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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

Issued: November 02, 2014
Reply to: Dan Worcester
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Email: dworcester@swri.org

These are the unapproved minutes of the 10.20.2014 Sequence VI Surveillance Panel call.

The meeting was called to order at 1:01PM by Chairman Charlie Leverett.

Agenda

The Agenda is the included as Attachment 1.

1.0 Roll Call

The Attendance list Attachment 2. Several were added to the guest list and member changes made where needed.

2.0 Approval of minutes

2.1 Approval of the minutes of the 08.12.2014 meeting.

Motion – Accept the minutes of the 08.12.2014 VIx SP Conference Call.
Dan Worcester, Jason Bowden, second. This received unanimous approval.

3.0 Action Item Review

3.1 OHT to report VIE engine usage and depletion date of VID engines.
There are 17 2009 and 99 VIE engines in inventory.

3.2 VIE Draft - This is waiting for the Precision Matrix.

3.3 Update from OHT on the availability of the new oil pan displacement block.

Motion – Allow the use of the new VIE oil pan block [VIE001021] on all VIE builds and it is optional on VID builds. This is effective 10.20.2014.
Dave Glaenzer, Robert Stockwell, second. This received unanimous approval.

3.4 VIE Draft Procedure Updates – Procedure has been updated as of the changes made at the 7/1/14 conference call and is posted on the TMC web site. Section 11.6.16 needs modification for the new oil consumption limit and A5.20 for the new oil level markings.

3.5 Obtain the proposed VIE oil "Tech 1" and labs will run demo tests. Oil is available at TMC. One lab has ordered the new oil.

3.6 Lubrizol will summarize their work on carryover and present to the SP 10/20/14.
See Attachment 3.

4.0 Old Business

4.1 **Service Engines –** Bruce Matthews has check on service engines and he stated they had "Hundreds" of these available, the group asks if it was possible to get these that were built in the same time frame (~October 2012) as the OHT VIE engine, Bruce commented he believes it would be possible. OHT will perform a survey for the industry quantity desired. More research will be needed to ensure they are the same as the current VIE engine.

Action Item – OHT to issue survey to the industry to estimate additional VIE test engine needs for a GM Service Engine purchase to supplement OHT's current VIE test engine inventory (99 engines as of 10/20/14).

4.2 **Clarification of the break in procedure –** Afton has done a new engine break-in running an additional 50 hrs and we will discuss the outcome at the SP meeting 10/20.
See Attachment 4. The test run on oil 542 was mild and had ½ the oil consumption. Extended

break in is allowed in the procedure as long as additional traces are taken every 50 hours. A new engine hour correction equation will be needed from the precision matrix.

4.3 **Demo Runs on Proposed Tech 1 Reference Oil –** Labs have volunteered to run Demo VIE tests on the proposed Tech-1 oil once it is available at TMC. It is available and one lab has placed an order.

5.0 New Business

5.1 Test Ready for Matrix – The Seq. VI Surveillance Panel will review a Test Ready Template 10/20 to determine if the test is considered ready for matrix.

5.2 The motion for fuel batches passed but received a negative at B. There is no data or further response on this issue.

5.3 There was a presentation of fuel flow. See Attachment 5. The fuel temperature of the fuel going to the micro-motion has a positive effect on flow. When the procedure was converted to metric, the tighter tolerances were not updated for Celsius.

Action Item – Labs to check to see if their VIE stands can run with fuel temperature at the flow meter controlled to 26°C ± 2°C.

Motion – Recommend that Fuel to Flow Meter temperature be moved to "critical measurement and control parameter" in the VIE draft procedure with a hard specification of 26°C ± 2°C. Effective 11/15/14.

Dave Glaenzer / Robert Stockwell / Passed 12 – 0 – 2

Action Item – TMC to work with labs that have been reporting VIE tests with missing data, so that all reported tests are complete.

5.4 Modify the Sequence VIE Draft procedure to list Horiba MEXA 110 AFR analyzer along with the other listed analyzers. These units are still active on stands and available used.

Motion – Modify the VIE draft procedure to list the Horiba MEXA 110 AFR analyzer along with the other listed analyzers as acceptable for use in the VID test.

Dave Glaenzer / Bill Buscher / Passed 11 – 0 – 3

5.5 TMC has received 542-2, we need to determine how we want to introduce it and if it should be assigned for VIE tests going forward. This oil will be used on VID and VIE when available. There will also be a new blend 1010-1.

Action Item – Once the analyticals have been made available to the TMC and are approved, ASTM REO 542-2 will be made available for VID and VIE testing.

5.6 TMC Semiannual Review There was no discussion on this issue.

5.7 Oil Temperature Measurement. Dave Glaenzer wanted clarification on oil heater temperature.

Action Item – Charlie Leverett and Dave Glaenzer to revise Figure A5.6 and edit wording to clarify oil temperature locations in the VIE draft procedure.

5.8 The PCEOCP has requested equivalent data for older test types.

Action Item – Surveillance Panel chair and the test sponsor to investigate what would be needed to determine VID equivalence limits for the VIE test.

5.9 The ASTM new test type method was reviewed. See Attachment 6. The reference oils will be Tech 1 and the new blends of 542 and 1010. The critical parts list will be updated. Labs will need to provide information for the matrix.

Action Item – Survey labs to identify what VIE engines, with varying engine age, are available for the precision matrix.

5.10 The engine hour correction for the VIE has been reviewed. See Attachment 7.

5.11 Nathan Moles is the new VI Surveillance Panel Chair.

6.0 Next Meeting or Conference Call at the call of the new Chair

Meeting Adjourned

The meeting adjourned at 3:40 PM.

Sequence VI Surveillance Panel Meeting Agenda
October 20th @ 1:00 – 5:00 CDT

<u>Call-in information is included below:</u>

1.0) Roll Call

Do we have any membership changes or additions?

2.0) Approval of minutes

2.1) Approve the minutes from the 08/12/14 Sequence VI Surveillance Panel CC.

3.0) Action Item Review

3.1 OHT to report VID & VIE engine usage and expected depletion date of VID engines. - OHT

3.2 VIE Draft - Table 5 information which cannot be generated until sufficient testing/precision matrix has taken place (stats group).

3.3 Update from OHT on the availability of the new oil pan displacement block. Available, do we need a motion specifying there use in the VID?

3.4 VIE Draft Procedure Updates – Procedure has been updated as of the changes made at the 7/1/14 conference call and is posted on the TMC web site.

3.5 Obtain the proposed VIE oil “Tech 1” and labs will run demo tests. Oil is available at TMC.

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5.2 Modify the Sequence VIE Draft procedure to list Horiba MEXA 110 AFR analyzer along with the other listed analyzers.

5.3 TMC has received 542-2, we need to determine hw we want to introduce it and if it should be assigned for VIE tests going forward.

5.4 TMC Semiannual Review

5.5 Dave has a question concerning Oil Temp measurements.

5.7 Any additional New Business?

5.8 Special Announcement????

6.) Next Meeting

Call of the chairman

7.) Meeting Adjourned

ASTM SEQUENCE VI

Name	Address	Phone/Fax/Email	Attendance
Jason Bowden Voting Member	OH Technologies, Inc. P.O. Box 5039 Mentor, OH 44061-5039	Phone: 440-354-7007 Fax: 440-354-7080 jhbowden@ohtech.com	attend
Timothy Caudill Voting Member Amol Savant for	Ashland, Inc. 21st and Front Streets Ashland, KY 41101	Phone: 606-329-5708 Fax: 606-329-3009 Tlcaudill@ashland.com ACSavant@ashland.com	attend
David Glaenzer Voting Member	Afton Research Center 500 Spring Street Richmond, VA 23218	Phone: 804-788-5214 Fax: 804-788-6358 Dave.Glaenzer@aftonchemical.com	attend
Rich Grundza Voting Member	ASTM TMC 6555 Penn Ave. Pittsburgh, PA 15206-4489	Phone: 412-365-1034 Fax: 412-365-1047 reg@astmtmc.cmu.edu	attend
Tracey King Voting Member	Haltermann	tking@jhaltermann.com	attend
Charlie Leverett Voting Member	Intertek Automotive Research 5404 Bandera Road San Antonio, TX 78238	Phone: 210-647-9422 Fax: 210-523-4607 charlie.leverett@intertek.com	attend
Terry Kowalski Voting Member	Toyota	teri.kowalski@tema.toyota.com	
Bruce Matthews Voting Member	GM Powertrain Engine Oil Group Mail Code: 483-730-472 823 Joslyn Rd	Pontiac, MI 48340 Phone: 248-830-9197 bruce.matthews@gm.com	phone
Timothy Miranda Voting Member	BP Castrol Lubricants USA 1500 Valley Road Wayne, NJ 07470	Phone: 973-305-3334 Timothy.Miranda@bp.com	
Nathaniel Moles Voting Member	Lubrizol 29400 Lakeland Blvd. Wickliffe, OH 44092	Phone: (440) 347-4472 Nathaniel.Moles@Lubrizol.com	attend
Mark Mosher Voting Member	ExxonMobil 600 Billingsport Road Paulsboro, NJ 08066	Phone: 856-224-2132 Fax: 856-224-3628 mark_r_mosher@exxonmobil.com	attend

ASTM SEQUENCE VI

Name	Address	Phone/Fax/Email	Attendance
Andy Ritchie Voting Member	Infineum 1900 East Linden Ave. Linden, NJ 07036-0735	Phone: 908-474-2097 Fax: 908-474-3637 Andrew.Ritchie@infineum.com	Mike Warholic sub
Ron Romano Voting Member	Ford Motor Company 21500 Oakwood Blvd POEE Bldg Rm DR 167 MD 44 Dearborn, MI 48121-2053	Phone: 313-845-4068 rromano@ford.com	attend
Kaustav Sinha Voting Member	Chevron Oronite Company LLC 4800 Fournace Place Bellaire, TX 77401	Phone: 713.432.6642 Fax: 713.432.3330 LFNQ@chevron.com	attend
Mark Sutherland Voting Member	TEI	Phone: 123.456.7890 Fax: 123.456.7890 msutherland@tei-net.com	
Haiying Tang Voting Member	Chrysler	Phone: 248-512-0593 HT146@Chrysler.com	
Dan Worcester Voting Member	Southwest Research Institute 6220 Culebra Road San Antonio, TX 78228	Phone: 210.522.2405 dan.worcester@swri.org	attend

Guests

Ed Altman	ed.altman@aftonchemical.com	Afton	
Bob Campbell	Bob.Campbell@aftonchemical.com	Afton	attend
Todd Dvorak	todd.dvorak@aftonchemical.com	Afton	attend
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Don Smolenski	Donald.Smolenski@Evonik.com	Evonik	

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Mark Adams	mark@tribologytesting.com		
Dan Lanctot	dlanctot@tei-net.com	TEI	attend

ASTM SEQUENCE VI

Name	Address	Phone/Fax/Email	Attendance
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Mike Warholic	Michael.warholic@Infineum.com 908.474.2065	Infineum	attend
Jordan Pastor	Jordan.pastor@Infineum.com 313.348.3120	Infineum	attend
Jim Linden	lindenjim@jlindenconsulting.com 248.321.5343	J Linden Consulting	attend

