

Sequence IV Surveillance Panel | MINUTES

Revision Date 8/2/2017 3:30:00 PM

Relevant Test:	Sequence IVA and IVB
Note Taker:	Chris Mileti
Meeting Date:	07-19-2017
Comments:	Surveillance Panel conference call to discuss preparations for Sequence IVB prove-out testing.

1. AGENDA AND ACTION ITEM REVIEW:

a) Agenda for Meeting (Bill Buscher):

- i) Review previous action items.
- ii) Haltermann KA24E fuel status:
 - (1) Update from Haltermann.
 - (2) Update from the labs.
- iii) Sequence IVB hardware status:
 - (1) Update from OHT on applying chamfers to the Batch-C intake camshafts.
 - (2) Update from OHT and Toyota on the status of the next shipment of critical hardware.
- iv) Update on Keyence VR-3000 3D Measurement System Generation-2 (G2) software.
 - (1) Update from labs on purchase of G2 software.
 - (2) Discussion on settings and lifter templates for G2 software.
- v) Discuss and vote on motion regarding modifications to oil pan pick-up tube.
- vi) Discuss concerns about removing the oil separator.
- vii) Discuss timing of oil pan modifications and the possibility of conducting Row 1 prove-out tests without the oil pan modifications.
- viii) Discuss procedure review.
- ix) Next steps for Sequence IVB.
- x) Review of Sequence IVB timeline.
- xi) Motion and action item review.
- xii) Adjourn.

b) Review of General Action Items from 07-12-2017 Conference Call:

- i) The Sequence IVB labs need to collect coolant temperature data using the latest control strategy.
 - (1) This control strategy uses the outlet temperature as the set point instead of the inlet temperature.
 - (2) The data will be provided to the statisticians so that they can recommend revised QI limits.
- ii) Lubrizol has provided the Industry with basic drawings of their latest oil pan modifications.
 - (1) These modifications include a downward facing oil inlet that drops into a small oil well.
- iii) Lubrizol is still investigating whether the oil sample valve is introducing foam into the oil sample.
 - (1) Lubrizol hopes to have an update by the end of the week.

- iv) The statisticians need to provide a recommendation to the Surveillance Panel for the format of the 2nd Precision Matrix and how to handle supplemental data from non-participating laboratories.

c) Intertek Trials with Lubrizol Oil Pan:

- i) Intertek ran trials with the oil pan that Lubrizol modified with a sight glass and portal for backlighting.
- ii) *Video #1 – Mechanical Oil Pressure Gauge at 2400mL and 3000mL Oil Charges:*
 - (1) The oil pressure is higher with the 3000mL oil charge than the 2400mL oil charge.
- iii) *Video #2 – Mechanical Oil Pressure Gauge and 2400mL Oil Charge with 1000mL of Oil Removed:*
 - (1) Intertek confirmed the original findings by Lubrizol.
 - (2) The top-half of the oil pick-up tube is above the oil level.
 - (3) The oil is also very milky.
 - (4) At these extremely low oil levels, the thermocouple for the oil sump temperature is above the level of oil.
- iv) *Video #3 – 3000mL Oil Charge:*
 - (1) There is clearly more oil draining from the top of the engine with the larger initial oil charge (3000mL vs. 2400mL).
 - (2) The oil pick-up tube and thermocouple are both fully submerged.
 - (3) Intertek still needs to overlay the measured oil pressure data from their trial to replicate the plots from the original Lubrizol trial.
- v) *General Comments from Intertek:*
 - (1) Intertek used a 3000mL initial oil charge with their three latest prove-out tests.
 - (a) The lowest dipstick reading from these trials was 62mm.
 - (2) Intertek believes that with the previous test conditions it was possible to have oil volumes at 200HRS that were less than 1400mL.
 - (3) They believe that the 600mL increase to the initial oil charge will put the test in a “safe” situation.
- vi) *Comments from Toyota:*
 - (1) The fact that the oil sump temperature thermocouple was above the oil level will not have an impact on the ability to control the oil temperature.
 - (2) The oil temperature is controlled by the thermocouple in the oil gallery and not the oil sump.

d) Discussion about “High Event” Camshaft Lobe Failure Oil:

