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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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Originally Issued: February 9, 2016

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Unapproved Minutes of the January 21, 2016
Sequence IV Surveillance Panel Meeting.

The meeting was called to order by Chairman Buscher at 9:06 AM Eastern Time.

A list of attendees is included as attachment 1.

A copy of the agenda is included as attachment 2.

Minutes from the 10/27/2015 Meeting were approved with no corrections.

Action Items from Previous Meeting
A review of the status of action items from the previous meeting was under taken.
Action items from June 4, 2015 Meeting

January 21, 2016 Sequence IV Surveillance Panel

1. Action Item – Haltermann to supply C of A data, in Excel format, for Haltermann KA24E Green fuel batches, produced from 1/1/2013 through 12/31/2015, to the ASTM TMC for posting on the TMC website.
   Incomplete. TMC to follow up with Haltermann.
2. Action Item – Add Haltermann KA24E Green fuel batch C of A data into Sequence IVB test report and data dictionary.
   Incomplete, but will be included with revisions incorporated after completion of the IVB precision matrix.

Action items from October 27, 2015 Meeting.

3. Action Item – Test Monitoring Center to survey the Sequence IVA test labs on the total quantity of both new and used Sequence IVA test engines and cylinder heads on hand. Survey to include a response on the total number of new test engines and cylinder heads on hand and the total number of used test engines and cylinder heads on hand. The survey to also include the total number of runs available from the new engines and cylinder heads and the total number of runs available from the used engines and cylinder heads, based on 48 runs per engine and 24 runs per cylinder head.
   Status? Not complete

4. Action Item – Sequence IVB test development team to confirm the offset of the camshaft lobe to the lifter for Sequence IVB test engine.
   Completed. Toyota confirmed that there is a small offset, but the offset is not the primary driver of lifter rotation.

5. Action Item – Toyota to review SwRI's "Effect of Valve Springs on Lifter Rotation in Sequence IVB" presentation and consult with their valve-train engineers.
   Completed. Toyota engineers completed review and provided feedback, which was shared with the Sequence IVB test development team, Sequence IVB task force and Sequence IV Surveillance Panel.

6. Action Item – Toyota to schedule a follow-up conference call for 8:00pm Eastern Time this evening, 10/27/15, to discuss SwRI's "Effect of Valve Springs on Lifter Rotation in Sequence IVB" presentation with Hirano-san and the entire Sequence IV Surveillance Panel.
   Completed. Conference call conducted on 10/27/15.

Action items from December 4, 2015 Meeting

1. Action Item – Sequence IVB test development team to develop a standardized engine cleaning/flushing procedure to implement after a lobe failure occurrence for the Sequence IVB test.

Incomplete, but in process. To discuss at today's meeting.

2. Action Item – Sequence IV surveillance panel to develop an improved flushing method for the Sequence IVB test and incorporate it into the precision matrix, if finalized prior to the start of the precision matrix.
   Incomplete, but in process. To discuss at today's meeting.

3. Motion – The Sequence IVB task force and the Sequence IV surveillance panel recommend that the PCEOCP and AOAP consider progressing the Sequence IVB test to the precision matrix without the implementation of any hardware or procedural changes to address the lobe failure issue, with the surveillance panel taking action to address any tests that experience lobe failures and with continued efforts to develop a viable solution to the lobe failure issue, which, if successful, would be applied post-precision matrix.
   Bill Buscher / Teri Kowalski / Passed 11- 1 -3

4. Action Item – Sequence IV surveillance panel to reconvene to define and finalize a method to address tests that experience lobe failures for the Sequence IVB test.
   Incomplete, but in process. To discuss at today's meeting.

5. Action Item – Sequence IVB task force to reconvene to define and finalize operational control ± limits and validity criteria for the Sequence IVB test, prior to the start of the precision matrix.
   Incomplete, but in process. To discuss at today's meeting.

Test Development and Prove Out Data Review.

