

## **DD13 Scuffing Task Force Meeting Minutes**

Lubrizol - Wickliffe, OH

1/14/2014

**Attendance:** See attached attendance sheet

### **Agenda:**

John Cruz and Jim Matasic presented an update on the latest test activity. The presentation is attached to these minutes.

Bob Salgueiro asked about the reversal of results on each of the oils. When running the previous procedure the oil that was previously referred to as the "poor" formulation (now called DD13-A) had caused the earliest scuffing while with the new procedure the oil formerly called the "good" formulation (now called DD13-B) lead to earlier scuffing in all tests. John Loop explained that there never had repeatable data on the DD13-A with the old procedure and that while the results on the new procedure are odd the fact that the test is responding to different chemistries is promising.

One IAR test that started to scuff at 92 hours had an issue with connecting rod bolts that started to come out during operation. This engine was a workshop build engine. Rod failure occurred during startup. There were various alarms during operation. There was some evidence that the piston contacted the cylinder head during operation as well. Up to the point of failure (~first 87 hours) the test ran pretty well.

Riccardo asked about coolant temperature of tests? The test is run at 110C and the pressure set at 70 kPa.

There was discussion about the tests in red in the presentation. They are operationally questionable tests. Other tests were run fairly well but not necessarily without unplanned shutdowns.

Jim Matasic asked the group what operational and or analytical data the group would like to review. Martin Thompson asked about analytical data and Jim showed information about the copper levels from the appendix. Two tests show minimal increases in copper. Copper is leaching from oil cooler. Greg Shank asked if the oil coolers are changed everytime. They are not. Low copper tests could be test that were run on used coolers. Some copper potentially coming from reused overhead assemblies but Martin indicated rockers are included in kit parts so they should have been changed.

Jim Matasic reviewed the operational data from each test.

The torque curve showed some degradation in torque at longer test durations. The data on the plot from SwRI is near taken from near the 200 hour mark while the data from the other labs was recorded earlier in the test. Torque control will need to be looked at because once 100% throttle is hit there is no other way to make torque.

-Fuel flow is nominal.

-Intake manifold pressure exhibits slow decrease. Appears to be typical engine aging.

Martin indicated that they are getting ready to tear down the engine that didn't scuff at 200 hrs and they will be comparing parts to test kits parts to be certain the engine was built with the right parts. This test showed no iron increase or CCP increase.

John Cruz then summarized the test plan situation to this point.

**MOTION:**

John Cruz motioned for Task Force acceptance and Jim Matasic seconded.

**COMMENTS ON MOTION:**

Riccardo commented that there is a good plan but that results need to be shown for the remaining tests. Jim agreed but pointed out that time is running out.

Bob indicated that it is troubling that the oils flipped from previous results. The goal was to be able to identify oils from the field that have scuffing issues but now that the oil that the “poor” oil (DD13-A) was performing better than the oil that was supposed to have better wear characteristics there is no way of knowing whether this test can identify poor performing oils. John Loop indicated that the results were unexpected but they thought that they had approximated the bad field data but obviously couldn’t be sure. Mark Cooper indicated that he was under the impression that the “POOR” oil (DD13-A) was formulated to represent the bad field oil. It was brought up that previous minutes of DD13 meetings reflected that that was the case.

Jim indicated that we never had a repeatability point on the original oils and we don’t know if the two oils wouldn’t have shown the same results on this new procedure.

Michael Alessi asked about a timeframe for completion of the remaining tests. Tests are scheduled to start very soon.

Greg Shank asked if there was confidence that all of the operational issues were resolved and that we could be confident that the remaining tests would run successfully from an operational standpoint.

The question was asked whether we could get more time for the rest of the tests to complete. Greg indicated that EMA was to summarize the TF results and pass that data on to ACC and API for them to make a decision about moving forward on the 30<sup>th</sup>.

Riccardo asked if the concern is simply reproducibility or if there were other concerns.

Bob asked why the timeframe to scuffing suddenly changed so much for each formulation from long to short on the new rings back to long with new procedure. Brad Carter said that the procedure was changed to keep from subjecting the engine to high load after short warm up. Changing the throttle stepping helped to stretch the scuffing timeframe back out.

Both A & B are low HTHS oils. John Loop said they were formulated towards PC-11B. Greg Braziunas indicated that this was the key point because they set out to show the test could discriminate chemistries and that it was important to the category to understand.

Mike asked if EMA could wait to talk on the 24<sup>th</sup> to give more time for the data to be completed. Riccardo said that concessions were made for the EOAT and could we go with data from just two labs in order to be acceptable.

The data needs to be in by the 21<sup>st</sup> to meet the timeline. There was discussion about running oil DD13-B at IAR again to generate the necessary data.

Greg Braziunas asked if we could consider the IAR DD13-B test that had a connecting rod failure since it indicated it was about to scuff. We have never seen indications of scuffing on an engine that had “hung around” very long so every indication was that the engine was going to scuff relatively soon.

Brad Carter asked that if a re-run of DD13-B scuffs at 90 hrs at IAR and one with LZ at 110 hrs does that then become a reproducibility issue.

Bob Campbell asked again how we can be sure that this test will protect engines in the field from the supposedly poor field formulation. Greg Braziunas indicated that while LZ tried to replicate the poor field oil they don’t really know how it actually correlates to the poor field oil.

Mark Cooper also brought up that the poor tests in the field occurred with coated rings and that this test is running with uncoated rings. It was pointed out that other tests use various methods to accelerate tests.

Greg Shank brought up even if we had the time to run DD13-B would it still resolve the questions about suitability.

If there is a known bad oil that with two runs on it would be more important than runs on oil DD13-B. The test potentially discriminates but is it meaningful to the category?

The question was asked that if a known bad oil was available by Thursday who could run? LZ and IAR could both run if oil was available.

The question was asked whether January 30<sup>th</sup> is an in or out date? Or is there opportunity to continue to work? Multiple things are dependent on getting the decision made about what tests are in and what tests are out.

The question was asked whether there is a precedent for a test that was in the matrix but then was dropped from the category. There is no precedent. Tests have been dropped prior to the matrix.

What is the timeline for LZ and IAR to run oil a known bad oil (DD13-C) which is a formulation that has shown issues in the field?

Can we tie the results on DD13-A to results in the field to show how a good field oil performs in the test?

The poor field oil is a 3.5 HTHS 30W oil.

#### **DECISION:**

The task force asked for a poor field oil to be run at a minimum of two labs with a call the evening of the 21<sup>st</sup> in order for ACC members to review the results before their face-to-face meeting on the 23<sup>rd</sup>.

#### **FURTHER DISCUSSION:**

The question was asked about the relevance of the hardware. Are uncoated rings relevant?

There were concerns with unscheduled shutdowns and the effects on the test. It was pointed out that some of the tests did have unplanned shutdowns.

Bob Campbell asked whether the scuffing events were the same for the new test procedure as the old procedure. Jim Matasic said that the number of cylinders varies but that the CCP indication is consistent. Oil consumption and blowby both increase.

The question was asked whether the tests that scuffed at 110 hours were at the power change? The scuffing indications had already started at the 90% power level and fully scuffed at the 100% throttle step. Both were coming out of the 100 hr shutdown.

**DECISION:**

The motion was officially tabled by John Cruz until the next meeting tentatively scheduled for the 21<sup>st</sup> of January.

Jim Matasic will keep the task force informed of the status of the test starts and will send out a meeting notice for around noon on the 21<sup>st</sup>.

Meeting adjourned at 4:41 PM.

Detroit DD13 Task Force Attendance

Member	Company	E-Mail Address	Phone Number	Sign-In
Bob Campbell	Afton	<a href="mailto:bob.campbell@aftonchemical.com">bob.campbell@aftonchemical.com</a>	804-788-5340	<i>BC</i>
Tom Wingfield	Chevron Phillips	<a href="mailto:wingftm@cpchem.com">wingftm@cpchem.com</a>		
Greg Brazunas	Detroit	<a href="mailto:gregory.brazunas@daimler.com">gregory.brazunas@daimler.com</a>	313-592-7007	PHONE IN
John Cruz	Detroit	<a href="mailto:john.cruz@daimler.com">john.cruz@daimler.com</a>	313-592-7469	PRESENT
Mesfin Belay	Detroit	<a href="mailto:mesfin.belay@daimler.com">mesfin.belay@daimler.com</a>	313-592-5970	
Jeremy Dean	Detroit	<a href="mailto:jeremy.dean@daimler.com">jeremy.dean@daimler.com</a>	313-592-7434	<i>J.D.</i>
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Detroit DD13 Task Force Attendance

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# DAIMLER

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## **Development of the DDC Scuffing test for use in the PC-11 category and/or as a DDC specification test**

- Task Force Update January 14<sup>th</sup> 2013
- John Cruz - Daimler
- Jim Matasic - LZ

## The story to date

- A test was developed that showed repeatability and discrimination between two relevant oils.
- A parts change necessitated a change of plans and we are re-doing the work currently.



## Compliance to test acceptance criteria – data anticipated for acceptance of the test in January 2014

- Discrimination – 9-15 test results are anticipated covering the two oils, showing discrimination and repeatability/reproducibility using the latest procedure.
  - **In Process**
- Operational use at test laboratories - Each laboratory will have run at least two operationally valid tests using the latest test procedure.
  - **In Process**
- Lab Inspection – Engine builds have been conducted at both Lubrizol and at a common facility for IAR and SWRI support. Lab inspections complete as well.
  - **Complete**
- Critical parts availability - The current batch supply of critical test parts e.g. rings is sufficient for both the precision matrix and subsequent reference periods
  - **Complete**

## Operational Specifics (1 of 3)

	Step	Time (min:sec)	Total Time (hr:min:sec)	Speed (RPM)	Speed Ramp (min:sec)	Torque (Nm)	Torque Ramp (min:sec)
Flush Warm-up	1			600		idle	
	2	30:00	30:00	1800	3:00	600	3:00
Flush	1	15:00	15:00	1800		600	
Flush Cool Down	1	02:00	00:02:00	600	02:00	idle	
Oil Change	<i>* Drain oil for 30 minutes</i>						
Test Warm-up	1		32:00	600		idle	
	2	30:00		1800	3:00	600	3:00
	3	2:00		600	2:00	idle	2:00
Test	1	02:00	250:00:00 (See table below for specific details)	600		idle	
	2	15:10		1800	00:10	800/1150/1475/1700/1825/1950	00:10
	3	02:20		900	00:10	650	00:10
	4	02:20		600	00:10	idle	00:10
	5	21:00		1100	00:10	1060/1325/1600/1875/2150/2430	00:10
	6	28:00		2000	25:00	750/1025/1300/1450/1450/1450	25:00
	7	04:00		1800	02:00	800/1150/1475/1700/1825/1950	02:00
	8	00:10		600	00:10	idle	00:10
Cool Down	1	02:00	00:02:00	600	02:00	idle	
Soak	1	240:00	04:00:00				
						50%/60%/70%/80%/90%/100%	

## Operational Specifics (2 of 3)

Test Hours	Throttle %
0-20	50
4 hr soak	
20-30	50
30-40	60
4 hr soak	
40-50	60
50-60	70
4 hr soak	
60-70	70
70-80	80
4 hr soak	
80-90	80
90-100	90
4 hr soak	
100-110	90
110-120	100
4 hr soak	
120-140	100
4 hr soak	
140-160	100
4 hr soak	
160-180	100
4 hr soak	
180-200	100
4 hr soak	
200-220	100
4 hr soak	
220-240	100
4 hr soak	
240-250	100

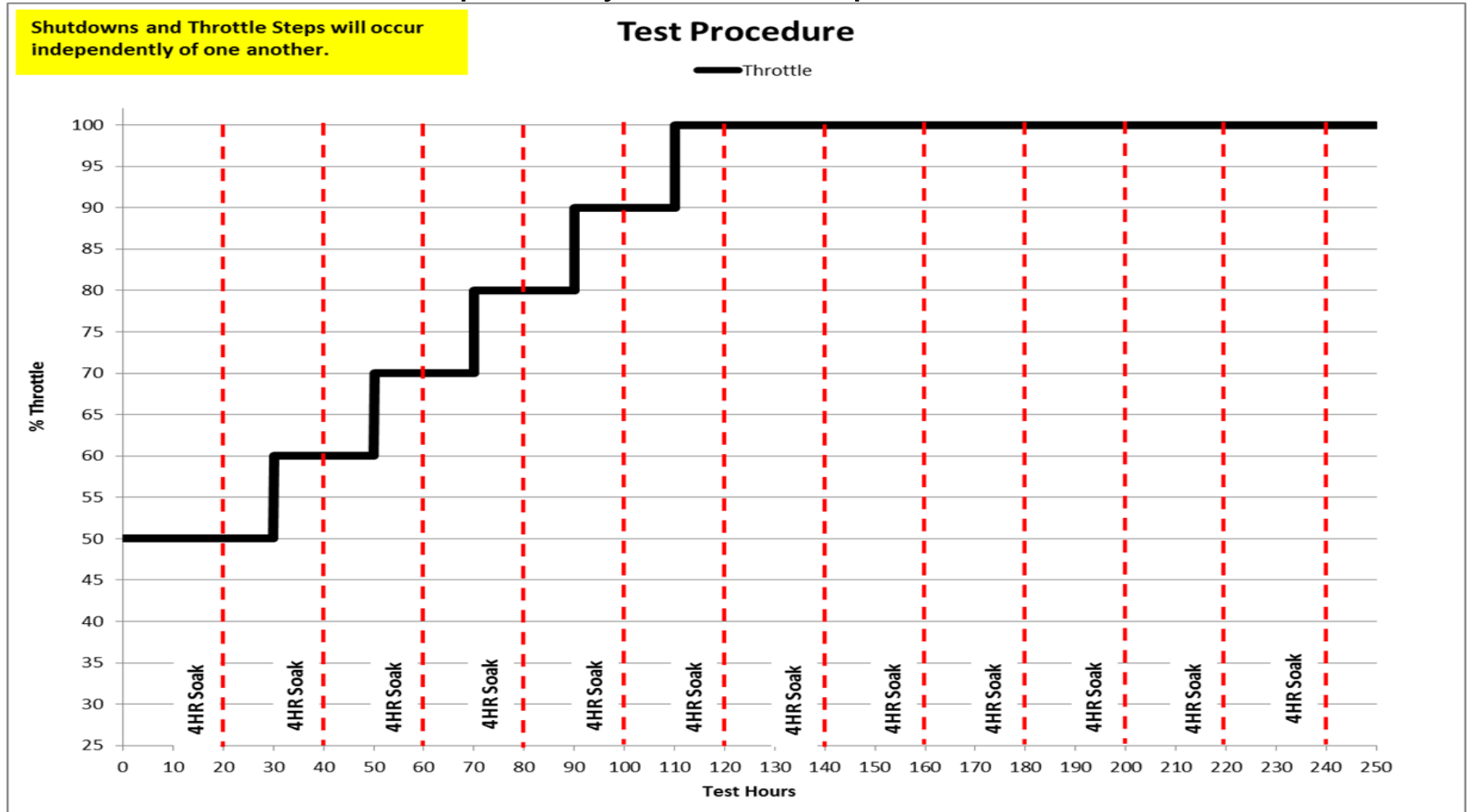
Only "Test" segment counts for Test hours. Engine shuts down every 20 hours for soak. Total test length is 200hrs (currently)

Flush Charge = 34.4kg  
Test Charge = 28.2kg

10Hz trace log taken of the 1st cycle following each soak period.

