

**September 20-21, 2017
at Southwest Research Institute**

Caterpillar Surveillance Panel Conference Minutes

Conference Attendees:

Jim Gutzwiller (Chairman) Elisa Santos, Bob Salgueiro, Gang Hu – Infineum
Jim Carroll (Secretary), Jim McCord, Travis Kostan, Randy Harmon, Christine Eickstead
- SwRI

Mark Jarrett, Hind Abi-Akar – Caterpillar

Jim Moritz, Tim Griffin– Intertek

Sean Moyer - TMC

Mark Cooper – Chevron-Oronite

Bob Campbell, Christian Porter - Afton

Alex Ebner, Kevin OMalley - Lubrizol

Dan Lanctot – TEI

Jim Gutzwiller opened the meeting by showing the compiled list of the aeration hardware setups at each of the labs. Updates were made to the list produced by the small laboratory group.

Lab B's C13 engine internal oil cooler has narrow baffles, the other two labs have wide baffles.

Total line length into and out of the external oil cooler was much longer at Lab B (54", max spec is 36") Tim's tubing lengths on the list do not include the fittings on the end.

McCord: The intent is to keep volume the same.

Tim: I use stainless and a tubing bender for the line from the pressure regulator to the flow density meter (FDM) to keep from over curving the bend. Lubrizol has a couple of fittings.

Alex: I can put straight fittings in since I have more room.

Jim G: We can add to the procedure that straight fittings should be used. We are supposed to be on a path to resolution. Why can't we draw the box, and everyone do the same thing. We need three boxes that are exactly the same. Going thru like this won't get us there. How do we get there, we've been on this road a long time. We know the system is sensitive, make them the same.

Tim: I'll build the boxes, and you can pick the one you want. Plus labor costs.

McCord: We still need to decide on whether to run the meter at 90C.

Bob: I hate the golden stand concept, but this may be a case for it.

Jim G to Tim: You have different flanges on your meter.

Tim: I can change.

Kevin: Add a column to the list with agreed upon settings.

Tim made a suggestion to change the heated line's tubing to Teflon from SS. Alex and McCord agreed it was a good idea. It was decided by all to do this. Tim will get a new part number.

There was some discussion of supporting or not supporting the regulator valve. Tim contended that the SS tubing to the first cross would adequately support it.

The suggestion was made to set the crosses horizontally.

Alex: I suggest an inlet kPaA transducer with a delta P transducer.

Carroll: We need our transducers in a controlled environment.

Tim: There were problems in my calculation of density from frequency.

Carroll: I prefer two absolute pressure transducers to be able to check them against each other, and against the barometer prior to each test.

Jim G put on the screen the four options for correcting density.

Four Options:

- 1. Control all temperatures in an isothermal environment.**
- 2. Use external TCs and average and write the temperature to the transmitter and processor.**
- 3. Emerson can provide the frequency signal and labs calculate density. (thru the Modbus) Or map it to the mA or pulse signal from the transmitter.**
- 4. Back out frequency from the equation, and then calculate forward with new temperatures.**

Jim G: Tim Patten said he believes the tube temperatures are at our measured fluid temp. The low fluid flow is the reason the meter didn't read the right temperature. We kind of proved that by recalculation.

Option 2. Needs to reprogram software.

Option 3. Needs to reprogram software. Modbus access needs a 5700 transmitter.

Digital updates at 20hz, analog is much quicker.

Tim: I recommend using the 5700 transmitter.

Mark: We need to have meter constants registered in the report.

Sean: We can't recalculate results at TMC because the 10 hrs of data is not saved to TMC.

Moritz: We only sent data to TMC for the special mini matrix.

McCord: Tim Patten did say the iso-thermal option is the most robust. One study I did when I compared backed-out density to iso-thermal showed that it did not make much difference. Plus, everything around it is isothermal.

Randy: We can overcome the challenge of the Modbus drop out.

McCord: If we go to 90C we have to isolate the transducers.

Kevin: Then every lab has a box within a box.

Tim: It could be a box on the side of the box.

Sean: I make a motion that we use option 3.

Moritz: I second that.

McCord: Are we calibrating 50-90C? Then the box has to be different.

Kevin: Don't need to read the transducer while doing that.

Sean: You could do it at another stand remove it.

