

CAT Aeration Test Task Force meeting July 15, 2014

Attendees:

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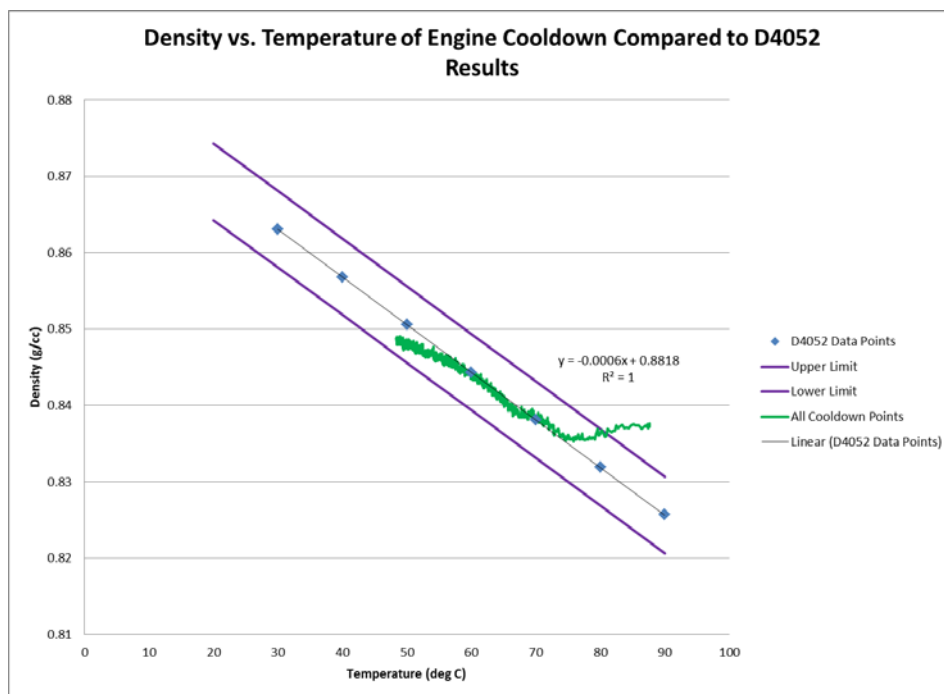
Agenda:

- 1) Lab Status:
 - a) SWRI
 - b) Intertek
 - c) Lubrizol
- 2) Operational Parameter Discussion (Test Conditions):
- 3) Appendix K (Elisa Santos)
- 4) Timeline
- 5) General Discussion

Lab Status:

1- SWRI

Engine#2 is on the aeration test stand. All the flushes have been completed. It has been charged with the LZ development oil. Martin turned off the aeration pump exactly when the engine shutdown and then opened the regulator to relieve the pressure (ramp to full open 5secs) so the pressure will drop down to atmospheric. The process may have to change slightly from lab to lab? The density curve vs temperature was derived as the engine / oil cooled down. The time it took was approximately 30 minutes to cool down and take the following data. Martin will take some additional data by re-run the test slightly but not run the engine up to temperature so we can fill in the lower part of the curve. Could use some ball valves to seal which would not cause a pressure drop? Assuming the lower part of the curve looks good we agreed to go ahead and start the aeration shakedown test.