## Operational Specifics (3 of 3)

- New test procedure was agreed upon Nov. 13
  - 10% throttle steps every 20 hrs independent of 4 hour heat soaks



## Test Results (1 of 3)

- 9 complete tests on current procedure
  - 4 on “DD13-A” (2 operationally questionable)
  - 5 on “DD13-B” (3 operationally questionable)

DD13-A = Poor

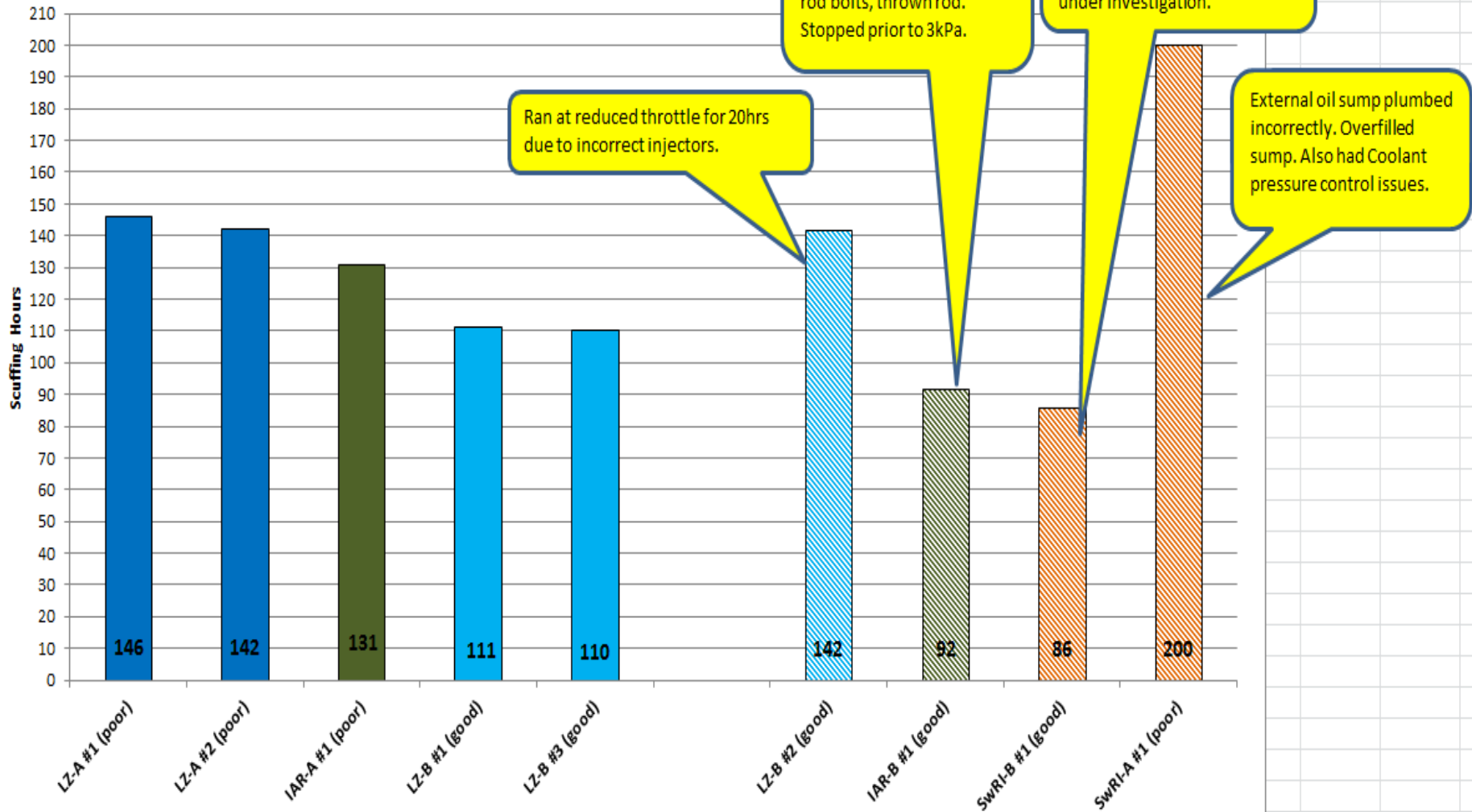
DD13-B = Good

## Test Results (2 of 3)

- LZ
  - “DD13-A”
    - 2 Tests
    - Scuffed @ 146 and 142hrs
  - “DD13-B”
    - 3 Tests
    - Scuffed @ 111 and 110hrs
    - 2<sup>nd</sup> Test scuffed @ 142hrs
      - *ran with incorrect injectors and reduced throttle*
- IAR
  - “DD13-A”
    - 1 Test
    - Scuffed @ 131hrs
  - “DD13-B”
    - 1 Test
    - Scuffed @ 92hrs
      - *3 unscheduled shutdowns due to high fuel temp/pressure issues and found loose rod bolts, failed connecting rod*
- SwRI
  - “DD13-A”
    - 1 Test
    - No scuff @ 200hrs
      - *External oil system plumbed incorrectly, coolant pressure control issues*
  - “DD13-B”
    - 1 Test
    - Scuffed @ 86hrs
      - *6 unscheduled shutdowns due to low oil pressure faults in the MCM*

## Test Results (3 of 3)

### DD13 Scuffing Results



## Test Plan

LAB	"DD13-A"	"DD13-A"	"DD13-B"	"DD13-B"
IAR	131hrs			
LZ	146hrs	142hrs	111hrs	110hrs
SwRI				
		Test Complete		
		In Progress		
		Test Scheduled		

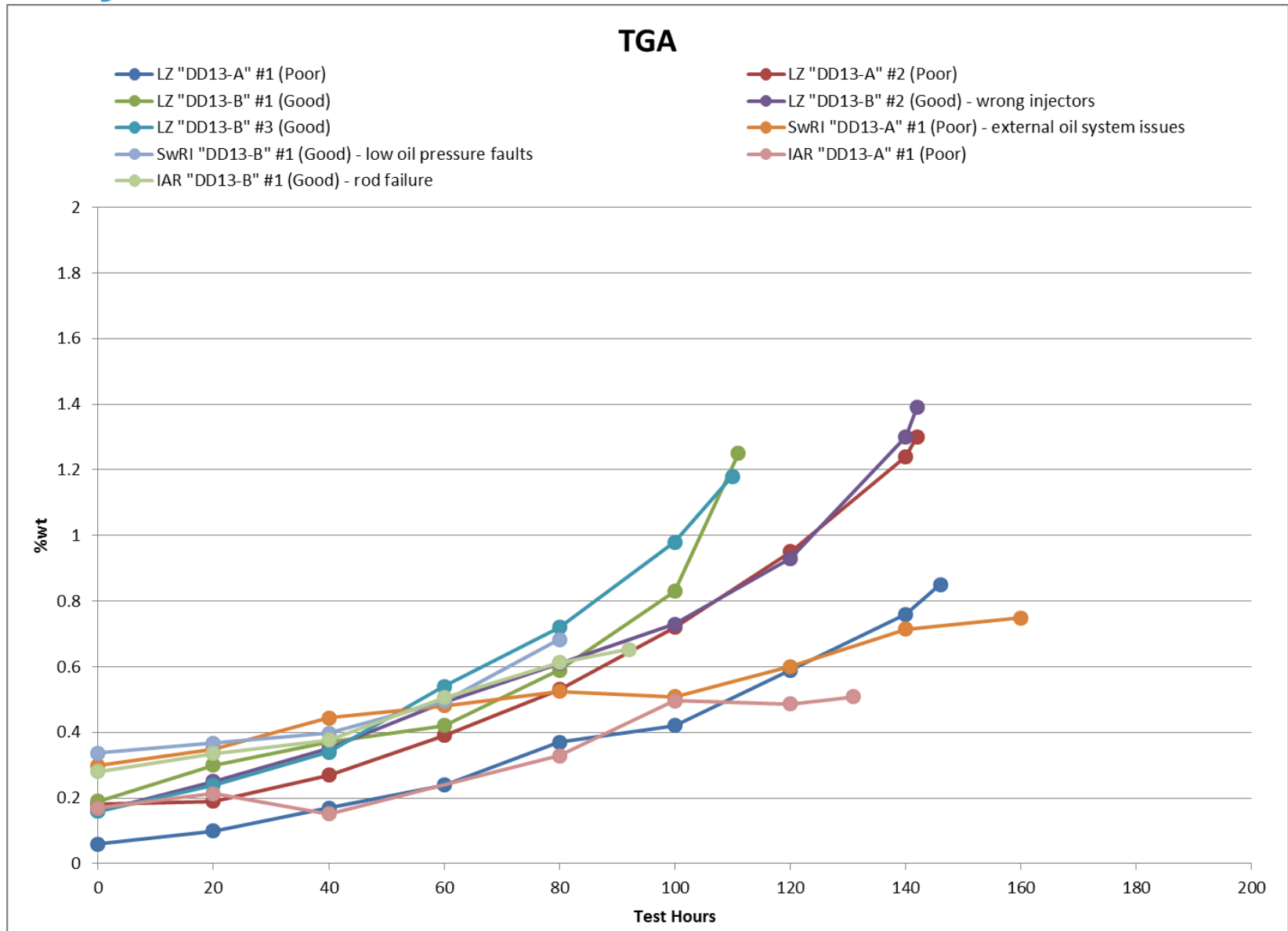
Current test results provide:

- **Repeatability** → Lubrizol's repeat test results are within 4 hrs of each other
- **Reproducibility** → IAR's DD13-A result is within 15 hrs of Lubrizol's test result
- **Discrimination** → Lubrizol's discrimination between DD13-A and DD13-B is ~30 hrs



