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COMMITTEE D02 ON PETROLEUM PRODUCTS, LIQUID FUELS, AND LUBRICANTS

Issued: Nov. 08, 2016

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 11.07.2016 Sequence VI Conference Call.

The meeting was called to order at 12:35 PM Central Time by Greg Miranda.

Agenda

The Agenda is the included as Attachment 1.

1.0 Roll Call

The Attendance list is Attachment 2.

2. **Approval of Meeting minutes from October 19 , 2016 Seq. VI SP meeting**

Motion #1: Approve the Surveillance Panel minutes.

2.1 Greg made the motion and Dave seconded.

2.2 The vote received unanimous approval.

3. **Old Business and Update Item Review**

3.1 VIE Procedure taskforce update

3.1.1 VIE Procedure document finalized and preparing for balloting

Hap has completed edits and is preparing the procedure for ballot. Amol had some questions on a specific area, and Rich will confirm he has access to the latest version.

The Task Force updates and current version of the Draft procedure are at the TMC web site. That is dated October 28, 2016.

ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/procedure_and_ils/VIE/

3.2 VID Extension taskforce update

This group met one time. These is no further update at this time.

3.3 VIE hardware taskforce update

There was a meeting Nov. 03, 2016. GM has agreed to build more of the right cylinder heads for the second industry order. There will also be a supplemental kit including the parts needed for the short blocks and heads to be assembled. Adrian will supply a list of those parts. Orders for the industry will then be placed when final pricing is available to the labs.

4. **New Business**

4.1 Seq. VI SP to decide whether to include Lubrizol Seq. VIF supplemental test runs into the Seq. VIF precision matrix analysis. See Attachments 3 and 4.

Lubrizol ran 4 runs: 1011, 543, 542-2 and a repeat on 1011. No engine hour adjustment is applied to the results. They had an extended lab shutdown so ran break in out to 200 hours. Slide 5 shows FEI 1 and 2 and slide 6 FEI sum. There was a low value on fuel temperature to the micro-motion of 23.8 but this rounds to 24 so the test is valid.

The STAT group presentation shows the VIF uses 4 runs per engine. This reduced the data set so Lubrizol donated the 4 runs for the industry. There were 3 labs, 3 oils and 36 tests, but 18 will be used for analysis. 4 were invalid and 14 removed for engine life.

Motion #2: Accept the Lubrizol 4 VIF data points into the VIF Matrix Analysis.
Greg Miranda, Rich Grundza, second.

11 yes, 1 waive. The motion passes.

4.2 Seq. VI SP to decide whether to begin the VIF precision matrix analysis, given the available data set. See Attachment 5. There were concerns about SwRI running break in with drive by wire instead of the throttle body and an actuator. Dave Glaenzer noted the Dyne at SwRI and Afton plots are equivalent. The plots are comparable to all labs. There are different plot formats, so there will be an action to standardize. Amol asked if the Dyne actuator was in the procedure. The VIE procedure does not specify the actuator, only the mechanical throttle body. He also discussed APP 1 and 2 and the Throttle box inputs. There will be an effort to define this for labs. Dan Worcester made a motion to allow all VIE and VIF data from the 3 labs be included in matrix analysis. There was then a second motion to move on with VIF analysis

Action #1: Rich Grundza will coordinate with all labs so plots from this point forward use the same format. There may be a change in plotted parameters to assist in break in evaluation.

Motion #3: SwRI recommends to the Surveillance Panel that SwRI data is acceptable for VIE, and VIF analysis to begin.
Dan Worcester, Andy Ritchie, second.

11 yes, 1 waive. The motion passes.

Motion #4: The Surveillance Panel has reviewed all data for the VIF [3 labs and 18 tests] and that data analysis can begin and the STAT group review the data.
Greg Miranda, Dan Worcester, second.

11 yes, 1 waive. The motion passes.

5.0 Next Meeting.

To be determined with completion of VIF matrix STAT analysis.

The meetings adjourned at 1:46 PM.

Sequence VI Surveillance Panel Conference Call Agenda
November 7, 2016 @ 13:30-15:30 EST

Audio Connection

Call-in Number: +1-415-655-0001
Conference Code: 193 667 005

Webex Meeting URL:
https://meetings.webex.com/collabs/#/meetings/detail?uuid=MBVAWTGRPNK0WX5BRMLZIC4KY7-20XT&rnd=603788.12427

1. **Roll Call (start 13:35 EST)**

   1.1. SP Membership changes and additions

2. **Approval of Meeting minutes from October 19, 2016 Seq. VI SP meeting**

3. **Old Business and Update Item Review**

   3.1. VIE Procedure taskforce update
      3.1.1. VIE Procedure document finalized and preparing for balloting

   3.2. VID Extension taskforce update

   3.3. VIE hardware taskforce update

4. **New Business**

   4.1. Seq. VI SP to decide whether to include Lubrizol Seq. VIF supplemental test runs into the Seq. VIF precision matrix analysis.

   4.2. Seq. VI SP to decide whether to begin the VIF precision matrix analysis, given the available data set.

5. **Next Meeting**

   5.1. TBD

6. **Meeting Adjourned**

ASTM SEQUENCE VI

Name	Email/Phone	Company	Attend
Adrian Alfonso **Voting Member**	Phone: (210) 838-0431 Adrian.Alfonso@intertek.com	Intertek	**ATTEND**
Jason Bowden **Voting Member**	Phone: (440) 354-7007 jhbowden@ohtech.com	OHT	**ATTEND**
Amol Savant **Voting Member**	ACSavant@ashland.com	Valvoline	**ATTEND**
Tim Cushing **Voting Member**	Phone: (248) 881-3518 Timothy.Cushing@gm.com	General Motors	**ATTEND**
David Glaenzer **Voting Member**	Phone: (804) 788-5214 Dave.Glaenzer@aftonchemical.com	Afton	**ATTEND**
Rich Grundza **Voting Member**	Phone: (412) 365-1034 reg@astmtmc.cmu.edu	TMC	**ATTEND**
Jeff Hsu **Voting Member**	Phone: (832) 419-3482 j.hsu@shell.com	Shell	
Teri Kowalski **Voting Member**	Phone: (734) 995-4032 Teri.Kowalski@tema.toyota.com	Toyota	
Dan Lanctot **Voting Member**	Phone: (210) 690-1958 dlanctot@tei-net.com	TEI	**ATTEND**
Brian Marks **Voting Member**	Phone: (973) 686-3325 Brian.Marks@bp.com	BP Castrol	
Greg Miranda **Voting Member**	Phone: (440) 347-8516 Greg.Miranda@Lubrizol.com	Lubrizol	**ATTEND**
Andy Ritchie **Voting Member**	Phone: (908) 474-2097 Andrew.Ritchie@infineum.com	Infineum	**ATTEND**
Ron Romano **Voting Member**	Phone: (313) 845-4068 rromano@ford.com	Ford	
Clifford Salvesen **Voting Member**	Phone: (856) 224-2954 Clifford.r.Salvesen@exxonmobil.com	ExxonMobil	**ATTEND**
Kaustav Sinha **Voting Member**	Phone: (713) 432-6642 LFNQ@chevron.com	Chevron Oronite	**ATTEND**
Haiying Tang **Voting Member**	Phone: (248) 512-0593 HT146@Chrysler.com	Chrysler	
Dan Worcester **Voting Member**	Phone: (210) 522-2405 Dan.Worcester@swri.org	SwRI	**ATTEND**

ASTM SEQUENCE VI

Name	Email/Phone	Company	Attend
Ed Altman	Ed.Altman@aftonchemical.com	Afton	
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Lisa Dingwell	Lisa.Dingwell@AftonChemical.com	Afton	
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Jeff Kettman	Jeff.Kettman@gm.com	GM	
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Jerry Brys	Jerome.Brys@lubrizol.com Phone: (440) 347.2631	Lubrizol	
Jessica Buchanan	Jessica.Buchanan@Lubrizol.com	Lubrizol	
Joe Gleason	Jog1@lubrizol.com	Lubrizol	
James Matasik	James.Matasic@lubrizol.com	Lubrizol	ATTEND

ASTM SEQUENCE VI

Name	Email/Phone	Company	Attend
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Kevin O'Malley	Kevin.OMalley@lubrizol.com Phone: (440) 347.4141	Lubrizol	ATTEND
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Dave Passmore	dpassmore@imtsind.com	IMTS	
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Matt Bowden	mjbowden@ohtech.com	OHT	ATTEND
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Robert Stockwell	rsto@chevron.com	Oronite	ATTEND
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Patrick Lang	Patrick.Lang@swRI.org Phone: (210) 522-2820	SwRI	ATTEND
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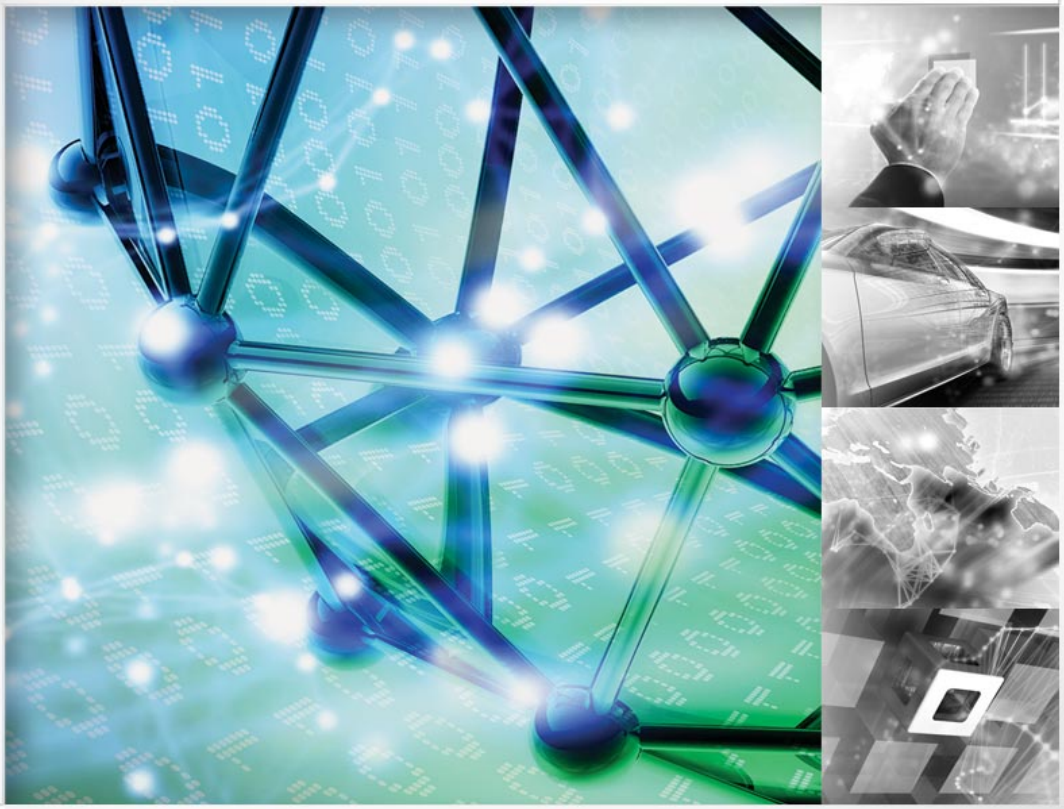
Hirano Satoshi	Satoshi_Hirano_aa@mail.toyota.co.jp	Toyota	
Jim Linden	lindenjim@jlindenconsulting.com Phone: (248) 321-5343	Toyota	ATTEND
Mark Adams	mark@tribologytesting.com	Tribology Testing	
Tom Smith		Valvoline	
Hap Thompson	Hapjthom@aol.com	VIx Facilitator	ATTEND
Chris Taylor	Chris.Taylor@vpracingfuels.com	VP Racing Fuels	

