August 8, 2017

Caterpillar Surveillance Panel Teleconference Minutes

Teleconference Attendees:
Jim Gutzwiller (Chairman, Elisa Santos, Bob Salgueiro– Infineum
Jim Carroll (Secretary), Jim McCord - SwRI
Hind Abi-Akar – Caterpillar
Alex Ebner, Kevin O'Malley – Lubrizol
Jim Moritz, Tim Griffin – Intertek
Sean Moyer - TMC
Christian Porter - Afton
Mark Cooper – Chevron-Oronite

The conference began by discussing and updating the table of Micromotion sensor descriptions.

Jim G. has sent last week's list of questions to Emerson.

Lab B to send Processor sensor number and SN for their first density meter to Jim G. to forward to Emerson.

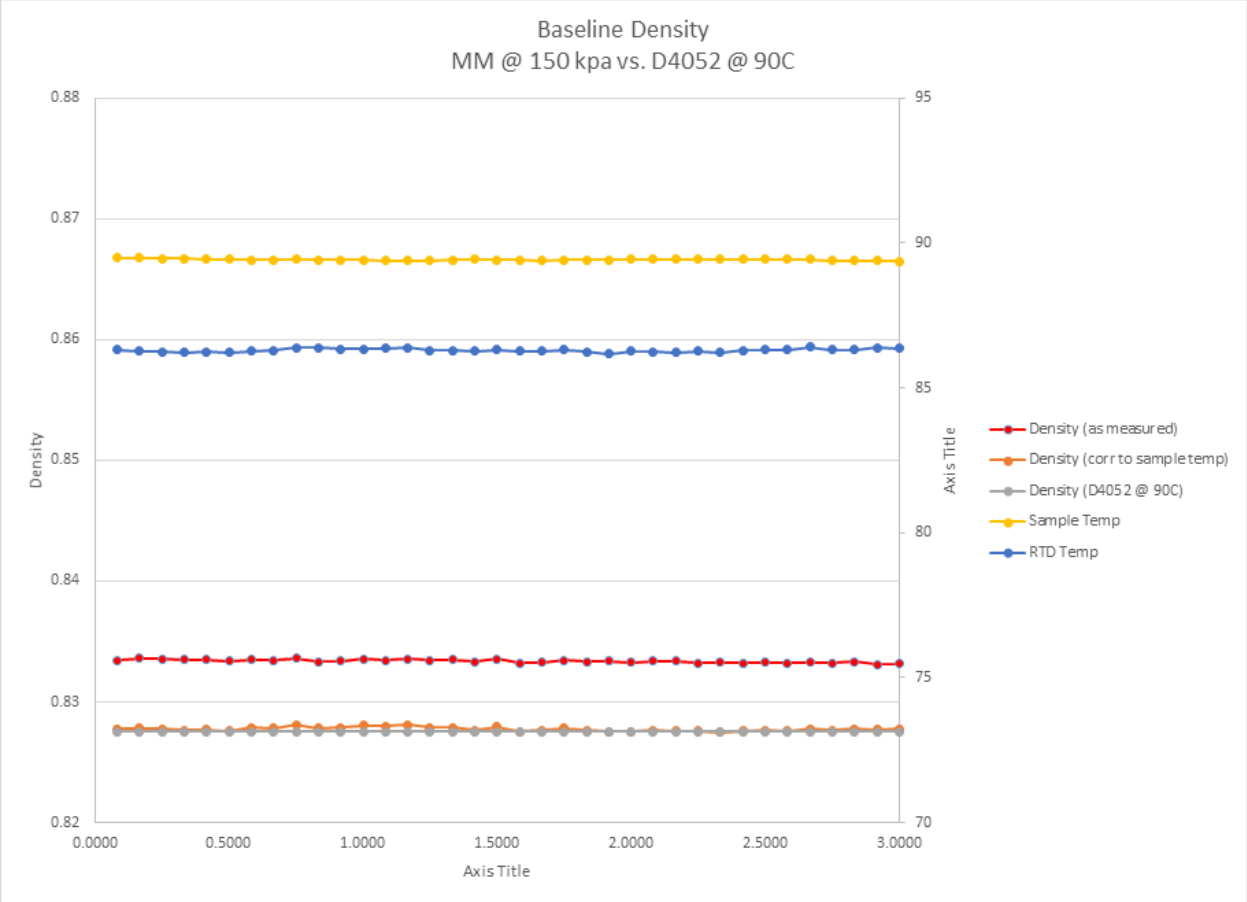
Sean Moyer set up a presentation on his MM Temp density normalizations study.

Plot 1 showed aeration results with and without the new slope and offset calibrated at the labs.Lab B has a very different result. Has trouble believing that Lab B was so far out of calibration.
Alex: There offsets from D4052 found at the higher temperatures of the D4052 readings, not at the lower which resulted in a larger correction.

