

**May 18, 2018**

**Caterpillar Surveillance Panel COAT Engineering Group Teleconference Minutes**

Conference Attendees:

Hind Abi-Akar, Mark Jarrett – Caterpillar

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

Tim Griffin, Jim Moritz – Intertek

Demetrius Lytle, Alex Ebner - Lubrizol

Jim Carroll (Secretary), Jim McCord - SwRI

Christian Porter- Afton

Sean Moyer – TMC

Mark Cooper – Chevron

**AGENDA ITEMS**

1. MicroMotion Calibration technique and data (fill-in Ops Data spreadsheet (all columns))
  - Review how labs performed the MM calibration
  - Data file with 30 minutes of data to show stabilization and then 2 minutes of 1Hz data logged for calculations ( @ each specified temperature 50, 60, 70, 80, and 90 C )
  - Review data from stabilization period and the 2 minutes of data used for each temperature density calibration check
  - Review how to handle data, plot data and generate regression line and equation
  - Report GAIN and OFFSET (this will be going into the LTMS file – reading back through old meeting minutes)
  
2. I have some questions about what data is in some of the columns from the 9 tests that have been run and sent out to the group.
  - Verify that each lab is entering the same data in each column of the Ops Data file (raw signal or filtered , MicroMotion channels - analog or digital or Modbus or analog Density, Frequency)
  - Lab A - 832, 833 and CAT DEO (additional 832 test completed week of May 6 – data should be sent week of May 13)
  - Lab B - 832 and 833
  - Lab G - MM-System prove-out run 833 Box-B, MM-System prove-out run 833 Box-A, 833 and 832
  
3. Review Warm-up procedure

- Updated Table 3 Warmup Conditions (attached) (this would be replacement for current table on page 10 of ASTM D8047)
  - Step 2 is now 30 minutes and ADDED Step 3 of 5 minutes targeting the On-Test conditions.
  - One of the tests appears to go On-Test and run the first 15-minutes out-of-spec high between 112 to 118 kPaA for the MicroMotion Oil Pressure target (Average pressure MMinlet and MMoutlet spec. is 84 kPaA)
4. Need 1 second warm-up data from all labs
  5. Lubrizol tests on 832 and 833 with production 1R-1808 oil filters with New-Aeration measurement system
  6. Engine Oil Pressure Differences
    - Secondary oil filter block off cap 7C-9542 Is this part# used at all labs?
    - Engine Oil Pump 223-1608 was specified during the engine rebuilds before original Matrix testing
    - Oil Cooler, model and age (plugging)
      - o Is everyone using the stainless steel tube on-board engine oil cooler, 1Y-4026?
      - o Is the oil flow path and restriction the same between the 1Y-4026 SS cooler and the 236-8745 oil cooler?
      - o Have some aged to the point where there may be old, hard oil deposits restricting the oil flow?
      - o Pre-filter (pump out) oil pressure differences line up inversely with tube frequency differences on the 833 runs. I (Moritz) plotted tube frequency due to some of the uncertainty JimG mentioned.
  7. Any additional topics

JimG: We need to check that all the labs are doing things the same. Looking over the data it appears we are not. Tim sent a spreadsheet with data from the first box he built. JimG showed graphs of the data and an input table that he used.

Moritz: These are changes to the density post-test.

Tim: When I reported I sent out data without any corrections for D4052 calibration.

Moritz: So these could show differences in the labs daq.

Tim: These calcs were done before and after the change in Emerson's calibrations. They are similar. I reported all tests without corrections. When we do our calculations we end up with a 0.5% correction. We are in a very small area of correction for a wide range of calibration. It is hard to justify applying the curve fit way outside our test range.

Hind: The decimal points that change are small but it will make a big difference in aeration.

Alex: Aren't we concerned about the differentiation between oils. We looked at our data and with or without correction we see a lack of discrimination.

Tim to JimG: You can forward the spreadsheet to the other labs and have them input their cal data.

JimG: We just need to verify that all labs are doing this the same.

Elisa: Why do we have a 0.5% change now and not before.

Tim: The aeration formula changes the denominator one way the numerator the other way so you get a double effect.

Moritz: Isn't Elisa asking about the difference between today's correction and last years?

Tim: I think it's an overcorrection when we get down to 0.75 density oil. Maybe heptane could be used as a check.

McCord: Maybe diesel fuel.

Moritz: We could then use the Modbus output only.

Alex: Is everyone using Modbus to get tube frequency?

Yes, all are.

Moritz: Why would you still run the cal?

Tim: It shows we are measuring the density correctly.

Alex: Could severity adjustments correct if we do not correct our data?

Tim: Maybe, the other factor maybe that the accuracy of TCs are plus minus 2 degrees.

Alex: Now we should check the difference between test with and without the correction factor.

McCord Next time we should run the cal on the 832 oil also. Does anyone know if a 0W-20 has density below 0.8? We could run one. We could run fuel or solvent here

Alex: The reason we did the calibration was so that we didn't have to pull the meter out.

Moritz: And once it was just a verification.

Hind: Are we targeting the density because the lower the density the more effect the correction has?

McCord: That is the effect.

Hind: Before we saw discrimination, now we are applying the correction we lost discrimination.

Alex: I don't think that is the problem.

McCord: The CAT oil we ran was in the same range as we had before.

