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## **Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS**

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Issued: August 28, 2015  
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These are the unapproved minutes of the 08.25.2015 Sequence VI Surveillance Panel call.

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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 is **Attachment 2**. Mike Mcmillan was voting for Infineum, Adrian Alfonso for Intertek, Brian Marks for BP, Dan Lanctot for TEI, Robert Stockwell for Oronite and Tim Cushing will be the GM representative.

## 2.0 Approval of minutes

- 2.1 Approval of the minutes of the 08.18.2015 meeting.

MOTION: Approve the minutes from the 08.18.2015 conference call.  
[Jason Bowden, Dave Glaenger, second] Approved unanimous.

## 3.0 Action Item Review

- 3.1 OHT to provide update on current VIE inventory and service engine order. –OHT  
It has been reported that only 144 VIE engines will be available for purchase. Need to investigate option to prolong usable life of the available engines. There are 59 of the current engines remaining. An order has been received for 144 engines. The Panel will look at the method to refresh VIE engines. See Attachment 3. Distribution of the remaining new engines will be based on historic use and the engine survey responses. One engine has cleaned with 1740 hours and about 2000 ml of oil consumption. Afton is running an engine that was cleaned and will report the results. There was discussion on parts to replace. There was a motion for the Precision Matrix to continue in parallel to used engine refresh and an action for the Stat Group to review used engines for use in the VIF matrix. These were dropped with no further action.

ACTION: An Engine Build Task Force will be created. Adrian Alfonso has volunteered to be Chair.

- 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: 2 engines*  
*Lab3: 3 engines*  
*Lab4: 1 engines This will be an on-going effort.*
- 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.
- 3.4 TMC to follow up with supplier of 5W-30 Tech1 and 542 oils to see if they can be made available as a reference oil. Also, if additional batches of 542 0W-20 can be re-blended.  
The goal is to use different oil technologies in the Precision Matrix now that a 0W-16 version has been removed. TMC will confirm a 542-2 reblend.

MOTION: Proceed with approval of 5W-30 Tech 1 as a reference oil for the Precision Matrix.  
[Robert Stockwell, Gail Evans, second] 11 yes and 5 waive.

## 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 Update on progress of 5W-30 Tech1 in VIE testing. –Labs  
- $FEI1/2 = 1.09/1.05$  @ 349 hours [This test exceeded the procedure limit of -0.2 to 0.4 BLB Delta.](#)  
-  $FEI1/2 = 0.29/0.37$  @ 2059 hours [This test was later declared invalid.](#)  
[This will be an on-going effort.](#)
- 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. Two design approaches were selected for the stats group to investigate further. –Jo Martinez [Approaches 2 and 3](#) were reviewed after their selection in the last meeting. [See Attachment 4.](#) One would include BOI/VGRA if acceptable to that group. There was discussion on the number of hours on each engine, and what to do for an engine failure. The recommendation was to target a maximum of 2500 hours on engines. The Stat group reviewed options 2 and 3 but also presented version 2.5. New VIE reference oil assignments will be random instead of the current fixed order for the VID and the industry may move to 2 reference oils due to reduced engine life and longer test length.
- 4.6 Update from task force, to investigate alternative Sequence VIE procedures that would improve 0W-16 response in the Sequence VIE test. – Dan Worcester/Satoshi Hirano [Hirano-san](#) gave the presentation. [See Attachment 5.](#) There is a new Task Force with Dan Worcester as Chair to develop the VIF test. That group will work on matrix design and oil selection and the goal would be to have the VIF work parallel to the VIE Precision Matrix.

## 5.0 New Business

- 5.1 It has been reported that only 144 VIE engines will be available for purchase. Need to investigate option to prolong usable life of the available engines. [This was covered in detail on Action Items 3.1.](#)

## 6.0 Next Meeting will be at the Chair notification.

The meeting adjourned at 9:34 AM.