24 tests from 9 stands were reviewed by the panel during the meeting. Consensus was there is a mix of mild and severe stands. Test results, means and standard deviations are included in attachment 3.

Review of Test Operations

Attachment 4 contains operational summaries from the current Sequence IVB report forms. Operational plots created by Kevin O'Malley of Lubrizol were reviewed by the group. Some of the data reported was incorrect and the corrected data plots will be posted on the TMC website when available. Attachment 5 contains comments on some of the operational data as well as test operation presented by Chris Miletti of Lubrizol. The panel agreed to assign an action item to address time constants and filtering of operational parameters prior to starting the matrix. Videos of running engines were also reviewed during this meeting, these presentations are not included in these minutes.

Method to Address Lobe Failures

The panel discussed the condition of test incurring high wear which result in a failure of a cam lobe. The panel, after much discussion, approved a motion to address lobe failure during the matrix. The exact motion is contained in attachment 7. Longer term, the panel will need to address a method for servicing engines where lobe failure occurs for candidate tests. An action item was assigned to address this and is also listed in attachment 7.

Operational Control Limits

The panel discussed operational control limits defined in the procedure. Some items discussed included removing the delta coolant temperature spec and replacing with coolant flow. Limits on fuel and intake air pressure may need to be addressed and other limits will require review as well. Another meeting will be scheduled to finalize operational limits prior to the start of the matrix.

Oil Consumption Reproducibility

Members of the task force had concerns about the variable nature of oil consumption measurements. The task force will evaluate different methods for determining oil consumption to remove the variability.

Improved Flushing Method

The task force reviewed flushing procedures currently employed and potential enhancements. Additional flush was discussed as well as modifications to the oil pan to allow a more comprehensive drain of the previous test oil.

Items to be Addressed Prior to Matrix Start

In an effort to remove inconsistency, vibration analysis will be conducted on all nine stands currently installed in laboratories by Paul Zubritsky of Advanced Vibrational Solutions. A list of items agreed to by the task force, to be addressed prior to start of matrix was developed and is listed below:

1) Conduct torsional vibration analysis of all 9 stands
2) Install an OBD II wiring harness to allow access to engine codes and parameters
3) Evaluate improved oil purge systems
4) Implement the use of the OHT fixture to be used for measurement with the Keyence machine
5) Implement updated Keyence Measurement procedure
6) Introduce improved oil pan
7) Finalize operational validity criteria
8) Institute coolant flow measurement to replace coolant delta T specifications

A review of failed or damaged hardware was also conducted. Also noted was the engine build manual needs to be completed and the task force members felt that lab visits should be conducted again. The task force hopes to have these items completed by mid/late March, at which time another face to face meeting will be scheduled prior to start of the matrix.

Scope and Objectives

The scope and objectives were reviewed and are included as attachment .
No changes were made.

No new or old business was discussed, however, prior to adjournment, Kevin O'Malley asked if, based on the prove out results, the task force has chosen the correct stands to conduct the matrix on. Bill Buscher suggested that the stand mix be reviewed, prior to matrix start.

The meeting was adjourned at 3:55 PM.

A listing of action items from this meeting is included as attachment 7.

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January 21, 2016

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January 21, 2016

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Attachment 2

Sequence IVB Task Force
and
Sequence IV Surveillance Panel

San Antonio, TX
Intertek Automotive Research
January 21, 2016
9:00 a.m. - 5:00 p.m.