ASTM SEQUENCE VI

Name	Address	Phone/Fax/Email	Attendance

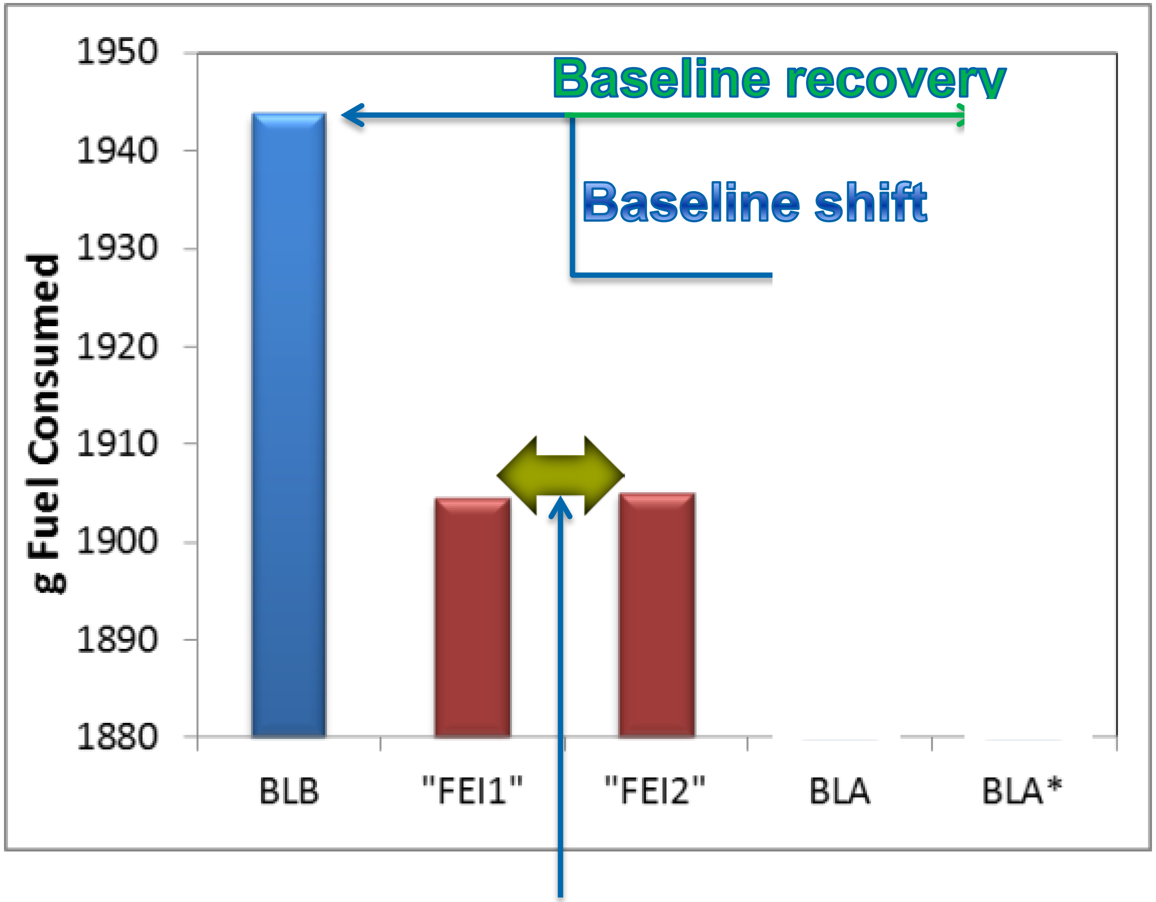
Sequence VI FM Carry Over

Nathan Moles

VID Observations

SUCCESS TOGETHER

- Carefully analyzed weighted fuel consumption of baseline and candidate oils
- In cases where high levels of FM carryover effects were observed



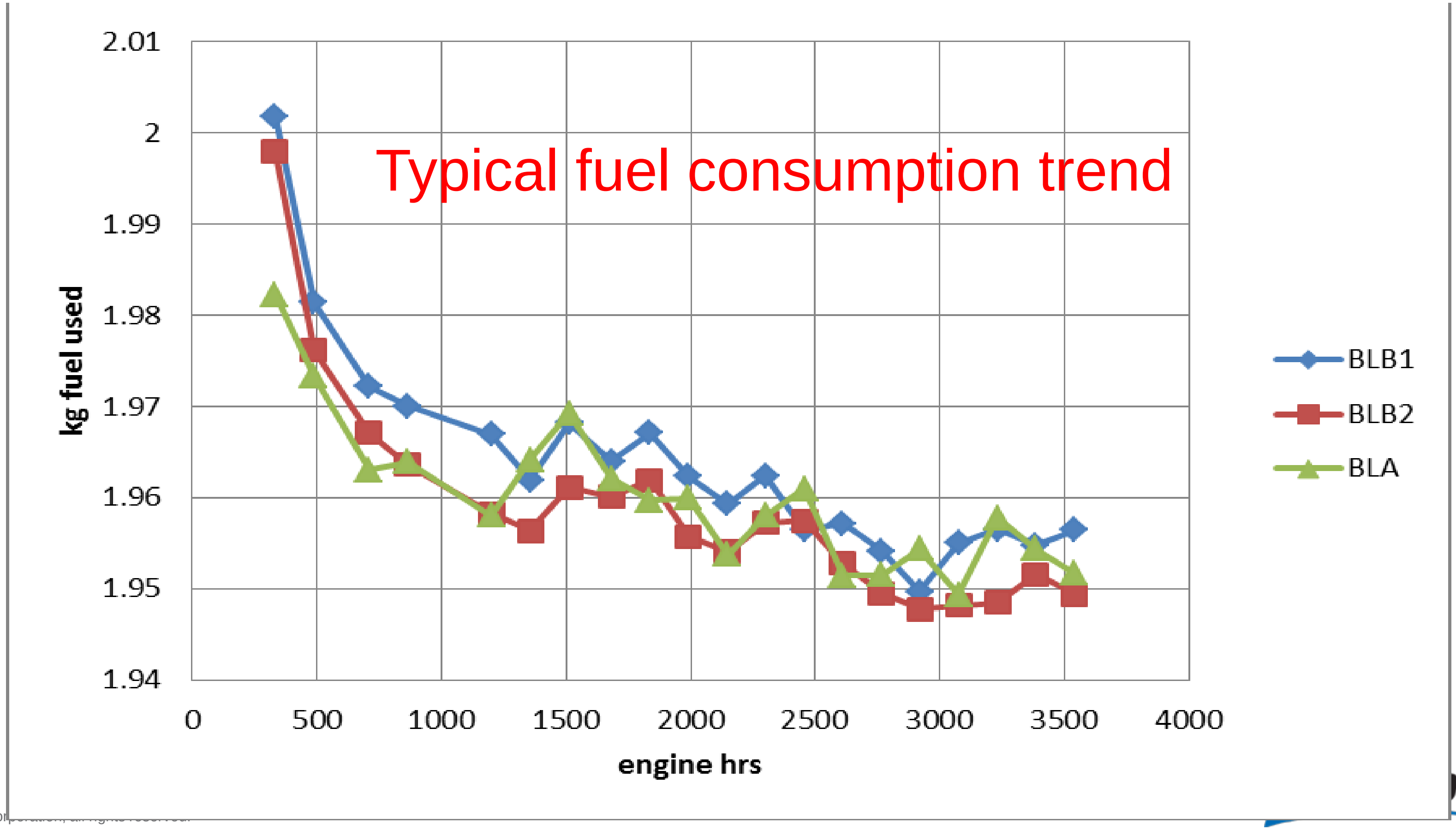
Virtual parity between “FEI1” and “FEI2” on amount of fuel consumed

Lubrizol

FM Carry Over testing summary

SUCCESS TOGETHER

- Large BLA shifts on the order of 0.70% observed following high FM formulations



Attempts at Fixing the Problem

- To date, attempted to make incremental changes to remove the carry over effect for ease of gaining approval for updating in the procedure
  - Additional BL Flushes
  - Lower Viscosity HDFO

Additional BL Flushing Test Procedure

SUCCESS TOGETHER

- A decision was made to add additional HDFO and BLA flushes to the end of Sequence VID Test to remove carryover effect

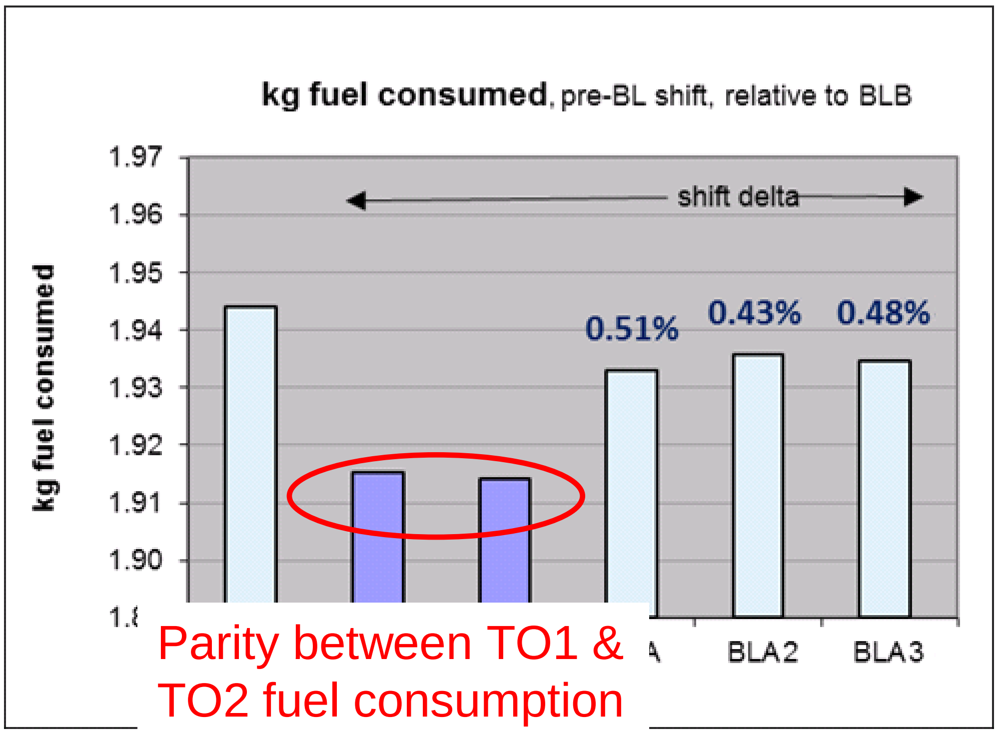
1. Triple Flush to BLB1 Oil
   - 6 stage evaluation
2. Triple Flush to BLB2 Oil
   - 6 stage evaluation
3. Triple Flush to Test Oil
   - 16 hour aging
   - 6 stage evaluation
   - 84 hour aging
   - 6 stage evaluation
4. Double Flush to HDFO
5. Triple Flush to BLA
   - 6 stage evaluation

Lubrizol

BL Flushing Test Results

SUCCESS TOGETHER

- Additional HDFO and BLA shifts initially showed a decrease in the baseline shift; however, an additional flush did not show any significant change
- This test was a repeat run that had a 0.72% BLA shift (more consistent with the BLA shift observed with this formulation)
  - Believed BLB was suppressed from the previous run



