

# Sequence IV Surveillance Panel | MINUTES

REVISION DATE: 9/22/2017 9:11:00 AM

<b>Relevant Test:</b>	Sequence IVA and IVB
<b>Note Taker:</b>	Chris Mileti
<b>Meeting Date:</b>	09-21-2017
<b>Comments:</b>	Surveillance Panel conference call to review the "mini" prove-out matrix being conducted at Intertek and Southwest.


## 1. REVIEW OF INTERTEK PRESENTATION:

### 1.1. Background:

- 1.1.1. This presentation was provided to the Surveillance Panel by Bill Buscher (Intertek) via email on 09-20-2017.
- 1.1.2. **File name:** "IVB Update to Surveillance Panel 20170921.pptx"

### 1.2. Slide #2:

**PROVE-OUT MINI-MATRIX**



Run Order	IAR Stand 1	IAR Stand 2	SwRI Stand 1	SwRI Stand 2	Lubrizol	ExxonMobil
	Required	Required	Required	Required	Supplemental	Supplemental
1	300	IVB-LFO-1	1012	IVB-LFO-1	1012	300
2	1012		300	IVB-LFO-2	300	1012

- Row 1 of the required testing has completed
- Row 2 of the required testing currently running
- Row 1 of the supplemental testing to start

= Completed  
 = Running

1.2.1. Two of the Row #2 tests (one at Intertek and one at Southwest) will complete within the next 24-hours.

### 1.2.2. Update from Lubrizol:

- 1.2.2.1. Lubrizol has broken-in its new engine and installed the next test kit.
- 1.2.2.2. Lubrizol was waiting for the procedure to near completion before it proceeded with prove-out testing.

1.2.2.3. Now that the procedure is mostly complete, Lubrizol is auditing its test stand, work instructions and data acquisition programming to make sure it is all in compliance.

1.2.2.4. Prove-out testing will likely start next week.


**1.2.3. Update from Exxon:**

1.2.3.1. Exxon was also waiting for the procedure to near completion before it started any prove-out testing.

1.2.3.2. They are calibrating their stand now and performing an internal audit.

1.2.3.3. Exxon has some information on the load cell calibration that they will share with the (5) laboratories before the next procedure review.

**1.3. Slide #3:**

PROVE-OUT MINI-MATRIX																		
Test Number	Lab	Test Purpose	Test Oil	Date Completed	Test Fuel Sulfur Content	Test Oil Change	Intake Camshaft Bech	Intake Camshaft Chamfered	Oil Pan Sign-up Tube Modified	Oil Pan Sign-up Tube Sample Size	5-4R on Rig or Oil Sampled	Oil Separator and Plumbing Installed	Engine Cooling Fans On	Engine Cooling Fan On	Fuel GPT ppm	Intake Camshaft Lobe Failure	Final g/Liter Average Volume Loss (ml)	
169-D-24	Int	Prove-out test for lower sulfur content fuel and longer interval oil change	ASTM P60-300	6/24/2017	E1 L723 GP01	124 ppm	2600 g (+ 3000 ml)	C	N	N	60 ml	Y	N	IN = Pipe OUT = Head	OUT: 52°C	380	None	1.65 **
122-D-60	Int	Prove-out test for all post-procedure machine changes	ASTM P60-300	5/16/2017	F03723L T30	124 ppm	2600 g (+ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT: 52°C	387	None	1.76 **
18-D-36	SwRI	Prove-out test for all post-procedure machine changes	ASTM P60-300	6/22/2017	F03723L T30	124 ppm	2600 g (+ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT: 52°C			
133-D-58	Int	Prove-out test for lower sulfur content fuel and longer interval oil change	ASTM P60-300	6/25/2017	E1 L723 GP01	124 ppm	2600 g (+ 3000 ml)	C	N	N	60 ml	Y	N	IN = Pipe OUT = Head	OUT: 52°C	353	None	1.10 *
18-D-26	SwRI	Prove-out test for all post-procedure machine changes	ASTM P60-300	6/22/2017	F03723L T30	124 ppm	2600 g (+ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT: 52°C	70	None	1.06 **
122-D-61	Int	Prove-out test for all post-procedure machine changes	ASTM P60-300	6/16/2017	F03723L T30	124 ppm	2600 g (+ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT: 52°C			
130-D-62	Int	Prove-out test for lower sulfur content fuel and longer interval oil change	IVB LFO-1	6/23/2017	E1 L723 GP01	124 ppm	2600 g (+ 3000 ml)	C	N	N	60 ml	Y	N	IN = Pipe OUT = Head	OUT: 52°C	340	None	N/A
155-D-25	Int	Prove-out test for all post-procedure machine changes	IVB LFO-1	5/16/2017	F03723L T30	124 ppm	2600 g (+ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT: 52°C	234	None	N/A
20-D-52	SwRI	Prove-out test for all post-procedure machine changes	IVB LFO-1		F03723L T30	124 ppm	2600 g (+ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT: 52°C	118	None	N/A
20-D-53	SwRI	Prove-out test for all post-procedure machine changes	IVB LFO-1	6/22/2017	F03723L T30	124 ppm	2600 g (+ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT: 52°C			N/A