A G E N D A

1.	Chairman comments	
2.	Attendance sign-in sheet distribution	
3.	Membership changes	
4.	Motion and action recorder	
5.	Approval of minutes for 10/27/2015	All
6.	Action item review	Chairman
7.	Sequence IVB action items:	All

a. Review all available development and prove-out test results from all nine test stands, including the five precision matrix test stands
   i. Data from 24 tests conducted with the same test hardware and operational conditions available for review
b. Review all available operation data from the development and prove-out tests
   i. Data from 40 tests available for review

c. Define and finalize a method to address tests that experience lobe failures
    i. Short-term need is for the precision matrix
    ii. Long-term need is for all reference oil and candidate oil testing
d. Define and finalize operational control ± limits and validity criteria, prior to the start of the precision matrix
e. Address oil consumption measurement reproducibility between labs
    i. One lab typically measures negative oil consumption, while two labs typically measure positive oil consumption
f. Develop an improved flushing method (further minimize the amount of carryover oil that the next set of test camshafts and lifters are exposed to)
    i. Introduction of a modified oil pan
    ii. Consider a 5th flush at the start of test: An oil pan flush with the oil pan installed, but the engine not running

8. Review scope & objectives — Chairman
9. Old business

10. New business
11. Motion and action item review
12. Next meeting
13. Adjourn

IVB ASTM REO 1006-2

Lab	IAR	IAR	IAR	SwRI	Lubrizol	Lubrizol	IAR	IAR	SwRI	Lubrizol	IAR	Lubrizol	SwRI	Average and Std Dev of DOE Matrix tests.		Average and Std Dev of all tests.	
Stand	I-102	I-100	I-102	S-20	347	347	I-101	I-101	S-17	347	I-165	347	S-17				
Oil	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2	1006-2
Purpose	DOE Matrix	DOE Matrix	DOE Matrix	DOE Matrix	Prove-out	Prove-out	Test Development Support	Test Development Support	Prove-out	Prove-out	Prove-out	Prove-out	Prove-out	AVERAGE (1)	STD DEV (1)	AVERAGE (2)	STD DEV (2)
Test Number	IVB102-0-2	IVB100-0-3	IVB102-0-3	20-0-28	TRNHRJKCD	TRNRCV08C	IVB101-0-17	IVB101-0-18	17-0-4	TRNXN0P3C	IVB165-0-1	TRNBHTJXB	17-0-6				
Fe Content @ 200 hours, ppm	143	134	141	162	310	300	305	189	252	355	137	510	780	145	11.97	286	185.48
Intake Bucket Lifters Average Area Loss, μm^2	145894	179554	171764	203830	279284	261655	256482	200098	363431	268600	153717	292911	307683	175260	23869.81	237300	66541.92
Exhaust Bucket Lifters Average Area Loss, μm^2	82005	106952	103052	85559	113197	130022	208444	131544	108780	168047	85838	176536	125168	94392	12439.46	125011	38392.38
Intake Bucket Lifters Average Volume Loss, mm^3				1.80	2.68	2.80	2.36	1.59	3.72	2.81	1.34	3.04	3.13	1.80	#DIV/0!	2.53	0.75
Exhaust Bucket Lifters Average Volume Loss, mm^3				0.85	1.47	1.77	2.06	0.96	0.76	2.38	0.85	2.29	1.25	0.85	#DIV/0!	1.46	0.63

Yi (Area Loss)	-1.23	0.18	-0.15	1.20	4.36	3.62	3.40	1.04	7.88	3.91	-0.90	4.93	5.55	
Yi (Volume Loss)				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	NOTE: Volume loss was only performed on 1 DOE matrix test for ASTM REO 300.
Yi (Volume Loss)				0.71	6.70	7.48	4.54	-0.71	13.74	7.54	-2.43	9.10	9.73	NOTE: Used tests 20-0-28 and IVB101-0-18 to calculate average and standard deviation for this Yi calculation.

