressure:

- 2.21.1. There are still significant lab-to-lab differences with this parameter.
- 2.21.2. Intertek and Lubrizol display similar intake manifold pressure curves.
- 2.21.3. Exxon and Southwest display similar intake manifold pressure curves.

2.22. Throttle Position (CAN):

- 2.22.1. There is an inexplicable change in throttle position between the two Lubrizol tests.
 - 2.22.1.1. Both tests were run on the same engine.
 - 2.22.1.2. Toyota cannot explain this difference either.

Action Items	Person responsible	Completion Date

Follow-up Notes/Updates	Initials	Date Added

Attendees	Organization	Contact Information
See attachment.		

Sequence IV Surveillance Panel

Conference Call

November 7, 2017

8:30 a.m. - 10:30 a.m.

A G E N D A

1. Prove-out and precision matrix testing update
2. Prove-out and precision matrix testing operational data analysis review
3. Sequence IVB timeline review
4. Motion and action item review
5. Next meeting
6. Adjourn

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November 7, 2017

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Sequence IV Surveillance Panel

November 7, 2017

8:30AM – 10:30AM

Conference Call

Motions and Action Items

As Recorded at the Meeting by Bill Buscher

1. Action Item – Utilize the final prove-out and precision matrix tests to identify which controlled parameters have a significant influence test severity and re-evaluate the Qi targets and windows for those parameters at the conclusion of the precision matrix.
2. Action Item – Create a database of the temperature parameters that have a significant influence test severity, including the different temperatures and their corresponding test results, and have the industry statisticians group to perform a statistical analysis to identify correlations.
3. Action Item – Histogram
4. Action Item – Labs to work together to investigate, understand and possibly correct difference in CAN data.
5. Action Item – Analyze blowby coolant out temperature to water content and test results to see if there is any correlation.
6. Action item – Intertek to draft a blowby flow meter cleaning procedure to add to the Sequence IVB test procedure.
7. Action Item – Surveillance panel chair to update the Sequence IVB timeline based on the current status of the precision matrix labs
8. Action Item – Intertek and SwRI to provide 1 hour, test hour 101 to 102 (NOTE: if an unscheduled shutdown occurred between test hour 101 and 102, then obtain data from the next full hour of test time without any scheduled or unscheduled shutdowns), of operational data, using the updated operational data review Excel template, from the Row 2 precision matrix tests, with the exception of SwRI Stand 1, to the TMC

for posting, so that an additional operational data analysis can be performed by Rich Grundza and Kevin OMalley. A total of 4 precision matrix tests to be included. Labs to have data uploaded by end of business on 11/9/17.

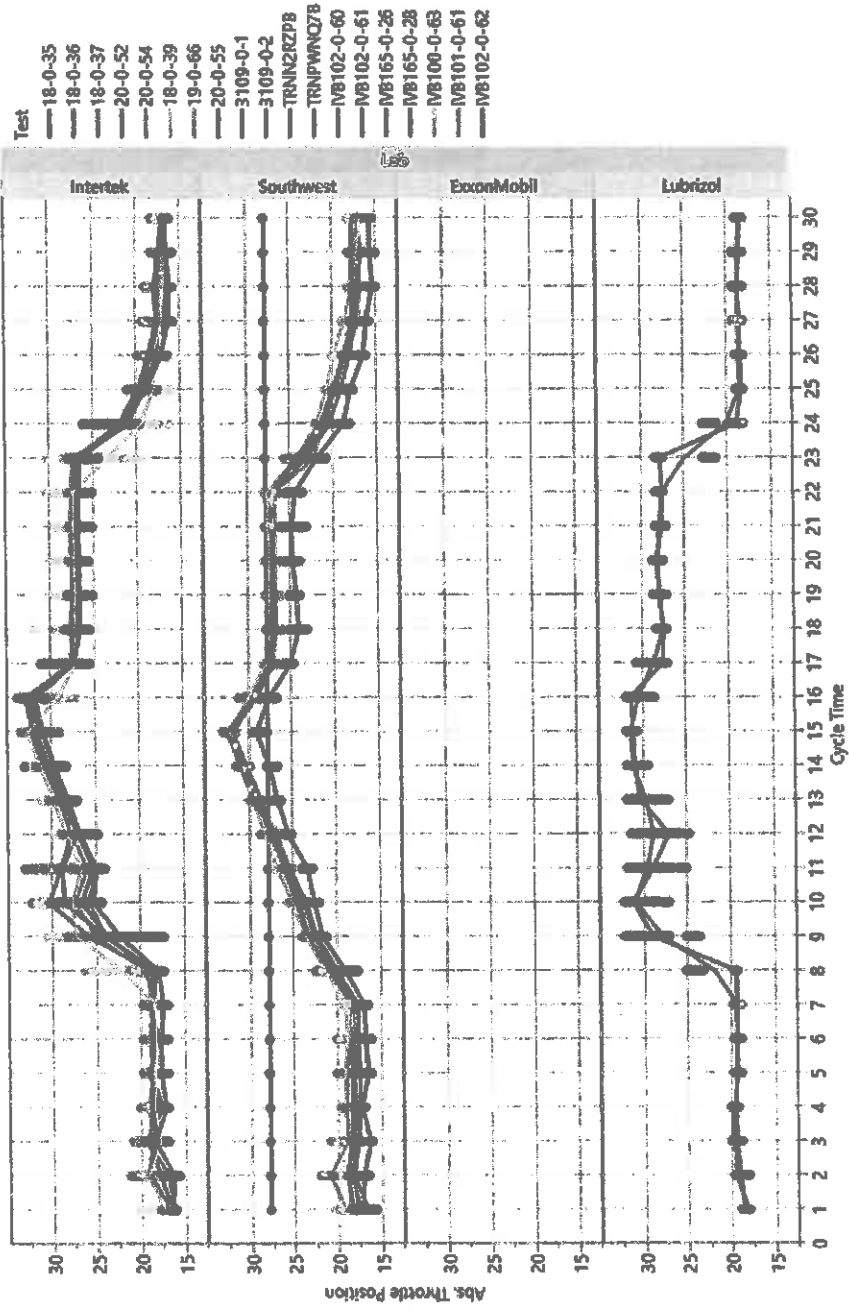
9. Action item – For review at the 11/15/17 face-to-face Sequence IV surveillance panel meeting, Rich Grundza and Kevin OMalley to perform an operational data analysis on the 9 available precision matrix tests only. Do not include any prove-out tests in this analysis.