\* Volume loss measurements performed using the old Keyence software, the old settings and Talc Powder.  
\*\* Volume loss measurements performed using the new Keyence software, the new settings and Talc Powder.

1.3.1. There are some key differences between the prove-out tests that Intertek is running now and the prove-out tests that they ran in June 2017.

**1.3.2. These differences include:**

Parameter	June 2017	September 2017
Camshaft Lobes	Chamfered	Unchamfered
External Blowby System	Uninsulated	Insulated
Oil Pan	Standard Pick-Up Tube	Slotted Pick-Up Tube
Keyence Software	G-1	G-2

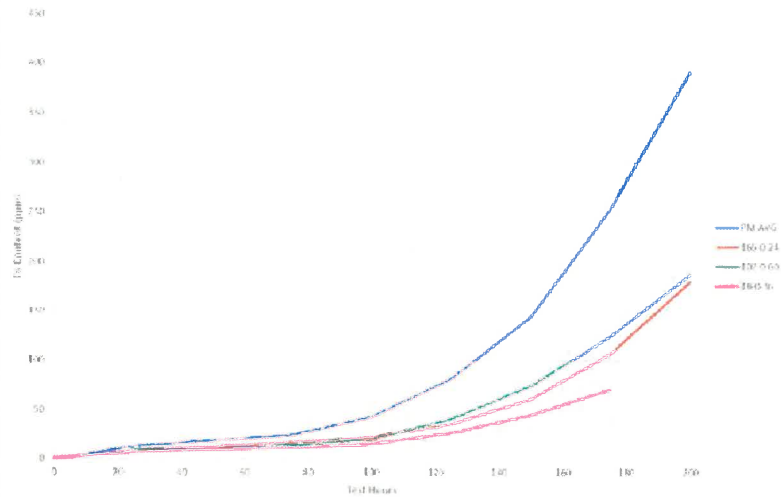
1.3.3. The results between the two rounds of prove-out testing at Intertek have been very similar despite these differences.

**1.4. Slides #4 and #5:**

## PROVE-OUT MINI-MATRIX



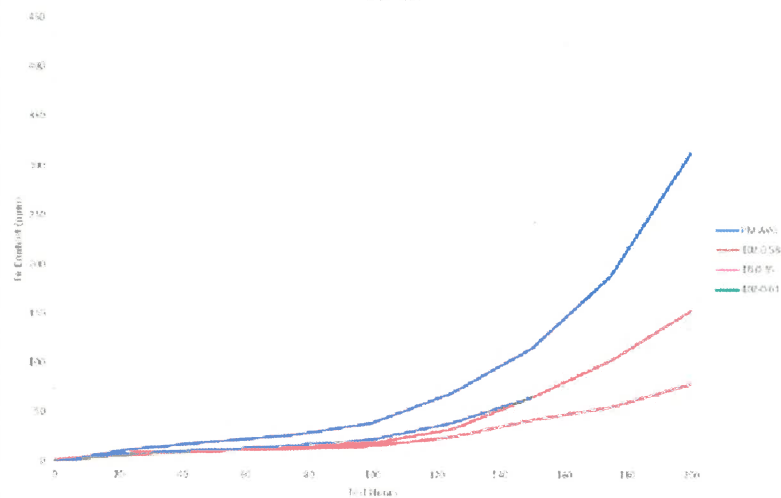
IVB PROVE-OUT MINI-MATRIX  
ASTM REQ 30C  
Fe Content



## PROVE-OUT MINI-MATRIX



IVB PROVE-OUT MINI-MATRIX  
ASTM REQ 1012  
Fe Content



1.4.1. The blue line in both slides is the average iron content from the original Precision Matrix for each oil ("PM-AVG").

