Address *100 Barr Harbor Drive*
PO Box C700
W. Conshohocken, PA
19428-2959 | USA

Phone *610.832.9500*
Fax *610.832.9666*
Web *www.astm.org*

Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

Chairman: KENNETH O. HENDERSON, Cannon Instrument Co., 2139 High Tech Road, State College, PA 16803, (814) 353-8000, Fax: (814) 353-8007, e-mail: kenohenderson@worldnet.att.net
First Vice-Chairman: BEN R. BONAZZA, TI Group Automotive Systems, Caro Research Center, 326 Green Street, Caro, MI, 48723 (989) 673-8181 ext. 227, Fax: (989) 673-3241, e-mail: bbonazza@us.tiauto.com
Second Vice-Chairman: JANET L. LANE, ExxonMobil Research & Engrg., 600 Billingsport Rd, Paulsboro, NJ 08066-0480 (856) 224-3302, Fax: (856) 224-3616, e-mail: janet.l.lane@exxonmobil.com
First Secretary: RALPH A. CHERRILLO, Shell Global Solutions (US) Inc., Westhollow Tech Ctr., 3333 Highway 6 South, Houston, TX 77082 (281) 544-8789, Fax: (281) 544-8150, e-mail: ralph.cherrillo@shell.com
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 22, 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 06.18.2015 Sequence VI Surveillance Panel call.

The meeting was called to order at 8:30 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.

2.0 Approval of minutes

2.1 Approval of the minutes of the 06.02.2015 and 06.12.2015 meeting.

2.2 The Secretary included all presentations on each sets of minutes.

MOTION: Approve the minutes from 06.02.2015 and 06.12.2015.
Dan Worcester, Jason Bowden second. Approved Unanimous.

3.0 Action Item Review

3.1 OHT to report VIE engine usage and update on service engine order (345 additional engines being ordered).
There are 65 of the current VIE batch available. The new VIE order is not yet placed.

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
Lab3: 4 engines IAR now has 3 new engines remaining.
Lab4: 4 engines SwRI now has 3 new engines remaining.

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 are completed.
-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). This will be an on-going effort.

4.3 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.

4.4 Update on the progress of 5W-30 Tech 1 in VIE testing. Afton will start the week of 06.22. SwRI reported results compared to the 0W-16 Tech 1 runs earlier. 5W-30 Tech 1 FEI 1 = 1.09. 5W-30 Tech 1 FEI 2 = 1.05. This was the first run on a new VIE engine. For comparison, the 0W-16 first run was 2200 hours and FEI 1 = 1.52 and FEI 2 = 1.18. The second run was 2750 hours and FEI 1 = 1.34 and FEI 2 = 1.03, with all three tests using the VID engine hour correction and no severity adjustments.

4.5 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. *Statisticians will come up with the list of potential designs once all variables (engines, oils, etc.) have been decided.*
There are 12-14 VIE stands in the industry. There is concern the engine life may be less than 3000 hours. SwRI is currently removing engines at about 2400 hours. There may be a response change in the 2000 hour range. The industry needs more reference oils run in higher hour engines. The Precision Matrix will determine the engine hour correction, so design will need to consider how many hours will be on engines for that matrix.

4.6 There is a request to standardize the way the labs report data collected from the precision matrix to simplify analysis of results.
TMC has a secondary data file but it needs to be updated. Sending full data sets would be huge amounts of data. The Panel would need to find what labs can actually send and create a template. There are no changes to the current data collection.

4.7 Update from task force, to investigate alternative Sequence VIE procedures that would improve 0W-16 response in the Sequence VIE test. - Charlie Leverett
Afton is gathering fuel dilution data on the 8 stage test conditions. They would then run a 0W-16 and 0W-20 JAMA oils for comparison. IAR will be ready to start the week of 06.22 and would run a 0W-16 and 0W-20 oils from the Toyota matrix.

5 New Business

5.1 Lubrizol ILSAC presentation regarding prove out data (presentation attached). -Michael Conrad See Attachment 3. This report considers engine hour correction and engine life, FM carryover, discrimination of the VID versus the VIE and hours to date on reference oils. Most data is early in engine life and more runs are needed in the 1800 to 2000 range. The Precision Matrix should include engines out to 3000 hours to develop the engine hour correction. SwRI agreed to run oil 1010 on an engine with about 2200 hours.
Concerns originally raised during January surveillance panel meeting:
ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/minutes/VIMinutes20150108%20Conference%20call.pdf

5.2 Update from industry statisticians for 542-2 targets with 20 test results no available (presentation attached). –Jo Martinez The recommendation is no change at this time. Lab A will run 541-1 and 1010 on engine 87D to gather more data. See Attachment 4.

5.3 Updated on survey for quantities of VIBL and VIDFO remaining at the laboratories and anticipated life. –Rich Grundza

Survey was sent out 6/12/2015 Not all responses have been returned. There will be a price update this month.

6 **Next Meeting**

Call of the chairman

Proposed date of 6/30, on site meeting? The Task Force and some additional VIE test data will not be available for this time. There is also an ASTM set of meetings that may affect VIE decisions. The next meeting will be scheduled later. The Surveillance Panel will need information for the AOAP meeting mid-July.

The meeting adjourned at 9:50 AM.

Sequence VI Surveillance Panel Conference Call Agenda
June 18 @ 9:30-11AM EST

Call-in information is included below:

Call-in Number: 866-528-2256
Conference Code: 3744024

1.0) Roll Call

Do we have any membership changes or additions?

2.0) Approval of minutes

2.1 Approve the minutes from the June 2, 2015 Sequence VI Surveillance Panel.
ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/minutes/VIMinutes20150602.pdf

2.2 Approve the minutes from the June 12, 2015 Sequence VI Surveillance Panel.
ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/minutes/VIMinutes20150612.pdf

3.0) Action Item Review

3.1 OHT to report VIE engine usage and update on service engine order (345 additional engines being ordered). – OHT

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

-Expected life of engines range from 2016 Q1
Lab1: 2 engines
Lab2: 4 engines
Lab3: 4 engines
Lab4: 4 engines

3.3 SP chair and test sponsor to investigate what is needed to establish VID equivalent limits for VIE

4.) 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.

4.2 Discussion regarding Sequence VIE test ready to proceed with precision matrix.

-The Memorandum of Agreement must be signed and the test receive AOAP approval before the Precision Matrix begins.

-Lab visits required by TMC are completed.

-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).

4.3 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.

4.4 Update on progress of 5W-30 Tech1 in VIE testing. –Labs

Afton will start the week of 06/22

SwRI test will complete the week of 06/15

4.5 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.