# Appendix

## Analytical Data

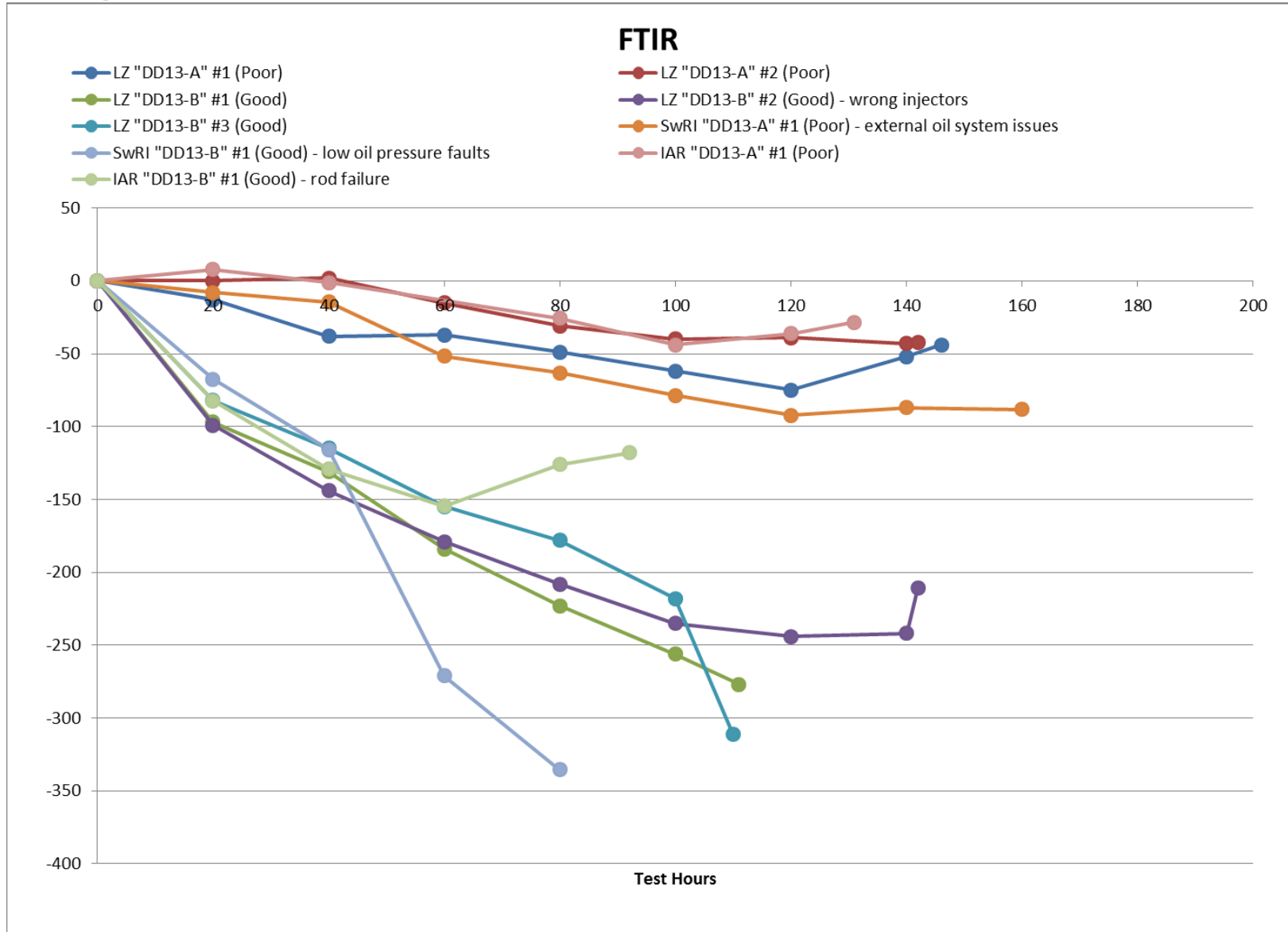






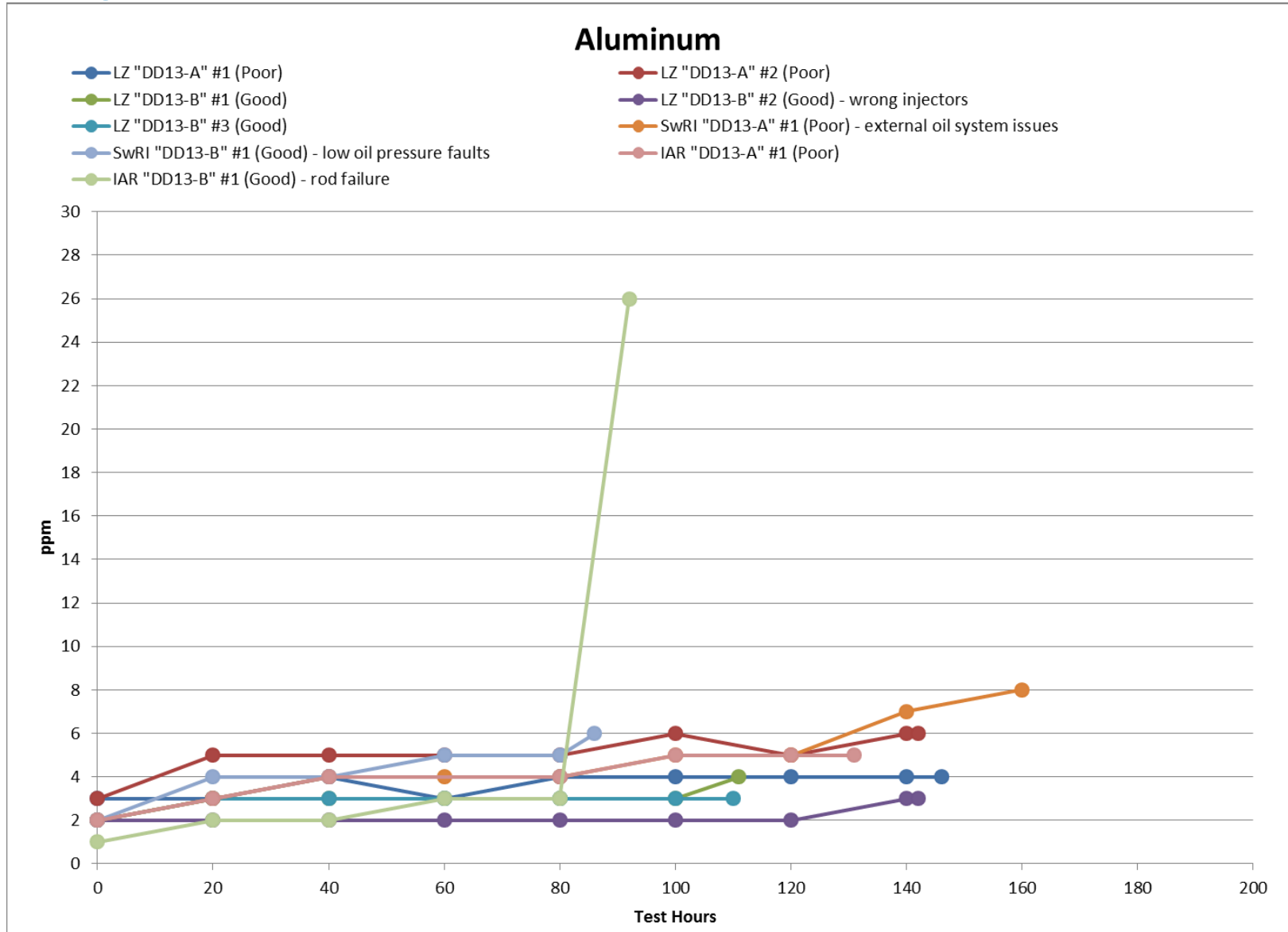


## Analytical Data





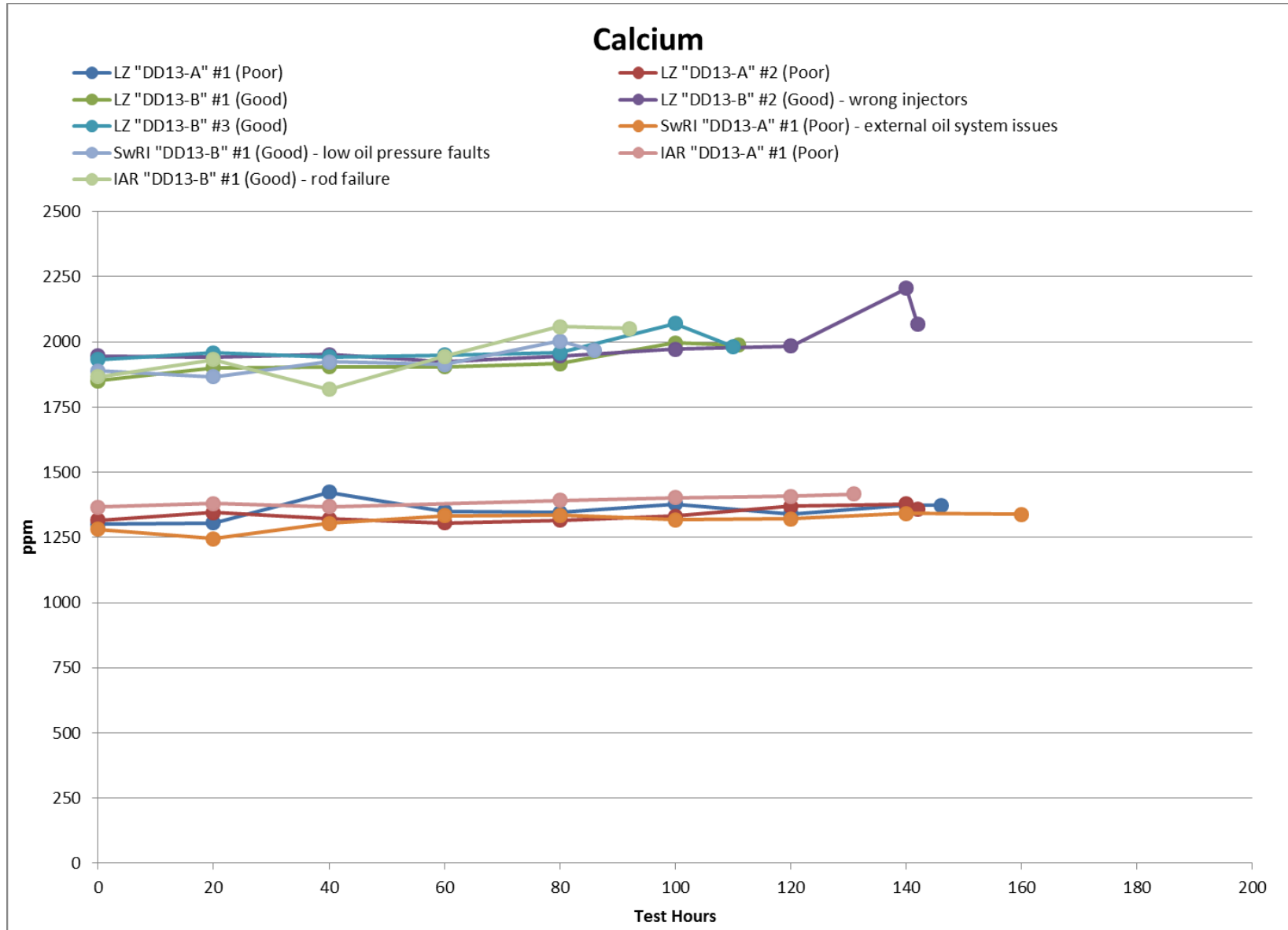
## Analytical Data







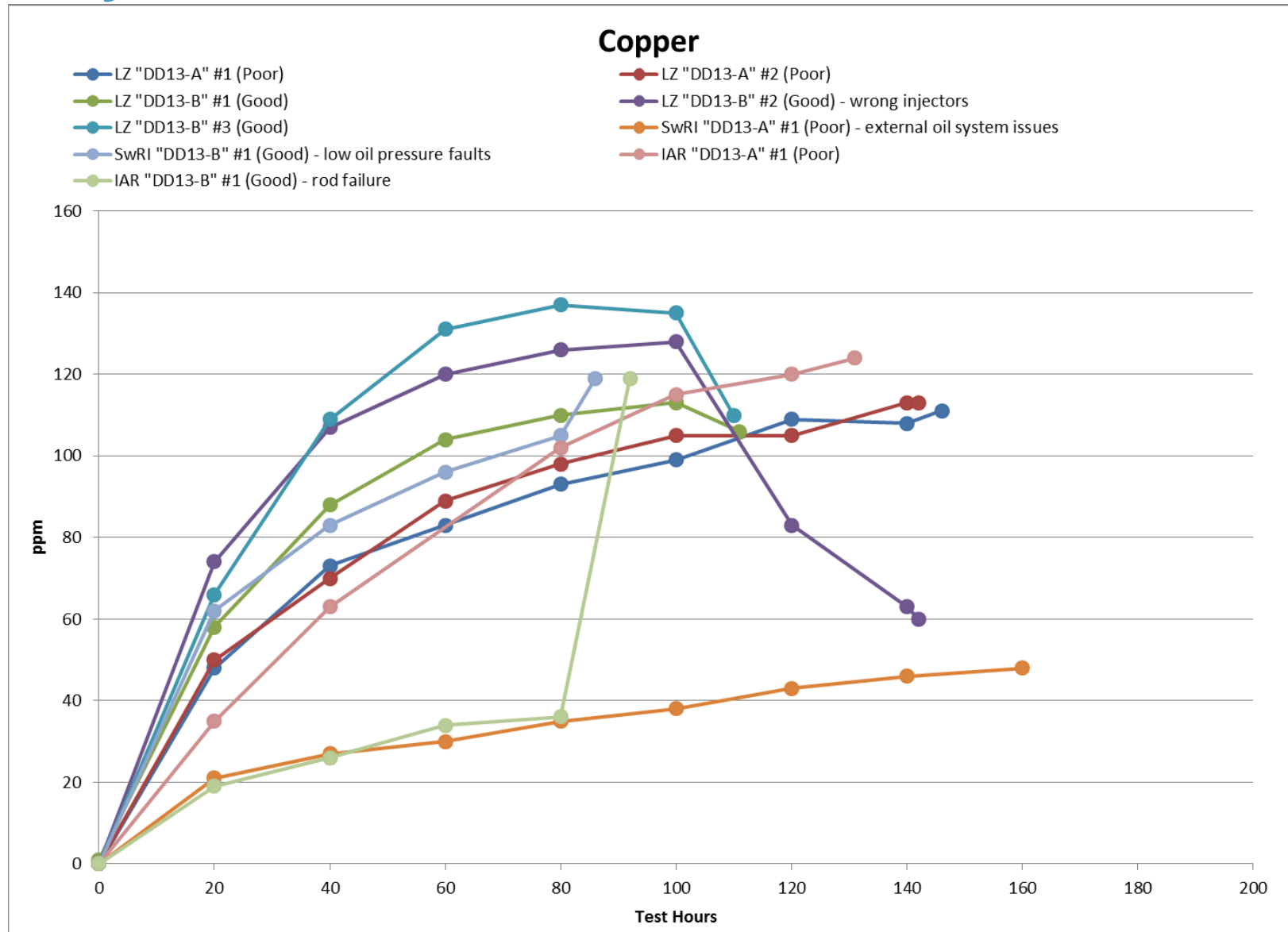
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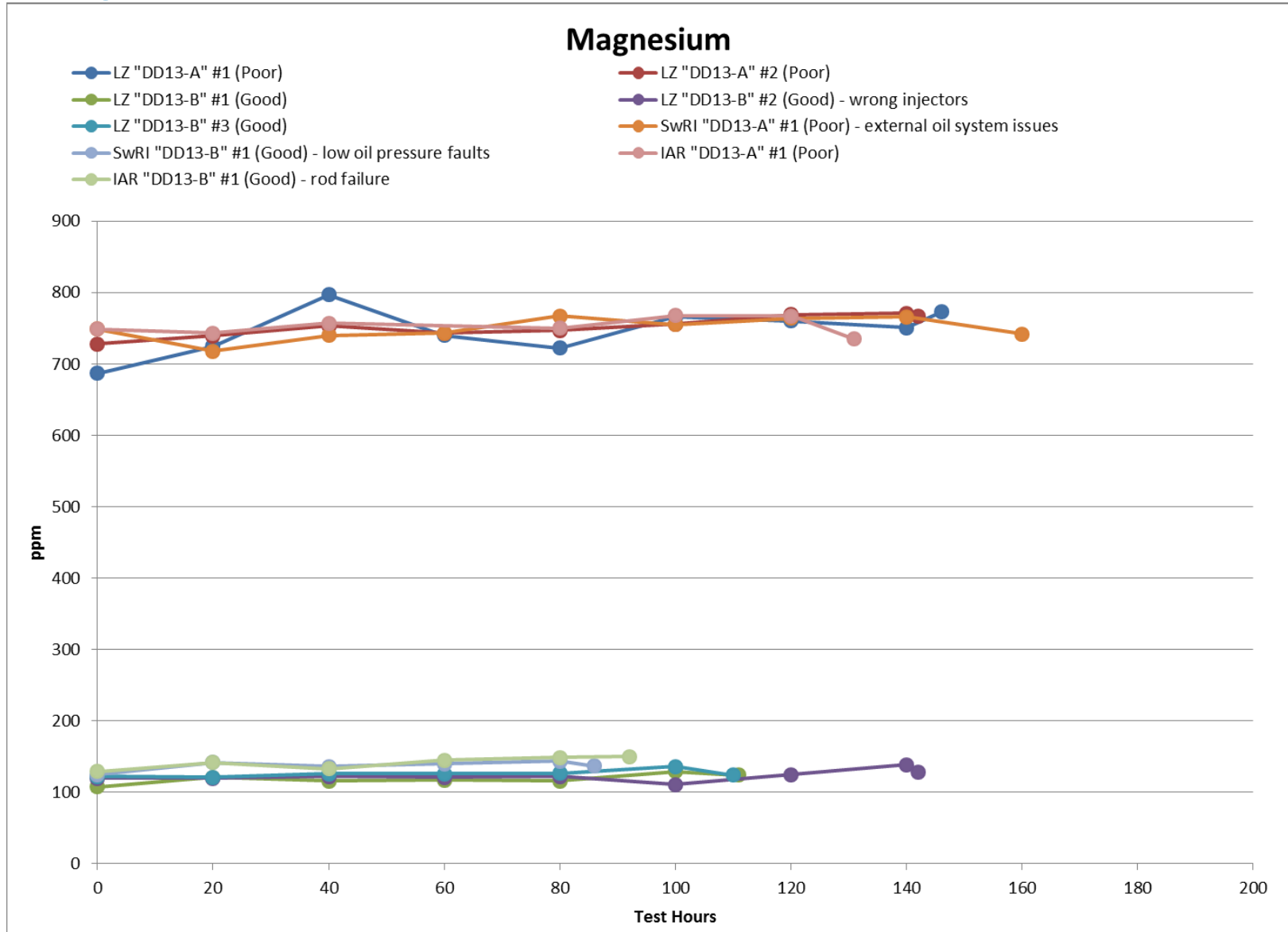




