Minutes of the Sequence VIF Task Force Teleconference Call

April 27, 2016 08:00 CDT

The Sequence VIF Task Force was called to order by Chairman Dan Worcester at 08:00 CDT. The meeting Agenda is included as Attachment 1. The meeting attendance is included as Attachment 2.

Chairman Worcester opened the meeting with a few general comments; both Southwest Research and Intertek Automotive Research have completed the four tests in "Sense Check, Part 2". Reports have been submitted to ASTM-Test Monitoring Center, the Stats Group has met, reviewed the data and has prepared a presentation for today.

The minutes from the April 06, 2016 meeting were approved as written and are available on the ASTM-TMC web site. A motion for approval was made by Dan Worcester, second by David Glaenzer.

ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/minutes/VIFTaskForceMinutes20160406.pdf

Todd Dvorak presented the report from the Stats Group, included as Attachment 3. Based on the available data, it was generally decided that the Sense Check, Part 2 testing generated data consistent with expectations.

There was concern raised relative to one test that had oil consumption at the test limit of 1800 mL. During discussion of the impact of oil consumption on test results, it was noted that the test in question had a slight oil leak that contributed to the higher level of consumption. The test that followed the high oil consumption test was also elevated at 1700 mL. A wide ranging discussion ensued as to what course of action might be taken if the matrix were continued and engines started to exceed the maximum oil consumption limit. Each of the four matrix engines has three tests to complete and two of them have four tests yet to complete. Concern was raised about the potential of spending time bringing an engine into use with three reference oil qualification tests and then losing the engine due to high oil consumption after only a few candidate tests.

A motion to proceed with the remainder of the matrix was offered by Dan Worcester and seconded by Hiranosan. The motion passed 10-0-1.

The next call will be in approximately two weeks once new data becomes available.

Having no further business, the meeting was adjourned at 08:56 CDT.

Respectfully submitted,

David L. Glaenzer, Afton Chemical Corporation

Sequence VIF Task Force
04.27.2016

ATTACHMENT 1

Toll-free dial-in number (U.S. and Canada):
(866) 588-1857
International dial-in number:
(678) 373-4882
Conference code:
1908975

Scope

The ASTM Sequence VI Surveillance Panel requested a Task Force be formed to determine if the Sequence VIE could be used for 0W 16 oils. The TF will look at development of the VIF test using 100 °C oil temperature and 94 °C coolant temperature for stages 1, 3, 4, and 6.

Objective

Review the Toyota proposal and work on selection of reference oils, stands to support testing, and running the Sense Check and test matrices.

The agenda for this meeting is shown below.

1.0 Chairman's Comments
2.0 Roll Call
3.0 The minutes for 040.06.2016 are posted. They are:
ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/minutes/VIFTaskForceMinutes20160406.pdf

4.0 VIF Test Matrix
- 4.1 Sense Check # 2 was run on different engines from SC #1.
- 4.2 The 4rd SwRI test has been reported to TMC.
- 4.3 The 4th IAR test has been reported to TMC.
- 4.4 The Stats Group is reviewing Sense Check # 2 results will recommend to the Task Force the next step in the VIF matrix.

5.0 The remaining matrix would be 14 tests: 7 at each lab on two engines at each lab, 4 on one engine/stand and 3 on the second engine/stand.

6.0 Next meeting will be Conference Call will be decided.

Attachment 2

Name	Affiliation		03/09/16		04/06/16		04/27/16	
Adrian Alfonso	Intertek	V	P		P		P	A
Amol C Savant	Ashland	V	P					
Andrew Ritchie	Infineum	V	P				P	A
Charlie Leverett	Intertek							
Chris Castanien	Nesteoil	V					P	W
Cliff Salvensen	ExxonMobil							
Cole Hudson	SwRI							
Dan Worcester Jr.	Chairman, SwRI	V	P		P		P	A
David Glaenzer	Secretary, Afton Chemical	V	P		P		P	A
Denny Gaal	ExxonMobil							
Doyle Boese	Infineum		P		P		P	
Eric Liu	SwRI							
Gordon Farnsworth	Infineum		P		P		P	
Guy Stubs	SwRI		P		P		P	
Jason Bowden	OH Technologies	V	P		P			
Jim Linden	Total	V			P			A
Jo Martinez	Chevron		P		P		P	
Kaustav Sinha	Chevron	V						
Kevin OMalley	Lubrizol	V						
Mark Adams	Tribology Testing							
Mark Mosher	ExxonMobil	V						
Martin Chadwick	Intertek							
Matthew Bowden	OH Technologies		P		P			
Michael Conrad	Lubrizol							
Mike McMillan	Infineum		P		P		P	A
Nathaniel Moles	Lubrizol	V	P		P		P	
Patrick Lang	SwRI		P					
Ray Burn	ExxonMobil							
Rich Grundza	ASTM Test Monitoring	V	P				P	A
Robert Stockwell	Oronite		P		P		P	A
Ron Romano	Ford Motor Company	V						
Satoshi Hirano	Toyota				P		P	
Teri Kowalski	Toyota	V			P		P	A
Timothy Cushing	General Motors	V	P		P		P	A
Todd Dvorak	Afton Chemical		P		P		P	
Tracy King	Haltermann							
Valerie Lieu	Chevron							
William Buscher	Intertek						P	
Bob Campbell	Afton							
Mike Ragomo	ExxonMobil							
Travis Kotan	SwRI		P		P		P	
Thomas Hickl	GM Europe							
Jonas Leber	GM Europe							
Jerry Brys	Lubrizol						P	
Christine Eickscade	SwRI		P		P			

Attachment 3
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VIF Stage 2 Data Review