Statisticians will come up with the list of potential designs once all variables (engines, oils, etc.) have been decided.

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

TMC has a secondary data file but it needs to be updated. Sending full data sets would be huge amounts of data. The Panel would need to find what labs can actually send and create a template.

4.7 Update from task force, to investigate alternative Sequence VIE procedures that would improve 0W-16 response in the Sequence VIE test. - Charlie Leverett

5.) New Business

5.1 Lubrizol ILSAC presentation regarding prove out data (presentation attached). -Michael Conrad

Concerns originally raised during January surveillance panel meeting:
ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/minutes/VIMinutes20150108%20Conference%20call.pdf

5.2 Update from industry statisticians for 542-2 targets with 20 test results no available (presentation attached). –Jo Martinez

5.3 Updated on survey for quantities of VIBL and VIDFO remaining at the laboratories and anticipated life. –Rich Grundza

Survey was sent out 6/12/2015

6.) Next Meeting

Call of the chairman
Proposed date of 6/30, on site meeting?

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	ATTEND
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	
Teri Kowalski Voting Member	Toyota	teri.kowalski@tema.toyota.com	
Bruce Matthews Voting Member	GM Powertrain Engine Oil Group	Phone: 248-830-9197 bruce.matthews@gm.com	
Timothy Miranda Voting Member	BP Castrol Lubricants USA	Phone: 973-305-3334 Timothy.Miranda@bp.com	
Nathaniel Moles Voting Member	Lubrizol	Phone: (440) 347-4472 Nathaniel.Moles@Lubrizol.com	ATTEND
Mark Mosher Voting Member	ExxonMobil	Phone: 856-224-2132 mark_r_mosher@exxonmobil.com	
Andy Ritchie Voting Member	Infineum	Phone: 908-474-2097 Andrew.Ritchie@infineum.com	ATTEND
Ron Romano Voting Member	Ford Motor Company	Phone: 313-845-4068 rromano@ford.com	ATTEND
Kaustav Sinha Voting Member	Chevron Oronite Company LLC	Phone: 713.432.6642 LFNQ@chevron.com	ATTEND
Mark Sutherland Voting Member	TEI	Phone: 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	Phone: 210.522.2405 dan.worcester@swri.org	ATTEND

ASTM SEQUENCE VI

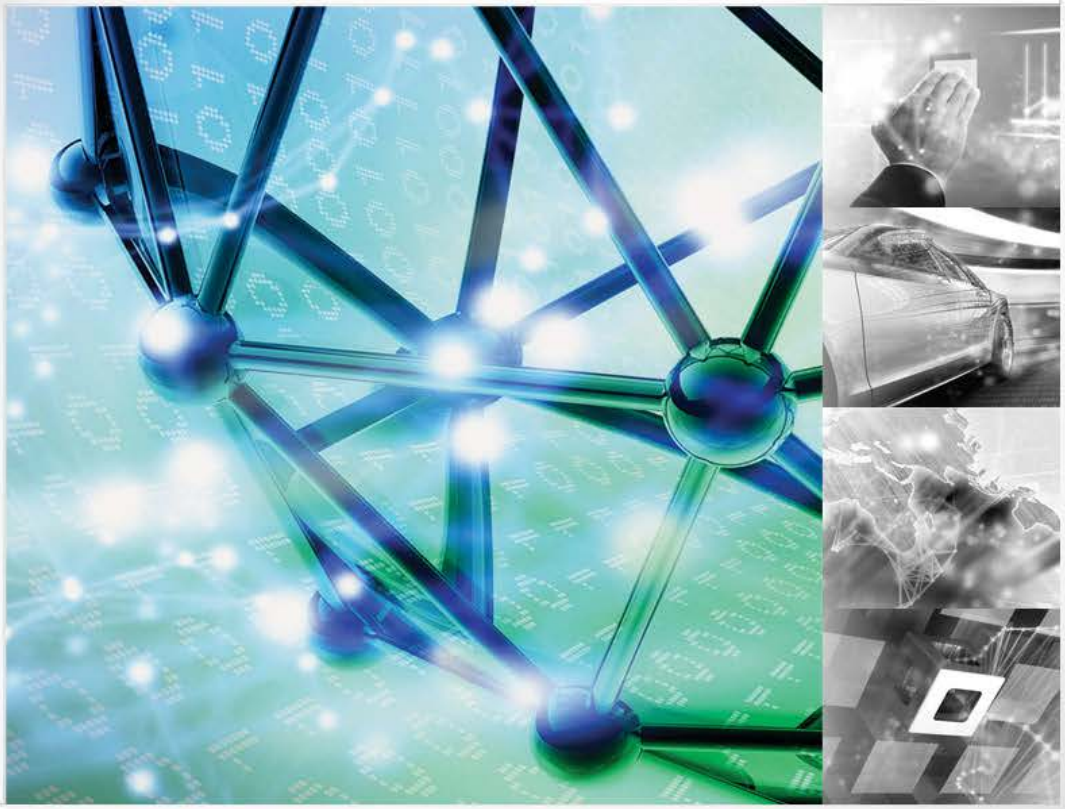
Name	Address	Phone/Fax/Email	Attendance
Ed Altman	ed.altman@aftonchemical.com	Afton	
Bob Campbell	Bob.Campbell@aftonchemical.com	Afton	
Todd Dvorak	todd.dvorak@aftonchemical.com	Afton	
Christian Porter	Christian.porter@aftonchemical.com	Afton	
Terry Hoffman	Terry.Hoffman@aftonchemical.com	Afton	
Jeremy Styer	Jeremy.styer@aftonchemical.com	Afton	
Greg Guinther	greg.guinther@aftonchemical.com	Afton	
Don Smolenski	donald.j.smolenski@gm.com	Evonik	
Doyle Boese	Doyle.boese@infineum.com Phone: 908.474.3176	Infineum	
Mike McMillan	mmcmillan123@comcast.net	Infineum	
Gordon Farnsworth		Infineum	ATTEND
Mike Warholic	Michael.warholic@Infineum.com 908.474.2065	Infineum	
Jordan Pastor	Jordan.pastor@Infineum.com Phone: 313.348.3120	Infineum	
Bob Olree	olree@netzero.net	Intertek	
Addison Schweitzer	addison.schweitzer@intertek.com	Intertek	
William Buscher	william.buscher@intertek.com	Intertek	ATTEND
Adrian Alfonso	adrian.alfonso@intertek.com 210.838.0431	Intertek	ATTEND
Angela Willis	angela.p.willis@gm.com	GM	
Jeff Kettman	Jeff.kettman@gm.com	GM	
Mike Raney	Michael.p.raney@gm.com Phone: 248.408.5384	GM	
Andy Buczynsky		GM	
Timothy Cushing		GM	ATTEND
Jerry Brys	Jerome.brys@lubrizol.com	Lubrizol	ATTEND
Jessica Buchanan	Jessica.Buchanan@Lubrizol.com	Lubrizol	
Michael Conrad	Michael.Conrad@Lubrizol.com	Lubrizol	ATTEND
Joe Gleason	Jog1@lubrizol.com	Lubrizol	
G. Szappanos		Lubrizol	
Dwight Bowden	dhbowden@ohtech.com	OHT	
Matt Bowden	mjbowden@ohtech.com	OHT	
Robert Stockwell	Robert.Stockwell@chevron.com	Oronite	
Jo Martinez	jogm@chevron.com	Oronite	ATTEND
Valeriu Lieu		Oronite	

