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COMMITTEE D02 ON PETROLEUM PRODUCTS, LIQUID FUELS, AND LUBRICANTS

Issued: 09.13.2017

Reply to: Dan Worcester
Southwest Research Institute
6220 Culebra Rd.
San Antonio, TX 78238
Phone: 210.522.2405
Email: dworcester@swri.org

These are the unapproved minutes of the 09.12.2017 Sequence VI Conference Call.

The meeting was called to order at 9:05 AM Central Time by Chair Greg Miranda.

Agenda

The Agenda is the included as Attachment 1.

1.0 Roll Call

The Attendance list is Attachment 2. Kevin Brodwater will replace Kaustav Sinha as Chevron voting member.

2.0 Approval of Meeting minutes from 08.09.2017 Seq. VI SP meeting.

2.1 Greg Miranda made the motion and Adrian Alfonso seconded.

2.2 The minutes were approved unanimously.

3.0 Old Business

3.1 Seq. VIE/F Short Block Hardware Task Force Update — Adrian Alfonso

3.1.1 Hardware availability update

All labs have received their engines. The supplemental kits are still in process waiting for injectors. All OHT-2 engines have been distributed to labs. The current testing levels indicates labs will move to the GM Kit engines in October.

3.2 Seq. VIE Severity Task Force Update — Dan Worcester

The new and FEI 2 oils are being analyzed at IAR. Todd noted there was a possible crankcase pressure effect. Greg asked for a presentation for the next SP meeting.

3.3 Sequence VIE Procedure Revision per Information Letter — Rich Grundza

Sequence VIE Information Letter 17-3
Sequence Number 3
August 2017

This letter has been approved and will go to distribution. See Attachment 3.

Note: Seq. VIF Procedure

This is still in process.

3.4 Seq. VIE Short Block Engine Matrix Analysis Review

See Attachment 4. 20 tests have been completed and reported to TMC site. There is discussion of going to a 5th run on VIE engines. The LTMS targets and engine hour correction equations will need further review. The kit engines do show equivalent results. The short blocks are showing the second test milder, and the FEI 2 borderline response. There was a question on whether a VIF matrix would be run. Bill asked if labs should hold OHT-2 engines for VIF tests. This would be the choice of each lab. There are only two calibrated VIF labs to date. Andy noted Infineum did not want to change engine hours or targets. Bob asked the group to look at moving to a 5th run on each engine. Jo noted the current data could be reviewed to decide if more test data is needed. 11 of 5th run tests have been completed. Cliff will work on running his 5th run test. Discussion turned to approval of the short block kits. The motion was worded to show equivalent results and that the motion should be for VIE and VIF testing.

Motion # 1: The Sequence VI Surveillance Panel deems the Sequence VIE/F short block engine and the OHT -1 and -2 engine assemblies equivalent, and approves introduction of the short block engine in the Sequence VIE and VIF tests, through the normal referencing systems, without any changes to the engine hour correction factors or reference oil targets. Effective 9/12/17, with the intention that all OHT -1 and -2 engine assemblies are depleted prior to introducing the short block engine.
Adrian Alfonso / Katerina Pecinovsky / Passed 12-0-1

3.5 Update on Seq. VID-VIF Equivalence Work Greg Miranda

This was discussed at AOAP then moved to the Surveillance Panel. Intertek and SwRI each ran two tests on Toyota oil 300. Rich will provide CMIR numbers so those tests can be posted on the TMC site. Jim Linden thanked Infineum and Oronite for donated tests for the industry for this effort.

4.0 New Business

4.1 Short block build workshop

Intertek will sponsor a build workshop and a VH workshop will be at the same time.

Action # 1: Bill Buscher will provide possible dates for a build workshop. This will be targeted in November.

4.2 VIE/VIF Research Report

A Volunteer was needed. Greg Miranda has agreed to chair this effort. He will ask for lab support.

5.0 Next Meeting

5.1 The next SP meeting is planned in 3-4 weeks. There is also discussion of a Face to Face meeting with other test types this fall.

The meeting adjourned at 10:52 AM.