IVB ASTM REO 300

Lab	IAR	SwRI	SwRI	SwRI	IAR	Lubrizol	Lubrizol	IAR	Average and Std Dev of DOE Matrix tests.		Average and Std Dev of all tests.	
Stand	I-101	S-18	S-20	S-20	I-101	347	347	I-165				
Oil	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300 (5W-30)	300	300	300	300
Purpose	DOE Matrix	DOE Matrix	DOE Matrix	DOE Matrix	Prove-out	Prove-out	Prove-out	Prove-out	AVERAGE (1)	STD DEV (1)	AVERAGE (2)	STD DEV (2)
Test Number	IVB101-0-5	18-0-6	20-0-26	20-0-27	IVB101-0-9	TRNX713KB	TRNTZHLGB	IVB165-0-7				
Fe Content @ 200 hours, ppm	227	245	332	323	330	471	493	107	282	53.46	316	126.77
Intake Bucket Lifters Average Area Loss, μm^2	239274	301518	244467	286161	265340	378016	353890	123761	267855	30725.49	274053	78222.76
Exhaust Bucket Lifters Average Area Loss, μm^2	83198	104168	107098	122576	143408	172282	133625	71670	104260	16198.48	117253	32777.62
Intake Bucket Lifters Average Volume Loss, mm^3		2.93	2.38	2.73	2.51	4.27	3.75	1.14	2.68	0.28	2.82	1.01
Exhaust Bucket Lifters Average Volume Loss, mm^3		0.74	0.87	1.04	1.72	2.37	1.83	0.74	0.88	0.15	1.33	0.64

Yi (Area Loss)	-0.93	1.10	-0.76	0.60	-0.08	3.59	2.80	-4.69
Yi (Volume Loss)		0.90	-1.08	0.18	-0.61	5.72	3.83	-5.53

IVB REO3 (5W-20)

Lab	IAR	IAR	Lubrizol	Average and Std Dev of initial dev. tests.		Average and Std Dev of all tests.	
Stand	I-100	I-101	347				
Oil	REO3 (5W-20)	REO3 (5W-20)	REO3 (5W-20)	REO3	REO3	REO3	REO3
Purpose	Test Development Support	Test Development Support	Prove-out	AVERAGE (1)	STD DEV (1)	AVERAGE (2)	STD DEV (2)
Test Number	IVB100-0-6	IVB101-0-8	TRNWVQKSC				
Fe Content @ 200 hours, ppm	90	115	627	103	17.68	277	303.08
Intake Bucket Lifters Average Area Loss, μm^2	102011	116375		109193	10157.22	109193	10157.22
Exhaust Bucket Lifters Average Area Loss, μm^2	81629	59174		70402	15878.08	70402	15878.08
Intake Bucket Lifters Average Volume Loss, mm^3	0.70	0.98	3.88	0.84	0.20	1.86	1.76
Exhaust Bucket Lifters Average Volume Loss, mm^3	1.11	0.61	2.09	0.86	0.35	1.27	0.75
Yi (Area Loss)	-0.71	0.71	-10.75				
Yi (Volume Loss)	-0.71	0.71	15.45				

Attachment 4

Sequence IVB
Form 5
Operational Summary – Phase 1

Lab	EG	Oil Code	
Stand	102	Test No.	
Laboratory Oil Code			
Formulation Stand Code			