1.4.2. There has clearly been a reduction in iron generation since the original matrix.

1.4.2.1. This drop was expected.

1.4.2.2. There is less corrosive wear in the engine with the new test conditions.

1.4.2.3. There should also be less wear from the non-measured parts in the engine.

1.4.3. There are differences in the iron content between the Intertek and Southwest tests.


1.4.3.1. The results from the two labs have been similar despite these differences in iron.

### 1.4.4. Comments from Shell:

1.4.4.1. The differences in iron between Intertek and Southwest are relatively small.

- 1.4.4.2. The overall shift in iron concentration with this test is not a concern at this point.
- 1.4.5. Intertek and Southwest agreed to swap end-of-test oil samples to compare ICP, TAN, TBN and Karl Fischer measurements.

### 1.5. Slide #6:



#### CURRENT AND FUTURE ACTIVITIES AND STATUS

- Testing completed to-date indicates discrimination between ASTM REOs 1012 and 300
- No lobe failures have occurred on testing completed to-date
- All 4 tests from row 2 of the required testing to be completed by early Friday, 9/22/17
- Row 1 of the supplemental testing to start week of September 18<sup>th</sup> or 25<sup>th</sup>
- ± Limits for Engine Coolant Out Temperature Qj calculation to be set at conclusion of the prove-out mini-matrix
- Precision matrix lab audits to be conducted on Monday, 10/2/17
- Sequence IVB procedural review sub-group has deemed the test procedure in acceptable shape to continue with prove-out mini-matrix supplemental testing and precision matrix testing
- Precision matrix stand Instrumentation calibration, Batch Code 2 precision matrix test engine preparation, break-in and aging to be completed between 9/22/17 and 10/6/17
- Surveillance panel face-to-face meeting scheduled for Tuesday, 10/3/17
- Precision matrix to start on or before Friday, 10/6/17

1.5.1. There appears to be discrimination between REO300 and REO1012.

1.5.2. There have been no camshaft lobe failures since the changes were made to the test.

1.5.3. Laboratory audits are scheduled in San Antonio on the Monday before the face-to-face Surveillance Panel meeting.

1.5.3.1. The TMC will facilitate these audits.

1.5.3.2. The three dependent laboratories are invited to attend.

1.5.4. Toyota's goal is to start the 2<sup>nd</sup> Precision Matrix immediately after the October 3<sup>rd</sup> Surveillance Panel meeting.

#### 1.5.5. IVB Test Report Format:

1.5.5.1. The test report format requires some minor "clean up".

1.5.5.2. However, this does not necessarily need to be done by the start of the Precision Matrix.

#### 1.5.6. Tentative Schedule for October Meetings in San Antonio:

1.5.6.1. Monday Laboratory Audits:

1.5.6.1.1. Audits will start around 10:30AM.

1.5.6.1.2. The audits can continue into the evening if needed.

1.5.6.2. Tuesday Face-to-Face Meeting:

1.5.6.2.1. Meeting time will be from 9:00AM to 5:00PM.

1.5.6.2.2. Intertek will issue a specific agenda shortly.

### 1.6. Slide #7:

TIMELINE	Task	S-Stand Precision Matrix
	Complete Test Fuel Blending	DONE
	Complete Test Hardware Procurement and Preparation	DONE
	Complete Preparation for Prove-out Testing	DONE
	Complete Row 1 Prove-out Tests	DONE
	Start Row 2 Prove-out Tests	9/13/2017
	Complete Row 2 Prove-out Tests	9/24/2017
	Complete Procedure Update	10/1/2017
	Complete Precision Matrix Lab Audits	10/1/2017
	Seq. IV Surveillance Panel vote for Ready for Precision Matrix	10/3/2017
	Complete Preparation for Precision Matrix	10/5/2017
	Restart Precision Matrix (Start Row 1 Tests)	10/6/2017
	Complete Row 1 Precision Matrix Tests	10/17/2017
	Complete Row 1 Precision Matrix Operational Review	10/24/2017
	Continue Precision Matrix	10/27/2017
	Complete Precision Matrix	11/29/2017
	Complete Final Precision Matrix Operational Review	12/6/2017
	Start Statistical Analysis of Precision Matrix	12/9/2017
	Complete Statistical Analysis of Precision Matrix	1/9/2018
	Complete Development and Approve LIMS	1/9/2018
	PCEOC/ADAP Vote for Test Acceptance	1/11/2018
	Stand Calibration Starts	2/12/2018