Lubrizol

Low Viscosity FO Flushing Test Procedure

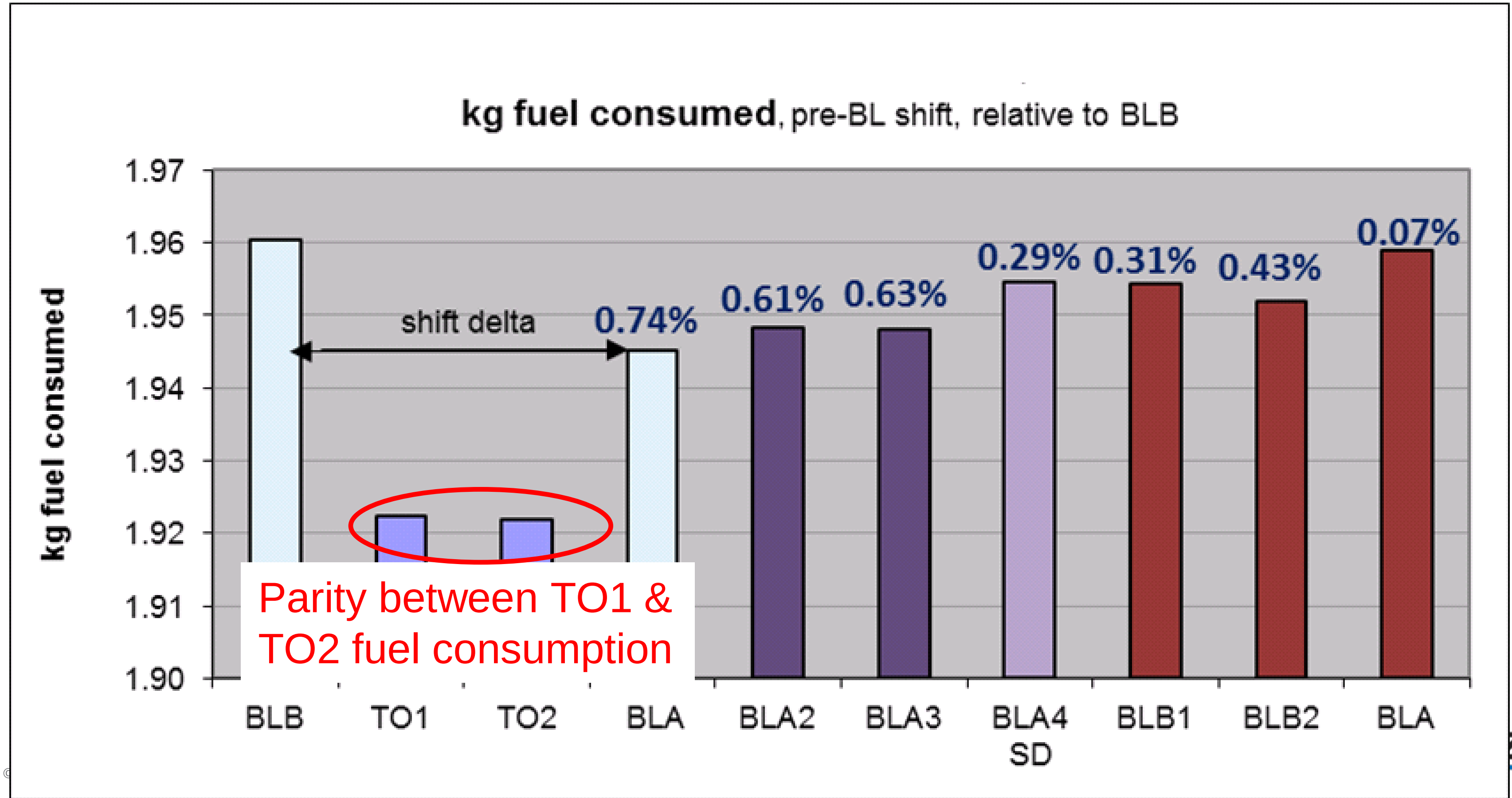
SUCCESS TOGETHER

- Next experiment was to add additional run time to a lower viscosity 0-W20 version of the existing HDFO to the end of Sequence VID Test
  1. Triple Flush to BLB1 Oil
     - 6 stage evaluation
  2. Triple Flush to BLB2 Oil
     - 6 stage evaluation
  3. Triple Flush to Test Oil
     - 16 hour aging
     - 6 stage evaluation
     - 84 hour aging
     - 6 stage evaluation
  4. Double Flush to HDFO
  5. Triple Flush to BLA
     - 6 stage evaluation

Low Viscosity HDFO Test Results

SUCCESS TOGETHER

- Actual test procedure:
  - 12hrs HDFO run → 6 stage evaluation
  - 22hrs HDFO run → 6 stage evaluation
  - shutdown ~48hrs → 6 stage evaluation (ran out of HDFO)
  - Follow-up test candidate same formulation w/o FM



FM Carry Over Implications

SUCCESS TOGETHER

- Sequence VI Fuel Economy test is actually penalizing stronger/more durable FM formulations
- Lingering effects can impact BLB fuel consumption of subsequent tests and ultimately FEI results

Lubrizol

Next Steps…

SUCCESS TOGETHER

- Utilizing proprietary in house test to evaluate new flushing formulations to use as HDFO
- Investigating effects of altering the HDFO operating conditions (temperature, speed and load)

Lubrizol

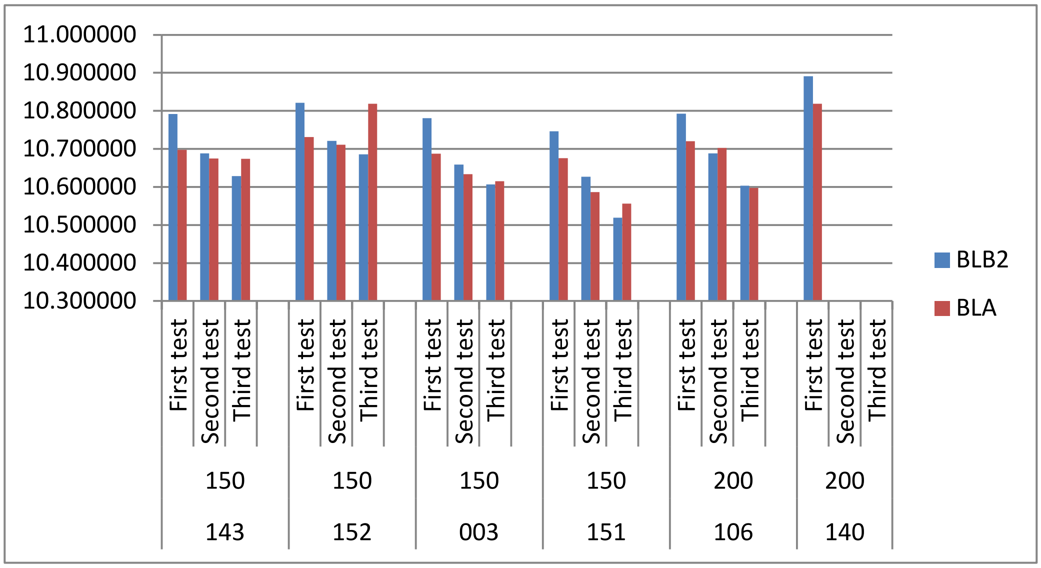
OHT Engine	Stand	R.O.	EOT	FEI 1 Original	FEI 1 **VID** Hour Corr	FEI 1 **VID** Final	FEI 2 Original	FEI 2 **VID** Hour Corr	FEI 2 **VID** Final	Engine Hours	
143	1	542	03/13/13	2.85	-0.41	2.44	1.50	-0.39	1.11	386	Not final procedure
152	2	542	05/17/13	2.86	-0.44	2.42	1.98	-0.41	1.57	352	Not final procedure
003	1	542-1	03/27/14	2.65	-0.44	2.21	1.82	-0.41	1.41	352	
051	2	542-1	06/20/14	2.89	-0.42	2.47	2.32	-0.40	1.92	370	
106	1	542-1	09/18/14	2.55	-0.40	2.15	1.66	-0.37	1.29	405	200 hour break in
051	2	542-1	09/19/14	2.18	0.04	2.22	1.41	0.03	1.44	1815	Ran to evaluate hour factor
140	3	542-1	10/10/14	2.84	-0.40	2.44	2.05	-0.37	1.68	404	200 hr BI; oil change at 150

OHT Engine	Avg. BI Transition Times (sec.) "A" to "B"	Avg. BI Transition Times (sec.) "B" to "A"	150 hour Break-In Oil Consumption	First Test Oil Cons.
069	12.0	10.0	17.3 ml / hour	
143	6.4	8.3	14.5 ml / hour	400 ml
152	6.4	6.5	14.6 ml / hour	600 ml
003	6.5	9.3	14.7 ml / hour	500 ml
051	6.2	6.8	10.0 ml / hour	400 ml
106	6.2	7.9	9.3 ml / hour	400 ml
140	7.0	7.0	27.0 ml / hour	700 ml

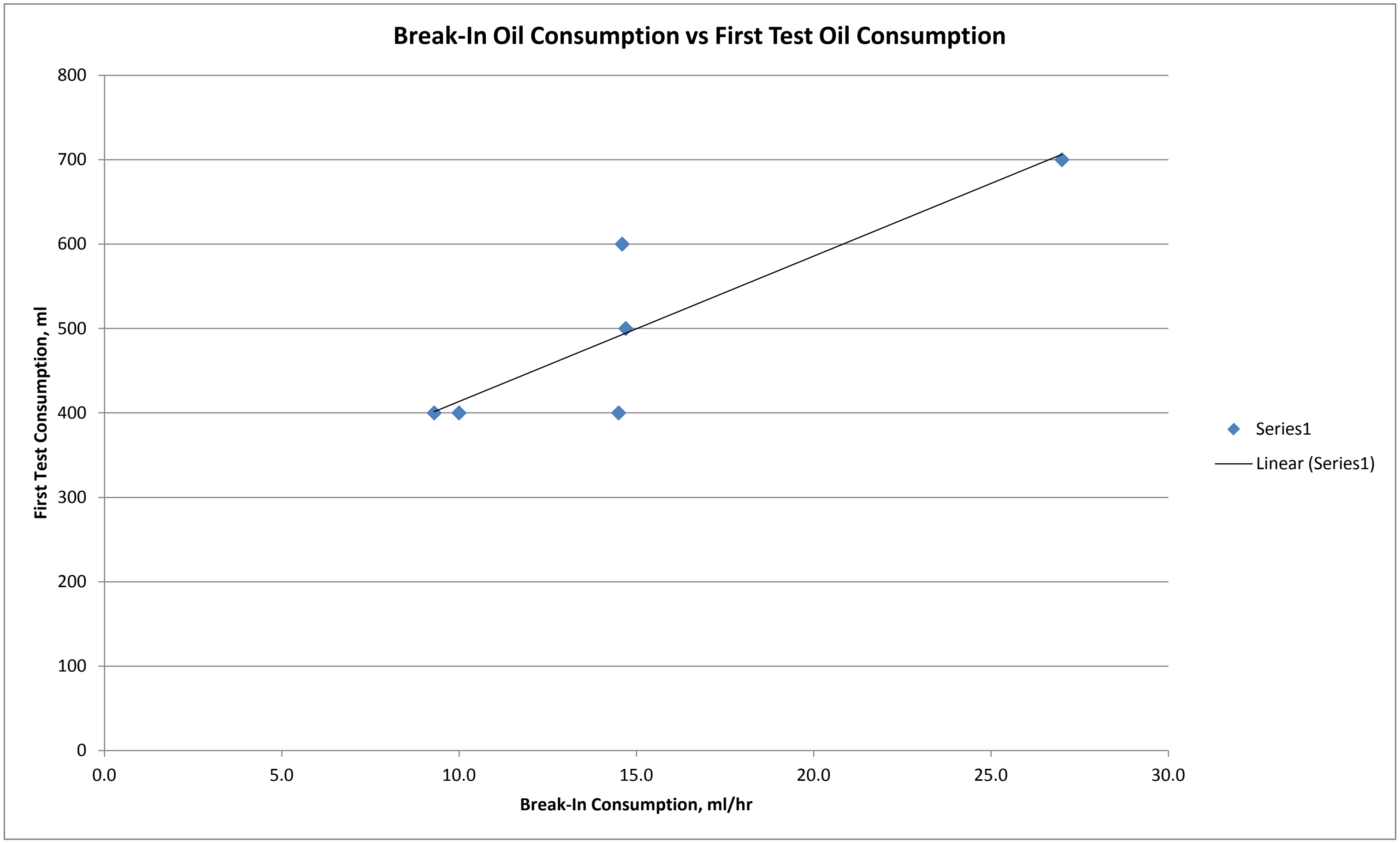
Afton CHEMICAL

			BLB2	BLA	BLS		
143	150	First test	10.791811	10.697337	0.88		
		Second test	10.688160	10.674481	0.13	0.96046	0.213661
		Third test	10.628634	10.673681	-0.42	0.556934	0.007495
152	150	First test	10.821566	10.731356	0.83		
		Second test	10.721533	10.711214	0.10	0.924386	0.187693
		Third test	10.685814	10.818380	-1.24	0.333152	-1.0005
003	150	First test	10.781244	10.687233	0.87		
		Second test	10.659171	10.633359	0.24	1.132272	0.504097
		Third test	10.607031	10.615109	-0.08	0.489156	0.17163
151	150	First test	10.746030	10.675893	0.65		
		Second test	10.627136	10.586294	0.38	1.106399	0.839265
		Third test	10.518845	10.555853	-0.35	1.019005	0.287551
106	200	First test	10.792780	10.720657	0.67		
		Second test	10.688664	10.702565	-0.13	0.964682	0.168758
		Third test	10.603167	10.597755	0.05	0.799885	0.979298
140	200	First test	10.890776	10.818719	0.66		
		Second test			#DIV/0!	100	100
		Third test			#DIV/0!	#DIV/0!	#DIV/0!