## Analytical Data

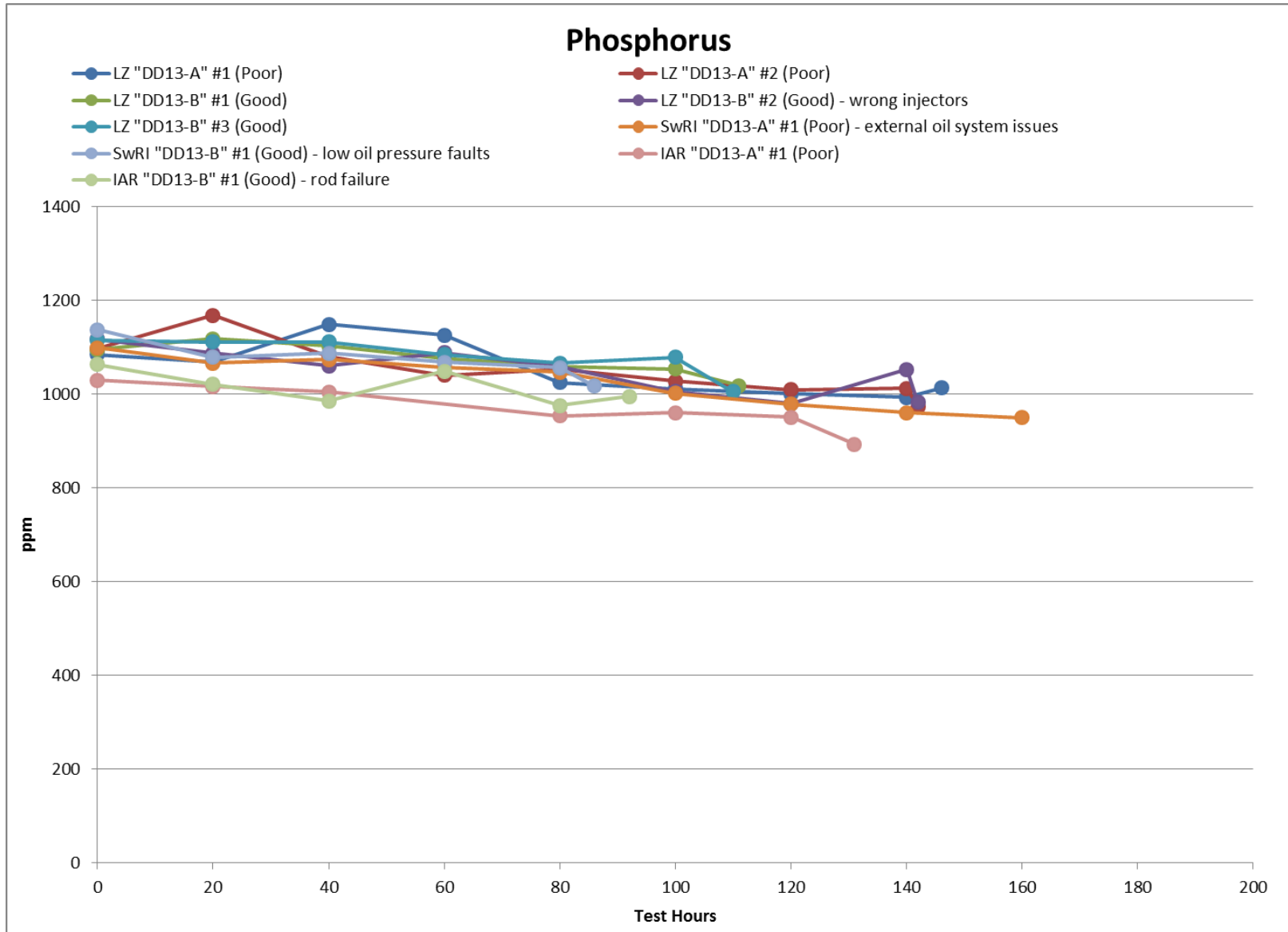


## Analytical Data





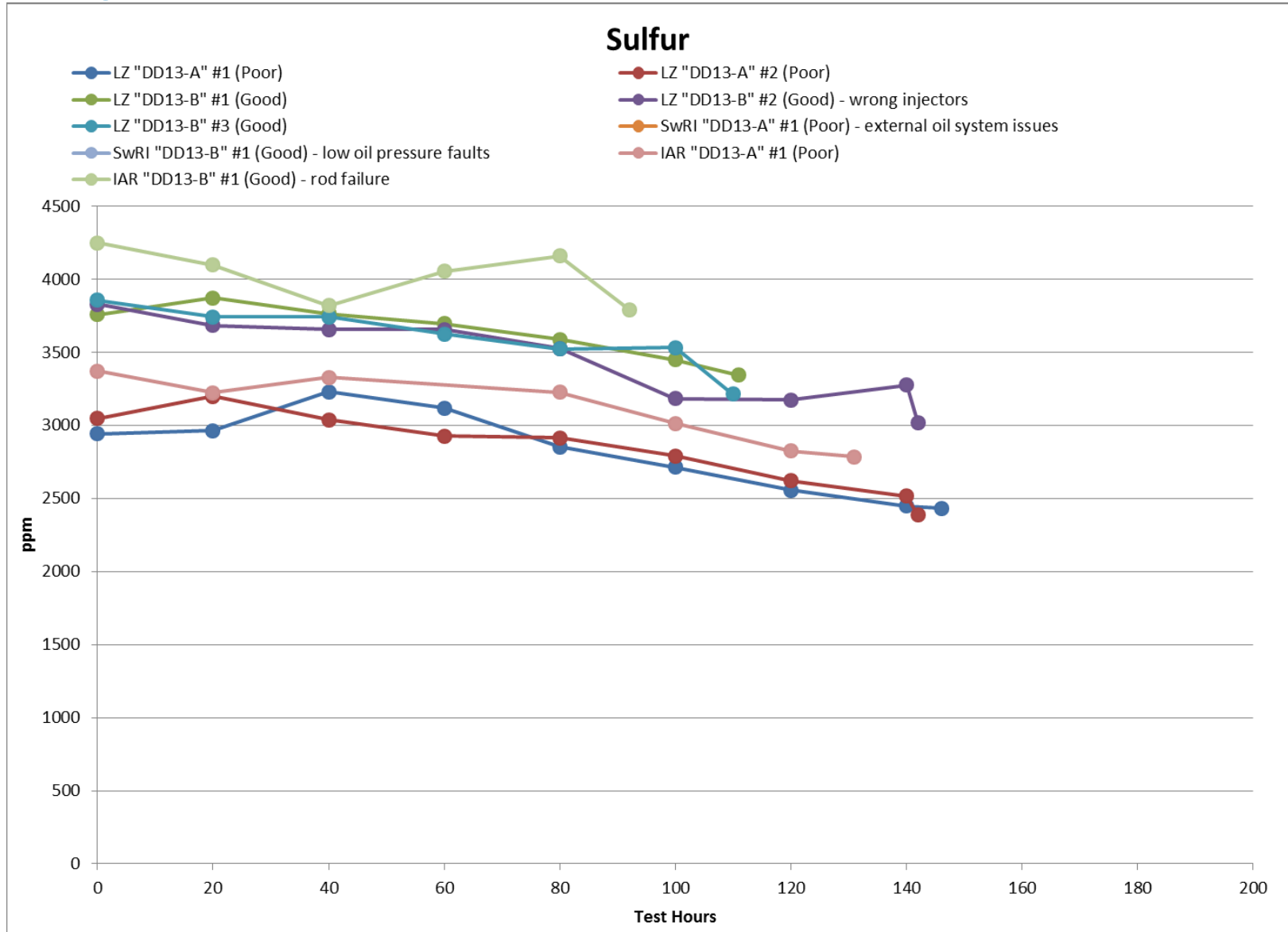
## Analytical Data





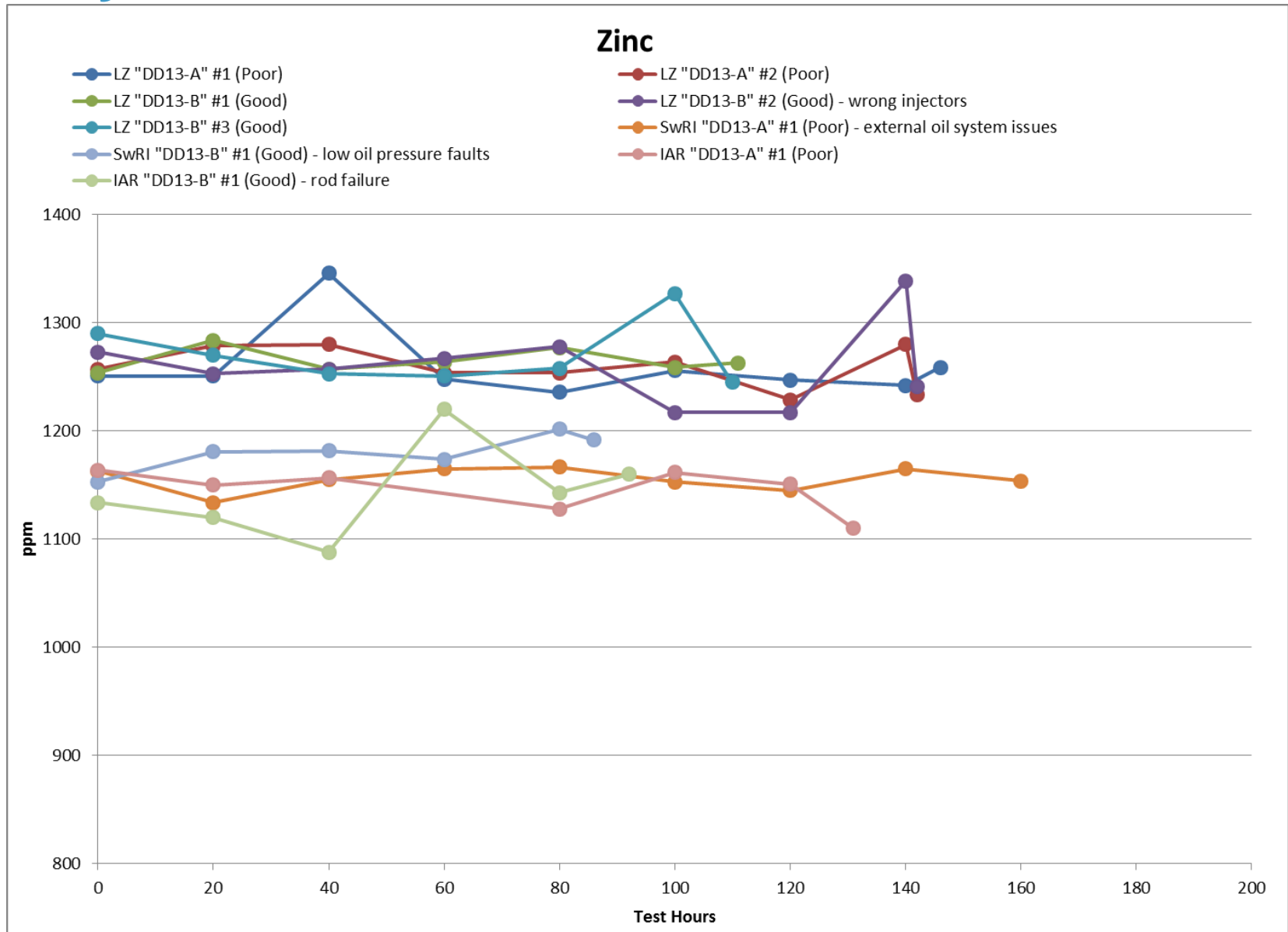


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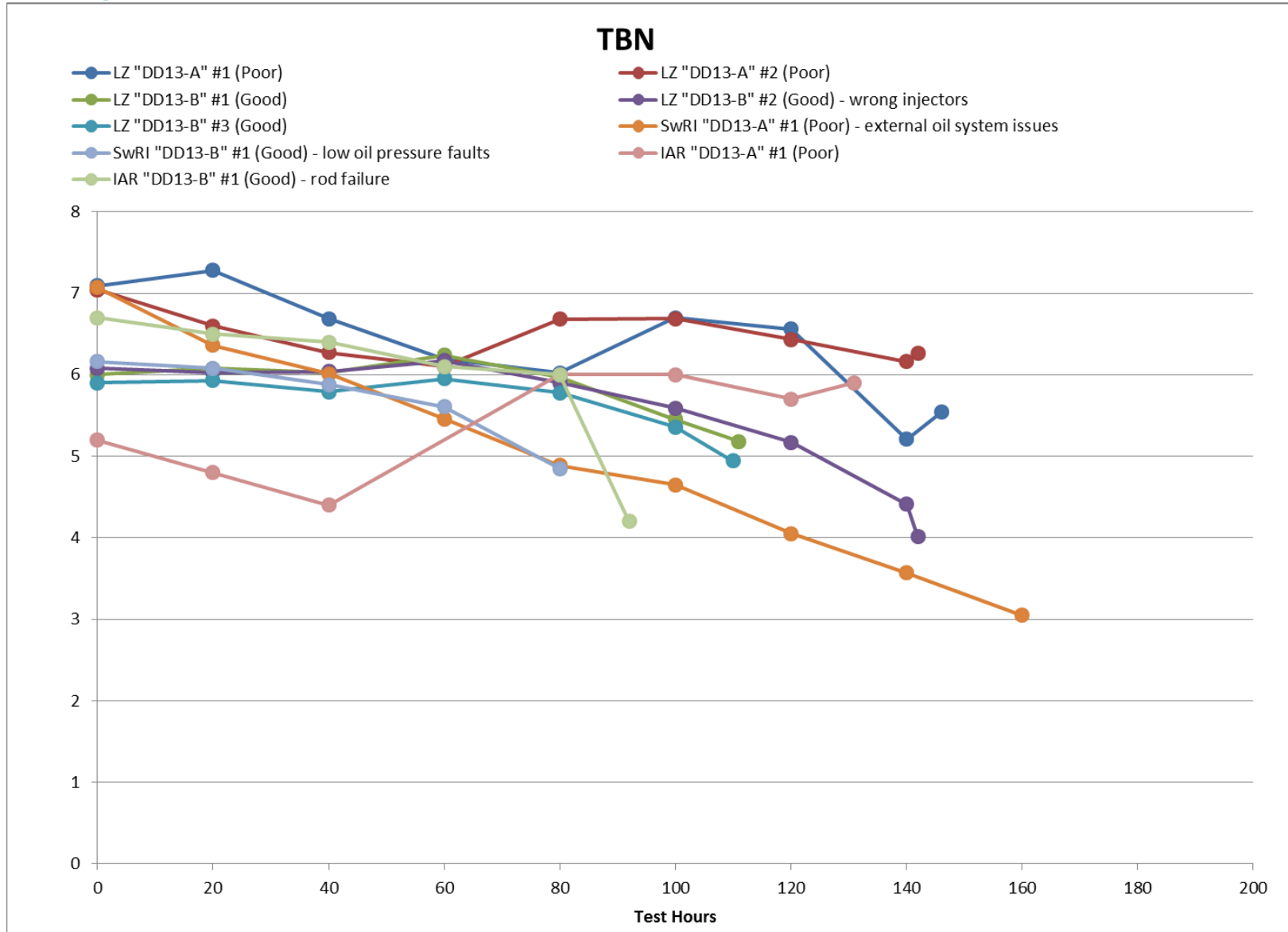