# Sequence VI Surveillance Panel Conference Call Agenda August 25 @ 9:00-10:30AM 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?*

*Tim Cushing for Bruce Mathews, GM*

### 2.0) Approval of minutes

2.1 Approve the minutes from the August 18, 2015 Sequence VI Surveillance Panel.

<ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/minutes/VIMinutes20150818%20Conference%20call.pdf>

### 3.0) Action Item Review

3.1 OHT to provide update on current VIE inventory and service engine order. –OHT

*It has been reported that only 144 VIE engines will be available for purchase. Need to investigate option to prolong usable life of the available engines.*

3.2 Update of VID engine inventory and expected depletion date of VID engines.

*-Expected life of engines range from 2016 Q1*

*Lab1: 2 engines*

*Lab2: 2 engines*

*Lab3: 3 engines*

*Lab4: 1 engines*

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

- 3.4 TMC to follow up with supplier of 5W-30 Tech1 and 542 oils to see if they can be made available as a reference oil. Also, if additional batches of 542 0W-20 can be re-blended.

#### **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 Update on progress of 5W-30 Tech1 in VIE testing. –Labs
- FEI1/2 = 1.09/1.05 @ 349 hours This test exceeded the procedure limit of -0.2 to 0.4 BLB Delta.*
  - *FEI1/2 = 0.29/0.37 @ 2059 hours This test was later declared invalid.*
- Lubrizol will run this oil and SwRI will repeat a run on a new engine with the same hours.*
- 4.3 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. Two design approaches were selected for the stats group to investigate further. –Jo Martinez
- 4.4 Discussion on third reference oil for precision matrix (replacement for 1011). Two options discussed were 5W-30 versions of Tech1 or 542.
- 4.5 Update from task force, to investigate alternative test procedure Sequence “VIF” that would improve 0W-16. – Dan Worcester/Satoshi Hirano (presentation attached)

#### **5.) New Business**

- 5.1 It has been reported that only 144 VIE engines will be available for purchase. Need to investigate option to prolong usable life of the available engines.

#### **6.) Next Meeting**

Call of the chairman

**7.) Meeting Adjourned**

**ASTM SEQUENCE VI**

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# ASTM SEQUENCE VI

Name	Address	Phone/Fax/Email	Attendance



# Sequence VIE Ultra Sonic Cleaning

**August 2015**

NAML

# Cleaning VIE Engine



- The intent of this experiment was to prove out the working theory that the build up of deposits was resulting in increased oil consumption and loss of response
- Engine #129 removed with 1740 hours with oil consumption 2000ml
  - Engine was losing responsiveness and had exceeded oil consumption limits
- Engine was run through ultrasonic cleaner and reassembled
  - All original parts were cleaned and reused
  - Valves, bearings and rings were removed and hand cleaned
  - Only new parts used were head gaskets and yield bolts

# Cleaning VIE Engine



- LZ 0W-20 Results:
  - FEI1/FEI2/Sum = 1.81/1.21/3.02 Cleaned engine with 2039 hours
  - FEI1/FEI2/Sum = 1.79/1.48/3.27 Original run with 361 hours
- RO 542-1 Results:
  - FEI1/FEI2/Sum = 2.01/1.26/3.27 Cleaned engine with 2240 hours
  - FEI1/FEI2/Sum = 2.17/1.48/3.65 Original run with 558 hours
- Cleaning the engine brought the response back within ranges of the new engine and OC back down to 1200ml