Industry Statistician Team – Data Review

Date: 04-25-16

Statistics Group - Team Members

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

Agenda

- Review VIF Sense Check 2 Data
  - 16 total test results to analyze *([8] Stage 1 + [8] Stage 2)*
- Reach consensus on next step

VIF Design

- Original Design (Approved at Taskforce Sept. 2nd)

Run	EOT Hour	Engine 11	Engine 21	Engine 12	Engine 22
1	350	Oil 400	TMC1011	TMC542-2	TMC1011
2	550	TMC542-2	TMC542-2	Oil 400	Oil 400
3	750	TMC542-2	TMC1011	Oil 400	TMC1011
4	950	Oil 400	Oil 400	TMC542-2	TMC542-2
5	1150	TMC1011	Oil 400	TMC1011	TMC542-2
6	1350	Oil 400	TMC1011	Oil 400	TMC1011
7	1550	TMC542-2	TMC542-2	TMC1011	Oil 400
8	1750	TMC1011		TMC542-2	

Stage 1 Sense Check Runs will be tested in 2 engines/2 labs

Stage 2 Sense Check Runs will be tested in other 2 engines/2 labs

Stage 2 – Sense Check Evaluation Criteria

- REO Sense Check Runs:
  - Comparisons between TMC542-2 , TMC543 (Oil 400), and TMC1011
  - Oil Ranking (VID):
    - TMC543 (Oil 400) > TMC542-2
  - Expected Oil Ranking[1] (VIF):
    - TMC543 (Oil 400) ≥ TMC1011 (Reblended 5W-30T1 to 0W-16) > RO542-2
  - Precision
    - VID Prove Out Estimate of S_p
    - FEI1=0.22
    - FEI2=0.26

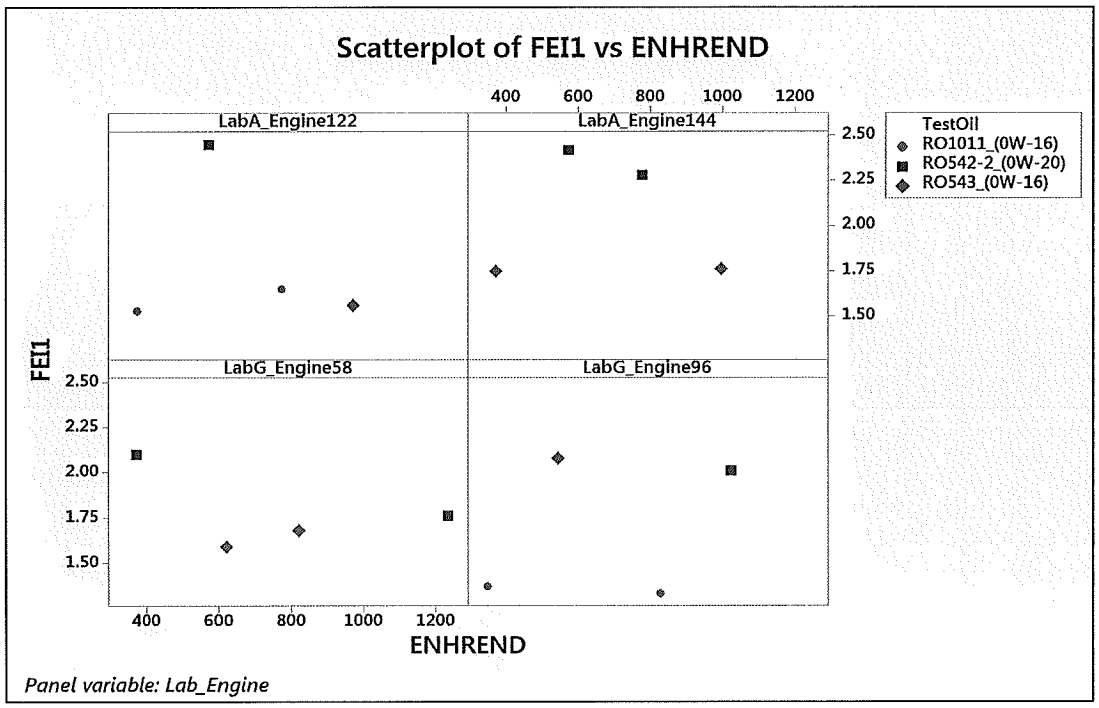
	TMC542-2 (0W-20)	TMC543 (Oil 400) (0W-16)
FEI1	1.49	1.36
FEI2	0.80	1.51
FEISUM	2.29	2.87
Source	LTMS (Aug-2015)	Avg of 4 Runs in Toyota VID Matrix

[1] *Please reference Appendix 2 for more information*

Sense Check Evaluation

	TMC542-2 (0W-20)	TMC543 (Oil 400) (0W-16)
FEI1	1.49	1.96
FEI2	0.80	1.51
FEISUM	2.29	2.87
Source	LTMS (Aug-2015)	Avg of 4 Runs in Toyota VID Matrix