## Analytical Data

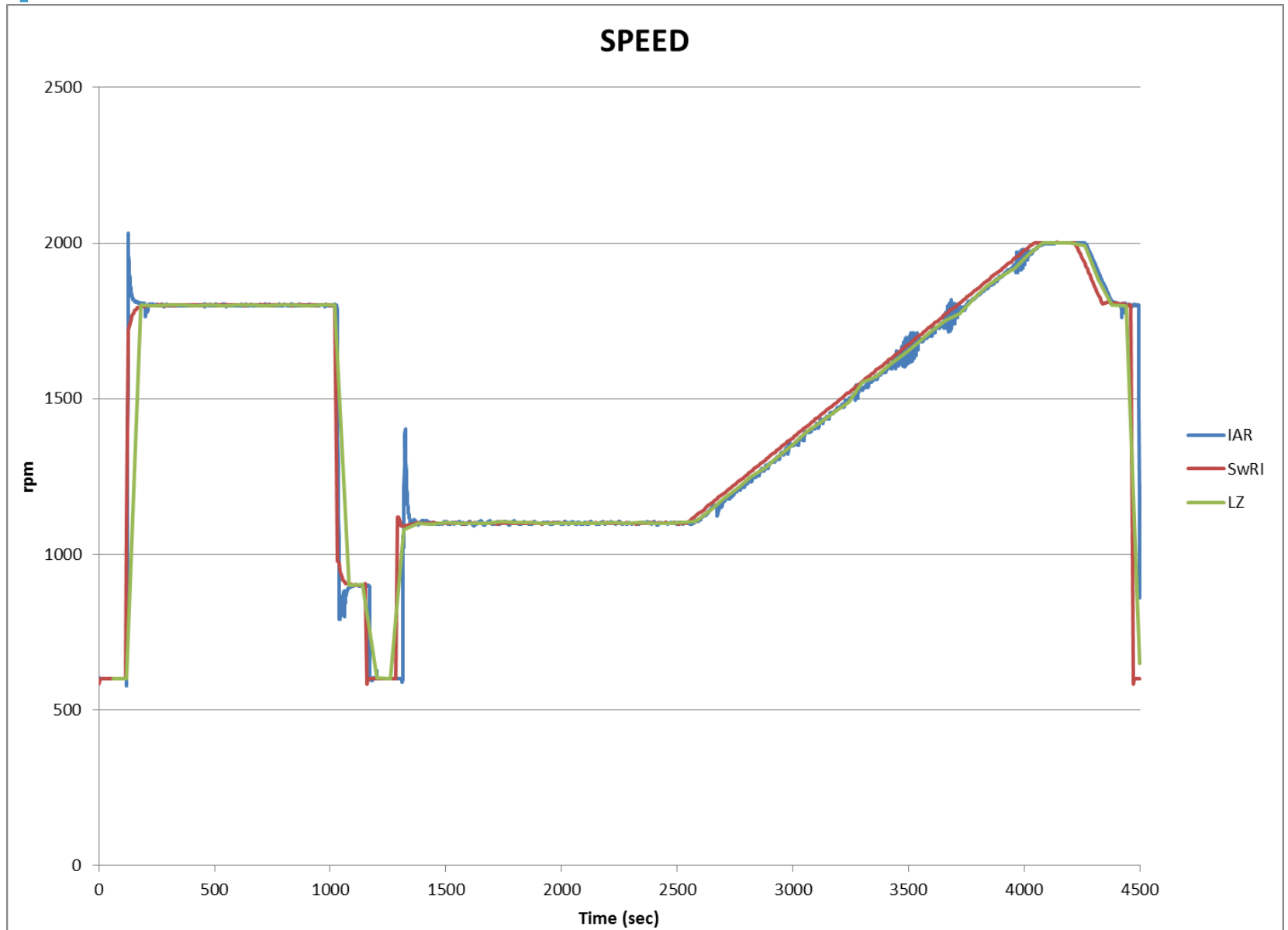


## Analytical Data

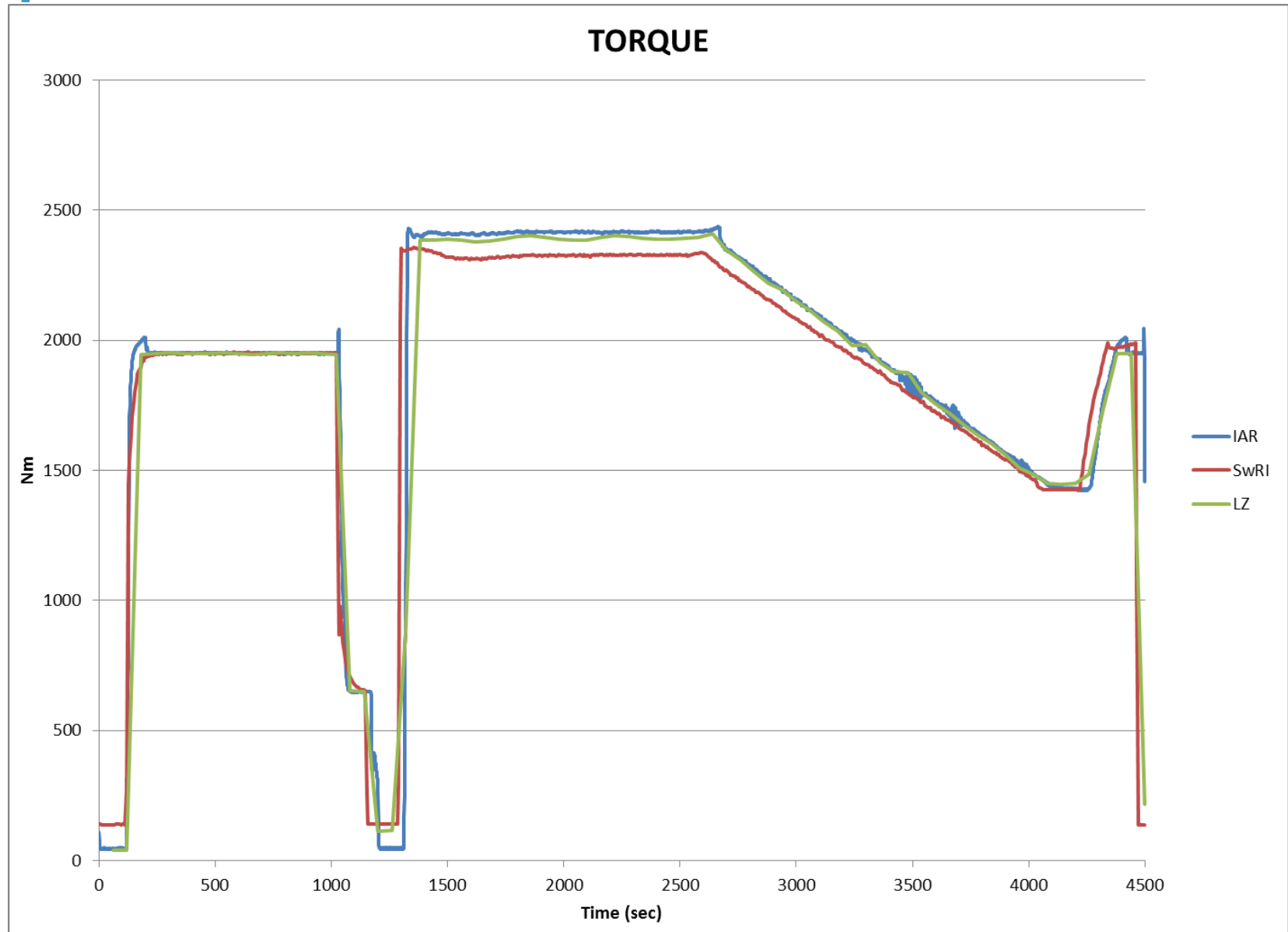




## Operational Data

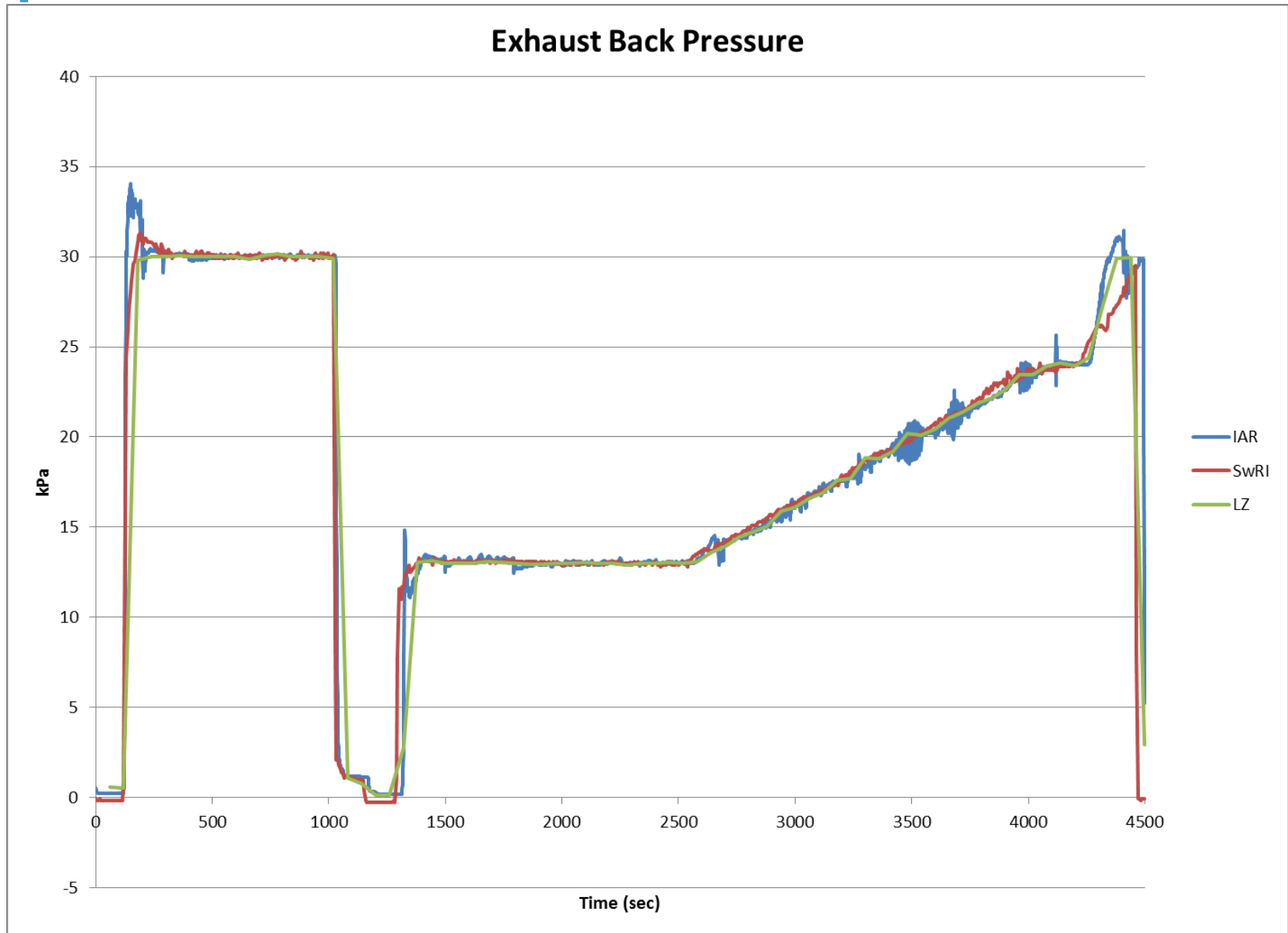


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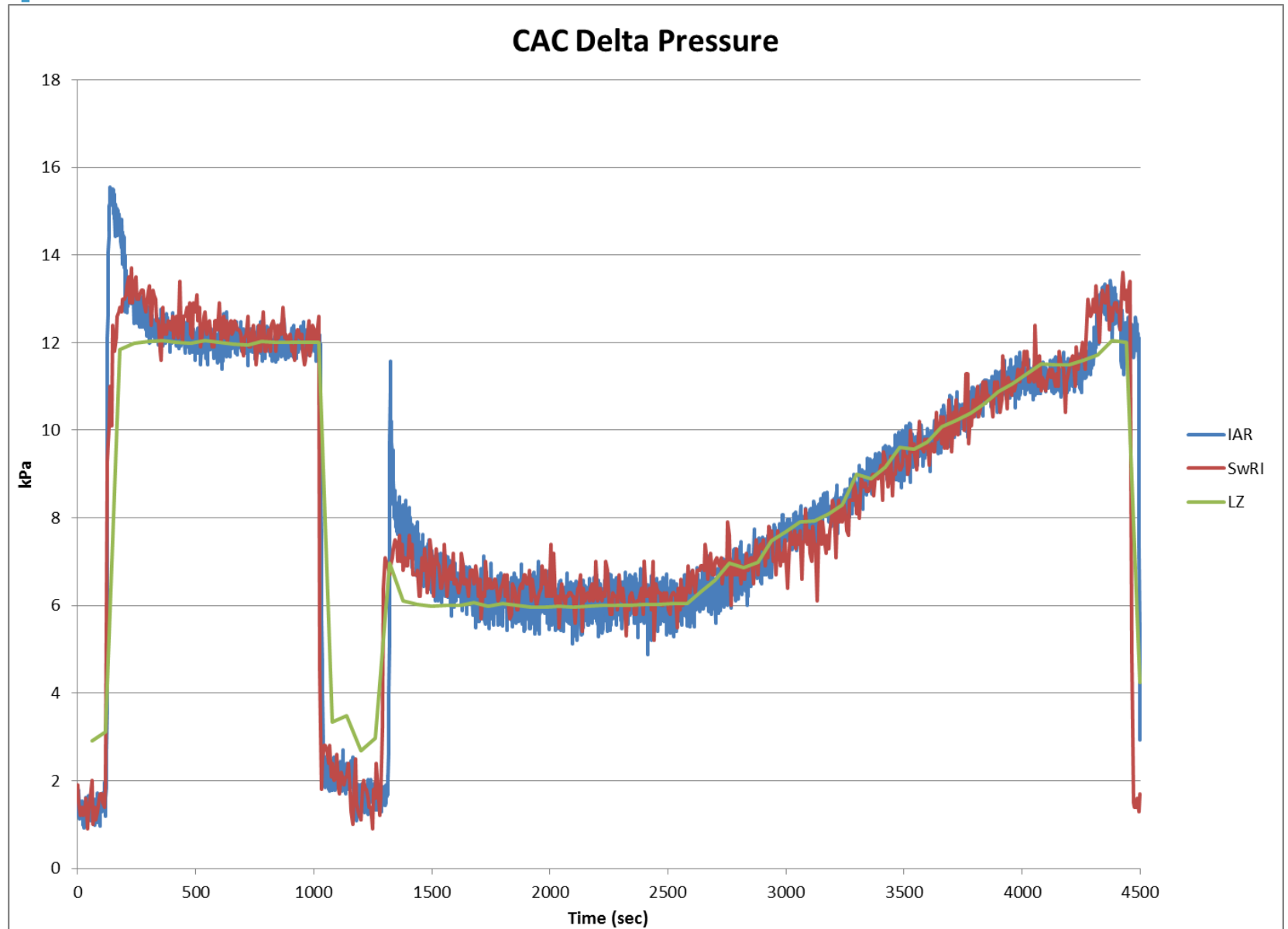