Sequence VI Surveillance Panel Conference Call Agenda
September 12, 2017 @ 10:00-12:00 EST

Audio Connection

Call-in Number: +1-415-655-0001
Conference Code: 224 244 173

Webex Meeting URL:
https://meetings.webex.com/collabs/#/meetings/detail?uuid=MD9ATSK9ZJV3WJ2FBQGL4JWSWG-20XT&rnd=501440.88978

1. **Roll Call (start 10:05 EST)**

   1.1. SP Membership changes and additions

2. **Approval of Meeting minutes from August 09, 2017 Seq. VI SP meeting**

3. **Old Business**

3.1	Seq. VIE/F Short Block Hardware Task Force Update 3.1.1 Hardware update	Adrian Alfonso
3.2	Seq. VIE Severity Task Force Update	Dan Worcester
3.3	Sequence VIE Procedure Revision per Information Letter: Sequence VIE Information Letter 17-3 Sequence Number 3 August 2017	Rich Grundza
3.4	Seq. VIE Short Block Engine Matrix Analysis Review	Stats Group
3.5	Update on Seq. VID-VIF Equivalence Work	Greg Miranda

4. **New Business**

   4.1. Short block build workshop: TBD

   4.2. VIE/VIF Research Report: Volunteer needed to lead this effort

5. **Next Meeting**

   5.1. TBD

6. **Meeting Adjourned**

ASTM SEQUENCE VI

Name	Email/Phone	Company	Attend
Adrian Alfonso **Voting Member**	Phone: (210) 838-0431 Adrian.Alfonso@intertek.com	Intertek	ATTEND
Jason Bowden **Voting Member**	Phone: (440) 354-7007 jhbowden@ohtech.com	OHT	ATTEND
Kevin Brodwater **Voting Member**	KBrodwater@chevron.com	Chevron	ATTEND
Tim Cushing **Voting Member**	Phone: (248) 881-3518 Timothy.Cushing@gm.com	General Motors	ATTEND
Rich Grundza **Voting Member**	Phone: (412) 365-1034 reg@astmtmc.cmu.edu	TMC	ATTEND
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Andy Ritchie **Voting Member**	Phone: (908) 474-2097 Andrew.Ritchie@infineum.com	Infineum	ATTEND
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Clifford Salvesen **Voting Member**	Phone: (856) 224-2954 Clifford.r.Salvesen@exxonmobil.com	ExxonMobil	ATTEND
Amol Savant **Voting Member**	acsavant@valvoline.com	Valvoline	ATTEND
Haiying Tang **Voting Member**	Phone: (248) 512-0593 HT146@Chrysler.com	Chrysler	
Dan Worcester **Voting Member**	Phone: (210) 522-2405 Dan.Worcester@swri.org	SwRI	ATTEND

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ASTM SEQUENCE VI

Name	Email/Phone	Company	Attend

MOTION:	**GM KIT**			
Adrian Alfonso **Voting Member**	YES			
Jason Bowden **Voting Member**	YES			
Kevin Brodwater **Voting Member**	YES			
Amol Savant **Voting Member**	YES			
Tim Cushing **Voting Member**	YES			
Rich Grundza **Voting Member**	YES			
Jeff Hsu **Voting Member**				
Jim Linden **Voting Member**	YES			
Dan Lanctot **Voting Member**	WAIVE			
Greg Miranda **Voting Member**	YES			
Katerina Pecinovsky **Voting Member**	YES			
Brianne Pentz **Voting Member**				
Andy Ritchie **Voting Member**	YES			
Ron Romano **Voting Member**				
Clifford Salvesen **Voting Member**	YES			
Amol Savant **Voting Member**	YES			
Haiying Tang **Voting Member**				
Dan Worcester **Voting Member**	YES			
VOTES	12 Y, O N, 1 W			

ASTM SEQUENCE VI

Name	Email/Phone	Company	Attend

MOTION:				
Adrian Alfonso **Voting Member**				
Jason Bowden **Voting Member**				
Kevin Brodwater **Voting Member**				
Tim Cushing **Voting Member**				
Rich Grundza **Voting Member**				
Jeff Hsu **Voting Member**				
Teri Kowalski **Voting Member**				
Dan Lanctot **Voting Member**				
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Ron Romano **Voting Member**				
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Amol Savant **Voting Member**				
Haiying Tang **Voting Member**				
Dan Worcester **Voting Member**				
VOTES				

