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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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Second Secretary : MICHAEL A. COLLIER, Petroleum Analyzer Co. LP, PO Box 206, Wilmington, IL 60481, (815) 458-0216, Fax: (815) 458-0217, e-mail: macvarlen@aol.com
Staff Manager: DAVID R. BRADLEY, (610) 832-9681, Fax: (610) 832-9668, e-mail: dbradley@astm.org

Issued: June 05, 2015

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 06.02.2015 Sequence VI Surveillance Panel meeting.

The meeting was called to order at 8:00 AM Central Time by Chairman Nathan Moles.

Agenda

The Agenda is the included as Attachment 1.

1.0 Roll Call

The Attendance list Attachment 2. Amol Savant was proxy for Ashland.

2.0 Approval of minutes

2.1 Approval of the minutes of the 04.09.2015 conference call.

Motion – Accept the minutes of the 04.09.2015 VI SP Conference Call.
Dan Worcester, Rich Grundza, second.

2.2 This motion received unanimous approval.

3.0 Action Item Review

3.1 OHT to report VID & VIE engine usage and expected depletion date of VID engines. There are 0 VID and 71 VIE engines in inventory. The VIE survey for new engine purchases is complete. There will be a final count review and then a conference call with the labs to generate the order.

3.2 Labs reported VID engine inventory and expected depletion date of VID engines.
-Expected life of engines range from 2016 Q1 to 2018
Lab1: 2 engines
Lab2: 4 engines Note: these numbers were updated during the meeting.
Lab3: 4 engines Note: these numbers were updated during the meeting.
Lab4: 4 engines

3.3 SP chair and test sponsor to investigate what is needed to establish VID equivalent limits for VIE. This will be an on-going effort.

4.0 Old Business

4.1 List of items to be reviewed after the Precision Matrix
-Do we really need to run three RO tests to establish the new engine for LTMS?
-Discussion of reducing the new reference requirement to two oils, then a third oil run after a defined number of candidates.
-Discussion of using FEI 2 and FEI Sum for references to match candidate pass/fail criteria.
-Discussion of evaluating 80/20 ratio of BL before to after for FEI 1 and 10/90 for FEI 2.
-Should the acceptance bands value of 1.96 be rounded up? Due to the rounding on FEI 1 and 2 the actual pass limit is 1.91 and 1.92. This will be an on-going effort.

4.2 Discussion regarding Sequence VIE test ready to proceed with precision matrix. Chair to report results of vote at joint AOAP and PCEOCP meeting May 14th in Detroit.
-The Memorandum of Agreement must be signed and the test receive AOAP approval before the Precision Matrix begins.
-Lab visits required by TMC to be completed by 4//16.
-Labs must have two valid tests run on their stands to participate. 4 of 6 interested labs have data on the current version of the test (must use additized fuel).
-Presentation from stats group analysis of prove out data was reviewed at AOAP meeting March 19th meeting. All lab visits by TMC are complete, but one lab needs to run the demonstration tests.

4.3 Order of service engines. OHT has requested that the laboratories participating in the Seq. VI Surveillance Panel provide their final numbers to them no later than April 8th, 2015. All survey results are complete. Rebuild of engines will be kept as a possible action item. GM and OHT are working on the new engine order of about 345 engines. There will be a call to discuss before the order is placed.

4.4 There are several of items in the most current draft version of the Seq. VIE test procedure posted on the TMC website that need to be updated. Dave Glaenzer has agreed to reconvene the Task Force to review the procedure. This will be an on-going effort.

4.5 TMC to check with ASTM on the removal process for the Seq. VIB. This will be an on-going effort.

4.6 Stats group to review targets for Sequence VID RO 542-2 and updated results from TMC
-The Data Analyst Group has reviewed the recent 542-2 data for the VID and does not recommend any target updates at this time. While there are some concerns in the group that 542-2 is not performing with the same severity as past 542 blends the presence of significant lab differences and the mix of data across engines and labs make it difficult to recommend any target updates at this time. The group agrees that significant lab differences exist in the data set that includes 542-2 and recommends the SP pursue these differences on a technical level. These differences can be observed in the attached graphs of FEI1yi and FEI2yi which contain data from engines that have been used to test 542-2. We will continue to review the 542-2 data as additional tests are reported and notify you if our recommendations change. See Attachment 3.

4.7 Request following review of prove out data at March AOAP meeting (see attached presentation):

1. Precision of the VID is 0.12 while the VIE is 0.21. Taskforce needs to demonstrate it is working on understanding this and what measures need to be put in place to reduce variation. Why does the VIE have worse precision?

a. Is it because of the 0W-16 data or something else?

b. Does the precision improve (using only the 542 and 541 oils) if the 0W-16 data is removed?

c. Calculate VIE and VID standard deviations for both FEI1 and FEI2 using only the 541 and 542 oils.

2. The taskforce needs to understand why 0W-16 Tech1 performs similar to 10W-30 and not better than 0W-20. Is this a viscometric or chemistry issue?

a. Run 0W-16 Tech1 in VID

b. Run 5W-30 Tech1 in VIE

There are limited VID runs remaining in the industry so 0W-16 will not be run in the VID. Labs received their 5W-30 Tech 1 oils the week of the meeting and will start donated tests. Jim Linden gave a presentation on the Toyota VID matrix on 0W-20 and 0W-16 oils. See Attachment 4. This led to discussion on modification of test conditions for 0W-16 response in the VIE engines. There was discussion on matrix options to optimize VIE engine life. See Attachment 5. The concern was calibrated stands at the end of the Precision Matrix, but the VID tests had 4 of 7 calibrated stands at the end of the VID. The Statistical Group gave a presentation of prove out data analysis.

See Attachment 6. Several Action items were generated and a list of items to review for the Precision Matrix. See Attachment 7. There was a motion on the precision of the VID versus the VIE.

MOTION: Based on prove-out data available to-date, the precision of the Sequence VIE data is similar to the precision of the Sequence VID prove-out data, and is acceptable to the Sequence VI Surveillance Panel.

Charlie Leverett / Andy Ritchie / Passed 14 – 0 – 1

ACTION: GM to look into the availability of FTP cycle temperature data from the VIE test engine (MY2012 Chevrolet Malibu LY7) to compare to similar data from the VID test engine (MY2009 Cadillac SRX LY7).

ACTION: Industry statisticians to review and report on the original reasoning for having a fixed reference oil sequence for calibrating new Sequence VID engine/stand combinations.

ACTION: JAMA will share 0W-16 field data.

ACTION: A Task Force will be created to review VIE oil temperature and oil response. This group will review procedures for 0W-16 oil response. Charlie Leverett has agreed to chair this group.

5 New Business

5.1 There is not enough RO 541 to meet the needs for the remaining VID engines. –Rich Grundza

The remaining 4 labs have 19 engines that can potentially calibrate, but no lab has enough of 541-1 to calibrate.
Breakdown is as follows:
A 2 engines 1 can 541-1
B 4 engines 3 cans 541-1
C 4 engines 2 cans 541-1
D 4 engines 3 cans 541-1

So there are two problems, how to distribute the three cans returned to the TMC and how to address calibration sequence going forward.

MOTION: Once reference oil 541-1 is depleted within a lab, the next sequence for calibrating a new Sequence VID engine/stand combination would be reference oil 542-2, 540 and 1010 in that lab.

Charlie Leverett / Dave Glaenzer / Passed 12 – 0 – 1

5.2 Engine hours needs to be addressed in the precision matrix and there is concern in the industry that the current design does not adequately address this. Alternate matrix designs have been requested. This will be reviewed as part of the action list.

5.3 There is a request to standardize the way the labs report data collected from the precision matrix to simplify analysis of results. This will be an on-going effort.

6 Next Meeting will be at the Chair notification.

The meeting adjourned at 5:00 PM.

Sequence VI Surveillance Panel Conference Call Agenda
June 2 @ 2-5PM EST

San Antonio, TX
SwRI, Bld. 209

Call-in information is included below:

Dial: 866-588-1857

Code: 2894131

1.0) Roll Call

Do we have any membership changes or additions?

2.0) Approval of minutes

2.1) Approve the minutes from the April 9, 2015 Sequence VI Surveillance Panel.
ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/minutes/VIMinutes20150409%20Conference%20call.pdf

3.0) Action Item Review

3.1 OHT to report VIE engine usage. – OHT

3.2 Labs reported VID engine inventory and expected depletion date of VID engines.

-Expected life of engines range from 2016 Q1 to 2018
Lab1: 2 engines
Lab2: 6 engines
Lab3: 7 engines
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-The Memorandum of Agreement must be signed and the test receive AOAP approval before the Precision Matrix begins.

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-The Data Analyst Group has reviewed the recent 542-2 data for the VID and does not recommend any target updates at this time. While there are some concerns in the group that 542-2 is not performing with the same severity as past 542 blends the presence of significant lab differences and the mix of data across engines and labs make it difficult to recommend any target updates at this time. The group agrees that significant lab differences exist in the data set that includes 542-2 and recommends the SP pursue these differences on a technical level. These differences can be

observed in the attached graphs of FEI1yi and FEI2yi which contain data from engines that have been used to test 542-2. We will continue to review the 542-2 data as additional tests are reported and notify you if our recommendations change.

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5.3 There is a request to standardize the way the labs report data collected from the precision matrix to simplify analysis of results.