Parameter	Units	Target	Minimum	Maximum	Average	Std. Dev.	CV, %
Engine Speed	r/min	800 ± 25	575	1125	807	13.4075	1.66
Engine Torque	N-m	25 ± 2	24.55	25.40	25.00	0.1042	0.42
Engine Power	kW		1.52	2.93	2.11	0.0357	1.69
Brake Mean Effective Power	bar		2.0	2.1	2.1	0.0087	0.42
Air Fuel Ratio	afr	14.5 ± .2	13.45	20.51	14.90	0.7150	4.80
Fuel Flow Rate	kg/h		-0.09	1.54	0.71	0.2407	34.08
Coolant Temperature Into Engine	°C	49 ± 3	44.4	50.8	48.4	0.1738	0.36
Coolant Temperature Out of Engine	°C		45.1	54.4	51.2	0.2800	0.55
Coolant Delta	°C	2 ± 1	0.6	4.8	2.8	0.3703	13.16
Engine Oil Sump	°C		32.1	65.1	63.5	0.8302	1.31
Engine Oil Gallery	°C	53 ± 3	31.4	57.0	55.0	0.9907	1.56
Intake Air Temperature	°C	32 ± 3	29.3	35.0	32.1	1.1377	3.54
Exhaust Gas Temperature	°C		223.9	486.7	466.7	8.6196	1.85
Fuel Rail Temperature	°C	24 ± 3	23.3	24.7	24.0	0.1320	0.55
Test Cell Air Temperature	°C		22.3	33.9	29.0	2.2053	7.60
Rocker Cover Coolant In Temperature	°C		12.7	20.9	20.1	0.4556	2.27
Rocker Cover Coolant Out Temperature	°C	20 ± 2	-0.4	33.0	19.8	0.5936	2.99
Oil Gallery Pressure	kPa G		73.0	228.0	118.6	12.2186	10.30
Exhaust Pressure	kPa Abs	103.5 ± 1	97.277	108.780	103.397	1.2190	1.18
Intake Air Pressure	kPa G	0.07 ± 0.02	-0.024	0.229	0.057	0.0441	77.43
Fuel Rail Pressure	kPa G	335 ± 5	319.0	337.9	325.8	2.4200	0.74
Crankcase Gas Pressure	kPa G		-0.971	1.904	0.435	0.5725	131.73
Barometric Pressure	kPa Abs		97.2	98.6	97.9	0.3723	0.38
Intake Manifold Pressure	kPa Abs		19.4	64.5	36.6	6.1120	16.69
Intake Air Humidity	g/kg	11.5 ± 0.5	10.6	12.1	11.5	0.1735	1.51
Blowby Flow Rate	sl/min		1.98	14.23	7.37	0.7850	10.65

Sequence IVB
Form 6
Operational Summary – Phase 2

Lab	EG	Oil Code	
Stand	102	Test No.	
Laboratory Oil Code			
Formulation Stand Code			

Parameter	Units	Target	Minimum	Maximum	Average	Std. Dev.	CV, %
Engine Speed	r/min	4300 ± 25	4116	4407	4300	10.3572	0.24
Engine Torque	N-m	25 ± 2	24.26	25.97	24.99	0.0886	0.35
Engine Power	kW		10.68	11.65	11.25	0.0469	0.42
Brake Mean Effective Power	bar		2.0	2.2	2.1	0.0074	0.35
Air Fuel Ratio	afr	14.5 ± .2	12.73	15.31	14.40	0.2263	1.57
Fuel Flow Rate	kg/h		3.76	7.82	5.12	0.8811	17.20
Coolant Temperature Into Engine	°C	49 ± 3	44.9	51.3	49.6	0.1473	0.30
Coolant Temperature Out of Engine	°C		47.0	56.3	53.8	0.3712	0.69
Coolant Delta	°C	5 ± 1	2.1	6.1	4.2	0.4401	10.41
Engine Oil Sump	°C		36.1	64.8	63.2	0.7858	1.24
Engine Oil Gallery	°C	55 ± 3	31.8	57.0	55.3	0.8785	1.39
Intake Air Temperature	°C	32 ± 3	29.3	34.9	32.0	1.1250	3.52
Exhaust Gas Temperature	°C		331.0	532.6	513.8	9.7227	1.89
Fuel Rail Temperature	°C	24 ± 3	23.5	24.5	24.0	0.1481	0.62
Test Cell Air Temperature	°C		22.2	33.9	29.0	2.2107	7.63
Rocker Cover Coolant In Temperature	°C		13.0	20.9	20.1	0.4483	2.23
Rocker Cover Coolant Out Temperature	°C	20 ± 2	-0.4	33.9	19.8	0.5638	2.84
Oil Gallery Pressure	kPa G		176.7	389.7	277.9	29.0112	10.44
Exhaust Pressure	kPa Abs	104.5 ± 1	98.427	109.441	104.115	1.4853	1.43
Intake Air Pressure	kPa G	0.07 ± 0.02	-0.087	0.378	0.139	0.0650	46.90
Fuel Rail Pressure	kPa G	335 ± 5	319.9	334.0	326.3	2.4263	0.74
Crankcase Gas Pressure	kPa G		-1.834	2.844	0.491	1.0680	217.54
Barometric Pressure	kPa Abs		97.2	98.6	97.9	0.3722	0.38
Intake Manifold Pressure	kPa Abs		33.5	72.6	43.9	2.1374	4.87
Intake Air Humidity	g/kg	11.5 ± 0.5	10.6	12.2	11.5	0.1728	1.50
Blowby Flow Rate	sl/min		7.71	21.70	10.13	1.7544	17.31