VOTE				

ASTM SEQUENCE VI

Name	Email/Phone	Company	Attend

MOTION	#1	#2	#3	
Adrian Alfonso **Voting Member**	YES	YES	YES	
Jason Bowden **Voting Member**	YES	YES	YES	
Timothy Caudill **Voting Member**	YES	YES	YES	
Tim Cushing **Voting Member**	YES	YES	YES	
David Glaenzer **Voting Member**	YES	YES	YES	
Rich Grundza **Voting Member**	YES	YES	YES	
Jeff Hsu **Voting Member**				
Teri Kowalski **Voting Member**				
Dan Lanctot **Voting Member**	WAIVE	WAIVE	WAIVE	
Brian Marks **Voting Member**				
Greg Miranda **Voting Member**	YES	YES	YES	
Andy Ritchie **Voting Member**	YES	YES	YES	
Ron Romano **Voting Member**				
Clifford Salvesen **Voting Member**	YES	YES	YES	
Kaustav Sinha **Voting Member**	YES	YES	YES	
Haiying Tang **Voting Member**				
Dan Worcester **Voting Member**	YES	YES	YES	



Lubrizol Sequence VIF Supplemental Data Update

Greg Miranda

11/01/16

Sequence VIF Supplemental Data Update

SUCCESS TOGETHER

- At the July Sequence VI SP face-to-face meeting in San Antonio, Lubrizol volunteered, and the SP unanimously agreed to produce an engine's worth (4 test runs) of Seq. VIF data to support the VIF Precision Matrix analysis.

Test #	Test Oil (per 7/27/16)	TMC Oil Code (CMIR #)	FEI1 (%)	FEI2 (%)	FEISum (%)	Engine Hours (at EOT)
1	1011	118168	1.53	1.63	3.16	445
2	543	118267	2.36	2.62	4.98	646
3	542-2	119631	1.99	1.58	3.57	849
4	1011	119628	1.51	1.52	3.03	1046

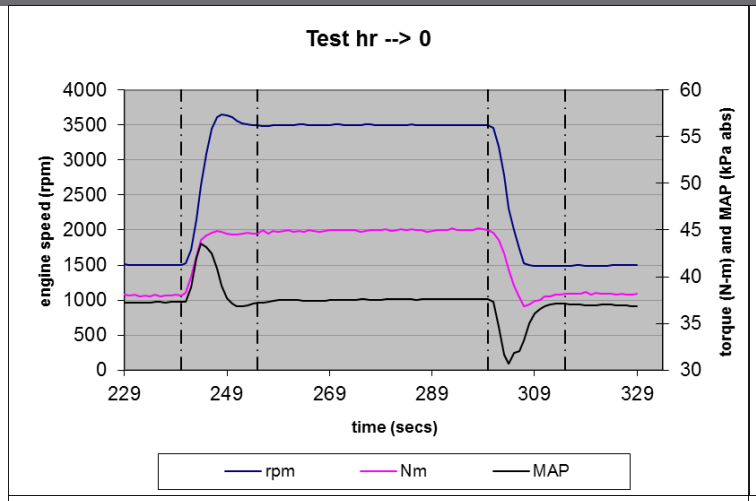
Complete =
In Progress =
Planned =

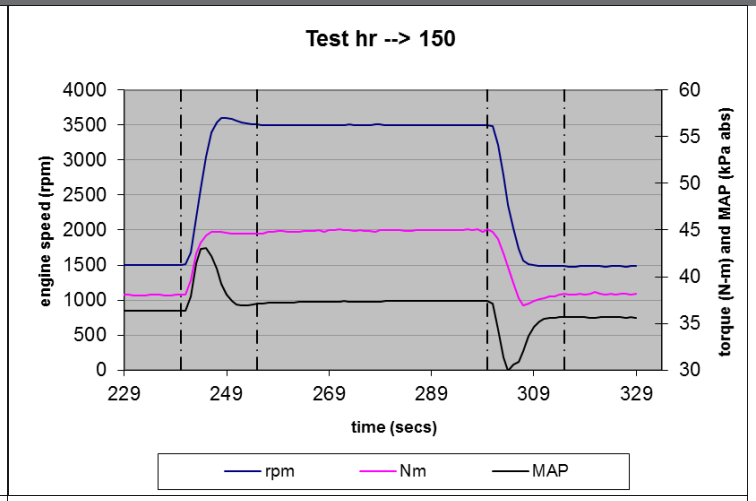
NOTE: All tests were deemed operationally valid by the test lab per operational and test methodology requirements defined in the Seq. VIF procedure pertaining to engine break-in and test operation.

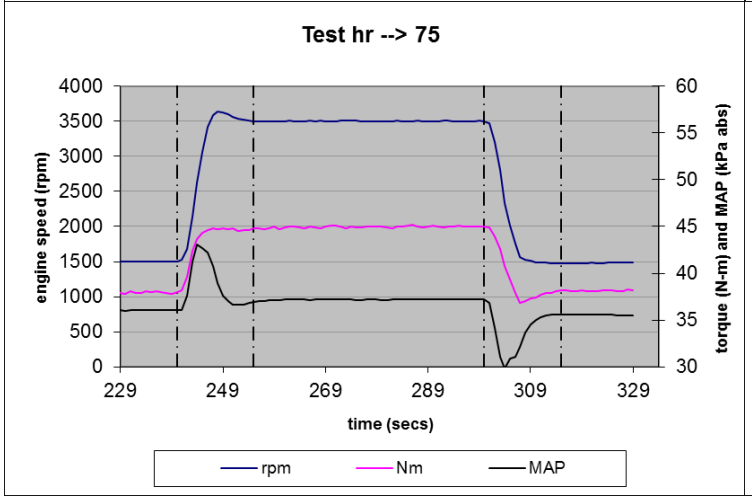
Lubrizol Seq. VIF supplemental data completed on October 30, 2016

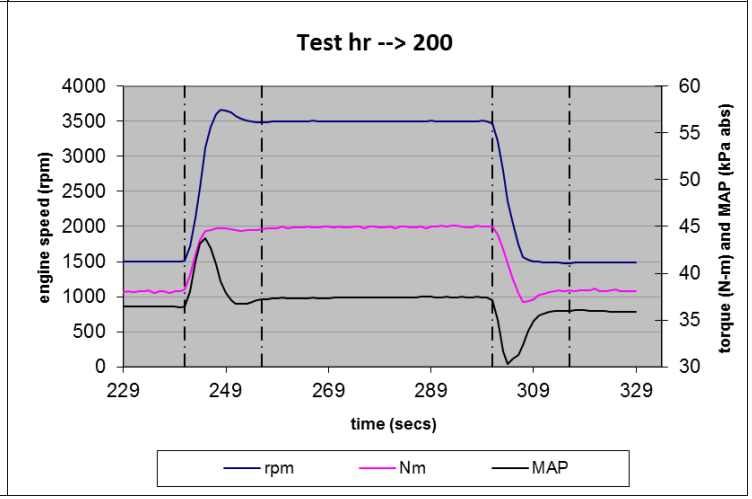
Lubrizol

Engine Break-In Data (Engine #: 306)