ASTM SEQUENCE VI

Name	Address	Phone/Fax/Email	Attendance
Guy Stubbs	Guy.Stubbs@swri.org	SwRI	
Patrick Lang	Patrick.lang@swir.org 210.522.2820	SwRI	
Michael Lochte	mlochte@swri.org	SwRI	
Scott Stap	Scott.stap@tgdirect.com	TG Direct	
Clayton Knight	cknight@tei-net.com	TEI	
Dan Lanctot	dlanctot@tei-net.com	TEI	
Zack Bishop	zbishop@tei-net.com 210.877.0223	TEI	
Jeff Clark	jac@astmtmc.cmu.edu	TMC	
Hap Thompson	Hapjthom@aol.com	VIE Facilitator	
Tom Smith		Valvoline	
Mark Adams	mark@tribologytesting.com	Tribology Testing	
Ricardo Affinito	affinito@chevron.com 510.242.4625	Oronite	
Jim Linden	lindenjim@jlindenconsulting.com Phone: 248.321.5343	Toyota	ATTEND
Jeff Hsu		Shell	
Amol Savant		Ashland	ATTEND
Kevin O'Malley		Lubrizol	ATTEND
Chris Castanien		Nestles	ATTEND
Eric Liu		SwRI	ATTEND

ASTM SEQUENCE VI

Name	Address	Phone/Fax/Email	Attendance



Concerns with the Sequence VIE Prove-Out

Presentation to ILSAC

June 9, 2015

Lubrizol

Sequence VID Consortium Scope & Objectives

SUCCESS TOGETHER

The Sequence VID test development was done under the direction of the VID Consortium. They defined a clear scope & objectives (outlined below).

They met their objectives by following rigorous test development practices

Scope

Develop an engine dynamometer-based fuel economy test for ILSAC GF-5 that will replace the ILSAC GF-4 Sequence VIB fuel economy test. The new test should represent both viscometric and friction modifier oil effects on the fuel economy of current and future North American and Japanese engines.

Objectives

1) *The test should be responsive to both viscometric and friction modifier effects in oils.*
2) *Ideally, the test should show improved test precision over the current Sequence VIB fuel economy test. This will be quantified by showing that the new test has a lower standard deviation of fuel economy improvement.*
3) *Develop a VID engine test based on operating conditions mapped proportionally to FTP-75 and Highway Fuel Economy Tests, and which generally agrees with the FTP fuel economy data generated by the Consortium. Other data may be considered, as appropriate. The test should emulate aging observed during mileage accumulation at Xk miles from the FTP program, discriminate between Oil Z and the other matrix oils based on viscosity effects, and determine FM effects.*

From *Consortium to Develop a new Sequence VID Fuel Efficiency Test for Engine Oil – Final Report*; Issued Oct 15, 2008

Lubrizol

Is this really “Prove Out” Data?

SUCCESS TOGETHER

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

5

This is NOT how other GF-6 new test development is being done

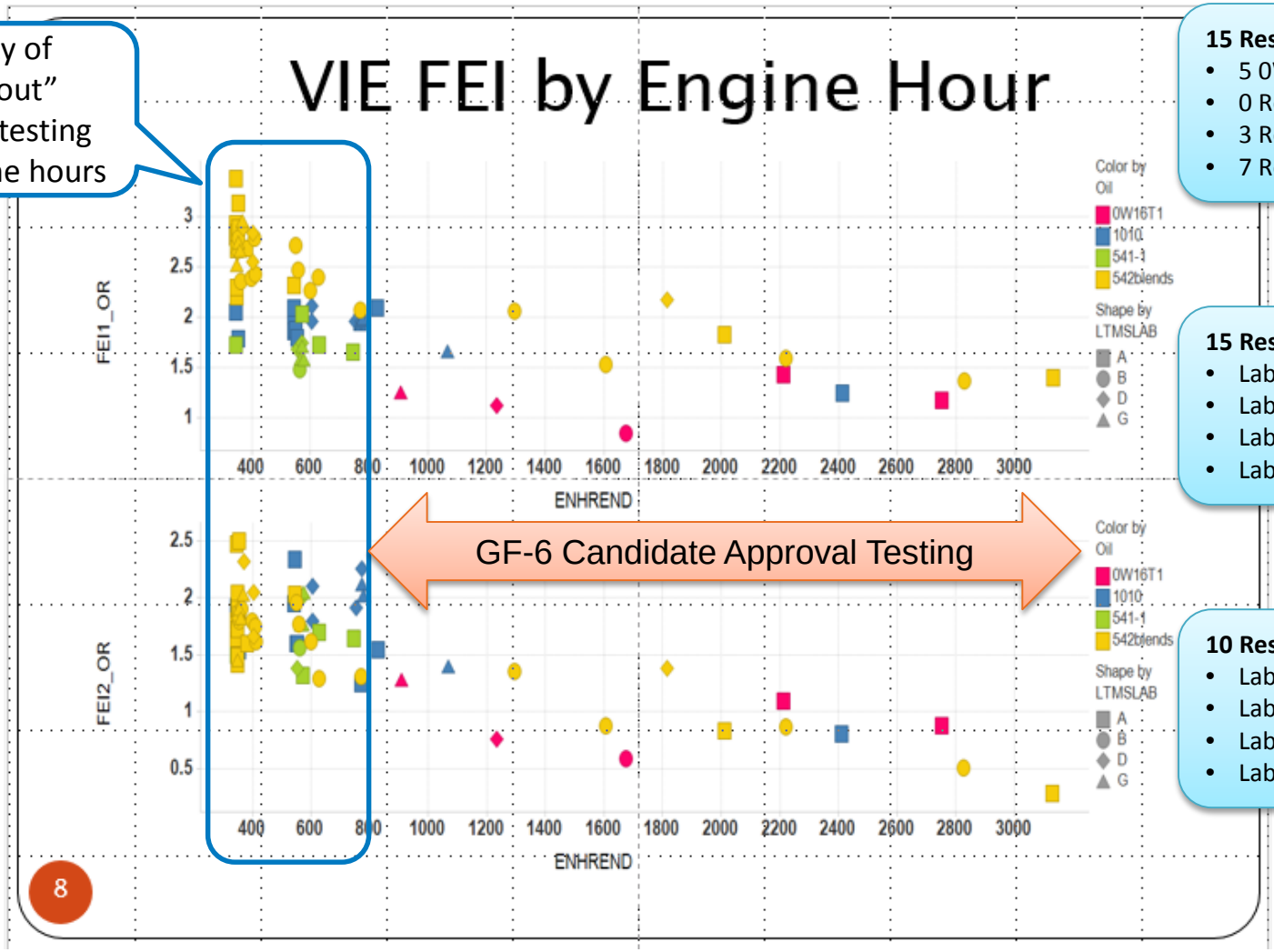
Base Slide from May 14, 2015; Sequence VIE Update Presentation