# Cleaning VIE Engine

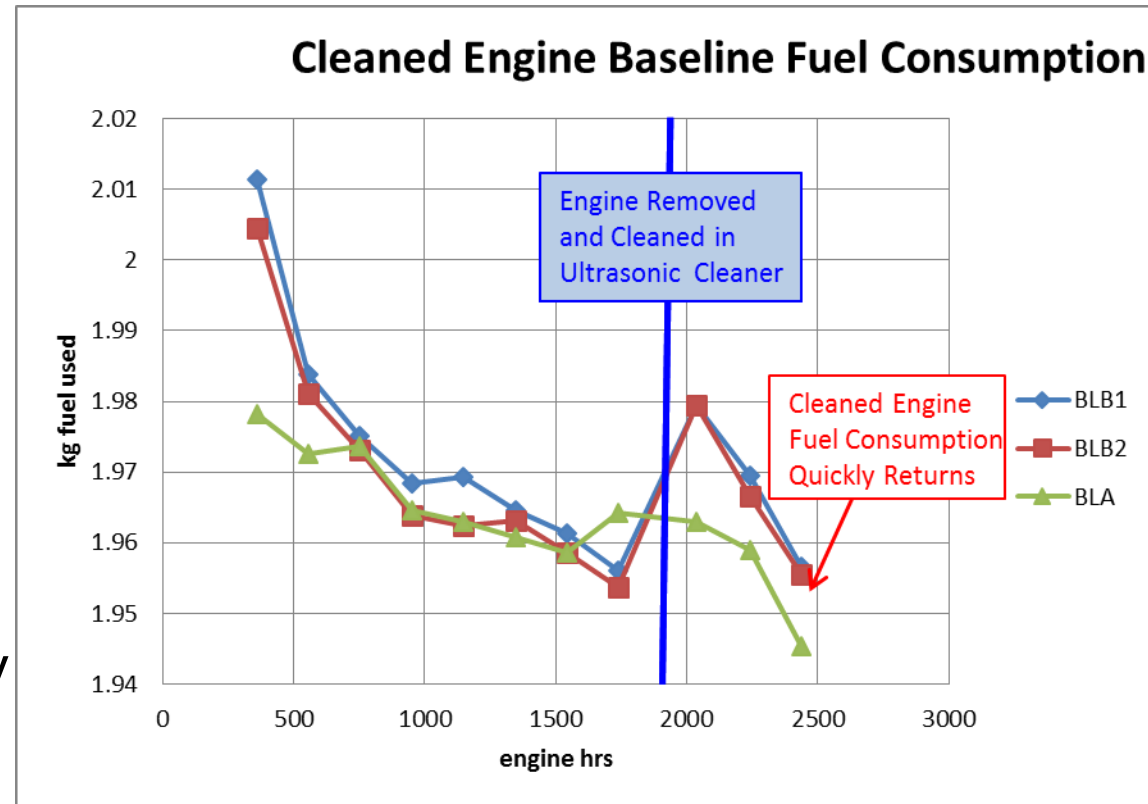


- What do the results look like on a older engine run per the current test procedure?
- LZ 0W-20 Results:
  - FEI1/FEI2/Sum = 1.42/0.72/2.14 Alternate engine with 2415 hours
- RO 542-1 Results:
  - FEI1/FEI2/Sum = 1.68/0.96/2.64 Alternate engine with 2220 hours
- LZ 0W-20 Results:
  - FEI1/FEI2/Sum = 1.81/1.21/3.02 Cleaned engine with 2039 hours
  - FEI1/FEI2/Sum = 1.79/1.48/3.27 Original run with 361 hours
- RO 542-1 Results:
  - FEI1/FEI2/Sum = 2.01/1.26/3.27 Cleaned engine with 2240 hours
  - FEI1/FEI2/Sum = 2.17/1.48/3.65 Original run with 558 hours

# How Long Does it Last?



- As the engine ages the total fuel consumption of the baseline oils decrease, as does the relative response to friction modifiers
- Cleaning the engine resulted in the response to friction modifiers to be on par with a new engine as did the baseline oil's total fuel consumption
- This trend declined rapidly and returned to “pre-clean” levels within three tests



1<sup>st</sup> Candidate on Cleaned Engine was a Repeated Run:

FEI1/FEI2/Sum = 1.49/0.77/2.26 Cleaned engine with 2437 hours, OC 1400ml

FEI1/FEI2/Sum = 1.58/1.18/2.76 Original run with 1150 hours



# Alternative Method



- Appears cleaning only, does not extend engine life significantly
- Cleaning accompanied with new rings and pistons could have significant/lasting impact
  - Are new rings and pistons available?
  - Timing of parts availability?



# GF-6 VIE PRECISION MATRIX

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Statisticians Task Force

August 25, 2015

# GF-6 PM Design Statisticians Task Force

- Doyle Boese, Infineum
- Kevin O'Malley, Lubrizol
- Todd Dvorak, Afton Chemical
- Jo Martinez, Chevron Oronite
- Ricardo Affinito, Chevron Oronite
- Martin Chadwick, Intertek
- Eric Liu, SwRI
- Rich Grundza, TMC

# Objectives:

- Modify designs with Approaches 3 and 2 presented on 8/18/2015
- Oils need to be finalized
  - 542-2; 0w20
  - 1010-1; 5w20
  - 0w16 Tech 1: No longer a viable VIE matrix oil