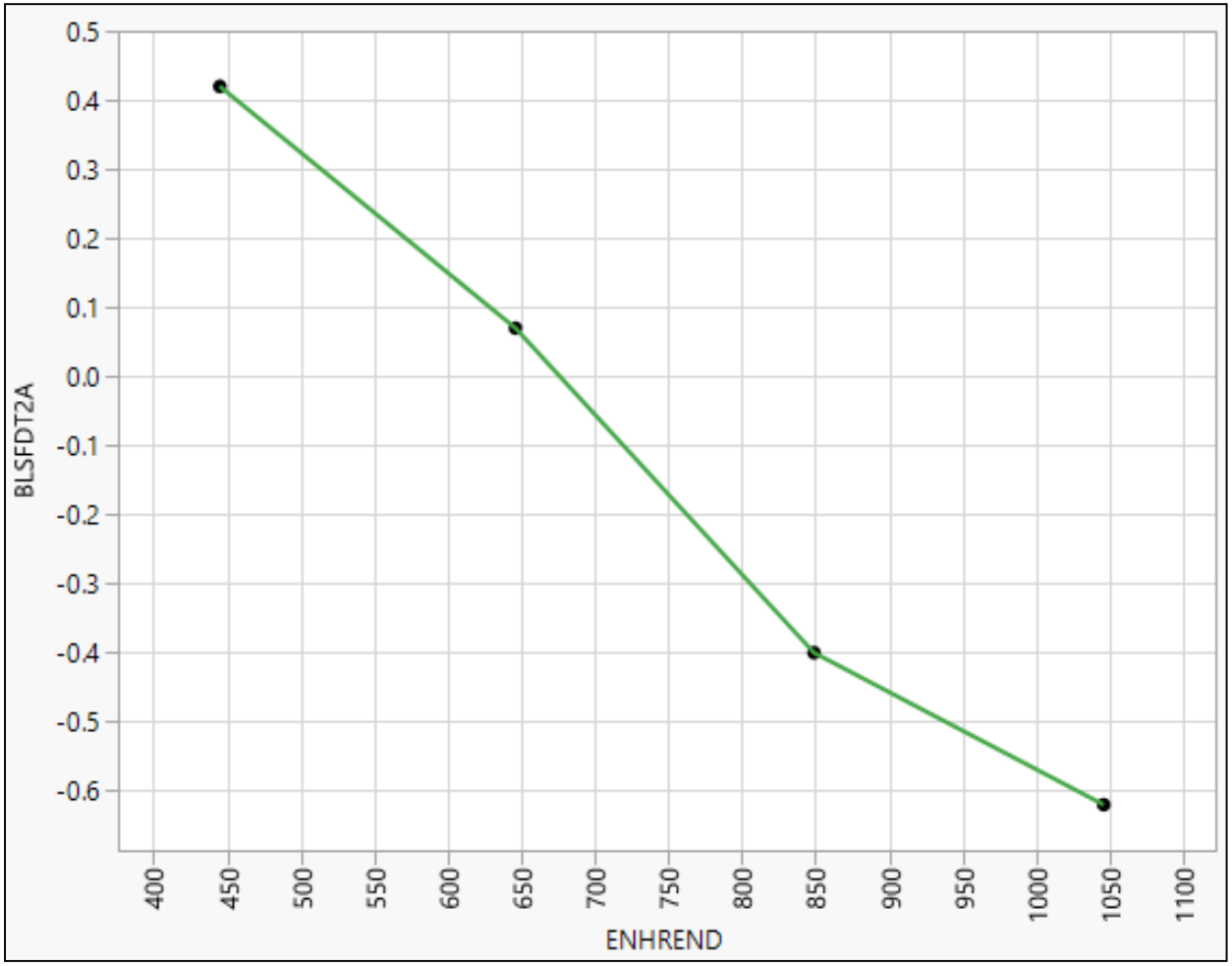


RUNID	TRN6MCSXB
Stand #:	258
EOT Date:	9/23/2016
EOT hrs:	200
Oil Level (ml):	68
Engine #:	306
Serial #:	10K22 A121400389
Injector Flow Delta	3

Engine break-in completed 9/23/2016

BLB2 to BLA Shift vs Engine Hours at Test EOT

SUCCESS TOGETHER



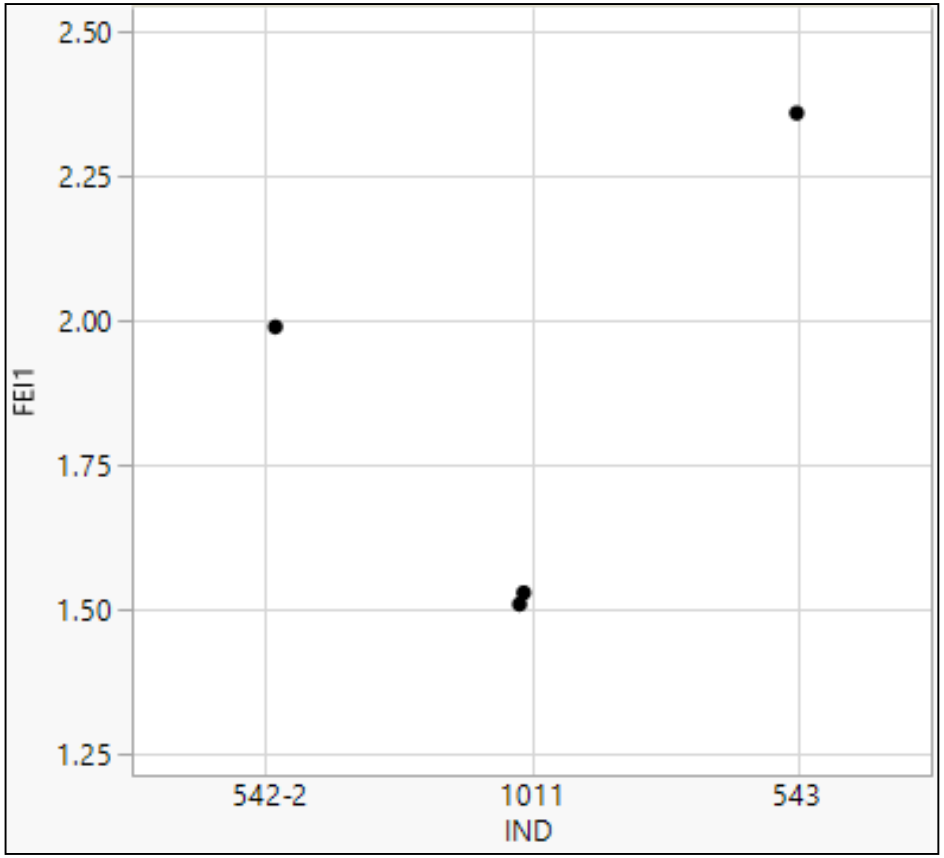
Engine BLB2 to BLA shift appears consistent with other VIF PM engines

Lubrizol

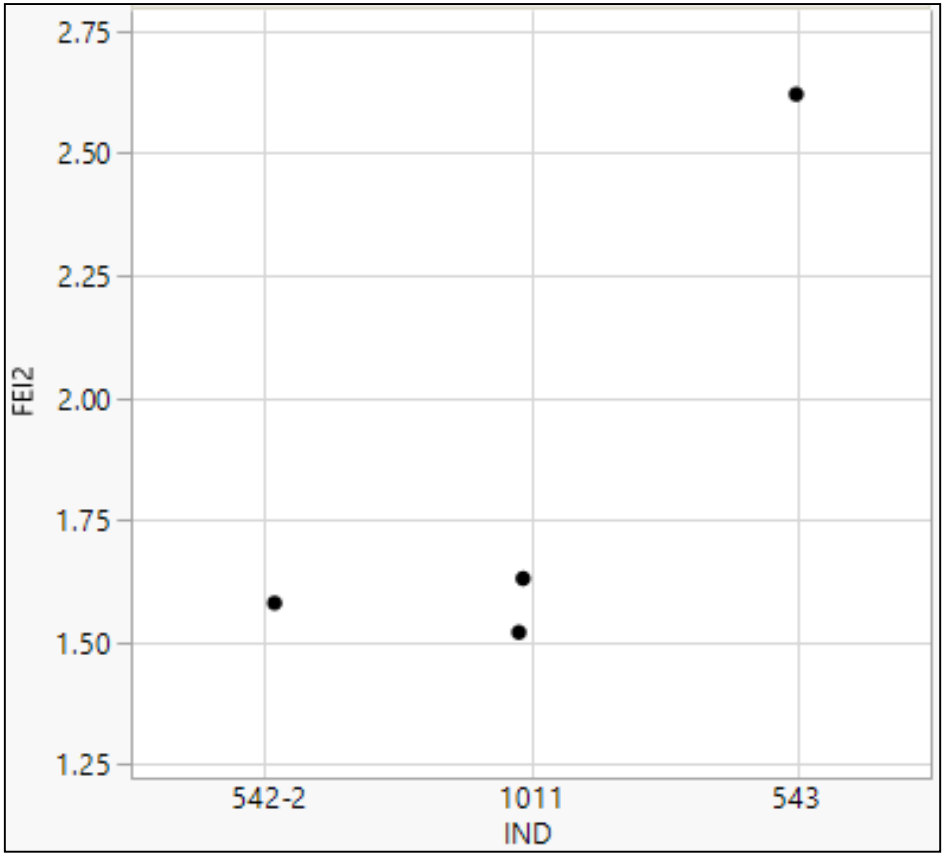
Results: FEI1 & FEI2

SUCCESS TOGETHER

FEI1 Test Result



FEI2 Test Result



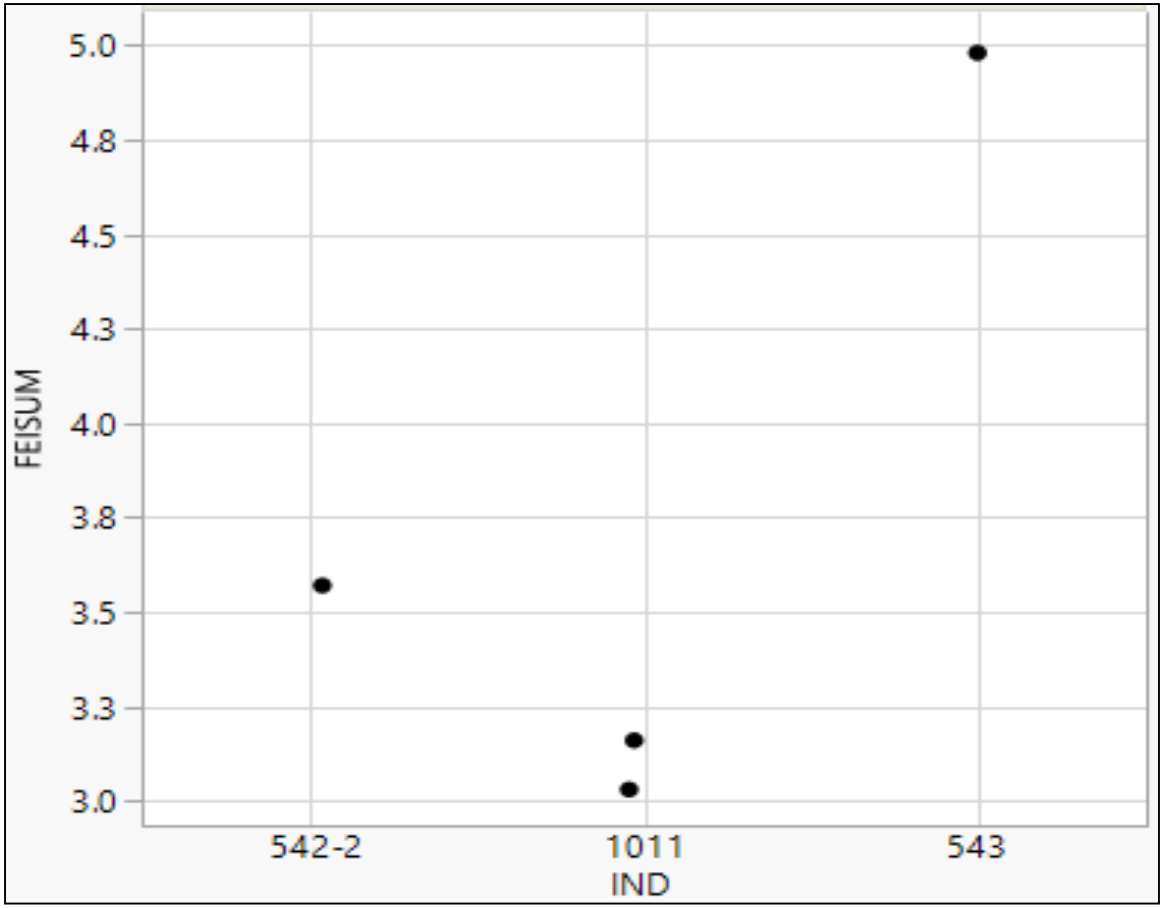
FEI1 and FEI2 results by test oil 1011, 543, & 542-2