IVB Operational Data Review 19 Prove Out and Matrix Tests

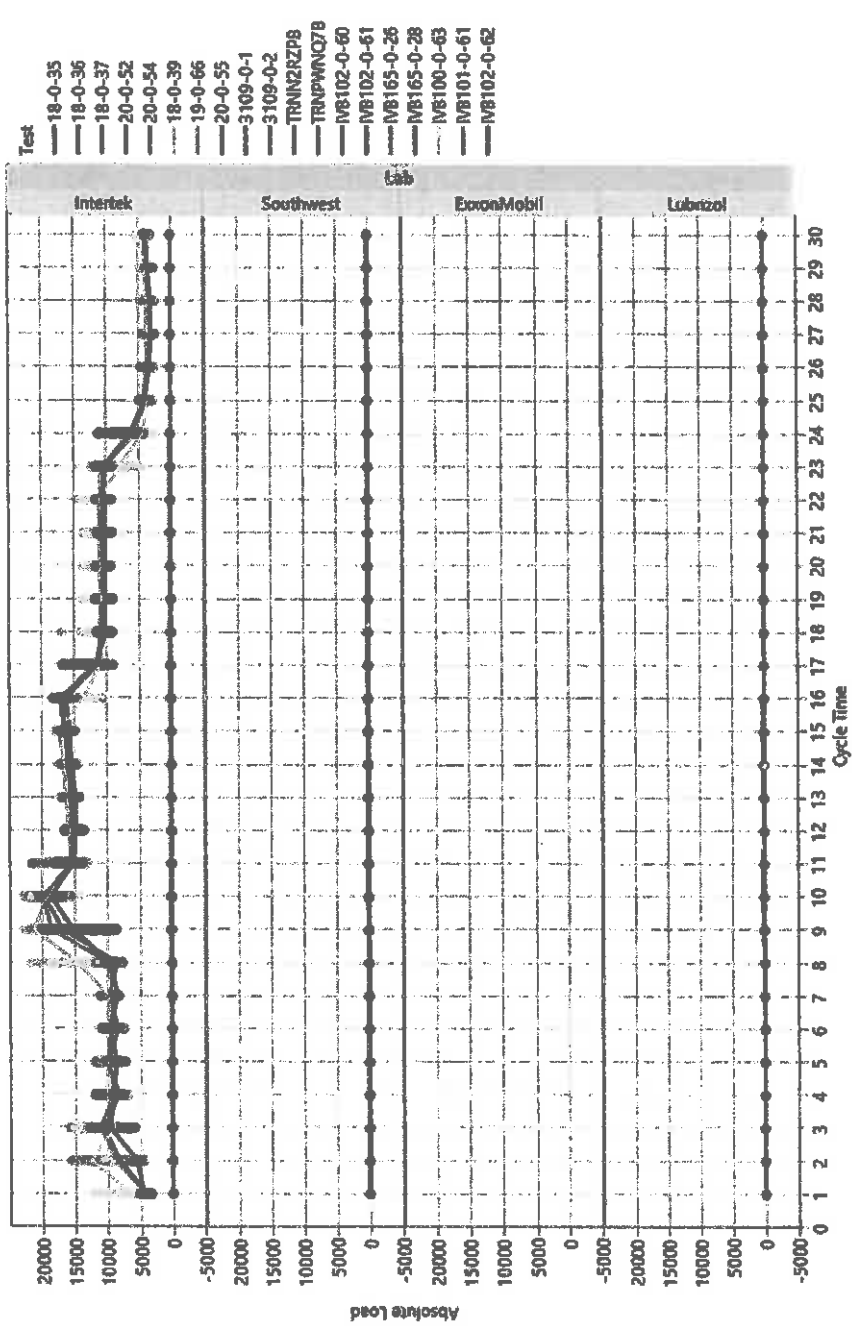
Prepared by: Kevin O'Malley

11-7-17

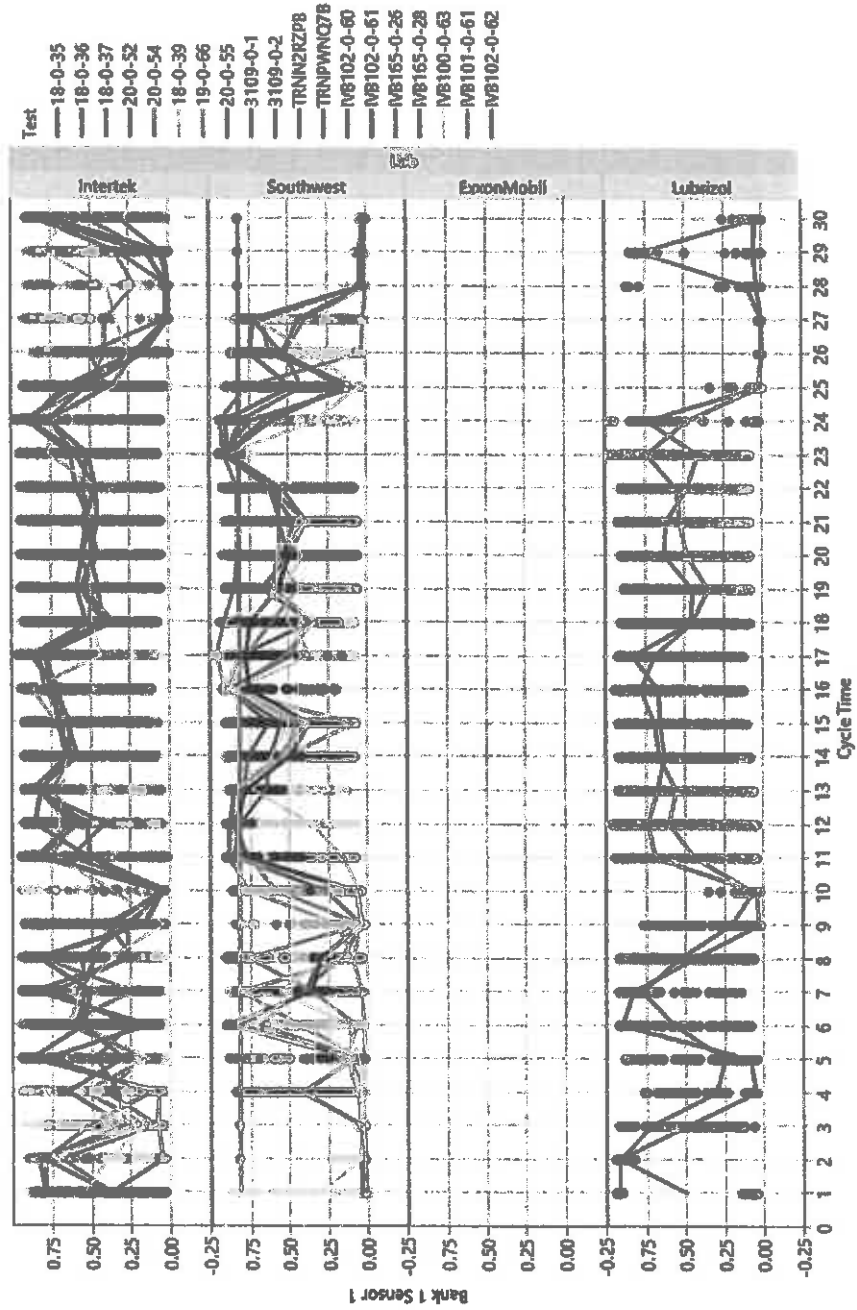
Graph Builder



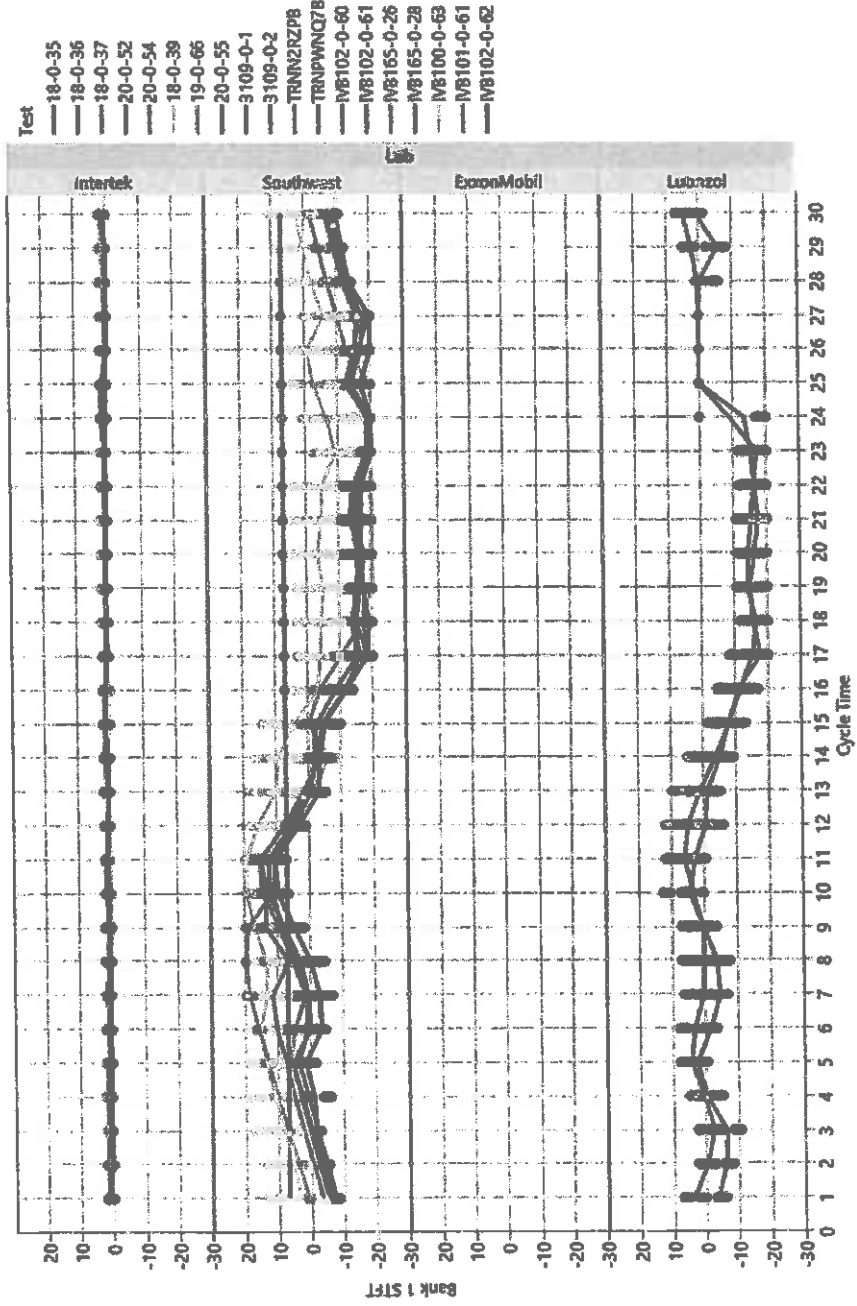
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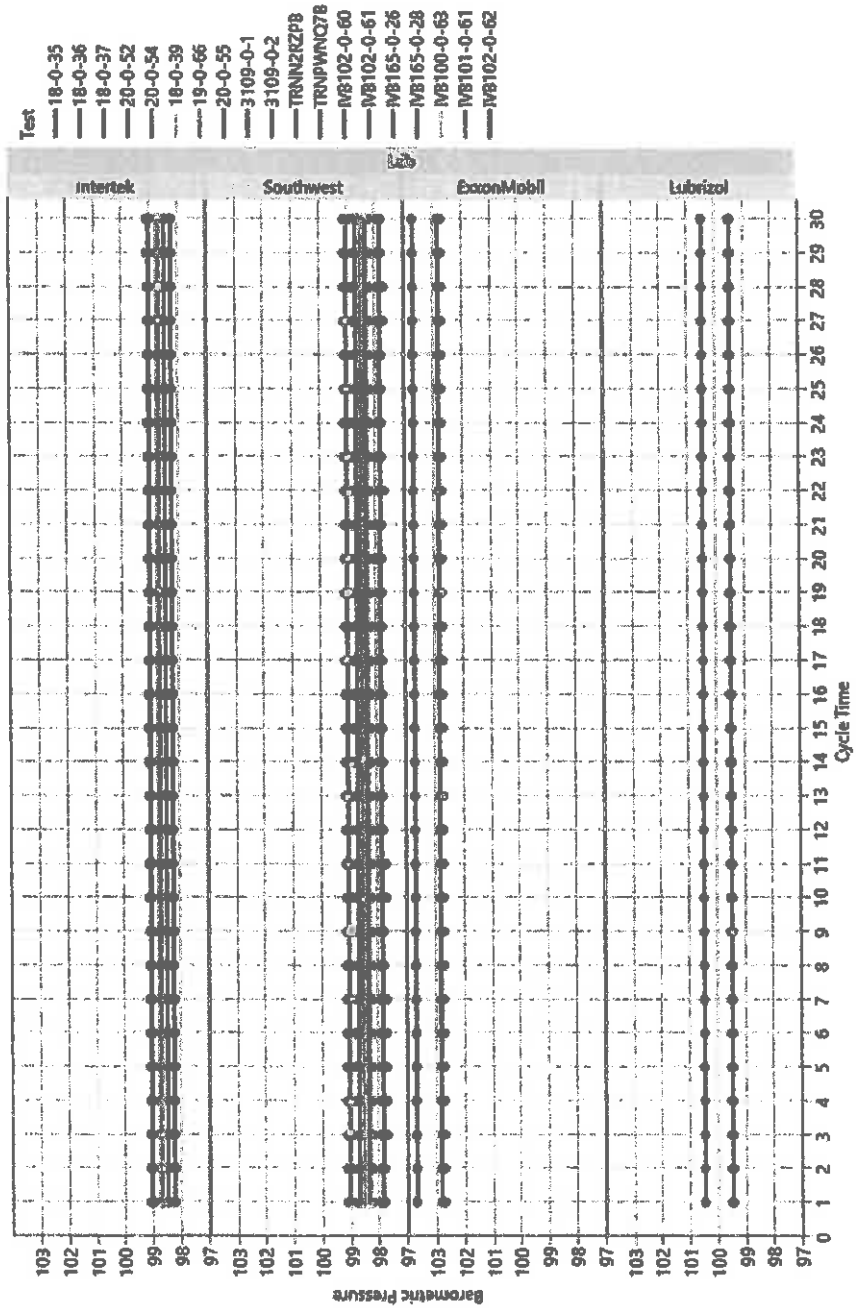
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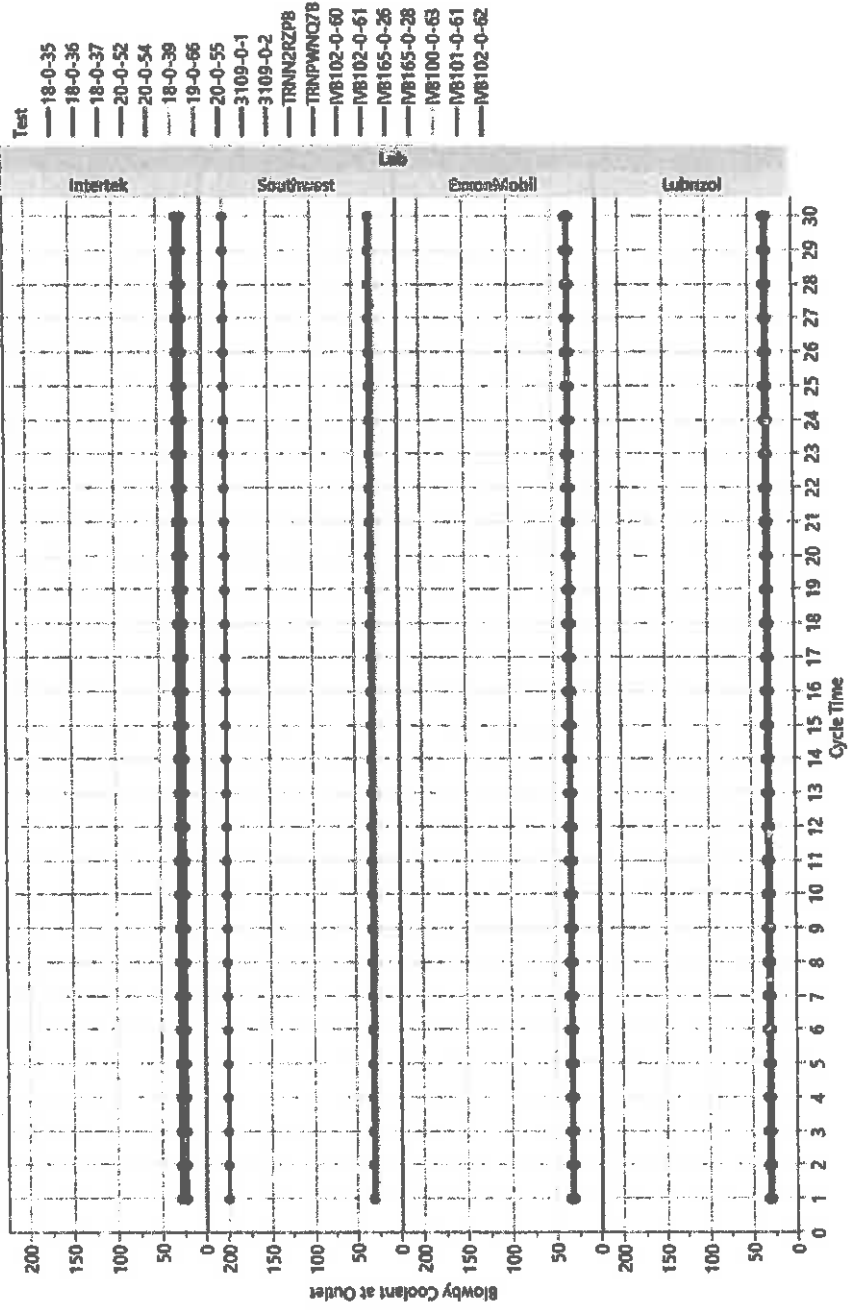
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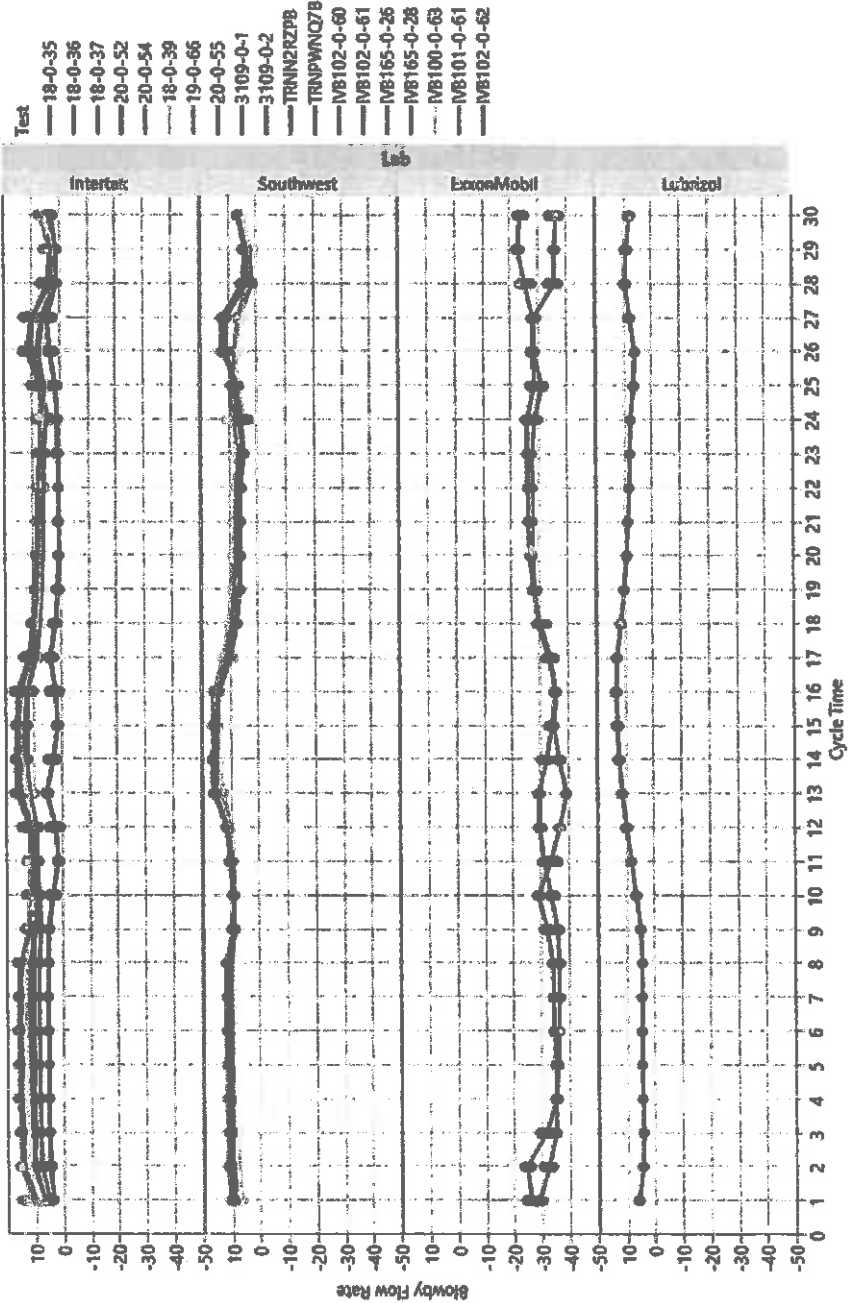
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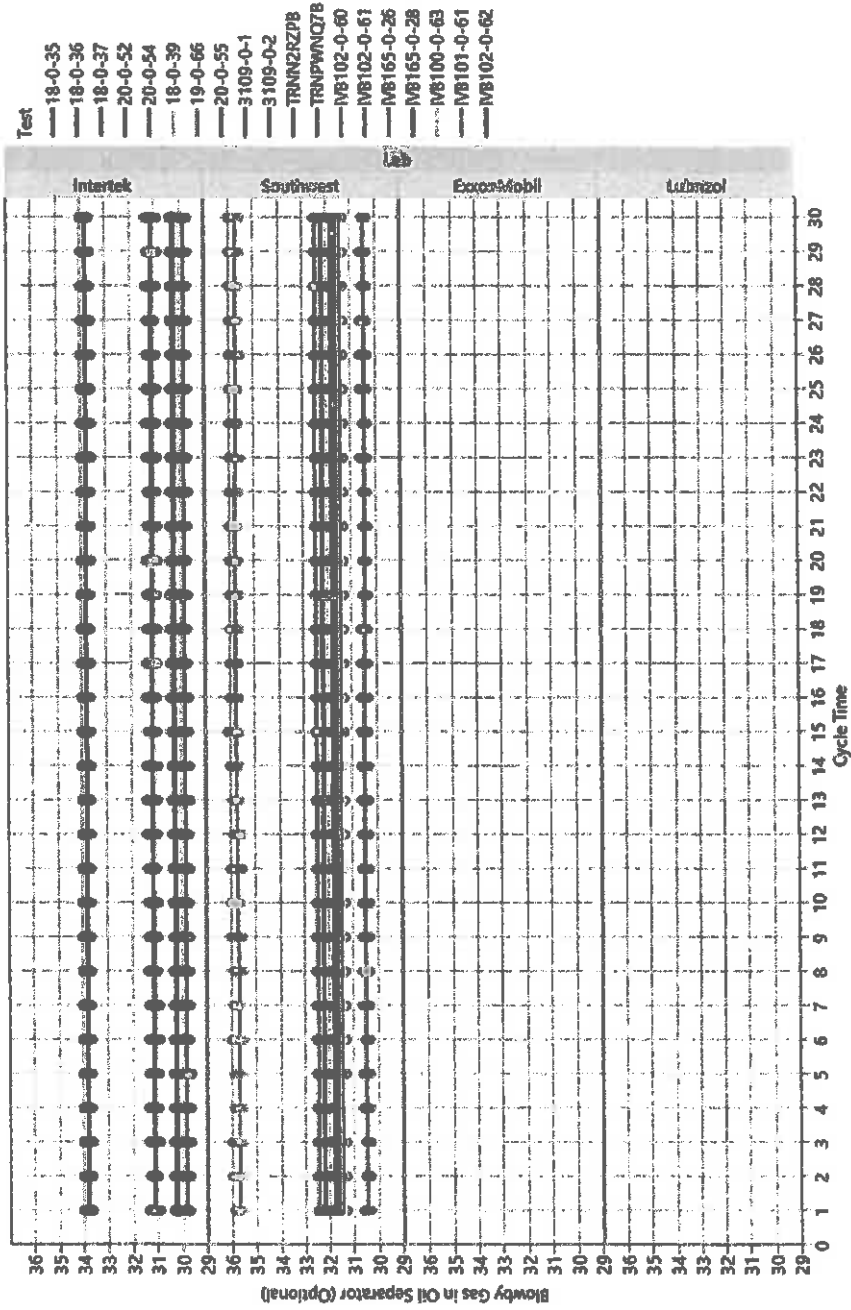