Averag BLSD with 150 BI (first te	0.81	4
Average BLS with 200 BI (first te	0.66	2


11.000000
10.900000
10.800000
10.700000
10.600000
10.500000
10.400000
10.300000
First test
Second test
Third test
150
143
150
152
150
003
150
151
200
106
200
140
BLB2
BLA

BI	Test
14.5	400
14.6	600
14.7	500
10.0	400
9.3	400
27.0	700



Investigating Possible Factors affecting VIE Fuel Flow Measurement

By: Todd Dvorak

10/20/2014

Passion for Solutions™

Fuel Flow Measurement Analysis

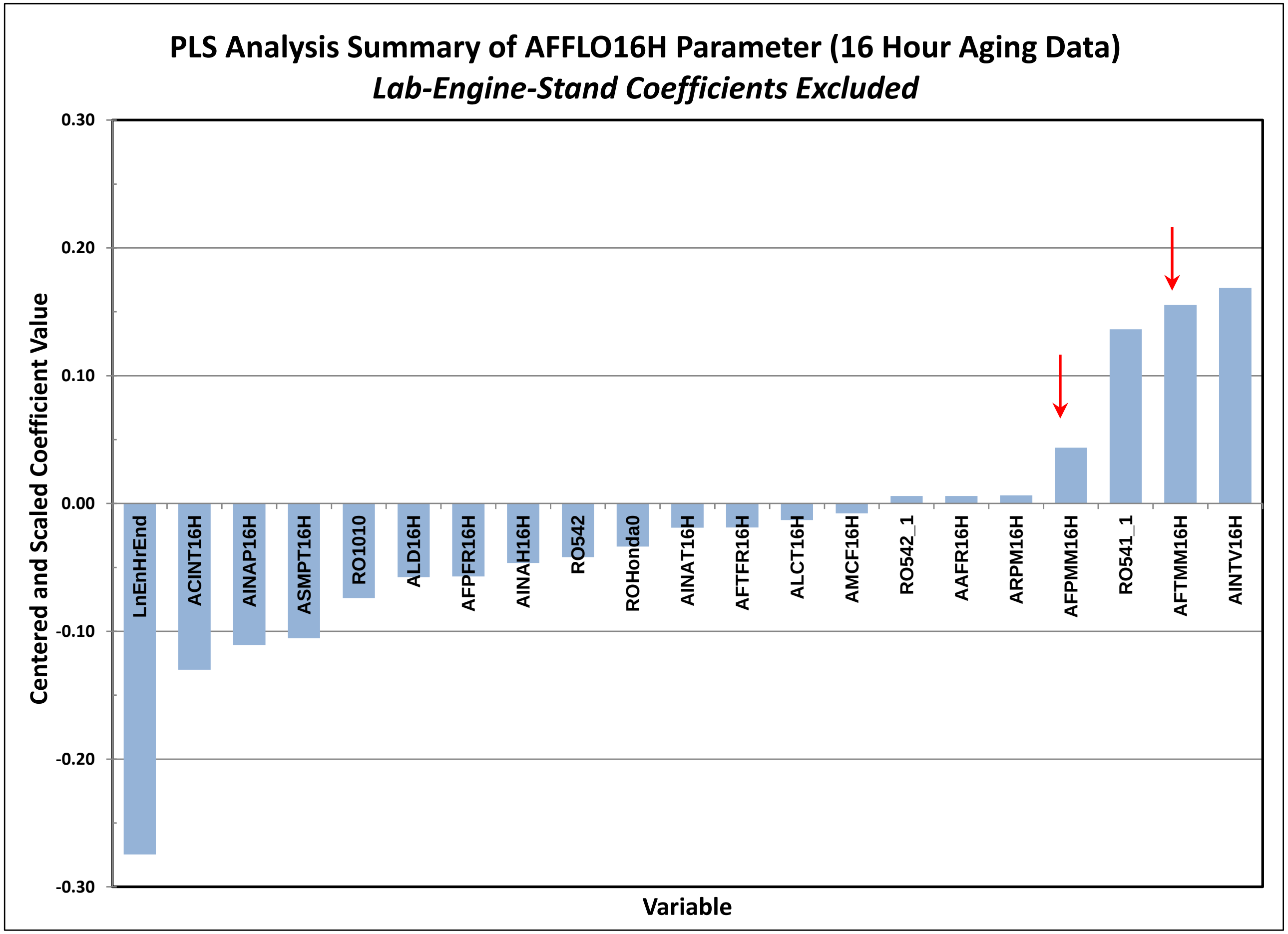
- Objective – examine relationship of fuel temperature on fuel flow measurement.

- Analysis Approach: VIE "Aging" operational data was analyzed to investigate possible factors that influence fuel flow measurement
  - Most complete data set was the 16 hour aging data.
    - Number of observations *n* = 40
      - Too many missing observations for 109 hour aging data (*n* = 25)
    - Number of variables in analysis = 38
  - Partial Least Squares and Stepwise Regression analysis (PLS) was selected for the analysis
    - Primary output parameter analyzed is AFFLO16H, *the average fuel flow for 16 hour aging*
  - The fuel flow analyses are supplemented with matrix plots of the data
    - Additional plots are provided in the appendix.

Fuel Flow Measurement Analysis

PLS Analysis results – excluding Lab-Engine-Stand coefficients

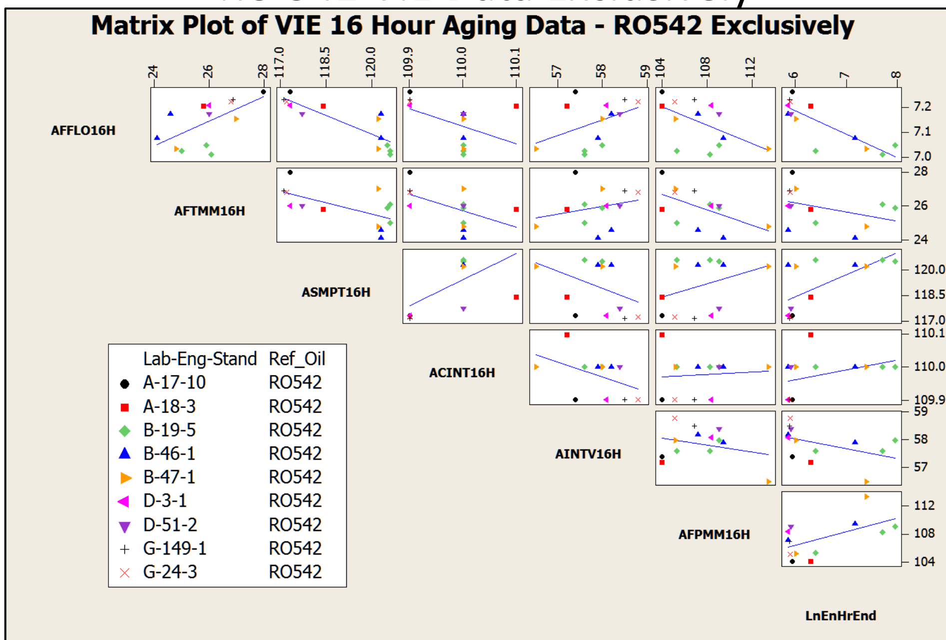
- Bar chart of centered and scaled coefficients on fuel flow.
  - Note relative effect of Micro-Motion related factors



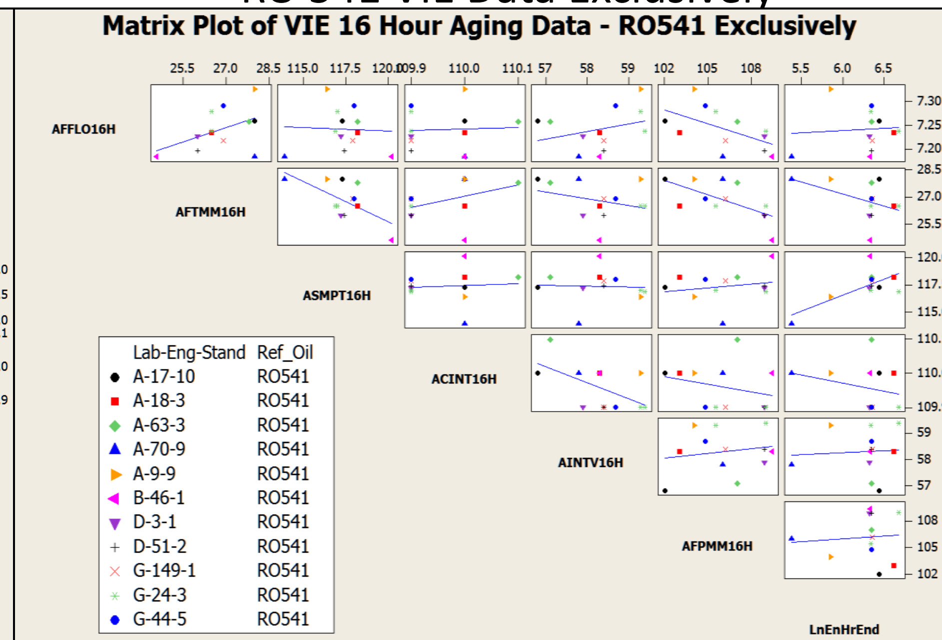
Fuel Flow Measurement Analysis

- Matrix Plot of factors with factors highlighted in PLS analysis
  - Plots suggest some factors are correlated with fuel consumption
  - Caution … very few repeats in data to draw “solid” conclusions from data

RO 542 VIE Data Exclusively



RO 541 VIE Data Exclusively



Afton CHEMICAL

Passion for Solutions™

Fuel Flow Measurement Analysis

SAS Stepwise Regression Analysis Results

- Stepwise regression results suggests temperature effect on average fuel consumption

VIE Analysis Summary

The REG Procedure
Model: MODEL1
Dependent Variable: AFFLO16H

Number of Observations Read	69
Number of Observations Used	40
Number of Observations with Missing Values	29

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	0.26741	0.02228	27.68	<.0001
Error	27	0.02173	0.00080496		
Corrected Total	39	0.28914			

Root MSE	0.02837	R-Square	0.9248
Dependent Mean	7.18740	Adj R-Sq	0.8914
Coeff Var	0.39474		

Parameter Estimates								
Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Standardized Estimate	Variance Inflation
Intercept	Intercept	1	47.45238	9.88435	4.80	<.0001	0	0
LabA_Eng18_St3	LabA-Eng18-St3	1	0.08826	0.01631	5.41	<.0001	0.31141	1.19001
LabA_Eng63_S3	LabA-Eng63-S3	1	0.05128	0.01924	2.66	0.0128	0.15887	1.27654
LabA_Eng70_S9	LabA-Eng70-S9	1	-0.11901	0.02314	-5.14	<.0001	-0.30507	1.26353
LabB_End19_S5	LabB-End19-S5	1	-0.08902	0.01932	-4.61	<.0001	-0.31411	1.66918
LabB_Eng47_S1	LabB-Eng47-S1	1	-0.05660	0.02209	-2.56	0.0163	-0.14510	1.15225
LabD_Eng51_S2	LabD-Eng51-S2	1	-0.04773	0.01792	-2.66	0.0129	-0.14785	1.10673
LabG_Eng149_S1	LabG-Eng149-S1	1	-0.04788	0.01945	-2.46	0.0205	-0.14835	1.30355
LnEnHrEnd		1	-0.04629	0.01085	-4.27	0.0002	-0.30949	1.89099
RO541		1	0.04029	0.01054	3.82	0.0007	0.21717	1.15889
ROHonda0		1	0.04551	0.02007	2.27	0.0315	0.14099	1.38805
ACINT16H		1	-0.36952	0.08971	-4.12	0.0003	-0.27142	1.55975
AFTMM16H		1	0.02526	0.00486	5.20	<.0001	0.33588	1.49955