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.	Phone: 440-354-7007 jhbowden@ohtech.com	ATTEND
Timothy Caudill Voting Member	Ashland, Inc.	Phone: 606-329-5708 Tlcaudill@ashland.com	
David Glaenzer Voting Member	Afton Research Center	Phone: 804-788-5214 Dave.Glaenzer@aftonchemical.com	ATTEND
Rich Grundza Voting Member	ASTM TMC	Phone: 412-365-1034 reg@astmtmc.cmu.edu	ATTEND
Tracey King Voting Member	Haltermann	Phone: tking@jhaltermann.com	ATTEND
Charlie Leverett Voting Member	Intertek Automotive Research	Phone: 210-647-9422 charlie.leverett@intertek.com	ATTEND
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Bruce Matthews Voting Member	GM Powertrain Engine Oil Group	Phone: 248-830-9197 bruce.matthews@gm.com	ATTEND
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Andy Ritchie Voting Member	Infineum	Phone: 908-474-2097 Andrew.Ritchie@infineum.com	ATTEND
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Kaustav Sinha Voting Member	Chevron Oronite Company LLC	Phone: 713.432.6642 LFNQ@chevron.com	ATTEND
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Haiying Tang Voting Member	Chrysler	Phone: 248-512-0593 HT146@Chrysler.com	
Dan Worcester Voting Member	Southwest Research Institute	Phone: 210.522.2405 dan.worcester@swri.org	ATTEND

ASTM SEQUENCE VI

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Timothy Cushing		GM	ATTEND
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Jo Martinez		Oronite	ATTEND
Valeriu Lieu		Oronite	

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Clayton Knight	cknight@tei-net.com	TEI	
Dan Lanctot	dlanctot@tei-net.com	TEI	ATTEND
Zack Bishop	zbishop@tei-net.com 210.877.0223	TEI	
Jeff Clark	jac@astmtmc.cmu.edu	TMC	
Hap Thompson	Hapjthom@aol.com	VIE Facilitator	ATTEND
Tom Smith		Valvoline	
Mark Adams	mark@tribologytesting.com		PHONE
Ricardo Affinito	affinito@chevron.com 510.242.4625	Oronite	
Jim Linden	lindenjim@jlindenconsulting.com Phone: 248.321.5343	J Linden Consulting	ATTEND
Jeff Hsu		Shell	ATTEND
Amol Savant	PROXY FOR ASHLAND	Ashland	ATTEND
Kevin O'Malley		Lubrizol	
Chris Castanien		Nestles	

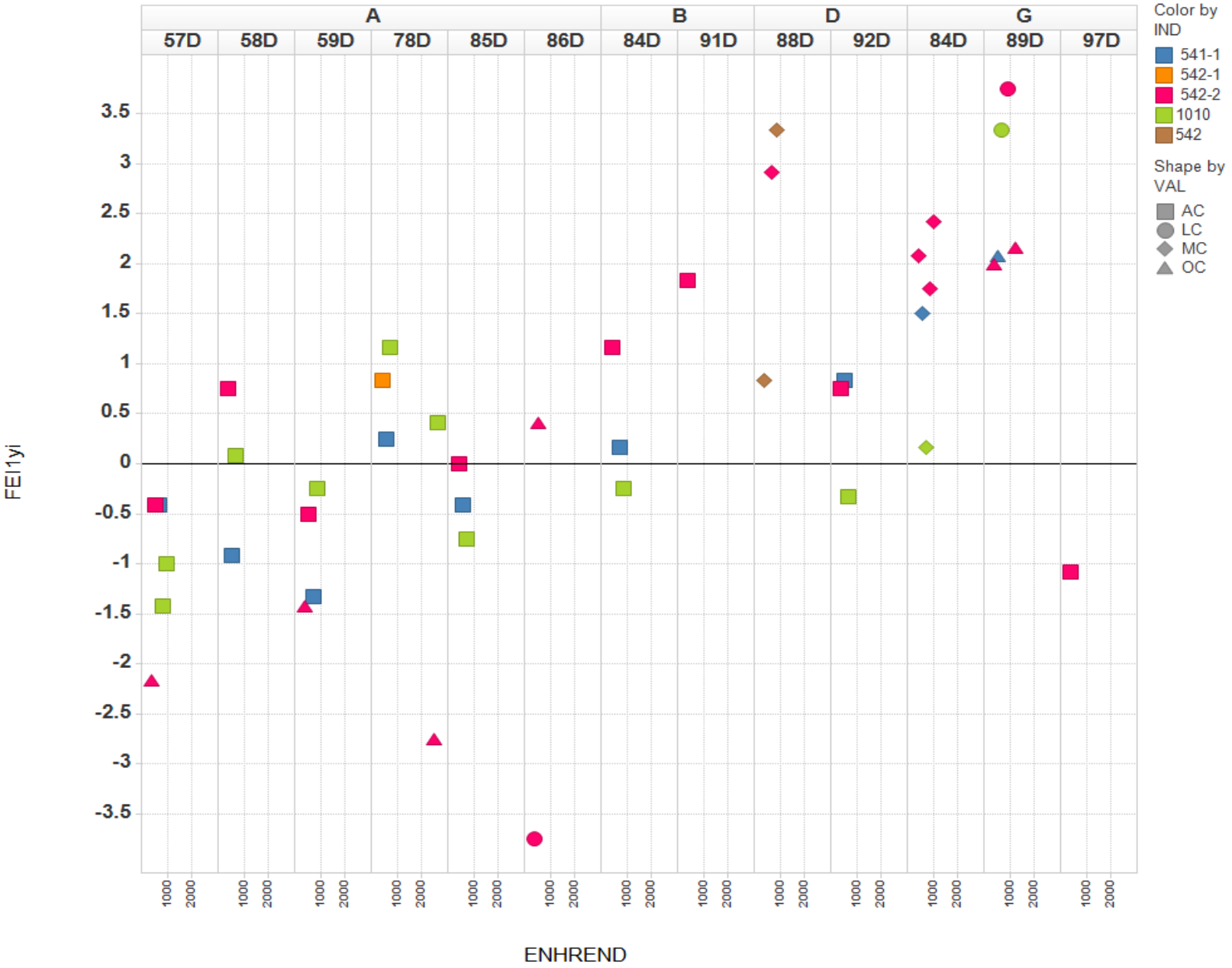
ASTM SEQUENCE VI

Name	Address	Phone/Fax/Email	Attendance

Sequence VID FElyi Plots (In Engines with 542-2 Runs)

May 4, 2015

FEI1yi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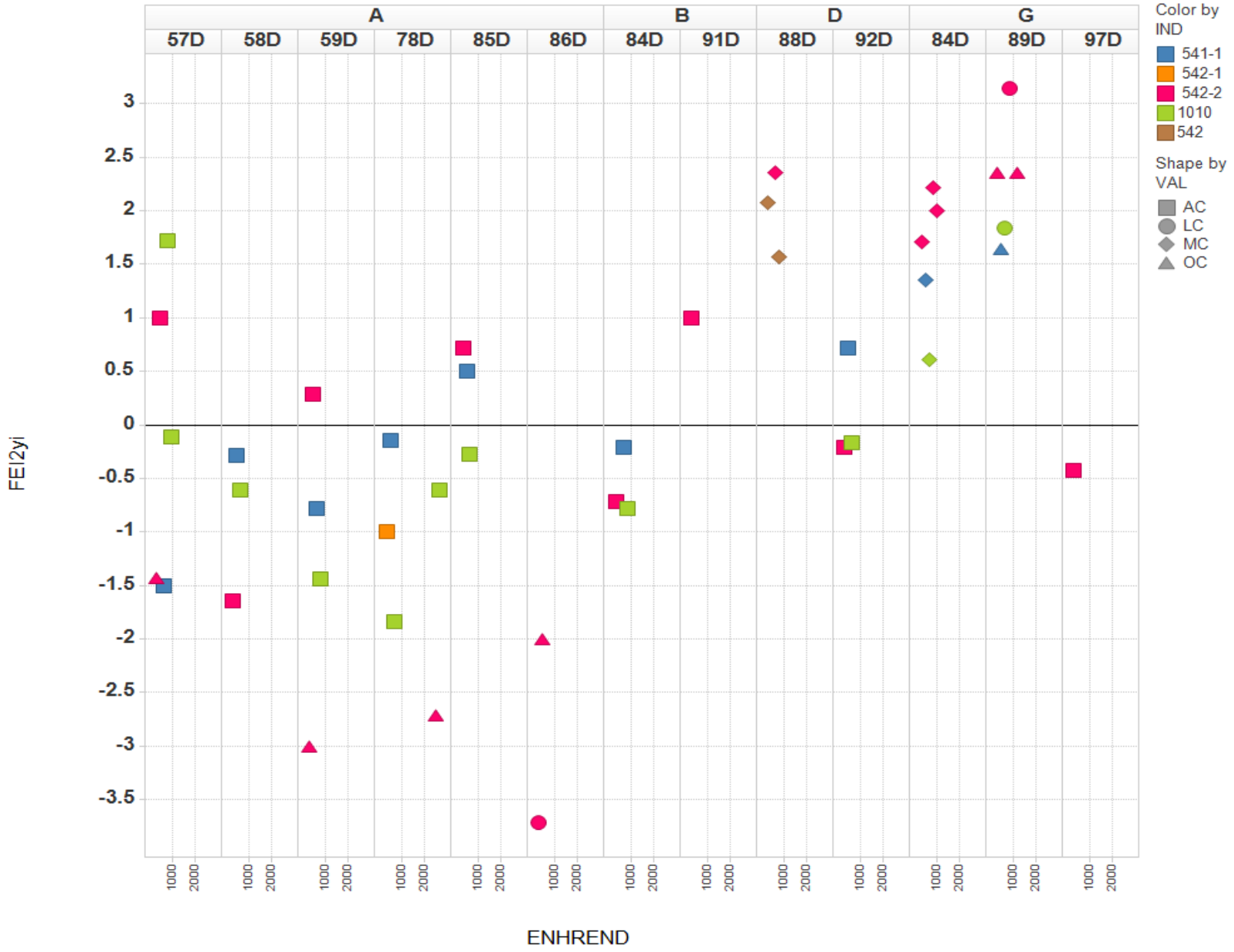
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TOYOTA

Toyota Sequence VID Matrix Update and Proposal for Seq VIE Improvement

June 2nd, 2015

Toyota Motor Corporation

JAMA Members' Concern

TOYOTA

- Potential Delay of GF-6 0W-16 Introduction
  - Toyota has proposed to add RC for API SN 0W-16 to mitigate the risk
  - Toyota has completed Seq.VID matrix to compare 0W-16 and 0W-20 (3add techs x 2 labs x 2 vis grades x 2 tests = 24 tests)
    - Data will be shared

- Correlation between Seq.VID and Seq.VIE, especially for 0W-16
  - Some JAMA members have run Seq.VID on their own 0W-16 products and seen benefit by lowering vis grade from 0W-20 to 0W-16.
  - JAMA members are confident that 0W-16 will provide fuel economy benefit over 0W-20 in the real market.
  - We should improve the precision, correlation, and discrimination of Seq.VIE to make it good fuel economy measurement tool in order to deliver true FE benefit through GF-6.