ASTM SEQUENCE VI

Name	Email/Phone	Company	Attend

MOTION:				
Adrian Alfonso **Voting Member**				
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Ron Romano **Voting Member**				
Clifford Salvesen **Voting Member**				
Amol Savant **Voting Member**				
Haiying Tang **Voting Member**				
Dan Worcester **Voting Member**				
VOTES				

ASTM SEQUENCE VI

Name	Email/Phone	Company	Attend

A Program of ASTM International

Test Monitoring Center

@ Carnegie Mellon University
6555 Penn Avenue, Pittsburgh, PA 15206, USA

http://astmtmc.cmu.edu
412-365-1000

Sequence VIE Information Letter 17-3
Sequence Number 3
August , 2017

ASTM consensus has not been obtained on this information letter. An appropriate ASTM ballot will be issued in order to achieve such consensus.

TO: Sequence VI Surveillance Panel

SUBJECT: 1. Information Letters 17-1 and 17-2 Revision to the test method
2. Change in Part Number for oil filter
3. Additional oil pump
4. Clarification to Table 5
5. Corrections to annex A15 and A16

1. The following sections of Test Method D8114-17 have been revised to incorporate Information Letters 17-1 and 17-2: 11.5.4, 10.1.1.2, 10.2.2.
2. The part number for the oil filter specified in 6.6.5.7 has changed and section 6.5.5.7 has been revised to reflect this change.
3. The oil pump specified in 6.6.5.2 is no longer available. Section 6.6.5.2 has been revised to include a replacement pump from the same manufacturer.
4. A clarification was added to Table 5 with regards to the flush to BLA.
5. Annex A15 was found to have extraneous information contained in Section A15.1 and this section has been deleted and subsequent sections renumbered accordingly. Also, additional equations were added to A15 and A16 to address calculations when BLB3 is required.

The test procedure has been revised to incorporate these changes. The text of the revisions is shown in the attachment. These changes are effective with the issuance of this letter.

Tim Cushing
Engine Oil Test Development and Support
GM Global Propulsion Systems

Frank M. Farber
Director
ASTM Test Monitoring Center

Attachment

c: ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/procedure_and_ils/VIE/IL17-1.pdf

Distribution: Email

Revises VIE Test Procedure

10.1.1.2 The calibration period on a given stand and engine combination is three full–length non-reference oil tests or 900 engine hours or 100 days, whichever occurs first.

10.2.2 Every three months perform a partial instrumentation calibration according to Table 7.

11.5.4: Stand Requirements for Conducting New Engine Break-In - Perform engine break-in in a stand configured in accordance with the test method. Alternately, break-in may be conducted on a test stand configured in accordance with the test method, but with the exceptions that adherence to the following subsections is not required: 6.6.1, 6.6.3, 6.6.4, 6.6.4.1, 6.6.4.2, 6.6.4.3, 6.6.4.4, 6.6.4.5, 6.6.4.6, 6.6.5.3 (1), 6.6.5.3 (2), 6.6.5.3 (4), 6.7.2, 6.8, 6.8.1, and 6.8.2.

6.6.5.2 Use a positive displacement oil circulation pump. A Viking Series 4125, Model G4125 or G4124A, no relief valve, basemounted are specified (see X1.15). The pump shall have a V-belt or direct drive electric drive motor of 1140 r/min to 1150 r/min with a minimum power of 0.56 kW. Voltage and phase are optional.

6.6.5.7 Install one oil filter (FIL-1 in Fig. A5.6) in the external oil system. The filter specified is OHT6A-012-5 with a stainless steel screen having a rating of 60 µm, Part No. OHT6A-013-3 (see X1.20). Locate the filter between the engine oil pump and where the oil enters the engine oil gallery.