# Operational Data



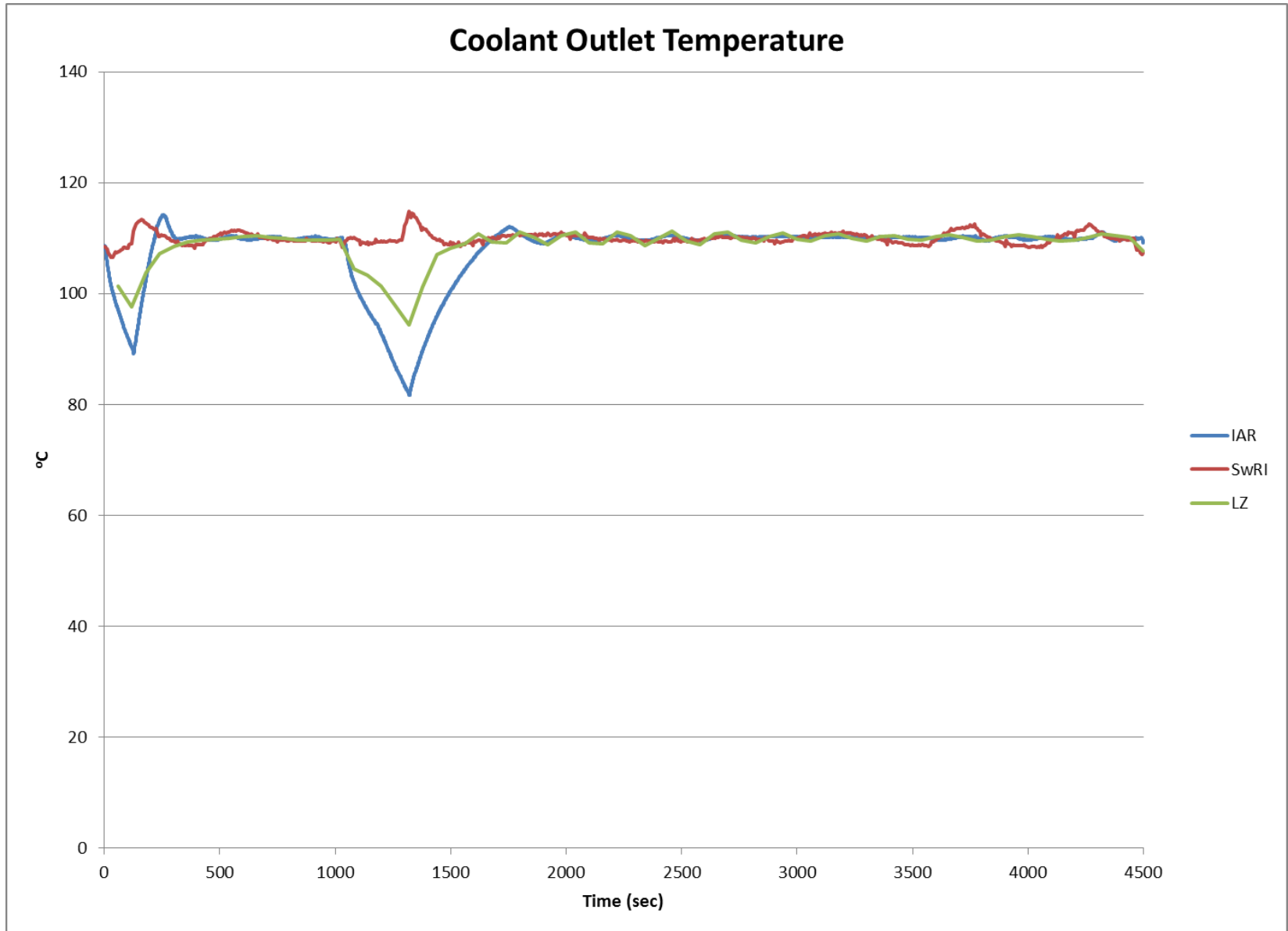
## Operational Data



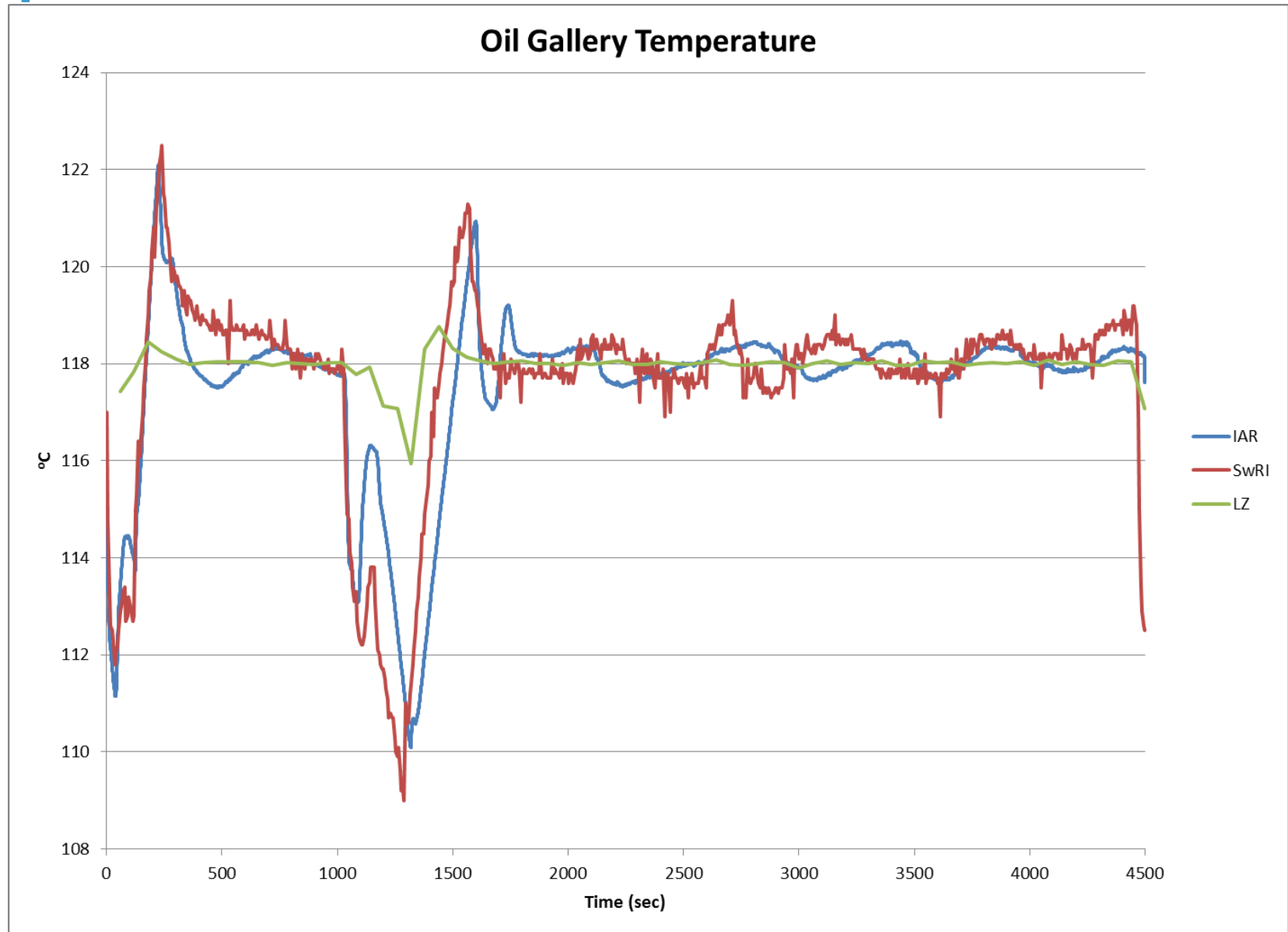
# Operational Data



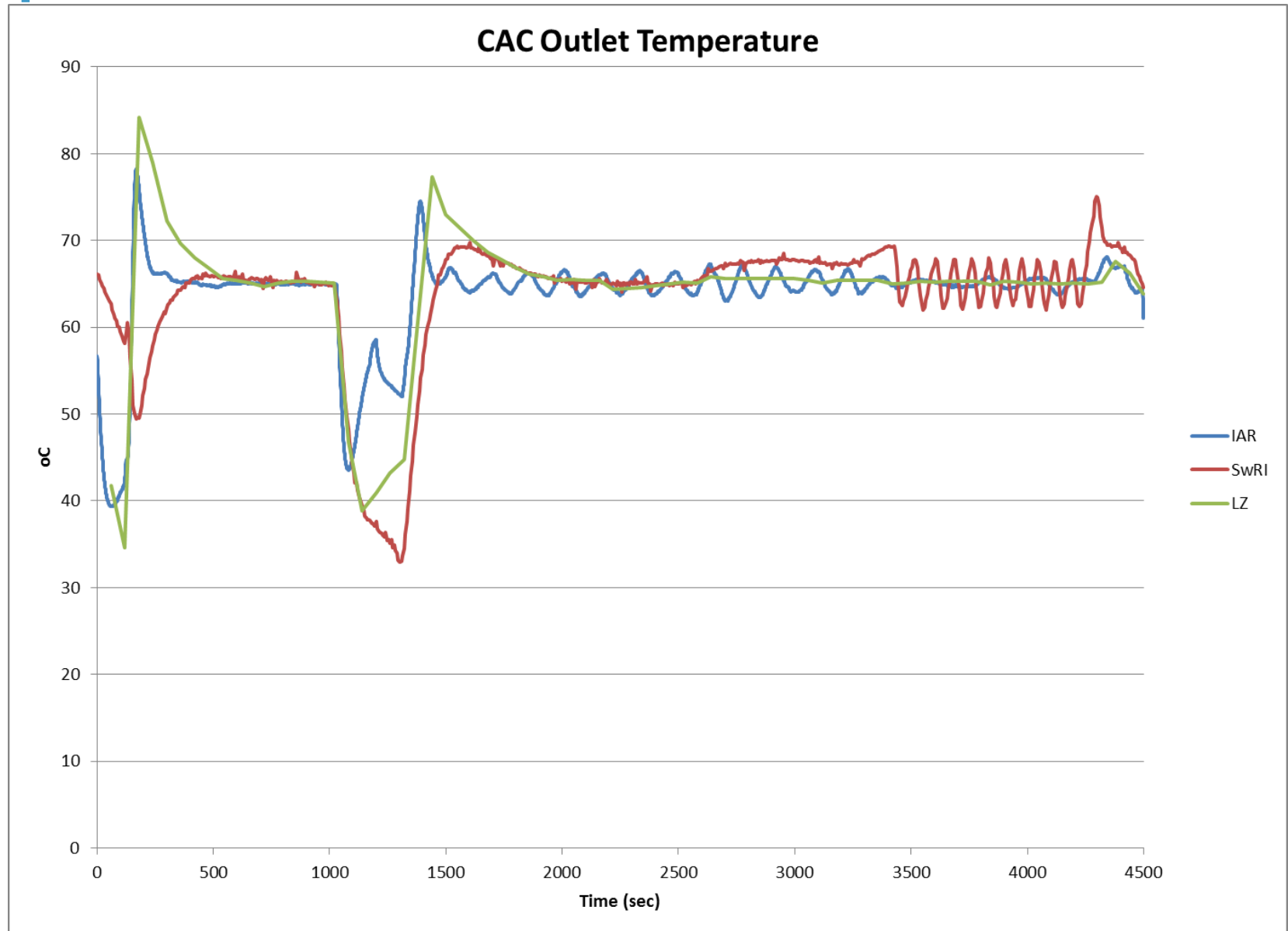
## Operational Data



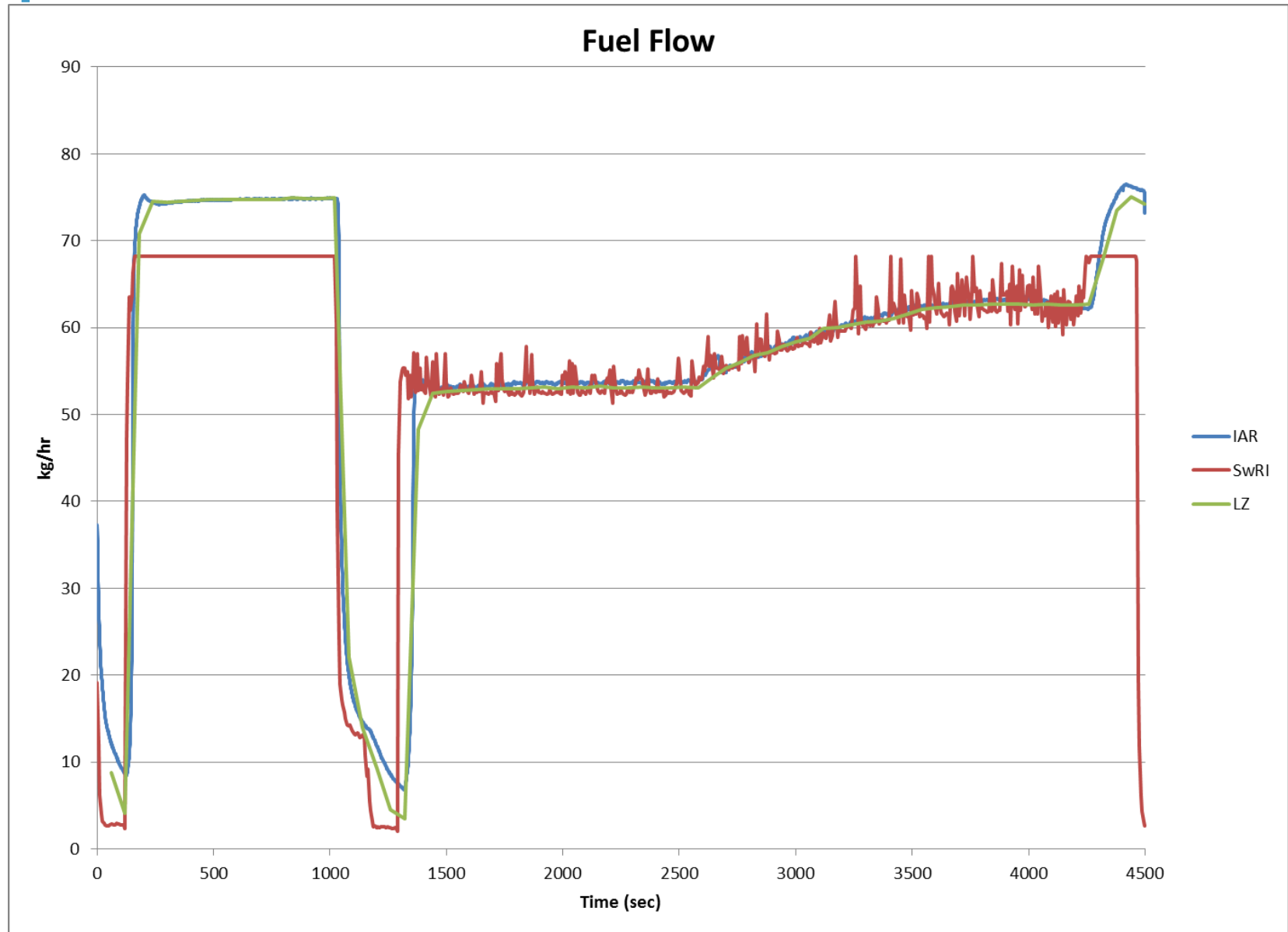
## Operational Data



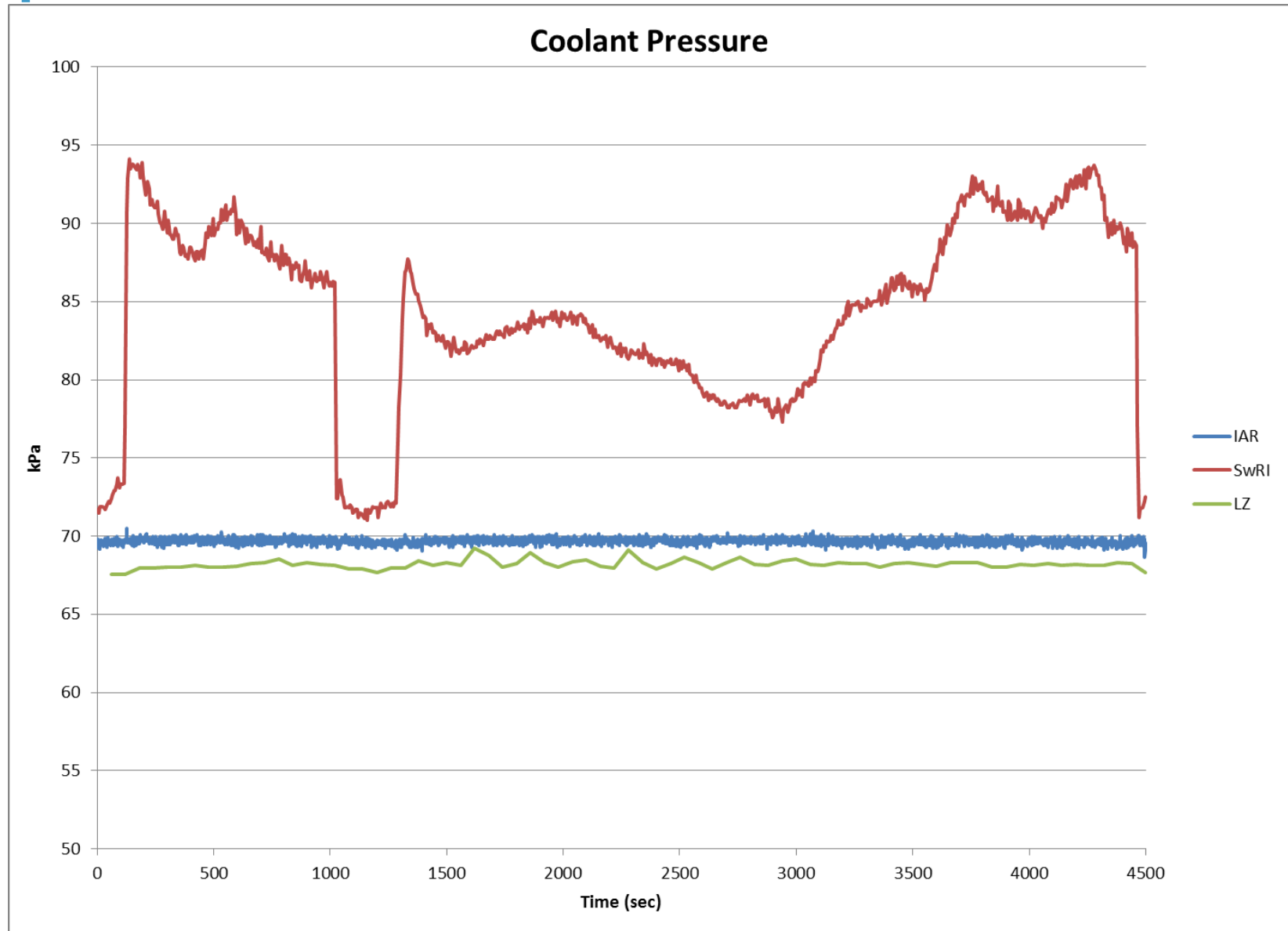