- i) Southwest received a different “high event” camshaft lobe failure oil than is being used by Intertek.
- ii) Intertek stated that the supplier of this oil wants to see duplicate data.
 - (1) They asked if Southwest could run a 2nd test with the “high event” oil on Test Stand #20.
- iii) The supplier is willing to provide iron and test validity information on the 2nd “high event” oil to the Industry for review.

e) Status of Re-Blended Haltermann Fuel:

- i) The fuel has been re-blended and the C of A is ready for distribution.
- ii) The final sulfur content is 124ppm.
 - (1) This is within the new release limits of 130±10ppm.
- iii) Intertek, Southwest and Lubrizol have all placed their orders and are ready for delivery.
- iv) **Exxon:**
 - (1) Exxon is not yet ready to receive the new fuel batch.
 - (2) They need to drain and flush one of their tanks first.

- (3) Exxon plans to be on the same batch of fuel as the other laboratories for the Precision Matrix but not the prove-out testing.

f) Status of Batch-C Intake Camshafts with Chamfered Edges:

- i) OHT stated that the modified camshafts will be received tomorrow.
 - (1) They hope to ship them to the labs by the end of the week.
- ii) **Distribution to Labs:**
 - (1) Three camshafts will be sent to each of the independent labs for prove-out testing.
 - (2) One additional camshaft will be made for Southwest's additional run on Test Stand #20 with the "high event" oil.
 - (3) Two camshafts will be sent to both Lubrizol and Exxon.

2. NEW DISCUSSION ITEMS:

a) Engines for Prove-Out Testing:

- i) **How many runs should an engine have if it is going to be used for prove-out testing?**
 - (1) Lubrizol and Toyota both believe that all of the secondary wear within the engine (i.e. bore polishing, piston ring wear, valve stem wear, bearing pitting, etc.) should disappear with the low sulfur fuel and the modified oil pans.
 - (a) However, this needs to be confirmed.
 - (b) The best way to confirm this is by running the prove-out tests with new engines.
- ii) **Engines currently installed on test stands:**
 - (1) IAR102: New Batch Code-1 engine
 - (2) IAR165: Batch Code-1 Precision Matrix engine with 5 runs.
 - (3) LZ347: Batch Code-1 engine with 3 runs.
 - (a) This engine was used for several trials (~25 hours).
 - (4) SWR120: Batch Code-1 Precision Matrix engine with 4 runs and 200 hours of experiments.
 - (5) SWR118: Batch Code-1 engine with 3 runs.
- iii) OHT is willing to send an additional engine to Intertek, Southwest, Exxon and Lubrizol if needed.
 - (1) OHT still needs to work out some administrative issues with shipping engines to Exxon.
- iv) It may be possible to use the prove-out engines for the Precision Matrix.
 - (1) However, this means that the engines would exceed (6) runs during the Precision Matrix.
 - (2) This will require changing the cylinder heads.
- v) Toyota stated that any engine run with the older test conditions cannot be used for the upcoming prove-out or Precision Matrix testing.
- vi) **Batch Code-1 (BC1) vs. Batch Code-2 (BC2) Engines:**
 - (1) There are BC2 engines currently in service.
 - (a) However, these engines have only been used for candidate oils and not reference oils.
 - (2) OHT has purchased a lifetime supply of BC2 engines.
 - (3) Toyota did not move production of these engines from Japan to India like they originally planned.
 - (4) Lubrizol asked if the laboratories should switch to BC2 engines for prove-out testing.
 - (a) Intertek replied that they want to run the BC1 engines to use up the inventory.
 - (b) Intertek does not expect any batch-to-batch variation.

b) New Keyence Software:

- i) Exxon's Keyence was purchased with the Generation-2 (G2) software.
- ii) Lubrizol noted that the G1 and G2 software are stand-alone programs.
 - (1) As a result, labs can switch back and forth between the two versions if needed.
- iii) Southwest has submitted a purchase order request but has not yet placed their order.
- iv) Intertek has the G2 software installed.
 - (1) They noted that new templates will need to be developed.
- v) Afton has the G2 software installed.
- vi) The new software will probably require new settings.
 - (1) There will be a tradeoff between accuracy and measurement time.
- vii) Intertek will schedule a sub-group meeting to discuss this further.
- viii) Lubrizol's Proposal:**
 - (1) Lubrizol would like to work directly with one other lab to evaluate key software settings and prototype templates.
 - (a) This may include a mini-round robin between the two labs.
 - (2) A metrology workshop will then be held so that Lubrizol and the other lab can share their findings with the rest of the Industry.
 - (a) This will provide the opportunity for all (5) labs to agree on final settings and templates.
 - (3) Conduct a full, (5) lab round-robin with the final settings and templates.
- ix) The Surveillance Panel will need to decide whether the PDI measurements can be removed from the procedure.
 - (1) The statisticians will need to compare the PDI measurements to Keyence measurements collected with the G2 software.