Proposals from JAMA Members

TOYOTA

- JAMA members support to evaluate 0W-16 Tech 1 Oil on Seq.VID for correlation work
  - JAMA members have confirmed that 0W-16 provides FE benefit in Seq.VID and their own products
  - Seq.VIE should have reasonable correlation and capability to measure the benefit of 0W-16

- Toyota can provide our Seq.VID matrix oil for Seq.VIE correlation work
  - Toyota's VID matrix includes 3 additive technologies representing current GF-5 products in the industry and the comparison between 0W-16 and 0W-20 (Total 24 tests data)
  - Approx. 20 – 25gals of each test oil are still available
  - If additive suppliers agree, Toyota can provide these oils for further correlation work

Toyota Sequence VID Matrix Study

TOYOTA

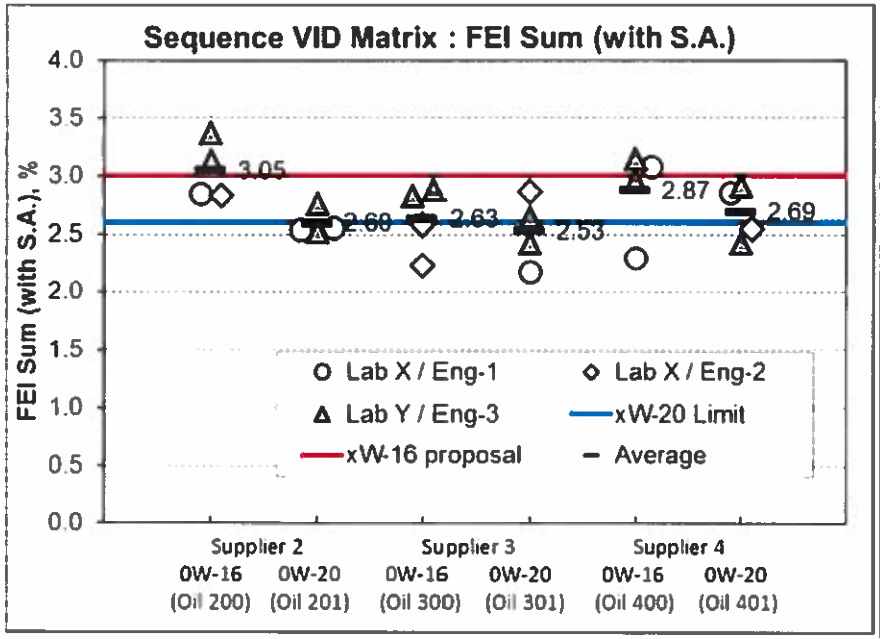
- Matrix Design
  - 3 Additive Technologies (GF-5 Market General) from Major Additive Suppliers
    - Selected as anonymously
  - Viscosity Grade
    - 0W-16 vs 0W-20
  - Base Stock
    - 4cSt Group-3 100%
  - 2 Test Laboratories
    - Calibrated Test Engine and Test Stands are utilized
  - 2 Repeat Tests on Each Test Oil

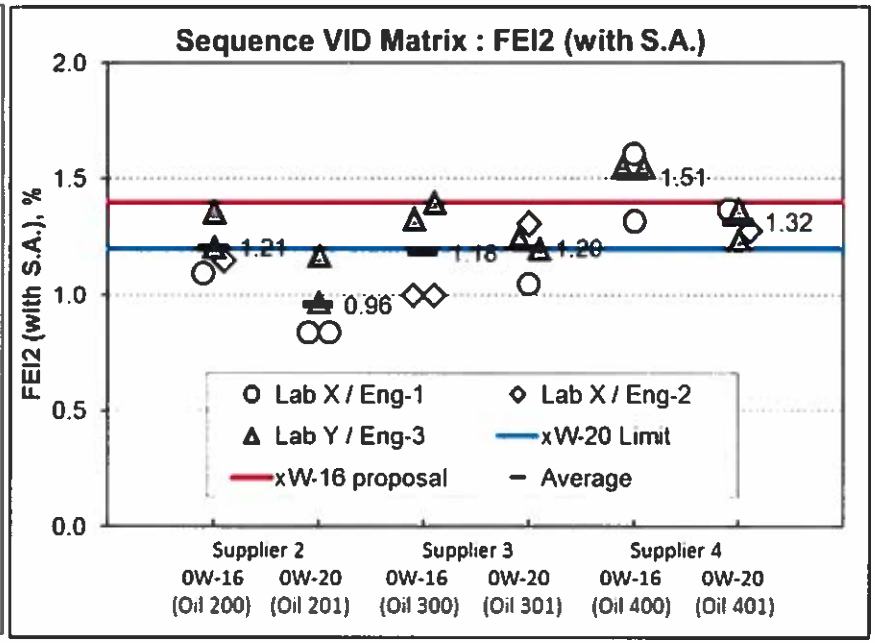
- Total 24 tests Matrix
  - 0W-16 : Oil 200, Oil 300, Oil 400
  - 0W-20 : Oil 201, Oil 301, Oil 401

Toyota VID Matrix Results

TOYOTA

Sequence VID Test Results Summary (with Severity Adjustment)



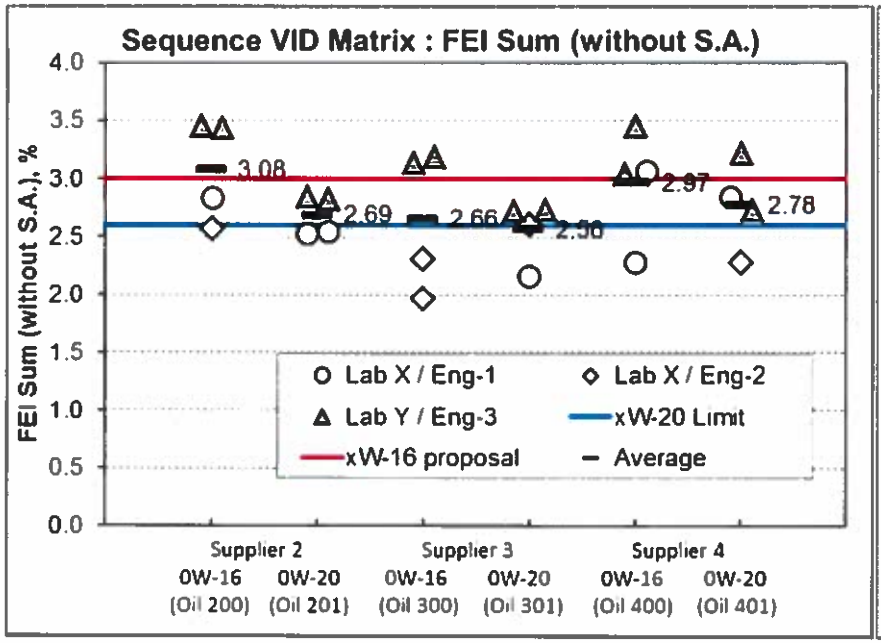


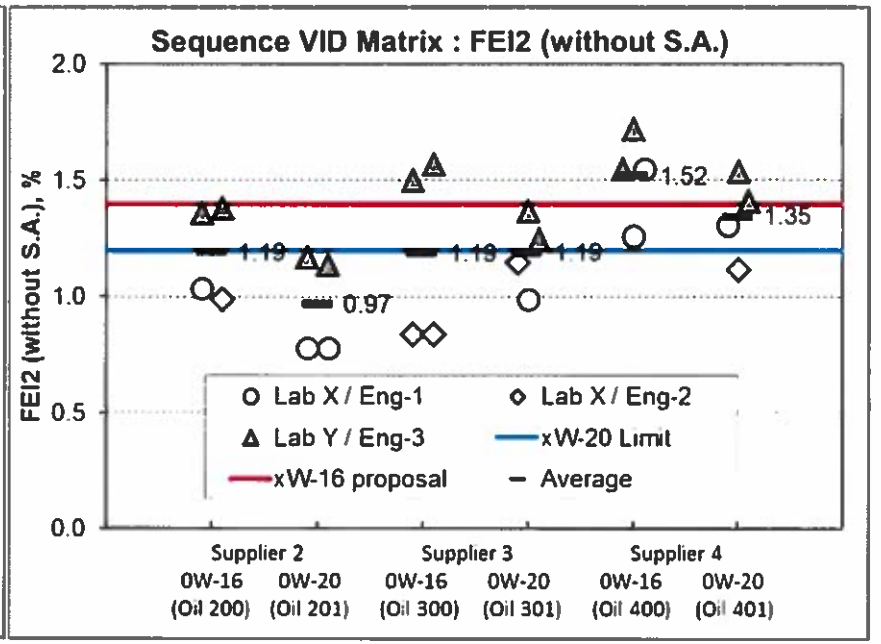
- Laboratory X had to change test engine in the middle of matrix and used 2 engines
- Laboratory X showed more severe results and wider variation compared with Labo Y
- As overall, 0W-16 showed better fuel economy than that of 0W-20
- Toyota's proposal for xW-16 (3.0% for FEI Sum and 1.4% for FEI2) seems achievable

Toyota VID Matrix Results

TOYOTA

Sequence VID Test Results Summary (without Severity Adjustment)





Proposals from JAMA Members (1/2)

TOYOTA

- Characteristics of Sequence VID Test
  - Seq.VID was designed to emphasize the measurement capability of friction modifier, and resulted in significant contribution from high temperature stages (Oil Temp = 115degC, 95.6%).
  - As a trade-off, Seq.VID became less sensitive to viscosity effect.

- Potential Modifications of Sequence VIE
  - VIE has lost the response to 0W-16, but has maintained the response to 0W-20.
  - SAE Paper 2013-01-0297 reported that lowering oil temperature from 115degC to 100degC for high temp stages provided better discrimination between viscosity grades (0W-16, 5W-20, and 5W-30).
  - Modification of oil temperature at high temperature stages may recover the response to 0W-16 and improve the correlation with Seq.VID.
  - This is just one idea. We are open for any ideas and discussions.