TABLE 5 VIE Test Schedule

		Estimated Elapsed Time, h[A]
BLB-1 Oil Test		
1.	Double flush to BLB-1	1:30
2.	S90, BSFC/fuel flow × 6 at Stage 1[B]	2:00
3.	S90, BSFC/fuel flow × 6 at Stage 2	2:00
4.	S90, BSFC/fuel flow × 6 at Stage 3	2:00
5.	S90, BSFC/fuel flow × 6 at Stage 4	2:00
6.	S90, BSFC/fuel flow × 6 at Stage 5	2:00
7.	S90, BSFC/fuel flow × 6 at Stage 6	2:00
	Warm-up to Stage Flush	0:30
	Sub Total	14:00
BLB-2 Oil Test		
1.	Double flush to BLB-2	1:30
2.	S90, BSFC/fuel flow × 6 at	2:00

	Stage 1[B]	
3.	S90, BSFC/fuel flow × 6 at Stage 2	2:00
4.	S90, BSFC/fuel flow × 6 at Stage 3	2:00
5.	S90, BSFC/fuel flow × 6 at Stage 4	2:00
6.	S90, BSFC/fuel flow × 6 at Stage 5	2:00
7.	S90, BSFC/fuel flow × 6 at Stage 6	2:00
	Warm-up to Stage Flush	0:30
	Sub Total	14:00

BLB-3 Oil Test (if required)

1.	Double flush to BLB-2	1:30
2.	S90, BSFC/fuel flow × 6 at Stage 1[B]	2:00
3.	S90, BSFC/fuel flow × 6 at Stage 2	2:00
4.	S90, BSFC/fuel flow × 6 at Stage 3	2:00
5.	S90, BSFC/fuel flow × 6 at Stage 4	2:00
6.	S90, BSFC/fuel flow × 6 at Stage 5	2:00
7.	S90, BSFC/fuel flow × 6 at Stage 6	2:00
	Warm-up to Stage Flush	0:30
	Sub Total	14:00

Phase I Aging

1.	Double flush to Non-reference Oil	1:30
2.	Age 16 Hours	16:00
3.	S90, BSFC/fuel flow × 6 at Stage 1[B]	2:00
4.	S90, BSFC/fuel flow × 6 at Stage 2	2:00
5.	S90, BSFC/fuel flow × 6 at Stage 3	2:00
6.	S90, BSFC/fuel flow × 6 at Stage 4	2:00
7.	S90, BSFC/fuel flow × 6 at Stage 5	2:00
8.	S90, BSFC/fuel flow × 6 at Stage 6	2:00
	Sub Total	29.30

Phase II Aging

1.	Age 109 Hours	109

2.	S90, BSFC/fuel flow × 6 at Stage 1[B]	2:00
3.	S90, BSFC/fuel flow × 6 at Stage 2	2:00
4.	S90, BSFC/fuel flow × 6 at Stage 3	2:00
5.	S90, BSFC/fuel flow × 6 at Stage 4	2:00
6.	S90, BSFC/fuel flow × 6 at Stage 5	2:00
7.	S90, BSFC/fuel flow × 6 at Stage 6	2:00
8.	Warm-up to Stage Flush	0:30
	Sub Total	121:30
FO to BL Flush	Flush in FO & Run	0:30
	Flush in FO & Run	2:00
1.	Two Double flushes to BL After	2:30
2.	S90, BSFC/fuel flow × 6 at Stage 1[B]	2:00
3.	S90, BSFC/fuel flow × 6 at Stage 2	2:00
4.	S90, BSFC/fuel flow × 6 at Stage 3	2:00
5.	S90, BSFC/fuel flow × 6 at Stage 4	2:00
6.	S90, BSFC/fuel flow × 6 at Stage 5	2:00
7.	S90, BSFC/fuel flow × 6 at Stage 6	2:00
	Sub Total	17:00

[A] Adhere to stabilization times and times for the 6 replicate BSFC measurements. Warm-up and cool-down times included in flushing elapsed times are estimates.
[B] Example: Stabilize 90 min followed by 6 replicate BSFC measurements at intervals of 5 min.

11.6.17.2 *BSFC Measurement of BL Oil After Test Oil*—Run Stages 1 through 6 as detailed in Table 2. When the BLA Test Oil is completed, calculate the BL shift Using equations A16.4 or A16.5, if BLB3 was required to be run.