Lubrizol

Result: FEISum

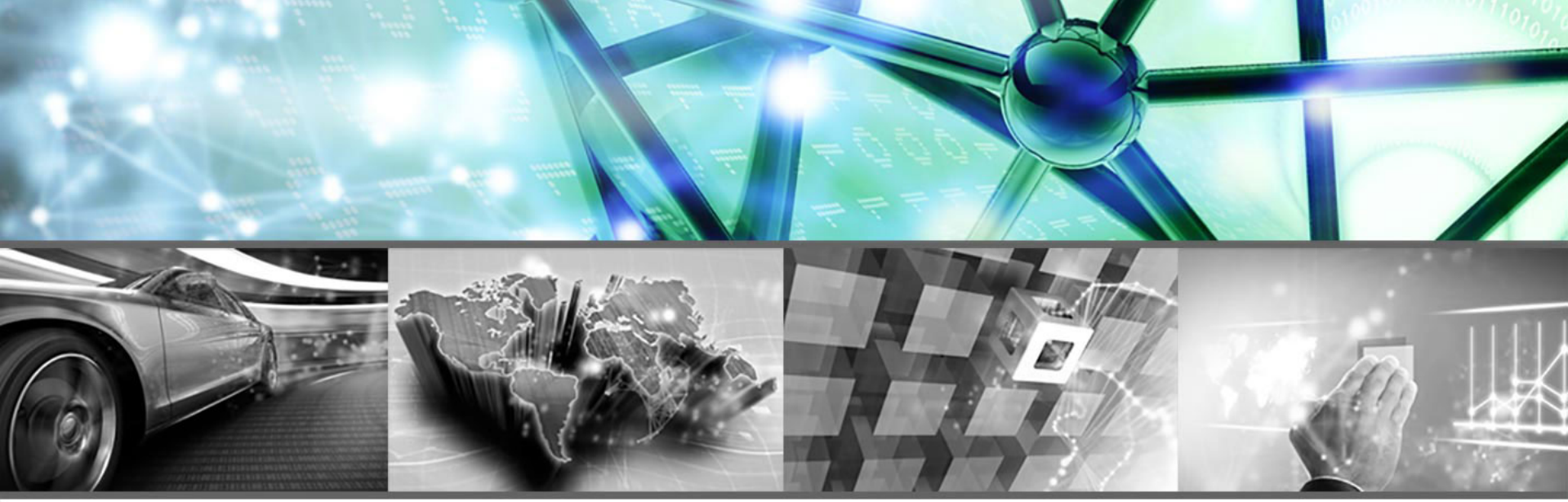
SUCCESS TOGETHER

FEISum Test Result



FEISum results by test oil 1011, 543, & 542-2

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

VIF Precision Matrix Data Review

Statistics Group

November 1, 2016

Statistics Group

- Arthur Andrews, ExxonMobil
- Doyle Boese, Infineum
- Jo Martinez, Chevron Oronite
- Kevin O'Malley, Lubrizol
- Martin Chadwick, Intertek
- Richard Grundza, TMC
- Lisa Dingwell, Afton
- Todd Dvorak, Afton
- Travis Kostan, SwRI

Executive Summary

- VIF engine life is restricted to 4 full length tests with the 4th test starting no later than 900 engine hours. This led to 14 valid precision matrix tests remaining for the matrix analysis.
- Four additional tests were run at Lubrizol to increase the sample size for each matrix oil.
- BL shift, FEI1, and FEI2 results are plotted for review to aid in the determination of tests used in the statistical analysis.
- The results of the four LZ tests are not dissimilar to the other 14 tests previously considered.
- Once the 4 tests are deemed valid, the Statistics Group will commence with the analysis.

Agenda

- Review PM Data for Analysis
- Review BL Shift Within Each Engine
- PM Data Plots
  - FEI1
  - FEI2

Agenda

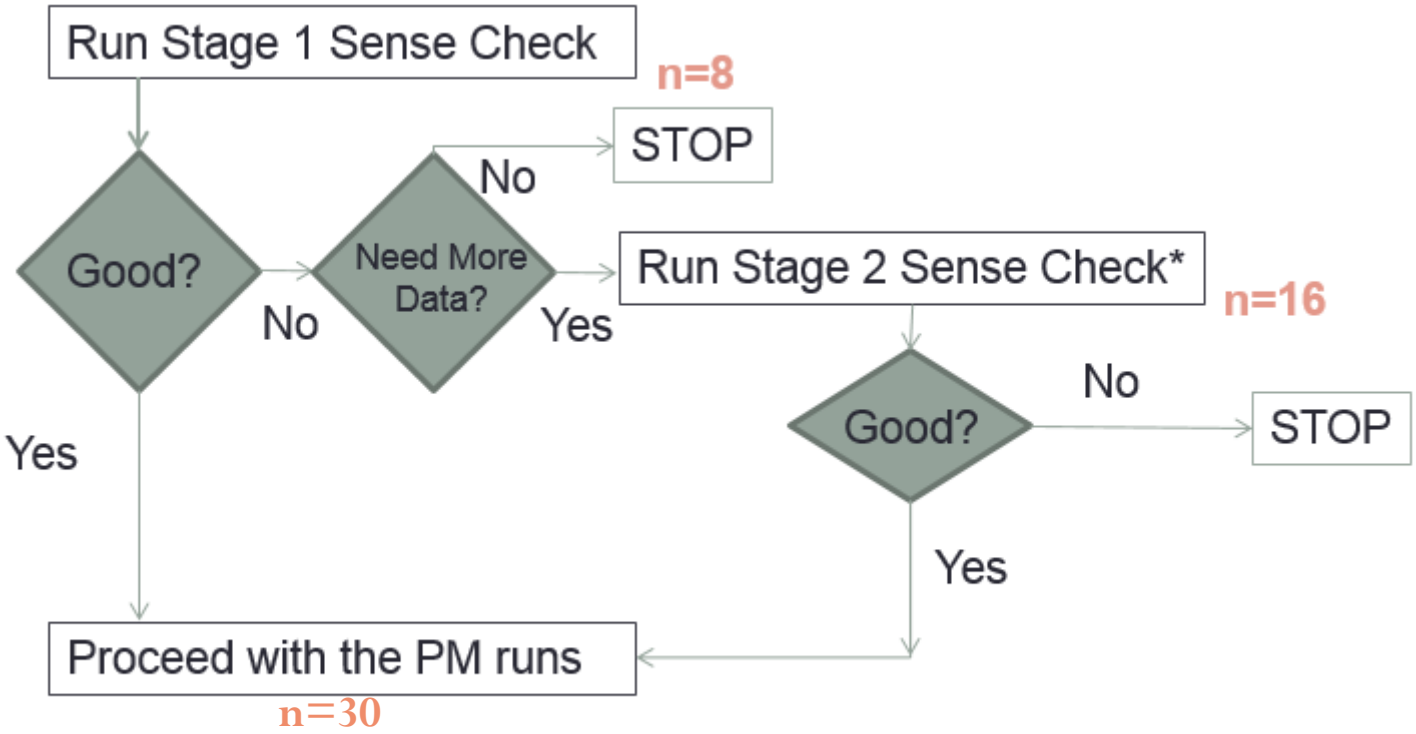
- Review PM Data for Analysis
- Review BL Shift Within Each Engine
- Analyze PM Data Plots
  - FEI1
  - FEI2

Review PM Data for Analysis

- Precision Matrix data summary:
  - 3 Labs {A, G, B}
  - 3 Reference Oils {1011, 542-2, 543}
  - 5 Engines {58 & 96 at Lab G; 122 & 144 at Lab A; 306 at Lab B}
- 36 tests were considered; 18 are viable for inclusion in precision matrix analysis due to following reasons:
  - 4 were deemed invalid
  - 14 don't meet engine life restriction

Review PM Data for Analysis

- Precision matrix tests were conducted in a stage gate process



*Stage 2 Sense Check can be re-designed based on the outcome of Stage 1 Sense Check

- 4 additional tests were conducted at Lubrizol upon initial matrix review

Review PM Data for Analysis

- Precision Matrix (PM):
  - On 7-19-16 the surveillance panel passed a motion to limit the VIF engine life to 4 full length tests with the 4th test starting no later than 900 engine hours

Run Order	EOT Engine Hours	SwRI #1		SwRI #2		IAR #1		IAR #2	
1	350	Stage 1 Sense Check	543 112952-VIF	Stage 2 Sense Check	1011 112953-VIF	Stage 1 Sense Check	542-2 112957-VIF	Stage 2 Sense Check	1011 112955-VIF Baseline Shift
2	550		542-2 112951-VIF		542-2 116037-VIF		543 112958-VIF		543 113824-VIF
3	750		542-2 113818-VIF		1011 112954-VIF		543 113823-VIF		1011 112956-VIF
4	950		543 113819-VIF		543 113820-VIF		542-2 113822-VIF EBP Calibration Shift 542-2 113231-VIF		542-2 116030-VIF
5	1150	1011 117508-VIF		543 113821-VIF Worn Throttle Controller 543 [illegible]-VIF		1011 116832-VIF		542-2 116031-VIF Baseline Shift	
6	1350	543 117626-VIF		1011 117509-VIF		543 113825-VIF		1011 117495-VIF	
7	1550	542-2 116038-VIF		542-2 117511-VIF		1011 117496-VIF		543 117494-VIF	
8	1750	1011 117510-VIF				542-2 117493-VIF			

Excluded From Analysis

LZ	
Additional Testing	1011 118268-VIF
	543 118267-VIF
	542-2 119631-VIF
	1011 119628-VIF