SAE 2013-01-0297 : Modification of FE Measurements

TOYOTA

Table 2. Sequence VID Fuel Economy Measurement Stages

Stage #	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Speed, rpm	2000	2000	1500	695	695	695
Power, kw	22	22	16.5	1.5	1.5	2.9
Oil Temp, C	115	65	115	115	35	115
Coolant In Temp, C	109	65	109	109	35	109
Stage Weight	0.300	0.032	0.310	0.174	0.011	0.172

Oil Temperatures were modified to 100degC for Stage 1, 3, 4, and 6.

Improved discrimination among 0W-16, 5W-20, and 5W-30.

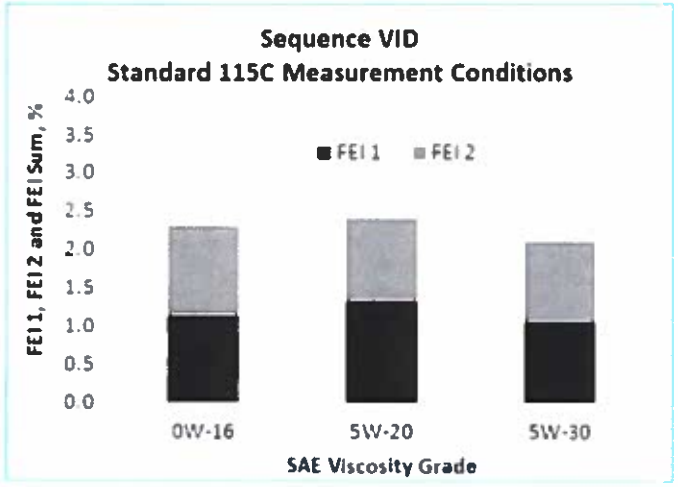


Figure 8. Sequence VID Results Under Standard Test Conditions

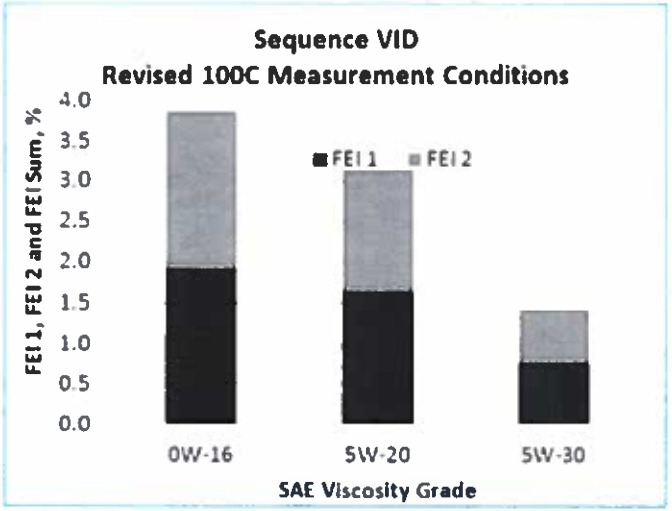


Figure 9. Sequence VID Results Under Modified Test Conditions

Proposals from JAMA Members (2/2)

TOYOTA

- Next Sequence VI Surveillance Panel
  - Need to work on the VIE improvement as soon as possible
  - Propose to hold the SP meeting monthly basis until the issue is fixed
  - Next SP should be held early July

- JAMA members will provide further information and data to support Seq.VIE improvement
  - Toyota will update the matrix result with statistical analysis
  - Other JAMA members are reviewing their internal data to see if there is any useful information

Potential Path Forward For VIE Matrix Design

5/21/2015

Passion for Solutions™

VIE Engine Hours and Matrix Efficiency

- **Engine hours need to be accounted for in matrix**
- **Path forward needs to be win/win for industry and labs**
  - Industry “win” is getting sufficient data in a timely fashion to accurately account for engine hours
  - Lab “win” is ability to run candidates post matrix on calibrated engine
- **Matrix timeliness is a must**
  - VID test is in poor shape (hardware availability and pass/fail)
  - VIE matrix needs to complete in a timely fashion so correlation to VID can be determined

Potential Design To Cover Engine Hours Dilemma

							Engine 1														Engine 2			
	B/I	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		B/I	1	2	3	4
Stand	150	350	550	750	950	1150	1350	1550	1750	1950	2150	2350	2550	2750	2950	3150	3350	3550	Stand	150	350	550	750	950
1																			1					
2																			2					
3																			3					
4																			4					
5																			5					
6																			6					
7																			7					
8																			8					
				These tests may move up or down in test hours, depending on O/C rates and what engines are actually available																				

- **Some stands can start with older engines and swap to new ones to recoup calibration investment**
- **Reduces degrees of freedom but benefit may outweigh loss**
- **Should ensure adequate capacity during Tech Demo**

Conclusions

- **VIE matrix needs to run efficiently and without interruption**
- **Industry needs to understand engine hour effect thoroughly**
- **Labs need incentive to offer “older” engines**
- **Industry needs capacity immediately following matrix completion**

VIE Prove-Out Data Analysis

Statisticians Group

4/20/15

Statisticians Group

- Art Andrews, Exxon Mobil
- Doyle Boese, Infineum
- Janet Buckingham, SwRI
- Martin Chadwick, Intertek
- Todd Dvorak, Afton
- Rich Grundza, TMC
- Kevin O'Malley, Lubrizol
- Jo Martinez, Oronite

Conclusions

The current VIE data indicates statistical discrimination among the oils tested for FEI1 and FEI2.

Based on the analysis presented the estimated standard deviation for FEI1 and FEI2 is 0.21 and 0.16, respectively. VID standard deviation is 0.12 and 0.14 for FEI1 and FEI2, respectively.

The standard deviations above were based on inclusion of statistically significant engine hour effect.

Engine Hours should be included in the precision matrix design.

In some of the analyses, lab and engine within lab effects are statistically significant.

Data

Oil	Sample Size	Engine Hours
542	8	347-1606
542-1	27	347-2827
542-2	2	2011-3130
1010	17	346-2411
541-1	10	346-746
0W16T1	5	908-2751
Total	69	346-3130

Data Concerns

- Data used in the analysis is not designed but observational and therefore have a lot of correlation among the variables
  - Engines did not run the same mix of oils
  - Many engines have limited tests
- High percentage of the tests were run in early engine hours
  - In most cases there's a lack of randomization of oil order in new engines
- Most of the data in higher hours are with 542
- FM carry-over effects could not be accounted for in this data

VIE FEI1_OR

Combined Oils 542, 542-1, 542-2

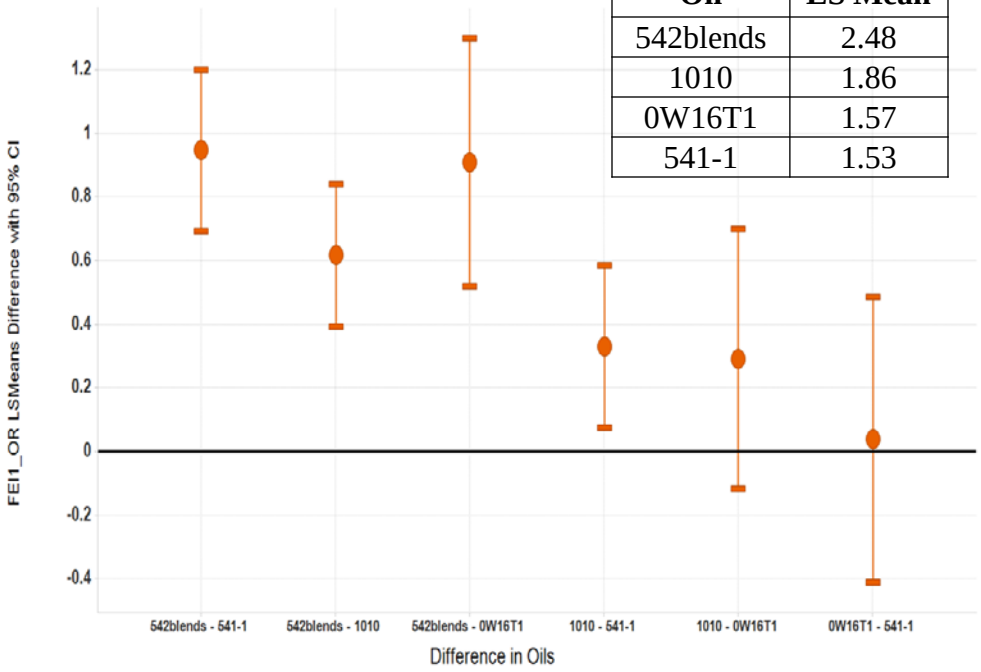
Model: s = 0.21

- Engine Hours [linear]
- Oils [542, 1010, 541-1, 0W16T1]
- Labs [A, B, D, G]
- Engine(Lab)

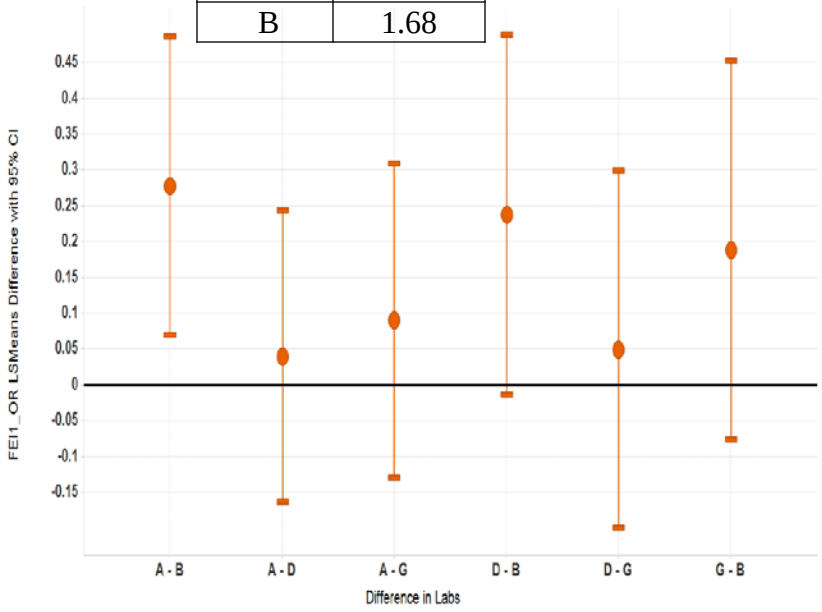
Conclusions (5% level of significance):