Lubrizol

Data Spread of VIE "Prove Out"

SUCCESS TOGETHER

Majority of "Prove-out" reference testing ≤ 800 engine hours



15 Results > 800Hrs:
- 5 0W-16
- 0 Ref Oil 541
- 3 Ref Oil 1010
- 7 Ref Oil 542

15 Results > 800Hrs:
- Lab A: 6 tests
- Lab B: 5 tests
- Lab D: 2 tests
- Lab G: 2 tests

10 Results >1500 Hrs:
- Lab A: 5 tests
- Lab B: 4 tests
- Lab D: 1 tests
- Lab G: none

Base Slide from Feb 23, 2015; Sequence VIE Prove-Out Analysis Presentation

Lubrizol

Proof of Discrimination is biased by the lack of Statistical Design

SUCCESS TOGETHER

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

VIE Prove-Out Oil Discrimination
FEI1: 542blends > 1010

FEI2: 1010 > 542blends

VID Data Oil Discrimination
FEI1: 542blends > 1010

FEI2: 1010 > 542blends

Oil	# of VIE Tests with Engine Hours ≤ 800	# of VIE Tests with Engine Hours > 800
542	6	2
542-1	24	3
542-2	0	2
1010	14	3
Total	44	10

VIE Analysis is heavily biased by data on low engine hours

8

Base Slide from May 14, 2015: Sequence VIE Update Presentation

Lubrizol

FEI1 (Combined Oils 542, 542-1, 542-2)

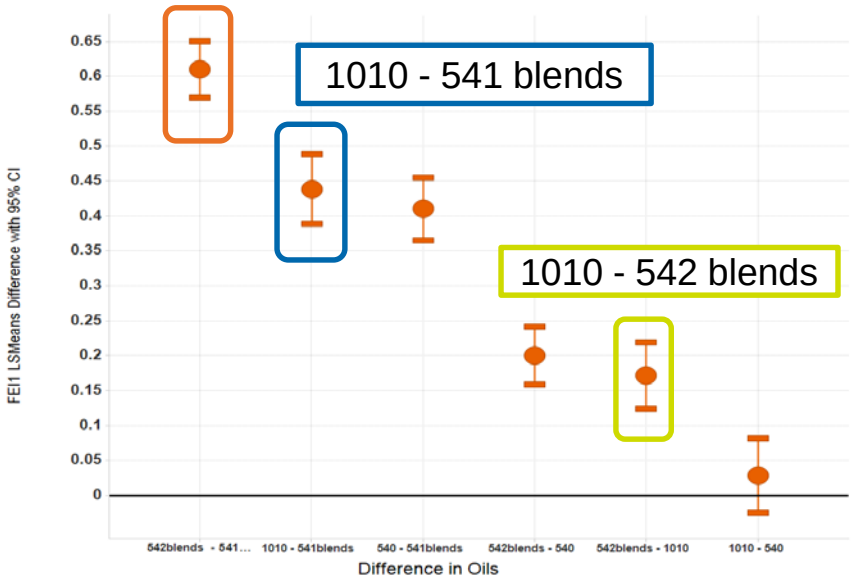
SUCCESS TOGETHER

VID

- Model: s = 0.12
- Oils [542, 1010, 541, 540]
- Labs [A, B, C, D, F, G]
- Engine(Lab)

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

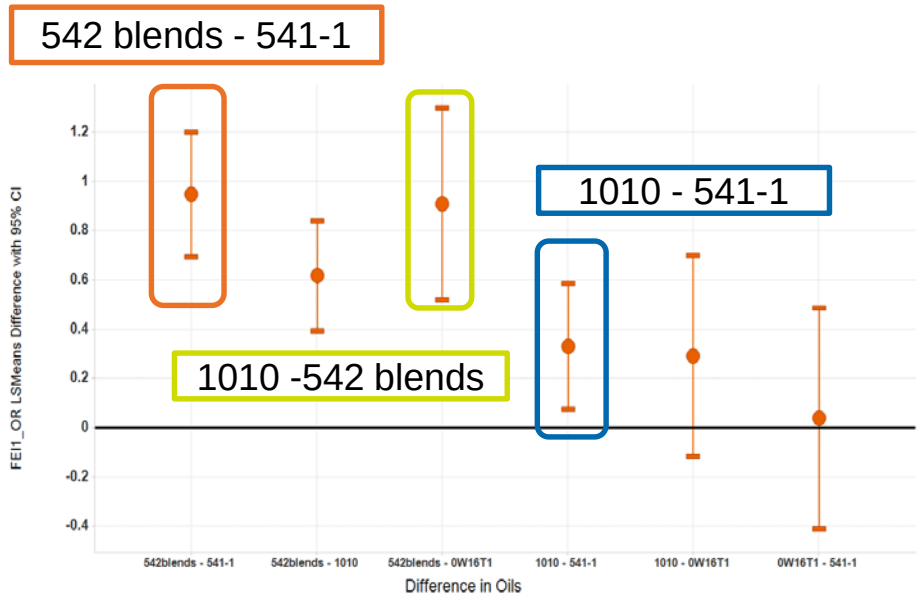
542 blends - 541 blends



VIE

- Model: s = 0.21
- Engine Hours [linear]
- Oils [542, 1010, 541-1, 0W16T1]
- Labs [A, B, D, G]
- Engine(Lab)

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



Crossing the zero line means oil pair does not discriminate

Note: VID is calculated across engine life; VIE is biased to new engines

Combined Data from Feb 23, 2015; Sequence VIE Prove-Out Analysis Presentation; Slides 6 & 14

