

Sequence III Surveillance Panel

Teleconference

January 11, 2017 09:00 – 10:30 CST

WebEx sent separately

Agenda

1.0) Attendance

Note: Jeff is unavailable so I will need a secretary for the meeting.

Dave Passmore has requested to become a voting member, the panel agreed to this request.

Voting Members Present: Ed Altman, Jeff Betz, Jason Bowden, Tim Caudill (Amol Savant acting as proxy), Rich Grundza, Jeff Hsu (Karin Haumann acting as proxy), Dan Lanctot, Patrick Lang (Ankit Chaudhry acting as proxy), Addison Schweitzer, Kaustav Sinha, Thomas Smith, George Szappanos, Haiying Tang, Doyle Boese, Andy Ritchie, and Cliff Salvesson

16 out of 22 voting members present, quorum achieved.

2.0) Chairman Comments

3.0) Approval of minutes

3.1) Minutes from 11/15/2016 WebEx Conference

Minutes approved.

4.0) Action Item Review

4.1) IAR BC3 Experiment. **Schweitzer.**

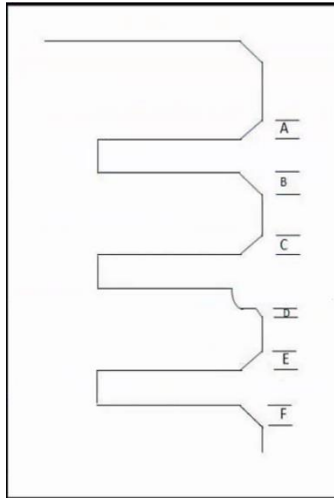
Addison Schweitzer presented two experimental tests performed at IAR to gauge impacts on test severity with TMC RO 438-1 and BC3 hardware. The first experiment was performed with a modified PCV valve with the camshaft seal removed to improve condensate drain-back using BC3 hardware. Although the first experiment produced results within 1.5 standard deviations of target on 438-1, it was not pursued further due to the high level of oil consumption experienced. The second experiment was performed with modified OEM piston ring gaps (Top = 0.020", Second = 0.030") on BC3 pistons. The second experiment produced results within 1.04 standard deviations of target on 438-1. The experimental test with modified ring gaps showed a more mild PVIS and MRV response, whereas WPD and PRET remained relatively unchanged when compared to historical 438-1 reference results on previous batch code hardware. A noticeable difference was identified in blowby levels, TBN-TAN delta performance, final TAN, and final oil consumption as compared against BC3 performance versus previous batch codes. In summary, IAR recommended that the Sequence III Surveillance Panel and Chrysler further pursue additional testing with modified ring gaps. Addison stated that he was open to exploring alternate ring gapping strategies to further dial in severity with historic performance levels. Addison stressed that ideally the BC4 piston rings from OHT had not been gapped and could be used for experimentation, however that production rings have been confirmed to be available that could be gapped by OHT. George Szappanos of Lubrizol also performed an experiment on an internal reference oil with the same piston ring gapping strategy (Top = 0.020", Second = 0.030") but the result had similar PVIS and WPD to a previous result on BC3 hardware. Amol Savant of Valvoline committed that he would be willing to donate an experimental test with modified ring gaps to provide additional data.

Amol Savant commented that he had tried a similar experiment with ring gap reduction on production rings and did see a lower blowby using oil 438 but the test was still too severe.

George Szappanos from LZ also commented that he conducted some testing with reduced ring gaps yielding a reduction in initial blowby of approximately 10 LPM. On a LZ reference oil, he observed no change in WPD performance and a slight reduction in percent viscosity increase. He cautioned the group that the ring gap change by itself may not correct the current severity issue.

4.2) SwRI BC2 BC3 blowby experiment. **Chaudhry.**

Ankit Chaudhry presented experiments performed on BC2 and BC3 hardware. The experiment consisted of 6 iterations. The preliminary experimental data (iteration 1 through 4) was presented at the face to face SP meeting on 11/15/2016. Iteration 5 was performed by modifying chamfer D from 0.056 mm to 0.199 mm and re-running the test to see impacts on blowby. Iteration 6 was performed by modifying chamfer B from 0.085 to 0.178 mm to see impacts on blowby.