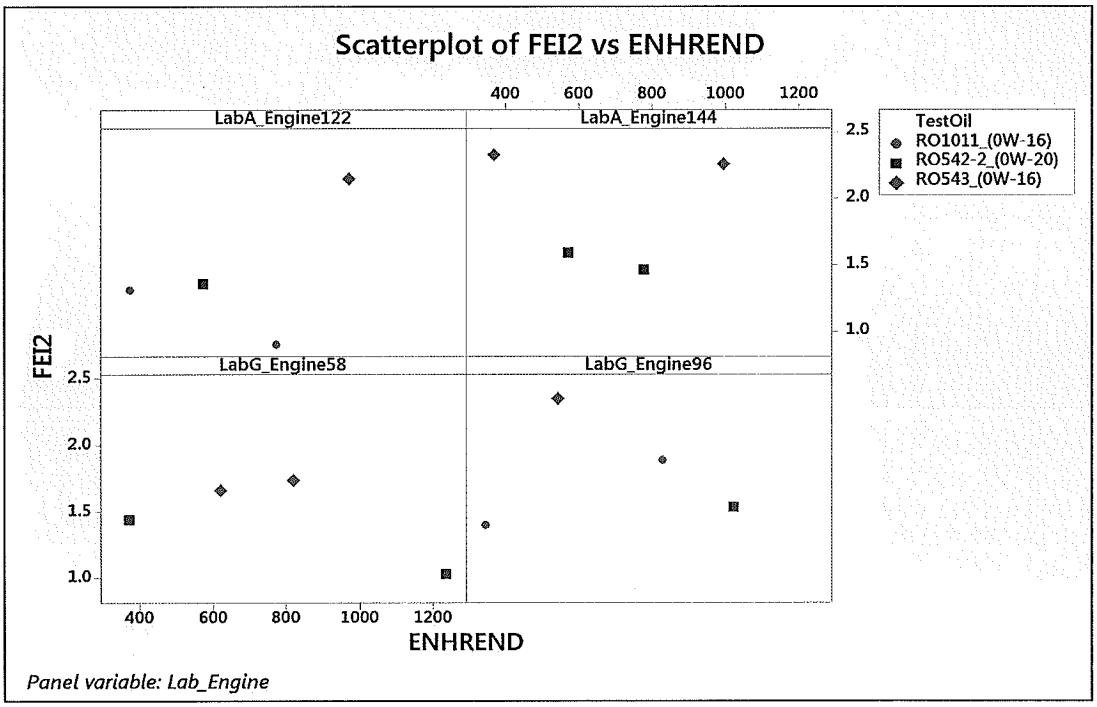
- Plot of Raw FEI1 data by Oil, Lab



Sense Check Evaluation

	TMC542-2 (0W-20)	TMC543 (Oil 400) (0W-16)
FEI1	1.49	1.36
FEI2	0.80	1.51
FEISUM	2.29	2.87
Source	LTMS (Aug-2015)	Avg of 4 Runs In Toyota VID Matrix

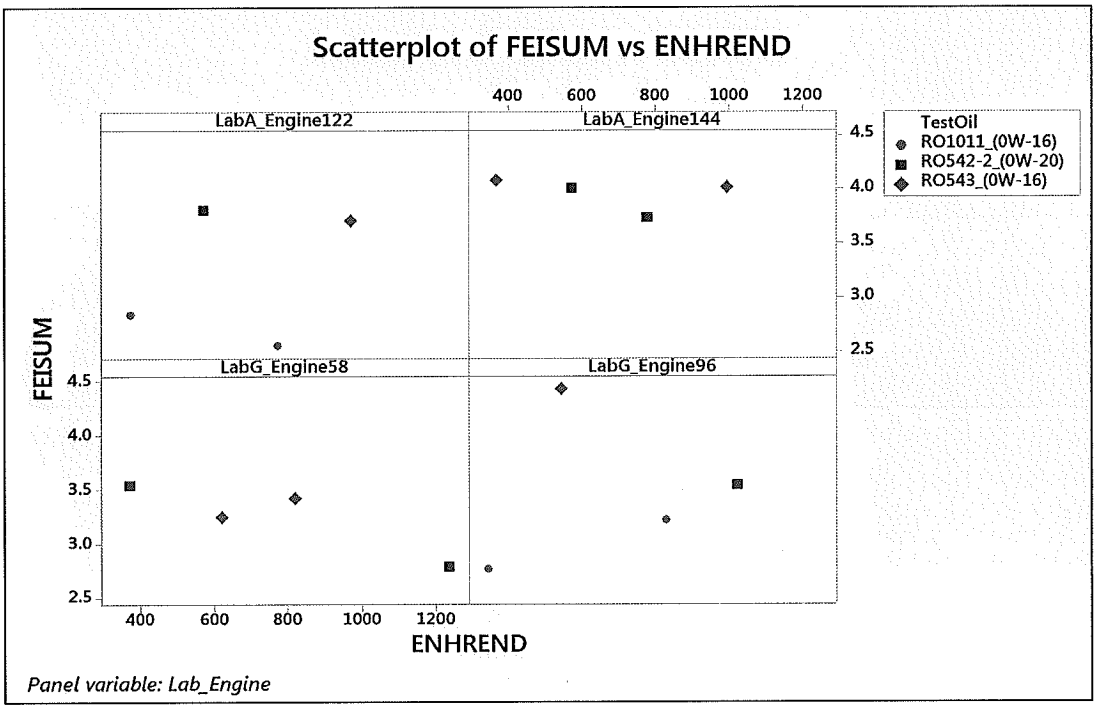
- Plot of Raw FEI2 data by Oil, Lab



Sense Check Evaluation

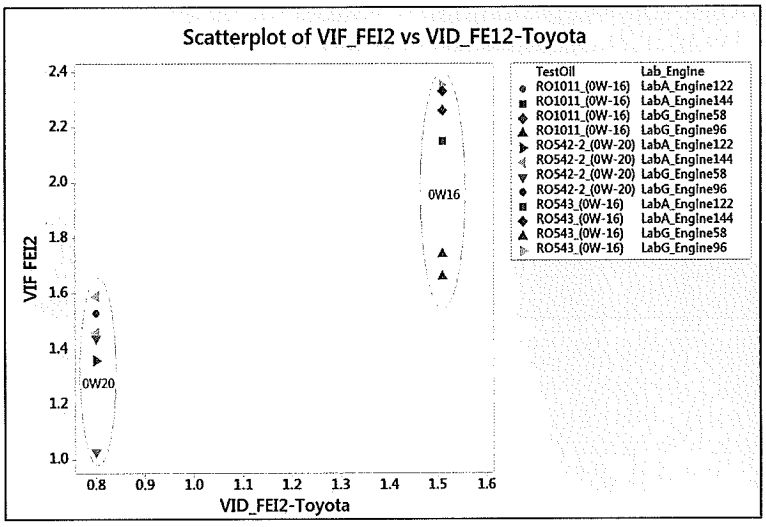
	TMC542-2 (0W-20)	TMC543 (Oil 400) (0W-16)
FEI1	1.49	1.36
FEI2	0.80	1.51
FEISUM	2.29	2.87
Source	LTMS (Aug-2015)	Avg of 4 Runs in Toyota VID Matrix