Lubrizol

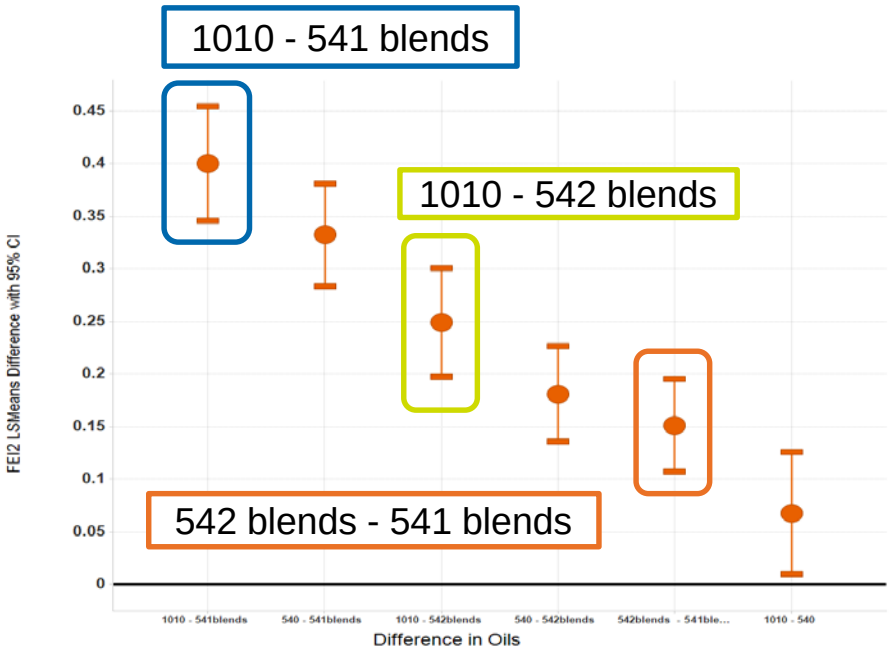
FEI2 (Combined Oils 542, 542-1, 542-2)

SUCCESS TOGETHER

VID

- Model: s = 0.13
- Oils [542, 1010, 541, 540]
- Labs [A, B, C, D, F, G]
- Engine(Lab)

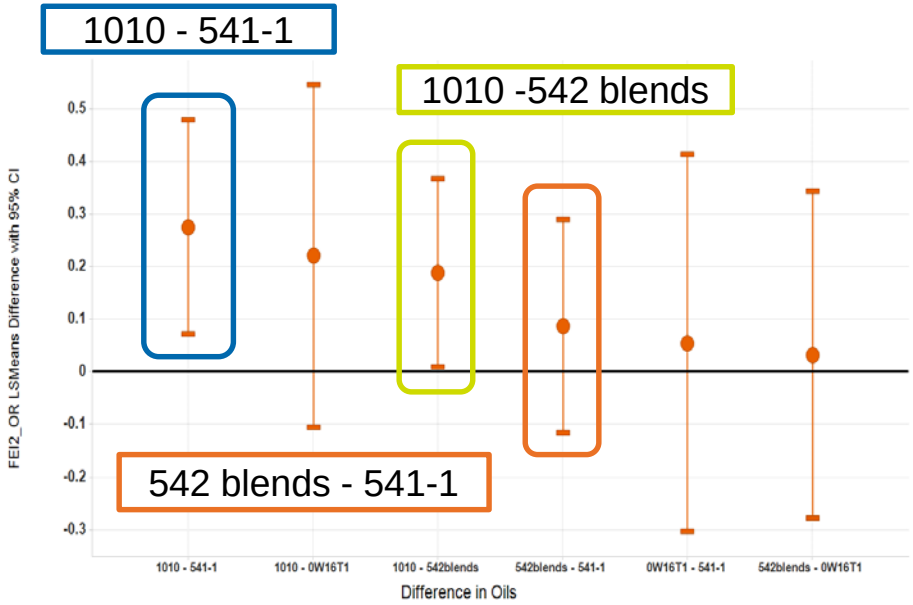
Oil	LS Mean
1010	1.07
540	1.01
542blends	0.83
541blends	0.67



VIE

- Model: s = 0.16
- Engine Hours [linear]
- Oils [542, 1010, 541-1]
- Labs [A, B, D, G]
- Engine(Lab)

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



Crossing the zero line means oil pair does not discriminate

Note: VID is calculated across engine life; VIE is biased to new engines

Combined Data from Feb 23, 2015; Sequence VIE Prove-Out Analysis Presentation; Slides 7 & 15