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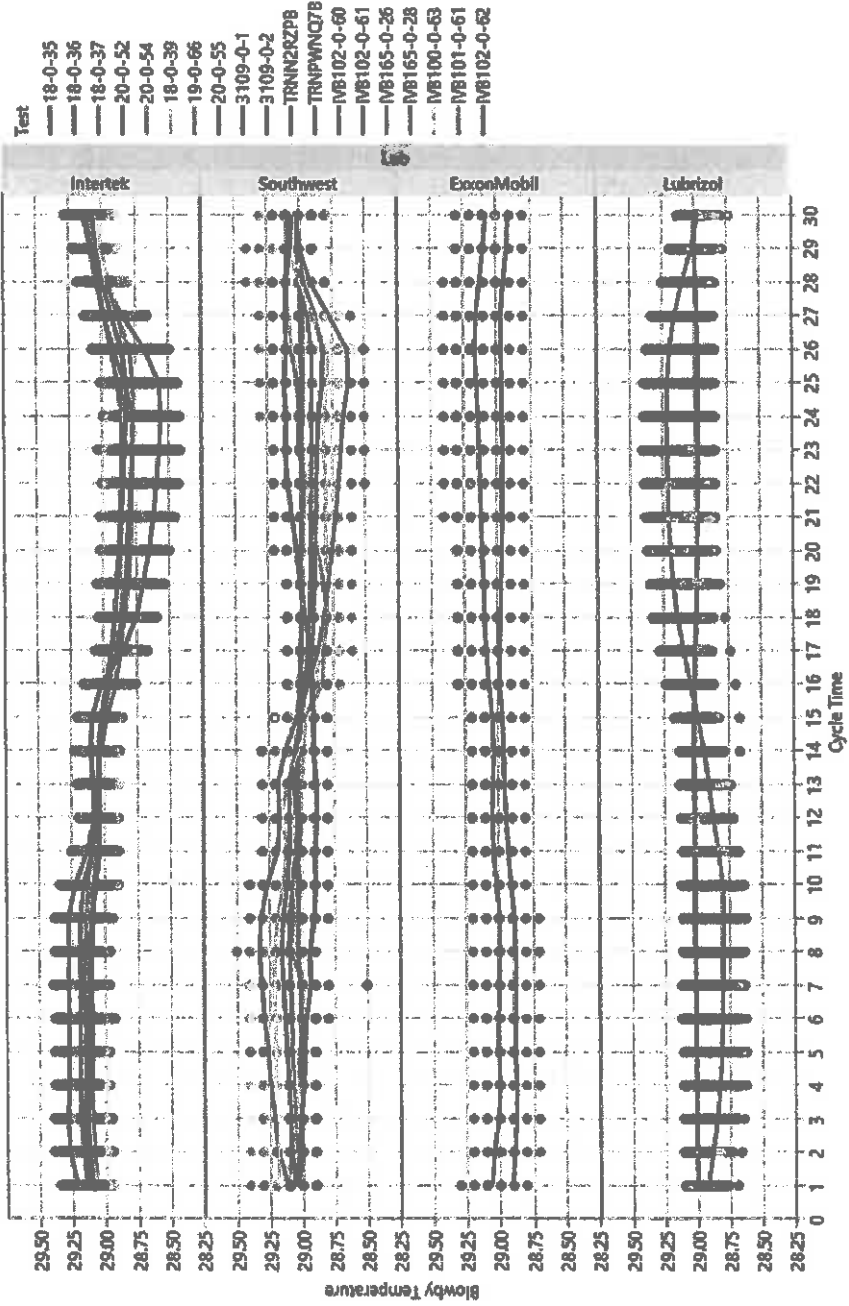
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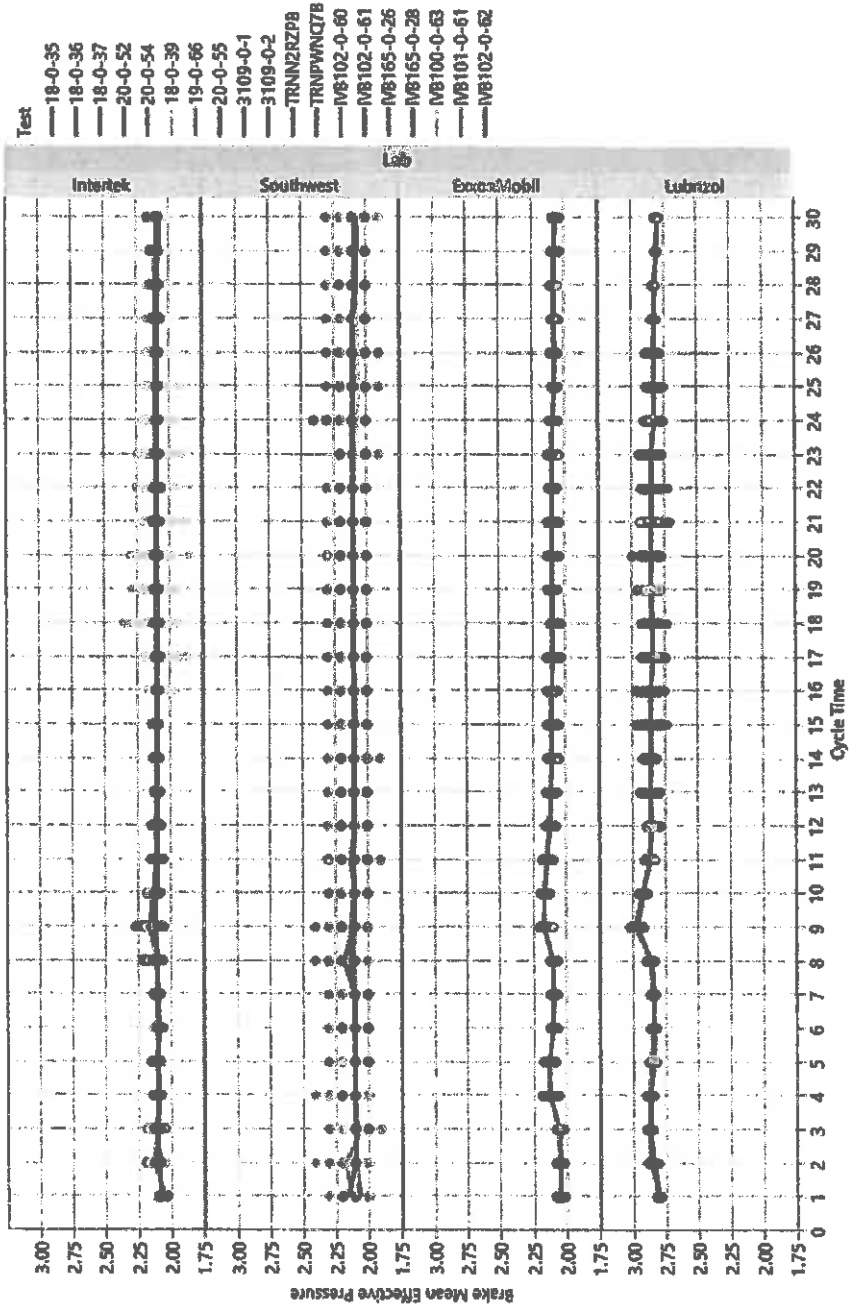
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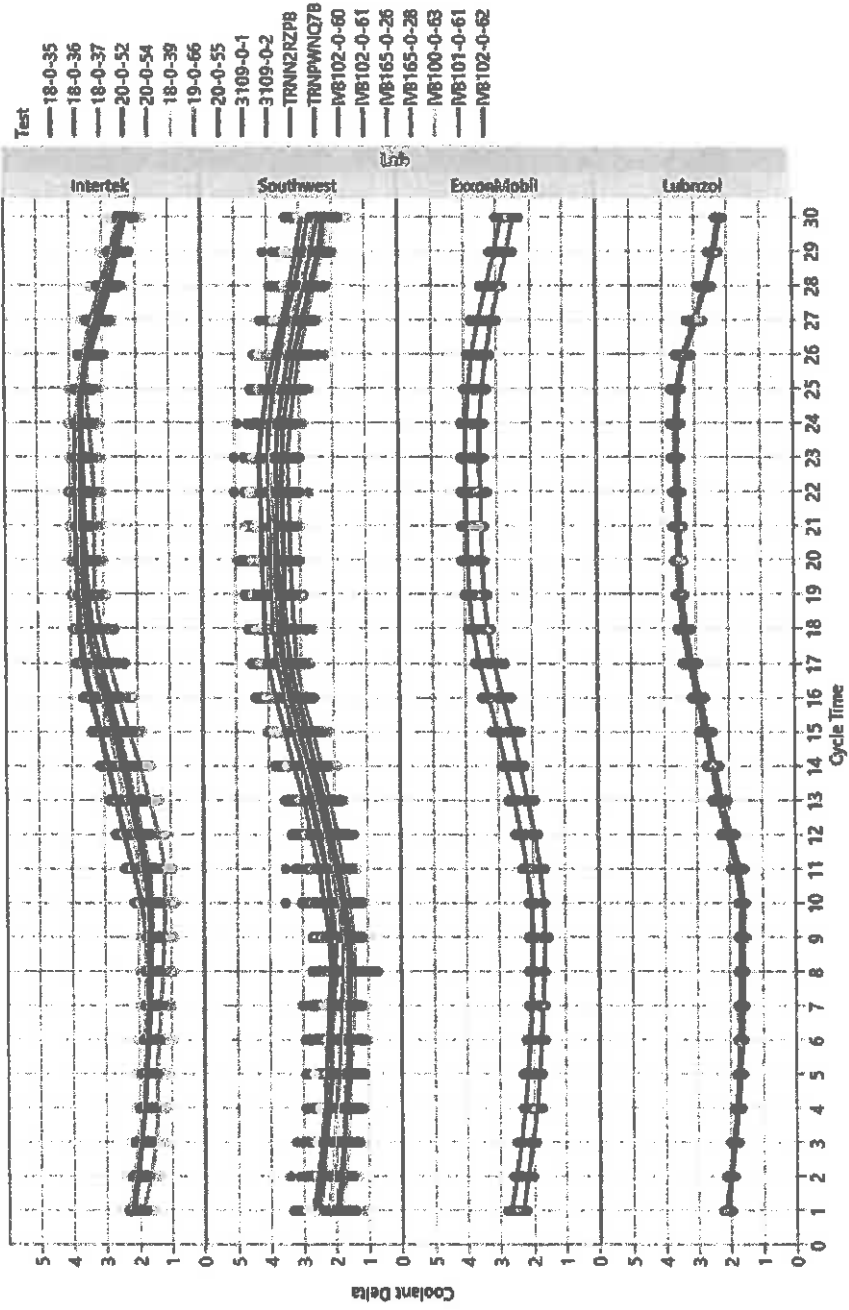
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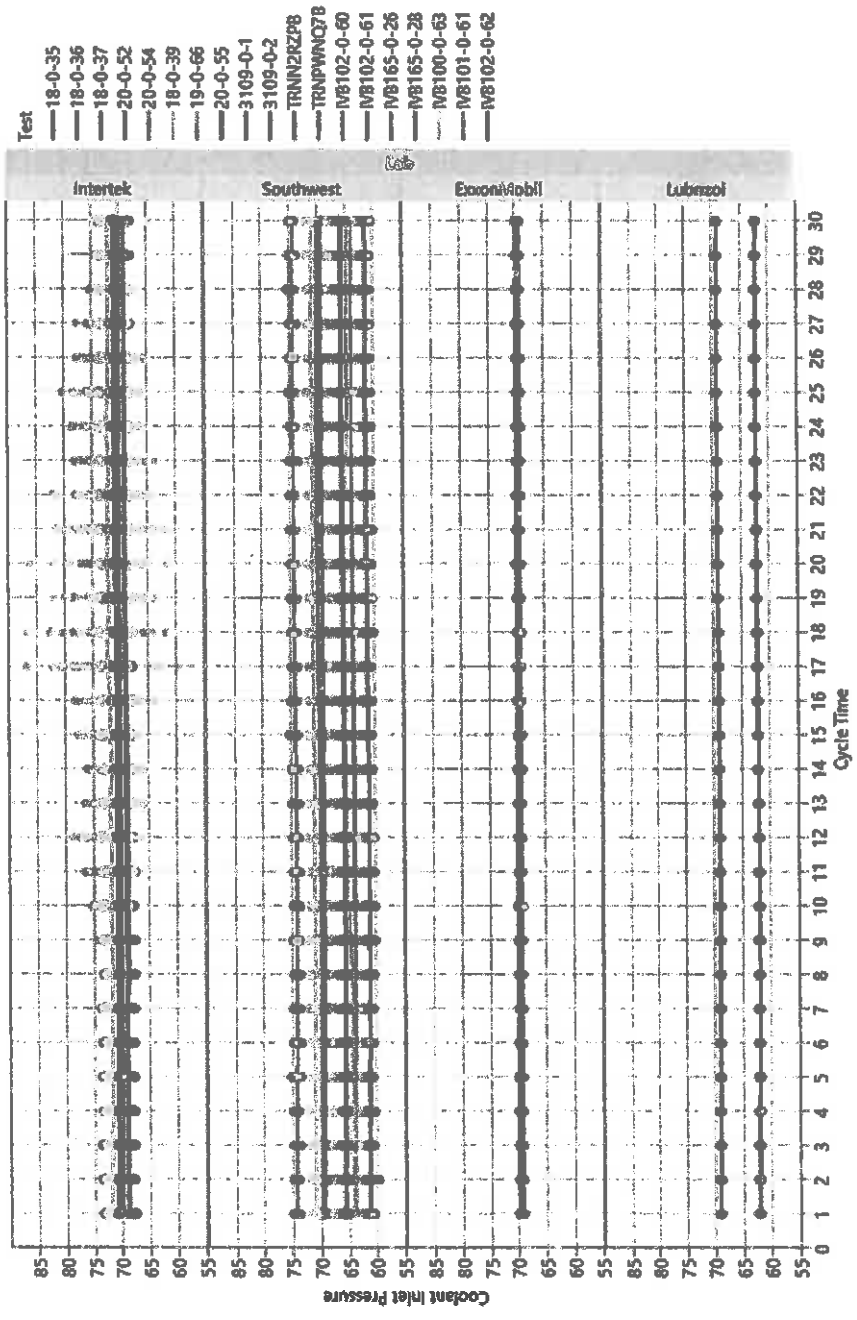
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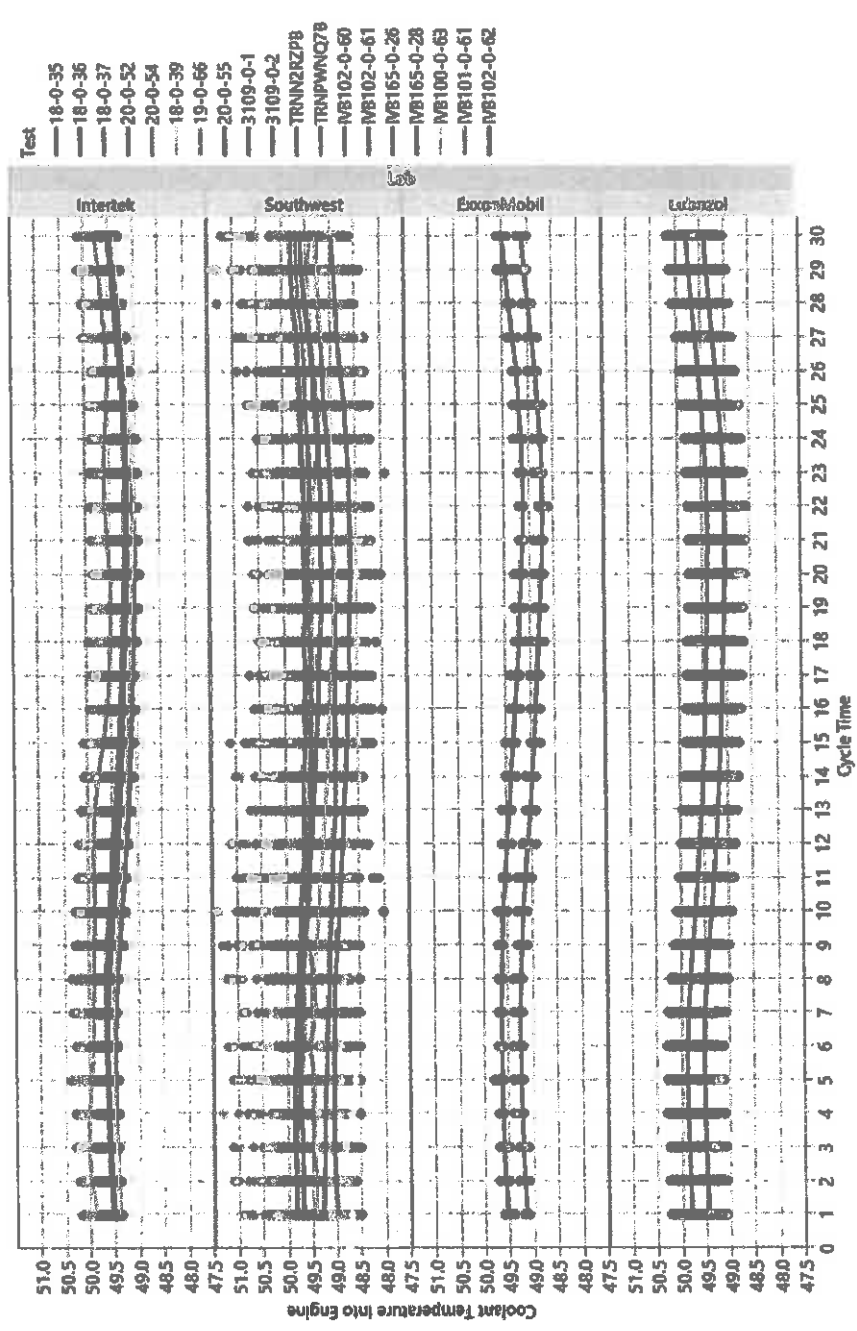
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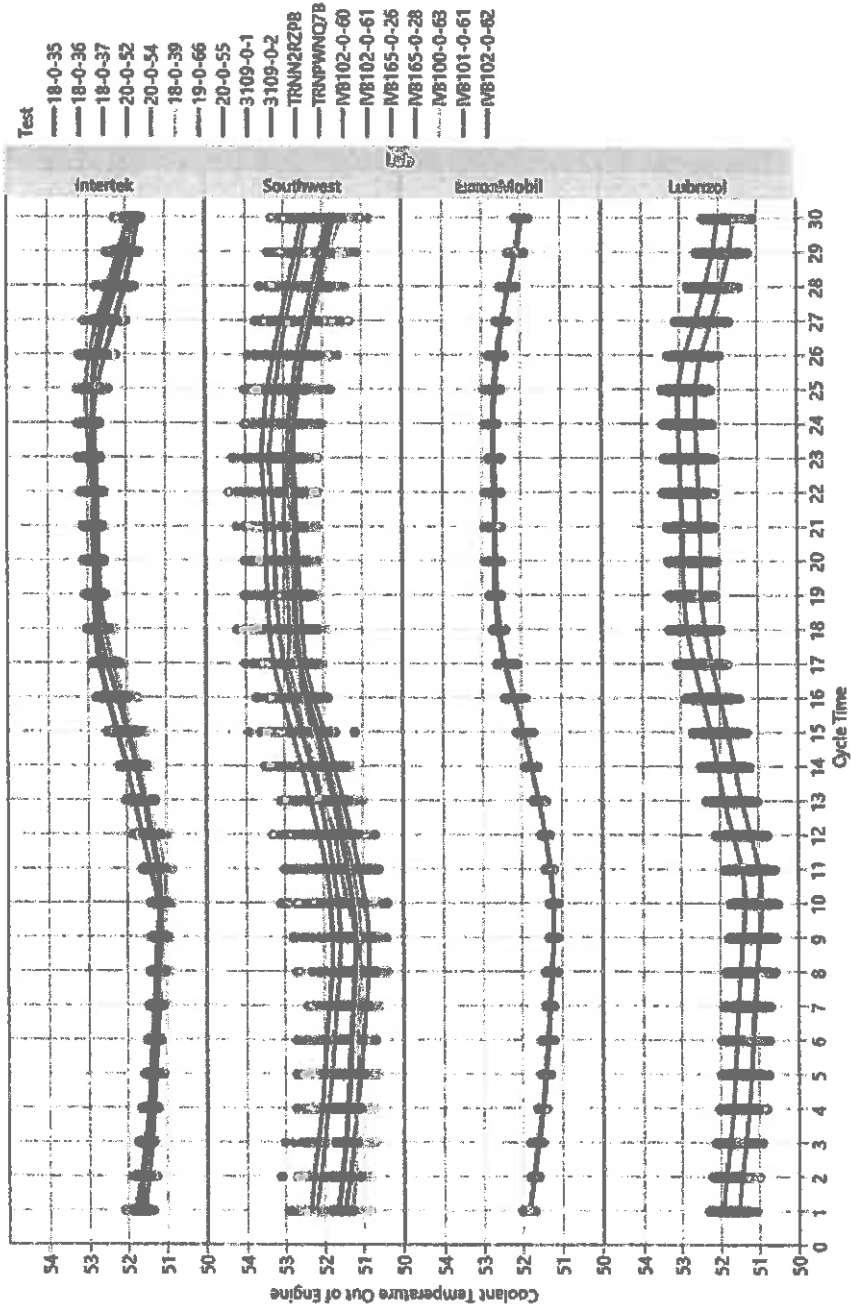