## Operational Data



## Operational Data

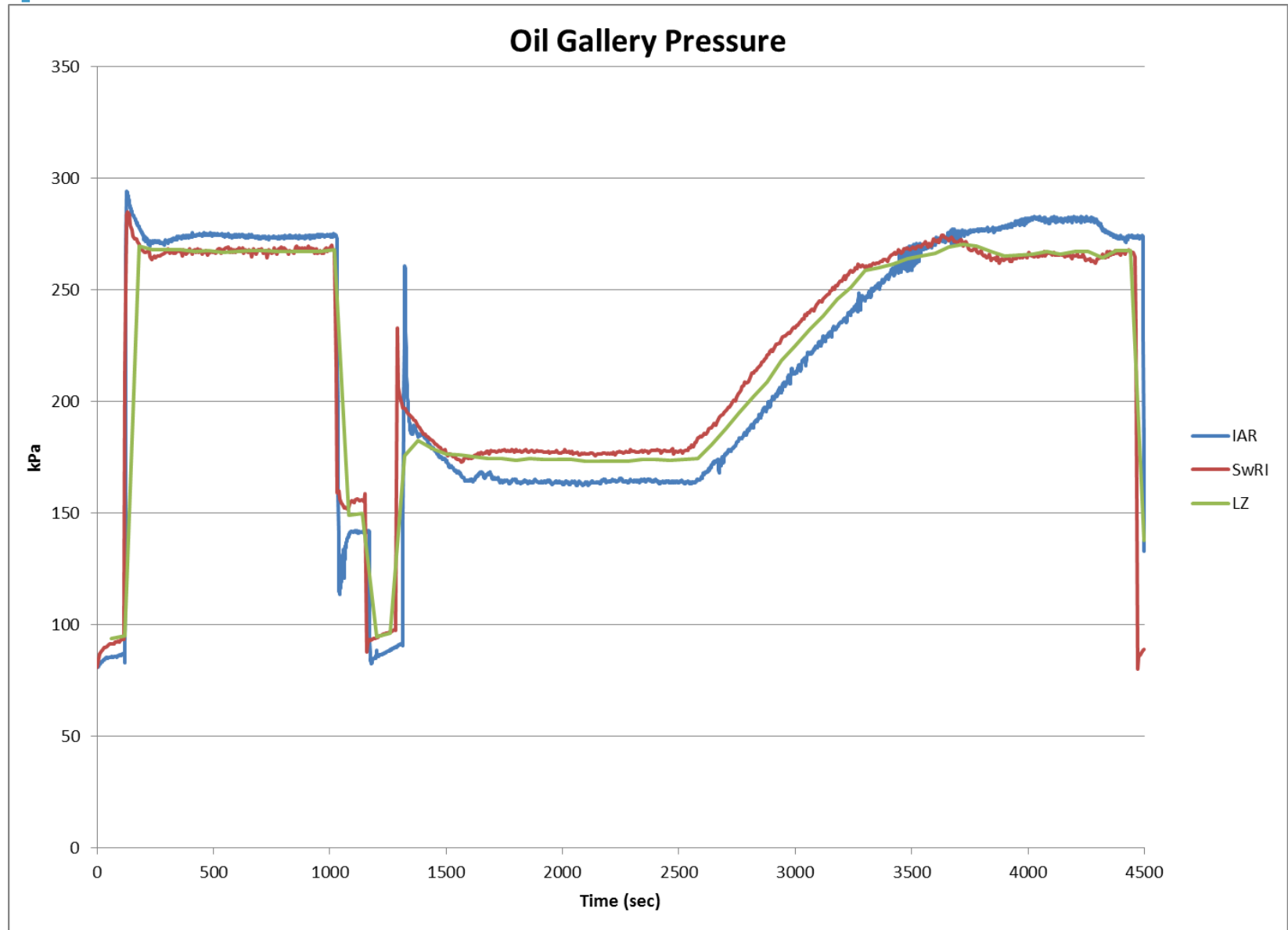


## Operational Data

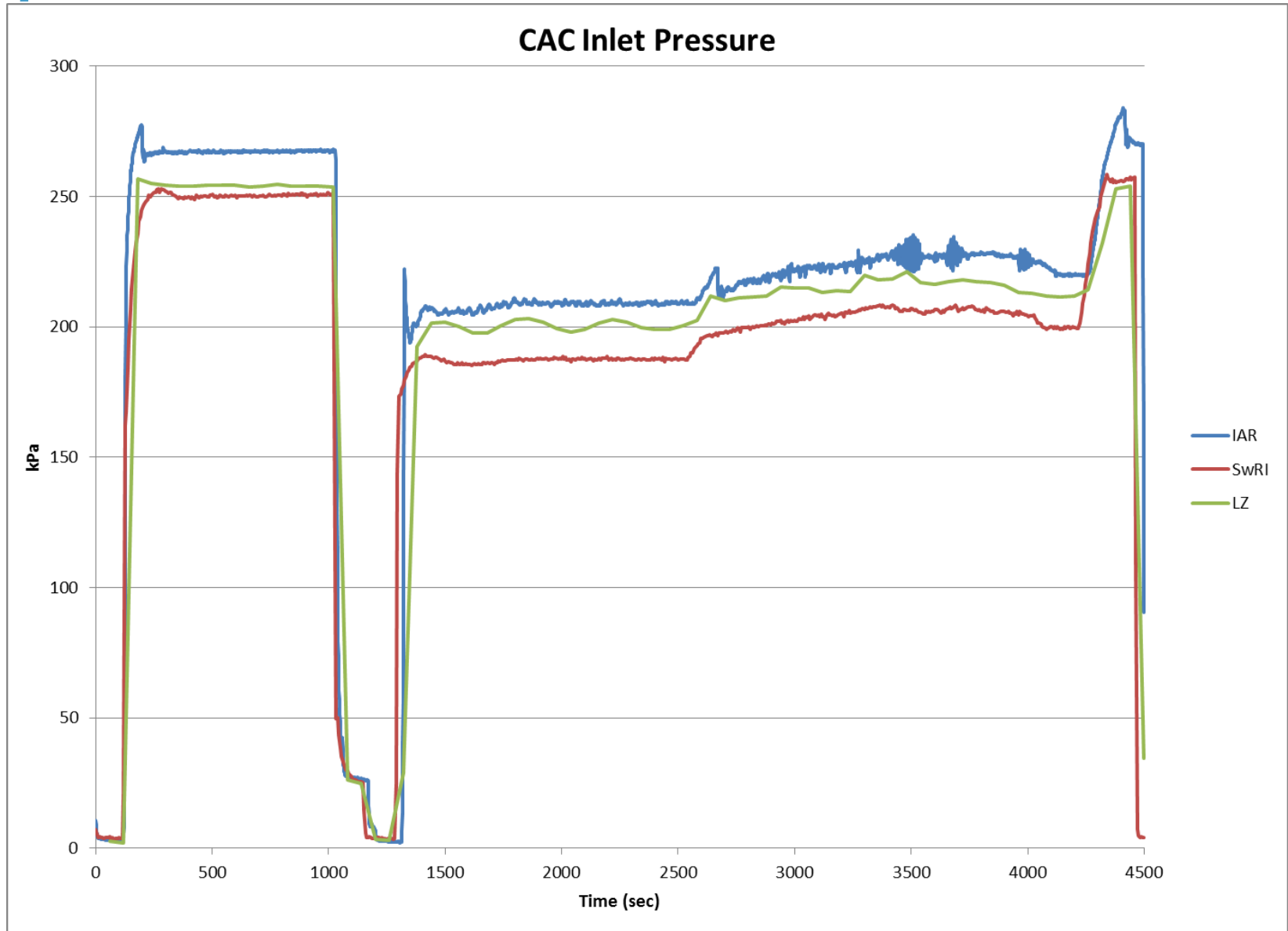




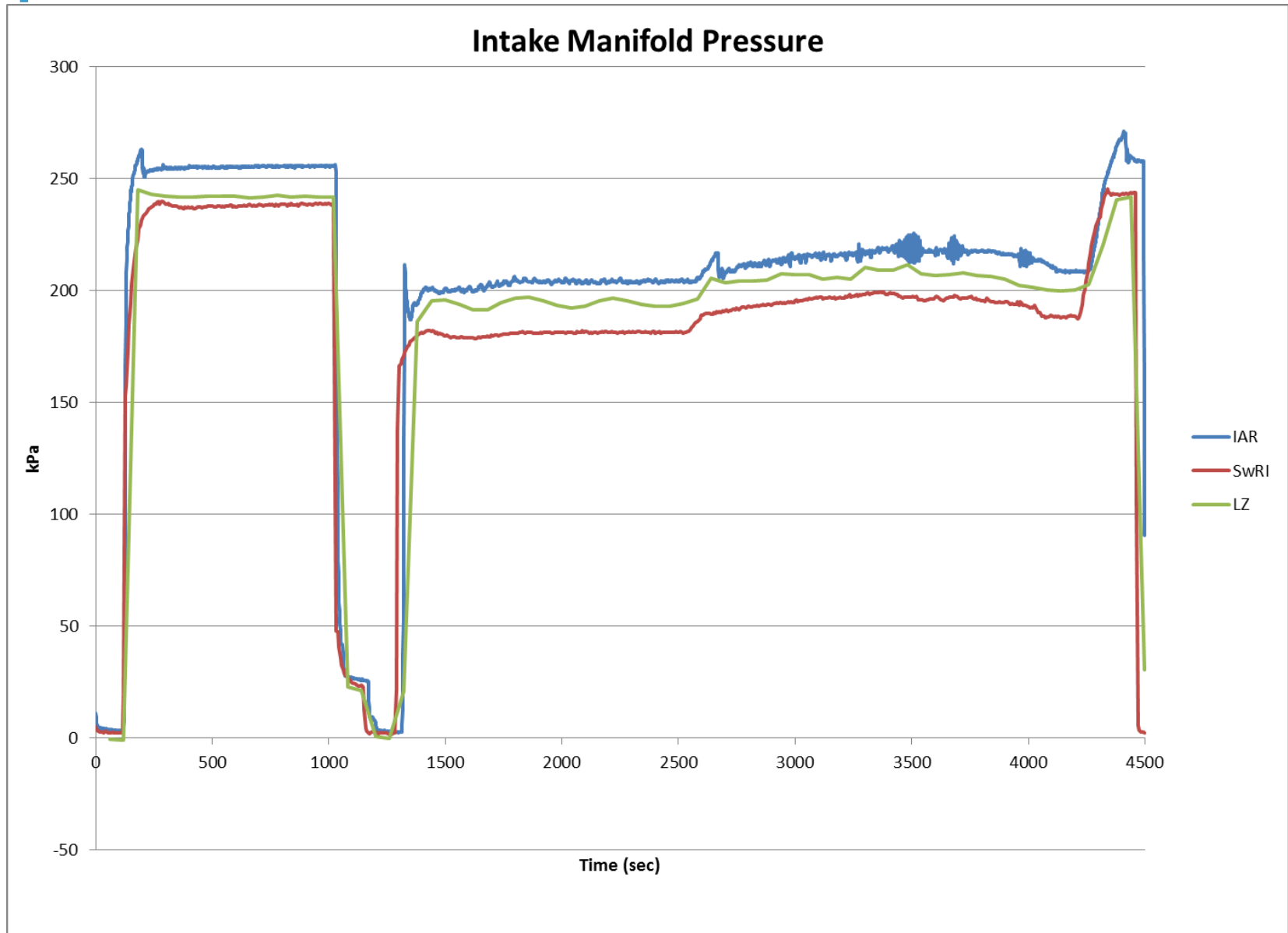
## Operational Data



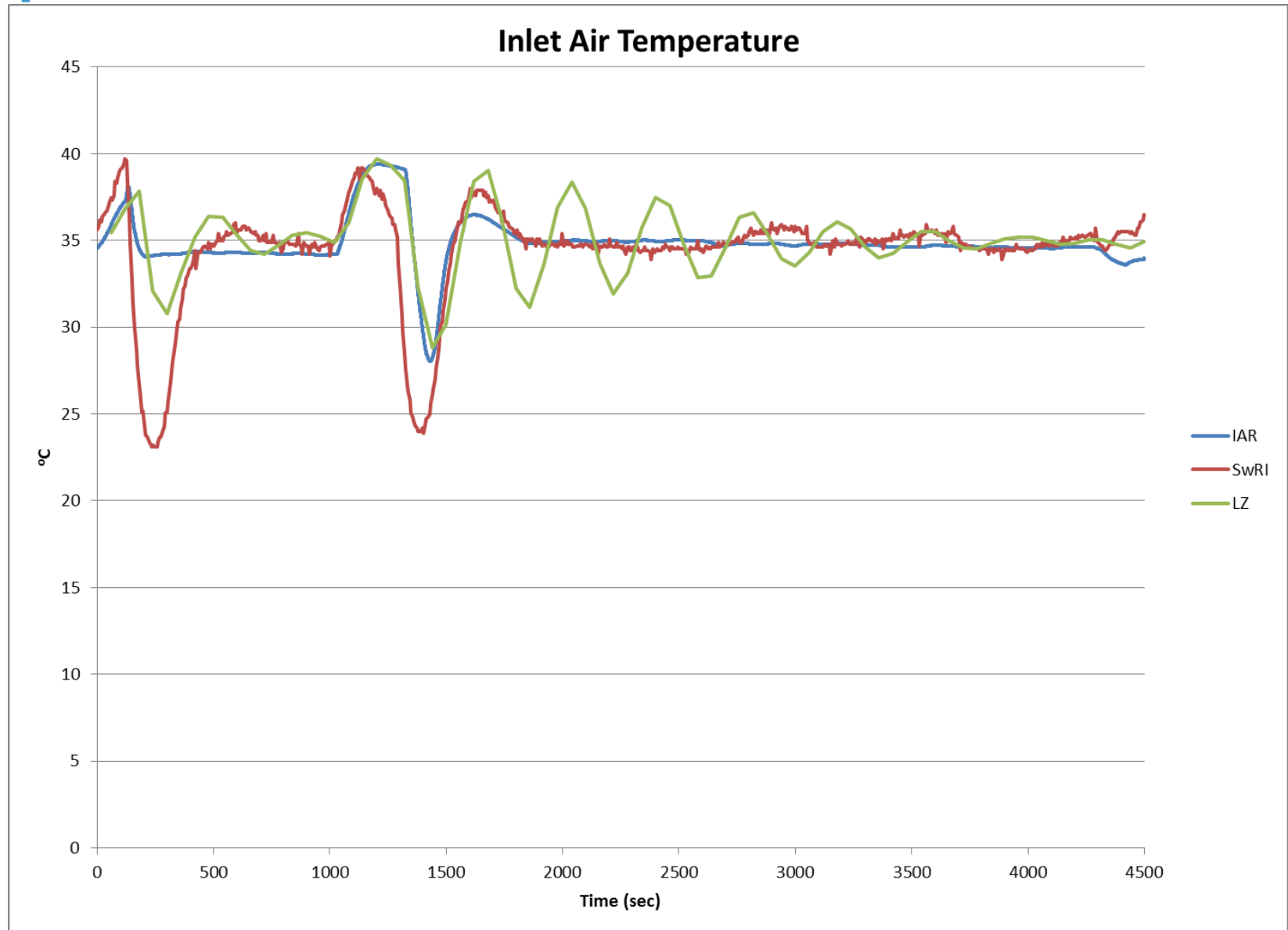
## Operational Data



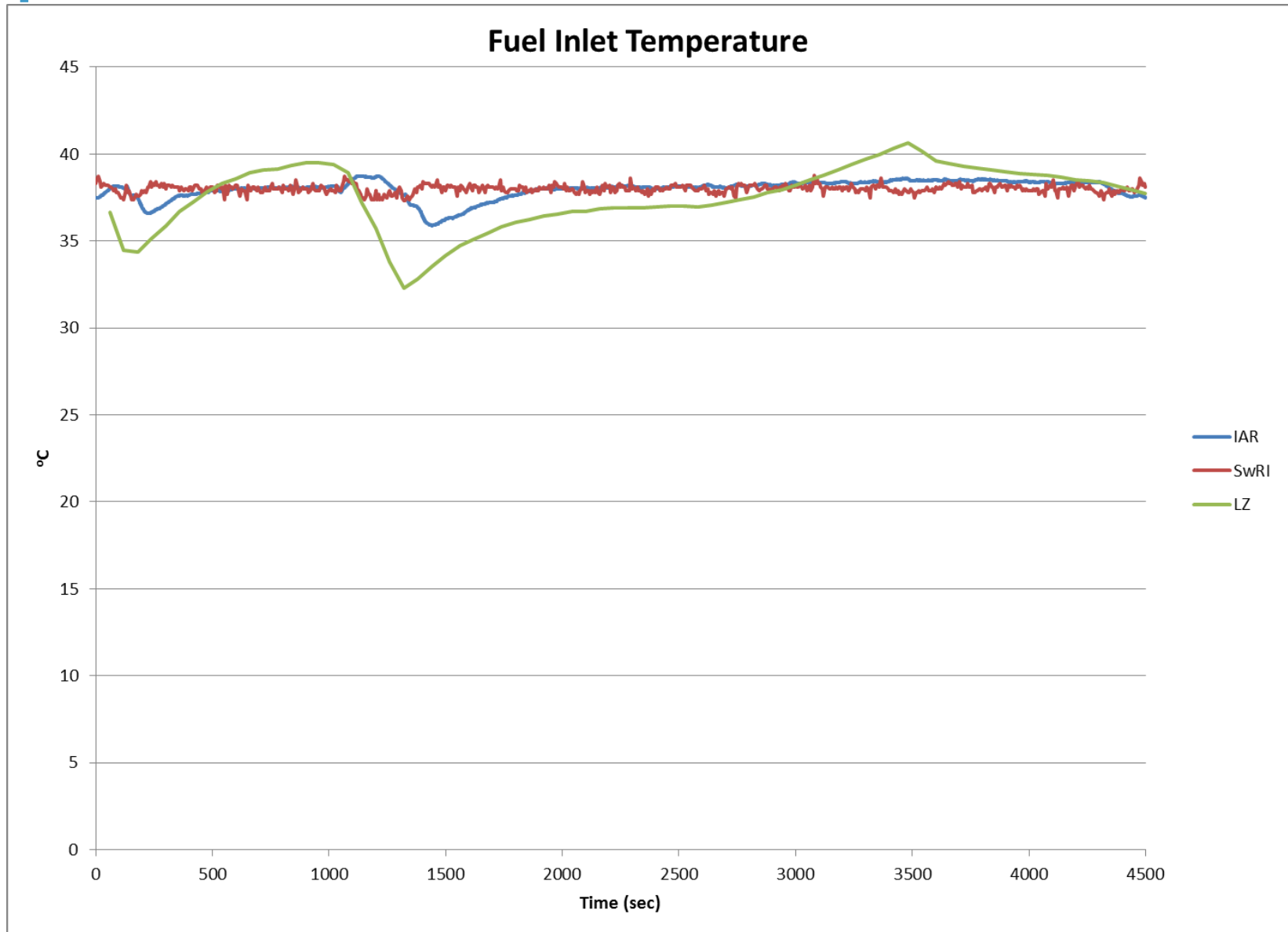