1. Oil: 542 > 1010 > 541-1
   542 > 0W16T1
2. Lab: A > B

Oil	LS Mean
542blends	2.48
1010	1.86
0W16T1	1.57
541-1	1.53



Lab	LS Mean
A	1.96
D	1.92
G	1.87
B	1.68



Oil/Lab Comparisons with intervals that do not include 0 are significantly different

VIE FEI2_OR

Combined Oils 542, 542-1, 542-2

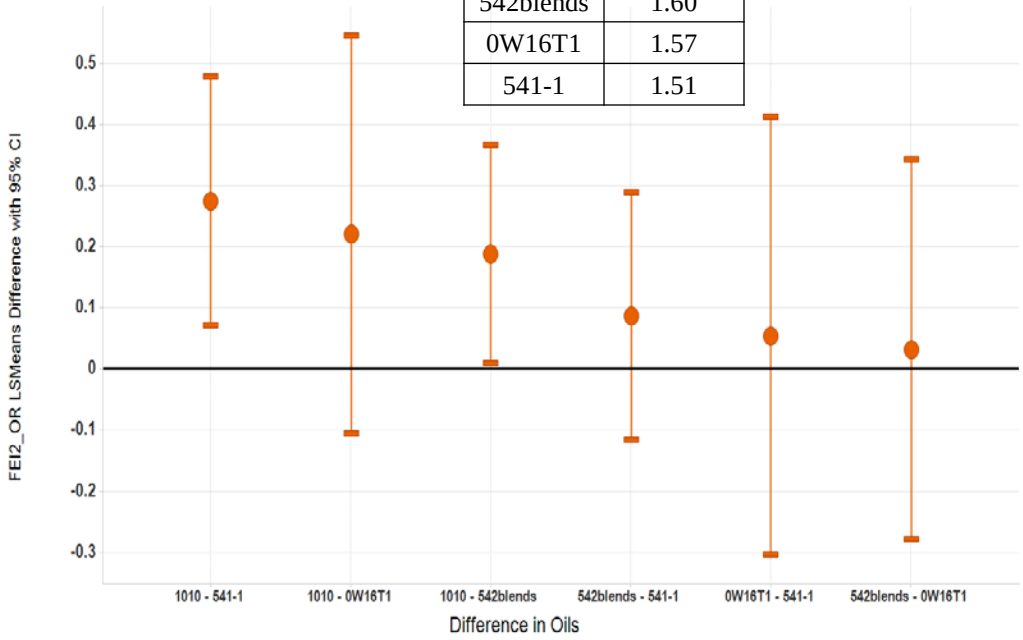
Model: s = 0.16

- Engine Hours [linear]
- Oils [542, 1010, 541-1]
- Labs [A, B, D, G]
- Engine(Lab)

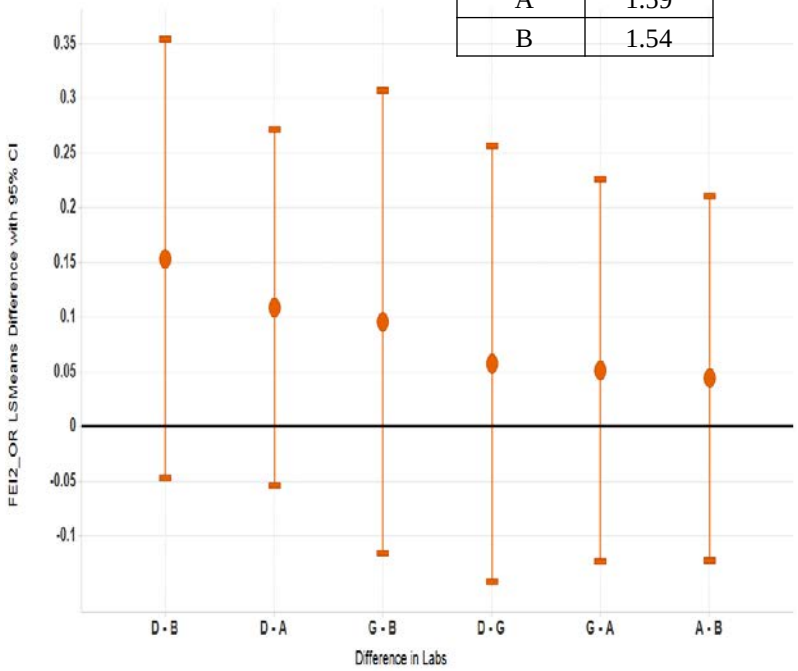
Conclusions (5% level of significance):

1. Oil: 1010 > 542 and 541-1
2. Lab: No significant differences

Oil	LS Mean
1010	1.79
542blends	1.60
0W16T1	1.57
541-1	1.51

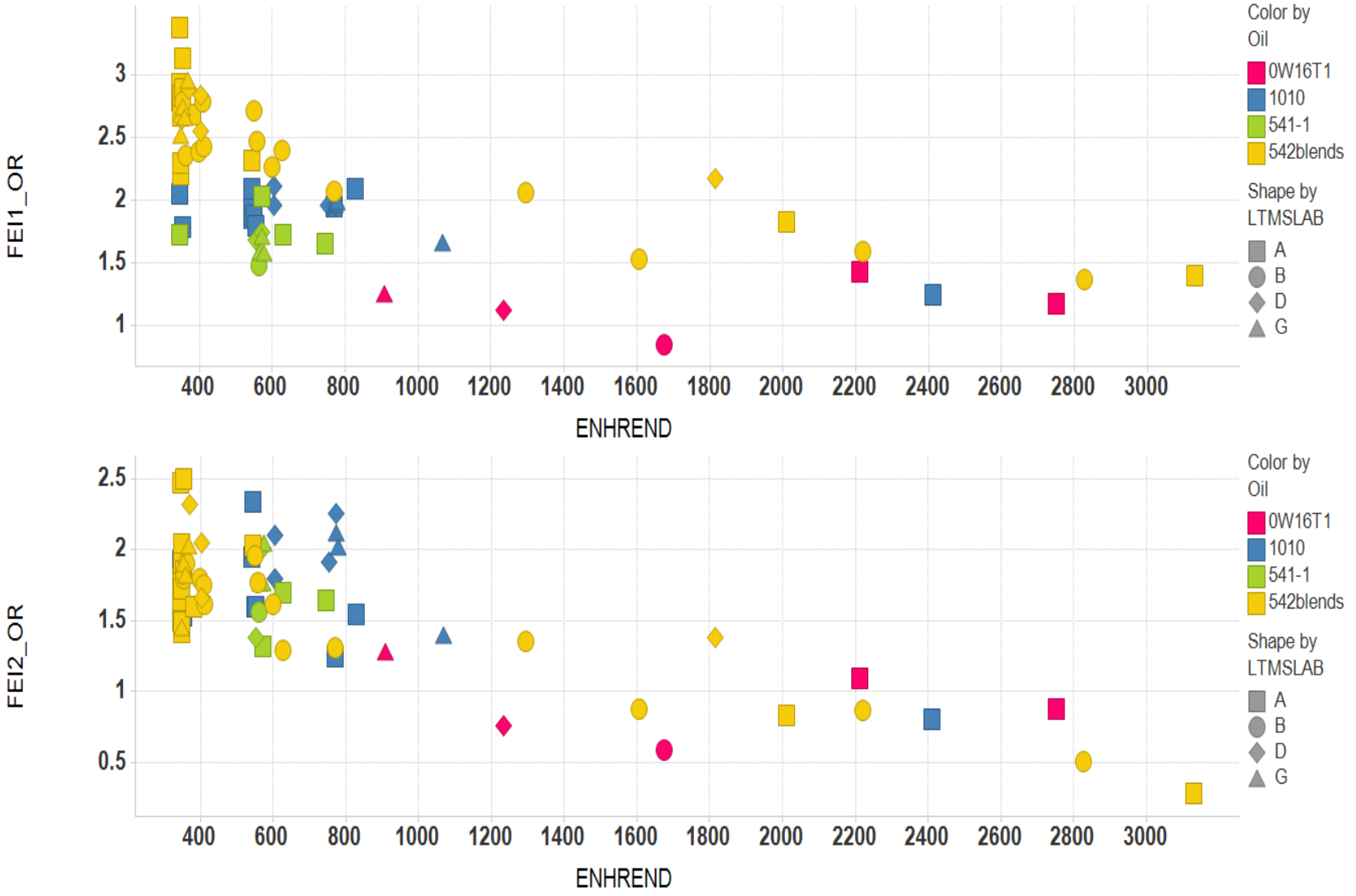


Lab	LS Mean
D	1.70
G	1.64
A	1.59
B	1.54



Oil/Lab Comparisons with intervals that do not include 0 are significantly different

VIE FEI by Engine Hour



VID Precision Matrix and VIE Comparison

FEI1				FEI2			
VID Precision Matrix		VIE Prove-Out		VID Precision Matrix		VIE Prove-Out	
Oil	LS Mean	Oil	LSMean	Oil	LS Mean	Oil	LSMean
X (542)	1.49	542blends	2.48	X (542)	0.8	542blends	1.6
		1010	1.86			1010	1.79
A (540)	1.32			A (540)	1.04		
		0W16T1	1.57			0W16T1	1.57
D (541)	0.87	541-1	1.53	D (541)	0.71	541-1	1.51
s	0.14	s	0.21	s	0.16	s	0.16

VID Precision Matrix Oil Discrimination

FEI1: X(542), A(540) > D(541)

FEI2: A(540) > D(541), X(542)