# Design Assumptions:

- 8 stands; 6 labs
- Funding for 53 matrix tests (Most likely 50 tests per MOA)
- **Funding for 12 BOI/VGRA matrix tests**

	Planned Test Stands						Stands	TEST Cost	GF-6 Precision Matrix ONLY			
	Afton	LZ	XOM	Ashland	IAR	SwRI			Total Runs	Cal Runs	Cal \$'s	Total \$'s
Chrysler Oxid. (Seq. IIIH Rep)	1	1	None	1	2	2	7	\$57,250	28	14	\$801,500	\$1,603,000
Sequence IVB (Toyota)	None	1	None	None	2	2	5	\$49,250	20	10	\$492,500	\$985,000
Sequence V-V8	1	1	None	1	2	2	7	\$63,000	28	14	\$882,000	\$1,764,000
LSPI (Ford)	None	1	None	None	2	2	5	\$14,250	20	10	\$142,500	\$285,000
Chain Wear Test (Ford)	1	None	None	1	2	2	6	\$45,750	24	12	\$549,000	\$1,098,000
Sequence VIE	1	1	1	1	2	2	8	\$32,750	53	24	\$786,000	\$1,735,750
											\$3,653,500	\$7,470,750

IAR and SwRI have 2 Stands for Each Test

Seq. IIIH, Seq. IVB, Seq. V, LSPI, Chain Wear are 4 Tests per Stand

Seq. VIE, 7 tests per stand for the first stand + 4 test per stand for the second.

Seq. IIIH, Seq. IVB, Seq. V, LSPI, Chain Wear have 2 Calibration Tests/Stand

Seq. VIE has 3 Calibration Tests/Stand

Test Funding - Total	\$7,470,750
Donated Tests - Total	\$3,653,500
Industry Funding MOA - Total	\$3,817,500
Actual Matrix Cost	\$3,817,250
Extra Funding	\$250

# VIE Approach 3

- BOI/VGRA interspersed within matrix
- 6 engines run longer; 2 end earlier
- Maximum engine hours: 1950
- Average engine hours: 1150

For Illustrative Purposes Only (Not Final Design):

Run Order	SW1	SW2	IAR1	IAR2	LZ	Afton	Ashland	XOM	
SOT Engine Hours	150	150	150	150	150	150	150	150	Engine Hrs
1	542-2	1010-1	Oil3	542-2	Oil3	1010-1	Oil3	1010-1	350
2	Oil3	542-2	1010-1	1010-1	1010-1	542-2	542-2	Oil3	550
3	1010-1	Oil3	542-2	Oil3	542-2	Oil3	1010-1	542-2	750
4	BOI/VGRA	Oil3	BOI/VGRA	Oil3	BOI/VGRA	BOI/VGRA	BOI/VGRA	BOI/VGRA	950
5	1010-1	542-2	542-2	1010-1	542-2	Oil3	1010-1	542-2	1150
6	BOI/VGRA	1010-1	BOI/VGRA	542-2	BOI/VGRA	BOI/VGRA	BOI/VGRA	BOI/VGRA	1350
7	Oil3		1010-1		1010-1	542-2	542-2	Oil3	1550
8	542-2		Oil3		Oil3	1010-1	Oil3	1010-1	1750
9	542-2		Oil3		Oil3	1010-1	1010-1	1950	
EOT Engine Hours	1950	1350	1950	1350	1950	1950	1750	1950	Total Runs
Runs/Engine	9	6	9	6	9	9	8	9	65

# VIE Approach 2

- Consecutive matrix tests
- 2 engines run longer; 6 end earlier
- Maximum engine hours: 2350
- Average engine hours: 1000

For Illustrative Purposes Only (Not Final Design):

Run Order	SW1	SW2	IAR1	IAR2	LZ	Afton	Ashland	XOM	EngHrs
SOT Engine Hours	150	150	150	150	150	150	150	150	EngHrs
1	542-2	1010-1	Oil3	542-2	Oil3	1010-1	Oil3	1010-1	350
2	Oil3	542-2	1010-1	Oil3	1010-1	542-2	542-2	Oil3	550
3	1010-1	Oil3	542-2	1010-1	542-2	Oil3	1010-1	542-2	750
4	1010-1	Oil3	542-2	Oil3	542-2	Oil3	1010-1	542-2	950
5	Oil3	1010-1	1010-1	1010-1	1010-1	542-2	542-2	Oil3	1150
6	542-2		Oil3						1350
7	1010-1		542-2						1550
8	542-2		542-2						1750
9	Oil3		1010-1						1950
10	1010-1		Oil3						2150
11	Oil3		542-2						2350
EOT Engine Hours	2350	1150	2350	1150	1150	1150	1150	1150	Total Runs
Runs/Engine	11	5	11	5	5	5	5	5	52