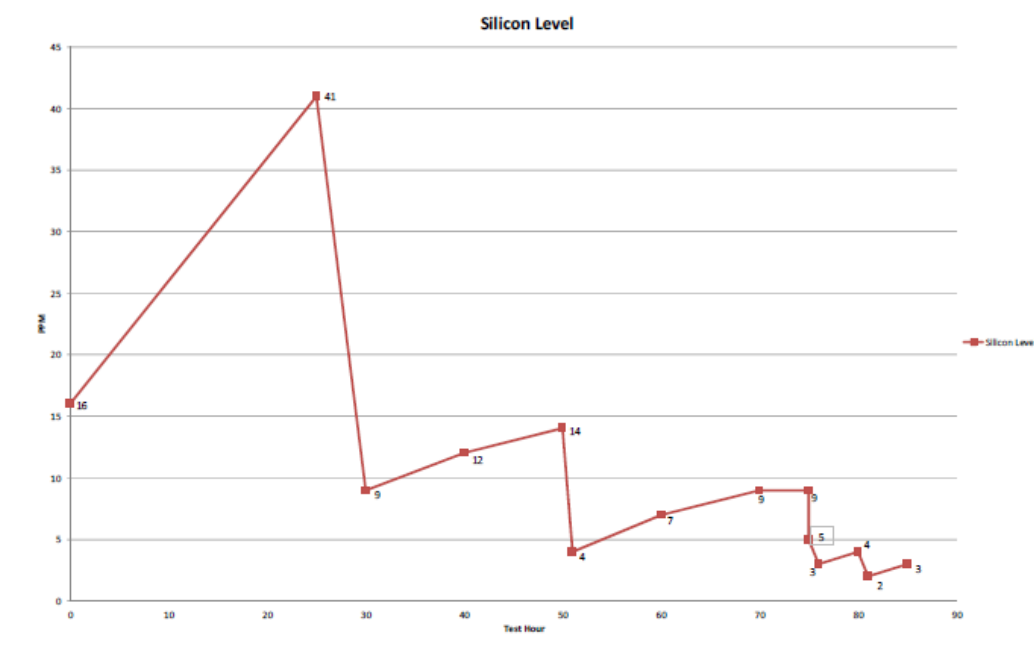
2- Intertek

The engine is on the endurance test. Completed the 25, 50, 75hrs break-in runs & oil changes. It is being broken in with the CAT DEO-ULS oil. It just completed the 80hr mark. The Si was 12ppm at 75hrs. The engine should be at 85hrs later tonight. It is running a little warm on the coolant temp 0.5C due to a partially fouled cooler. The oil consumption is running ~33g/hr. Intertec will send out the operational and Si to the task force. The engine is pretty much on schedule and should be able to be on the aeration stand the beginning of next week. The oil pressure is running 380kpa in the main oil gallery.

3 – Lubrizol

Lubrizol engine @ CAT (Engine s/n: KCB48186): 85hrs break-in completed last Friday. The engine has been removed from the cell and it is being prepped for shipping from CAT. The engine will ship out today. A complete report was sent out last week to the task force. The

following chart shows the Si level during the break-in. The Si level is low and it is dropping after the fill.

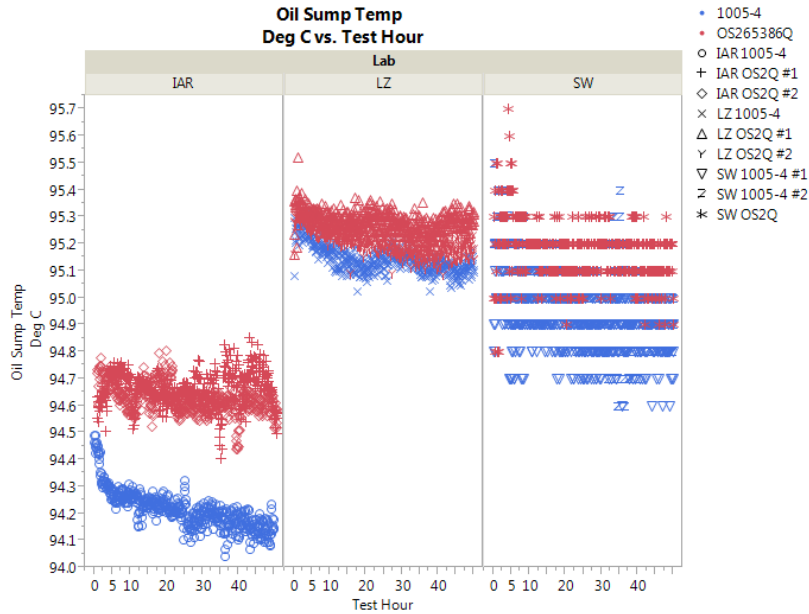


Operational Parameter Discussion (Test Conditions):