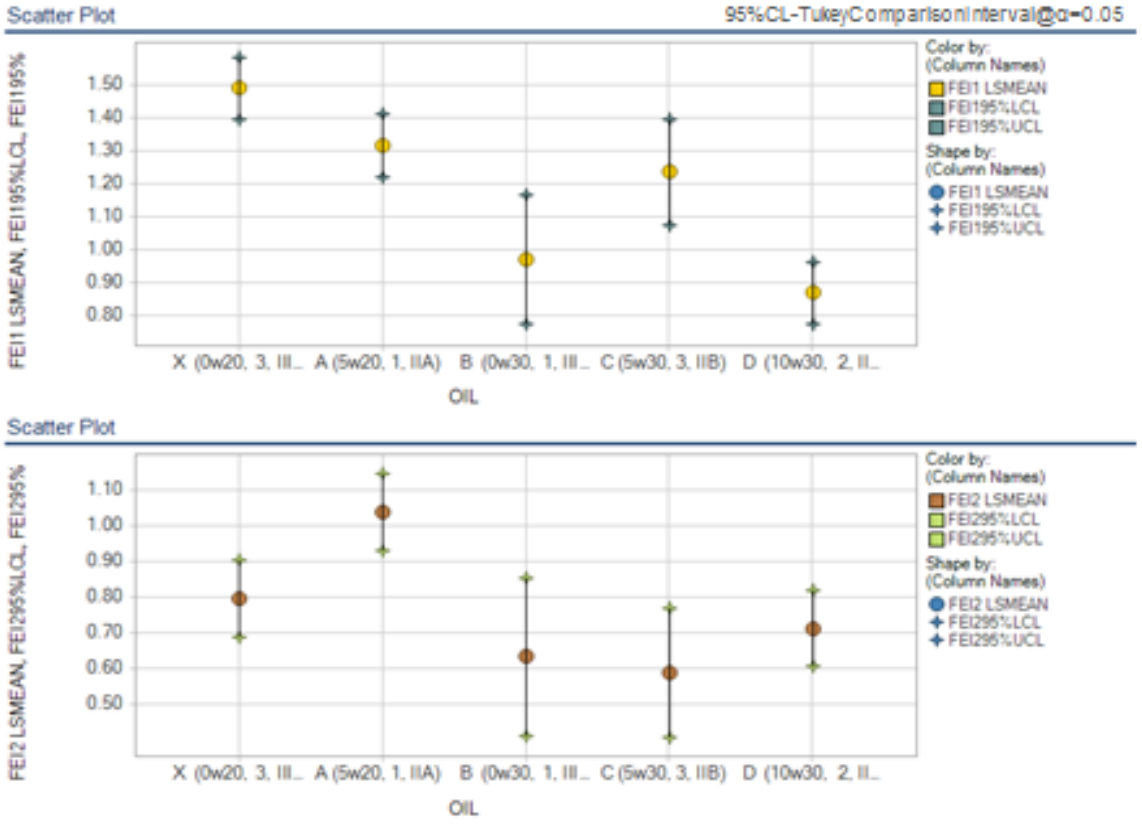
VIE Prove-Out Oil Discrimination

FEI1: 542blends > 1010 > 541-1
542blends > 0W16T1

FEI2: 1010 > 541-1, 542blends

VID Precision Matrix

FEI LSMean by Oil



OIL	FEI1 LSMEAN	FEI2 LSMEAN
A	1.32	1.04
B	0.97	0.63
C	1.24	0.59
D	0.87	0.71
X	1.49	0.80
OIL Difference	**P-value**	**P-value**
A-B	0.0172	0.0133
A-C	0.8792	0.0008
A-D	<.0001	0.0007
A-X	0.0706	0.0173
B-C	0.1651	0.9963
B-D	0.8579	0.9612
B-X	0.0002	0.6228
C-D	0.0018	0.7044
C-X	0.0468	0.2286
D-X	<.0001	0.7457

FEI1: A, X > B, D

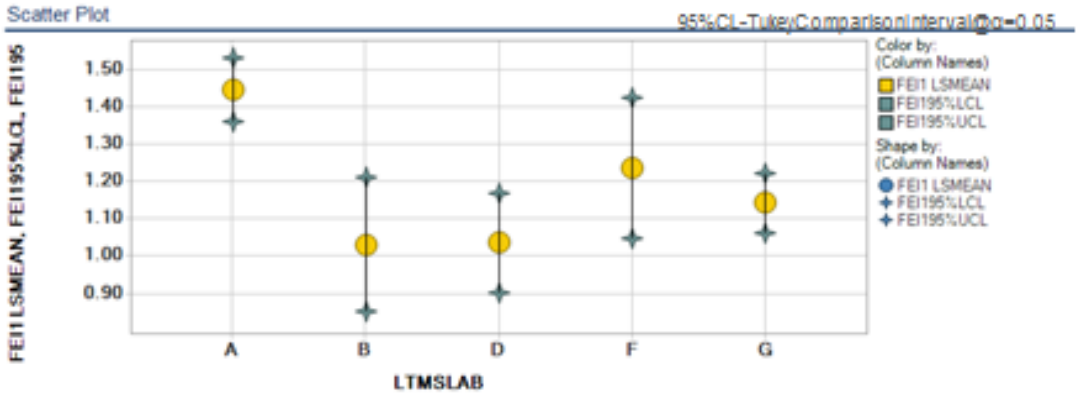
X > C > D

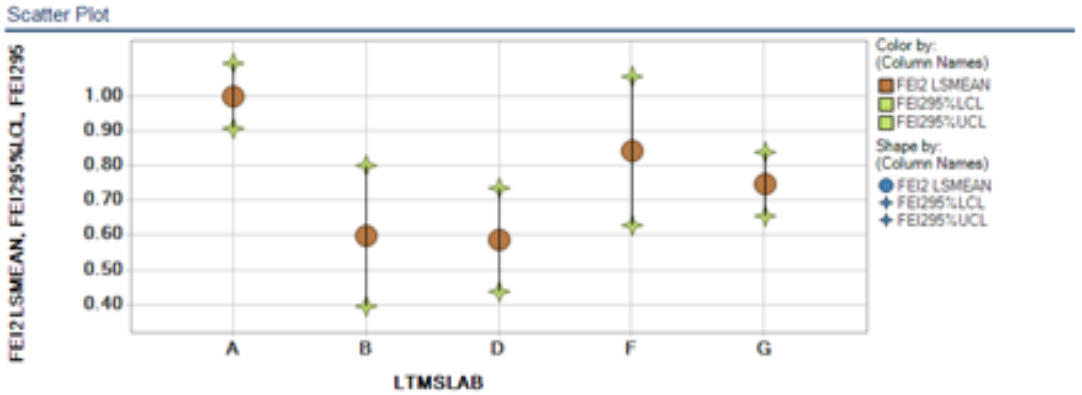
FEI2: A > B, C, D, X

Based on repeated oils data.

VID Precision Matrix

FEI LSMean by Lab



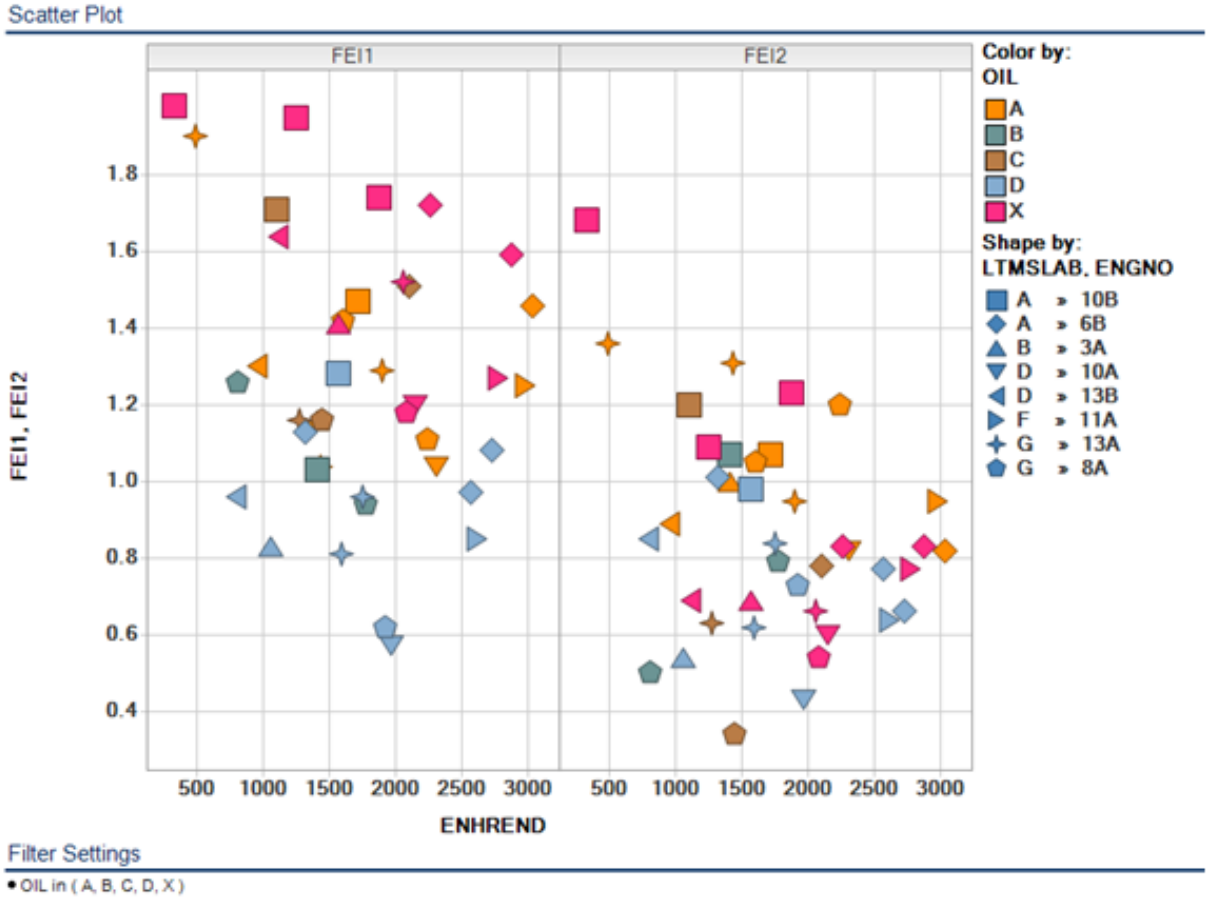


Lab A is significantly higher than labs B, D and G while lab F is not significantly different than the other labs.

Based on repeated oils data.