A15.1 Calculate each BSFC measurement taken at 5 min using the average speed, torque, and fuel flow acquired during the stabilized BSFC measurement cycle as follows:

$$\text{BSFC} = \frac{(\text{average fuel flow, kg/h})(9549.3)}{(\text{average speed, r/min})(\text{average torque N} \cdot \text{m})} \quad \text{(A15.1)}$$

A15.1.1 Ensure average speed is acquired to a minimum of one whole number (zero decimal places).
A15.1.2 Ensure average torque is acquired to a minimum of two decimal places.

A15.1.3 Ensure fuel flow is acquired to a minimum of three decimal places.

A15.2 For Stage 1, segment 1 through 6, round and record the 5 min BSFC measurements to 4 decimal places using ASTM rounding.

A15.3 Average the BSFC measurements of the six steps to 5 decimal places using ASTM rounding. Units for BSFC are kg/kWh.

A15.4 Multiply the average by the nominal power, stage length, and weight factor (below) for Stage 1 and record the answer to 6 decimal places. The unit for this number is kilograms of fuel consumed.

Table A15.1

Test Stage	Nominal Speed (r/min)	Nominal Power (kW)	Stage Length (h)	Weight Factor
1	2000	21.99	0.5	0.300
2	2000	21.99	0.5	0.032
3	1500	16.49	0.5	0.310
4	695	1.46	0.5	0.174
5	695	1.46	0.5	0.011
6	695	2.91	0.5	0.172

A15.5 Perform calculation steps A15.1 – A15.4 for the remaining test stages (2 to 6) using the respective nominal power, stage length, and weight factors.

A15.6 Total the mass fuel consumption values for all 6 stages.

A15.7 Complete the total fuel consumed calculation detailed in Steps A15.1 – A15.6 above for the BL Before Test Oil 1, BL Before Test Oil 2, BL Before Test Oil 3 (where required),Test Oil Phase I, Test Oil Phase II, and BL After Test Oil.

A15.8 Compute the test oil fuel economy improvement (FEI) as follows:

Percent FEI Test Oil Phase I =

$$\left\{\frac{[(BL\ before\ 2\ x\ 80\%)+(BL\ after\ x\ 20\%)-Test\ Oil]}{[(BL\ before\ 2\ x\ 80\%)+(BL\ after\ x\ 20\%)]}\right\} \text{ x } 100 \quad \text{(A15.2)}$$

When BLB3 is required Percent FEI Test Oil Phase I =

$$\left\{\frac{[(BL\ before\ 3\ x\ 80\%)+(BL\ after\ x\ 20\%)-Test\ Oil]}{[(BL\ before\ 3\ x\ 80\%)+(BL\ after\ x\ 20\%)]}\right\} \text{ x } 100 \quad \text{(A15.3)}$$

Percent FEI Test Oil Phase II =

$$\left\{\frac{[(BL\ before\ 2\ x\ 10\%)+(BL\ after\ x\ 90\%)-Test\ Oil]}{[(BL\ before\ 2\ x\ 10\%)+(BL\ after\ x\ 90\%)]}\right\} \text{ x } 100 \quad \text{(A15.4)}$$

When BLB3 is required Percent FEI Test Oil Phase II =

$$\frac{[(BL\ before\ 3\ x\ 10\%)+(BL\ after\ x\ 90\%)-Test\ Oil]}{[(BL\ before\ 3\ x\ 10\%)+(BL\ after\ x\ 90\%)]}\} \text{ x } 100 \quad \text{(A15.5)}$$

A15.9 Adjust the FEI results for engine hours as follows:

Adjusted FEI1 =FEI1+{0.000518 x [(engine hours) – 675]} (A15.6)

Adjusted FEI2 =FEI2+{0.000381 x [(engine hours) – 675]}

(A15.7)

A15.10 Adjust the FEI engine hour adjusted result(s) on non-reference oil tests for the stand/engine severity in accordance with Annex A3.