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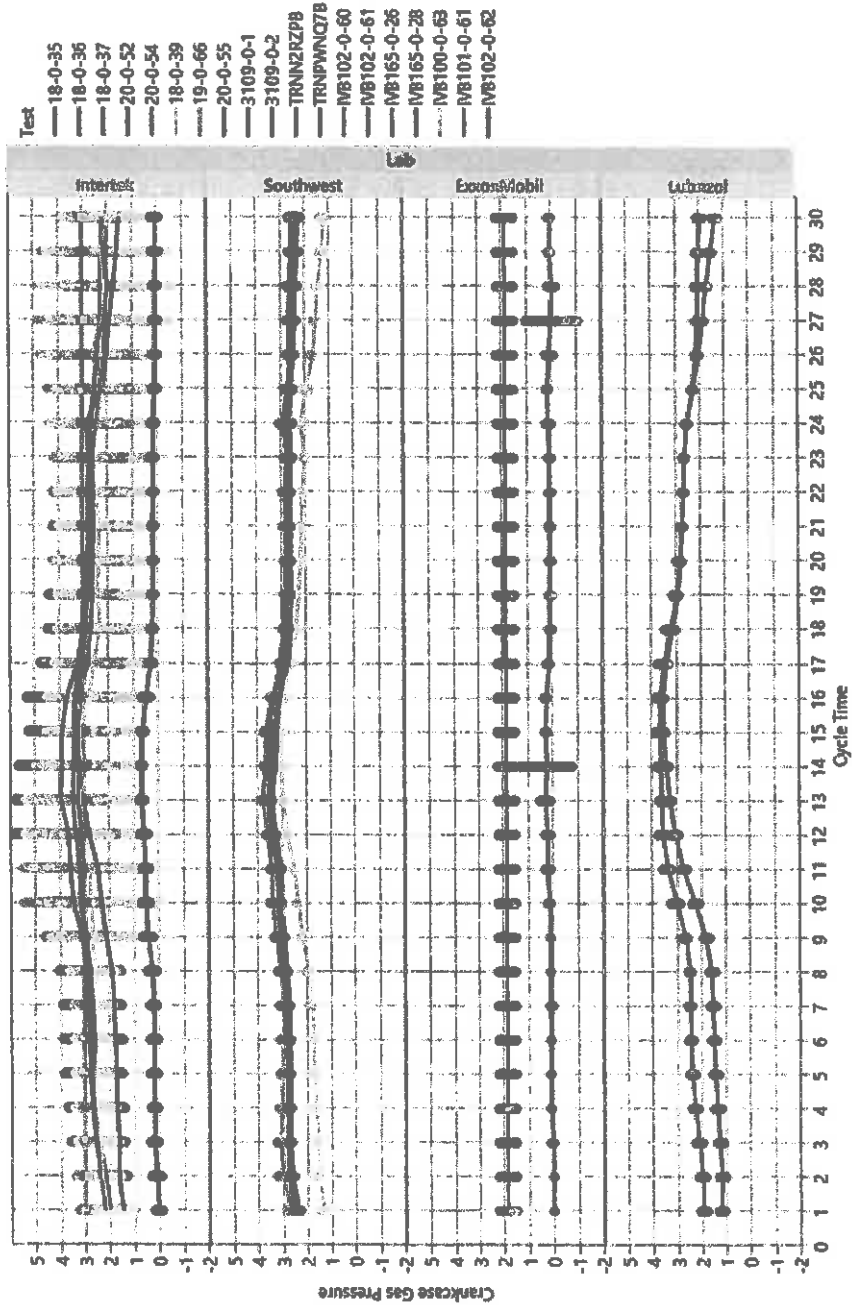
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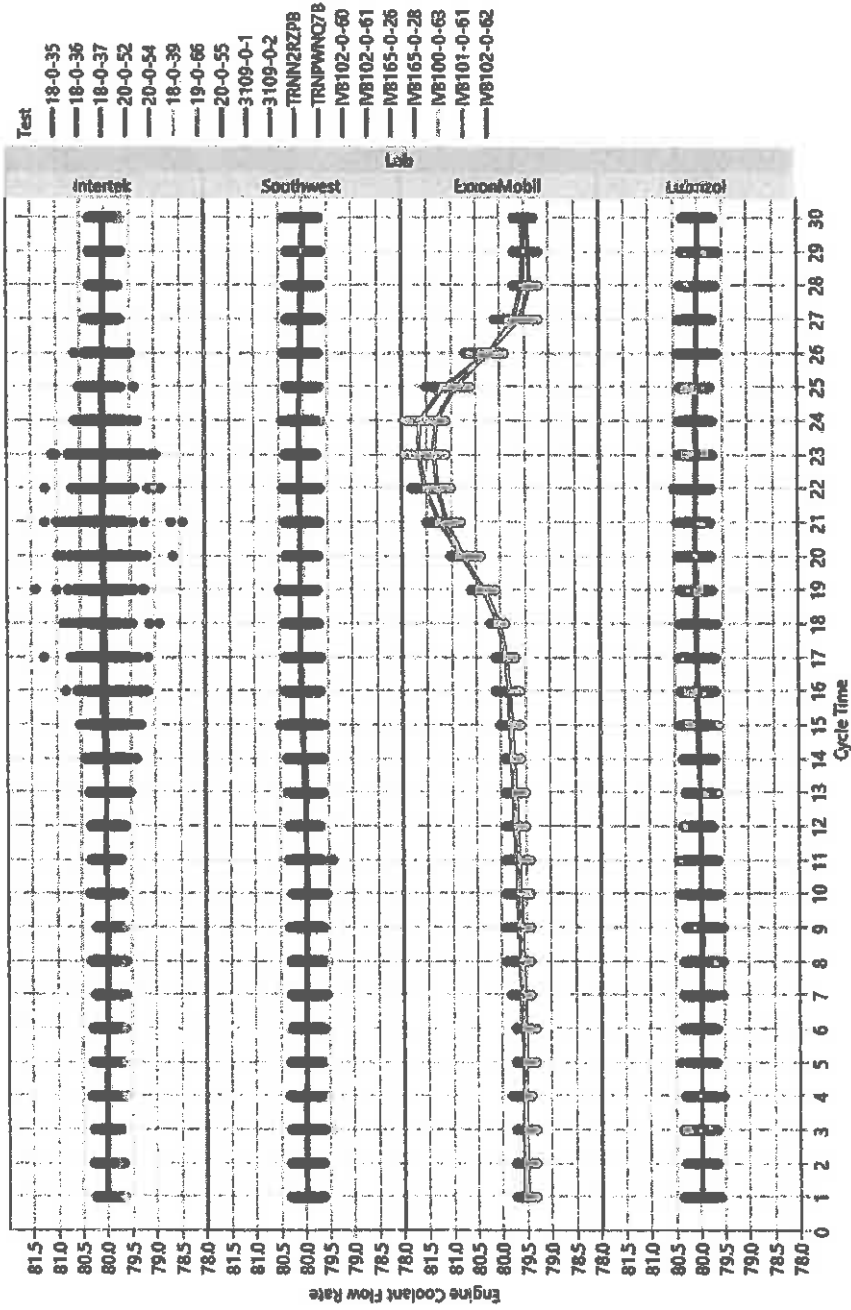
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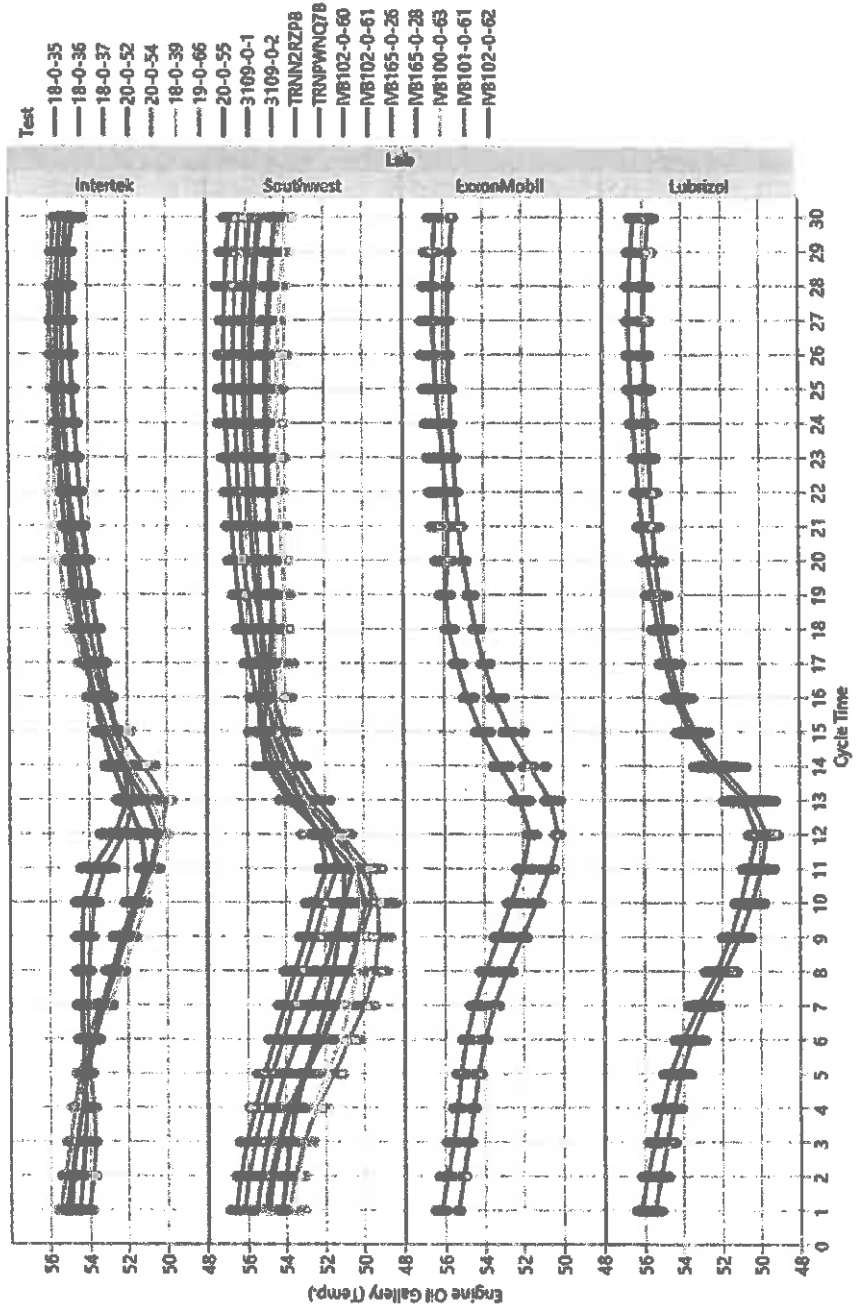
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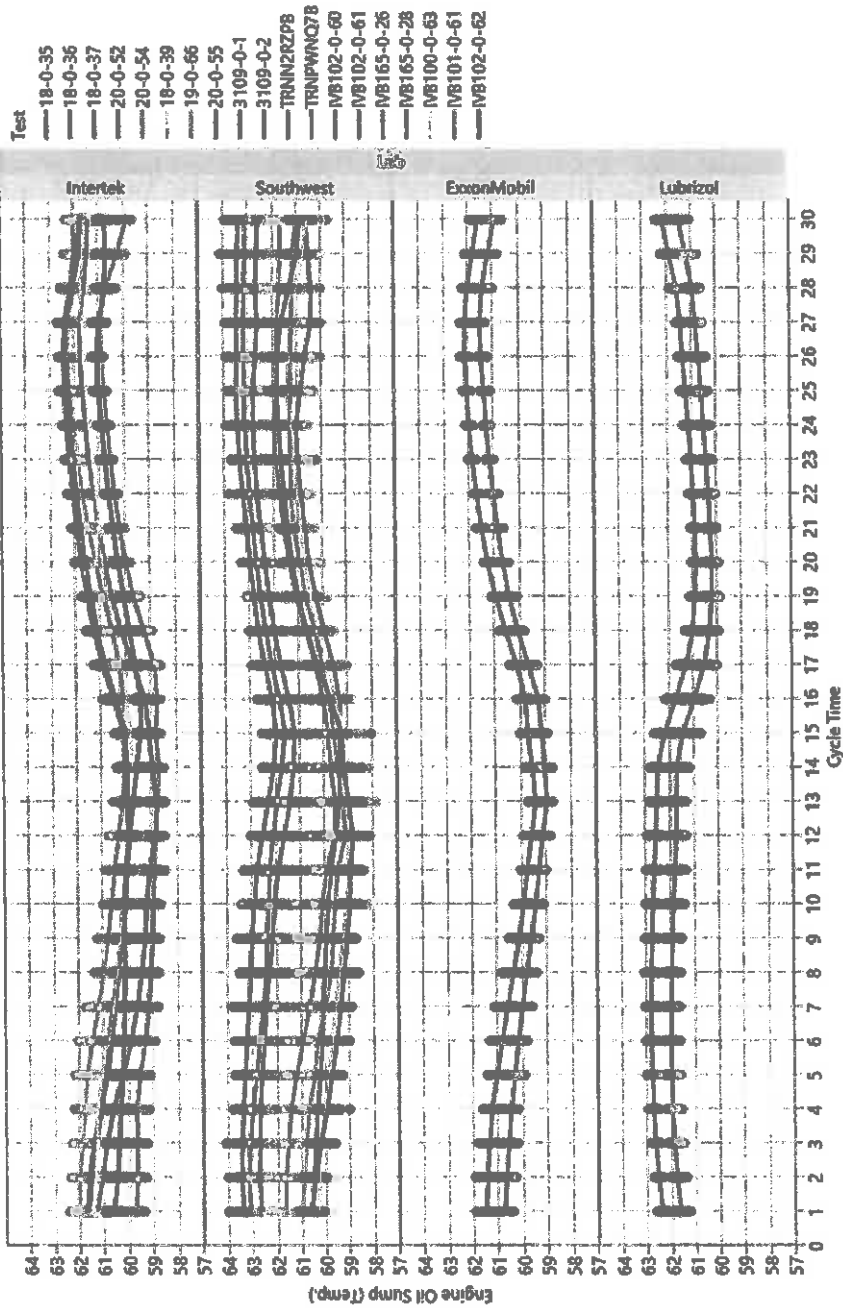
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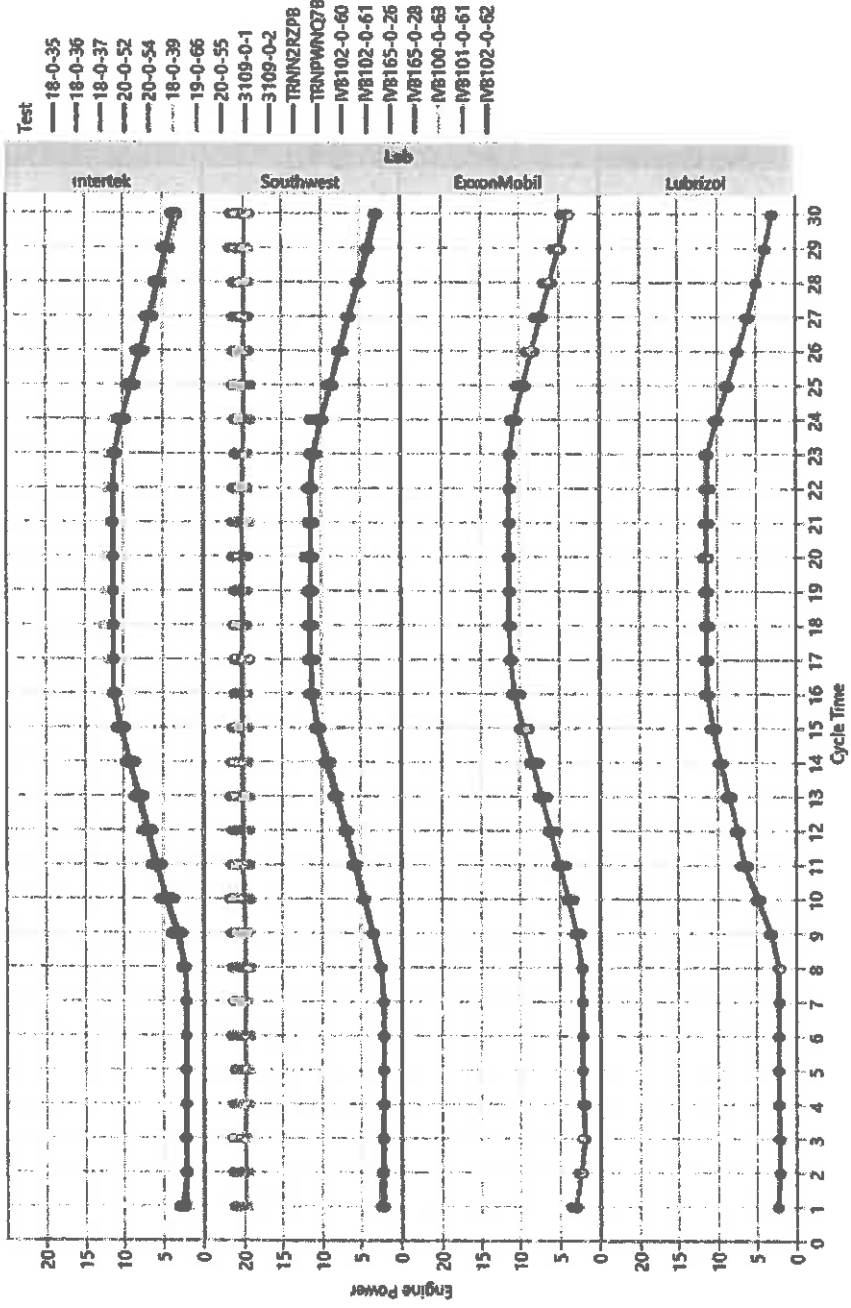
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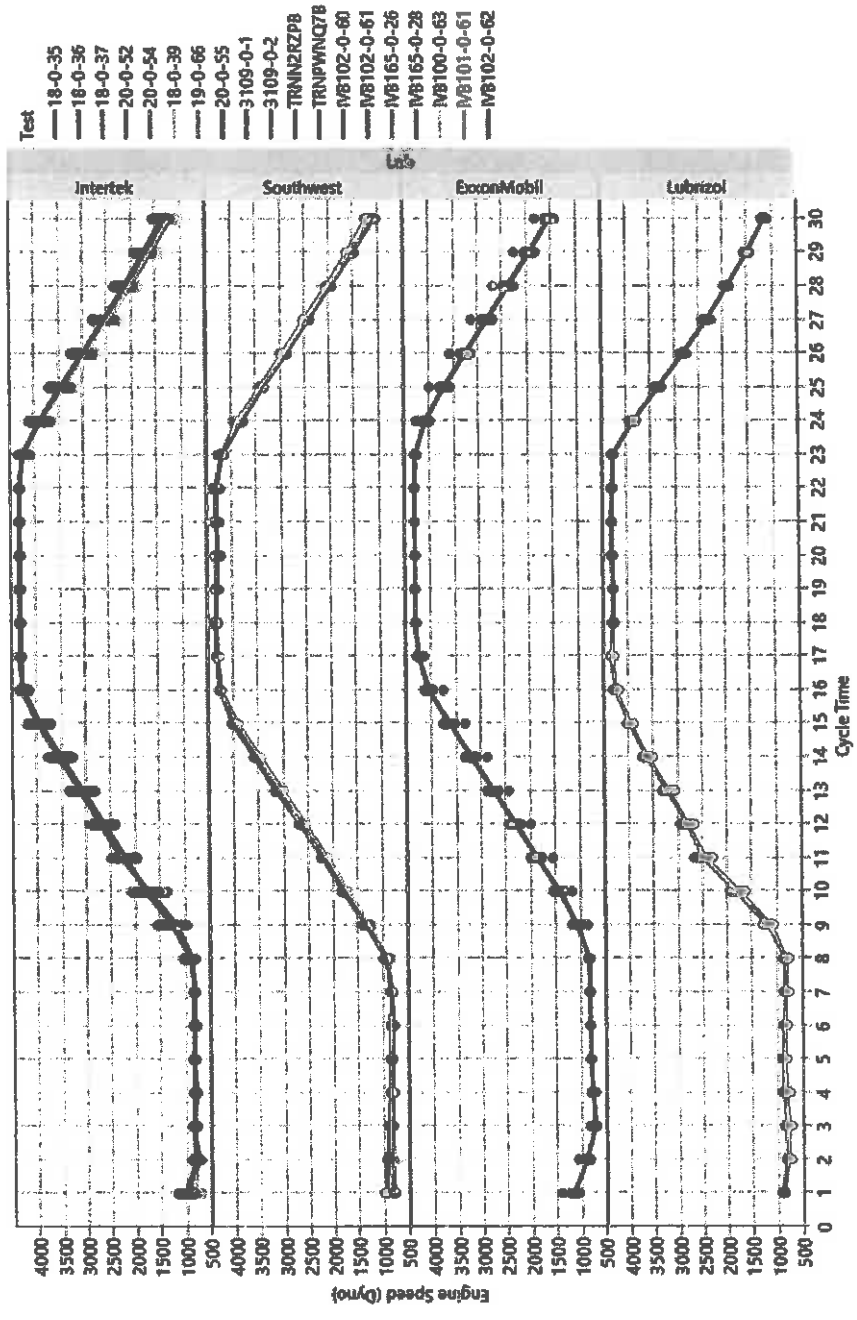
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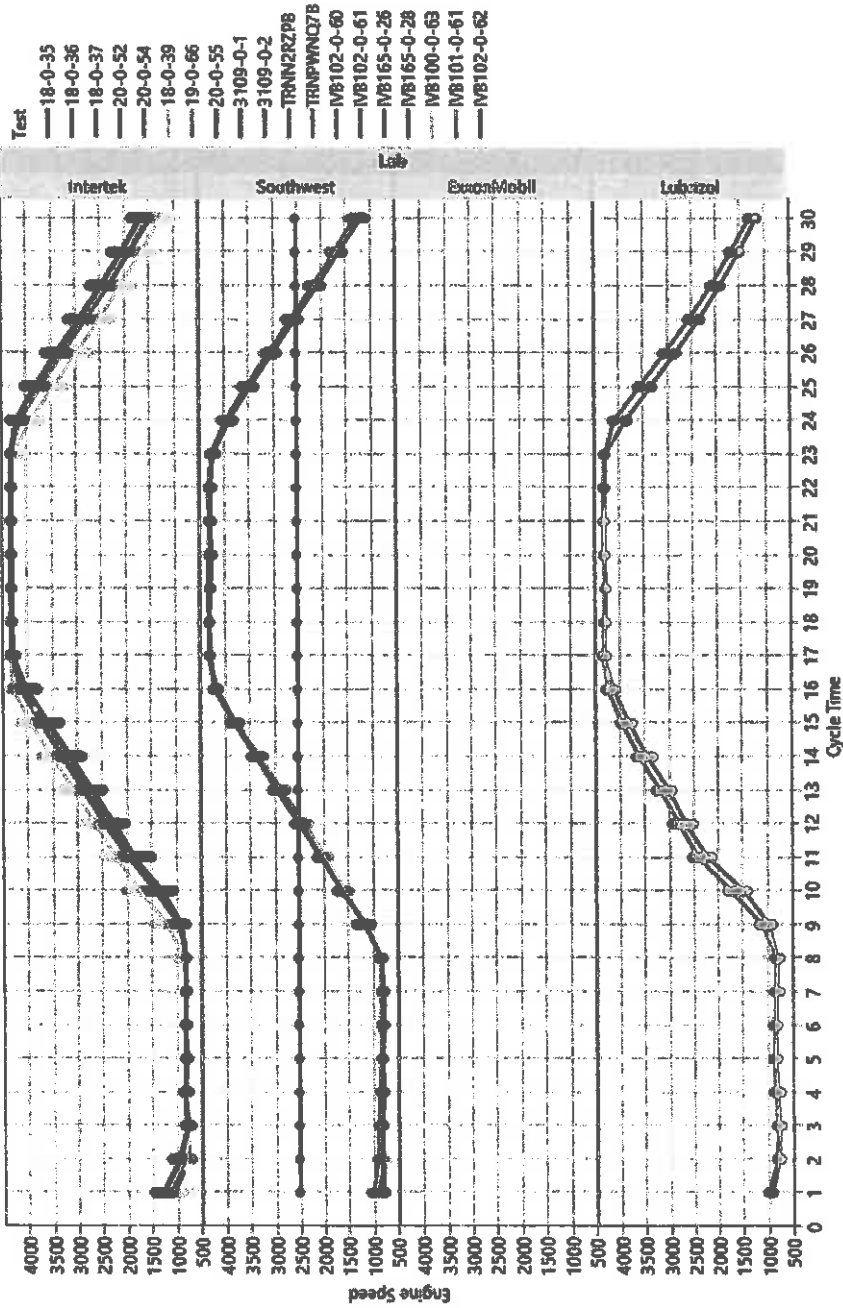