Jason Bowden questioned how the chamfer modifications were chosen. Ankit clarified that the measurements were obtained in a single location on the piston and an average chamfer was selected based on the previous batch codes. The modification to chamfer D did not change the blowby values seen previously in the experiment, however modifying chamfer B did show an increase in blowby values. Ankit cautioned that the increase in blowby could have been a stack-up effect and would need further investigation. Once the six iterations were completed, the original BC3 pistons were cleaned and installed to confirm blowby had not shifted. The blowby did not return to the original level of blowby from the third iteration. Ankit commented that their conclusion was that the engine hours may affect blowby levels over time. Ankit proposed that the path forward would be to acquire another used engine to perform a baseline with used BC3 pistons, a baseline with used BC2 pistons, machine chamfer “B” only on BC2 pistons (iteration 6), and repeat the used BC3 piston test to confirm blowby severity levels return. The panel was in agreement with this proposal. In summary SwRI views the potential chamfer change a long term solution with the goal of changing the piston blueprint to reflect the appropriate chamfer dimensions so all future batches would be made according to the revised print.

4.3) Batch 3 piston data analysis. **Martinez.**

Jo Martinez presented the statistical review of the BC3 pistons effect on IIIH test severity on behalf of the statistical group. The statistical analysis shows that BC3 pistons are marginally more severe than BC2 on PVIS, whereas WPD and MRV are not significantly different. The initial and six hour blowby values as well as the oil consumption on BC3 pistons are higher than BC2 pistons. Inconsistent oil response on BC3 pistons show that PVIS has lost discrimination between 434-2 and 436 and between 434-2 and 438-1. It appears that 434-2 and 438-1 PVIS have reversed ranking, and MRV discrimination has been lost amongst all oils. Jo stressed that

not all stands are showing the same severity trends. Three options were presented: do nothing LTMS is working, apply ICF's, or apply a fast start reset LTMS to BC3 pistons. In conclusion, applying a correction factor or severity adjustments cannot overcome PVIS ranking reversal of 434-2 and 438-1 and none of the mathematical options are recommended at this time. The statistical group recommends further investigation of the root cause at this time.

Robert Stockwell asked if the tests that were severe on viscosity increase and didn't go full length should be added to the data review to see if it would help choosing the path forward. Stats members commented that this would give a bigger SA but would not fix the reversal of 434-2 and 438.

Karin Haumann reminded the group that oil 438 was used during development as the low performing WPD oil and it was recognized that this oil was erratic on PVIS.

4.4) Issues with test report forms. **Grundza.**

- 1) The forms indicate test number as Stand, stand run, lab run. Since this is a stand based system, they should be stand, runs on stand since last reference, and total number of runs on stand or stand run. There is some confusion on how to handle this and clarifying this would address it

Rich clarified what was needed on the call.

- 2) Form 5 AFR left and right need to be moved to non-controlled section
- 3) Do we wish to remove MRV and PHOS from the IIIH forms as these are now treated as "separate" tests

The panel agreed that the MRV and PRET results could be removed from the IIIH forms. Bob questioned if one report could be used with indicators for IIIH/IIIHA/IIIHB. Rich stated if we could do this, then we can revisit 3) at another time.

4.4) Status of IIIH industry alarms. **Grundza.**

4.5) Infineum presentation. **Ritchie.**

Andy Ritchie presented IIIH reference data with BC3 pistons and outlined their concerns. Andy mentioned that the data presented by SwRI should be used to generate the next batch code of pistons through OHT. Andy confirmed with Jo that no mathematical solution could be formulated to resolve the severity issue at this time on the IIIH. Infineum does not believe that the approach of doing nothing and letting LTMS work will suffice. Slide 7 of the presentation showed that 6 of the last 10 WPD results on BC3 pistons have exceeded the EWMA Action Limit. Slide 8 of the presentation showed that 5 of the last 9 PVIS results have exceeded the EWMA Action limit. The MRV EWMA chart is similar to PVIS but slightly less severe. The WPD CUSUM plot is concerning with the variability seen between batch codes of hardware. A similar behavior was shown on the PVIS and MRV CUSUM plots. Andy stated that the comment that the test has returned to the severity seen in the precision matrix was valid, but that the PVIS, WPD, and MRV CUSUM plots showed that the test is in distress. In summary, the PVIS is trending severe and is in EWMA action alarm on BC3 pistons, the WPD is trending severe and are bouncing between EWMA warning and action alarms, the MRV is trending severe and approaching the EWMA warning alarm. Andy then presented candidate data from a test performed on BC2 versus BC3 hardware and demonstrated that Infineum believes that the test has shifted severe by at least 20 hours. Following Andy's presentation, he made the following motion:

MOTION:

Andy Ritchie made a motion to the surveillance panel that the IIIH and IIIHA tests are to be declared out of control.

Thomas Smith seconded the motion

10 For

3 Against

2 Waive

The recommendation requires a $\frac{3}{4}$ approval vote of voting members. This voting rule is under 3a and available on the TMC webpage. This will need to be brought up to the higher body for determination of the result of this motion. There is uncertainty as to whether or not the waives are considered in the total vote count when determining if we have a $\frac{3}{4}$ approval vote. The negative votes would have to be put in writing and support it for discussion next week.