A16.8 Compute the baseline shift results as follows:

Percent Unweighted Baseline Shift BLB1 to BLB2 =

$$\left[\frac{(Unweighted\ BLB1 - Unweighted\ BLB2)}{Unweighted\ BLB1}\right] x100$$

(A16.2)

When BLB3 is required then Percent Unweighted Baseline Shift BLB1 to BLB2 =

$$\left[\frac{(Unweighted\ BLB2 - Unweighted\ BLB3)}{Unweighted\ BLB2}\right] x100$$

(A16.3)

Percent Unweighted Baseline Shift BLB2 to BLA =

$$\frac{(Unweighted\ BLB2 - Unweighted\ BLA)}{Unweighted\ BLB2}\Big] x100$$

(A16.4)

When BLB3 is required then Percent Unweighted Baseline Shift BLB2 to BLA =

$$\left[\frac{(Unweighted\ BLB3 - Unweighted\ BLA)}{Unweighted\ BLB3}\right] x100$$

(A16.5)

VIE Engine Short Block Matrix Analysis Update

Statistics Group

Sep. 8, 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

- Based on current data analyses, the Lab Built (SBM) engines are not different from OEM built Engines (PM + PostPM).
  - No evidence at this time that would preclude the use of SBM engines for testing.
- Data is still being analyzed for possible changes to the engine hour adjustment and LTMS target (means & standard deviations).
  - Estimate 2 additional weeks to complete this activity.
- Interim solution (if needed) is to use SBM engines for Sequence VIE testing with the current engine hour adjustment and LTMS.
- The Statistics Group is also looking into the possibility of extending test life to 5th runs.

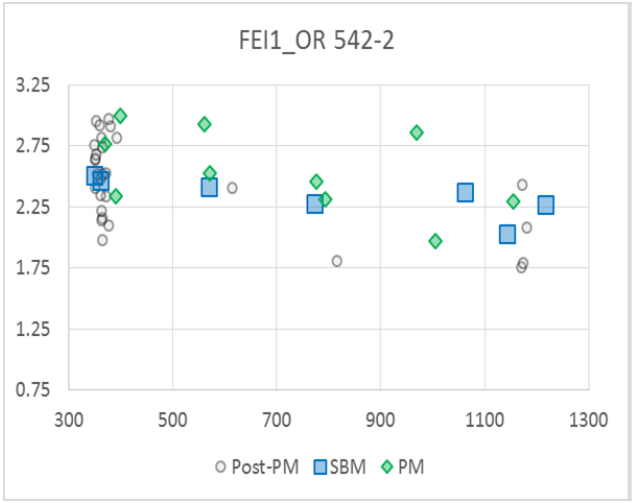
Data (as of 8/22/17)

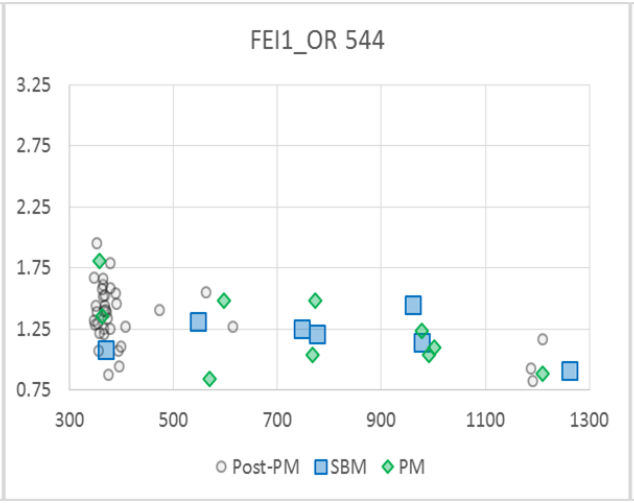
- **Short block matrix (with 5th runs)**
  - 3 Reference Oils {1010-1, 542-2, 544}
  - 4 Labs{A, D, G, F}
  - 4 Engines {A2 101A, D3 001G, F2 KT01D, G2 100C}
  - Total number of tests = 20
- **Precision matrix**
  - 3 Reference Oils {1010-1, 542-2, 544}
  - 6 Labs {A, B, C, D, F, G}
  - 8 Engines {A2 103, B1 123, D2 11, F2 136, C2 29, C2 31, G2 55, G1 60}
  - Within lab statistical tests - 2 Labs each with 2 engines
    - Lab C: 29 vs. 31
    - Lab G: 55 vs. 60
  - Total number of tests = 29 (31 including 5th runs)
- **Post Precision matrix with 5th runs**
  - 3 Reference Oils {1010-1, 542-2, 544}
  - 5 Labs {A, B, C, D, G}
  - 11 Engines {A8 262, A10 254, A11 99, B2 266, D1 112, D2 14, D3 100, C2 36, G2 222, G4 328, G6 253}
  - Total number of tests = 22
- **Post Precision matrix single run engines = 81**