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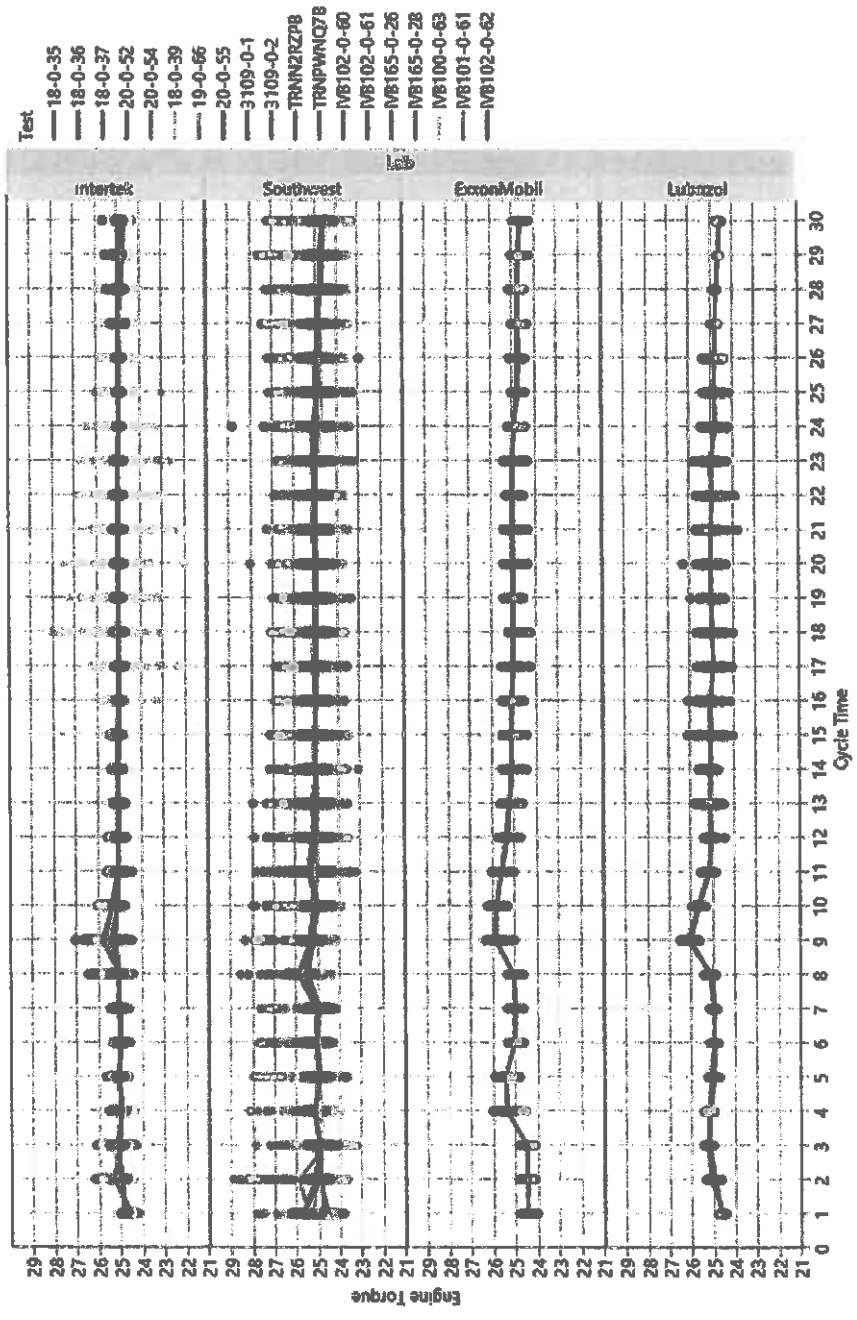
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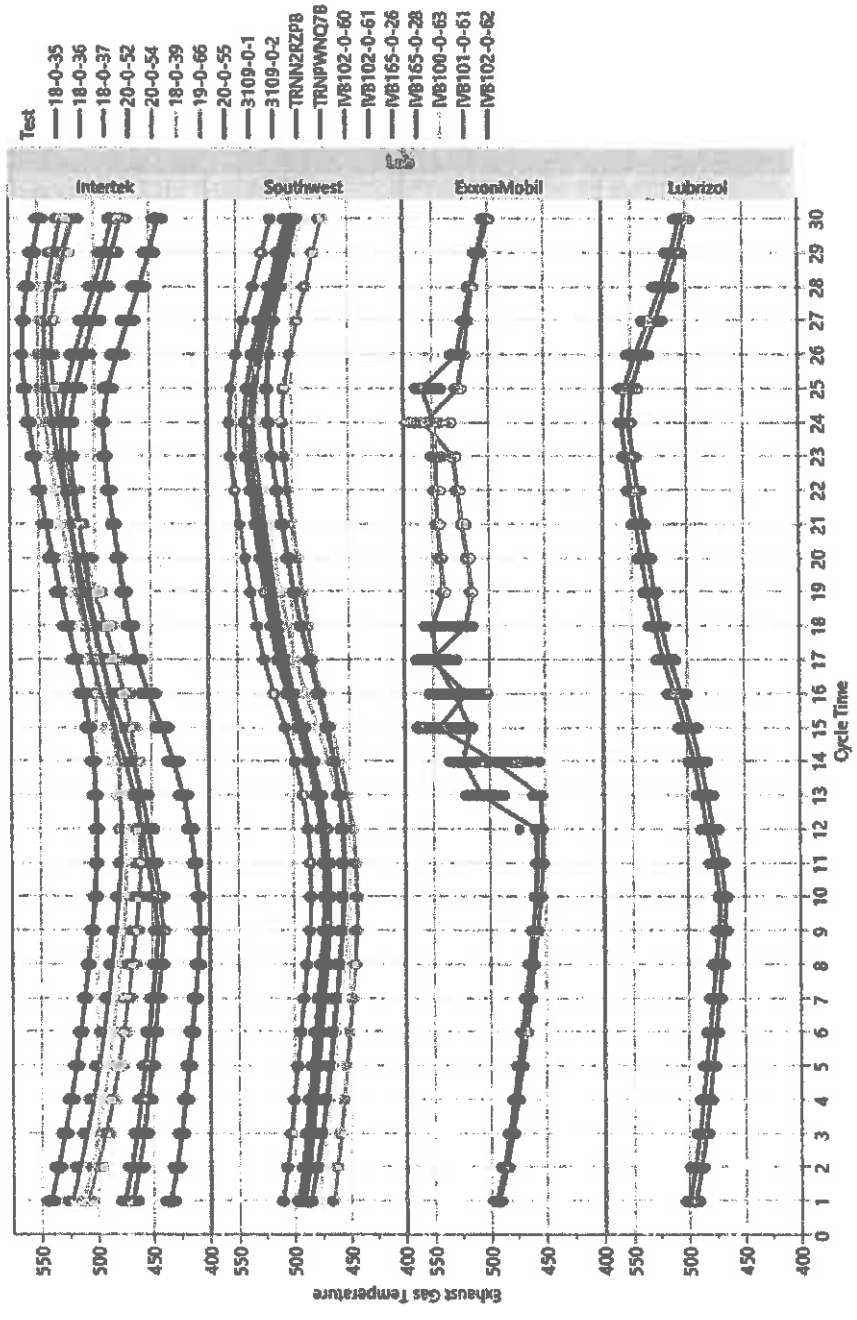
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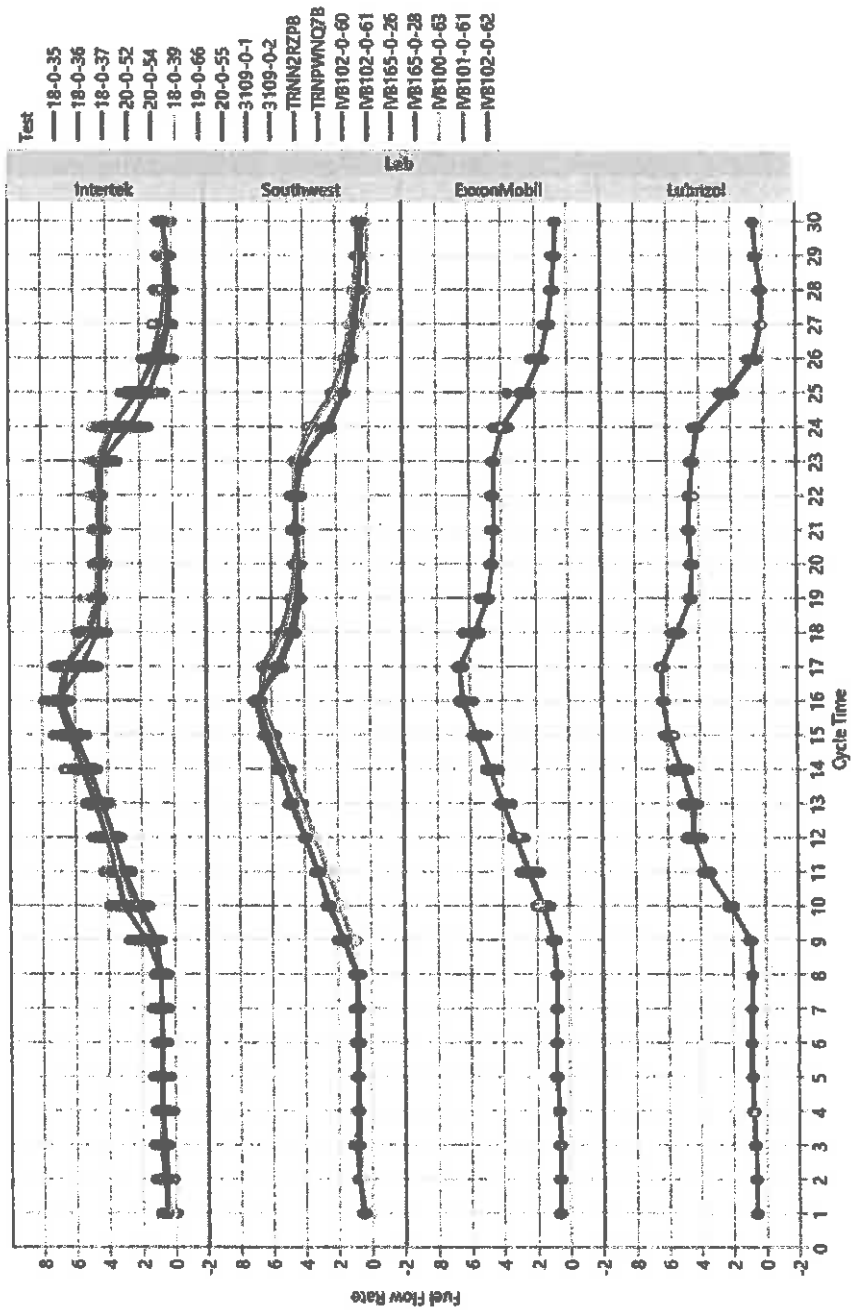
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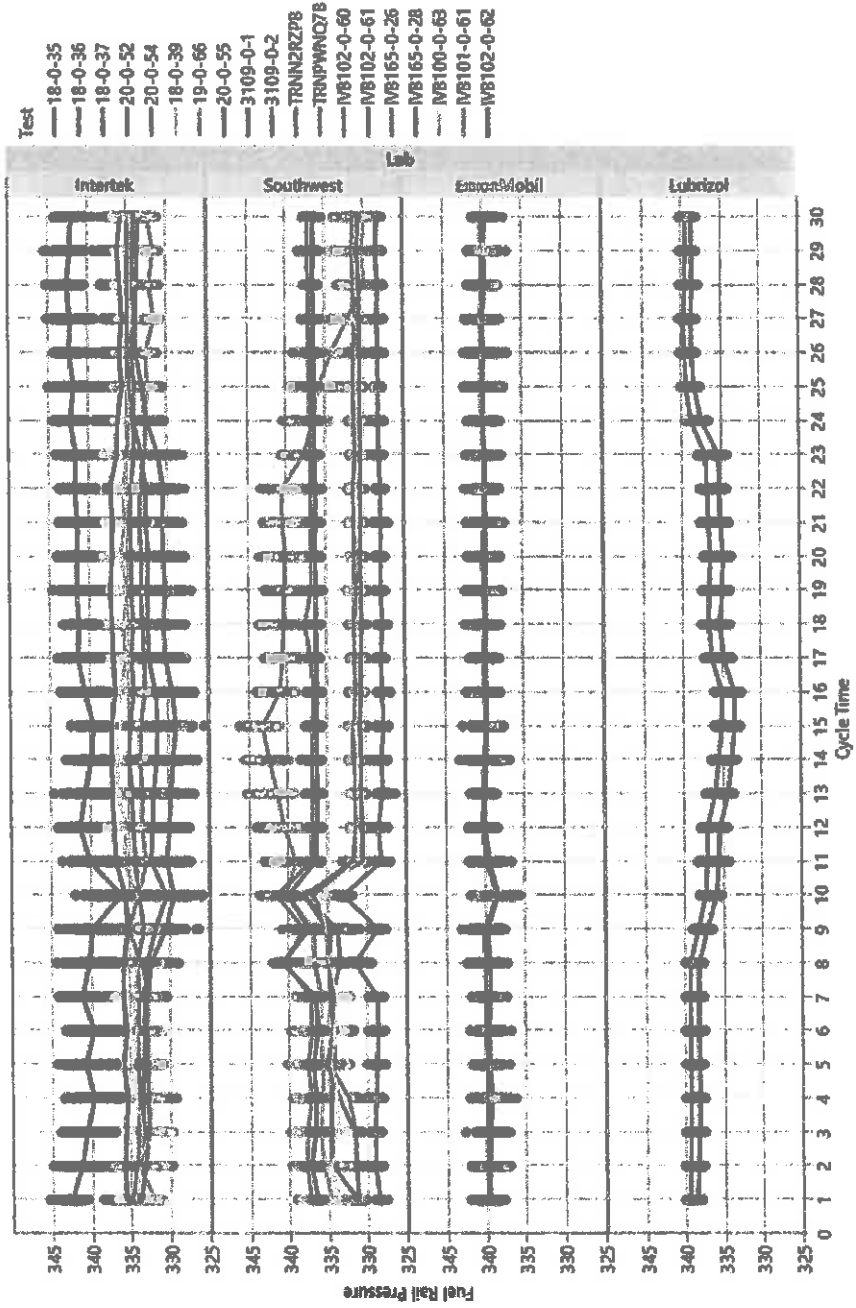
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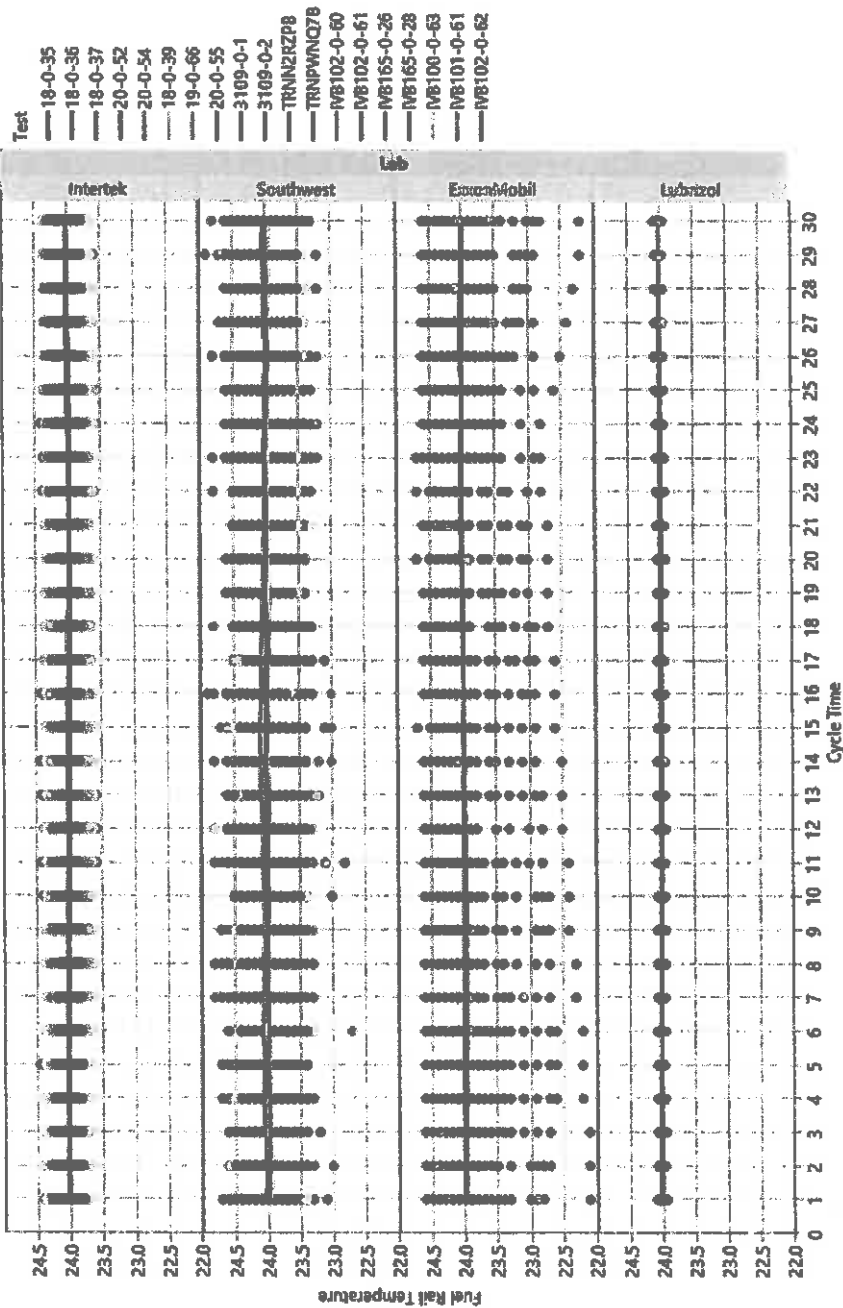
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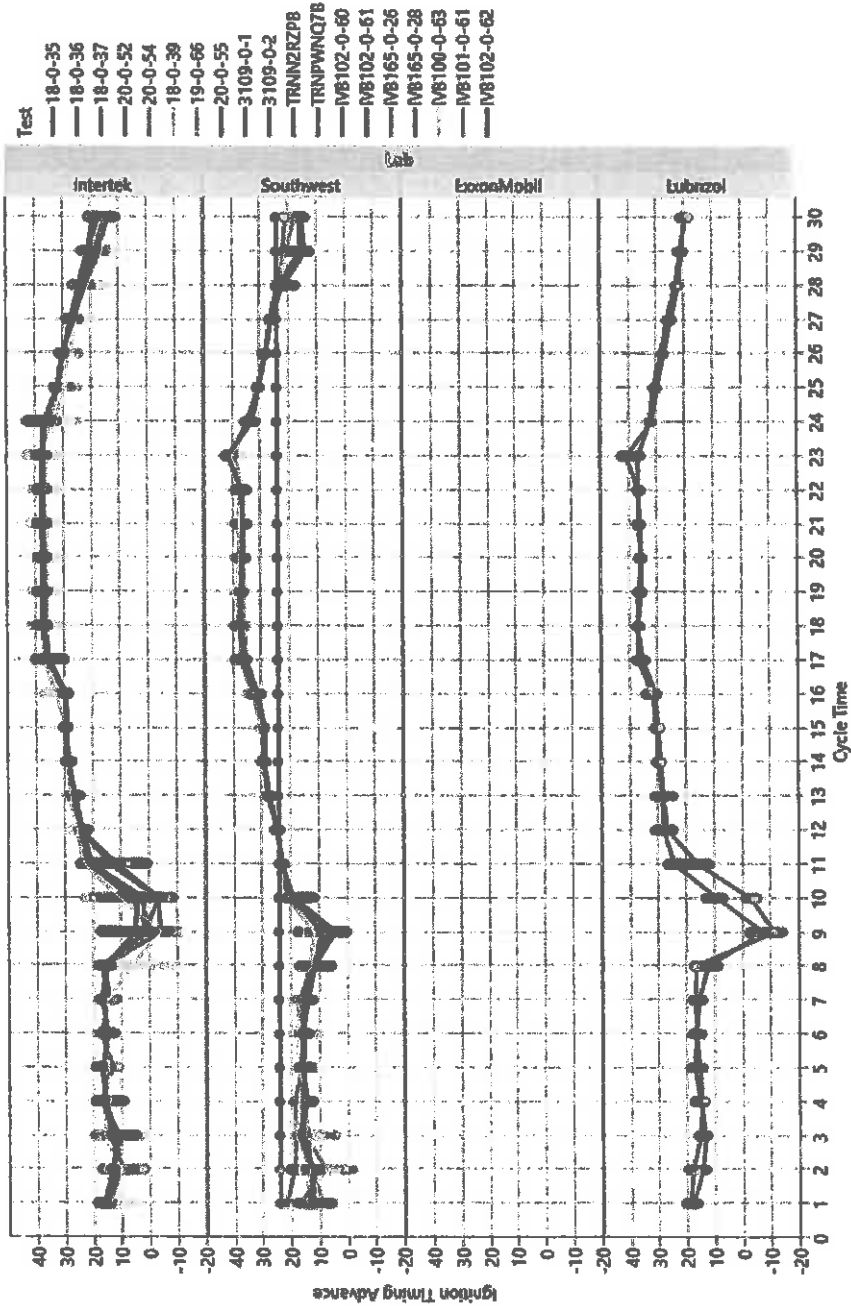