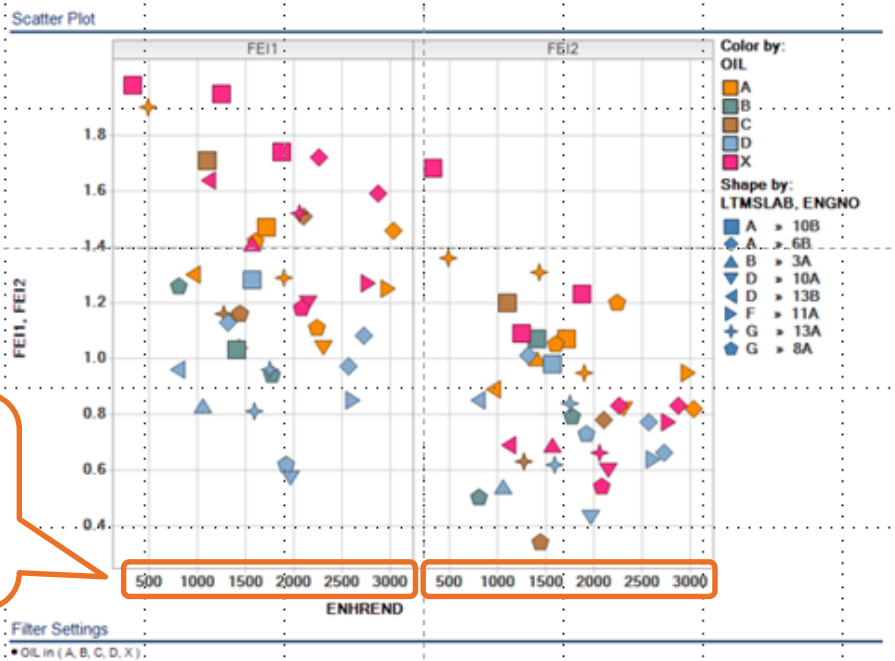
Lubrizol

VID Matrix Design covered the full Engine Life

SUCCESS TOGETHER

VID Precision Matrix

FEI by Engine Hours



Engine life evenly spread
From <500 to >3000 hours

12

6

Base Slide from Feb 23, 2015; Sequence VIE Prove-Out Analysis Presentation

Lubrizol

Consequences of Insufficient Prove-Out data

SUCCESS TOGETHER

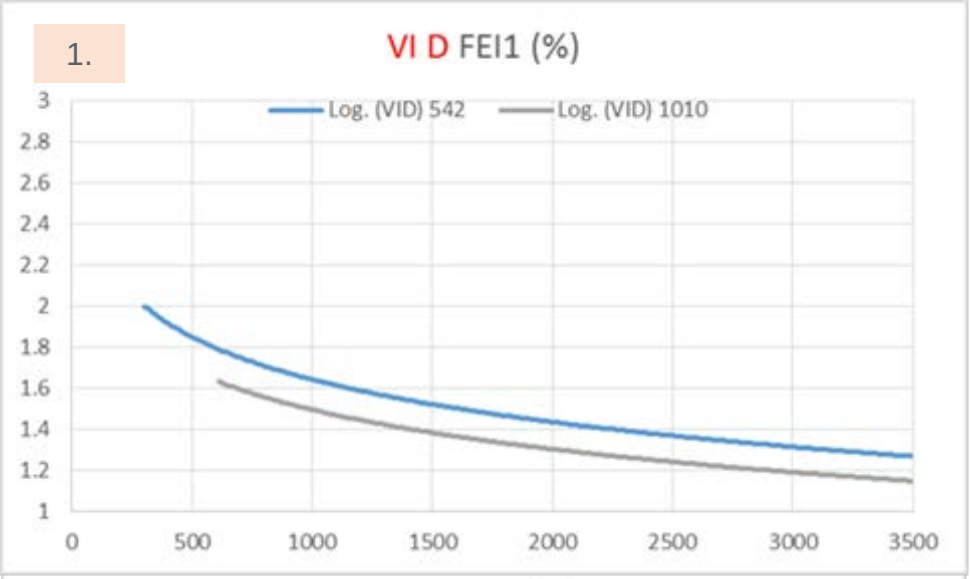
- What is important for a “Ready for Matrix” vote?
  - A test needs to show:
    - Repeatability
    - Reproducibility
    - Discrimination
- Has the Sequence VIE “prove-out” data shown this?
  - Maybe for new engines…
    - Yes, for FEI 1
    - Limited, for FEI 2
  - For the life of the engine?
    - Unknown….
- Why is this an issue?

Lubrizol

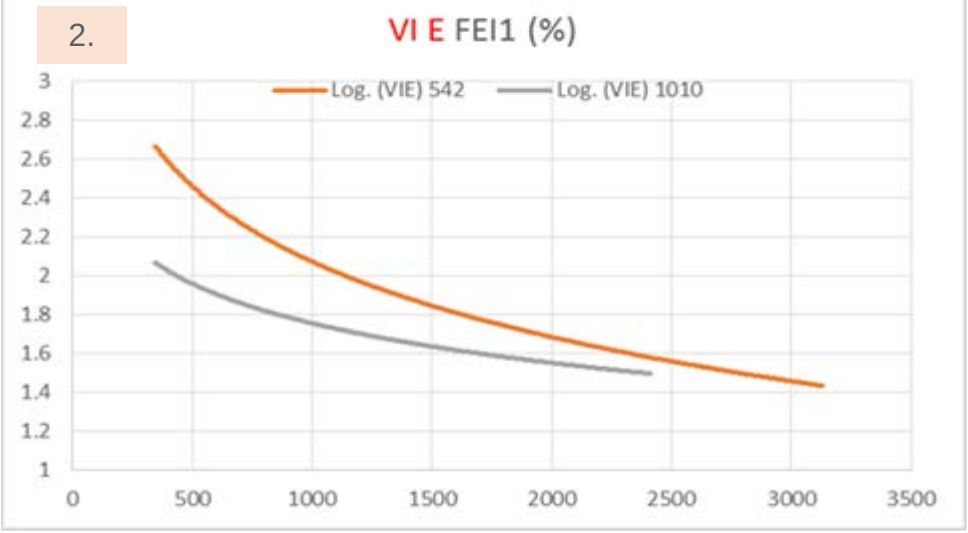
FEI1 Comparison of Reference Oils 542 and 1010

SUCCESS TOGETHER

1.



2.



Log Plot of Uncorrected Reference Oil data

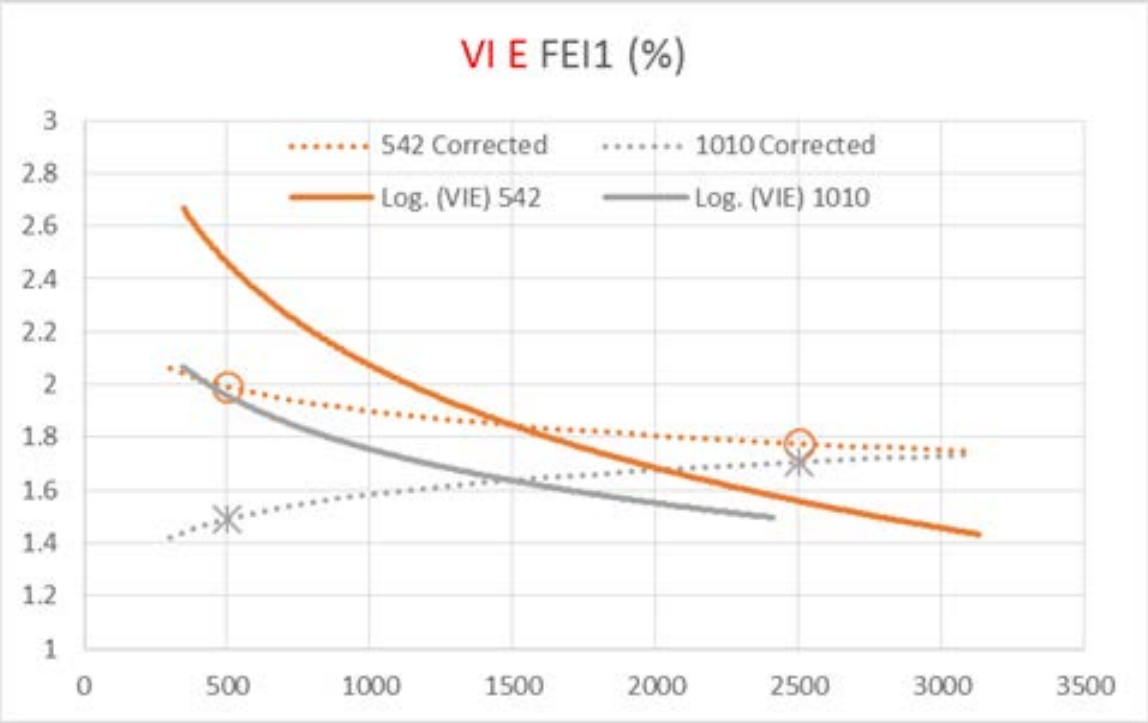
1. Comparison of 542 and 1010 in VID
   - Note: parallel lines → similar responsiveness drop off over the life of the engine
2. Comparison of 542 and 1010* in VIE
   - Note: the lines are not parallel; responsiveness drop off is different for the two oils