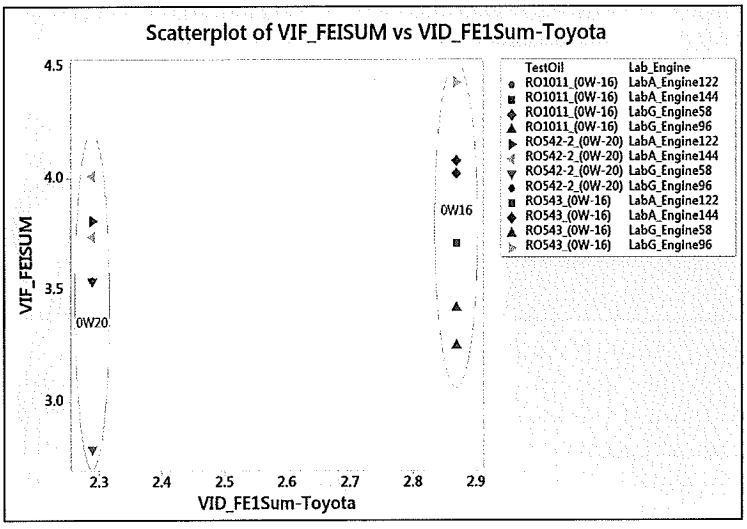
- Plot of Raw FEISUM data by Oil, Lab



Sense Check Evaluation

- Plot of Raw FEI2 & FEISum VIF & VID (target) Data:

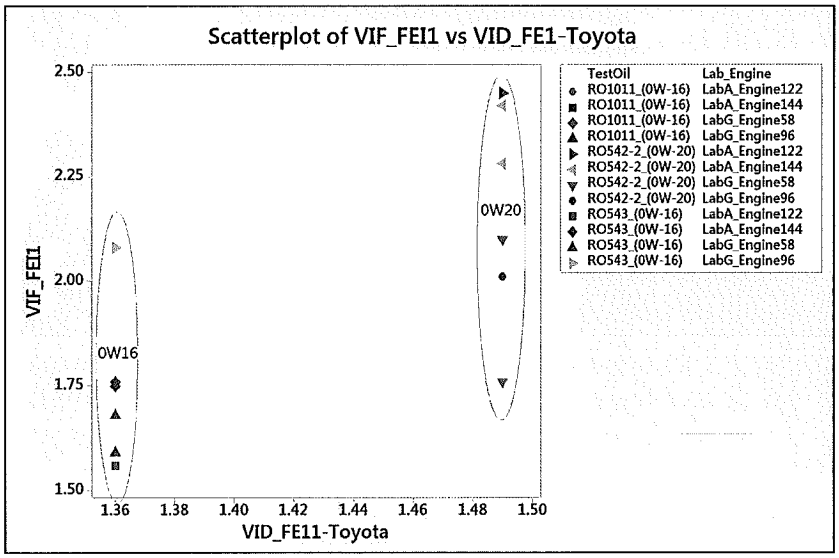




	TMC542-2 (0W-20)	TMC543 (Oil 400) (0W-16)
FEI1	1.49	1.36
FEI2	0.80	1.51
FEISUM	2.29	2.87
Source	LTMS (Aug-2015)	Avg of 4 Runs in Toyota VID Matrix

Sense Check Evaluation

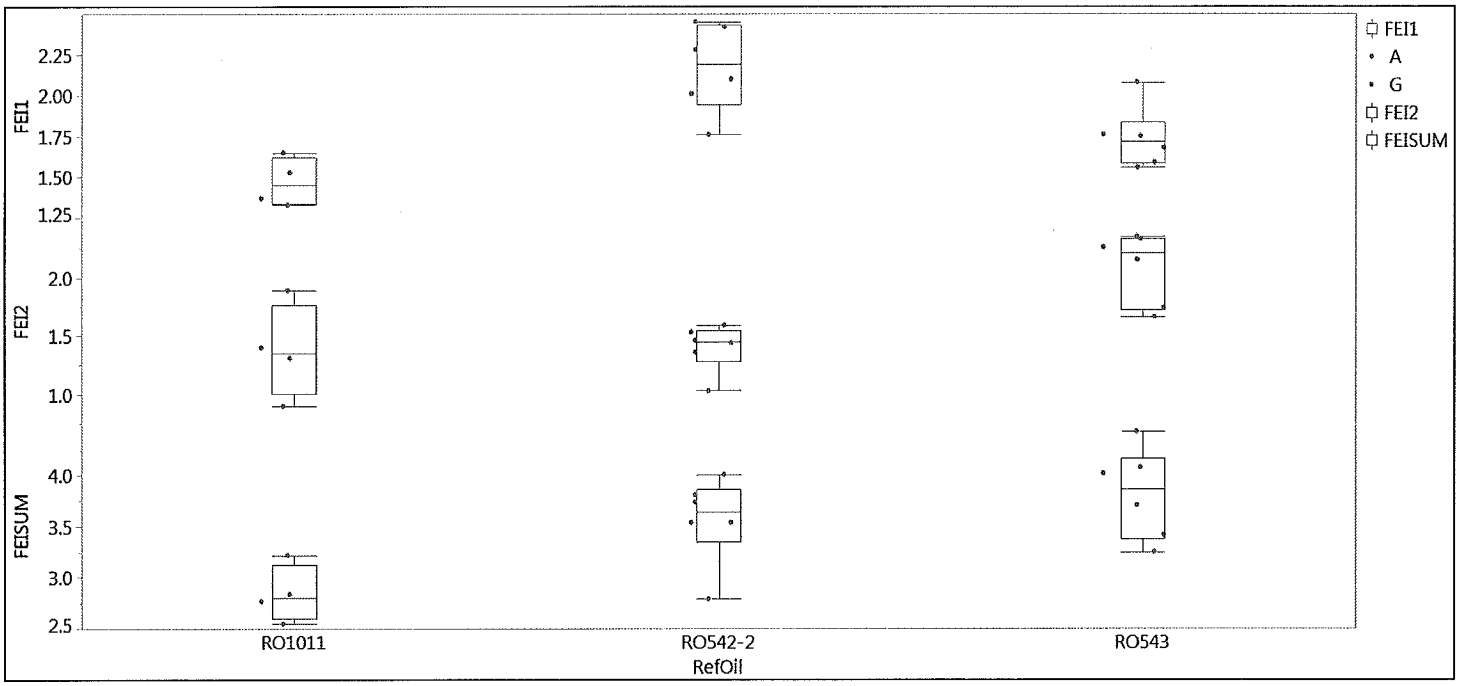
- Plot of Raw FEI1 - VIF & VID (target) Data:



	TMC542-2 (0W-20)	TMC543 (Oil 400) (0W-16)
FEI1	1.49	1.36
FEI2	0.80	1.51
FEISUM	2.29	2.87
Source	LTMS (Aug-2015)	Avg of 4 Runs in Toyota VID Matrix

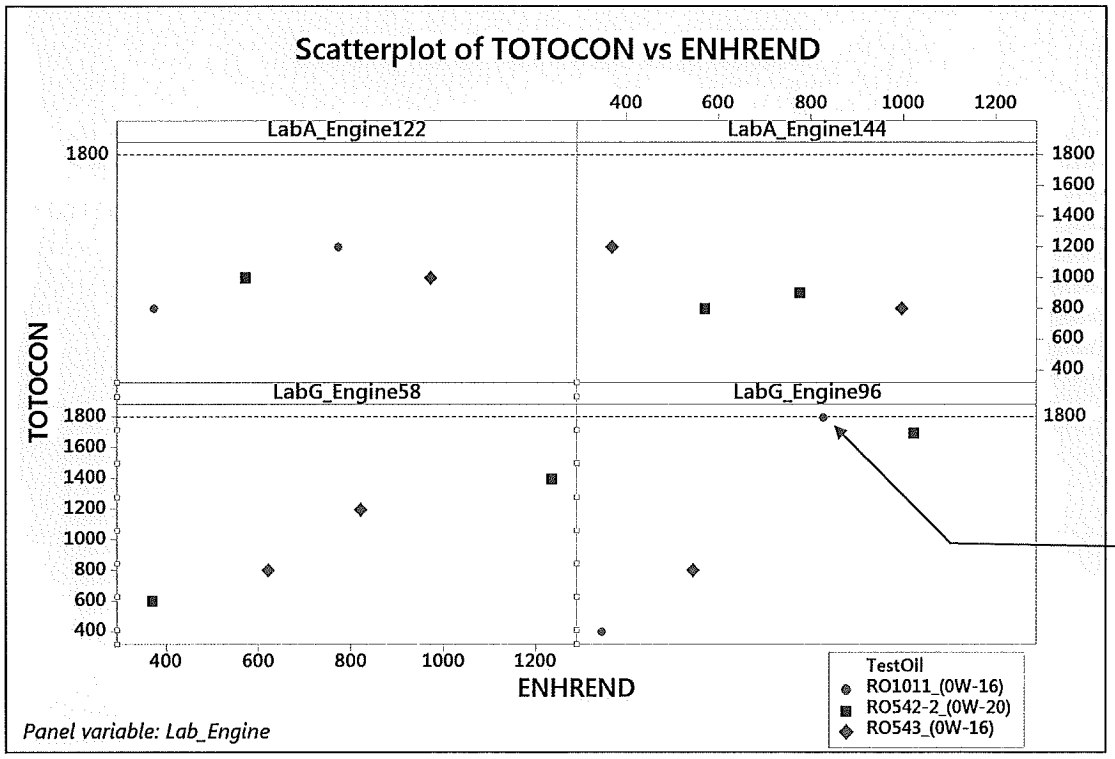
Plot of Raw FEI by Oil, Lab

	TMC542-2 (0W-20)	TMC543 (Oil 400) (0W-16)
FEI1	1.49	1.36
FEI2	0.80	1.51
FEISUM	2.29	2.87
Source	LTMS (Aug-2015)	Avg of 4 Runs in Toyota VID Matrix