Test Reported | Under Review | Invalid

- Table is from Frank Faber's 6-21-16 matrix update

Review PM Data for Analysis

- Average engine hour age[1]:
  - PM Average EngHrs = 700

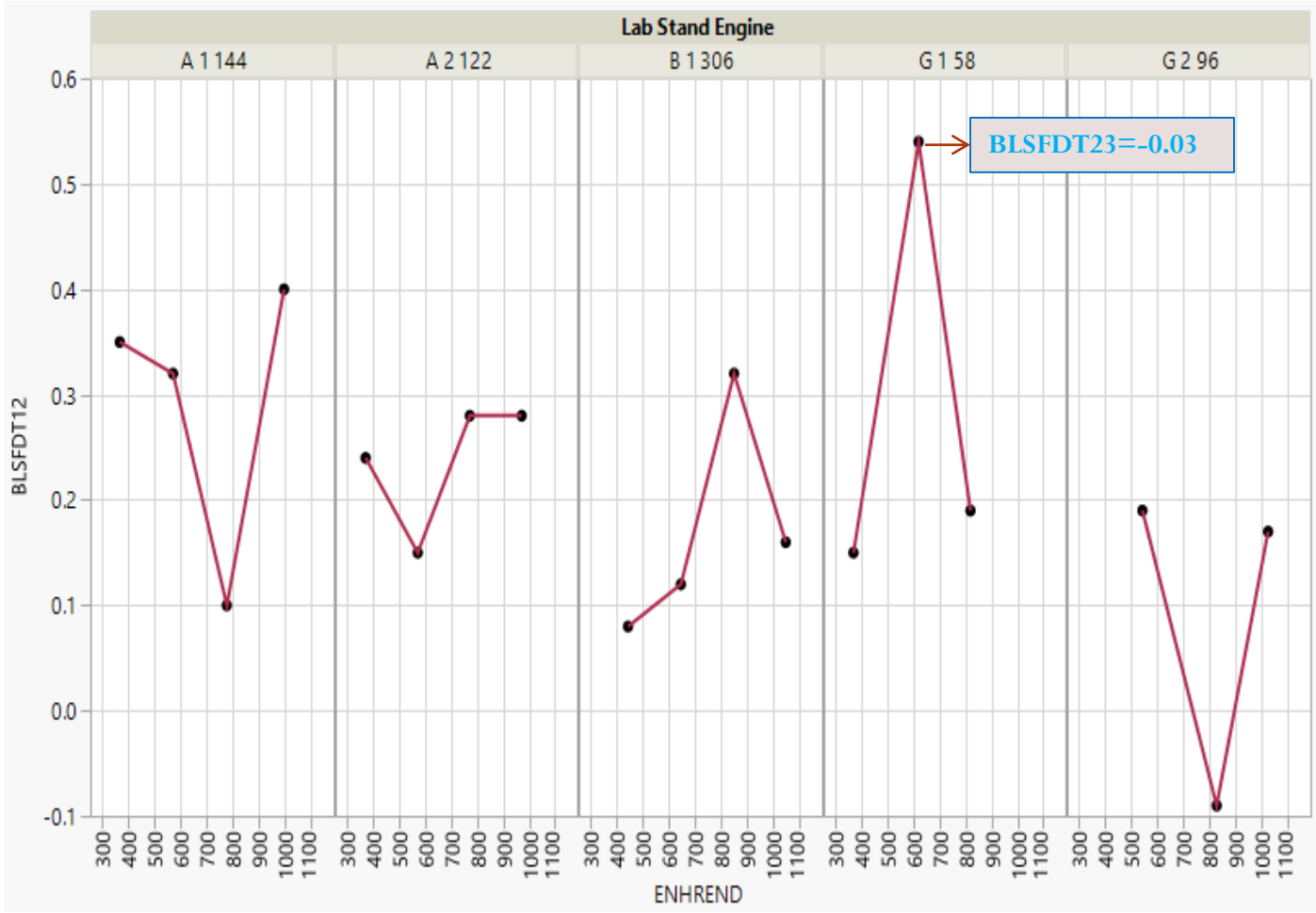
LTMSLAB	ENGNO	Average ENHREND	Max ENHREND
A	122	673	972
A	144	678	995
G	58	604	820
G	96	798	1023
B	306	747	1046

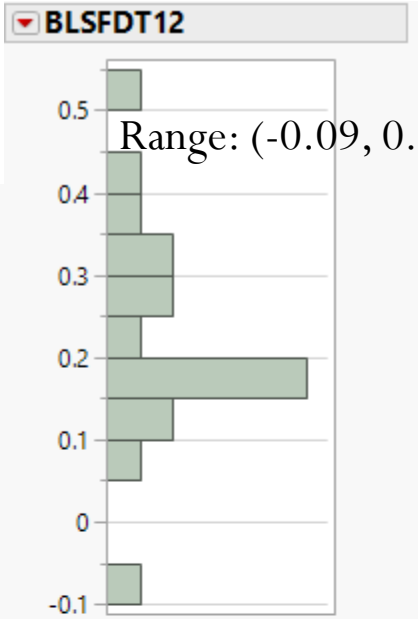
[1]For reference:VID Ln(EngHrs) = 7.37 ($e^{7.37}$ = 1598 hours)
VIE ENHREND = 675 Hours

Agenda

- Review PM Data for Analysis
- Review BL Shift Within Each Engine
- Analyze PM Data Plots
  - FEI1
  - FEI2

BL SHIFT % DELTA, BLB1 VS BLB2





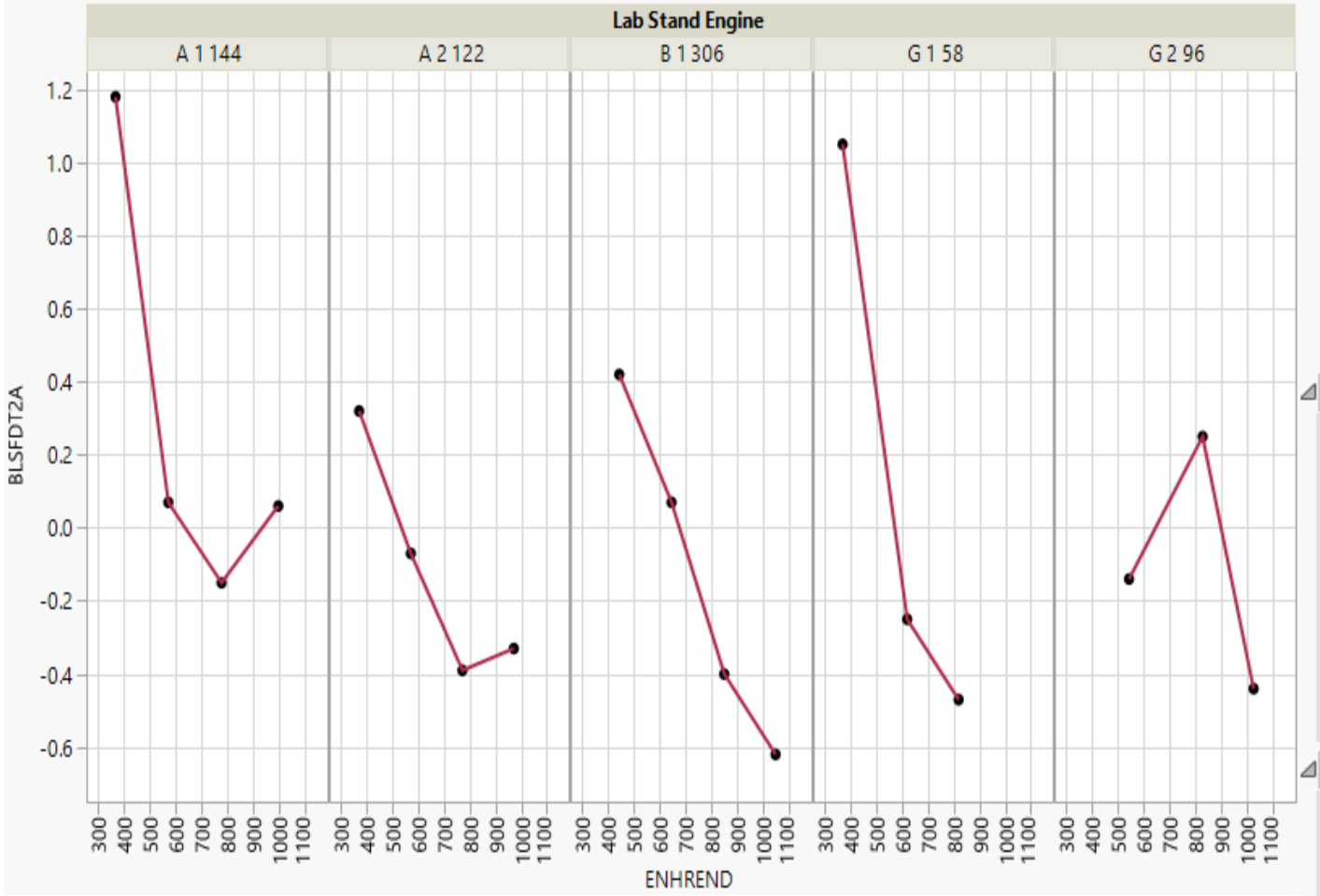
Quantiles

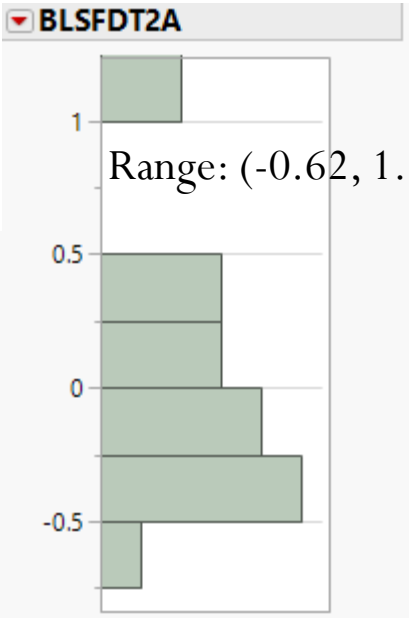
100.0%	maximum	0.54
99.5%		0.54
97.5%		0.54
90.0%		0.414
75.0%	quartile	0.32
50.0%	median	0.19
25.0%	quartile	0.1425
10.0%		0.063
2.5%		-0.09
0.5%		-0.09
0.0%	minimum	-0.09

Summary Statistics

Mean	0.2194444
Std Dev	0.1408158
Std Err Mean	0.0331906
Upper 95% Mean	0.2894705
Lower 95% Mean	0.1494184
N	18

BL SHIFT % DELTA, BLB2 VS BLA





Range: (-0.62, 1.18)

Quantiles

100.0%	maximum	1.18
99.5%		1.18
97.5%		1.18
90.0%		1.063
75.0%	quartile	0.2675
50.0%	median	-0.105
25.0%	quartile	-0.3925
10.0%		-0.485
2.5%		-0.62
0.5%		-0.62
0.0%	minimum	-0.62