VID Precision Matrix

FEI by Engine Hours



VID Data and VIE Comparison

FEI1				FEI2			
VID Data		VIE Prove-Out		VID Data		VIE Prove-Out	
Oil	LS Mean	Oil	LSMean	Oil	LS Mean	Oil	LSMean
542blends	1.52	542blends	2.48	542blends	0.83	542blends	1.6
1010	1.34	1010	1.86	1010	1.07	1010	1.79
540	1.32			540	1.01		
		0W16T1	1.57			0W16T1	1.57
541blends	0.91	541-1	1.53	541blends	0.67	541-1	1.51
s	0.12	s	0.21	s	0.13	s	0.16

VID Data Oil Discrimination

FEI1: 542blends > 1010, 540 > 541blends

FEI2: 1010 > 540 > 542blends > 541blends

VIE Prove-Out Oil Discrimination

FEI1: 542blends > 1010 > 541-1
542blends > 0W16T1

FEI2: 1010 > 541-1, 542blends

VID FEI1

Combined Oils 542, 542-1, 542-2 and Oils 541, 541-1

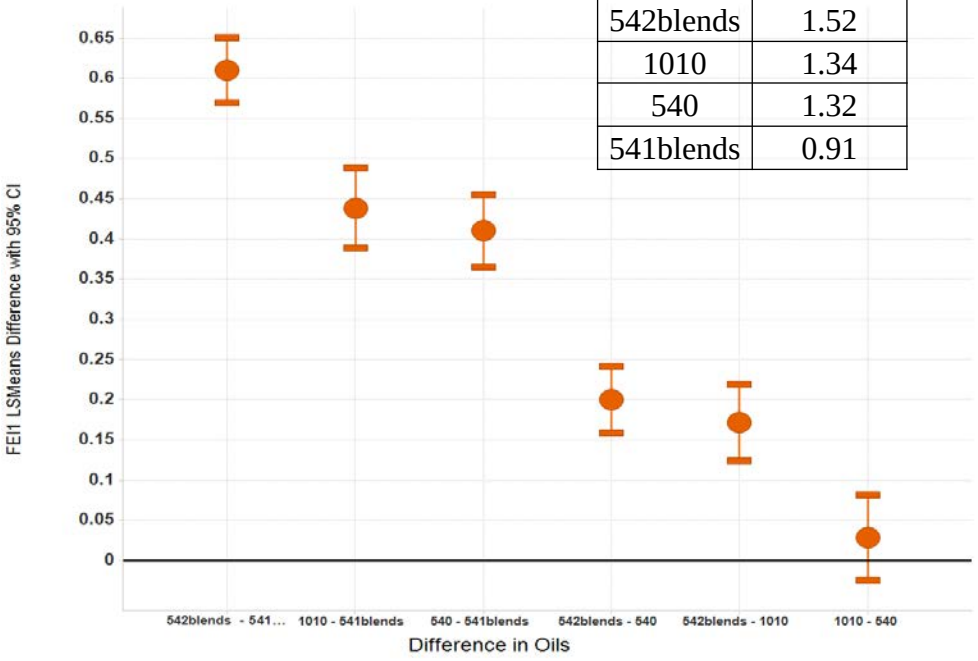
Model: s = 0.12

- Oils [542, 1010, 541, 540]
- Labs [A, B, C, D, F, G]
- Engine(Lab)

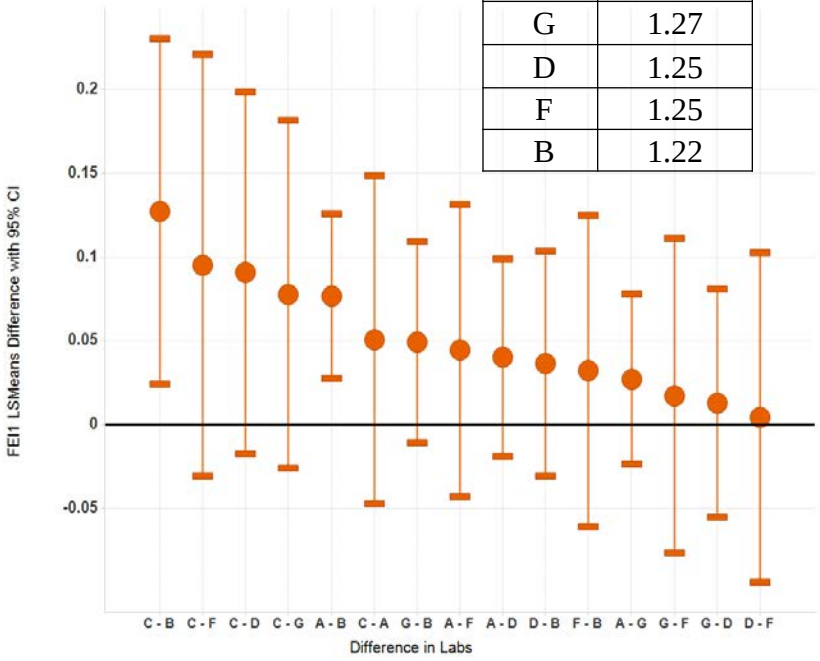
Conclusions (5% level of significance):

1. Oil: 542 > 1010, 540 > 541
2. Lab: C, A > B

Oil	LS Mean
542blends	1.52
1010	1.34
540	1.32
541blends	0.91



Lab	LS Mean
C	1.34
A	1.29
G	1.27
D	1.25
F	1.25
B	1.22



Oil/Lab Comparisons with intervals that do not include 0 are significantly different

VID FEI2

Combined Oils 542, 542-1, 542-2 and Oils 541, 541-1

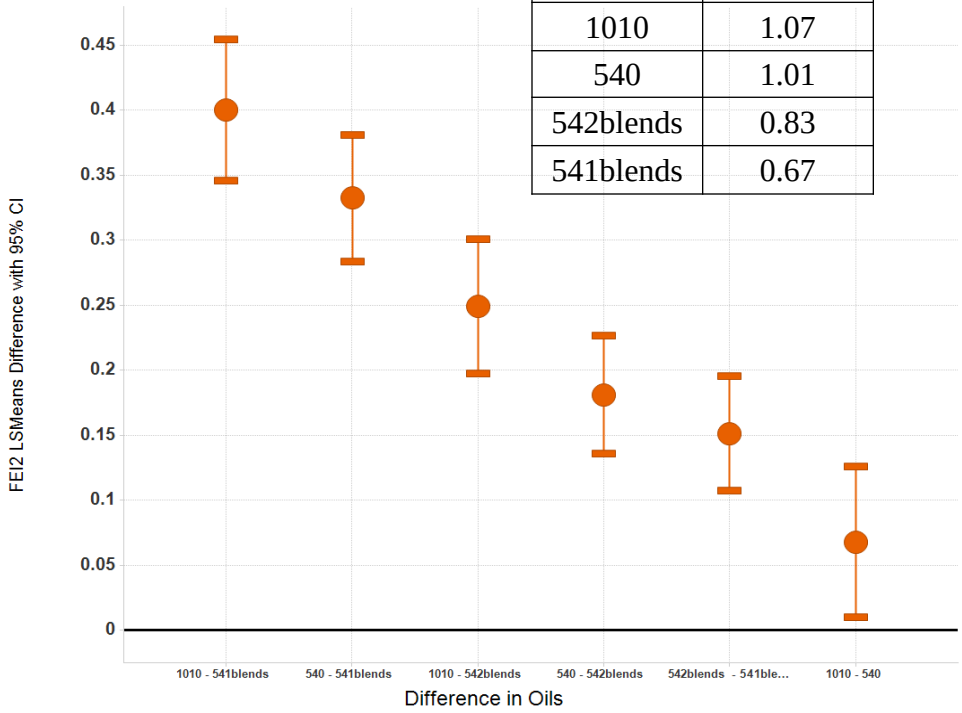
Model: s = 0.13

- Oils [542, 1010, 541, 540]
- Labs [A, B, C, D, F, G]
- Engine(Lab)

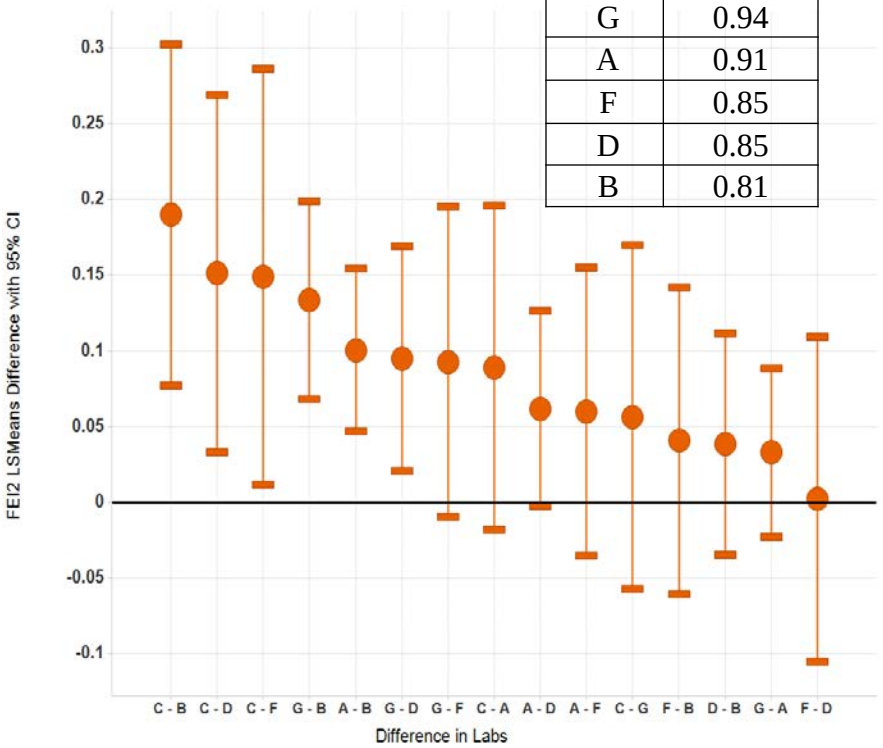
Conclusions (5% level of significance):

