

May 31, 2017

Caterpillar Surveillance Panel Teleconference Minutes

Teleconference Attendees:

Jim Gutzwiller (Chairman), Elisa Santos, Bob Salgueiro, Gang Hu – Infineum

Jim McCord, Jim Carroll (Secretary), Travis Kostan– SwRI

Hind Abi-Akar – Caterpillar

Alex Ebner, Kevin O'Malley Andrew Stevens – Lubrizol

Greg Shank -Volvo

Tim Griffin, Jim Moritz – Intertek

Barb Goodrich- John Deere

Sean Moyer - TMC

Christian Porter, Abaigeal Ritzenthaler - Afton

Jim Rutherford, Mark Cooper – Chevron-Oronite

Dan Lanctot - TEI

Agenda: Discuss SwRI findings from Full COAT test run with 832 reference oil and Micromotion Sensor's RTD controlled to 90C.

Elisa Santos showed the operational data from the latest reference tests with the 10th data set being the fourth test from SwRI with RTD temperature controlled to 90°C. (See attached file.)

Hind: Do fuel flow pressure and exhaust temperature impact aeration?

Tim: No

Alex: Oil gallery pressure between tests A3 and A4 changed.

McCord: This was discussed during the last tests

Comment: Lab A tests are the lowest oil filter-in pressure.

Moritz: Could be a leak.

McCord and Moritz: Gallery pressures are good.

Moritz: There could be a bypass. Might be worth investigation. If all oil is not going through the filter.

Alex: If you put all lab A's plots of oil gallery pressure on top of each other the fourth test looks different. I would assume the pressure controller would also change.

Tim: It's only a 2 kPa difference.

Alex: Looking at differences in the 4th test

Sean: Do you really think aeration would change?

Alex: I don't know.

McCord: We discussed controlling this during development.

Sean: Does anyone think this affects anything?

Alex: Lab B has the lowest pressure. I just note this as a difference.

Rutherford: Does this track across labs?

Alex: In the main, yes.

Hind: How could we control oil pressure?

McCord: We could set up a bypass, or stack shims on internal valves. This could add another cavitation spot. We could check other 832 oil pressures. Don't think it was affected by 90°C control. When we discussed a bypass loop previously we did not think it would impact aeration.

Hind: Are we saying the difference of lab B to lab A and C is something we need to address?

McCord: No.

Hind: Does anyone see something we can do?

Moritz: Not really.

Hind: Could this be taken care of by engine to engine differences and SAs?

McCord: Yes but it doesn't track with the SA of the lab. Exhaust temperature does seem to track with SA but it could be a coincidence.

McCord: There may be hardware difference. I would expect the pressures to be closer together.

Rutherford: During the matrix we saw a shift in P in all labs.

McCord: CAT has made a change in the regulator, the spring has changed. I had a spring that was failing in another C13 and put the new one in. The old PN is no longer good.

Rutherford put oil gallery pressure data from the old Matrix on screen.

Alex: Within an oil I would expect that gallery P would correlate to actual aeration of the oil. When oil becomes aerated it becomes more compressible.

Hind: Within each lab these are within 20 kPa.

McCord: What differences have you seen?

Alex: That is what I would expect but I have not done a comparison.

Rutherford: There are two variables with the data called POILG

A: The difference is in the units of kPaA vs kPaG.

Tim: You threw out my first 6 tests. And some of SwRI's were discarded due to a kinked line.

Rutherford: Oil P is higher now than during the first matrix

Hind: Is this engine aging?

McCord: We replaced the filter block after the matrix.

Hind: Are these levers that could impact aeration?

McCord: According to CAT these values are within their specs.

Hind: We need to understand the value of controlling Oil P.

Elisa showed the next graph.

McCord: As far as labs go, is everyone taking a snapshot of 30 second data, or an average?

All labs are taking snapshots.

Tim: Why does your SwRI data go from 150 to 84 immediately? Should be able to see it dropping.

Next graph: FDM T in and out, and FDM Pin and Pout

Moritz: This is pretty significant.

Hind: Isn't this controlled by the valve?

Moritz: Not the Delta P.

McCord: The pressure lines could be different.

Moritz: Is everyone using the same output from the sensor for flow?

Tim: Yes, it's an analog output.

McCord: There were early studies showing there was no impact on aeration

Tim: That's true.

McCord: Pressures are more sensitive.

Moritz: If we are not truly at 84kPa it could affect the reading.

Moritz: It appears that the thermocouple in and out are reversed.

Carroll and McCord stated that the temps are correct. Heat flux, location of heaters, fans, can all affect local temperature.

Comment: Delta T is larger during test 4 at SwRI.

Alex: They had an elevated calibration box temp of 96C, so we would expect this.

Moritz: It still doesn't feel right.

Alex: Sample oil temp is still good.

Tim: What gets the RTD to 90C? Is the heated line hotter, mine runs lower than that?

Alex: There are multiple ways to get the RTD to 90. And this changes other temps.

Sean: SwRI's heated line is running at a lower duty cycle. Does everyone record this?

Tim: Not the duty cycle

Moritz: What's the point?

McCord: To get the RTD to 90C.

Alex: There is no way following the procedure to do this

Sean: I would not have known without SwRI telling me.

Alex: The location of the enclosure thermocouple is specified above the sensor.

McCord: The big deal here is we need some way to get all the labs to run correctly.

Moritz: I think the delta P across the sensor is important.

Q: How important is the RTD temperature?

McCord: It is our matching D4052 density that is the right thing to do.

Moritz: Can the sensor take 90C?