Fuel Flow Measurement Analysis

SAS Correlation Analysis Results

- Factors identified as statistically significant ($p \leq 0.05$) indicated with red arrows
- Significant factors include the fuel temperature at MM factor

Pearson Correlation Coefficients, N = 40
Prob > |r| under H0: Rho=0

	AFFLO16H	LnEnHrEnd	AAFR16H	ACINT16H	AFPFR16H	AFPMM16H	AFTFR16H	AFTMM16H	AHEAT16H	AINAH16H	AINAP16H
	1.00000	-0.48525	0.21664	-0.33647	0.08700	-0.15506	-0.26857	0.52011	-0.68653	0.09404	-0.24042
AFFLO16H		0.0015	0.1794	0.0338	0.5935	0.3394	0.0938	0.0006	<.0001	0.5638	0.1351
	-0.48525	1.00000	-0.37492	0.06382	-0.18766	0.34259	0.10424	-0.37884	0.15638	-0.06870	-0.26325
LnEnHrEnd	0.0015		0.0171	0.6956	0.2462	0.0305	0.5221	0.0159	0.3353	0.6736	0.1007
	0.21664	-0.37492	1.00000	-0.03838	0.16925	0.02077	0.29885	0.27629	0.12352	-0.27721	-0.01375
AAFR16H	0.1794	0.0171		0.8141	0.2965	0.8988	0.0610	0.0844	0.4477	0.0833	0.9329
	-0.33647	0.06382	-0.03838	1.00000	0.06753	-0.26143	0.61354	-0.07789	0.34297	-0.34726	0.03674
ACINT16H	0.0338	0.6956	0.8141		0.6788	0.1032	<.0001	0.6328	0.0303	0.0281	0.8219
	0.08700	-0.18766	0.16925	0.06753	1.00000	-0.05189	-0.22423	0.40479	-0.18460	0.36592	-0.06459
AFPFR16H	0.5935	0.2462	0.2965	0.6788		0.7505	0.1642	0.0096	0.2542	0.0202	0.6921
	-0.15506	0.34259	0.02077	-0.26143	-0.05189	1.00000	-0.03818	-0.43857	0.19762	0.03809	-0.24902
AFPMM16H	0.3394	0.0305	0.8988	0.1032	0.7505		0.8151	0.0046	0.2216	0.8155	0.1213
	-0.26857	0.10424	0.29885	0.61354	-0.22423	-0.03818	1.00000	-0.16547	0.55205	-0.63434	-0.12361
AFTFR16H	0.0938	0.5221	0.0610	<.0001	0.1642	0.8151		0.3075	0.0002	<.0001	0.4473
	0.52011	-0.37884	0.27629	-0.07789	0.40479	-0.43857	-0.16547	1.00000	-0.56590	0.12222	-0.13696
AFTMM16H	0.0006	0.0159	0.0844	0.6328	0.0096	0.0046	0.3075		0.0001	0.4525	0.3994
	-0.68653	0.15638	0.12352	0.34297	-0.18460	0.19762	0.55205	-0.56590	1.00000	-0.38232	0.21617
AHEAT16H	<.0001	0.3353	0.4477	0.0303	0.2542	0.2216	0.0002	0.0001		0.0149	0.1803
	0.09404	-0.06870	-0.27721	-0.34726	0.36592	0.03809	-0.63434	0.12222	-0.38232	1.00000	0.07841
AINAH16H	0.5638	0.6736	0.0833	0.0281	0.0202	0.8155	<.0001	0.4525	0.0149		0.6306
	-0.24042	-0.26325	-0.01375	0.03674	-0.06459	-0.24902	-0.12361	-0.13696	0.21617	0.07841	1.00000
AINAP16H	0.1351	0.1007	0.9329	0.8219	0.6921	0.1213	0.4473	0.3994	0.1803	0.6306	

Fuel Flow Measurement Analysis

Analysis Summary

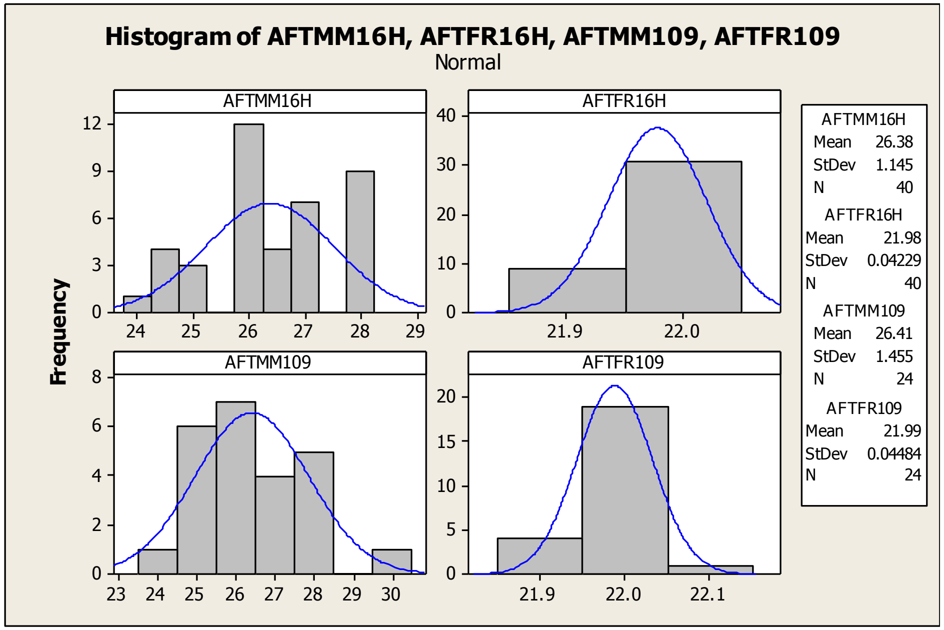
- Partial Least Squares, Matrix Plots, Regression, and Correlation Analysis suggests possible relationship between Fuel Temp and MicroMotion fuel flow measurement

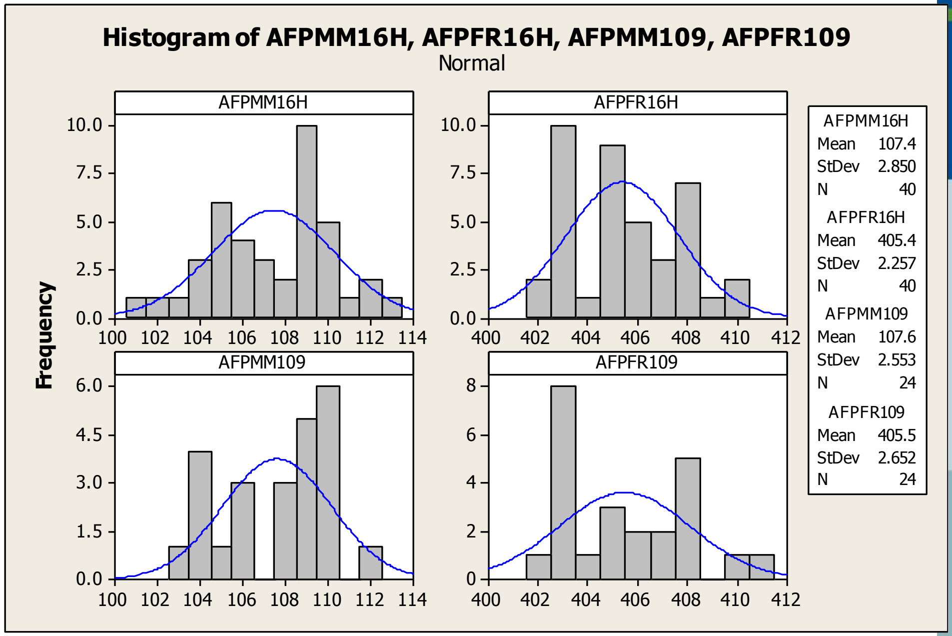
- Collinear relationships between data make it difficult to provide solid evidence of the cause-effect relationship

- May need additional follow-on testing to provide solid evidence to confirm the findings.

Appendix – VIE Histogram Plots

Histogram Plots of the Data





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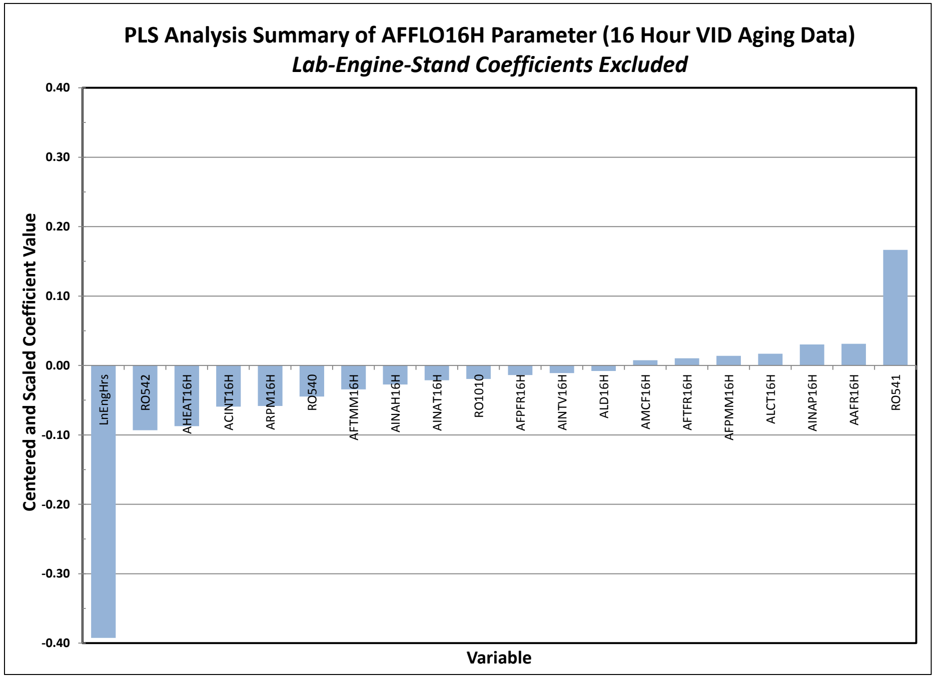
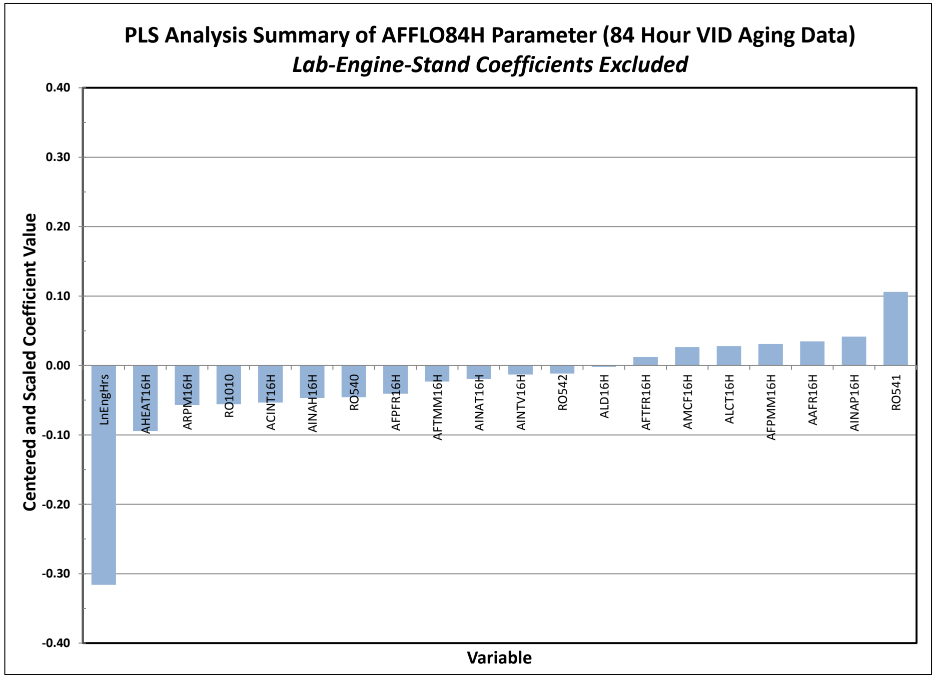
Appendix – VID Analysis