# VIE Approach 2.5

- BOI/VGRA interspersed within matrix
- 2 engines run longer; 6 end earlier
- Maximum engine hours: 2950
- Average engine hours: 1200

For Illustrative Purposes Only (Not Final Design):

Run Order	SW1	SW2	IAR1	IAR2	LZ	Afton	Ashland	XOM	
SOT Engine Hours	150	150	150	150	150	150	150	150	Engine Hrs
1	542-2	1010-1	Oil3	542-2	Oil3	1010-1	Oil3	1010-1	350
2	Oil3	542-2	1010-1	1010-1	1010-1	542-2	542-2	Oil3	550
3	1010-1	Oil3	542-2	Oil3	542-2	Oil3	1010-1	542-2	750
4	BOI/VGRA	Oil3	BOI/VGRA	Oil3	BOI/VGRA	BOI/VGRA	BOI/VGRA	BOI/VGRA	950
5	BOI/VGRA	1010-1	BOI/VGRA	542-2	BOI/VGRA	BOI/VGRA	BOI/VGRA	BOI/VGRA	1150
6	1010-1	542-2	542-2	1010-1	542-2	Oil3	1010-1	542-2	1350
7	Oil3		1010-1						1550
8	542-2		Oil3						1750
9	542-2		Oil3						1950
10	1010-1		542-2						2150
11	Oil3		Oil3						2350
12	542-2		Oil3						2550
13	1010-1		1010-1						2750
14	Oil3		1010-1						2950
EOT Engine Hours	2950	1350	2950	1350	1350	1350	1350	1350	Total Runs
Runs/Engine	14	6	14	6	6	6	6	6	64

# Caveats

- We could extend the hours on some engines by decreasing the engine hours on engines with most runs
  - For Example: Approach 2 but with 3 engines out to 1950 hours
- If engine fails before the matrix finishes, what do we do?
  - Run remaining tests on new engine?
  - Move remaining tests to another matrix engine?
- Do we want to have fixed run order for the first 3 oils?
- After all labs run the first 5-6 tests, can we reassess engine “health” at the labs to determine the engines that will run additional tests to reach higher engine hours?
  - Better chance of reaching higher engine hours may be achieved by selecting “healthiest” engines



# Proposal for Sequence VIF Matrix with REO Selection Options

Prepared for  
Sequence VI Surveillance Panel  
August 25th, 2015  
Toyota Motor Corporation

- It was decided that Sequence VIE would be proceeded to the Precision Matrix for ILSAC GF-6A
- Sequence VI Surveillance Panel decided to form a taskforce to develop Sequence VIF for ILSAC GF-6B
  - Dan Worcester of SwRI is new chair
- In order to proceed the Sequence VIF development to meet the ILSAC GF-6 introduction timing, the work should be started as soon as possible
  - Matrix Design to be finalized
  - REO Selection to be decided

- To maintain ILSAC GF-6A and GF-6B Timing
  - Seq VIF Matrix needs to be completed in parallel to the Seq VIE Precision Matrix.
    - VIF matrix will provide data to establish the LTMS targets
- To Mitigate Shortage of Seq VID Availability
  - Ballot for the addition of VID for API SN/RC xW-16 is in process in the API LC.
  - Once approved, xW-16 test demand is certainly expected.
  - Need to establish equivalent P/F criteria in the new FE tests, i.e., Sequence VIF for xW-16, and Seq VIE for xW-20 and xW-30.