Summary Statistics

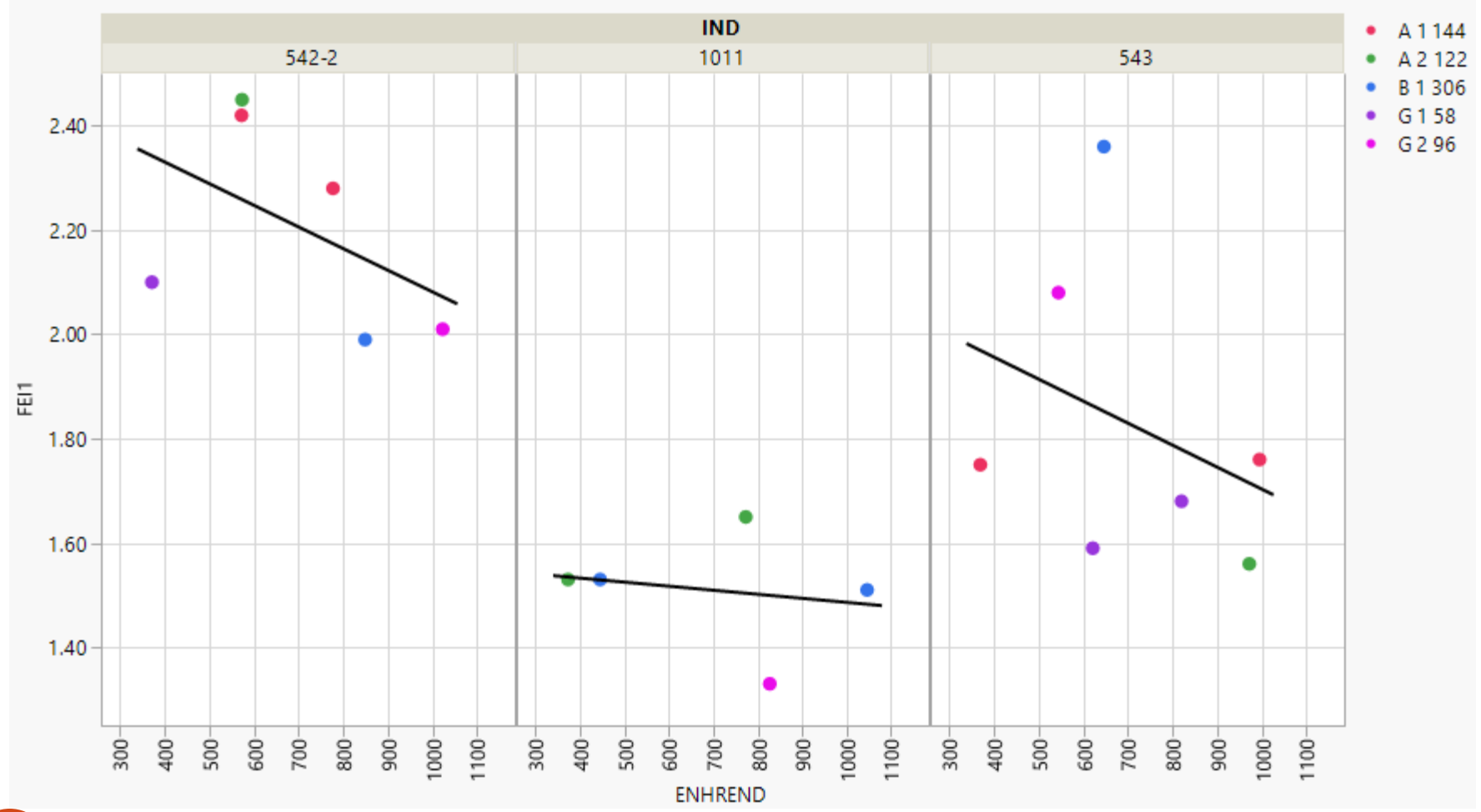
Mean	0.0088889
Std Dev	0.4957216
Std Err Mean	0.1168427
Upper 95% Mean	0.2554054
Lower 95% Mean	-0.237628
N	18

Agenda

- Review PM Data for Analysis
- Review BL Shift Within Each Engine
- Analyze PM Data Plots
  - FEI1
  - FEI2

Analyzing PM Data – FEI1

- Plot of FEI1 (unadjusted results are shown)



Agenda

- Review PM Data for Analysis
- Evaluating Baseline Weighting Scenarios
- Review BL Shift Within Each Engine
- Analyze PM Data Plots
  - FEI1
  - FEI2

Analyzing PM Data - FEI2

- Plot of FEI2 (unadjusted results are shown)

Sequence VIE and VIF Break In

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Sequence VIE Break In

- SwRI has been using the GM Drive by Wire throttle body for break in since 2006.
- We are now converting to Dyne throttle controller for all break in on all VIE and VIF stands.

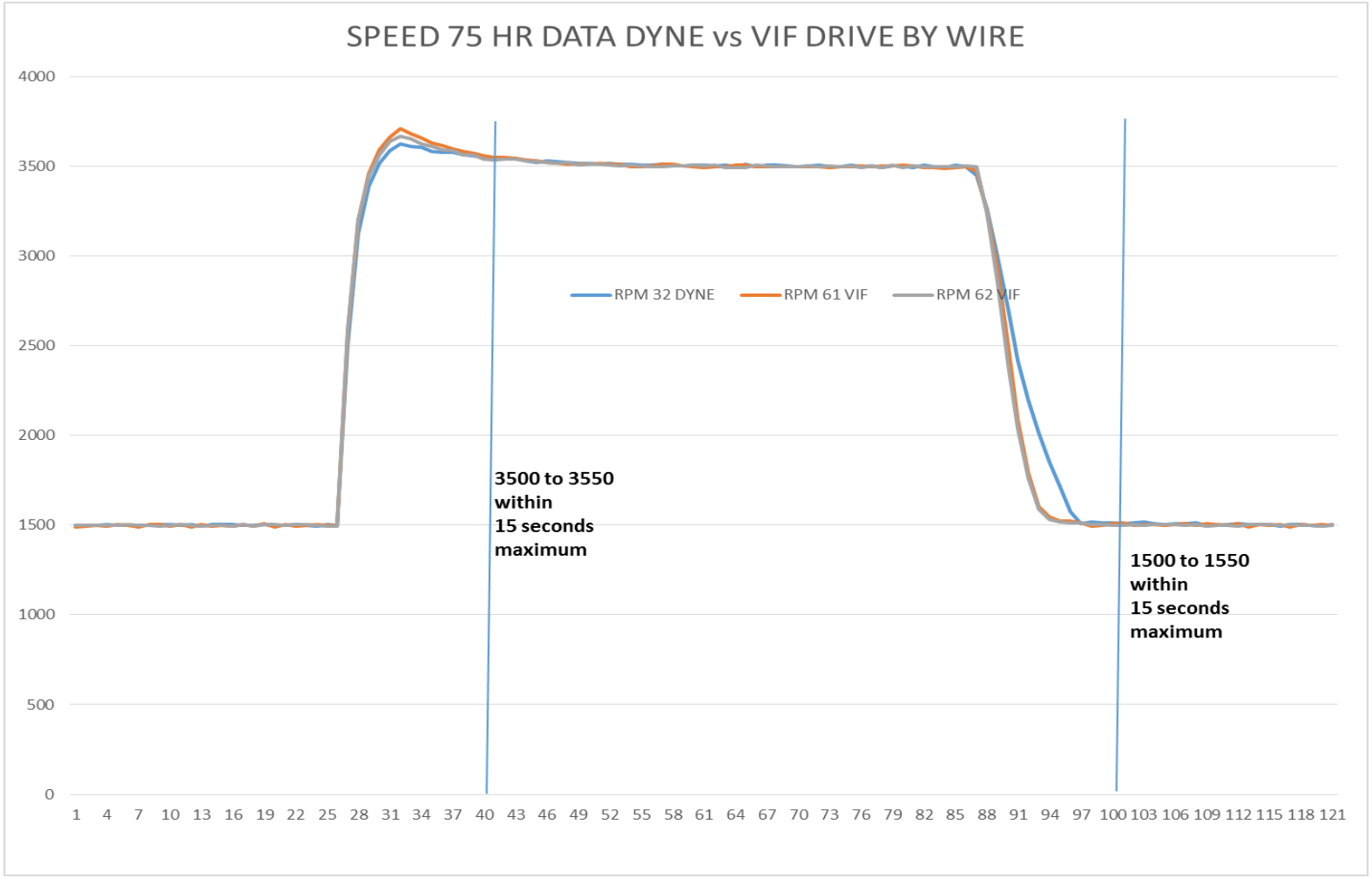
Sequence VIE Break In

- Stand 72 has calibrated twice for the VIE and both engines were broken in with drive by wire.
- Stand 76 will run Dyne break in then a reference this month.