- 1.6.1. This timeline was presented at the AOAP meeting last week.
- 1.6.2. Toyota would like condense this timeline if possible so that "test acceptance" can be voted on in December.
  - 1.6.2.1. Intertek would like to try to achieve this by shortening the time necessary for the operational data reviews.
- 1.6.3. Intertek is hopeful that supplemental data can be provided by the (3) dependent laboratories.

## 2. MISCELLANEOUS DISCUSSION:

### 2.1. Update on Procedure Review (Southwest):

- 2.1.1. The next procedure review meeting is next Tuesday.
- 2.1.2. The main agenda item for this meeting is to review the engine assembly manual.
  - 2.1.2.1. This manual was already reviewed by the Surveillance Panel in June 2017.

### 2.2. Metrology Workshop (Intertek):

- 2.2.1. Lubrizol hosted a Metrology Workshop in August 2017 that was attended by all five laboratories.
- 2.2.2. This meeting was very successful.
- 2.2.3. **The five labs agreed on the following:**
  - 2.2.3.1. Settings with the G-2 software.
  - 2.2.3.2. Templates with the G-2 software.
  - 2.2.3.3. Talc application process.
- 2.2.4. Intertek will have results available from both the G-1 and G-2 software for some of its prove-out tests.

### 2.3. Hardware Status (Intertek):

- 2.3.1. There are (5) engines and (20) test kits being shipped to the two San Antonio laboratories.

2.3.2. Additional oil pans (with slotted pick-up tubes) should also be arriving shortly.

2.3.3. All future candidate testing at the San Antonio laboratories will be done with Batch-C hardware.

**2.3.4. Oil Sampling Valve:**

2.3.4.1. Lubrizol has replaced the original oil sampling valve on its Golden Stand with a Swagelok valve.

2.3.4.2. A trial will be conducted in parallel with the upcoming prove-out testing to determine if the Swagelok valve offers a reduction in sample foaming.

Action Items	Person responsible	Completion Date

Follow-up Notes/Updates	Initials	Date Added

Attendees	Organization	Contact Information

**SEQUENCE IVB  
PROVE-OUT MINI-MATRIX UPDATE**

September 21, 2017





# PROVE-OUT MINI-MATRIX

Run Order	IAR Stand 1	IAR Stand 2	SwRI Stand 1	SwRI Stand 2	Lubrizon	ExxonMobil
	Required	Required	Required	Required	Supplemental	Supplemental
1	300	IVB-LFO-1	1012	IVB-LFO-1	1012	300
2	1012		300	IVB-LFO-2	300	1012

 = Completed

 = Running

- Row 1 of the required testing has completed
- Row 2 of the required testing currently running
- Row 1 of the supplemental testing to start