- Proposed Test Conditions

- Oil and Coolant Temperatures at Stage 1, 3, 4, and 6 are 15°C lower than those of Sequence VIE
- No Change in Aging Conditions

## Sequence VIF

Test Stage	1	2	3	4	5	6
Speed, RPM	2000	2000	1500	695	695	695
Torque , Nm	105	105	105	20	20	40
Oil Temp, °C	<b>100</b>	65	<b>100</b>	<b>100</b>	35	<b>100</b>
Coolant Temp, °C	<b>94</b>	65	<b>94</b>	<b>94</b>	35	<b>94</b>
Stage Weighting (%)	30	3.2	31	17.4	1.1	17.2

Aging condition: 2250 RPM, 110 Nm, 120 °C

- Proposed Matrix Design
  - 2 Laboratories
  - 2 Engines per Lab
  - 3 Reference Oils
  - Total 30 test runs
    - 10 Sponsors x 3 Tests / Sponsor = Total 30 Tests
  - Stepwise Execution
    - Step 1 : Sense Check Run with 9 tests (Latin Square Design)
    - Step 2 : Remaining Test to complete the Matrix

- Proposed Matrix Design

Run	EOT Hour	Engine 11	Engine 21	Engine 12	Engine 22
1	350	TMC1011	Oil B (0W-16)	Oil C (0W-20)	TMC1011
2	550	Oil B (0W-16)	Oil C (0W-20)	TMC1011	Oil C (0W-20)
3	750	Oil C (0W-20)	TMC1011	Oil B (0W-16)	Oil B (0W-16)
4	950	Oil B (0W-16)	Oil C (0W-20)	TMC1011	Oil B (0W-16)
5	1150	TMC1011	Oil B (0W-16)	Oil B (0W-16)	Oil C (0W-20)
6	1350	Oil C (0W-20)	TMC1011	Oil C (0W-20)	TMC1011
7	1550	TMC1011	Oil C (0W-20)	TMC1011	Oil B (0W-16)
8	1750	Oil B (0W-16)		Oil C (0W-20)	

**Sense Check Runs**

## • REO Selection Options

	Oil A	Oil B (0W-16)	Oil C (0W-20)	Pros	Cons
Option 1	TMC1011 (Tech1 0W-16)	Oil 400 of VID Matrix	Oil 401 of VID Matrix	<ul style="list-style-type: none"> <li>Evaluate viscosity effect directly</li> </ul>	<ul style="list-style-type: none"> <li>Only 2 technologies</li> </ul>
Option 2	TMC1011	Oil 400	Oil 201	<ul style="list-style-type: none"> <li>3 technologies</li> <li>Expect more separation btwn B and C</li> </ul>	<ul style="list-style-type: none"> <li>No direct viscosity comparison</li> </ul>
Option 3	TMC1011	Oil 400	TMC542 (VID/VIE REO)	<ul style="list-style-type: none"> <li>3 technologies</li> <li>Better tie back to VID</li> <li>Expect more separation btwn B and C</li> <li>Compare VIE and VIF</li> </ul>	<ul style="list-style-type: none"> <li>No direct viscosity comparison</li> </ul>

### Remarks :

- a) Oil 400 showed best result in the Toyota VID matrix.
- b) Oil 201 showed worse result than Oil 401 in the VID matrix, then can expect more separation between 0W-16 and 0W-20.
- c) TMC542 has comparable level of VID target in LTMS.

**-> Option 3 seems the best choice**

- 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



# Sequence VIF Test Development Action Plan



	Action Item	Action by	Target Timing
1	Finalize the SP proposal of the test plan to the AOAP and the PCEOCP for approval	Seq VI SP	Aug 25 <sup>th</sup>
2	Report the proposal and ask approval at the AOAP and PCEOCP meetings (Circulate the material in advance)	Seq VI SP/VIF TF	September 10th
3	Blend and deliver REO samples to labs	Toyota / TF	Mid ~ Late Sept
4	Choose 3 sponsors for the sense check matrix (Toyota and other 2 companies)	Toyota / TF	Early Sept
5	Allocate test engines/stands for the VIF	TF / Labs	Early Sept ?
6	Process documentations to start testing (RFQ and Purchase Order)	Sponsors and Labs	Mid Sept
7	Execution of the sense check matrix	Labs / TF	Late Sept ~ Mid Oct
8	Review of the Sense Check Matrix and Decision of Step 2	TF and SP	Late Oct
9	Process documentations to prepare Step 2	Sponsors and Labs	Late Sept ~ Late Oct
10	Execution of Step 2	Labs / TF	Nov ~ Dec
11	Analysis and Conclusion	TF and SP	Jan 2016 ?