Jim G: Everyone must have the 5700 transmitter and have the enhanced calibration of the FDM.

Mark: Are we confident we can do option 3?

Sean: Can we have a backup of analog out density?

Randy: Yes we can

McCord: We can use analog density, if necessary.

Motion was changed to remove analog option from 3.

Further discussion? No

None Opposed.

None Waived.

Motion passed.

Option 3 re-written: Emerson can provide the frequency (period) signal and labs calculate density through the Modbus.

Hind: This would make a change to the procedure.

Jim G: Yes we are working it out.

Hind: We will have to prove it out.

Jim G: One lab may build the box.

McCord: Now we can size the box.

Break for lunch

Alex: I think we should have one builder of three boxes.

McCord: We need a print of the schematic, we can use Solidworks.

Sean: We can put the print in the procedure, or on the website.

Mark: 3d?

Tim: 2d.

Tim: You use flare fittings, I use compression. If I build it, then I would do compression. But if we go by the build sheet it will all be the same. There can be differences if you make your own tubes or hoses. But if you buy from a manufacture then it will stay the same. We should have one person putting it all together. Even ferrule location can change.

Mark: Who's doing the drawing?

Randy and McCord: We can do it. All you need is the parts list and put it together.

The group returned to specifying the parts for the system.

McCord: Horizontal or vertical transducers. Not sure if horizontal is good because you could have dead fluid on the transducer.

Moritz: I looked up best practice and it said horizontal is best.

McCord: You will have a deeper box if horizontal.

Moritz: Thermocouples (TC) can come in from the back and put in grommets on the box.

McCord: As long as you calibrate that way.

Tim: 12 inches is not deep enough if horizontal. It would be very challenging to remove and calibrate.

Bob: You could screw the transducer into the outside of the box.

McCord: Put the thermocouples in front to be able to get them out. Keep the transducers in the box to calibrate at 50C.

Alex: You can set up an isolation valve for calibration and not remove the transducer.

McCord: Lab to lab differences in how we calibrate are real.

Transducers

Decided to go with horizontal transducers and shorter thermocouples with the transducers at the back of the system. There will be a 3-way valve in line to the transducers for calibration.

Tim: We use a 5 psi differential pressure (DP) transducer. Ours is now 30psi, but I calibrate at 0-5psi.

Randy: We would have to see how much of the resolution change it will give. We have used them and had mixed results.

Tim: I have perfect faith in Honeywell. They are smaller than the TGEs.

McCord: We can spec it out but there seems to be a push to not name a manufacturer in ASTM procedures.

Moritz: Unless it's critical.

Bob: Make the spec. tight and let the labs figure it out.

Tim: I need to make the connections as short as possible so we should specify the port connections on the transducers.

McCord: Need to also get 150 kPaA. 0-25 psiA transducer will do it.

Jim G continued filling out the "Industry box" list of parts and specifications.

Carroll: Need have extra insulation so 'buyers' can re-insulate. Include PN in spec. Make sure the PN for Tim's hoses into and out of the pump are the same.

Bob: I don't think we need to buy new parts when you already have them. It would be stupid. We need a print for other labs to build a system.

Randy: Whoever builds the system will get parts from existing boxes to build.

Tim: I see it as the whole box is built with new parts. Turnaround will be delayed otherwise.

Mark: Is the box portable? You could do round-robins then.

Randy: If we have a print then we should be able to bolt them up. Except for TCs.

Tim: I would insert the TCs from the labs.

Randy: We would specify the depth of insertion of each TC so each lab could do it.

Sean: Lets finish specifying the parts.

The panel did so.

It was decided not to use a shut off valve into the sump on the return line.

Jim G: I will send this list out to everyone tonight. The Micromotion CMF25 meter with 3Z spec. will be used for all aeration systems.

Height of box was discussed.

Alex: Could set the height of the box from the engine point. Keep the original spec for the meter height but it could be set using the box.

Jim G: We changed that on a call to go to the block's flat rail, not the pan gasket.

Mark: The other lines will determine the height of oil in the pan.

Moritz: There is a practical lower limit.

McCord: Is there a problem for you Alex?

Alex: No.

McCord: In the same lab with different engines you would have different weights in the oil buckets. They are 1" lines. We could tighten the spec but it would not change much.

McCord to Alex: Can you get the wide baffle heat exchanger? That could be the cause of your high pressure drop.