Discussion:

Bob Campbell questioned what would this declaration mean to the industry since this motion does not affect licensing at this time. Rich provided some clarification that the labs would work towards a solution and suspend calibration status. Bob Campbell stressed that the group has analyzed data to try to provide a correction and a path forward but that the process has been slow going. Bob agrees with Andy that the IIIH test is not where it is supposed to be and something needs to be done to fix it. Karin questioned if the test could be declared out of control when the reference data is not significantly different than the precision matrix. Todd Dvorak stated that there is marginal significant difference for PVIS noted since the precision matrix on BC3 pistons. Bob questioned Jason how long a new batch code of pistons would take to generate. Jason stated that without knowing where the chamfers needed to be, he could only provide a rough estimate. Jason confirmed that OHT expects the order of BC4 piston rings to be delivered this month (currently in the inspection process and ring gaps have been cut). Jason confirmed that the BC4 piston hardware should last about 6 months. Jason expects delivery of the BC4 pistons the third week of March (considering shrinking lead time). The remaining BC3 piston rings will likely last to the end of the month, the current inventory of BC3 pistons is expected to be depleted by the end of March. OHT is willing to generate another batch code of pistons if needed. OHT is also in the process with the vendor to analyze several BC2/BC3 piston sets provided by the industry test labs to ascertain differences or drivers in test severity. Bob questioned if a modification could be made to the BC4 pistons that are currently being manufactured. Jason stated that there are options to modify a small batch of pistons based on input from the panel. Bob questioned if OHT could match chamfers as BC2 for BC4 pistons scheduled for release in March. Jason stated that the chamfers would meet the blueprint and the supplier stated that they can't change the tolerance on the chamfers; the only option would be to not include chamfers (not recommended by piston supplier). Bob Campbell comments that we should

put more pressure on the supplier to meet our desired chamfer tolerance.

Bob and Robert agreed that another conference call needs to be scheduled for next week to have further discussions.

4.6) Lubrizol presentation. **Szappanos.**

5.0) Old Business

5.1) Update from TEI; parts cleaner soap. **Lanctot.**

5.2) IIIHA/IIIHB equivalency to IIIGA/IIIGB. ???

5.3) Update from CLOG on IIIH/IIIF correlation matrix. **Farber / Grundza**

5.4) IIIH procedural items to correct:

Comments:

Phil Davies:

Spelling of phosphorus.

Addison Schweitzer:

X1. SEQUENCE IIIHA TEST PROCEDURE

X1.3.1 There is no stand-alone calibration system for the Sequence IIIHA test. Consider any stand that is calibrated for Sequence IIIH testing to be calibrated for Sequence IIIHA testing. Conduct a Sequence IIIHA test simultaneously with each Sequence IIIH test. **It is my understanding from the interpretation of the current LTMS that the IIIH/IIIHA/IIIHB can be calibrated separately or together. X1.3.1 will need to be modified to reflect this if this is the intention of the LTMS.**

X1.3.3 No severity adjustments are calculated for MRV. **The IIIHA does have severity adjustments calculated for MRV, this appears to have been pulled directly from the IIIGA procedure. X1.3.3 will need to be modified or removed.**

X1.5.1.2 Start the MRV test within ~~168~~ 504 hours of EOT of the engine test. **The MRV test is specified to start within 504 hours per the current IIIGA procedure, the 168 hour specification appears to be referencing an outdated version of the IIIGA procedure.**

X2. SEQUENCE IIIHB TEST PROCEDURE

X2.3.1 There is no stand-alone calibration system for the Sequence IIIHB test. A stand that is calibrated for the Sequence IIIH is also calibrated for Sequence IIIHB testing. Conduct a Sequence IIIHB test simultaneously with each Sequence IIIH reference oil test. **It is my understanding from the interpretation of the current LTMS that the IIIH/IIIHA/IIIHB can be calibrated separately or together. X1.3.1 will need to be modified to reflect this if this is the intention of the LTMS.**

Other corrections?

Do we agree with these changes? If yes I will ask Terry to make the changes and send the procedure out for ballot.

5.5) Sequence IIIH Batch Code 3 piston update. **All**

Review of existing data with Batch Code 3 pistons for potential correction factor.

Discussion of potential use of LTMS to facilitate correction.

Life expectancy of Batch code 3 pistons? Quantity available? Timing for BC 4.

Is there a need to bring Batch Code 4 pistons into use with RO tests?

6.0) New Business

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7.0) Review / Update Scope and Objectives

8.0) Next Meeting

Wednesday January 18, 2017 at 9:00 AM CST

9.0) Meeting Adjourned

Meeting Adjourned at 11:35 AM CST