c) Review of Recent Lubrizol Motion:

- i) On 07-14-2017, Lubrizol submitted the following email motion to the Surveillance Panel:**
 - (1) *"Technical drawings for the revised oil pan pick-up tube design (which include a 90° downward-facing elbow and an oil well with drain plug) will be added to the Sequence IVB ASTM procedure. Each lab will be responsible for implementing these modifications and ensuring that the pan is compliant with the procedural prints. This compliance will be subject to review during routine TMC laboratory audits."*
 - (2) This motion was seconded by Southwest.
- ii) This motion involves two issues:**
 - (1) *Should the labs be able to modify their own oil pans, or should all modifications be made by an approved vendor?*
 - (a) This question aligns with recent debates being discussed at other levels in ASTM.
 - (2) *Should any prove-out tests be conducted before the oil pan modifications are implemented?*
 - (a) Lubrizol's position is that oil pump starvation is the biggest challenge facing the Sequence IVB test.
 - (b) As a result, Lubrizol believes that no further testing should be conducted without the pick-up tube modifications in place.
- iii) Infineum's Comments:**
 - (1) They are pleased with the recent Lubrizol oil level trials.
 - (2) However, the oil pan is a critical part.
 - (a) As a result, all modifications should be done by one lab or one supplier.
 - (3) They would like to see (5) modified oil pans supplied to the development labs in a timely manner to avoid additional delays.
 - (4) There is an offer from OHT to supply these modified oil pans at no cost.
 - (a) The Surveillance Panel should accept this offer.
 - (b) This will avoid overcomplicating the situation.
- iv) Toyota's Comments:**

- (1) They want the oil pan modifications performed by one supplier.
- (2) It makes sense to have OHT update the pick-up tube because they are already modifying the stock oil pan (dipstick tube, additional drain plug, etc.).

v) Chevron's Comments:

- (1) They support the Lubrizol oil-well design.
- (2) However, the Lubrizol drawings will need to be updated with tolerances before they can be added to the procedure.
 - (a) There will also need to be some way to pressure check the modified pick-up tubes to confirm that there are no leaks within the welds.
- (3) Chevron does not care who the supplier is as long as it is a single source.

vi) Intertek's Comments:

- (1) All oil pan modifications need to be in place for the Precision Matrix.
- (2) During the last conference call, the Surveillance Panel did agree to allow the laboratories to modify their own oil pans for prove-out testing.

vii) TMC's Comments:

- (1) *Is it possible to get the modified oil pans from OHT sooner rather than later?*

viii) OHT's Comments:

- (1) They are currently performing an engineering review of the latest Lubrizol design.
- (2) They are also contacting vendors about performing the modifications.
- (3) They anticipate a lead time of around 2-4 weeks.
- (4) OHT offered to modify existing oil pans that are in the field at no charge.
- (5) During the conference call, OHT reviewed a 3-D model that uses a slotted pick-up tube design instead of Lubrizol's oil-well design.
 - (a) They feel that the slotted design is easier to fabricate.

ix) Lubrizol's Comments:

- (1) Lubrizol believes that the oil-well is the best design option for extremely low oil levels.
- (2) However, a slotted design will definitely reduce oil starvation – especially now that the initial oil charge has been increased.
- (3) Lubrizol is willing to run a quick oil pressure analysis with OHT's slotted design.
 - (a) Afton would like to see the results from this trial before they finalize their opinion.

x) The general consensus among the Surveillance Panel is that they have no objections to the OHT slotted design proposal.

- (1) They also confirmed that they have no expectation for a sight glass in the new oil pans.

xi) Lubrizol agreed to withdraw its motion without a vote.

xii) Southwest is currently modifying one of their oil pans with an oil-well.