Sense Check Evaluation

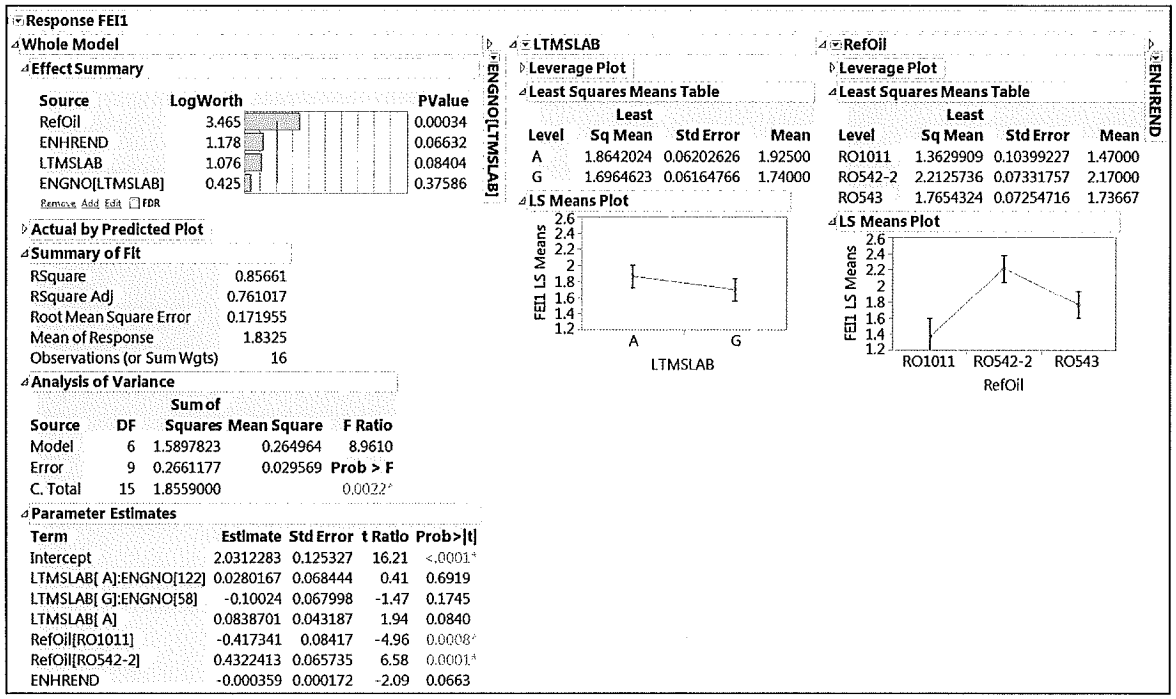
- Plot of OilCon by Lab, Engine



TestKey
112956-VIF

Sense Check Evaluation

- ANOVA Summary– FEI1
  - RO542-2 (0W-20) > Oil 1011 (0W-16), Oil 543 (0W-16)



Response FEI1

Whole Model

Effect Summary

Source	LogWorth	PValue
RefOil	3.465	0.00034
ENHREND	1.178	0.06632
LTMSLAB	1.076	0.08404
ENGNO[LTMSLAB]	0.425	0.37586

Remove Add Edit FDR

Actual by Predicted Plot

Summary of Fit

RSquare	0.85661
RSquare Adj	0.761017
Root Mean Square Error	0.171955
Mean of Response	1.8325
Observations (or Sum Wgts)	16

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	6	1.5897823	0.264964	8.9610
Error	9	0.2661177	0.029569	Prob > F
C. Total	15	1.8559000		0.0022*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	2.0312283	0.125327	16.21	<.0001*
LTMSLAB[A]:ENGNO[122]	0.0280167	0.068444	0.41	0.6919
LTMSLAB[G]:ENGNO[58]	-0.10024	0.067998	-1.47	0.1745
LTMSLAB[A]	0.0838701	0.043187	1.94	0.0840
RefOil[RO1011]	-0.417341	0.08417	-4.96	0.0008*
RefOil[RO542-2]	0.4322413	0.065735	6.58	0.0001*
ENHREND	-0.000359	0.000172	-2.09	0.0663

ENGNO[LTMSLAB]

LTMSLAB

Leverage Plot

Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
A	1.8642024	0.06202626	1.92500
G	1.6964623	0.06164766	1.74000

LS Means Plot

RefOil

Leverage Plot

Least Squares Means Table

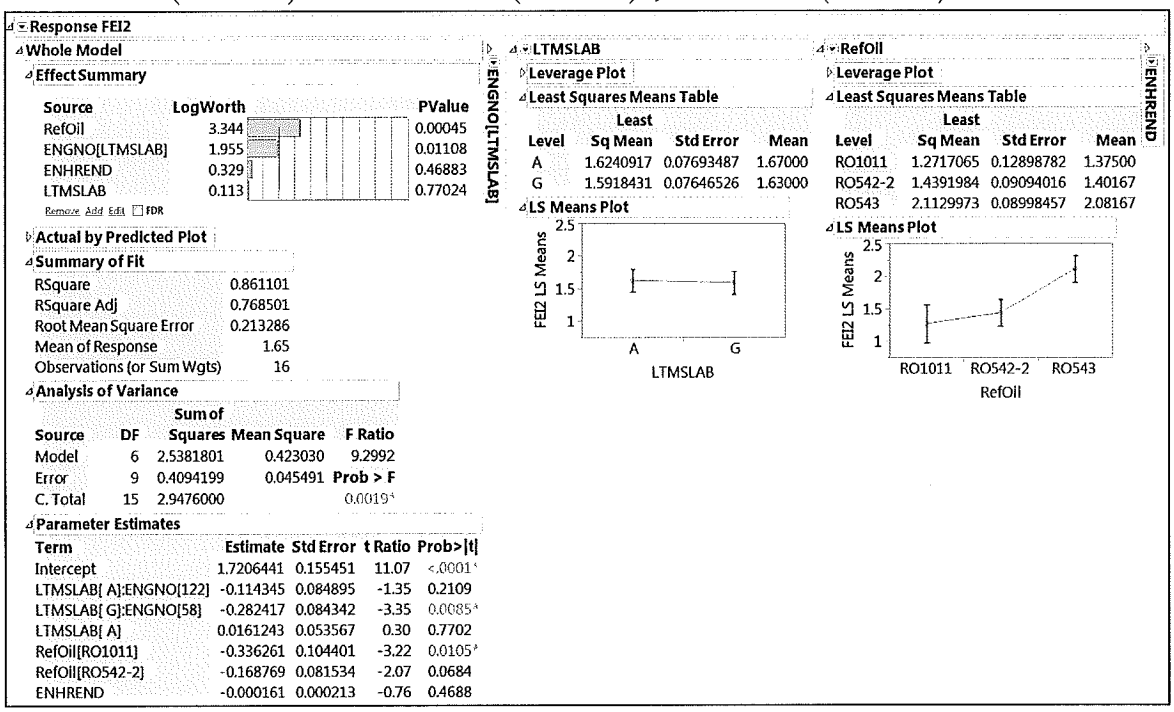
Level	Least Sq Mean	Std Error	Mean
RO1011	1.3629909	0.10399227	1.47000
RO542-2	2.2125736	0.07331757	2.17000
RO543	1.7654324	0.07254716	1.73667