Moritz: We don't have a clear document that shows the differences between the data collected thus far with clear methodologies as to how we calculated the data.

JimG: One lab has gone back to using the single point frequency to do their calculations and another is using the 6-point average. The more I look at the data the more I realize that the different labs do things differently. Including running the warmup. One of the tests showed that the first data point started at 124kPa and other tests do not.

Tim: That may be the way the lab runs.

JimG: We need to get everything right from here on.

Sean: We have made so many changes and not updated the procedure.

Moritz: We have used a word document that lists the steps.

Sean: I would be happy to do it but I am a bit confused too. We need to get together later to come up with that document.

JimG: I need the warm up data from all the labs to compare. New data sets will need to be sent in.

Hind: did you see differences in the data you have reviewed.

JimG: I am not sure if everything I present is correct. I need to go over the OPS data with the lab engineers. They agree what each column is, its units, and name. We should do this early next week.

Hind: API has announced provisional licensing. We are on the hook in terms of time to get the test back on. I know none of us expected, that after all the improvements, we would be here.

Alex: We can come up with headers, units, and embedded formulas.

Moritz: Don't you need to put in two aeration calculations one with the cal correction and one with no cal corrections?

JimG: One of the test results changed from 12.2% to 11.1% corrected.

Alex: What do you mean corrected?.

Moritz: Is that with Emerson's calibration

JimG: I used the newest Emerson calibration coefficients.

Moritz: Some of the confusion is coming from interchangeable names for different things.

We will have a conference next Tuesday May 22, 1pm central.

#### Lubrizol Tests with Production Oil Filters.

Demetrius presented data on tests run with 833 and 832 oil with a 'previous' batch of oil filters.

Demetrius: There is 'Not much difference'.

Alex: Jim McCord you ran the CAT oil and got similar results from earlier tests.

McCord: Yes. We also used the GM aeration stirring method and re-ran the 832 oi andl we came out with a 11.8% aeration which is a 0.2 lower from the previous run.

Moritz: Is there a way we can see the data values?

Sean: These data are in the LTMS files.

Hind: I want to go back to stirring. I believe you have two phases, first at TMC, and then at the lab. Sean can you go over that.

Sean: We stir before shipping, the GM procedure requires stirring before each test.

Tim: We use a shaking table.

Sean: We pull a barrel, stir the entire barrel, and then pour from it. I looked at the time between shipment and its use at the labs and did not see a difference in results between 6 months or 12 months storage at the labs.

Alex: Older filters had steeper slopes at the start. We still have some older filters.

McCord: If other labs have oil data that is consistent or inconsistent since going to the new boxes that would be helpful.

Hind: We have 2 things, changes to the box and engine side impacts, or changes to the oils.

Sean: Has anyone checked the aeration values using the old values for calibration?

Salgueiro: We have made too many changes simultaneously and now we have to decouple changes to get back.

### Oil Pressure Data from the different labs was shown by JimG

All labs put new filter assemblies on their engines.

Moritz: Did everyone use all new hardware?

McCord and Alex: Yes.

McCord: The new oil filter assemblies have to be disassembled when we get them to have welding done and plugs put in.

Moritz: Is everyone using the same oil pump.

JimG: 3 years ago, before running the matrix, everyone put in new oil pumps.

McCord: And verified that the oil coolers were correct.

Alex: Do you have op data from the tests before this?

JimG: No, I have ops data from the filter runs but I have not rearranged the data to match these.

Alex: It might be good to compare the 833 and 832 runs at each lab (Jun/July 2017 filter runs)

JimG: I could add it together once we fix the data files.

Elisa: Among all the changes is the filter bypass the biggest change?

Mark: The whole filter housing was changed.

JimG: Intertek's pump pressure went up when they pulled out the bypass valve and replaced it.

Elisa: Is it possible to run the test without the filter bypass plug?

JimG: Depending on how the plug was put it you may have disturbed the operation and sealing surface of the valve.

Mark I have to leave. If you have specific questions I can answer them later.

McCord: Why not run without the plunger?

JimG: Then your bypassing the filter.

McCord: Don't put it in or you just crack it somehow.

JimG: If you remove the plug and plunger you will end up with higher gallery P.

McCord: There is a gallery pressure regulator that may keep at the same P.

JimG: You could use a new system

McCord: With or without a controlled leak. What's the intent? Effect on gallery P or effect on aeration.

Salgueiro: It's a check on the changes we have made.

Moritz: We need to document all the changes.

Salgueiro: I agree. And go down the list as to what we think would have the most effect.

McCord to Sean: Do we have 832 oil at the lab?

Sean: You have both, with the new blend of 833 oil.

JimG: We need a list of changes and what we think have the most impact. We need to discuss calculations done during the meeting next week.

JimG showed data from the latest test with uncorrected density from the cal procedure and multiple pressures. He noted that the oil pre-filter pressure was different between Lab A and lab G.

Demetrius: How would this affect the 832?

McCord: About the same since the cal is the same.

Moritz Lowest pressure has lowest aeration and highest pressure has highest aeration.

Hind: Oil pressure where?

Moritz: Called pre-filter (actually pump outlet).

McCord: We discussed previously controlling oil P. but how, where, to what and do we want to.

Moritz: I don't think we have done a thorough a job of verifying that the labs are running the same.

JimG: I will look at the data I have. Pre-filter pressure appears to align with aeration levels.