Attachment 5

IVB Operational Data Review |NOTES

Revision Date *01-21-2016* |Revision *1.0*

Relevant Test:	Sequence IVB
Note Taker:	KVOM statistical analysis, CHTM notes
Comments:	Notes from operational data review conducted during 01-20-2016 IVB Development Task Force meeting in San Antonio.

OPERATIONAL DATA REVIEW:

1. **Average Intake Lifter Area and Volume Loss Charts:**
   a. It will take additional time to sort through this data because not all of the tests in this data set used the final procedure.

2. **Air-to-Fuel Ratio (AFR):**
   a. This is not a controlled parameter, but it does provide a lot of insight into how each engine is running.
      i. This parameter can be studied further once the new OBDII-compatible wiring harnesses are installed on the stands.
   b. There is not a lot of consistency in the AFR curves between the three laboratories.
      i. This is mainly due to the fact that the Horiba units saturate during the transitions (particularly the Stage 2→1 transition).
   c. The group recommends removing the current AFR validity spec from the procedure.

3. **Humidity [Controlled]:**
   a. The humidity parameter is controlling well at all three laboratories.

4. **Blowby:**
   a. IAR had an issue with the calibration of their blowby meter for test IVB100-0-1.
   b. The following tests had unusual blowby curves and should be investigated further:
      i. SWRI 20-0-26
      ii. IAR 101-0-9
      iii. IAR 102-0-4

5. **BMEP:**
   a. BMEP is a calculated parameter based on torque.
   b. Since the torque set point for the IVB test cycle in constant, the BMEP curve should be flat.
   c. IAR will investigate a potential BMEP calculation error on some of their tests.

6. **Crankcase Pressure:**
   a. SWRI has a slightly higher peak crankcase pressure than the other two laboratories.
   b. Lubrizol has flatter crankcase pressure curves than the other two laboratories.

7. **Coolant Temperature Differential (Delta) [Controlled]:**
   a. SWRI will review tests 19-0-32, 20-0-21 and 20-0-24 to confirm that the coolant temperature differential data is in the correct column on the templates.
   b. There is a lot of noise in the IAR 101-0-17 data.
   c. SWRI has the smoothest coolant temperature differential curves.
   d. Lubrizol has the most pronounced peak in its coolant temperature differential curves.

8. **Coolant Temperature at Inlet [Controlled]:**
    a. The coolant outlet temperature was controlled instead of the coolant inlet temperature for test IAR 100-0-1.
        i. This occurred early in test development.
    b. All three laboratories are comfortable with the current set point of 49±3°C.

9. **Coolant Temperature at Outlet:**
    a. SWRI will confirm that the coolant outlet temperature data is in the correct column of the template.

10. **Exhaust Backpressure [Controlled]:**
    a. Lubrizol has difficultly achieving the Stage 1 backpressure set point when the barometric pressure drops below 100kPa.
        i. In an attempt to correct this issue, Lubrizol moved its exhaust backpressure valve directly behind the engine.
        ii. This marginally improved the ability to control Stage 1 backpressure.
    b. IAR uses a flapper valve that is approximately 12-15ft from the turndown pipe.
        i. They hand select flapper valves that have the tightest tolerances.
    c. SWRI uses a cone valve to control backpressure.
        i. They also use a muffler on their exhaust line that is not used at Lubrizol or IAR.
        ii. This muffler probably helps dampen the pressure signal to improve overall control.
    d. SWRI needs to review the backpressure data for 19-0-32, 20-0-21 and 20-0-24 to confirm that it is in the correct column of the template.