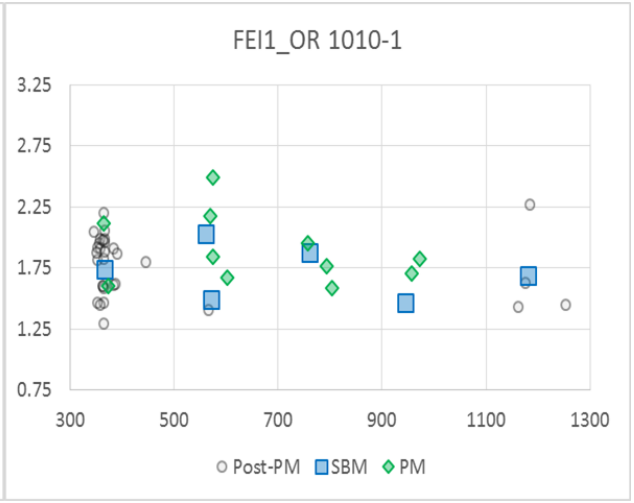
Lab Built (SBM) engines are not different from OEM built Engines (PM + PostPM)

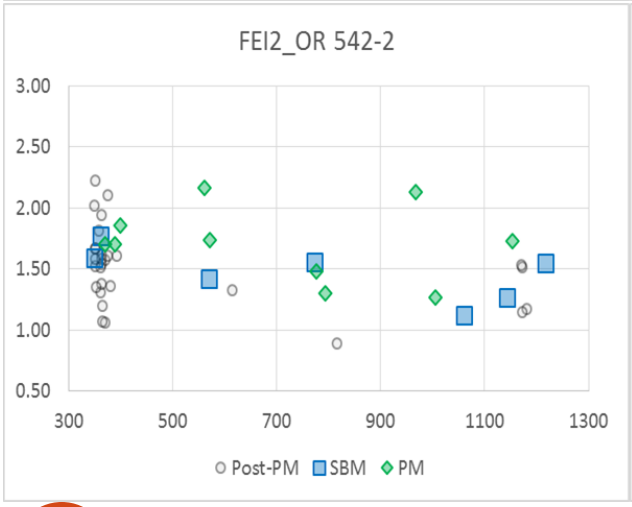
- To evaluate the SBM engines as a group compared to previous references all data through run four was divided into three groups given the variable name DATA; PM, PostPM, and SBM.
- Analysis of all available original unit data using the model DATA, IND, LTMSLAB, LTMSAPP (LTMSLAB), and ENGHREND was conducted to determine if the SBM engines as a group perform differently than the current engines.
  - ENGNO is not included as that is the variable of concern. If we adjust for engine differences we will not be able to identify differences between the SBM and previous engines
  - FEI1_OR and FEI2_OR are used with ENGHREND as we are trying to determine if the engines are different and not if the engine hour correction is appropriate at this time.