Fuel Flow Measurement Analysis

- PLS Analysis results of *VID* – excluding Lab-Engine-Stand coefficients
  - Bar chart of centered and scaled coefficients on fuel flow.
    - No relative effect of Micro-Motion related factors





Fuel Flow Measurement Analysis

Stepwise Regression Analysis of *VID* data

- Analysis results of Fuel Flow during 16 & 84 hour aging conditions indicates possible effect of temperature at micro motion

VID Analysis Summary

The REG Procedure
Model: MODEL1
Dependent Variable: AFFLO16H

Number of Observations Read	409
Number of Observations Used	408
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	60	1.47928	0.02465	20.85	<.0001
Error	347	0.41037	0.00118		
Corrected Total	407	1.88966			

Root MSE	0.03439	R-Square	0.7828
Dependent Mean	7.11729	Adj R-Sq	0.7453
Coeff Var	0.48318		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Standardized Estimate	Variance Inflation
Intercept	1	51.58374	18.21091	2.83	0.0049	0	0
LnEngHrs	1	-0.03777	0.00238	-15.84	<.0001	-0.46338	1.36715
ACINT16H	1	-0.07199	0.04058	-1.77	0.0769	-0.05993	1.82295
AFTMM16H	1	-0.00788	0.00207	-3.81	0.0002	-0.13276	1.94416
AINAP16H	1	2.96194	1.76993	1.67	0.0951	0.04304	1.05695
ALCT16H	1	0.00099434	0.00030700	3.24	0.0013	0.12114	2.23508
ARPM16H	1	-0.01611	0.00765	-2.11	0.0359	-0.05542	1.10624

VID Analysis Summary

The REG Procedure
Model: MODEL1
Dependent Variable: AFFLO84H

Number of Observations Read	409
Number of Observations Used	408
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	51	1.18079	0.02315	19.37	<.0001
Error	356	0.42553	0.00120		
Corrected Total	407	1.60631			

Root MSE	0.03457	R-Square	0.7351
Dependent Mean	7.13538	Adj R-Sq	0.6971
Coeff Var	0.48453		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Standardized Estimate	Variance Inflation
Intercept	1	9.31158	1.19253	7.81	<.0001	0	0
LnEngHrs	1	-0.02824	0.00233	-12.11	<.0001	-0.37571	1.29455
AHEAT84H	1	-0.00074260	0.00011828	-6.28	<.0001	-0.23640	1.90547
AINAP84H	1	2.61928	1.79203	1.46	0.1447	0.04113	1.06413
AINAT84H	1	-0.06931	0.04082	-1.70	0.0905	-0.06810	2.16244

Afton Chemical

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Fuel Flow Measurement Analysis

SAS Correlation Analysis Results for *VID* Average Fuel Flow at 16 Hours

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations	AFFLO16H	LnEngHrs	AAFR16H	ACINT16H	AFPFR16H	AFPMM16H	AFTFR16H	AFTMM16H	AHEAT16H	AINAH16H	AINAP16H	AINAT16H	AINTV16H	ALCT16H	ALD16H	AMCF16H	ARPM16H
AFFLO16H	1	-0.55262	0.06733	-0.14787	0.00762	-0.00492	0.06309	-0.04382	-0.27058	-0.08689	0.02557	-0.02864	0.05579	0.08308	-0.04666	-0.03115	-0.10992
		<.0001	0.1741	0.0027	0.8779	0.921	0.2029	0.3767	<.0001	0.0792	0.6062	0.5636	0.2603	0.0934	0.3466	0.5299	0.0262
LnEngHrs	-0.55262	1	-0.03582	0.00061	-0.00064	0.0488	-0.0779	0.01241	0.13546	0.08577	0.01133	-0.05294	-0.00767	0.07176	-0.00385	-0.04674	0.06469
	<.0001		0.4706	0.9901	0.9897	0.3255	0.1162	0.8026	0.0061	0.0836	0.8194	0.2861	0.8773	0.1479	0.9383	0.3464	0.1922
AAFR16H	0.06733	-0.03582	1	-0.10423	-0.20235	-0.00645	0.03962	0.23413	-0.03577	-0.0974	-0.00659	0.00182	0.08568	0.19063	-0.02919	-0.0684	0.03595
	0.1741	0.4706		0.0351	<.0001	0.8966	0.4242	<.0001	0.4707	0.049	0.8942	0.9707	0.0835	0.0001	0.5561	0.1674	0.4684
ACINT16H	-0.14787	0.00061	-0.10423	1	-0.10237	0.02543	-0.00293	0.05181	0.22613	0.28536	-0.02288	0.17436	-0.02515	-0.29826	0.09434	0.46603	-0.06111
	0.0027	0.9901	0.0351		0.0385	0.6081	0.9529	0.2959	<.0001	<.0001	0.6445	0.0004	0.6121	<.0001	0.0566	<.0001	0.2175
AFPFR16H	0.00762	-0.00064	-0.20235	-0.10237	1	-0.05393	-0.12859	0.06887	0.07354	-0.07996	0.03192	0.01983	0.14379	-0.01929	-0.12588	-0.04252	0.01227
	0.8779	0.9897	<.0001	0.0385		0.2766	0.0092	0.1644	0.1376	0.1064	0.5198	0.6892	0.0036	0.6973	0.0108	0.3911	0.8046
AFPMM16H	-0.00492	0.0488	-0.00645	0.02543	-0.05393	1	0.00536	-0.01359	0.04297	-0.00666	-0.01348	-0.01204	-0.05956	-0.16252	-0.01927	0.05051	0.01047
	0.921	0.3255	0.8966	0.6081	0.2766		0.9139	0.7841	0.3861	0.8933	0.7857	0.8081	0.2294	0.001	0.6976	0.3082	0.8328
AFTFR16H	0.06309	-0.0779	0.03962	-0.00293	-0.12859	0.00536	1	0.02419	0.01305	-0.10034	0.00075	0.02105	0.05943	-0.03366	0.01283	-0.00019	-0.04318
	0.2029	0.1162	0.4242	0.9529	0.0092	0.9139		0.6256	0.7925	0.0425	0.9879	0.6713	0.2304	0.4973	0.7958	0.997	0.3838
AFTMM16H	-0.04382	0.01241	0.23413	0.05181	0.06887	-0.01359	0.02419	1	0.14291	0.06922	0.03558	-0.0278	0.10886	0.17119	-0.12486	0.06995	0.00136
	0.3767	0.8026	<.0001	0.2959	0.1644	0.7841	0.6256		0.0038	0.1623	0.4731	0.5751	0.0277	0.0005	0.0115	0.1579	0.9782
AHEAT16H	-0.27058	0.13546	-0.03577	0.22613	0.07354	0.04297	0.01305	0.14291	1	-0.05799	0.02516	0.02138	-0.07916	-0.46814	0.10751	0.14457	0.06152
	<.0001	0.0061	0.4707	<.0001	0.1376	0.3861	0.7925	0.0038		0.2419	0.6119	0.6664	0.1099	<.0001	0.0297	0.0034	0.2144
AINAH16H	-0.08689	0.08577	-0.0974	0.28536	-0.07996	-0.00666	-0.10034	0.06922	-0.05799	1	-0.04062	0.04496	0.02443	-0.07488	0.10008	0.26679	-0.01253
	0.0792	0.0836	0.049	<.0001	0.1064	0.8933	0.0425	0.1623	0.2419		0.4126	0.3644	0.6223	0.1306	0.0431	<.0001	0.8005
AINAP16H	0.02557	0.01133	-0.00659	-0.02288	0.03192	-0.01348	0.00075	0.03558	0.02516	-0.04062	1	-0.00366	-0.00196	0.0333	0.02252	0.05497	-0.04157
	0.6062	0.8194	0.8942	0.6445	0.5198	0.7857	0.9879	0.4731	0.6119	0.4126		0.9411	0.9685	0.5019	0.6497	0.2674	0.4018
AINAT16H	-0.02864	-0.05294	0.00182	0.17436	0.01983	-0.01204	0.02105	-0.0278	0.02138	0.04496	-0.00366	1	-0.00764	0.00935	-0.07214	0.1179	-0.01692
	0.5636	0.2861	0.9707	0.0004	0.6892	0.8081	0.6713	0.5751	0.6664	0.3644	0.9411		0.8776	0.8505	0.1453	0.0171	0.733
AINTV16H	0.05579	-0.00767	0.08568	-0.02515	0.14379	-0.05956	0.05943	0.10886	-0.07916	0.02443	-0.00196	-0.00764	1	0.01656	-0.12841	-0.01714	0.04714
	0.2603	0.8773	0.0835	0.6121	0.0036	0.2294	0.2304	0.0277	0.1099	0.6223	0.9685	0.8776		0.7384	0.0093	0.7296	0.3416
ALCT16H	0.08308	0.07176	0.19063	-0.29826	-0.01929	-0.16252	-0.03366	0.17119	-0.46814	-0.07488	0.0333	0.00935	0.01656	1	-0.11568	-0.33257	-0.03358
	0.0934	0.1479	0.0001	<.0001	0.6973	0.001	0.4973	0.0005	<.0001	0.1306	0.5019	0.8505	0.7384		0.0193	<.0001	0.4983
ALD16H	-0.04666	-0.00385	-0.02919	0.09434	-0.12588	-0.01927	0.01283	-0.12486	0.10751	0.10008	0.02252	-0.07214	-0.12841	-0.11568	1	0.10068	-0.10751
	0.3466	0.9383	0.5561	0.0566	0.0108	0.6976	0.7958	0.0115	0.0297	0.0431	0.6497	0.1453	0.0093	0.0193		0.0418	0.0297
AMCF16H	-0.03115	-0.04674	-0.0684	0.46603	-0.04252	0.05051	-0.00019	0.06995	0.14457	0.26679	0.05497	0.1179	-0.01714	-0.33257	0.10068	1	-0.01905
	0.5299	0.3464	0.1674	<.0001	0.3911	0.3082	0.997	0.1579	0.0034	<.0001	0.2674	0.0171	0.7296	<.0001	0.0418		0.701
ARPM16H	-0.10992	0.06469	0.03595	-0.06111	0.01227	0.01047	-0.04318	0.00136	0.06152	-0.01253	-0.04157	-0.01692	0.04714	-0.03358	-0.10751	-0.01905	1
	0.0262	0.1922	0.4684	0.2175	0.8046	0.8328	0.3838	0.9782	0.2144	0.8005	0.4018	0.733	0.3416	0.4983	0.0297	0.701	

Fuel Flow Measurement Analysis

SAS Correlation Analysis Results for <u>*VID*</u> Average Fuel Flow at 84 Hours

Pearson Correlation Coefficients
Prob > |r| under H0: Rho=0
Number of Observations