11. **Exhaust Gas Temperature:**
    a. The Stage 2 exhaust temperature at SWRI is lower than at Lubrizol and IAR.
        i. This may be due to the fact that SWRI has better control over backpressure.
    b. The exhaust temperature for 101-0-1 is lower than that of the other tests.
    c. There is less cyclic variation in exhaust temperature for the 165-0-1 and 165-0-7 tests.
    d. The exhaust temperature for 17-0-6 is lower than that of the other SWRI tests.

12. **Fuel Flow:**
    a. The fuel flow for IAR test stand #165 does look different than the other stands.
        i. There is a lot of noise in the data.
    b. However, the intake manifold pressure for #165 does not show the same anomalous trends.
        i. This suggests that the unusual fuel flow data may be the result of measurement errors.

13. **Intake Manifold Pressure (Vacuum):**
    a. The intake manifold pressure data looks very different at all three laboratories.
        i. These differences are not the result of data stacking.
    b. There is a lot of noise in the data for 102-0-2.

14. **Fuel Pressure [Controlled]:**
    a. All three laboratories agreed that they need to review the filtering and time constants for all of the controlled parameters.

15. **Fuel Temperature [Controlled]:**

   a. The fuel temperature set point was changed from 30°C to 24°C during the middle of 2015.
   b. This change was made because the Golden Stand has no ability to heat the fuel (it can only cool the fuel).

16. Intake Air Pressure [Controlled]:

   a. All three laboratories have difficulty controlling this parameter.
      i. The intake air pressure goes negative for an extended period of time during the Stage 1→2 transition on many of the test stands.
      ii. Lubrizol tests TRNTZHLGB and TRNWVQKSC had the highest vacuum during the transitions.
      iii. SWRI test 19-0-3 had the highest vacuum during the transitions.
      iv. IAR stand #165 had the highest vacuum of all of their stands.
   b. The three laboratories agree that the set point needs to be increased so that there is never a vacuum in the air box.
      i. This vacuum will cause the engine to pull ambient air into the air box.
      ii. Obviously, the humidity and temperature of the ambient air is not controlled.
   c. OHT now has modified air boxes available.
   d. The group needs to revisit whether the intake air pressure should be measured before or after the air filter.

17. Oil Gallery Pressure:

   a. The oil gallery pressure data for the Lubrizol stand looks shifted.
      i. Lubrizol needs to confirm that there is no filter on this parameter.

18. Oil Gallery Temperature [Controlled]:

   a. None of the labs have ideal test-to-test consistency with this parameter.
   b. Ambient temperature is likely impacting the oil gallery and sump temperatures.
   c. A larger heat exchanger could improve oil gallery temperature control.
      i. However, this would be a major change because the initial oil charge would need to be increased.

19. Oil Sump Temperature:

   a. Lubrizol clearly has the lowest average sump temperature of the three laboratories.
   b. IAR stand #165 has the hottest sump temperature (and it is the mildest stand in the Industry).
   c. The group may need to add insulation to the sump.
   d. Lubrizol will determine if there is a correlation between sump temperature and soot level.

20. Power:

   a. IAR will review the calculations that they used for the power parameter.

21. Speed [Controlled]:

   a. The speed parameter is very similar for all three laboratories.

22. Load Cell Temperature [Controlled]:

   a. Lubrizol may need to add a curtain around its load cell to better isolate it from ambient temperature changes.
   b. There is an unusual anomaly in the load cell temperature data for IAR stand #165.