LS Means Plot

ENHREND

Sense Check Evaluation

- ANOVA Summary– FEI2
  - Oil 543 (0W-16) > RO542-2 (0W-20) , RO1011 (0W-16)



Response FEI2

Whole Model

Effect Summary

Source	LogWorth	PValue
RefOil	3.344	0.00045
ENGNO[LTMSLAB]	1.955	0.01108
ENHREND	0.329	0.46883
LTMSLAB	0.113	0.77024

Remove Add Edit FDR

Actual by Predicted Plot

Summary of Fit

RSquare	0.861101
RSquare Adj	0.768501
Root Mean Square Error	0.213286
Mean of Response	1.65
Observations (or Sum Wgts)	16

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	6	2.5381801	0.423030	9.2992
Error	9	0.4094199	0.045491	Prob > F
C. Total	15	2.9476000		0.0019*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.7206441	0.155451	11.07	<.0001*
LTMSLAB[A]:ENGNO[122]	-0.114345	0.084895	-1.35	0.2109
LTMSLAB[G]:ENGNO[58]	-0.282417	0.084342	-3.35	0.0085*
LTMSLAB[A]	0.0161243	0.053567	0.30	0.7702
RefOil[RO1011]	-0.336261	0.104401	-3.22	0.0105*
RefOil[RO542-2]	-0.168769	0.081534	-2.07	0.0684
ENHREND	-0.000161	0.000213	-0.76	0.4688

ENGNO[LTMSLAB]

LTMSLAB

Leverage Plot

Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
A	1.6240917	0.07693487	1.67000
G	1.5918431	0.07646526	1.63000

LS Means Plot

RefOil

Leverage Plot

Least Squares Means Table

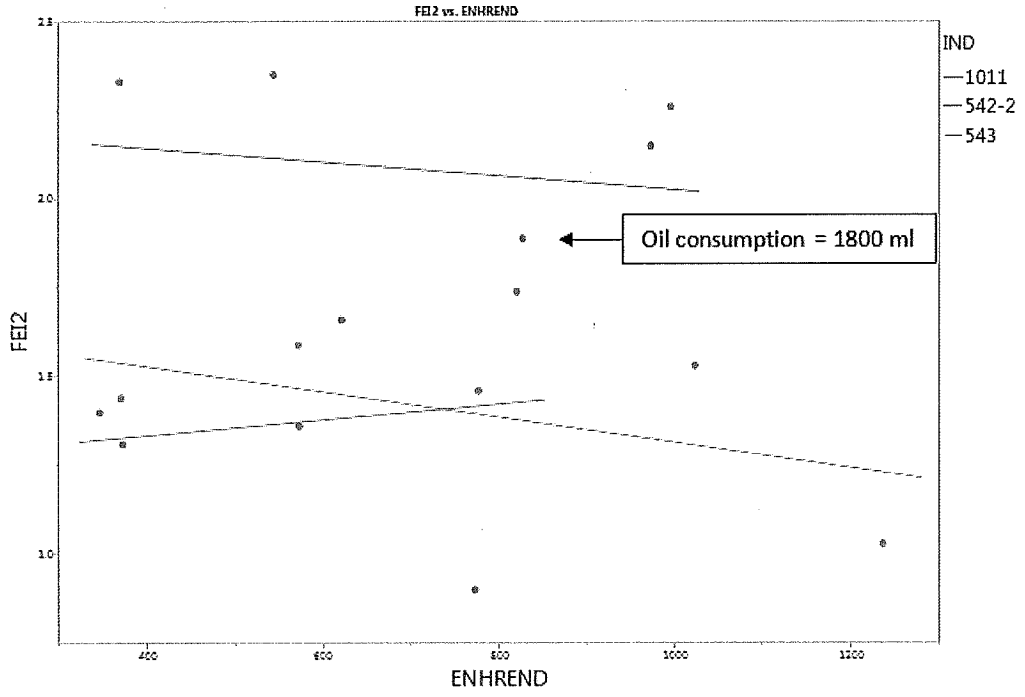
Level	Least Sq Mean	Std Error	Mean
RO1011	1.2717065	0.12898782	1.37500
RO542-2	1.4391984	0.09094016	1.40167
RO543	2.1129973	0.08998457	2.08167