	AFFLO84H	LnEngHrs	AAFR84H	ACINT84H	AFPFR84H	AFPMM84H	AFTFR84H	AFTMM84H	AHEAT84H	AINAH84H	AINAP84H	AINAT84H	AINTV84H	ALCT84H	ALD84H	AMCF84H	ARPM84H
AFFLO84H	1	-0.4489	0.08305	-0.02771	-0.0031	0.02104	0.10459	-0.01648	-0.27717	-0.06094	0.08315	-0.11648	0.03708	0.02242	-0.05503	-0.05775	0.01758
		<.0001	0.0935	0.5763	0.9501	0.6713	0.0345	0.7396	<.0001	0.2187	0.0931	0.0184	0.4546	0.6513	0.2669	0.2439	0.7229
LnEngHrs	-0.4489	1	-0.07596	-0.02167	0.00821	0.00783	-0.00728	-0.00202	0.12556	0.09839	-0.02248	-0.04829	0.0196	-0.0238	0.02366	-0.00303	0.01069
	<.0001		0.1256	0.6625	0.8687	0.8747	0.8834	0.9676	0.0111	0.047	0.6508	0.3305	0.693	0.6317	0.6337	0.9513	0.8296
AAFR84H	0.08305	-0.07596	1	-0.12527	-0.17605	-0.04456	-0.13637	0.24332	-0.02514	-0.02266	0.08269	-0.09123	0.0771	0.0811	0.01956	-0.15142	0.09031
	0.0935	0.1256		0.0112	0.0003	0.3688	0.0057	<.0001	0.6122	0.6477	0.0949	0.0653	0.1195	0.1015	0.6933	0.0021	0.0681
ACINT84H	-0.02771	-0.02167	-0.12527	1	-0.14633	0.07984	0.28721	0.04611	0.22855	0.23615	-0.01454	0.58233	-0.02683	-0.15685	0.02875	0.76771	0.05931
	0.5763	0.6625	0.0112		0.003	0.1069	<.0001	0.3522	<.0001	<.0001	0.7693	<.0001	0.5885	0.0015	0.5621	<.0001	0.2314
AFPFR84H	-0.0031	0.00821	-0.17605	-0.14633	1	-0.08585	-0.00172	0.04605	0.04884	-0.15811	0.00645	-0.1526	0.12067	-0.00182	-0.12989	-0.13055	-0.08412
	0.9501	0.8687	0.0003	0.003		0.0829	0.9723	0.3529	0.3244	0.0013	0.8965	0.002	0.0146	0.9708	0.0085	0.0082	0.0893
AFPMM84H	0.02104	0.00783	-0.04456	0.07984	-0.08585	1	-0.01094	-0.08318	0.05211	-0.03245	-0.04584	-0.08177	-0.08953	-0.04996	0.03555	0.05265	0.04746
	0.6713	0.8747	0.3688	0.1069	0.0829		0.8255	0.0929	0.2931	0.5128	0.3551	0.0987	0.0705	0.3135	0.4734	0.2881	0.3384
AFTFR84H	0.10459	-0.00728	-0.13637	0.28721	-0.00172	-0.01094	1	0.07242	0.19557	0.09163	-0.0085	0.2861	0.00737	-0.10072	0.0132	0.31947	-0.09867
	0.0345	0.8834	0.0057	<.0001	0.9723	0.8255		0.1437	<.0001	0.0641	0.8639	<.0001	0.8818	0.0418	0.7901	<.0001	0.0461
AFTMM84H	-0.01648	-0.00202	0.24332	0.04611	0.04605	-0.08318	0.07242	1	0.15404	0.12253	0.03244	0.00365	0.12049	0.04372	-0.1104	0.10776	0.08667
	0.7396	0.9676	<.0001	0.3522	0.3529	0.0929	0.1437		0.0018	0.0131	0.5129	0.9413	0.0148	0.3778	0.0256	0.0293	0.08
AHEAT84H	-0.27717	0.12556	-0.02514	0.22855	0.04884	0.05211	0.19557	0.15404	1	-0.11408	-0.00717	0.18879	-0.09541	-0.16115	0.07562	0.26764	-0.05983
	<.0001	0.0111	0.6122	<.0001	0.3244	0.2931	<.0001	0.0018		0.021	0.885	0.0001	0.0538	0.0011	0.1268	<.0001	0.2273
AINAH84H	-0.06094	0.09839	-0.02266	0.23615	-0.15811	-0.03245	0.09163	0.12253	-0.11408	1	0.01578	0.18804	0.02863	-0.01242	0.07898	0.33985	0.07673
	0.2187	0.047	0.6477	<.0001	0.0013	0.5128	0.0641	0.0131	0.021		0.7503	0.0001	0.5638	0.8023	0.1107	<.0001	0.1213
AINAP84H	0.08315	-0.02248	0.08269	-0.01454	0.00645	-0.04584	-0.0085	0.03244	-0.00717	0.01578	1	-0.07112	-0.01665	0.0108	0.00633	-0.00524	-0.00638
	0.0931	0.6508	0.0949	0.7693	0.8965	0.3551	0.8639	0.5129	0.885	0.7503		0.1511	0.7371	0.8277	0.8984	0.9159	0.8977
AINAT84H	-0.11648	-0.04829	-0.09123	0.58233	-0.1526	-0.08177	0.2861	0.00365	0.18879	0.18804	-0.07112	1	-0.00446	-0.12188	0.03699	0.58455	0.02867
	0.0184	0.3305	0.0653	<.0001	0.002	0.0987	<.0001	0.9413	0.0001	0.0001	0.1511		0.9283	0.0136	0.4556	<.0001	0.5632
AINTV84H	0.03708	0.0196	0.0771	-0.02683	0.12067	-0.08953	0.00737	0.12049	-0.09541	0.02863	-0.01665	-0.00446	1	-0.00243	-0.16111	-0.02392	0.04561
	0.4546	0.693	0.1195	0.5885	0.0146	0.0705	0.8818	0.0148	0.0538	0.5638	0.7371	0.9283		0.961	0.0011	0.6296	0.3575
ALCT84H	0.02242	-0.0238	0.0811	-0.15685	-0.00182	-0.04996	-0.10072	0.04372	-0.16115	-0.01242	0.0108	-0.12188	-0.00243	1	-0.01481	-0.16784	0.06622
	0.6513	0.6317	0.1015	0.0015	0.9708	0.3135	0.0418	0.3778	0.0011	0.8023	0.8277	0.0136	0.961		0.7653	0.0007	0.1814
ALD84H	-0.05503	0.02366	0.01956	0.02875	-0.12989	0.03555	0.0132	-0.1104	0.07562	0.07898	0.00633	0.03699	-0.16111	-0.01481	1	0.02466	-0.02265
	0.2669	0.6337	0.6933	0.5621	0.0085	0.4734	0.7901	0.0256	0.1268	0.1107	0.8984	0.4556	0.0011	0.7653		0.6191	0.6478
AMCF84H	-0.05775	-0.00303	-0.15142	0.76771	-0.13055	0.05265	0.31947	0.10776	0.26764	0.33985	-0.00524	0.58455	-0.02392	-0.16784	0.02466	1	0.0896
	0.2439	0.9513	0.0021	<.0001	0.0082	0.2881	<.0001	0.0293	<.0001	<.0001	0.9159	<.0001	0.6296	0.0007	0.6191		0.0703
ARPM84H	0.01758	0.01069	0.09031	0.05931	-0.08412	0.04746	-0.09867	0.08667	-0.05983	0.07673	-0.00638	0.02867	0.04561	0.06622	-0.02265	0.0896	1
	0.7229	0.8296	0.0681	0.2314	0.0893	0.3384	0.0461	0.08	0.2273	0.1213	0.8977	0.5632	0.3575	0.1814	0.6478	0.0703	

ASTM New Test Type Introduction Template

Sequence VIE

*Items rated as "A" status and marked with * require supporting documentation to be attached*

1.0 Action Plan

1.1 Reference Oils

1.1.1 Do the majority of reference oils represent current technology? A

1.1.2 Are the majority of reference oils of passing or borderline pass/fail performance? A

1.1.3 Is reference oil supply and distribution handled through ASTM/TMC? A

1.1.4 Is a quality control plan defined and in place? A

1.1.5 Is a turnover plan defined/in place to ensure uninterrupted supply of reference oil and an orderly transition to reblends? A

1.1.6 Is a process for introducing replacement reference oils defined and in place? A

1.1.7 Are oils blended in a homogeneous quantity to last 5 years? A

1.1.8 How many reference oil are there and what are the identifying oil codes?
TECH 1, 542-2, 1010, 1010-1

Comments:

2.0 Test Parts

2.1 Are all critical parts identified? A

Statement from Draft: 3.2.3.1 *Discussion*-Because of the need for availability, rigorous inspection, and control of many of the parts used in this test method, companies having the capabilities to provide the needed services have been selected as the official suppliers for the Sequence VIE test method. These companies work closely with the Test Procedure Developer and with the ASTM groups associated with the test method to help ensure that the critical engine parts used in this test method are available to the testing industry and function satisfactorily.

2.1.1 List the parts consider as critical. *Attachment #1*

2.2 Is a system defined/in place to maintain uniform hardware? A*

CPD handles the engines and related critical engine hardware, they are a Single Source Supplier. Attachment #2 shows details on engine and parts.

2.3 Is there a system for engineering support and test parts supply? A

2.3.1 How many tests can be run with the supply of parts currently in stock?

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action; E - TBD

ASTM New Test Type Introduction Template
Sequence VIE

As-of 10/20/14 the current supply is approx. 99 engines, the engine life has not been determined as-of changes made in the procedure to increase engine life. GM has stated they can supply additional engines to be determined once an Industry survey is completed.

2.4 Are critical parts distributed through a Central Parts Distributor (CPD)? A

2.5 Are critical parts serialized, and their use documented in test report? A

2.6 Are all parts used on a first in/first out basis? Engines were build D

Engines are preassembled and available from OHT, the initial batch was produced on the assembly line as one batch so the Seq. VI SP has determined the first in/first out requirement is not required.

2.7 Are all rejected critical parts accounted for and returned to the CPD? A

2.8 Does the CPD make status reports to the test surveillance body at least semi-annually? A

2.9 Is there a quality control and turnover plan in place for critical test parts, including identification and measurement of key part attributes, a system for parts quality, accountability and a turnover plan in place for simultaneous industry-wide use of new parts or supply sources? A*

OHT is the sole source supplier for the test engines and any critical hardware specified. See Attachment #2

2.10 Is the CPD active in industry surveillance panel/group, and in industry sponsored test matrices? A

3.0 Test Fuel

3.1 Is the fuel specified and the supplier(s) identified? A

3.1.1 Who is the fuel supplier? Haltermann (single source)

3.2 Is a process in place to monitor fuel stability over time? A*

Haltermann has a Quality Control system to monitor the test fuel, see Attachment #3

3.3 Are approval guidelines in place for fuel certification? A*

Test fuel is specified in the Draft test procedure, Attachment #4.

