

January 10, 2018

Caterpillar Surveillance Panel Teleconference Minutes

Conference Attendees:

Christian Porter - Afton

Mark Jarrett, Hind Abi-Akar – Caterpillar

Mark Cooper – Chevron-Oronite

Bhaskar Prabhakar - Exxon-Mobil

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

Garrett White, Josh Ward, Jim Moritz, Tim Griffin – Intertek

Bill Larch, Kevin OMalley, Andrew Stevens, Alex Ebner - Lubrizol

Jim Carroll (Secretary), Jim McCord, Randy Harmon - SwRI

Dan Lanctot – TEI

Sean Moyer - TMC

AGENDA

C13 Deposit test

- CAT S.P. agreed to bring in the “new” batch of liners with stand references by the end of January 2018. (some stands may be running on reference extensions that will expire the end of January 2018)
- Need to agree upon liner cleaning procedure for the “new” liners because of the different rust preventive coating. (labs were going to try different cleaning methods and solvents and report back to the panel)
- Align reference start dates for all the engine labs

COAT

- Update on the construction and prove-out testing of the New Aeration measurement systems for the 3 labs
- Continue discussion on Oil Gallery Pressure - Some options are:
- Should it be controlled to a tighter range (manually adjusting spring force with a fine thread screw manually controlling spring force/oil gallery pressure)
- Remove spool valve and plug “dump port” so all oil will flow through the oil filter (cold start high pressure relief valve is still functional, opens at approx. 100psi from service manual specifications page)
- Oil Filter Base Assembly
- Have seen wear (fretting) on the steel spool valve
- Should the Oil Filter Base Assembly be replaced after xxx-test hours, xx-runs, x-reference periods ?

C13 Deposit test

Jim McCord used multiple cleaning fluids to try cleaning the coatings off of the new liners. He showed the results on screen (Attached). He used Tide and hot water, an ultra-sonic bath for 3 hours, LAC 147 concentrate scrubbed, LAC 147 soaked in concentrate for 3 hours and rinsed, and new (no cleaning, not placed in oven). Before the liners went in the oven they all looked clean and silver. Discoloration happened after going into the oven. CAT also found this in their study.

Why are we heating in the oven? To replicate what happens in the engine.

Mark said that there was discoloration noticed and tracked it back to the RP (rust preventative).

McCord said he would try this with an older cylinder.

Mark: For production purposes there have been no issues.

Andrew: We were going to have CAT clean with LAC and send them to us and clean with Tide and hot water and then do surface analysis and see if the RP is being removed adequately and don't have the purple discoloration. Plus, the LAC is caustic and there are safety concerns.

Mark: We had samples from August that were a bit rusty. So we have a new liner we are cutting up and then we will clean some and send them out.

Andrew: We will run a coupon with the RP still on it and compare that to coupons with LAC cleaning and LAC and Tide cleaning.

Jim: Could SwRI send you theirs?

Moritz: Has anyone used NSOL(sp?)?.

McCord: I have some unheated coupons left. Note that the LAC 147 is no longer available. The manufacturer has another designation that is supposedly the same.

Hind: What did we do before?

Gutzwiller: It had a different RP, and we used tide and alcohol and then it was wiped down.

McCord: We did that, and then coated with EF411 (10W base stock) to keep from rusting.

Moritz: We may have used solvent first.

Mark: I will get them to you (Andrew) by the end of next week.

Andrew: I can heat the coupons after checking for RP removal. I will include NSOL and WD40 in our cleaning.

Gutzwiller: We will set up another call once Lubrizol has an idea of the surface analysis timing.

COAT aeration system update

Tim: I have everything here. All internal parts have been built. Most of electronics have been done. Will be putting holes in the boxes today. I will request the first oil for a start next week. I will be doing the 50-90C calibrations also which will take a day and a half

plus run the 50 hour aeration test. I will run Lubrizol's system first and ship it out and then run SwRI's, then mine.

Sean: Which oil do we want to run on?

Elisa: Is this part of the calibration runs?

Gutzwiller: No just to prove that we get the same answers with all three systems.

Elisa: I suggest 833.

McCord: Your (Tim's) last run will be part of the reference tests.

Tim: That is what we discussed.

Hind: 833 is the high aeration oil?

Tim: Yes, my last numbers were all higher during the last tests.

Hind: Is there a concern that we have seen more variation with 833?

Tim: I hope there is less variation. That is the goal of this.

Elisa: Are you going to provide operational data?

Tim: Yes, including warmup data.

C13 Filter housing unit

We have agreed to plug the filter bypass in the housing.