# PROVE-OUT MINI-MATRIX

Test Number	Lab	Test Purpose	Test Oil	Date Completed	Test Fuel Batch	Test Fuel Sulfur Content	Test Oil Charge	Intake Camshaft Batch	Intake Camshaft Chamfered	Oil Pan Pick-up Tube Modified	25-HR Interval Oil Sample Size	5-HR Interval Oil Samples	Oil Separator and Plumbing Insulation	Engine Coolant Flow Direction	Engine Coolant Temperature Control Point	Fe at EOT ppm	Intake Camshaft Lobe Failure	Intake Lifter Average Volume Loss mm <sup>3</sup>
165-0-24	IAR	Prove-out test for lower sulfur content fuel and larger initial oil charge.	ASTM REO 300	6/24/2017	EJ1721GP01	124 ppm	2600 g (≈ 3000 ml)	C	N	N	60 ml	Y	N	IN = Pipe OUT = Head	OUT, 52°C	180	None.	1.65 *
102-0-60	IAR	Prove-out test for all post-precision matrix changes.	ASTM REO 300	9/8/2017	FG1721LT10	124 ppm	2600 g (≈ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT, 52°C	187	None.	1.79 **
18-0-36	SwRI	Prove-out test for all post-precision matrix changes.	ASTM REO 300	running	FG1721LT10	124 ppm	2600 g (≈ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT, 52°C			
102-0-58	IAR	Prove-out test for lower sulfur content fuel and larger initial oil charge.	ASTM REO 1012	6/25/2017	EJ1721GP01	124 ppm	2600 g (≈ 3000 ml)	C	N	N	60 ml	Y	N	IN = Pipe OUT = Head	OUT, 52°C	153	None.	1.19 *
18-0-35	SwRI	Prove-out test for all post-precision matrix changes.	ASTM REO 1012	9/11/2017	FG1721LT10	124 ppm	2600 g (≈ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT, 52°C	79	None.	1.01 **
102-0-61	IAR	Prove-out test for all post-precision matrix changes.	ASTM REO 1012	running	FG1721LT10	124 ppm	2600 g (≈ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT, 52°C			
100-8-62	IAR	Prove-out test for lower sulfur content fuel and larger initial oil charge.	IVB-LFO-1	6/23/2017	EJ1721GP01	124 ppm	2600 g (≈ 3000 ml)	C	N	N	60 ml	Y	N	IN = Pipe OUT = Head	OUT, 52°C	340	None.	N/A
165-0-26	IAR	Prove-out test for all post-precision matrix changes.	IVB-LFO-1	9/8/2017	FG1721LT10	124 ppm	2600 g (≈ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT, 52°C	234	None.	N/A
20-0-52	SwRI	Prove-out test for all post-precision matrix changes.	IVB-LFO-1		FG1721LT10	124 ppm	2600 g (≈ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT, 52°C	118	None.	N/A
20-0-53	SwRI	Prove-out test for all post-precision matrix changes.	IVB-LFO-2	running	FG1721LT10	124 ppm	2600 g (≈ 3000 ml)	D	N	Y	60 ml	N	Y	IN = Pipe OUT = Head	OUT, 52°C			N/A

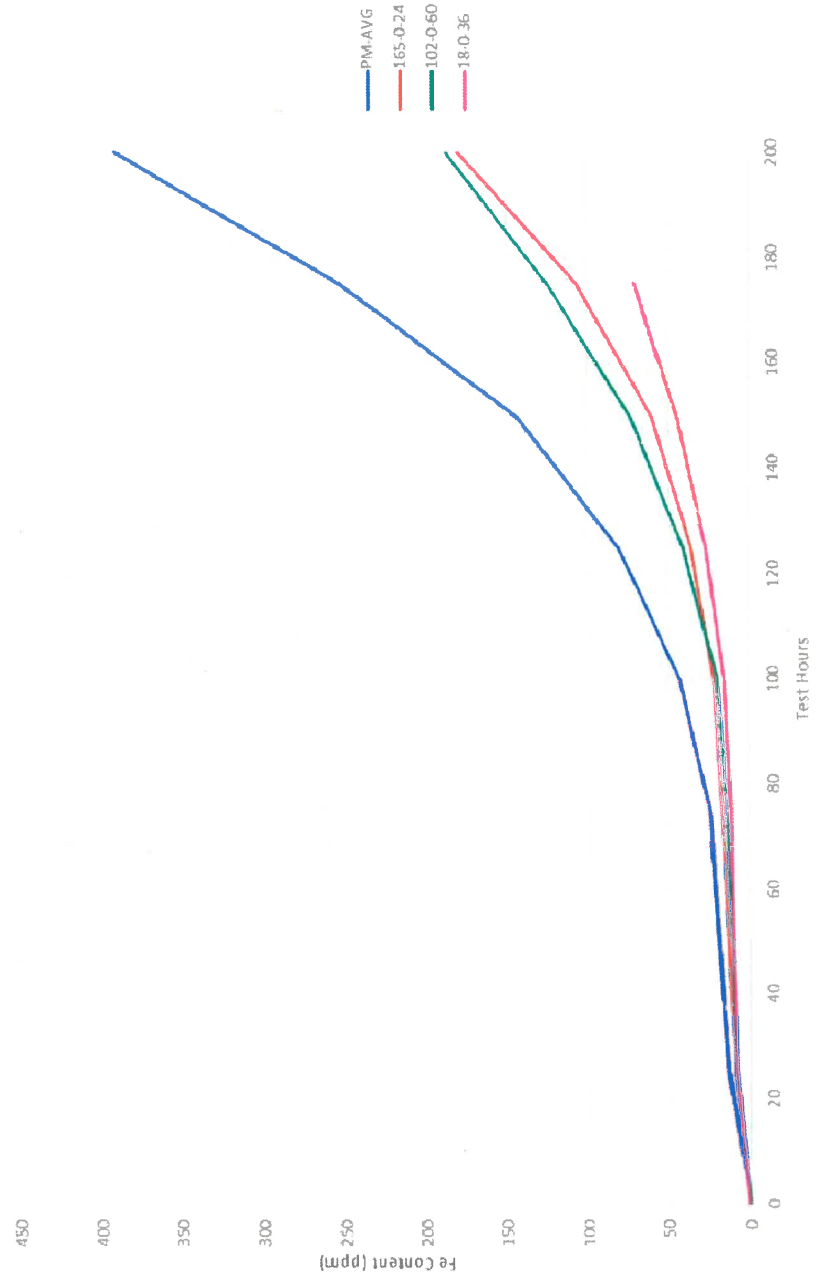
\* Volume loss measurements performed using the old Keyence software, the old settings and Talc Powder.