1. Oil: 1010 > 540 > 542 > 541
2. Lab: C > B, D, F; G, A > B; G > D

Oil	LS Mean
1010	1.07
540	1.01
542blends	0.83
541blends	0.67

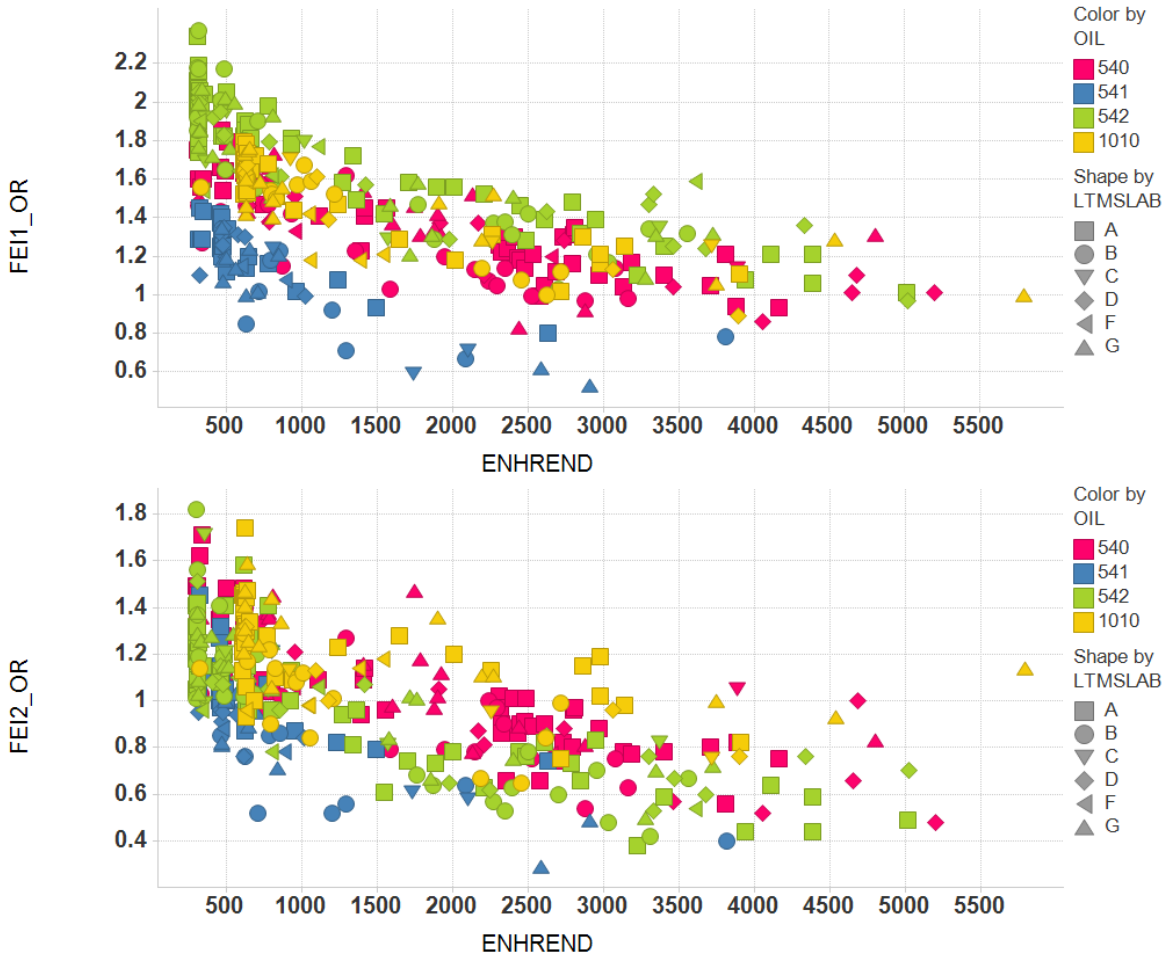


Lab	LS Mean
C	1.00
G	0.94
A	0.91
F	0.85
D	0.85
B	0.81

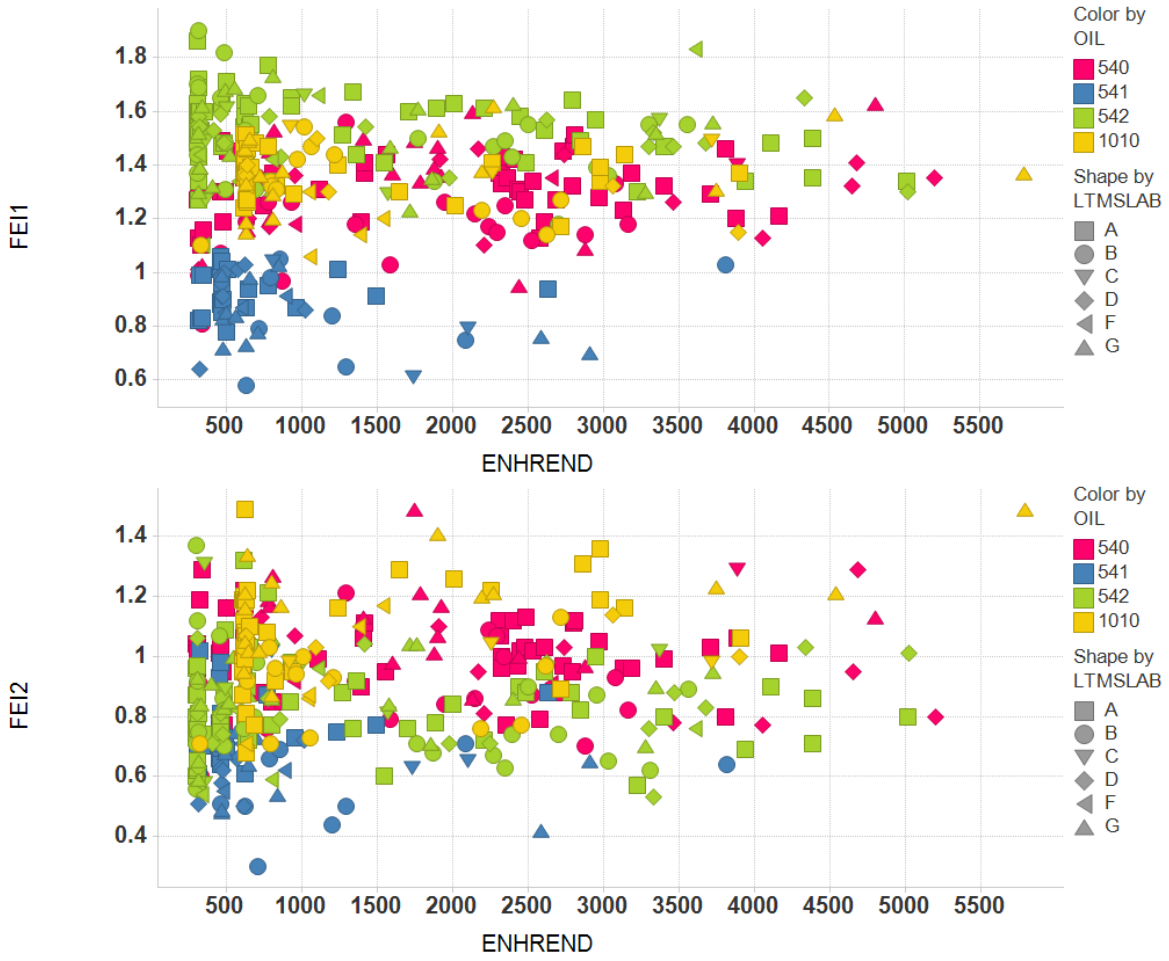


Oil/Lab Comparisons with intervals that do not include 0 are significantly different

VID FEI (Unadjusted) by Engine Hour



VID FEI (Adjusted) by Engine Hour



VID Data and VIE Comparison (Without 0W-16)

FEI1				FEI2			
VID Data		VIE Prove-Out		VID Data		VIE Prove-Out	
Oil	LS Mean	Oil	LSMean	Oil	LS Mean	Oil	LSMean
542blends	1.52	542blends	2.51	542blends	0.83	542blends	1.64
1010	1.34	1010	1.90	1010	1.07	1010	1.82
540	1.32			540	1.01		
541blends	0.91	541-1	1.57	541blends	0.67	541-1	1.55
s	0.12	s	0.19	s	0.13	s	0.14

VID Data Oil Discrimination

FEI1: 542blends > 1010, 540 > 541blends

FEI2: 1010 > 540 > 542blends > 541blends

VIE Prove-Out Oil Discrimination

FEI1: 542blends > 1010 > 541-1

FEI2: 1010 > 541-1, 542blends

VID Data and VIE Comparison (542 and 541 only)

FEI1				FEI2			
VID Data		VIE Prove-Out		VID Data		VIE Prove-Out	
Oil	LS Mean	Oil	LSMean	Oil	LS Mean	Oil	LSMean
542blends	1.52	542blends	2.53	542blends	0.83	542blends	1.66
541blends	0.91	541-1	1.57	541blends	0.68	541-1	1.59
s	0.13	s	0.17	s	0.12	s	0.14

VID Data Oil Discrimination

FEI1: 542blends > 541blends

FEI2: 542blends > 541blends

VIE Prove-Out Oil Discrimination

FEI1: 542blends > 541-1

FEI2: not significant

VID Data and VIE Comparison (542 and 1010 only)

FEI1				FEI2			
VID Data		VIE Prove-Out		VID Data		VIE Prove-Out	
Oil	LS Mean	Oil	LSMean	Oil	LS Mean	Oil	LSMean
542blends	1.52	542blends	2.49	542blends	0.82	542blends	1.64
1010	1.35	1010	1.92	1010	1.07	1010	1.82
s	0.12	s	0.22	s	0.15	s	0.11

VID Data Oil Discrimination

FEI1: 542blends > 1010

FEI2: 1010 > 542blends

VIE Prove-Out Oil Discrimination

FEI1: 542blends > 1010

FEI2: 1010 > 542blends

Standard Deviation Estimates

RMSE, estimate of s	FEI1		FEI2	
	VID	VIE	VID	VIE
All Oils, VID Precision Matrix	0.14	0.21	0.16	0.16
All Oils, Current VID Data	0.12	0.21	0.13	0.16
All Oils except 0W16T1	0.12	0.19	0.13	0.14
542 & 541 blends only	0.13	0.17	0.12	0.14
542 blends & 1010 only	0.12	0.22	0.15	0.11

1. 5W-30 Tech1 on VIE competed (GF6B)
    a. Complete end of June
2. Complete precision matrix design
    a. TBD based on start of precision matrix
    b. Determine if 0W-16Tech1 should be included
        i. Complete end of June
3. Finalize VIE procedure in regards to 0W-16 oils (Task Force, GF6B)
    a. Report end of June