Moritz: We are convinced that pressures are affecting this test. We either plug it, or replace the spool and plunger each test. Ours still needs to be plugged.

Tim: In the plate there is a return to the sump. There is a possibility of leaking. We noted fretting on the side of the valve. We noted that my pressures dropped a lot when we put it back together. When we flipped the spool pressures changed again.

Mark: How do we meter pressure?

Moritz: We don't regulate pressure.

Tim: All the engines should have similar pressures.

Moritz: They may differ but won't be variable.

Moritz: During the first 10 hours of the test the pressure is much higher than the manual says it should be.

Mark: It's going to be that way because it's not that tightly controlled.

Moritz: The manual states 275 or 375 kPa and we are well above that for hours.

McCord: We start with gallery pressure at 430 and ended at 408 kPa. Filter in pressure started at 605 and dropped over 30 hours to ~565 kPa. Is the filter rated to 100 psi (to Mark)? Should we switch filter housing units once a year, once a reference?

Tim: The risk is that it shifts the aeration.

Gutzwiller: (to Moritz) Did you have data to cover this discussion?

Moritz showed the oil schematic for the C13 and following pages from the manual in Skype.

Sean: Do we want to add this picture to the procedure?

Gutzwiller: The picture in the procedure will have to be modified.

Mark: We should had the cutaway from the manual for clarification.

Gutzwiller: At the start of the Matrix all labs put new oil pumps in.

Moritz put up graphs of pump pressures before and after Tim changed the spring and spring rate.

Then graphs of gallery pressure.

Then graphs of delta P across the filter.

Then graphs of aeration.

They showed the large differences in pressures and aeration due to the filter housing settings.

A discussion ensued about filter unit replacement options.

McCord: We had discussed whether to order the whole unit or just the bare base.

Gutzwiller: We don't use all the parts so price may be a wash.

Moritz: I still don't understand why our pressures are so high compared to those listed in the manual.

Mark: I will talk to our lubricant guys.

Tim: We could set the pressure during the reference during Flush 2 or early in the test using 833 oil.

Moritz: Or just put in new springs and plunger. We should not plug it completely.

Mark: You might start regulating on the high pressure valve.

Tim discussed the results on screen: Dark blue and yellow are the old results. Light blue and orange below are after changes to the spool valve. We could all set it to 640 kPa pre-filter pressure at the start of test.

Mark: Didn't everyone have similar oil gallery pressures?

Tim: I am talking about P in to the filter.

Mark: But the oil galleries were similar?

Moritz: Labs had ~400, ~407, and ~412 gallery pressure in the mini-Matrix tests we just ran.

Tim: I can move forward with my system as set up for the three systems I make. I will use the stock base plate without adjustable pressure system.

Mark: Should all labs have the same setup now?

Sean: Then all should be set up the same.

RESOLVED: All labs will prepare new filter housings with the filter bypass port plugged for use in all further COATs.

Note: The plug can either be pressed in, or a drilled and tapped insert.

McCord read off data: Filter in for 9 runs was SwRI 610 kPa, Lubrizol 670 kPa, Intertek 650 kPa.

Gallery pressure SwRI and Intertek 440, Lubrizol ~ 420 kPa.

Gutzwiller put up Intertek's amalgamation of the 9 oil matrix showing the oil pressures.

Tim: I will upload the operational and aeration data to TMC as it is generated.

McCord: Do we have an idea on how consistent we want the systems to perform?

Tim: My last 3 runs were 12.8-13.1%

McCord: So within 0.3%?

Tim: I will send Gutzwiller an email as the data is uploaded.

McCord: When should SwRI pick up our system, 2-3 weeks?

Tim: I haven't started Lubrizol so I may have theirs done by the end of next week.

Hind: In December we reported to API that no commercial tests were available.

McCord: We are talking about mid-march or April.

Hind: We need to expedite any step as much as we can.

Tim: I want to send it out as soon as possible if I deem my tests good.

Andrew?: A couple of months is very optimistic.

Hind: We have to put some limits on what we can do. We need to set realistic expectations.

Moritz: If we are all within two SDs of the reference we should be able to handle it.

Gutzwiller: Could it be handled with individual lab SAs?

Gutzwiller: We will inform ASTM / SAE through the link at the TMC website.

Mark Cooper is planning a Mack Panel face-to-face meeting.

Sean: We need to go over the COAT procedure in a face-to-face.

Tim: Need to add box drawings to the procedure.

Moritz: There is a lot of text that needs changes.

Gutzwiller: The next call will be set up once Lubrizol has data on the liner analysis, or we have operational data from Tim's tests.