January 21, 2016 Sequence IV Surveillance Panel

Action Items	Person responsible	Completion Date
Discuss removing the AFR validity spec from the procedure.	IAR, SWRI and LZ	
Investigate tests (20-0-26, 101-0-9 and 102-0-4) for unusual blowby data.	IAR and SWRI	
Investigate BMEP calculation error.	IAR	
Confirm that the coolant temperature delta data was inputted into the correct column of the template for 19-0-32, 20-0-21 and 20-0-24.	SWRI	
Confirm that the coolant outlet temperature data is in the correct column of the template.	SWRI	
Confirm that the exhaust backpressure data was inputted into the correct column of the template for 19-0-32, 20-0-21 and 20-0-24.	SWRI	
Discuss increasing the intake air pressure set point.	IAR, SWRI and LZ	
Revisit whether the intake air pressure should be measured before or after the air filter.	IAR, SWRI and LZ	
Confirm that there is no filter on the oil gallery pressure measurement.	LZ	
Correlate sump temperature to soot level.	LZ	
Review the calculation for the POWER parameter.	IAR	
Add curtain around load cell heater.	LZ	
Review unusual load cell temperature data from IAR stand #165.	IAR	
Review filtering and time constants for all parameters.	IAR, SWRI and LZ	

Follow-up Notes/Updates:	Initials	Date Added

Attachment 6

ASTM Sequence IV Surveillance Panel

Scope and Objectives

Scope

The Sequence IV Surveillance Panel is responsible for the surveillance and continued improvement of the Sequence IVA test documented in Test Method D 6891 as updated by the Information Letter system. Data on test precision and laboratory versus field correlation will be solicited and evaluated at least every six months. Improvements in wear measurement technique, test operation, test monitoring and test validation will be accomplished through continual communication with the Test Sponsor and Parts Distributor, ASTM Test Monitoring Center, ASTM Committee D02.B0.01 and the ASTM Passenger Car Engine Oil Classification Panel. Actions to improve the process will be recommended when deemed appropriate based on input from the proceeding. The Panel will review development and correlation of updated test procedures with previous test procedures. This process will provide a suitable test procedure for evaluating an automotive lubricant's effect on controlling cam lobe wear for overhead valvetrain equipped engines with sliding cam followers.

Objectives	Target Date
1. Pursue engine mounting and driveline identification, optimization and maintenance procedure and interval.	*On-going*

William A. Buscher III, Chairman
Sequence IV Surveillance Panel

Updated: Jan. 2016

Attachment 7

Sequence IVB Task Force
and
Sequence IV Surveillance Panel
January 21, 2016
9:00AM – 5:00PM
Intertek Automotive Research
San Antonio, TX

Motions and Action Items
As Recorded at the Meeting by Bill Buscher

1. Action Item – Sequence IVB test development team and precision matrix labs to re-review time constants and data filtration as per the DACA II requirements.

2. Motion – Accept the Sequence IVB Test Development Team's proposal for addressing any precision matrix tests that experience lobe failures. Proposal is as follows:
   1) A precision matrix test that experiences a lobe failure will not be included in the final precision matrix data set and will be replaced with a rerun test.
   2) The laboratory at which the precision matrix test that experienced a lobe failure was conducted at will cover the cost of the rerun test.
   3) The test engine in which the lobe failure occurred, will be removed from service for the remainder of the precision matrix.
   4) The laboratory will replace the test engine in which the lobe failure occurred with a new, zero run, engine and continue the precision matrix after the new engine completes break-in and aging.

   Bill Buscher / Jason Bowden / Passed 12 – 0 – 3

3. Action Item – Sequence IVB Test Development Team to establish a servicing procedure for test engines experiencing lobe failures. A recommendation will then be made for acceptance from the Sequence IVB Task Force and Sequence IV Surveillance Panel. Once approved, laboratories will immediately start following this procedure on any engines that they have removed from service due to a lobe failure or an engine that is currently in service and experiences a lobe failure in the future.

4. Action Item – Revisit precision matrix stand selection closer to the start of the precision matrix, once the Sequence IVB Test Development Team completes all items it desires to address prior to the start of the precision matrix.