\*\* Volume loss measurements performed using the new Keyence software, the new settings and Talc Powder.



# PROVE-OUT MINI-MATRIX

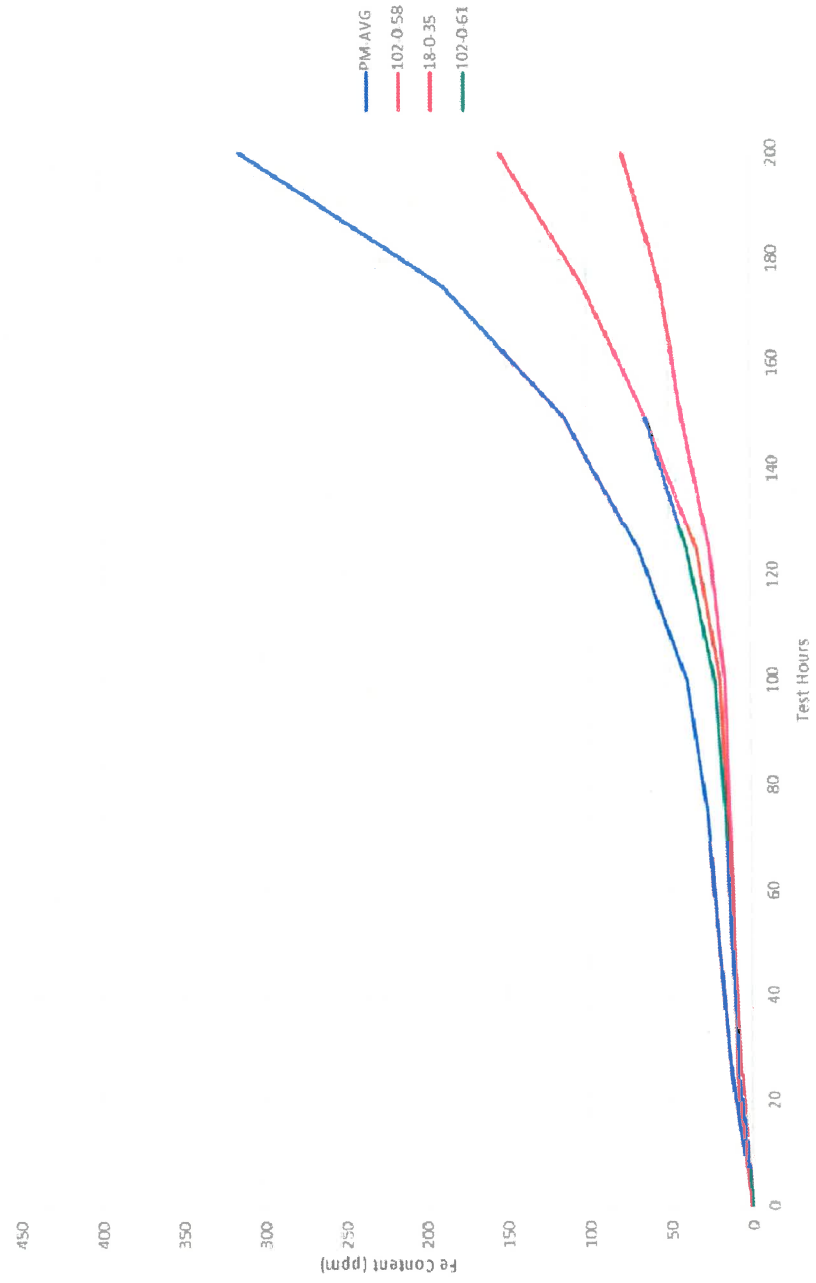
IVB PROVE-OUT MINI-MATRIX  
ASTM REO 300  
Fe Content