- Blowby barrel size equal to what is used on the deposit test minimum of 7Gallons
- Diameter of lines ID is **32mm**, mirror the wording the deposit test.
- **Item Sequence:** Breather-hose-barrel-hose-control valve-JTEC (recommend A or B model and should be able to measure ~ 70liter/min). Don't neck down the hose until after the control valve.
- Agreed on data sampling: every 30 seconds.
- Micromotion should have a consistent filter. Are there different filter rates? Martin is putting together a report from his instrumentation group.
- The locations of the thermocouples and pressure taps need to be exactly the same as the C13 deposit test. The only place not identified is the oil sump temperature.

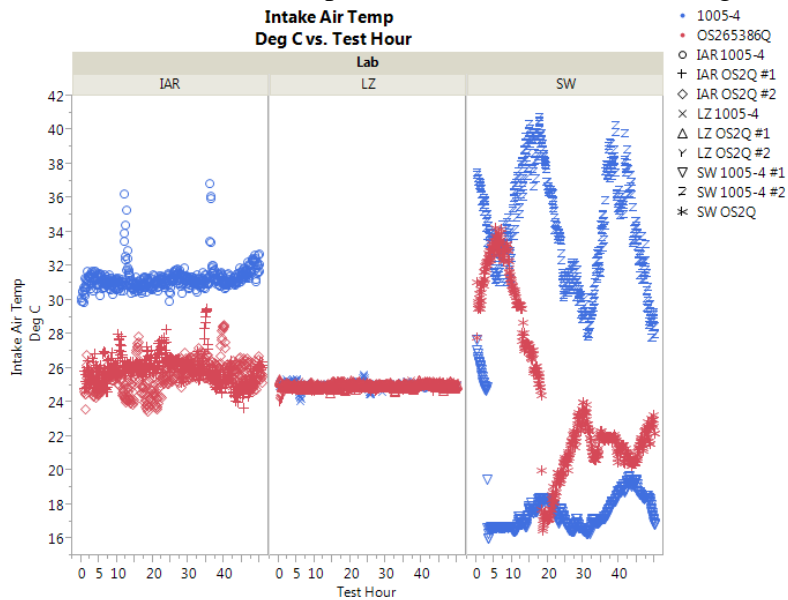
The task force reviewed the operational data put together by Elisa Santos. It was noticed that there are some slight differences from each of the labs on the oil sump temperature.

Action Item: All the labs should determine the position of the thermocouples in the sump. Right side rear port on the oil pan with at least 2 inches depth into the pan.