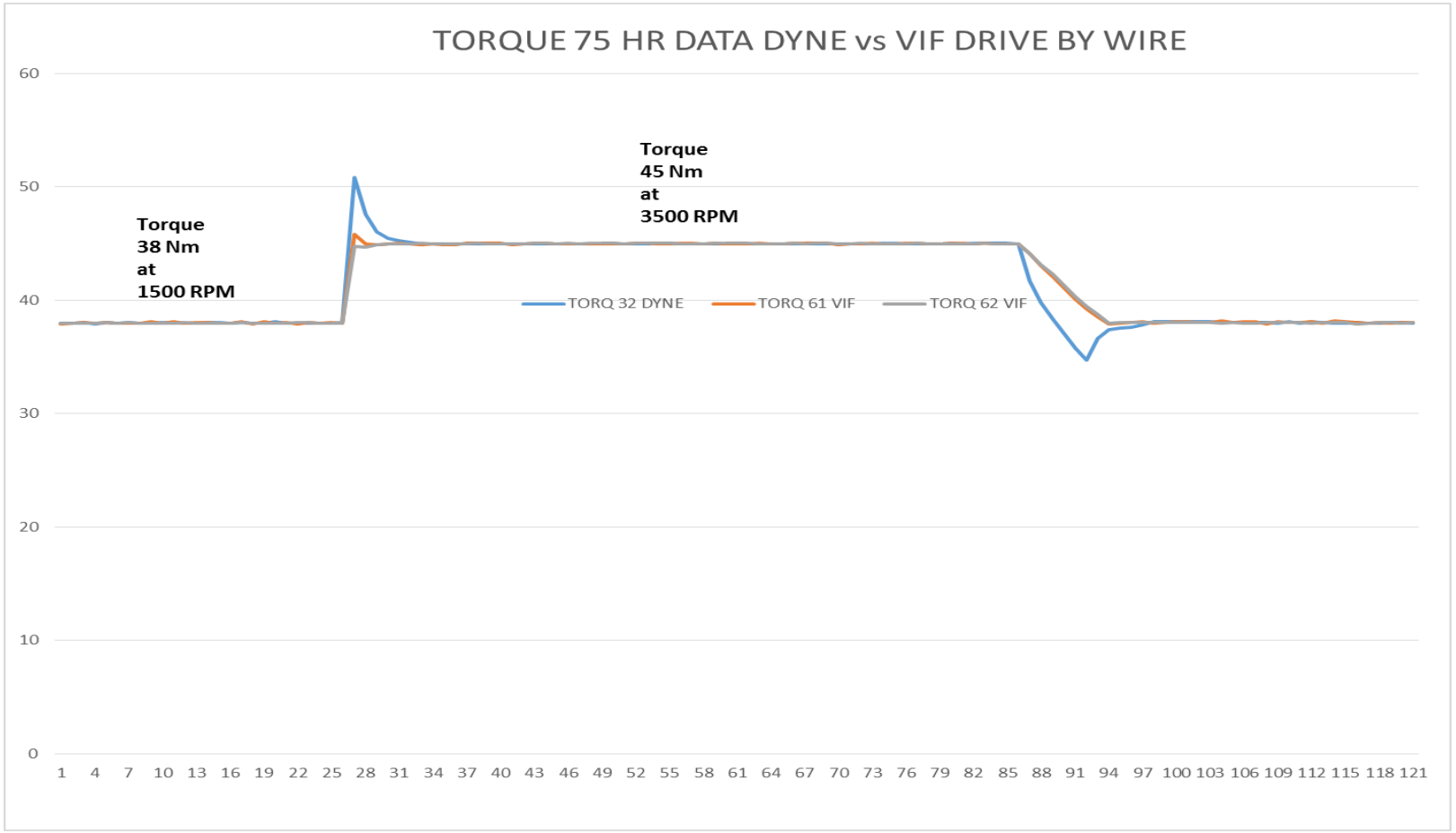
Sequence VIE Reference Rate

- 2 references were run on VIE engines with drive by wire.
- Pass rate is 100%.