Alex: Yes, I am going to verify what I have.

Moritz: We could change the limit on the lines to the heat exchanger to a min and max.

Bob: We should state lengths as port face-to-face distance.

Moritz: We could add back in the spec for location of the Micropump.

McCord: We will take the spreadsheet and start the solid works drawing.

Tim: We can have an ISO 17025 calibration to point to for flow calibration.

Sean: I thought we dropped it.

Tim: Emerson said if the density is good the flow calibration is good.

Sean: The higher accuracy density calibration from Emerson goes to 90C.

Other panelists disagreed.

Calibration of density

McCord: We need to show traceability and need to run up to 90C. I would prefer we go up to it at each reference.

Tim: I would not remove my transducers.

Alex: Do we adjust the vibration period after the calibration?

Tim: No we adjust the density output using linear correction.

Sean: So you would change the constants? Correct the Modbus density? How do you do it?

McCord: We will do a calibration every reference and run up to 90C.

Moritz: Right.

Alex: As written the digital signal is not mentioned in the calibration procedure.

Tim: It would need to added.

Sean: The calibration procedure needs to be updated for vibration period calculated density.

The panel went through the calibration procedure and made revisions. Tim will try to run the calibration using period input next week. Panel will get a copy of the revised procedure and plans to vote on a clean version tomorrow. (see attached)

End of day

September 21, 2017

Two motions were made by Jim Carroll

Motion 1: Move to modify the warmup procedure to control to sample oil pressure of 84 kPaA and sample oil flow of 1.5 L/min during the last 5 minutes of the 40-minute warmup.

Seconded by Tim.

The reason for the motion is to put the system into on-test conditions prior to going on test in order to reduce the adverse effects on Quality Index (QI) calculations.

None opposed.

None waived.

Motion passed.

Note: Table 3 of the procedure will need to be revised to show a step 3 with these conditions.

Motion 2: Move to allow removal of the first 10 minutes of data after each start from QI calculations to allow for control to stabilize on targets.

Bob: I do not want to delete data. No data should be thrown out. A comment can be sent to TMC to discuss negative QIs.

Motion withdrawn after discussion.

Alex: Are we going to declare the test unavailable?

Jim G: We can't.

Sean: We can if we disallow references.

Salgueiro: We can't do that.

Alex: The motion to use the period to calculate density is approved. Do we start now?

McCord: We can't. Plus we need to run multiple correction factors.

Sean: If we are not going to use the period then maybe we should run at 90C.

Alex: Are we going to control the RTD?

Jim G: This was a way forward.

Alex: I would like to have the RTD temp be close to the reference during candidates.

McCord: I don't like that since we won't have the ability to control. We do need it consistent though. Currently, if I don't control to 90C our severity will change. When we make a change to use the period to correct density ours will not change but others will.

Alex: Do you plan to keep controlling after the changes?

McCord: No

Bob: Do we have a sense on how much the RTD temp changes between tests?

Moritz: Very little.

Bob: We need to have some limits.

Moritz: We are kind of circling.

McCord: I can move the RTD temperature without adding heat. That's the whole reason we add insulation and boxes.

Alex: I think reference to reference should be the same.

McCord: I think I want to continue controlling to 90.

Alex: RTD should be plus minus 1C from the reference.

McCord: Once we look at period this RTD difference goes away.

Alex: Yes

Motion: The average RTD temperature for the last 10 hours of a candidate test cannot be more than plus or minus 1C from the same period of a reference for any start after today.

Seconded by Moritz

None opposed.

None waived.

Motion carried.

McCord: I am taking this as only until the new box is built.

Sean: Do you want to override my Option 3 motion?

Moritz: What are we doing now for testing?

Alex and Jim G: Just what we have been doing until the new box is ready

Bob: I want to put a timetable to terminate calibrations in 3 months. There is no pressure to get it a new box done.

McCord: Maybe we should shut down now Alex and Tim are not calibrated.

Bob Campbell made a motion:

Calibrations will be terminated upon completion of construction of the 3 boxes or December 31.

None opposed.

None waived.

Motion carried.

Moritz: Does that mean anyone that installs a box does not have to stop?

Bob: That's another discussion. The intent is to get people moving.

Tim: Some labs could start early or late which would mess up the schedule.

McCord: And we may need a correction factor.