- (1) They will probably stop this work as a result of this discussion.

d) Discussion About Oil Separators:

- i) Intertek, Southwest and Lubrizol have conducted over (40) tests with the oil separator in place.
- ii) The oil separator was moved below the heat exchanger as a result of an issue on the Lubrizol stand.
 - (1) Lubrizol's heat exchanger was becoming clogged with emulsion when the separator was above the heat exchanger.
 - (2) Lubrizol has not experienced this problem since the oil separator was moved below the heat exchanger.
- iii) Intertek suggested collecting test results with the latest changes (i.e. larger oil charge, lower sulfur fuel, revised oil pan, etc.) before the decision is made to remove the oil separator.
 - (1) Intertek is worried that removing the oil separator could lead to higher oil consumption or clogging in the external blowby system.

iv) Toyota's Comments:

(1) Is the oil separator actually keeping oil in the engine, or is it contributing to the production of emulsion outside of the engine [in the external blowby system]?

v) Southwest's Comments:

- (1) Southwest is concerned that the oil separator is acting like its own heat exchanger.
 - (a) This concern drove their recommendation to remove it from the stand.
- (2) They have no issue leaving the oil separator in place for now if that is the desire of the Surveillance Panel.

vi) Intertek's Comments:

- (1) They agree with Southwest's assertion that the temperature of the oil separator could be an issue.
- (2) They have seen the blowby gas temperature range from 27°C-33°C as it leaves the rocker arm cover.
 - (a) This variation is a big concern.
 - (b) This could be influenced by the oil separator.
- (3) There is just not enough data available to show how the separator impacts test results.
- (4) Intertek confirmed that all Golden Stands are using the same oil separator part number.

vii) Afton's Comments:

- (1) They would like to remove the oil separator because it would simplify the external oil system.
- (2) Keeping the oil separator in place without controlling its temperature will do more harm than good.
- (3) Experience with the oil separator from the Chain Wear Test cannot be used in this situation.
 - (a) The Chain Wear test has much higher blowby flow rates.
- (4) One possibility would be to insulate the oil separator.

viii) Southwest's Comments:

- (1) Their stands have a thermocouple between the oil separator and the heat exchanger.
 - (a) This thermocouple has been in place for several tests.
- (2) They will mine their blowby gas temperature data and provide a summary to the Surveillance Panel.

ix) Infineum's Comments:

- (1) They would like to leave the oil separator in place but add insulation to help reduce variations in temperature.
- x) The Surveillance Panel agreed to defer any decision about removing the oil separator until after the summary from Southwest is available for review.

e) Procedure Review:

- i) Lubrizol requested a review of the draft procedure before any further testing is conducted.
- ii) Intertek had already scheduled a procedure review prior to the Precision Matrix.
 - (1) However, Lubrizol is requesting one before the prove-out testing.
- iii) Southwest has a draft procedure that they will send to the Surveillance Panel.
 - (1) TMC will need to post this to their website.
- iv) Afton would like to archive all previous procedure documents that are on the TMC website.
 - (1) The latest draft from Southwest should be the only document in the active folder.

Action Items	Person responsible	Completion Date
OHT to donate Batch Code-1 engines for prove-out testing. <ul style="list-style-type: none"> • (2) donated engines already sent to IAR and SWRI • (4) additional donated engines to IAR, SWRI, XOM and LZ 	OHT	

Action Items	Person responsible	Completion Date
<ul style="list-style-type: none"> Total Number of Donated Engines = 6 		
Statisticians to compare Keyence, PDI and mass loss measurements from (13) completed Precision Matrix tests.	Buscher, Statisticians	
Establish Metrology sub-team and schedule first conference call.	Buscher	
Intertek to re-install Lubrizol's modified oil pan (with sight glass) and conduct additional oil level experiments.	Intertek	
Compile summary of blowby temperature data on SWRI stands to further study impact of oil separator.	Southwest	
Expedite machining and modification of one OHT oil pan with slotted pick-up tube design discussed in today's conference call. Lubrizol will repeat oil level studies with this oil pan.	OHT, Lubrizol	
Intertek to develop strategy for insulating oil separator.	Intertek	
Schedule procedure review sub-team.	Buscher	
Review draft procedure.	TBD	

Follow-up Notes/Updates:	Initials	Date Added



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SEQUENCE IV SURVEILLANCE PANEL**

July 19, 2017

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SEQUENCE IV SURVEILLANCE PANEL**

July 19, 2017

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Sequence IV Surveillance Panel

Conference Call

July 19, 2017

8:30 a.m. - 11:00 a.m.