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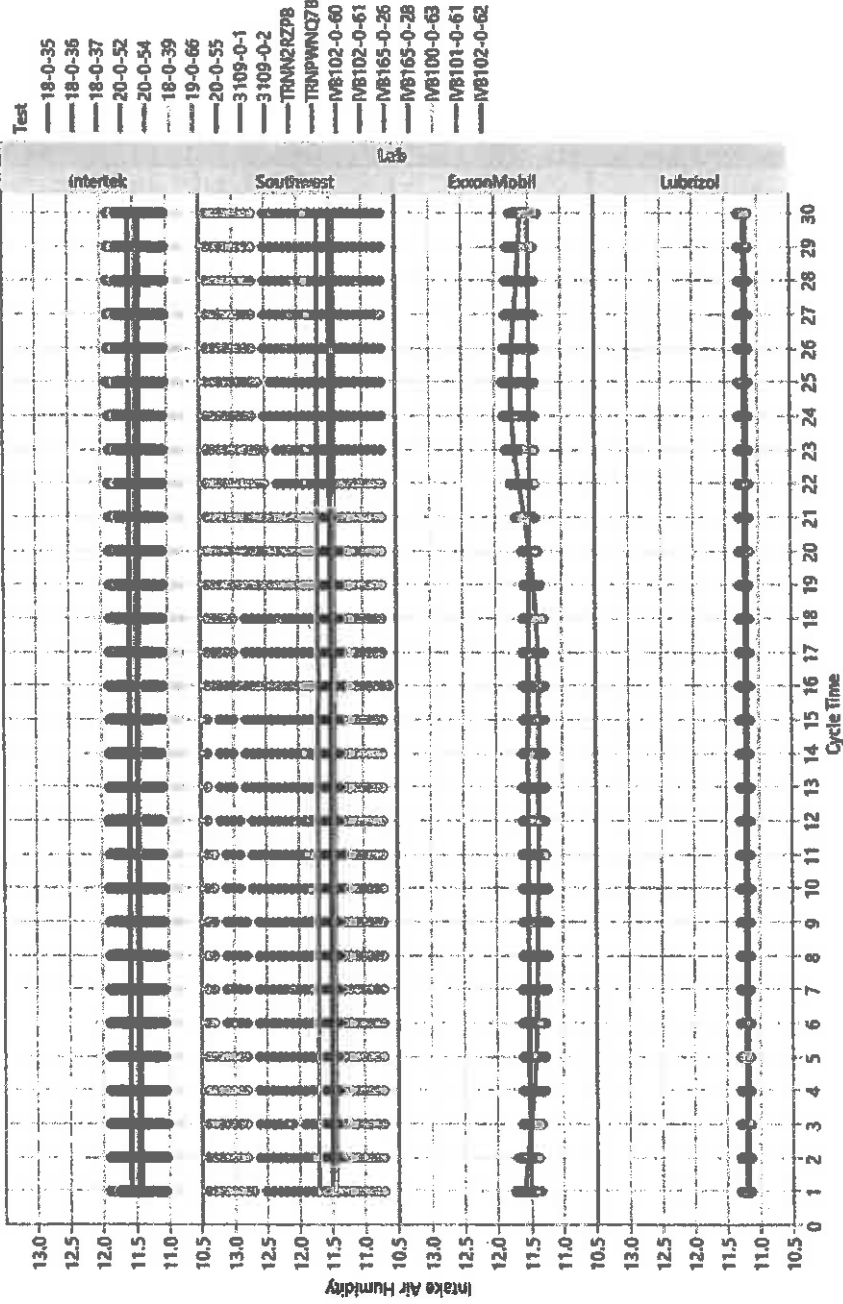
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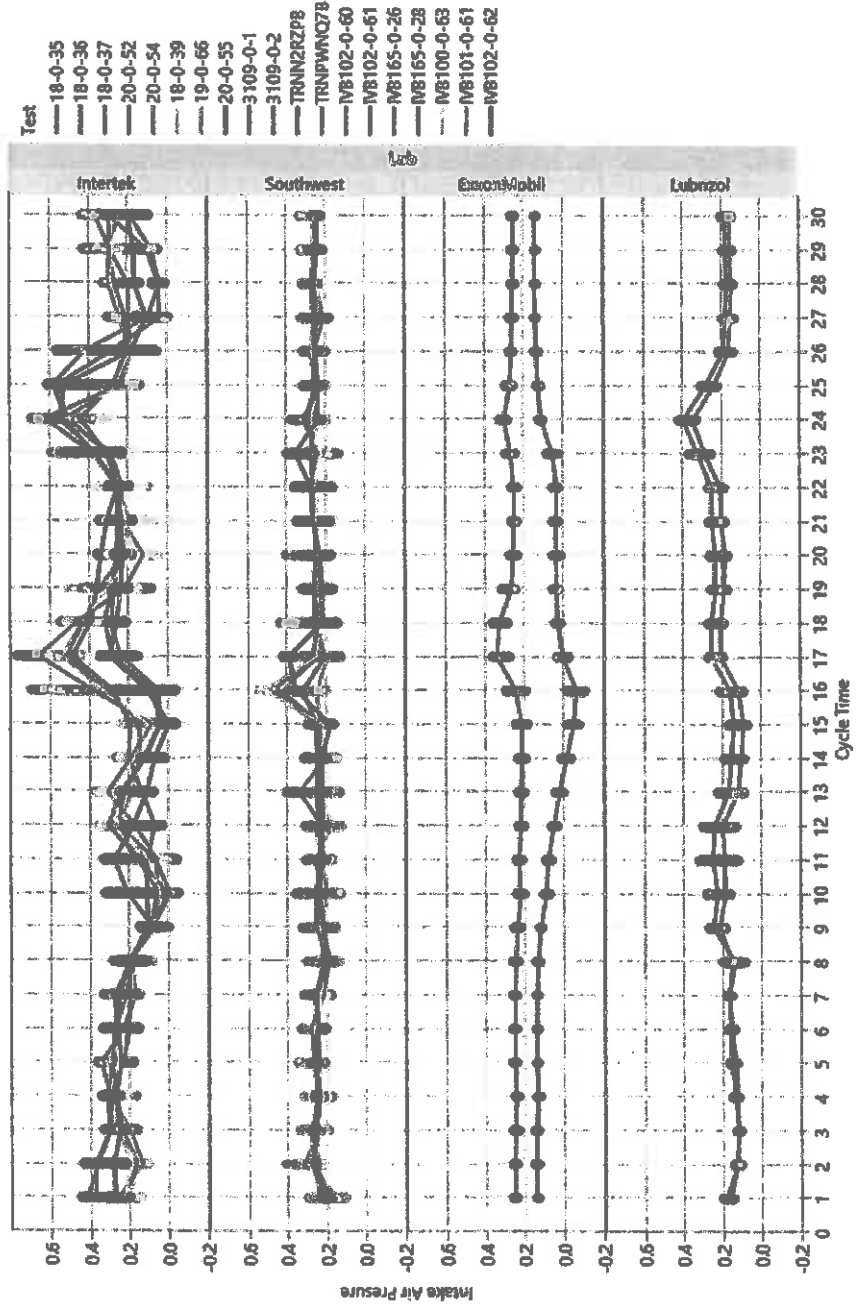
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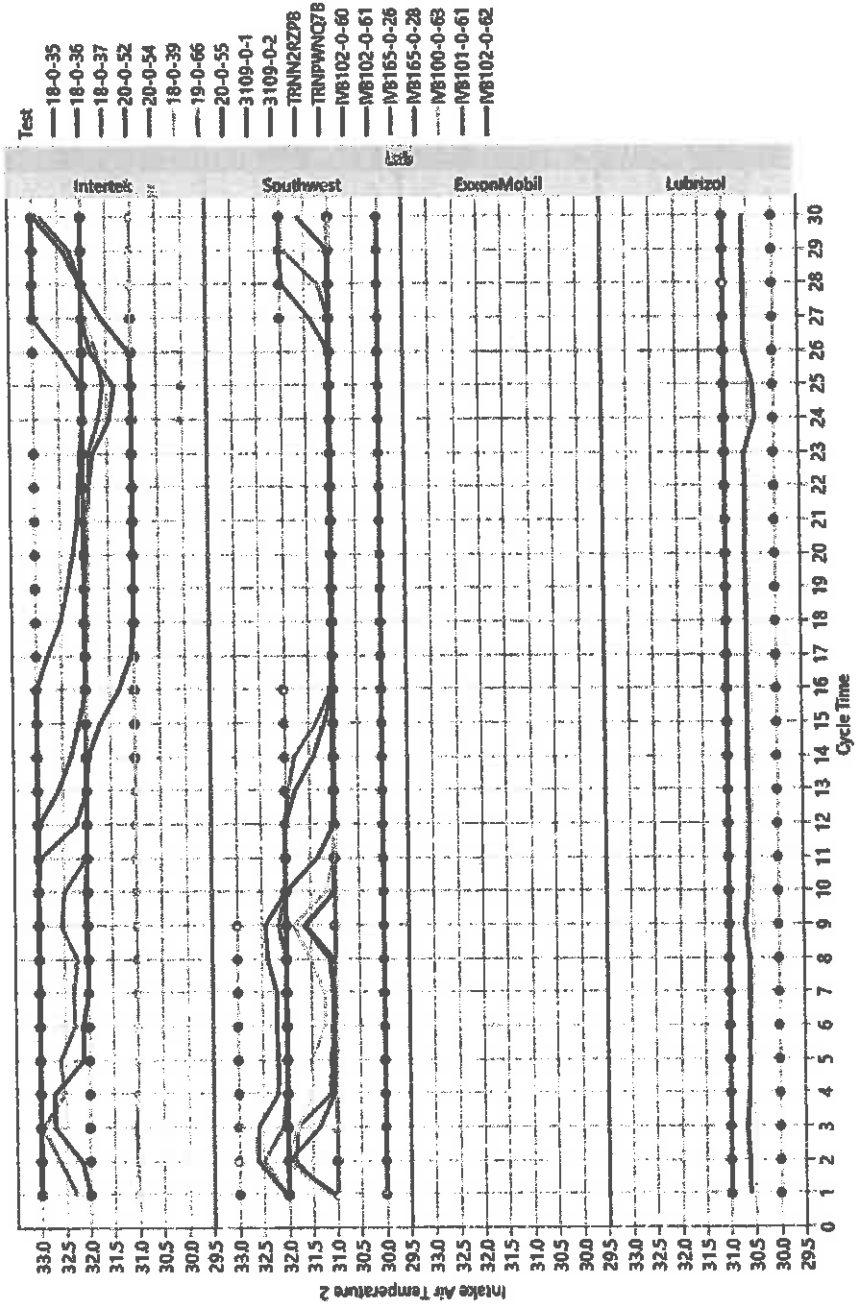
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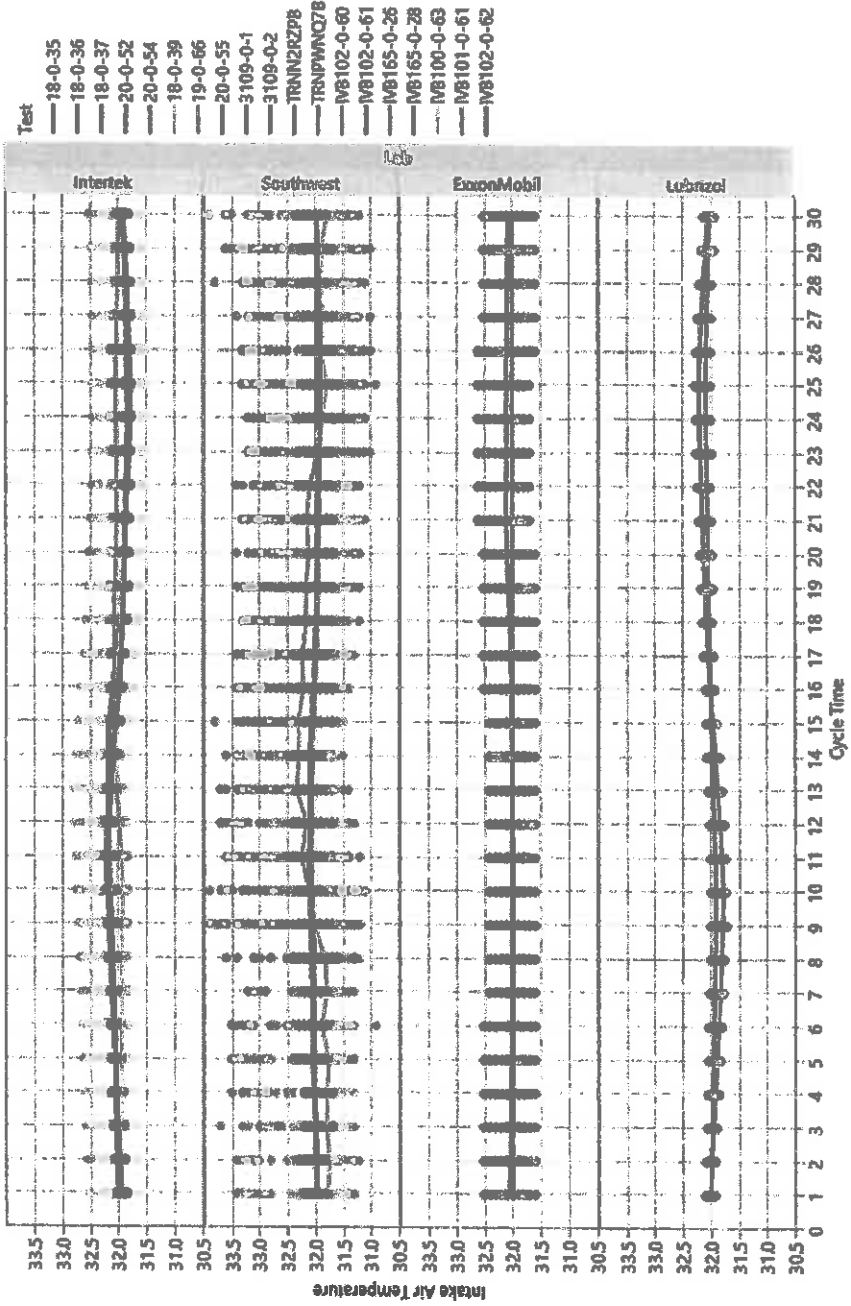
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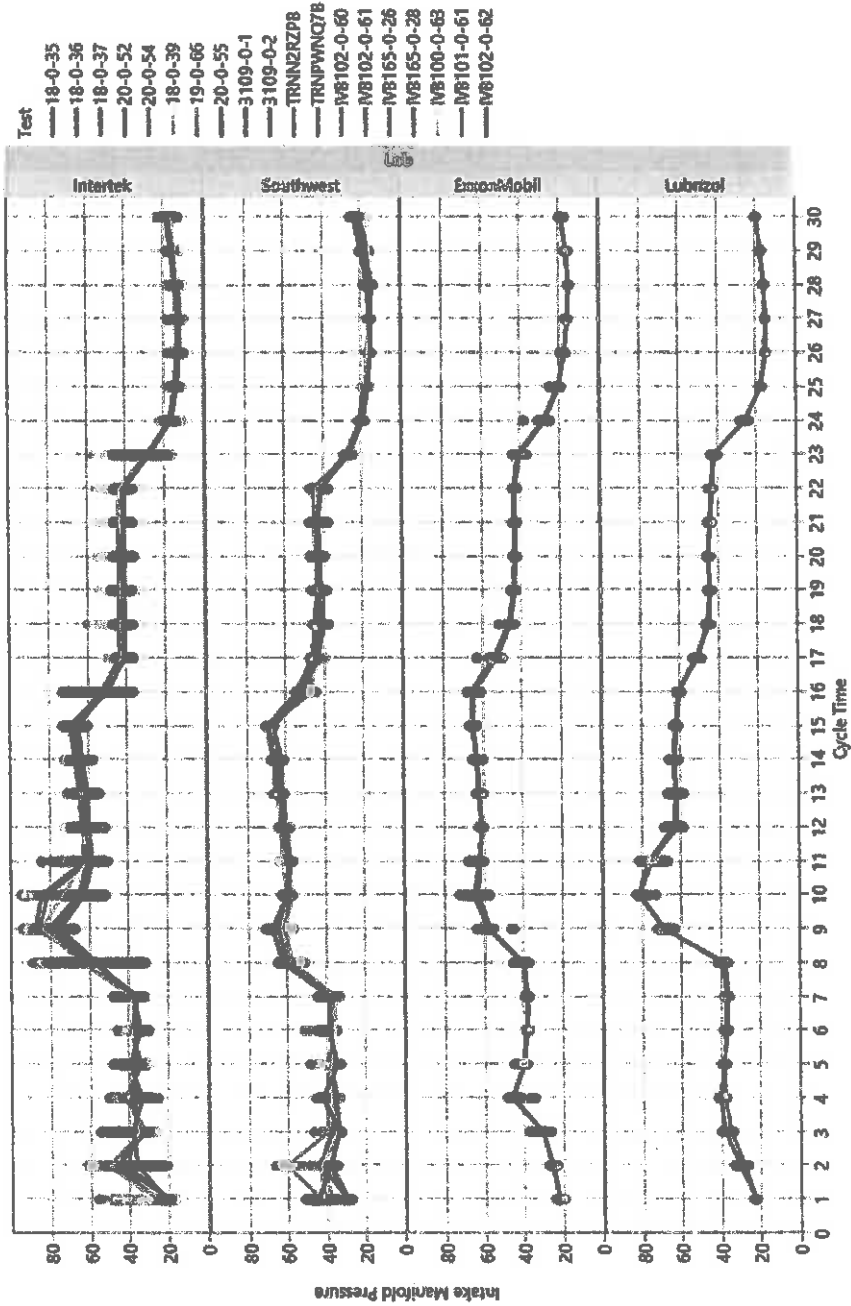
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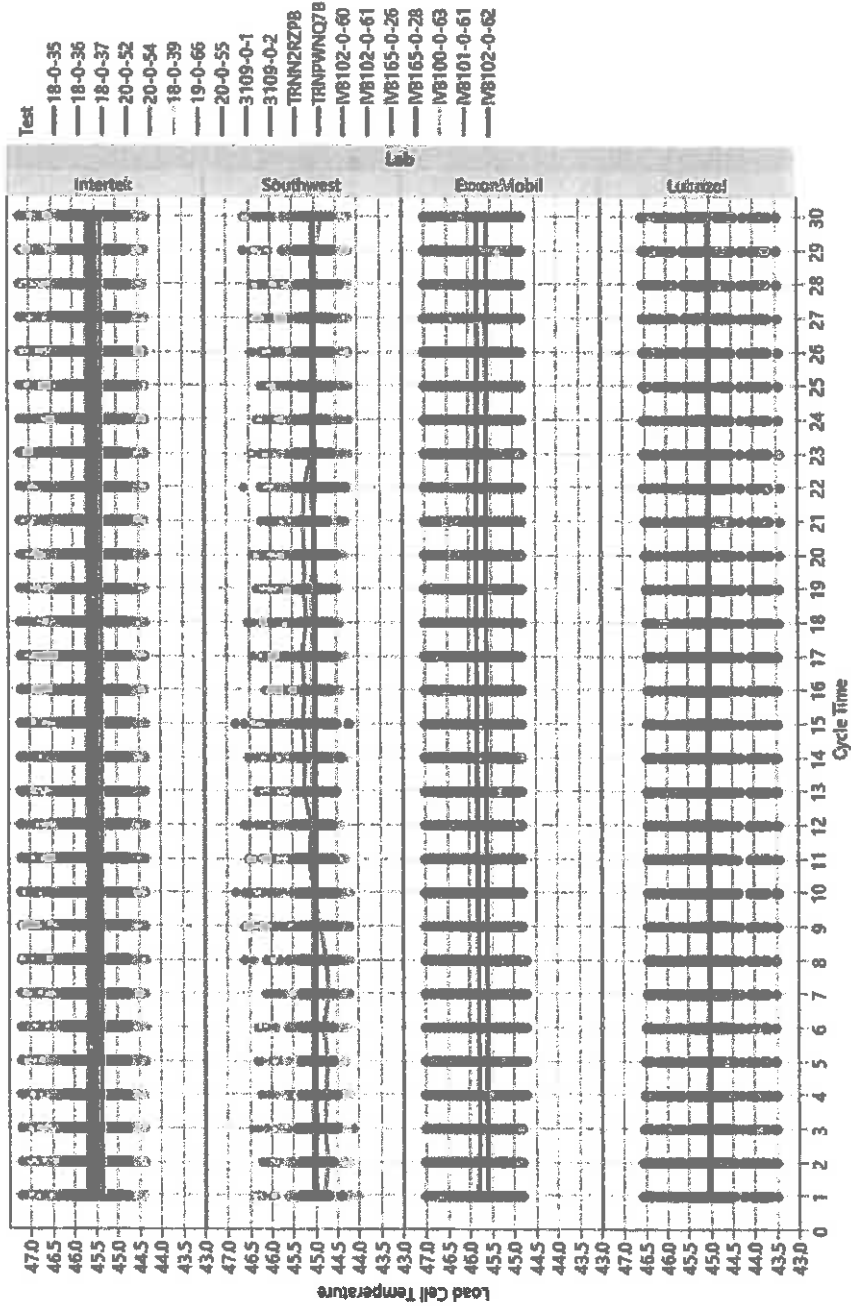
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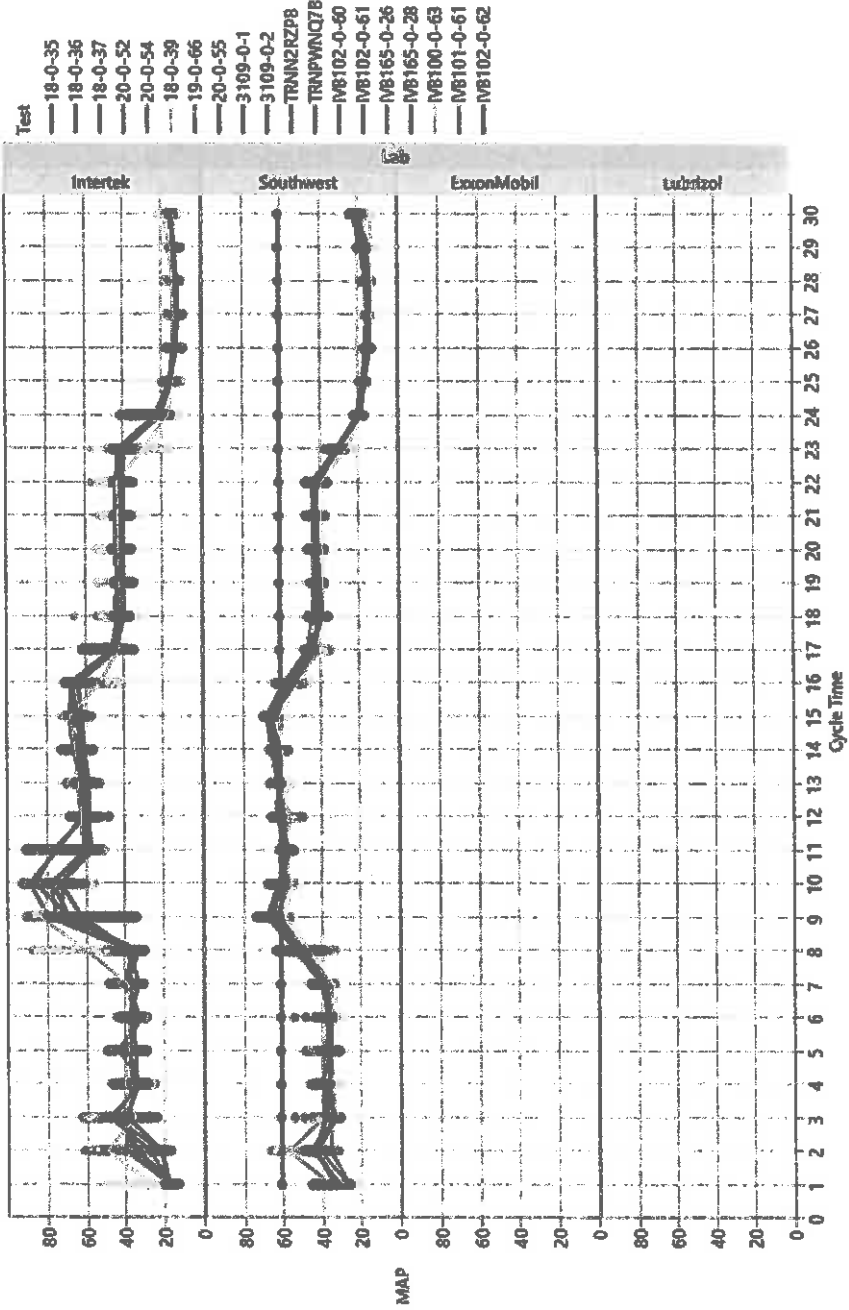