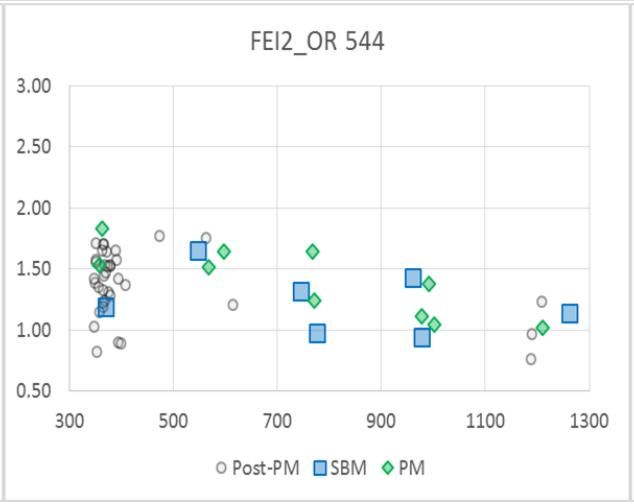
FEI1_OR & FEI2_OR by ENGHREND

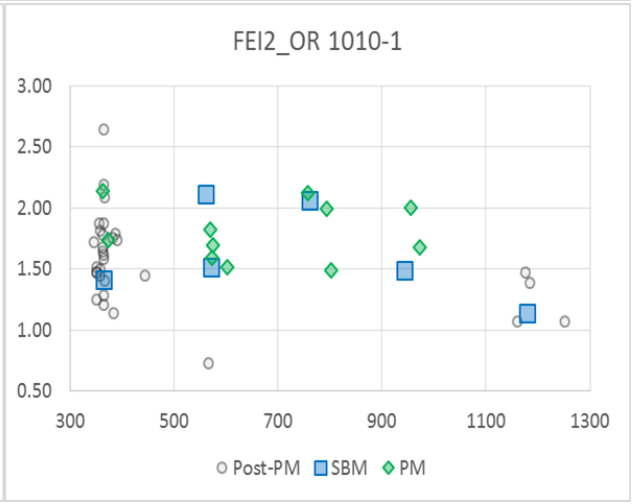












FEI1_OR & FEI2_OR Analysis

- Analysis of 137 results; runs 1-4 only.
- Model = DATA, IND, LTMSLAB, LTMSAPP (LTMSLAB), and ENGHREND
  - FEI1_OR: DATA is not significant (0.308)
  - FEI2_OR: DATA is borderline (0.129)
- Review of LS Means indicates the shift in FEI2 took place after the matrix with the original engine batch and is not related to the SBM engines.

FEI1_OR

Data	N	Mean	Grouping
PM	29	2.19214	A
SB	16	2.10859	A
PostPM	92	2.07653	A

FEI2_OR

Data	N	Mean	Grouping
PM	29	1.78212	A
PostPM	92	1.63550	A
SB	16	1.63395	A

Appendix

Short Block Matrix Design

Task Force Request

The availability of current OEM built VIE/F engines is expected to be depleted by 3Q2017. The Task Force for introducing the new lab built engines is requesting the stats group to provide input on the best manner to introduce the new lab built engines to the system by May 31st, 2017. Please consider the questions below when providing your recommendations.

- Can the lab built engines be introduced through the normal referencing system?

  If lab built engines are introduced through the normal referencing system there will be no data to determine if the engine hour adjustment has changed for the new engines as references are conducted on the first run only in most cases. If the SP believes the new engines may exhibit a different engine hour adjustment a matrix of tests across the life of the engines is required.

- How should the VIE and VIF be incorporated into the introduction?

  A decision about the VIF should be made after VIE data is available.

- Do we need to reevaluate the engine hour adjustment?

  This cannot be answered without producing the data to determine if a significant difference is present. If there is a belief in the SP that it could change based on the technical understanding of the process then data should be produced to evaluate the difference.

If a matrix or donated tests are determined to be necessary we expect four labs with one stand in each to be available.

VIE Matrix Design

Objectives:

1. Address the introduction of new engines
2. Confirm oil discrimination and appropriateness of engine hour adjustment
3. Address uniform reference oil selection for each row

Run Order	Engine/Lab 1	Engine/Lab 2	Engine/Lab 3	Engine/Lab 4
1	542-2	544	1010-1	542-2
2	544	1010-1	542-2	1010-1
3	544	542-2	544	1010-1
4	1010-1	542-2	544	544
5	542-2	544	1010-1	542-2

Notes:

1: Consider using only stands from the VIE precision matrix.

2: Determine VIF design depending on VIE matrix results.

3: If this matrix proves the test is different additional data may be required.