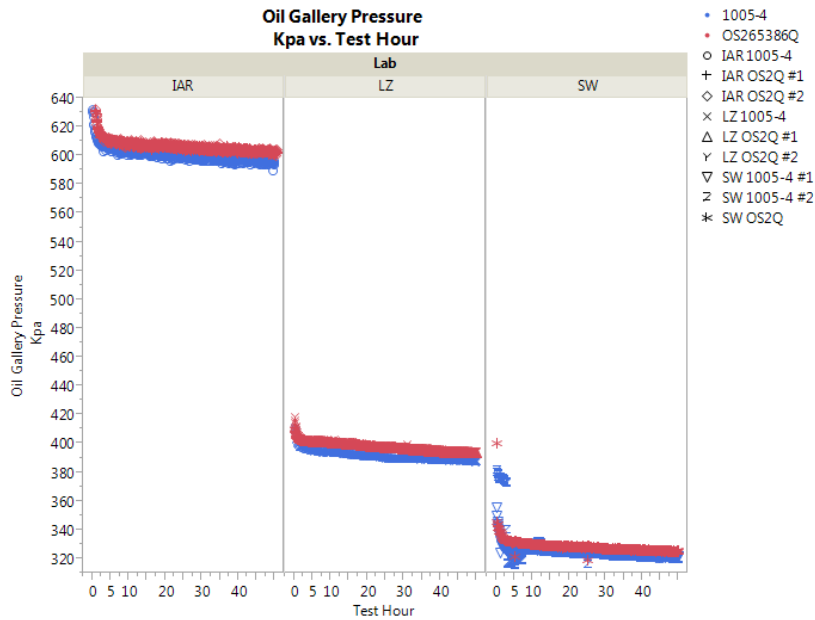


There seemed to be a large amount of variation in the inlet temperature at SWRI as compared to the other labs.

Action: The inlet air temperature control will be investigated at SWRI to meet the 25C spec.



The oil gallery pressure is much higher at Intertek but it is likely due to the pressure being measured before the oil filter instead on the oil gallery side. The SWRI engine was running low but the new rebuild engine is running around 390kpa oil gallery pressure.



Need to add an additional column for the two aeration calculation methods to Sean's standard format spreadsheet.

Sean – plot up the raw density from the previous tests.

Have each lab put together aeration calculations from the two methods with the D4052 and with the density during start-up.

Agree to use the D4052 and measure density every 10C from 30 to 90C.

The task force discussed the operational conditions and updated the following table.

PARAMETER	UNITS	Spec. Target	+ or -	Figure (see D7549-13)	
Test Time					
Engine Speed	RPM	1800			
Coolant Out Temp	Deg C	90		A4.12	
Inlet Air Temp	Deg C	25		A4.6	SW will check the con
Intake Manifold Temp	Deg C	40		A4.16	locations of the thermocouples and pr
Exhaust Temp (tailpipe)	Deg C	record		A4.7	
Fuel Temp	Deg C	40	1	A4.15	the same as C13 deposit test
Oil Gallery Temp	Deg C	90		A4.14	need to have the thermocouple tip extended to the middle o
Oil Sump Temp	Deg C	record			need pictue/location
Inlet Air Pressure	kPaA	96	1.5	A4.6	Right side rear port, how deep (at least decided July10th
Atmospheric Pressure	kPaA	record			
Fuel Rate	g/min	record			
Blowby Flow	L/min	record		A4.10	agreed on blowby models A or B to measure ~ 70l/min
Intake Manifold Pressure	kPaG	record		A4.16	
Fuel Pressure	kPaG	record		A4.25	
Oil Gallery Pressure	kPaG	record		A4.14	
Coolant System Pressure	kPaG	99 - 107		A4.18	
Exhaust Restriction	kPaA	104		A4.7	decided July10th
Crankcase Pressure	kPaA	103		A4.11	decided July10th
Oil Sample (MM Measured) Density	g/cm3	record			
Oil Sample Temp	Deg C	90			confirmed July15, average of inlet and outlet temperature
Oil Sample Pressure	kPaA	84			confirmed July15, average of inlet and outlet pressure
Oil Sample Flow	L/min	1.5			confirmed July15, micromotion measures the flow rate
Temperature Corrected Density	g/cm3				
Calculated Air Density	g/cm3				
Calculated Aeration	%				
Coolant In Temp	Deg C	record		A4.13	
Oil Filter Inlet Pressure	kPaG	record		A4.8	
Oil Filter Out Pressure	kPaG	record		A4.17	

Appendix K (Elisa Santos):

The task force quickly reviewed the appendix K form and agreed it looks acceptable at the moment.

Timeline:

The LZ engine is shipping today from Caterpillar. We are shooting to have the engine arriving by the end of the week. LZ can get it on the stand within 2 to 3 days. LZ should be able to run the shakedown towards the end of next week (week of July 21st)

Martin is completing some micromotion experiments and he will send out data shortly. Then he will continue on with the shakedown testing. SWRI should be able to start to run the prove out oils next week.

Intertek needs to make some modifications to the stand towards the end of the week? They will update the rest of the team with the break-in engine data.

General Discussion:

Covered nearly everything...