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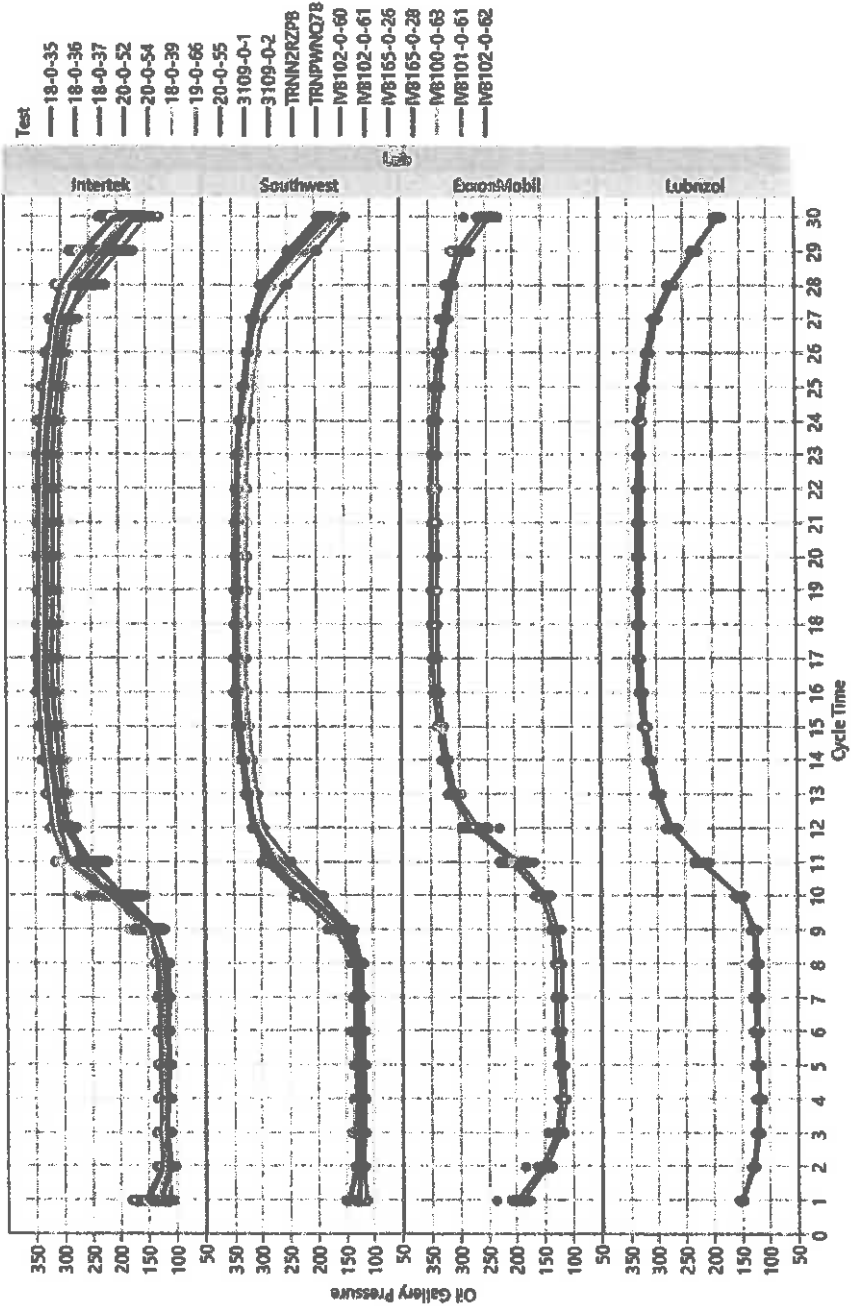
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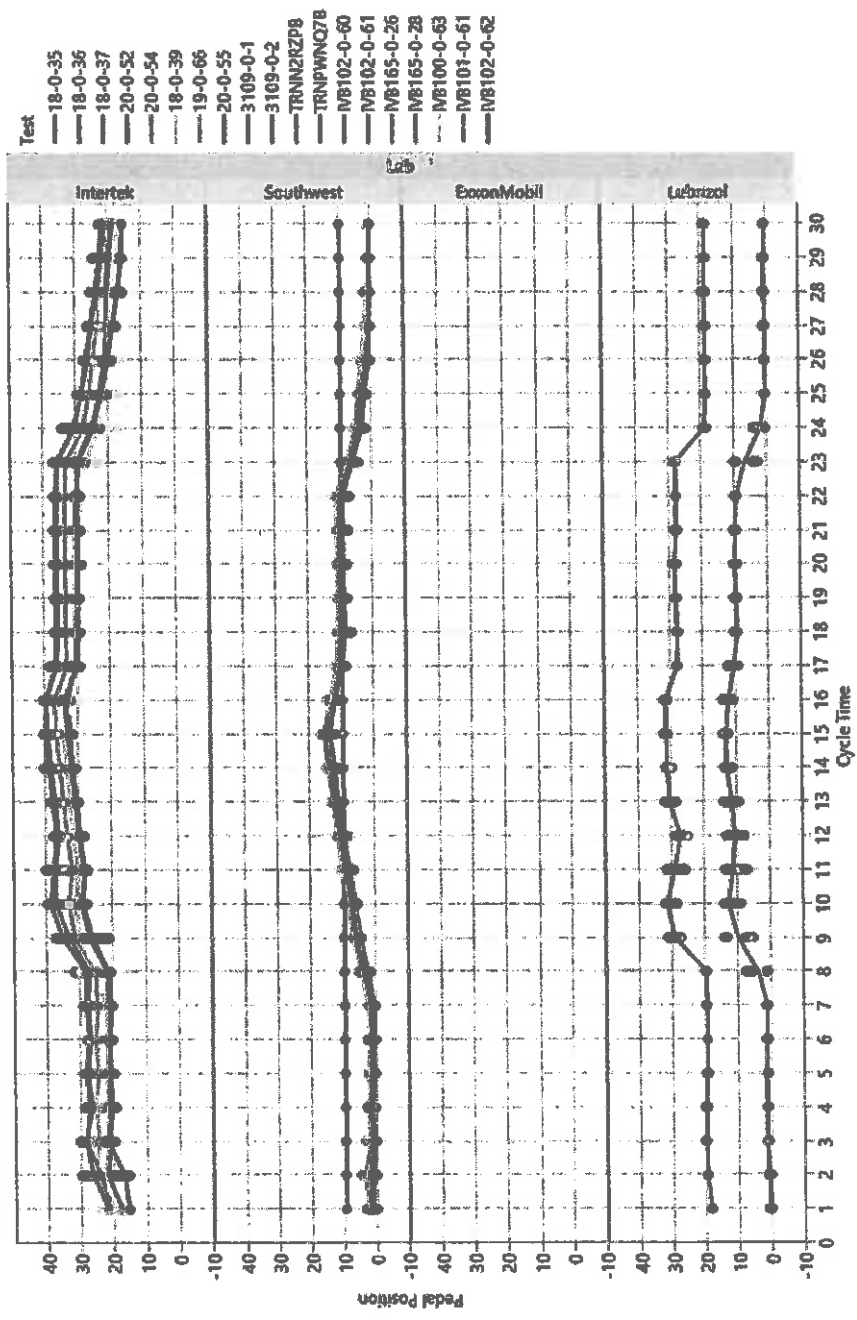
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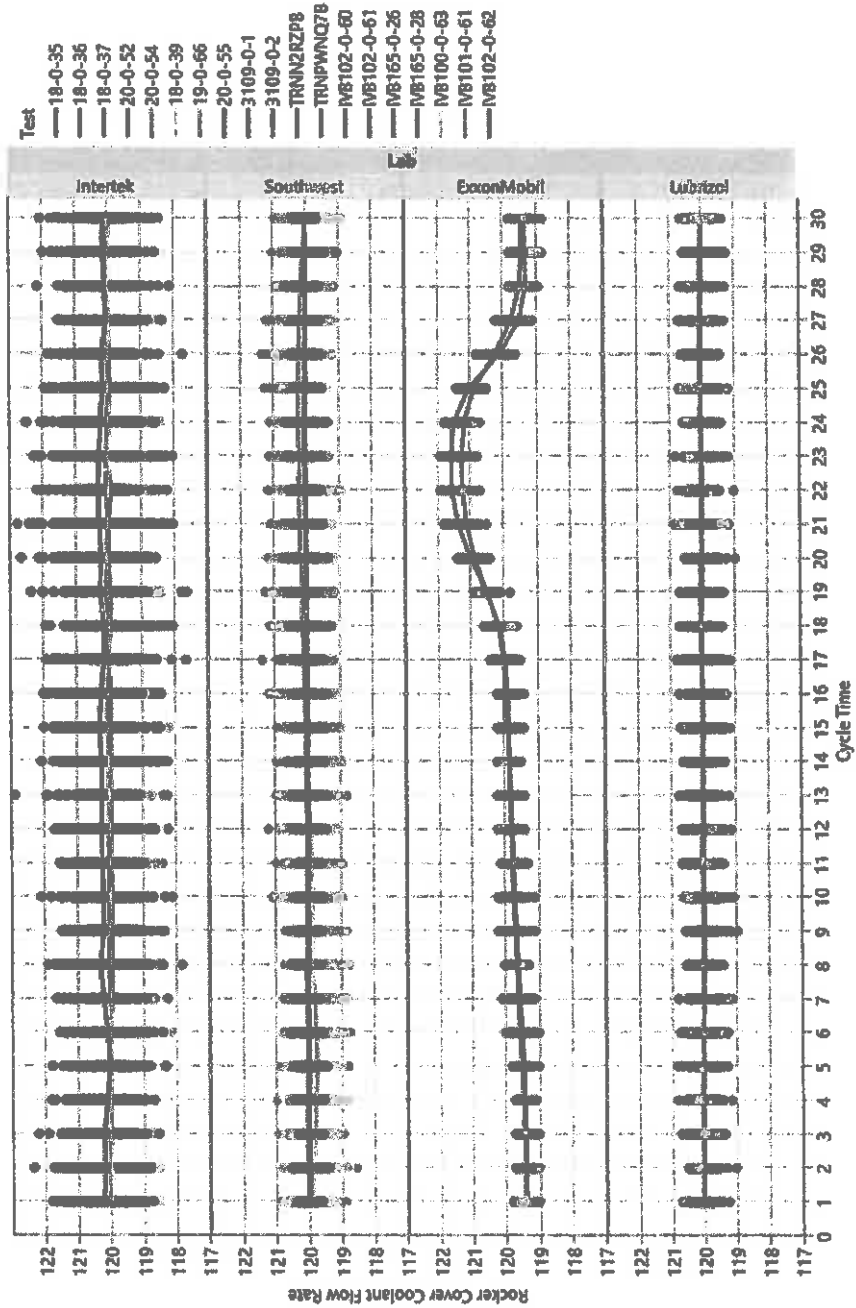
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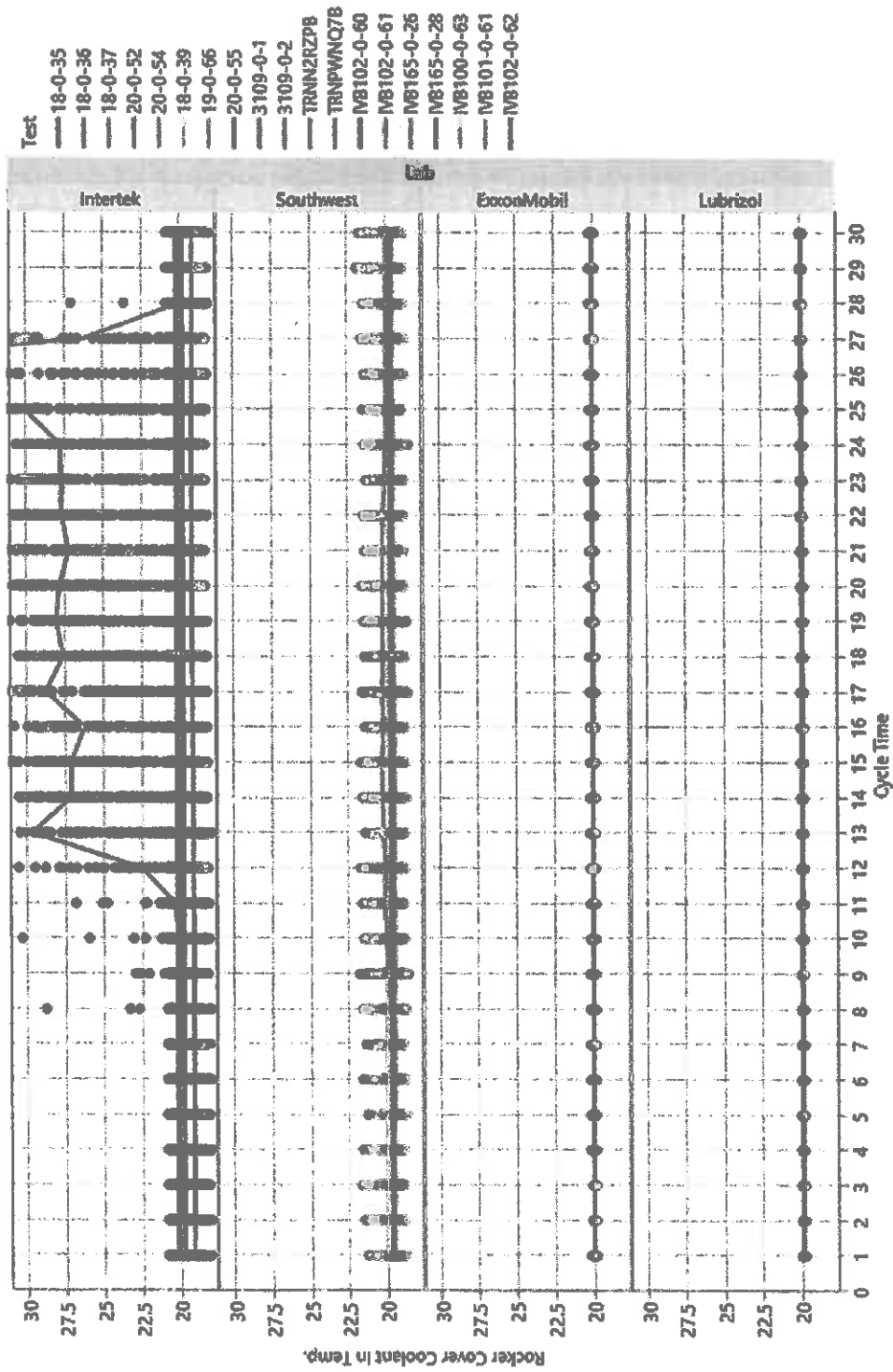
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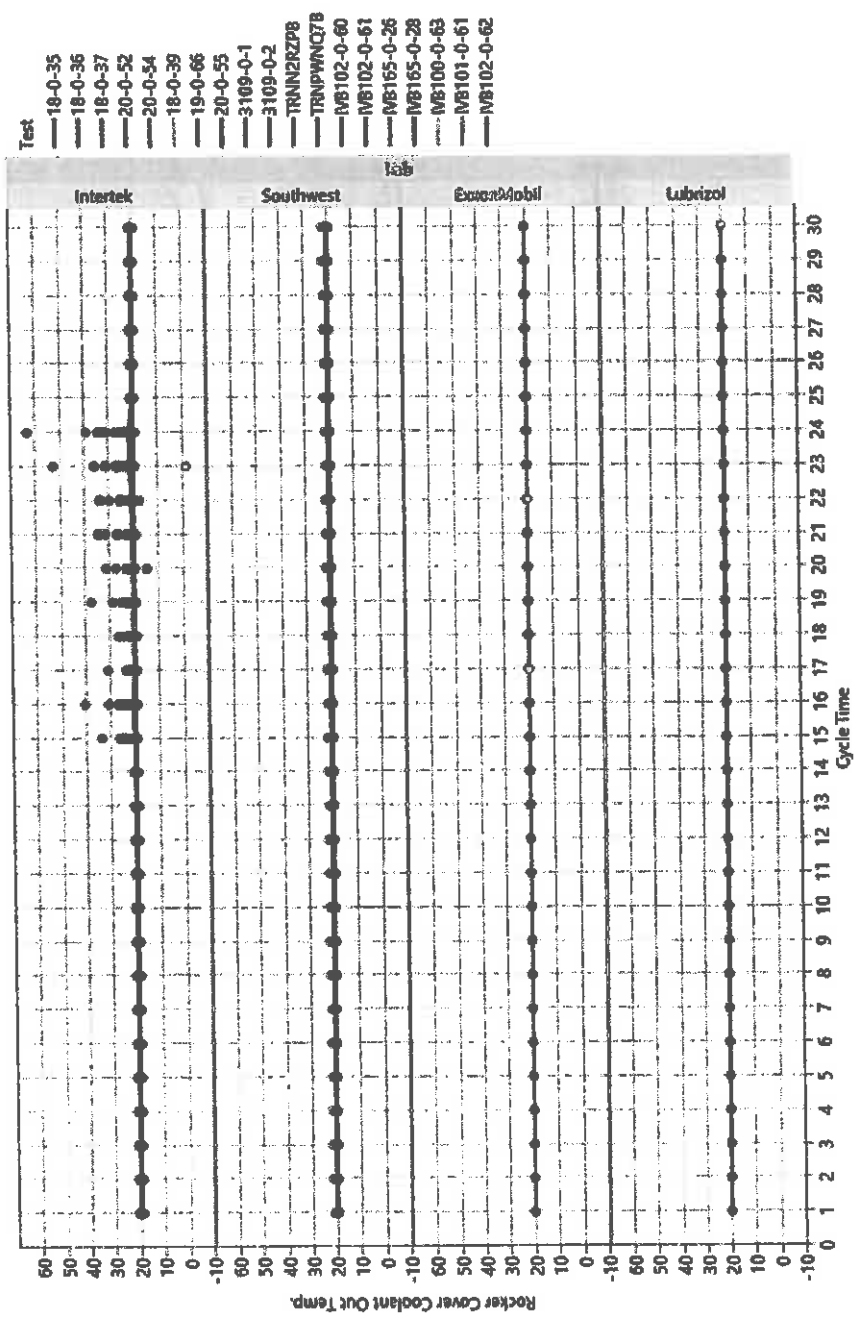
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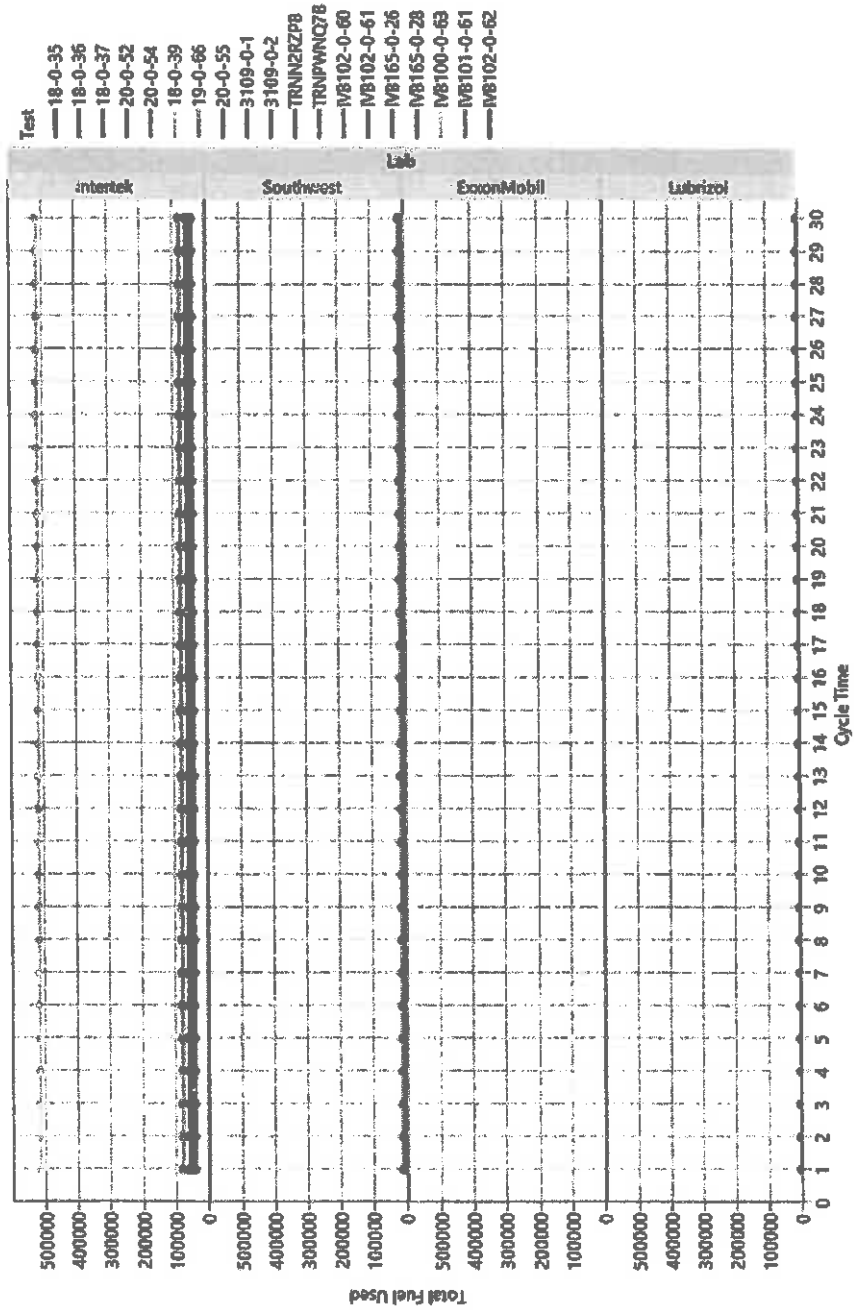
ZOOMED IN