McCord: Yes.

Moritz: What about the transducers? They would have to be moved. I think there may be other reasons for the RTD to be different

Tim: Output for ours is read digitally. There are slight slope differences.

McCord: We hook up the lap top to match its output to the significant figures in our DAQ.

Alex: We do to.

Tim: I would suggest we control the box to 90C.

McCord: I disagree. If you do, you won't control the RTD temperature. Internal box was not heated previously

Alex: When was that box put in?

McCord: The box was added with the calibration test update. This was discussed during the smaller task force meetings.

Alex: When was the TC moved?

McCord: The box was the same until we made modifications for the density calibration procedure. The walls of the box were there but not the door during the first 3 tests.

Jim G: Elisa, do you have more graphs?

Elisa showed plots of Pin and Pout.

Hind: We have done this for many years. Are the delta's significant? They are consistent at each lab.

Tim: Scaling is different. Not to say they are not calibrated.

Alex: Flow comes from sensor and we know that the density is not significantly affected by it.

Hind: I want to take us back to the goal. Can we take more data?

Sean: I would like the sensor RTD temp put into the reports.

Tim: Is it uncontrolled and just to monitor? I want the TIn and Tout kept in.

Moritz: I motion to include RTD temperature in the report.

Sean: Make it part of the procedure

Jim G: No opposed. No waives. Motion carries.

Moritz: Can the pictures be shared? I don't have them.

McCord: The TC in the box is coming in from the side.

A motion was made to have the 9 tests added to the matrix.

McCord: Without controlling RTD it is a mistake to move forward.

Hind: Is the idea that the other labs can't control to 90C?

Tim: I can start it today and run for a few hours. I want to see. If raising it to 90 makes a 1% difference then we will have to.

Hind: Can we correlate the data if we have two labs.

Hind to McCord: Is density linearly affected?

McCord: It appears to be.

Moritz It will take 2 tests at each lab minimum to check.

Alex: We need to compare the aeration curves.

Jim G: We need the raw numbers to line everything up.

Action: All labs send a test time vs aeration value to Sean.

Alex: The setup at SwRI does not seem to be by the procedure.

The panel went back to the motion to turning the test back on.

Hind: If this motion passes, will this start the tests?

Moritz: Yes

McCord: Didn't the statisticians have three suggestions?

Earlier Panel Consensus: Need to collect more data faster and the majority supported moving forward at this point with options 1 and 2 below

- Option 1: No change to the current standard deviation

- Lab A has Zi alarm

- Option 2: Update std using all the data

- Lab A has Zi alarm

- Option 3: Update std using 9 recent tests

- Lab A has Zi alarm

McCord: The last test at Lab A was donated, it is not a reference test.

Jim G: Last test should not be used

Moritz: Only if everyone went to 90C RTD temperature.

Alex: We could use option 1.

Hind to Elisa: What do you think of option1?

Elisa: It is possible.

Rutherford: If it is option 1, we should also discuss if the Zi limits should be updated.

Moritz: Why?

Rutherford: We stated that it is fairly arbitrary. We have never really come up with a check of this. We have not statistically evaluated it.

Alex: The three tests from A are potentially not valid.

McCord: It may not be invalid. Look at the fittings outlet. Appendix 7.1 7.2

Sean: McCord needs to talk to me about test validity.

Jim G to statisticians: Did you have a suggestion for the Zi limit?

Elisa: No

Moritz: Is the objective to get Lab A in?

McCord: The precision is better, separation is better, data repeats with a lower Zi.

Moritz: If the tests are valid and we need to adjust the Zi then we can do this later.

Tim: The tubing seems to be too short at Lab A.

A motion was made to restart the test under Option 1.

Jim G: Any more discussion? We need a roll call vote.

Sean: Are all the labs ready to get RTD input to the reports as an emergency fix?

McCord: Need the field size.

Alex: and field name.

Moritz: You have our support.

Intertek - for
Afton- for
Lubrizol - for
Oronite - waive
Caterpillar – for
SwRI - against
Deere - no answer
Infineum - for
TMC - waived

Motion carried. It does not need to be unanimous.

Hind: Can we see the option we are choosing?

Elisa put up Option 1.

Rutherford: This does leave an industry alarm.

Jim G: We need to continue work on this

Hind: Should we setup meetings for this?

Jim G: We will continue to have meetings.

McCord: Are we stating that the filter change had not enough of a measurable difference to make any changes?

Elisa: I don't think we are saying this. We should continue to collect data to ensure how and why we need to correct.

Cooper: Need to clarify how long it will take to implement the addition of RTD temp.

Sean: We need an emergency response from labs to get it done fast. We could get it done by the end of next week if everyone agrees.

Cooper: Can all the labs do it?

Yes, from all the labs.

Rutherford: There was discussion of reducing reference intervals.

Q: Should we shorten reference intervals?

Moritz: Temporarily shorten the interval to four tests.

Sean: If we have biweekly meetings then we can keep up with it.

Moritz: Should we shorten the time of reference?

Hind: Can we start candidate testing now?

Moritz: Once tests are processed through TMC.

Jim G: Can we get a motion for number of references going forward?

Alex made a motion that the next reference period be four candidate tests, or 6 months, whichever comes first.

Alex: And, we can extend it if needed for data collection.

Jim G: Seconded the motion.

Hind: 6 months is long.

Moritz: Make it 3 months.

Hind: What is reasonable?

Moritz: It depends on work load.

Hind: Workload does not seem to be intense. Six months seems generous.

Jim G asked if any were opposed.

None opposed. TMC waived. **Motion carried.**