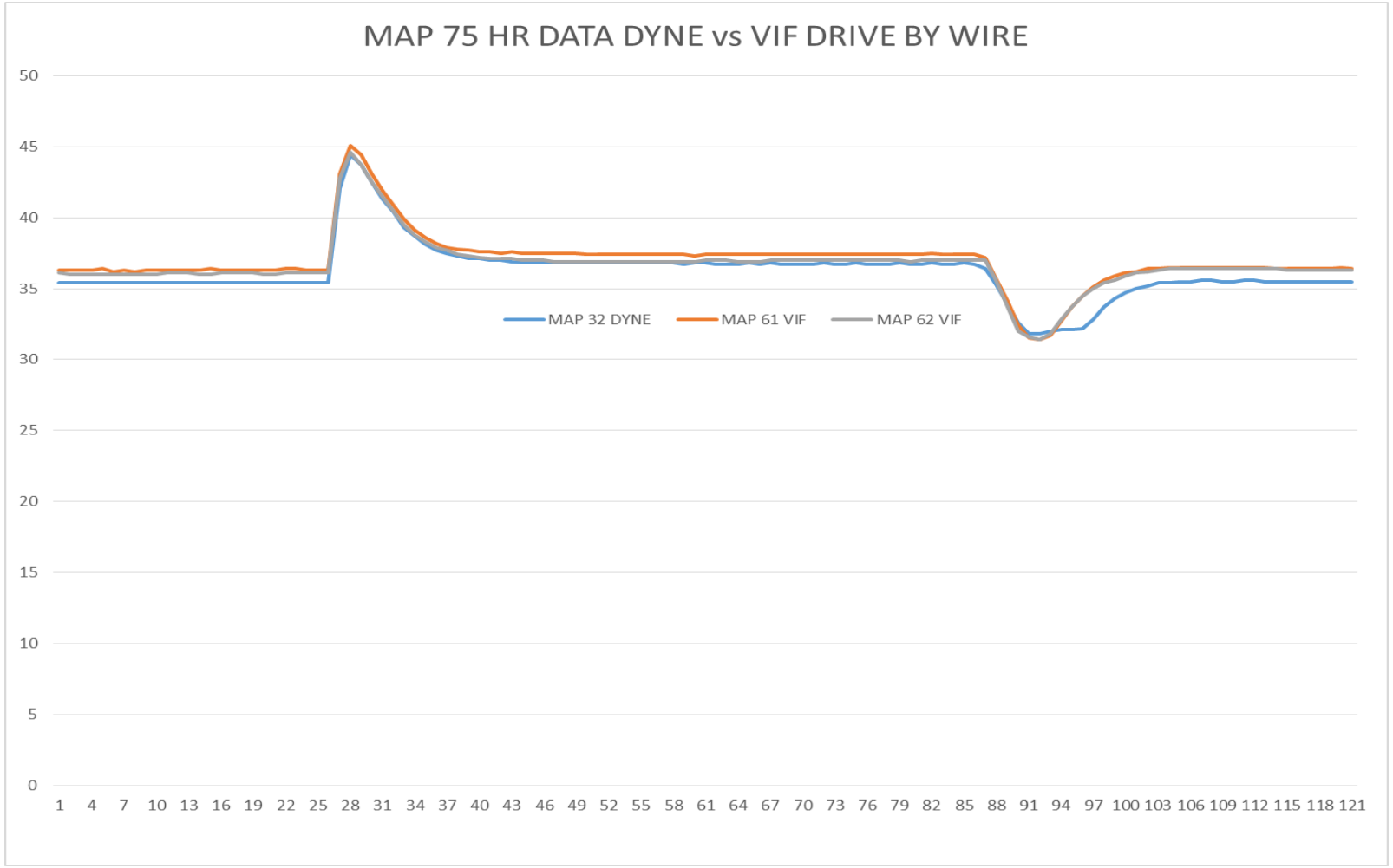
Sequence VIF Matrix Break In



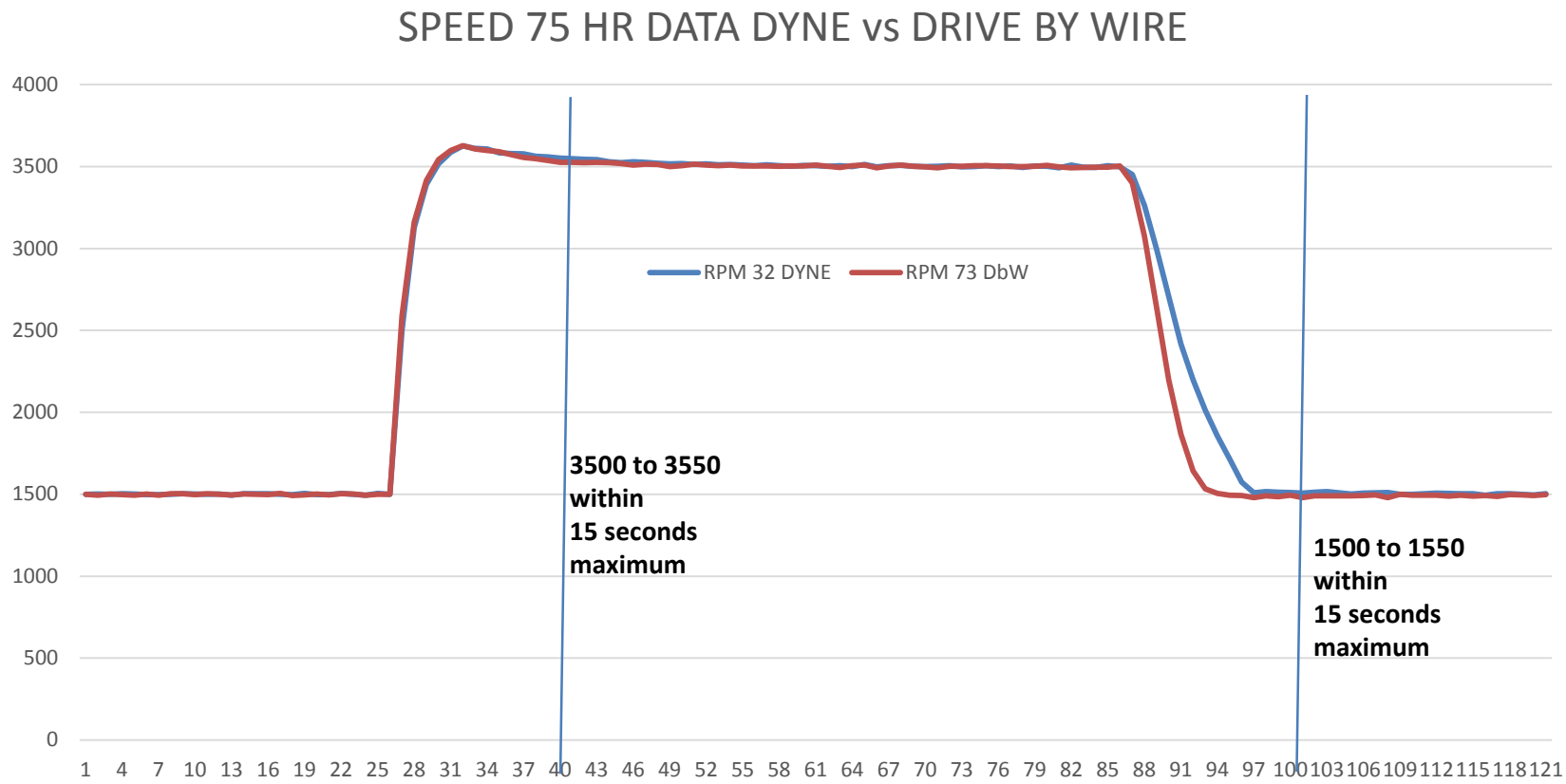
Sequence VIF Matrix Break In



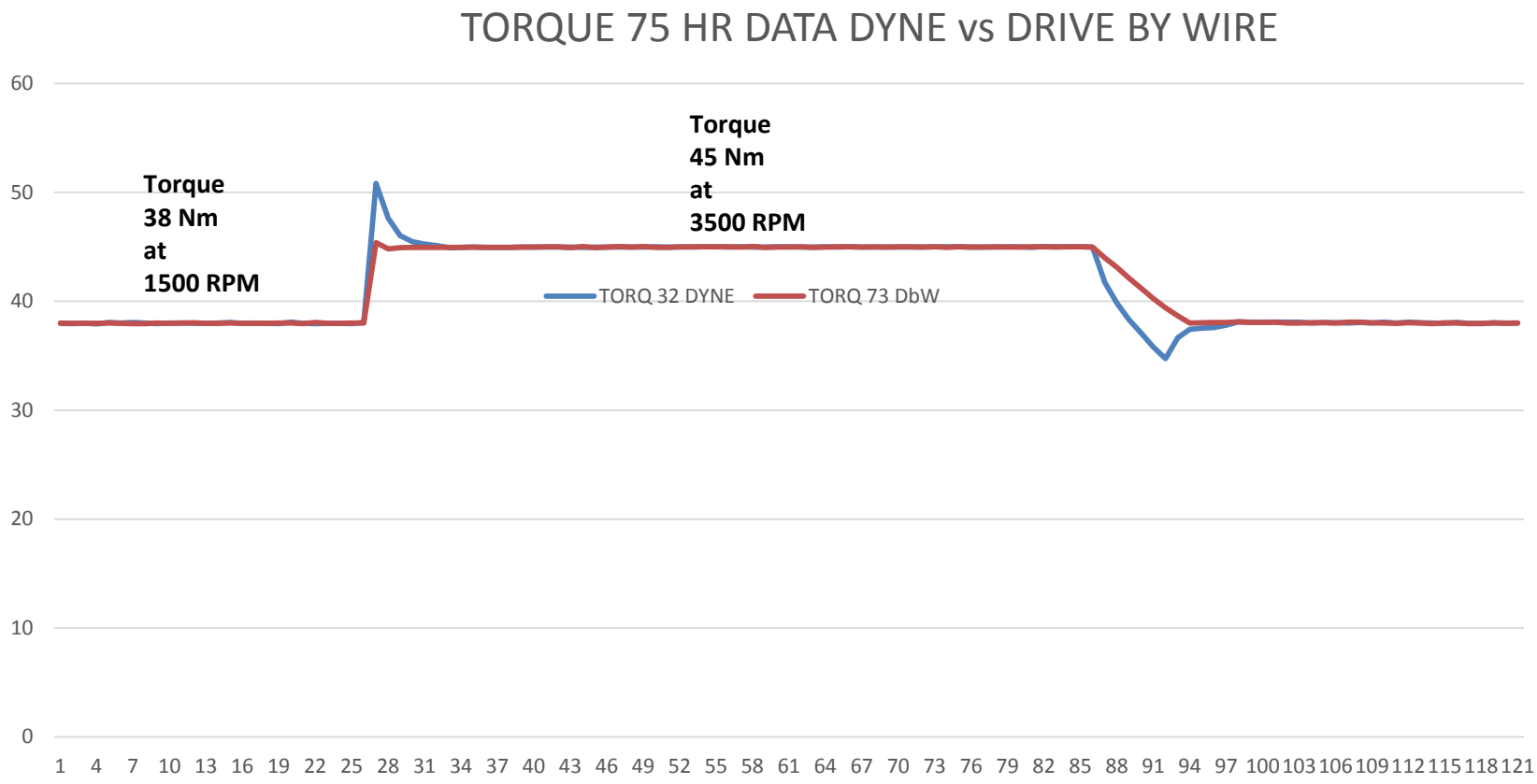
Sequence VIF Matrix Break In



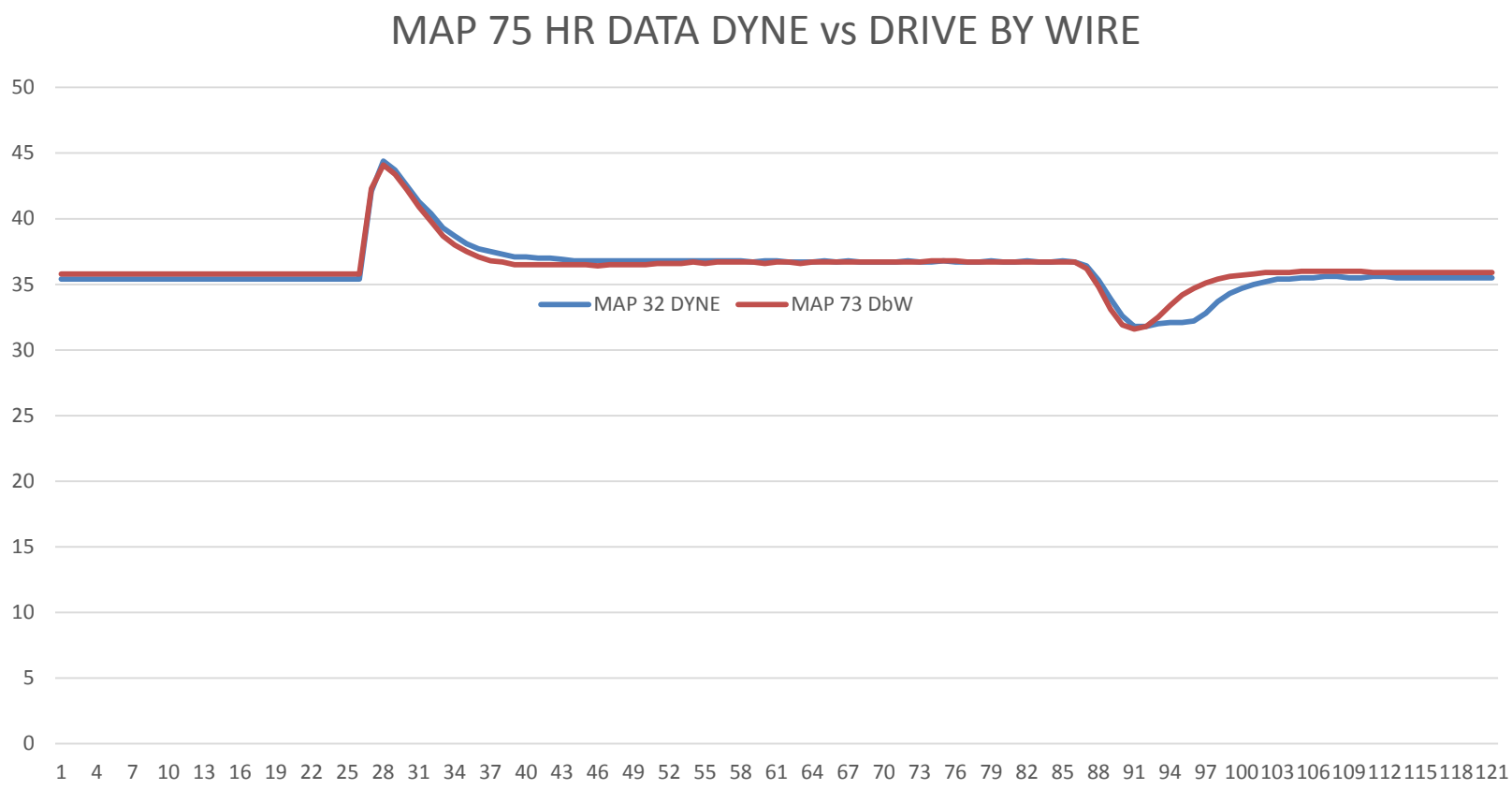
Precision Matrix Engine RPM to Dyne



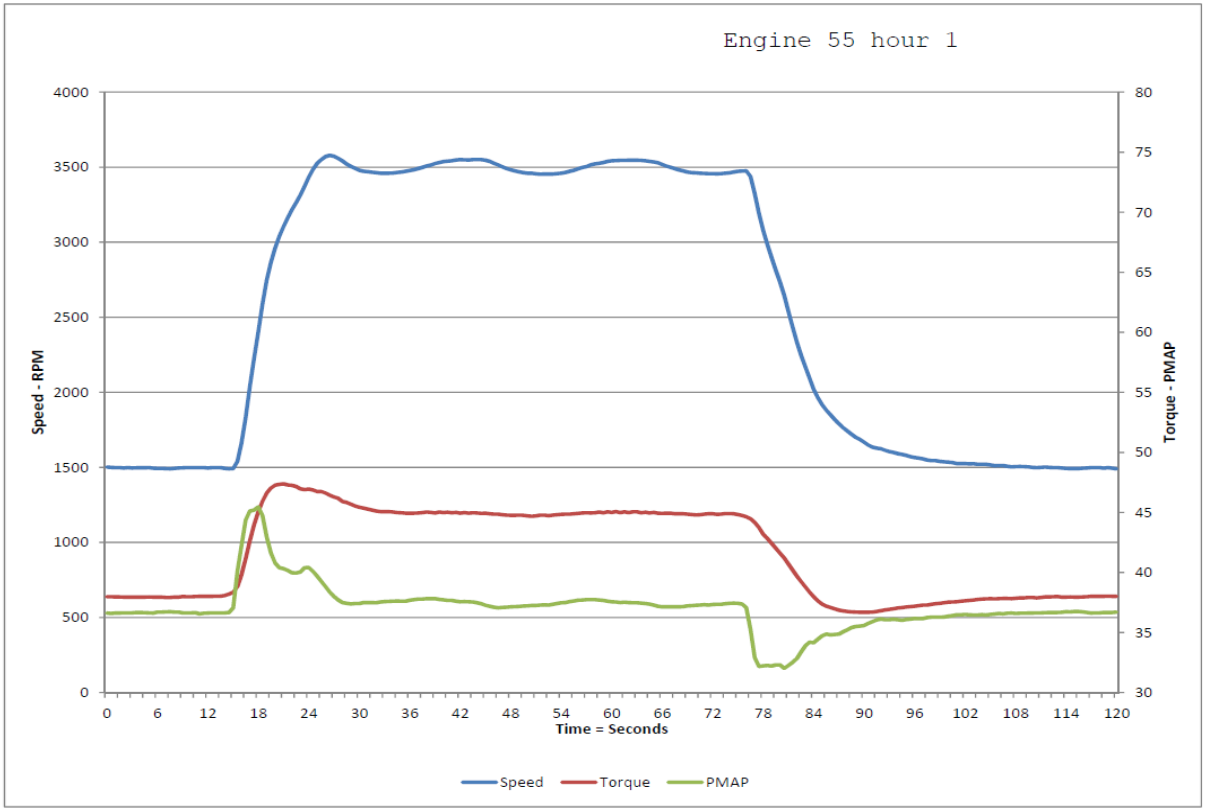
Precision Matrix Engine Torque to Dyne



Precision Matrix Engine Torque to Dyne



Precision Matrix Engine Other Lab Data



Precision Matrix Engine Other Lab Data