# PROVE-OUT MINI-MATRIX



IVB PROVE-OUT MINI-MATRIX  
ASTM REO 1012  
Fe Content





## **CURRENT AND FUTURE ACTIVITIES AND STATUS**


- Testing completed to-date indicates discrimination between ASTM REOs 1012 and 300
- No lobe failures have occurred on testing completed to-date
- All 4 tests from row 2 of the required testing to be completed by early Friday, 9/22/17
- Row 1 of the supplemental testing to start week of September 18<sup>th</sup> or 25<sup>th</sup>
- $\pm$  Limits for Engine Coolant Out Temperature Qi calculation to be set at conclusion of the prove-out mini-matrix
- Precision matrix lab audits to be conducted on Monday, 10/2/17
- Sequence IVB procedural review sub-group has deemed the test procedure in acceptable shape to continue with prove-out mini-matrix supplemental testing and precision matrix testing
- Precision matrix stand instrumentation calibration, Batch Code 2 precision matrix test engine preparation, break-in and aging to be completed between 9/22/17 and 10/6/17
- Surveillance panel face-to-face meeting scheduled for Tuesday, 10/3/17
- Precision matrix to start on or before Friday, 10/6/17

# TIMELINE



Task	5-Stand Precision Matrix
Complete Test Fuel Blending	DONE
Complete Test Hardware Procurement and Preparation	DONE
Complete Preparation for Prove-out Testing	DONE
Complete Row 1 Prove-out Tests	DONE
Start Row 2 Prove-out Tests	9/13/2017
Complete Row 2 Prove-out Tests	9/24/2017
Complete Procedure Update	10/2/2017
Complete Precision Matrix Lab Audits	10/3/2017
<b>Seq. IV Surveillance Panel vote for Ready for Precision Matrix</b>	10/3/2017
Complete Preparation for Precision Matrix	10/5/2017
Restart Precision Matrix (Start Row 1 Tests)	10/6/2017
Complete Row 1 Precision Matrix Tests	10/17/2017
Complete Row 1 Precision Matrix Operational Review	10/24/2017
Continue Precision Matrix	10/27/2017
Complete Precision Matrix	11/29/2017
Complete Final Precision Matrix Operational Review	12/6/2017
Start Statistical Analysis of Precision Matrix	12/9/2017
Complete Statistical Analysis of Precision Matrix	1/9/2018
Complete Development and Approve LTMS	1/11/2018
<b>PCEOC/ AOAP Vote for Test Acceptance</b>	1/11/2018
Stand Calibration Starts	1/12/2018

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September 21, 2017

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September 21, 2017

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September 21, 2017

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→ REPLACING KAUSTAV SINHA AS ORONITE'S VOTING MEMBER Page 5 of 6



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Sequence IV Surveillance Panel  
September 21, 2017  
8:30AM – 9:30AM  
Conference Call

Motions and Action Items

As Recorded at the Meeting by Bill Buscher

1. Action Item – SwRI and Intertek to swap EOT oil samples from their ASTM REO 300 and 1012 prove-out tests and perform D5185 Metals, D6304 Karl Fischer H<sub>2</sub>O Content, D3525 Fuel Dilution, D664 Total Acid Number and D4739 Total Base Number analysis for a lab-to-lab oil analysis comparison
2. Action Item – Surveillance panel chair to distribute a schedule and agenda for the 10/2/17 precision matrix lab audits and the 10/3/17 surveillance panel meeting.