** Based on only 3 high engine hour 1010 test results – more data is required to confirm if lines converge*

Lubrizol

FEI1 Comparison of Reference Oils 542 and 1010

SUCCESS TOGETHER



By applying a VID-type engine hour correction to both oils (based on the 542/1010 reference oils data we currently have) - the two reference oils show discrimination at early engine hours, but lose that discrimination as the engine ages

The oils would maintain discrimination if engine aging impact was the same for both oils as with the VID

Lubrizol

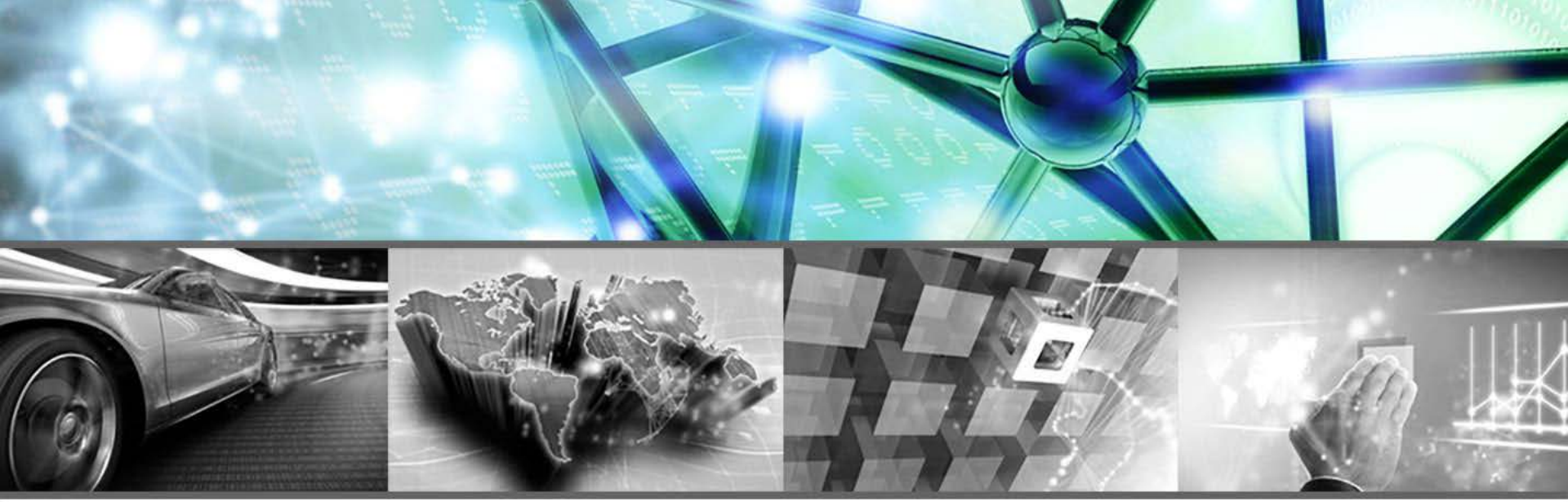
Recommended Path Forward

SUCCESS TOGETHER

Because of the lack of reference oil data at higher engine hours, we are concerned that there may be issues with the test's ability to discriminate oils as the engine ages. Lubrizol would prefer not waste Industry Precision Matrix Funding on test development

- Recommendations
  - Run a minimum of 5 more tests on Oil 1010 on older engines (>1500 hours)
  - Run a minimum of 3 tests on Tech1 0W-16 in newer engines (<800 hours)
    - *Lubrizol is willing to run the 0W-16 on a new engine*
  - Run at least 1 reference Oil Repeat in the same engine per matrix lab
- A Fit-for-Purpose Vote could get these Repeatability, Reproducibility, Discrimination issues out in the open

Lubrizol



SUCCESS TOGETHER

Working together, achieving great things

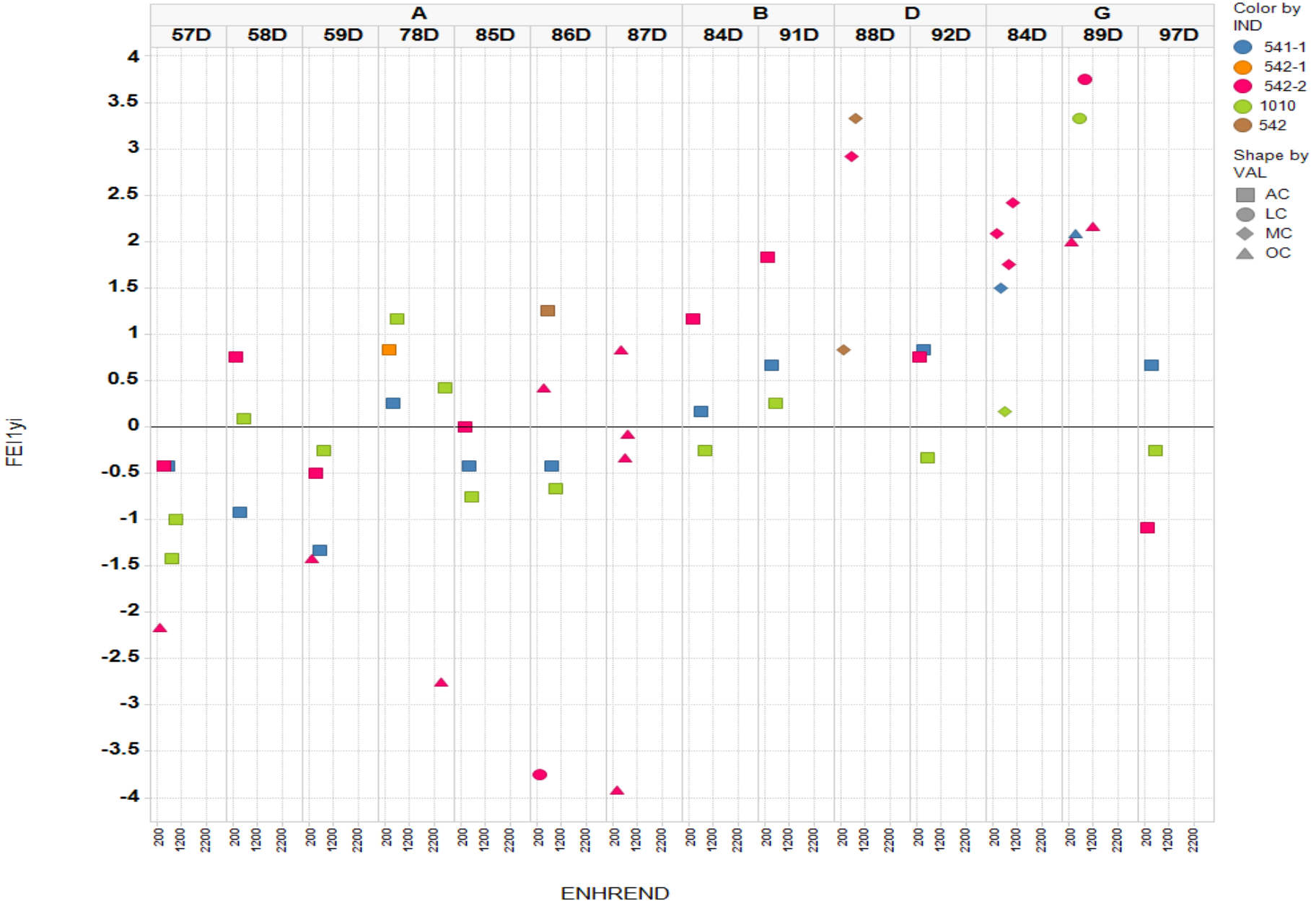
When your company and ours combine energies, great things can happen. You bring ideas, challenges and opportunities. We'll bring powerful additive and market expertise, unmatched testing capabilities, integrated global supply and an independent approach to help you differentiate and succeed.