3.4 If the test fuel is treated as a critical part of the test procedure: Is an approval plan and severity monitoring plan for each fuel batch in place? *See Comments* A*

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action; E - TBD

3.5 Is a quality control plan defined and in place to assure long term quality of the fuel? *See Comments* A*

3.6 Is a turnover plan defined, in place and demonstrated to ensure uninterrupted supply of fuel? *See Comments* A*

Comments: *The Seq.VIE Test Fuel is not considered critical by batch, the QC process is shown in Attachment #2*

4.0 Test Procedure

4.1 Is a technical report published documenting, per ASTM Flow Plan:

4.1.1 Test precision for reference oils? A*
4.1.2 Field correlation? A*
4.1.3 Test development history? A*

4.2 Are test preparation and operation clearly documented in a ASTM standard format?
A Draft Procedure in ASTM Format is available on the TMC Web Site A*

4.3 Are test stand configuration requirements documented and standardized?
A Draft Procedure in ASTM Format is available on the TMC Web Site A*

4.4 Are milestones for precision improvements established?
These are included in the Scope and Objectives for the Surveillance Panel
See Attachment #5 A*

4.5 Are routine engine builder workshops planned/conducted? D

4.5.1 How often and by whom? N/A

5.0 Rating and Reporting of Results

5.1 Are the reported ratings from single raters (i.e. not averages from various raters)? D

5.2 Is a suitable severity adjustment system in place? B*
Pending Precision Matrix Data

5.3 Is each pass/fail parameter unique and have a significant purpose for judging engine oil performance? A

5.3.1 List the pass/fail parameters. FEI2 and FEISUM

5.4 Do all rate and report parameters judge operational validity, help in test interpretation or judge engine oil performance? A

5.5 Are routine rater workshops conducted/planned? D
No ratings are required

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action; E - TBD

5.5.1 How often and by whom? N/A

6.0 Calibration, Monitoring and Surveillance

6.1 Is a process in place for independent monitoring of severity and precision with an action plan for maintaining calibration of all laboratories? *The Surveillance Panel will develop an LTMS once the Precision Matrix is completed* C*

6.2 Are stand, lab, and industry reference oil control charts of all pass/fail criteria parameters used to judge calibration status? *The Surveillance Panel will develop an LTMS once the Precision Matrix is completed* C*

6.3 Does the specified calibration test interval allow no more than 15 non-reference oil tests between successful calibration tests? *Will be determined following the Precision Matrix* C

6.4 Is an ASTM Surveillance Panel in place? A

6.4.1 Who is chairman? Charlie Leverett/Nathan Moles

7.0 Test prove out data

7.1 Has a test development Task Force/TMC visit been made to each of the labs that will participate in the industry precision matrix? *TMC has agreed to do the Lab Visits prior to the Precision Matrix* C

7.2 Have prove out tests been run with the finalized test procedure and test parts? *Data is available on TMC Web Site, a summary is shown in Attachments #6 & 7* A*

7.2.1 How many labs and stands? 5 labs and 7 stands, with potential for 6 labs and 8 stands

Attachment #1

Specified Engine Parts

Part Name	Part No.
Mass Air Meter	OHT6D-040-1
Throttle Body	OHT6D-041-1
Dual Throttle Body	OHT6D-050-1
Fuel Injector	OHT6D-042-1
Spark Plug	OHT6D-043-1
Crankshaft Sensor	GM#12615626
Camshaft Sensor	OHT6D-045-1
Knock Sensor	OHT6D-046-1
Pre-Cat Sensor	OHT6D-047-1
Coolant Sensor	OHT6D-048-1
Exhaust Shield (L.H.)	GM12617267
Exhaust Shield (R.H.)	GM12580706
Fuel Rail	GM12572886
Engine Air Cleaner Assembly	See description in standard text
Air Cleaner Element	GM 25798271
Engine Wiring Harness	OHT6D-011-2
Engine Control Module	OHT6D-012-4 (Revision 3)
Exhaust Manifold (R.H.)	GM12571101
Exhaust Manifold (L.H.)	GM12571102
Exhaust Adapter, (R.H.)	OHT6D-010-1
Exhaust Adapter, (L.H.)	OHT6D-009-1
Engine Flywheel	OHT6D-020-X (Lab specific)
Engine Mount Front	OHT3H-026-1
Engine Mount Rear	OHT3H-025-1
Engine Mount Isolators	Labs discretion
Gear, Camshaft, Exhaust, Non-Phased	OHT6E-0xx-1
Gear, Camshaft, Intake, Non-Phased	OHT6E-0xx-1
Orifice, Coolant, Internal	OHT6D-025-1

Attachment #2

A complete list may be found in the VIE Draft Procedure on the TMC web site.

X1.3 Test Engine:
Sequence VIE engines, part 2012 GM (HFV6) OHT6E-001-1
X1.4 Dynamometer:
A Midwest Model 758 (50-hp) dry gap dynamometer may be ordered from:
X1.5 Dynamometer Load Cell:
X1.7 Cooling System Pump (P-1): The specified cooling system pump may be obtained from:
Gould Pumps, Inc.
X1.8 Coolant Heat Exchanger (HX-1):
ITT (Model 320-20)
ITT Standard
Bell & Gossett (BP 75H-20 or BP 420-20)
Bell & Gossett ITT
X1.9 Coolant Orifice Plate (Differential Pressure):
Flowell
X1.10 Coolant Control Valves (TCV-104, FCV-103 and TCV-101):
Badger Meter, Inc.
X1.12 Water Pump Plate:
X1.13 Oil Scavenge Pump (P-3):
X1.16 External Oil System Solenoid Valves (FCV-150A, FCV-150C, FCV-150D, FCV-150E and FCV-150F):
Burkert Contromatic Corp.
X1.17 External Oil System Control Valves (TCV-144 and TCV-145):
X1.18 Oil Heat Exchanger (HX-6):
ITT (Model 310-20):
Bell & Gossett (Model BP 25-20 or BP 410-020):
Bell & Gossett ITT
8200 N. Austin Avenue
Morton Grove, IL 60053
X1.19 Electric Oil Heater Housing (EH-5):
X1.20 Oil Filter Housing Assembly OHT6A-012-2 and Filters (Screen) (FIL-2)
Racor 60 micron screen OHT6A-013-3:
X1.21 Modified Oil Filter Adapter Plate OHT6D-003-1:
X1.23 Modified Oil Pan and Modified Oil Pick-Up Tube OHT6D-001-1:
The oil pan and oil level blocking plate may be purchased from:
X1.24 Fuel Flow Measurement Mass Flow Meter:
MicroMotion, Inc.
X1.26 ECU (Engine Control Unit) Revision 3, OHT6D-012-4:
X1.27 Engine Wiring Harness Without Interface OHT6D-011-2:
X1.28 Modified Coolant Inlet:
X1.31 Damper drivelines

Attachment #3

Charlie, Nathan,

A COA for each batch of Lube Cert EEE (HF0003) is generated when the fuel is certified for use. After the fuel is certified, and the COA is generated, the batch is tested weekly for RVP and API Gravity. The data is entered into our control charts. We have an action level for each parameter, and the fuel is adjusted if the RVP or the API Gravity falls below the action level.

Please let me know if this explanation is not sufficient for your purposes at this time.

Best regards,

Tracey

____

Tracey King

Technical Liaison Manager

E: tking@jhaltermann.com

P: 947-517-4107

Attachment #4

TABLE 1 Sequence VIE Fuel Specification

Test Method			
Octane, research min	D2699		96
Pb (organic), mg/L max	D3237		0.01 max
Sensitivity, min		7.5	
Distillation range			
IBP, °C	D86		23.9 to 35
10 % point, °C	D86		48.9 to 57.2
50 % point, °C	D86		93.3 to 110
90 % point, °C	D86		148.9 to 162.8
E.P., °C (max)	D86		212.8
Sulfur, mass fraction %, max	D5453		3 min to 15 max
Phosphorous, mg/L, max	D3231		1.32
RVP, kPa	D323		60.0 to 63.4
Hydrocarbon composition			
Olefins, % max	D1319		10
Aromatics, %	D1319		26 min to 32.5 max
Saturates	D1319		Report
Existent gum, mg/100 mL, max	D381		5.0
Oxidation stability, min	D525		240 min
Carbon weight fraction	E191		Report
Hydrogen/Carbon ratio, mol basis	E191		Report
Net heating value, J/kg	D240		Report
Net heating value, J/kg	D3338		Report
API gravity	D4052		58.7 min to 61.2 max

Attachment #5

ASTM Sequence VI Surveillance Panel Scope and Objectives

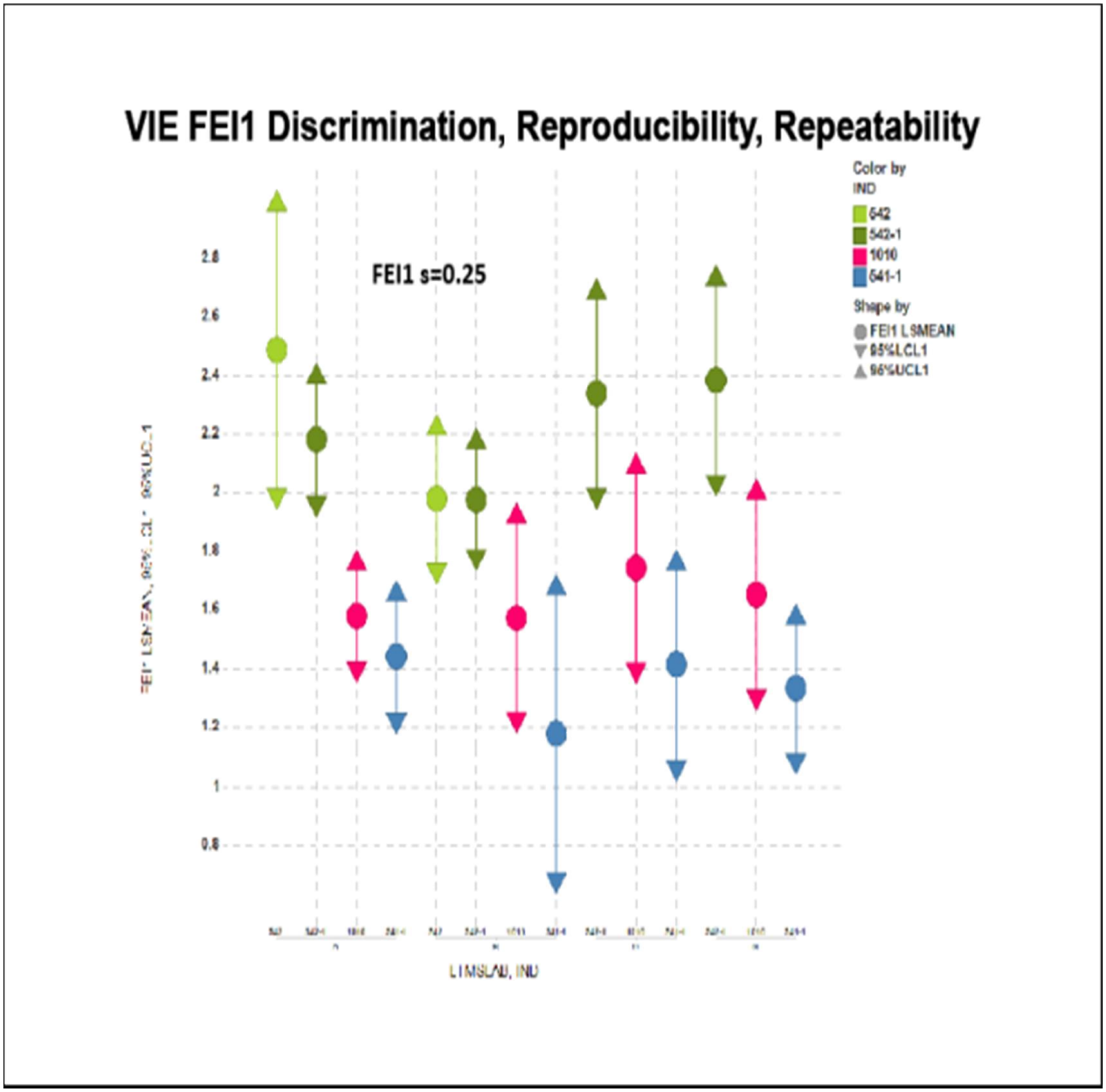
Scope:

The Sequence VI Surveillance Panel is responsible for the surveillance and continued improvement of the ASTM Sequence VI test documented in the current ASTM Standard for the Seq. VID as each is updated by the Information Letter System. Improvements in test operation, test monitoring and test validation will be accomplished through continual communication with the Test Sponsor, ASTM Test Monitoring Center, Central Parts Distributor, ASTM B.O1, and the ASTM Passenger Car Engine Oil Classification Panel. Actions to improve the process will be recommended when deemed appropriate based on input from the aforementioned. The panel will review development and correlation of updated test procedures with previous test procedures. This process will provide the best possible test procedure for evaluating automotive lubricant performance with respect to the lubricant's ability to provide fuel economy benefits.

Objectives	Target Date
Review development of Seq. VIE test for GF-6	In Process
Work with ASTM Facilitator to complete ASTM Standard for VIE completion	Pending PM
Review Proposed Precision Matrix (PM) for VIE From AOAP	Pending Doc.
Statistical Group to review VIE LTMS and Engine Hr. Adjustment completion	Pending PM

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action; E - TBD

Attachment #6



Attachment #7