Plot 2 was of post-calibration aeration. Sean picked 3 temperatures to normalize density using Emerson's equation:
1 Fluid
2 Average of RTD and fluid temperature (maybe double correcting)
3 RTD temp
He noted that it "sort of proves that the RTD temperature is used by MM."

Hind: Is the difference in temperatures due to the meter or our setup
Sean: It is the low flow through the meter driving the difference according to Emerson.
McCord: Insulation and the fan location may make a difference.
Jim G: Insulation and mounting of the meter to the box could affect it as it could be a heat sink.
Sean:Third plot clarifies that the meter is using the RTD temperature for its calculations. Pretty good evidence that the two temperatures should be the same

McCord showed a graph (below) of warm up data (150kpa sample pressure and ~90C sample temp) with density corrected to the sample temperature.



It showed that the density that is normalized to sample temperature matched D4052.

McCord: “D4052 is our baseline so we should match it.” In reality, the RTD temp is the correct temperature to match to D4052.
Tim: You expected a greater increase in final result (when using the equation).
McCord: Yes, but this was extrapolated from a small sample.
Tim: We are more than a 9 test matrix.
McCord: OK. I recalculated the 3-tests of the matrix at Lubrizol’s RTD temp. We are all different. Lab G has a more severe result.
Moritz: Lab G is 3 sigma different.
McCord: One test was aborted due to short tubing length.
Sean: I included the data for the invalid tests to show the differences.
Moritz: Heating the box will not improve the precision of the test.
Sean: It will only shift everyone’s aeration up.
McCord: Humidity was controlled after the T13 procedure was developed because we found it affected oxidation.

Hind: The aeration of the oil is based on the oil temperature and that is what we are trying to measure. In principle the oil temp is the critical parameter. There must be other parameters that affect it to see these lab differences.
McCord: It is the one thing we know that changes the results.
Moritz: We could control to another temperature, say 87 plus minus 0.5C.
McCord: Why not control to the D4052 temperature?
Moritz: We may have other things to fix first.
McCord: Everyone controls to the same sample temperature. It makes no technical sense to control at 85. The data shows we should be correcting this.
Moritz: Other things may need to be done.
Tim: Pressure has more affect. We see the Delta P is very different between labs.
McCord: It's one of the differences
Alex: No one is contending that there aren't other differences. We should deal with them, but we can't ignore the RTD difference.
Salgueiro: Is it possible to get the hardware closer together as a first step? Get a "where are we", and then move on?
Jim G: What about the list of setup differences, like the outlet connection at SwRI.
Carrol showed photos of the three density sensor enclosures and began noting differences.
McCord: We plan to change the outlet connection on our sensor to match the others.

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Hind: Do we need anything more before the meeting with Emerson?

Sean: I think we are ready. They may be able to discuss the differences between setups.

Hind: Jim Moritz sent out an updated PowerPoint presentation. Do we want to look at that?

Alex: We need to discuss it but we are over time.

Next meeting set for 9-11AM CDT pm Friday, August 11.

Jim Carroll is to send the photos of the lab's aeration measurement system enclosures (attached) and begin a list of differences between the labs (below).

Differences between Laboratories

All three laboratories are different from each other as follows:

- Engine
- Aeration measurement system enclosure size and insulation
- Heater types and locations
- Fan locations and types
- Insulation of the enclosure and all inner hardware
- Location of hardware within the enclosure
- Make of sample pressure transducers (range may also be different)

Particular Sampling System Differences

- Lubrizol and SwRI have the sample pressure regulator within the 50C enclosure. Intertek has its in the cell environment.
- Lubrizol has an inner enclosure around the Research valve control mechanism but not the valve itself.
- SwRI has an inner enclosure for 90C sensor calibration.
- Lubrizol and Intertek have valves and ports between the pressure transducers and the sample pressure ports (for calibration line connections). SwRI has quick connects at the port to connect to calibration lines.
- Intertek has its sample pressure transducers mounted with the sensor inlet pointed up and connected to the sample pressure ports by tubing. The other labs have their transducers mounted directly above the sample port with their sensor inlet pointed down.
- SwRI has its inner box insulation between the 50C enclosure thermocouple and the density sensor. There is no barrier between the TC and the sensor at the other labs.
- Lubrizol has a 90° turn in the line between the pressure regulator and the sensor. SwRI and Intertek do not.
- SwRI has a 90° turn between the outlet of the sensor and the inlet to the sample pump. Lubrizol and Intertek do not.
- Lubrizol has steel braided Teflon line between the pressure regulator and the sensor. Intertek has steel tubing between the pressure regulator and the sensor. SwRI has Teflon tubing between the pressure regulator and the sensor.