# Operational Data



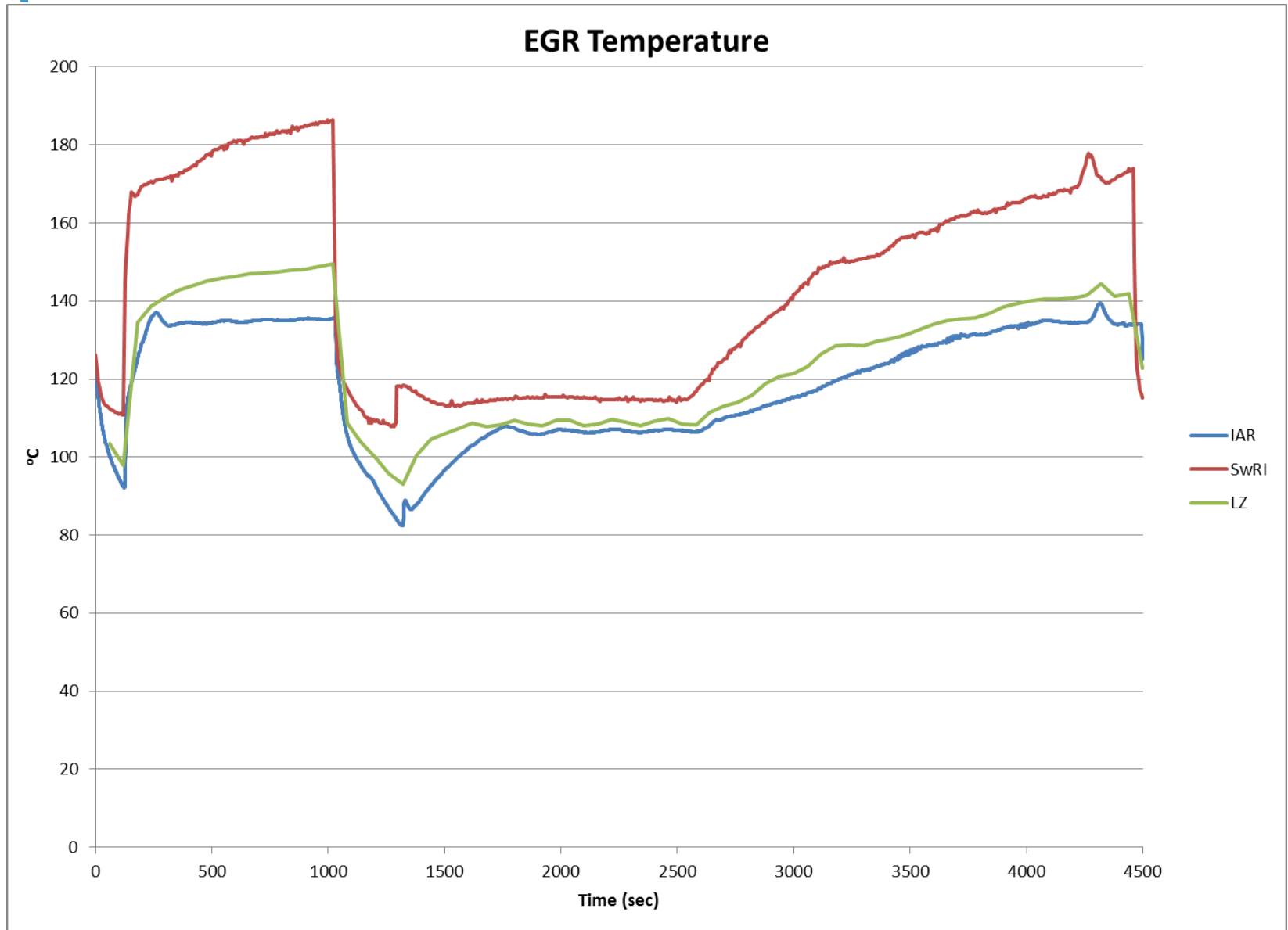
## Operational Data



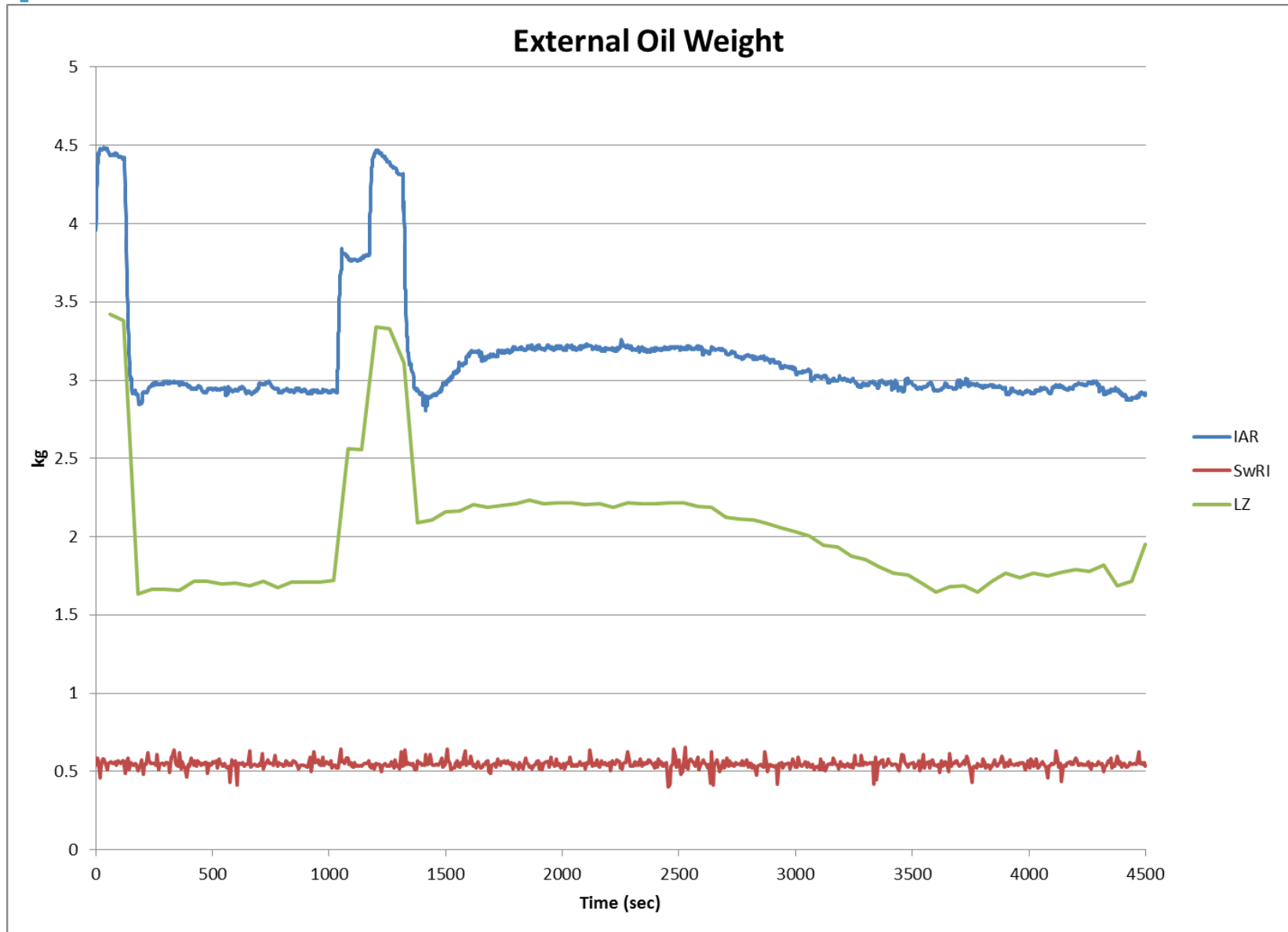
## Operational Data



## Operational Data



# Operational Data



## Hardware Update

- TEI has 1 complete kit
  - SwRI
- 2 kits are buildable
- 4 more kits on order
- High liner rejection rates
  - Pits