Jim G: Whoever builds the boxes should run all of them at their lab.

All agreed this was a good idea.

Jim G: This is not a round-robin, just a test at the lab.

Salgueiro: It eliminates the box as a variable. The test runs come with the cost of a box.

Jim G: I make a motion that the three new systems be produced by Carnot and that they run prove-out tests on each system on reference oils on a single engine. Seconded by Mark

Tim: I would also run the 50-90C calibration. My cost proposal will include a new Micromotion. SwRI will have to decide on the 5700 transmitter with or without HOP.

McCord: There are still some things to work out, we may also wish to do this. I need two quotes to get management approval, and I get why we are redoing the design but not why one person builds it.

Bob: I think it is an opportunity to get it all the same. It then becomes auditable. Not sure if the three boxes perform the same, but we shouldn't have to look at box differences.

McCord: Will the procedure have a sole-source comment in the procedure?

Jim G: This is only to get the boxes identical.

Kevin: We may have to live with the fact that we have 3 results from one lab. And then another range of data from the different labs.

McCord: Then we can look at other sources of differences.

Sean: What if we have the boxes built by each lab and then send the boxes to one lab and then we meet there and audit?

Bob: I see how that would go. That's fine but it must match the print.

Tim: It is the whole system from engine out to engine in

Sean: Then I can come to Carnot.

Bob: My fear is that holes and locations of things may differ.

Sean: It all must be specified.

Tim: We will be using the same fittings with high quality fittings.

Moritz: Is the constraint only two quotes needed?

McCord: No, I think we can build it separately.

Salgueiro: There is a chance that we will miss the December 31 deadline if three labs build.

McCord: I can't argue with that.

Tim: I will be doing it myself.

Jim G: I am trying to move this forward.

1 Opposed: SwRI

3 Waived: TMC, TEI, and Intertek

5 Approved: Lubrizol, Infineum, Caterpillar, Oronite, and Afton

Jim G: Can we put dates in for some of this?

McCord: Setup a small group conference in a few weeks.

Micromotion Sensor Density Calibration

Jim G put onscreen the revised density calibration procedure for review.

Sean: This will be an information letter, and I can send it out for ballot. Then in June of next year it will be approved for inclusion.

Moritz: I see we can reword some of this.

Alex: This is for the new boxes.

Sean: You can't approve this now because it becomes the procedure.

Alex: I will do the parts appropriate in the meantime.

Jim G: So this will be for the new system and will be voted on later.

Full Procedure Review

Sean: What are we reviewing?

Alex: General overview, plus motions.

Moritz: Need to add enclosure temperature to Table 4.

Moritz made a motion to strike all wording after 'Table 3' in Section 10.5.3.1.

Seconded by Carroll

None Opposed.

None Waived.

Motion carried.

Alex: I am concerned that the no shutdown after 30 hours may need revisiting due to the slow aeration climb with new filters.

Tim: We may need to include the warmup time after a shutdown.

Kevin: Earlier data showed sometimes the rebound was slower or quicker or higher or lower. I don't think we really dug into this.

Elisa: We had a shutdown meeting to cover this.

Alex: How long you were down should be checked.

Tim: Regarding pressure control springs in the filter housing (see attached) checked out by Jim Gutzwiller, once it was put back together I started running and gallery and pre-filter pressure dropped by 10%. Pre-filter earlier was 600 kPa replacing the springs it was lower. I also saw significantly higher aeration. I stopped and simply reversed the spring and went back on test and had 40 kPa more. It was an invalid reference. I might be offline for a while. I will use CAT-DEO with new springs and/or valves and run some more tests.

Mark: Was it a new filter housing?

Tim: No.

Bob: Are the other labs about the same pressure?

Moritz: During the 9 test matrix the pressure at Carnot was ~650 and SwRI was ~600 kPa.

McCord: We replace the whole housing on the C13 when there is a leak. The whole unit is stripped and cleaned after every C13 test.

Carroll: Should we stockpile filter bypass valve?

Mark stated there were plenty in stock.

Discussion then went to the idea of blocking the bypass hole.

Motion was made to plug the filter bypass pressure relief valve before a reference at each lab's discretion, and it is mandatory when the new aeration system is installed.

None Opposed.

None Waived.

Motion carried.

Jim Gutzwiller thanked everyone for attending.