A G E N D A

1. Previous action item review
2. Haltermann KA24E Green fuel status:
 - i. Update from Haltermann.
 - ii. Update from labs.
3. Sequence IVB hardware status:
 - i. Update from OHT on chamfering Batch Code C intake camshafts.
 - ii. Update from OHT and/or Toyota on status of next batches of critical hardware.
4. Keyence VR-3000 3D Measurement System software upgrade status:
 - i. Update from labs on purchase of version G2 software.
 - ii. Discussion on settings and Sequence IVB lifter templates for version G2 software.
5. Discussion and vote on the following motion:

Motion: "Technical drawings for the revised oil pan pick-up tube design (which include a 90° downward-facing elbow and an oil well with drain plug) will be added to the Sequence IVB ASTM procedure. Each lab will be responsible for implementing these modifications and ensuring that the pan is compliant with the procedural prints. This compliance will be subject to review during routine TMC laboratory audits."

Chris Mileti / Pat Lang /
6. Discussion on concern of removing the oil separator
7. Discussion on timing of oil pan modifications and possibly conducting Row 1 prove-out tests w/o oil pan modifications
8. Discussion on procedure review

9. Sequence IVB next steps
10. Sequence IVB timeline review
11. Motion and action item review
12. Next meeting
13. Adjourn

Sequence IV Surveillance Panel
July 19, 2017
8:30AM – 11:00AM
Conference Call

Motions and Action Items

As Recorded at the Meeting by Bill Buscher

1. Action Item – OHT to donate 4 additional Batch Code 1 engines (p/n OHTIVB-16000-1) to the testing labs for prove-out testing. OHT to ship ExxonMobil, Lubrizol, SwRI and Intertek 1 engine each. This will provide a total of 6 donated Batch Code 1 engines, so that each stand will start prove-out testing on a new Batch Code 1 engine.
2. Action Item – Surveillance panel chair to create an Excel database with all of the individual Keyence, PDI and mass loss lifter wear results from the 13 completed Sequence IVB precision matrix tests, and then provide it to the statistician group.
3. Action Item – Surveillance panel chair to establish a metrology sub-group, including engineering and metrology representation from Afton, ExxonMobil, Lubrizol, SwRI and Intertek. The objective of this sub-group will be to facilitate the Keyence VR-3000 3D Measurement System software upgrade (including determining settings, creating lifter templates and updating the Keyence procedure within the Sequence IVB draft procedure), coordinating a metrology workshop and reviewing the statistician group's analysis of the Keyence, PDI and mass loss lifter wear results from the 13 completed Sequence IVB precision matrix tests, to determine if the PDI and mass loss measurements can be dropped.
4. Action Item – Surveillance panel chair to schedule the first metrology sub-group conference call for later this week.
5. Action Item – Intertek to reinstall the Lubrizol modified oil pan and conduct the oil level/pressure/aeration experiment, including video recording at a 2000 ml oil level and possibly a few other oil levels.

6. Action Item – OHT to expedite machining and modification of one OHT modified oil pan (p/n OHTIVB-022-1) with the alternate design which was review during today's conference call.
7. Action Item – Once available, OHT to deliver this oil pan to Lubrizol, and Lubrizol to repeat their oil level/pressure/aeration experiment on this oil pan.
8. Action Item – Once the design of the additional oil pan modifications has been finalized and approved by this surveillance panel, all labs are to return their OHT modified oil pans (p/n OHTIVB-022-1) to OHT for the additional modifications to be performed, free of charge.
9. Action Item – Intertek to develop a procedure and materials specification for insulating the oil separator.
10. Action Item – Surveillance panel chair to solicit surveillance panel members for interest in joining the Sequence IVB procedural review sub-group.
11. Action Item – Surveillance panel chair to schedule the first Sequence IVB procedural review sub-group conference call for next week.
12. Action Item – Members of the Sequence IVB procedural review sub-group to start reviewing the latest Sequence IVB draft procedure, posted on the ASTM TMC's website, and to send all feedback on the test procedure to Chris Mileti at Lubrizol, for him to compile.