LS Means Plot

ENHREND

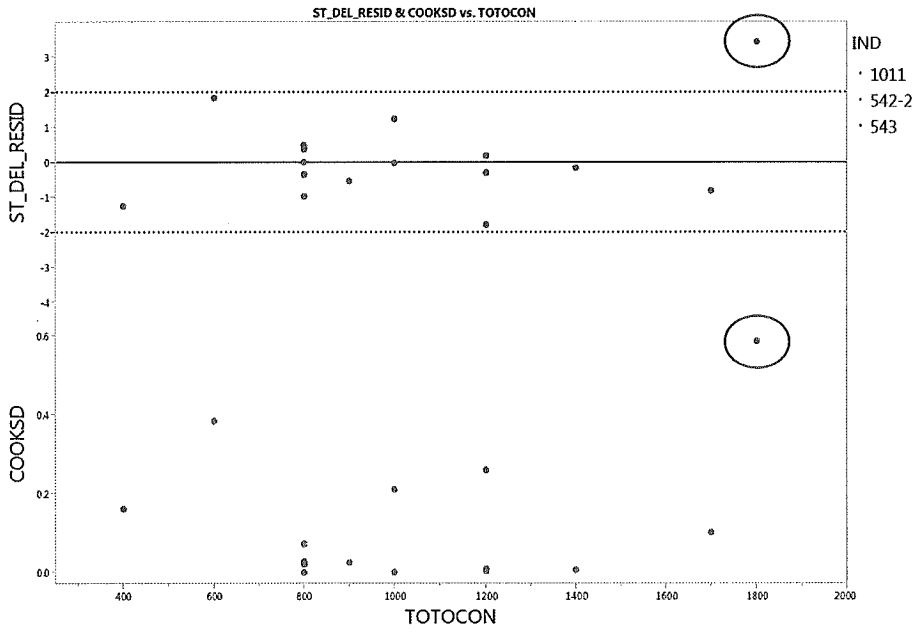
Sense Check Evaluation

- The Surveillance Panel should monitor closely all results with oil consumption near 1800 ml. to make a determination if these results are still valid.
  - The following graph shows how the engine hour term is currently affected.



Sense Check Evaluation

- The ith studentized deleted residual is the residual obtained from a model created with all data except for the ith observation, relative to the residual standard error. As a general rule, values greater than +/- 2 should be investigated.
- Cook's D is a statistic used to measure influence of a point on model parameter estimates. Currently, the 1800 ml oil consumption test has the greatest impact on model parameter estimates. Cutoff values for investigation vary for this statistic.



Sense Check Evaluation

- VID (Prove out) vs. VIF Summary Sense Check Summary

	VID			
	TMC542-2 (0W-20)	TMC543 (Oil 400) (0W-16)	S_p (Prove Out)	S_p (Post Precision Matrix)
FEI1	*1.49*	*1.36*	*0.22*	*0.12*
FEI2	*0.8*	*1.51*	*0.26*	*0.14*
FEISUM	*2.29*	*2.87*	*NA*	*NA*

(VID) RO543 - RO542-2 FEI2 Delta = 0.71
(VID) RO543 - RO542-2 FEISum Delta = 0.58

	VIF			
	TMC542-2 (0W-20)	TMC543 (Oil 400) (0W-16)	TMC1011 (0W-16)	S_p
FEI1	*2.21*	*1.76*	*1.36*	*0.17*
FEI2	*1.44*	*2.11*	*1.27*	*0.21*
FEISUM	*3.65*	*3.87*	*2.63*	*NA*

(VIF) RO543 - RO542-2 FEI2 Delta = 0.67
(VIF) RO543 - RO542-2 FEISum Delta = 0.22

Summary

- VIF Sense Check Highlights / Concerns:
  - The Toyota Study VID and VIF data test data have directionally similar test results for the FEI2 and FEISum parameters
  - The VIF prove out data has similar test precision as compared to the VID (prove out)
  - Residual diagnostics for FEI2 suggests that one unusual result corresponded with high oil consumption (1800 ml)

Summary

- VIF Sense Check Highlights / Concerns (continued):
  - The FEIsum delta between the two reference oils is smaller with the Sequence VIF as compared to the VID.
    - Reference Oil Technology may be a factor – could evaluate the same technology in a different viscosity grade to further investigate this concern.
  - RO1011 (T1 0W-16) has the lowest FEI1, FEI2, and FEISum of the 3 reference oils. This result does not match expectations.
    - Difficult to estimate the true viscosity grade effect with multiple additive technology packages in the test matrix. (No multiple visgrades within a Technology to check the viscosity effect within a technology)

Appendix 1

Sequence VIF Test Development

TOYOTA

- Reference Info

	VID FEI Sum	VID FEI2	Source
TMC542 (0W-20)	2.29 (1.49 + 0.80)	0.80	LTMS (Aug-2015)
Oil 400 (0W-16)	2.87	1.51	Average of VID Matrix Data
Oil 401 (0W-20)	2.69	1.32	Average of VID Matrix Data
Oil 201 (0W-20)	2.60	0.96	Average of VID Matrix Data

[1]Appendix 2 – Sense Check Evaluation

- Oil Ranking (Based on VID Data in Appendix 2)
  - Oil 400 ≥ TMC1011 > TMC542
- Precision, ≥
  - VID Prove Out Estimate of s
    - FEI1=0.22
    - FEI2=0.26

- Effect Size, s

Matrices	VIF Sense Check Proposed	VIF Sense Check Alternative	VIF Sense Check Alternative
No. of Stands	3	2	2
No. of Labs	2	2	2
No. of Oils	3	2	2
Total No. of Tests	9	8	8
No. of Tests/Oil	3,3,3	4,4	4,4
Significance level (α)	0.10	0.10	0.20
Detectable Difference in s of variable and using t	2.72	2.17	1.75
Detectable Difference in s of variable and MC	3.85		
Detectable Difference Assuming FEI2 s=0.26	1.00	0.56	0.45
Degrees of Freedom			
Oil	2	1	1
Stand(Lab)	1		
Lab	1	1	1
Engine Hour	1	1	1
Mean	1	1	1
Error	3	4	4
Total	9	8	8

[1] *Source: GF-6 VIF Precision Matrix, Statisticians Task Force, Sept. 2, 2015*