Lubrizol

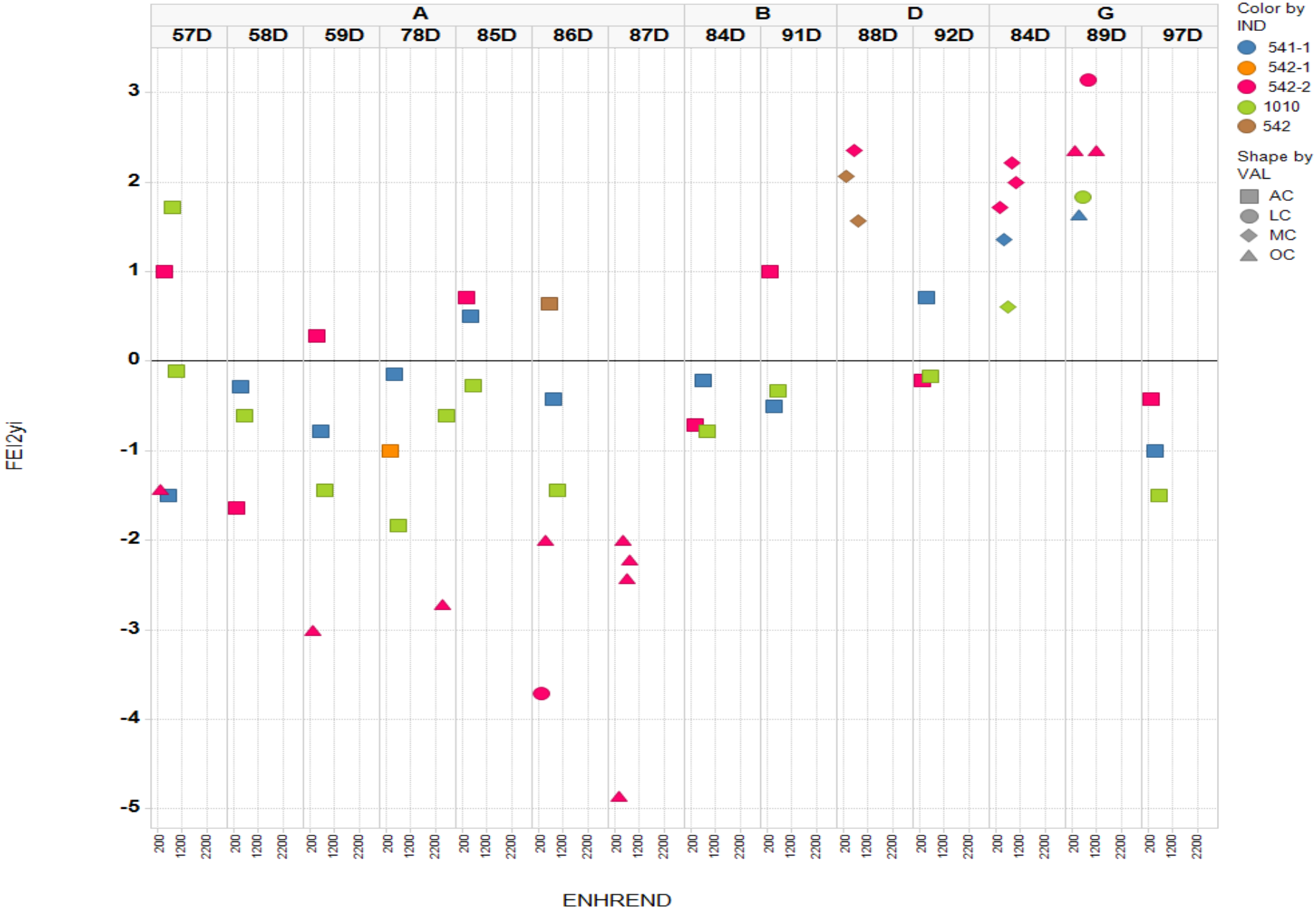
Sequence VID FElyi Plots (In Engines with 542-2 Runs)

June 15, 2015

FEI1yi


A
B
D
G
57D
58D
59D
78D
85D
86D
87D
84D
91D
88D
92D
84D
89D
97D
FEI1yi
ENHREND
Color by IND
541-1
542-1
542-2
1010
542
Shape by VAL
AC
LC
MC
OC

FEI2yi


A
B
D
G
57D
58D
59D
78D
85D
86D
87D
84D
91D
88D
92D
84D
89D
97D
3
2
1
0
-1
-2
-3
-4
-5
200
1200
2200
FEI2yi
ENHREND
Color by IND
541-1
542-1
542-2
1010
542
Shape by VAL
AC
LC
MC
OC