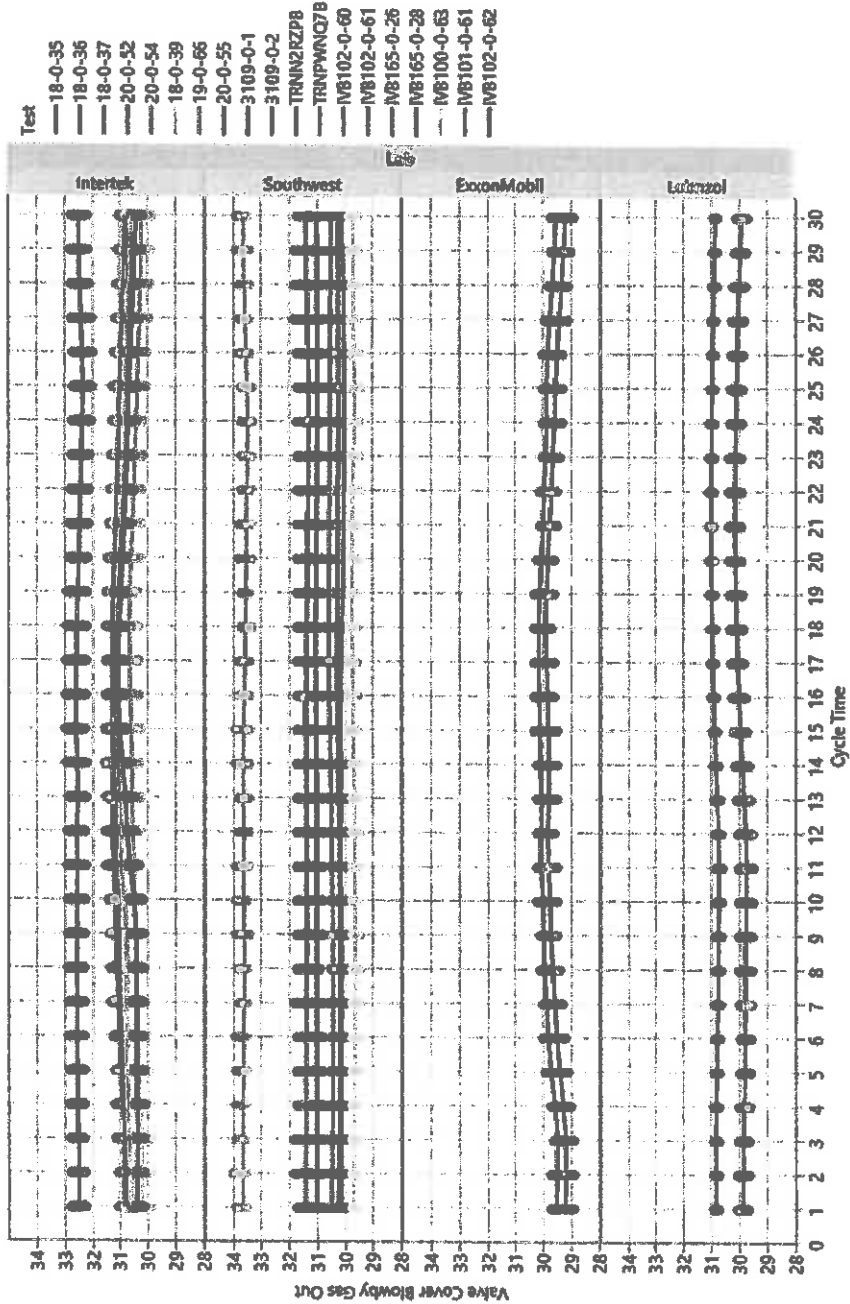
Graph Builder



Graph Builder



Graph Builder

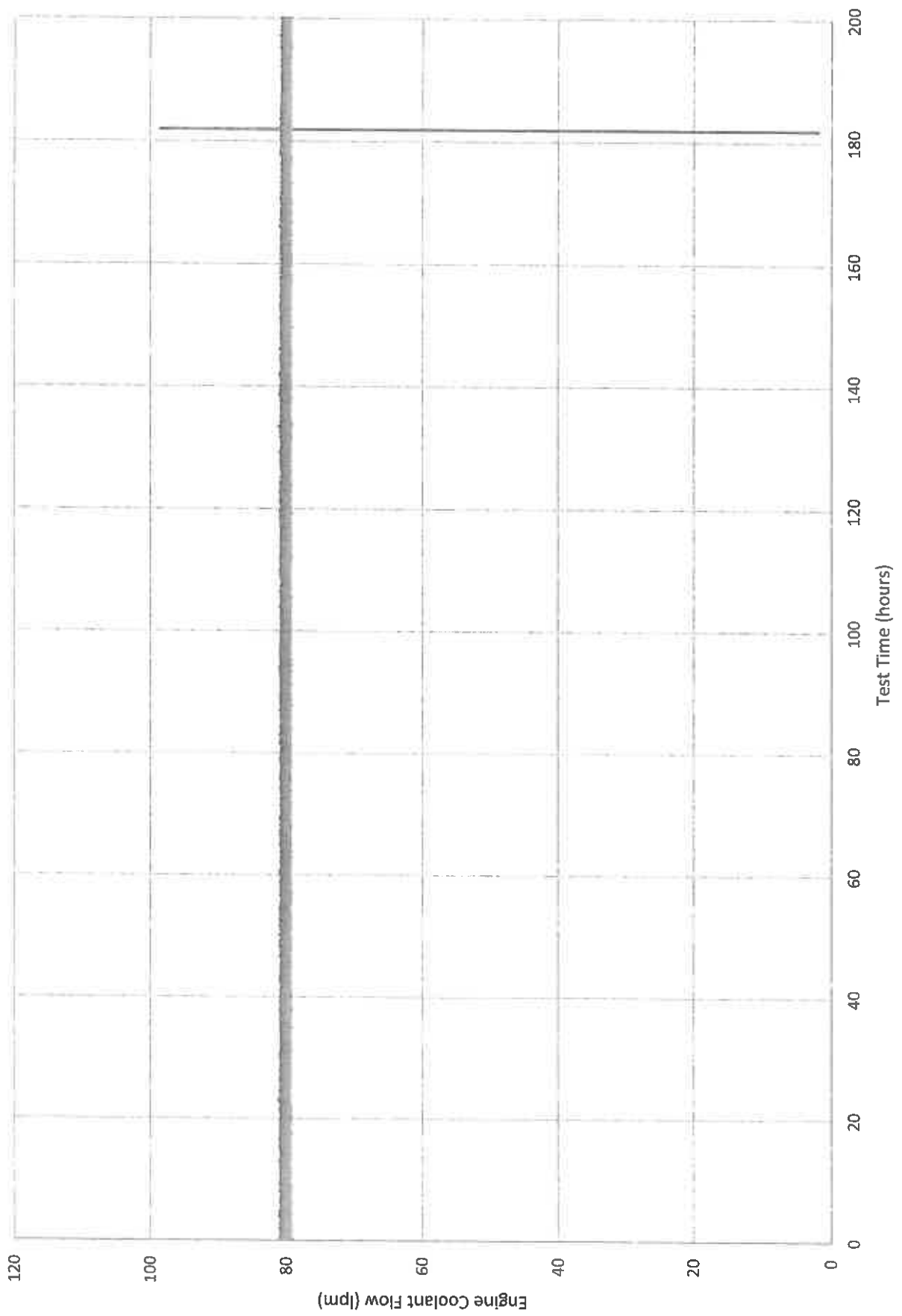


File	Target		QI						QI Overall	Average						Minimum						Maximum															
	Stage 2		Stage 1.0		Stage 1.1		Stage 2.0			Stage 2.1		Stage 1.0		Stage 1.1		Stage 2.0		Stage 2.1		Stage 1.0		Stage 1.1		Stage 2.0		Stage 2.1		Stage 1.0		Stage 1.1		Stage 2.0		Stage 2.1			
	Stage 1	Stage 2	Stage 1.0	Stage 1.1	Stage 1.1	Stage 2.0	Stage 2.0	Stage 2.1		Stage 1.0	Stage 1.1	Stage 1.1	Stage 2.0	Stage 2.0	Stage 2.1	Stage 1.0	Stage 1.1	Stage 1.1	Stage 2.0	Stage 2.0	Stage 2.1	Stage 1.0	Stage 1.1	Stage 1.1	Stage 2.0	Stage 2.0	Stage 2.1	Stage 1.0	Stage 1.1	Stage 1.1	Stage 2.0	Stage 2.0	Stage 2.1				
992	800	4300	0.725	0.873	0.408	0.947	0.750	811	2609	4305	2594	726	782	4310	776	4306	4512	800	4300	4305	2594	726	782	4310	776	4306	4512	800	4300	4305	2594	726	782	4310	776	4306	4512
992	25	25	0.994	0.985	0.995	0.995	0.992	25.00	25.10	24.99	24.94	24.46	24.06	25.64	23.95	26.10	25.76	25	25	24.99	24.94	24.46	24.06	25.64	23.95	26.10	25.76	25	25	24.99	24.94	24.46	24.06	25.64	23.95	26.10	25.76
992	54	54	0.962	0.611	0.950	0.858	0.838	54.23	51.69	54.60	55.46	35.45	35.06	55.62	35.49	53.67	55.81	54	54	54.60	55.46	35.45	35.06	55.62	35.49	53.67	55.81	54	54	54.60	55.46	35.45	35.06	55.62	35.49	53.67	55.81
000	52	52	0.944		0.892		0.918	51.45	51.44	52.67	52.46	50.30	50.26	54.74	50.98	54.88	55.38	52	52	52.67	52.46	50.30	50.26	54.74	50.98	54.88	55.38	52	52	52.67	52.46	50.30	50.26	54.74	50.98	54.88	55.38
992	80	80	-2.387	-3.394	-4.176	-3.289	-3.313	79.97	79.97	80.02	80.01	2.41	2.30	98.06	2.14	98.36	98.50	80	80	80.02	80.01	2.41	2.30	98.06	2.14	98.36	98.50	80	80	80.02	80.01	2.41	2.30	98.06	2.14	98.36	98.50
992	70	70	0.994	0.994	0.991	0.992	0.993	70.56	70.52	70.67	70.71	64.26	64.05	75.45	64.34	75.66	75.96	70	70	70.67	70.71	64.26	64.05	75.45	64.34	75.66	75.96	70	70	70.67	70.71	64.26	64.05	75.45	64.34	75.66	75.96
992	20	20	0.811	0.808	0.809	0.811	0.810	19.86	19.86	19.86	19.86	19.31	19.33	20.38	19.34	20.35	20.41	20	20	19.86	19.86	19.31	19.33	20.38	19.34	20.35	20.41	20	20	19.86	19.86	19.31	19.33	20.38	19.34	20.35	20.41
992	120	120	0.475	0.418	0.141	0.421	0.368	120.07	120.07	120.07	120.07	117.41	117.25	122.50	117.20	122.79	123.33	120	120	120.07	120.07	117.41	117.25	122.50	117.20	122.79	123.33	120	120	120.07	120.07	117.41	117.25	122.50	117.20	122.79	123.33
992	32	32	0.983	0.961	0.978	0.967	0.972	32.04	32.12	31.94	31.90	30.73	30.75	33.89	30.69	33.98	33.87	32	32	31.94	31.90	30.73	30.75	33.89	30.69	33.98	33.87	32	32	31.94	31.90	30.73	30.75	33.89	30.69	33.98	33.87
992	0.25	0.25	0.990	0.564	0.993	0.554	0.761	0.257	0.118	0.247	0.283	0.120	-0.103	0.335	0.039	0.656	0.440	0.25	0.25	0.247	0.283	0.120	-0.103	0.335	0.039	0.656	0.440	0.25	0.25	0.247	0.283	0.120	-0.103	0.335	0.039	0.656	0.440
992	11.5	11.5	0.780	0.796	0.794	0.777	0.787	11.39	11.40	11.40	11.39	10.12	10.15	12.88	10.09	12.91	12.93	11.5	11.5	11.40	11.39	10.12	10.15	12.88	10.09	12.91	12.93	11.5	11.5	11.40	11.39	10.12	10.15	12.88	10.09	12.91	12.93
992	24	24	0.882	0.891	0.873	0.867	0.878	24.02	24.00	23.98	24.00	23.56	23.52	24.44	23.55	24.52	24.57	24	24	23.98	24.00	23.56	23.52	24.44	23.55	24.52	24.57	24	24	23.98	24.00	23.56	23.52	24.44	23.55	24.52	24.57
992	335	335	0.885	0.889	0.879	0.870	0.881	335.60	334.90	336.06	336.44	320.63	312.66	345.98	319.63	345.86	345.34	335	335	336.06	336.44	320.63	312.66	345.98	319.63	345.86	345.34	335	335	336.06	336.44	320.63	312.66	345.98	319.63	345.86	345.34
992	29	29	0.912	0.959	0.925	0.907	0.926	29.13	29.07	28.90	28.92	28.31	28.11	32.87	27.85	32.81	32.56	29	29	28.90	28.92	28.31	28.11	32.87	27.85	32.81	32.56	29	29	28.90	28.92	28.31	28.11	32.87	27.85	32.81	32.56
000		104.5			0.983		0.983	102.31	104.74	104.16	101.80	100.71	97.16	109.89	97.86	110.13	109.94			104.16	101.80	100.71	97.16	109.89	97.86	110.13	109.94			104.16	101.80	100.71	97.16	109.89	97.86	110.13	109.94
992	45	45	0.972	0.972	0.972	0.972	0.972	45.52	45.52	45.52	45.52	41.72	41.92	47.59	41.57	47.57	47.60	45	45	45.52	45.52	41.72	41.92	47.59	41.57	47.57	47.60	45	45	45.52	45.52	41.72	41.92	47.59	41.57	47.57	47.60

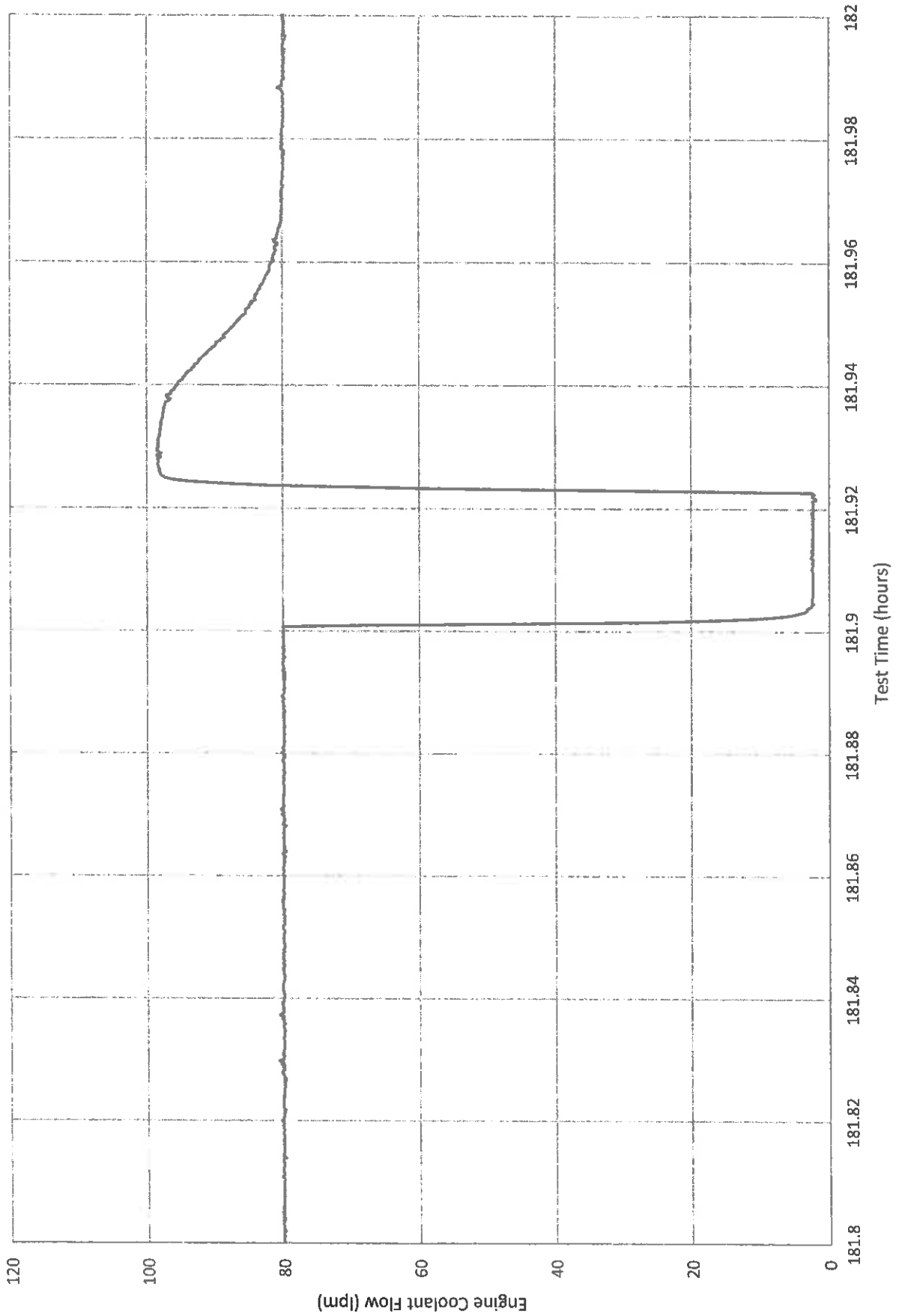
File ID	Target		QI				QI		Average			Minimum			Maximum			
	Stage 1	Stage 2	Stage 1.0	Stage 1.1	Stage 2.0	Stage 2.1	Overall	Stage 1.0	Stage 1.1	Stage 2.0	Stage 2.1	Stage 1.0	Stage 1.1	Stage 2.0	Stage 2.1	Stage 1.0	Stage 1.1	Stage 2.0
	992	800	4300	0.725	0.873	0.408	0.947	0.750	811	2609	4305	2594	726	782	778	776	4310	4306
992	25	25	0.994	0.985	0.995	0.995	0.992	25.00	25.10	24.99	24.94	24.46	24.06	24.11	23.95	25.64	26.10	25.76
992	54	54	0.962	0.611	0.950	0.858	0.838	54.23	51.69	54.60	55.46	35.45	35.06	36.13	35.49	55.62	53.67	55.81
000	52	52	0.944		0.892		0.918	51.45	51.44	52.67	52.46	50.30	50.26	50.23	50.98	54.74	54.88	55.38
906	80	80	0.768	0.705	0.511	0.747	0.686	79.98	79.98	80.03	80.02	79.46	79.20	78.98	79.33	98.06	98.36	98.50
992	70	70	0.994	0.994	0.991	0.992	0.993	70.56	70.52	70.67	70.71	64.26	64.05	63.67	64.34	75.45	75.66	75.96
992	20	20	0.811	0.808	0.809	0.811	0.810	19.86	19.86	19.86	19.86	19.31	19.33	19.34	19.34	20.38	20.35	20.41
992	120	120	0.475	0.418	0.141	0.421	0.368	120.07	120.07	120.07	120.07	117.41	117.25	116.54	117.20	122.50	122.79	123.33
992	32	32	0.983	0.961	0.978	0.967	0.972	32.04	32.12	31.94	31.90	30.73	30.75	30.70	30.69	33.89	33.98	33.87
992	0.25	0.25	0.990	0.564	0.993	0.554	0.761	0.257	0.118	0.247	0.283	0.120	-0.103	-0.023	0.039	0.335	0.656	0.440
992	11.5	11.5	0.780	0.796	0.794	0.777	0.787	11.39	11.40	11.40	11.39	10.12	10.15	10.18	10.09	12.88	12.91	12.93
992	24	24	0.882	0.891	0.873	0.867	0.878	24.02	24.00	23.98	24.00	23.56	23.52	23.50	23.55	24.44	24.52	24.57
992	335	335	0.885	0.889	0.879	0.870	0.881	335.60	334.90	336.06	336.44	320.63	312.66	317.53	319.63	345.98	345.86	345.34
992	29	29	0.912	0.959	0.925	0.907	0.926	29.13	29.07	28.90	28.92	28.31	28.11	27.96	27.85	32.87	32.81	32.56
000		104.5			0.983		0.983	102.31	104.74	104.16	101.80	100.71	97.16	98.31	97.86	109.89	110.13	109.94
992	45	45	0.972	0.972	0.972	0.972	0.972	45.52	45.52	45.52	45.52	41.72	41.92	42.18	41.57	47.59	47.57	47.60

from test hour 181.90123 to test hour 181.92459.

IVB102-0-62



IVB102-0-62



Sequence IVB Precision Matrix Design Update

Statistics Group

Nov. 2, 2017

Statistics Group

- 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

Sequence IVB Precision Matrix Design

Run Order	Precision Matrix						Supplemental		
	IAR - Stand1	IAR - Stand 2	IAR Stand 3	SwRI Stand 1	SwRI Stand 2	LZ	XOM	Afton	
1	1012	300	1011	300	1012	1012	300	1011	
2	1011	1012	1012	1011	300	300	1011	1012	
3	300	1011	300	1012	1011	1012	300	1011	
4	1012	300	1011	300	1012				

Recommendations:

1. Each supplemental lab runs a minimum of 3 tests
2. Order of supplemental tests is subject to change
 - Switched runs 2 and 3 for the supplemental labs in this update

