CAT Aeration Test Task Force meeting
Feb 10, 2015

Matrix Progress and Data Review

Meeting at South West Research Institute

Attendees: Names Highlighted in Yellow attended the meeting

Participant	Name	Email	
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Data review, Caroline Laufer:

The slopes of the Matrix oil aeration results were plotted and compared. Plots (linear regression fit) showed variability, including variability among labs. There was no apparent correlation between aeration average and slopes.

Due to the late consideration of this parameter and the fact that the preliminary analysis did not show correlation to the aeration levels, this parameter will be tracked and documented. Slopes will be evaluated as more data is accumulated.

> **Action:** Moving forward, track and report the slopes. Slope is from 40-50 hours and fit is first order linear regression.
> **Action:** Define the slope and add this parameter to the LTMS file (csv file).

Shutdown: Review of the shutdown data by Elisa.
Four tests with shutdowns were analyzed. Adjustment models were applied to the shutdowns. Test B04 had a shutdown at ~ 24 hours. In this test a small adjustment was needed and the data recovered readily.

Question on the expected slope change in the tests that did not have a shutdown.
Elisa shared the data. Some tests came back to the original level quickly.

Comments:

- Concern in case the shutdown is happening in an oil that is a solid performer where the aeration average is above the precision level. Should a minor change in slope matter if the oil will remain a solid performer?
- Would this scenario work: Last hour worth of data before and after the shutdown are within a certain percent (0.05%).
- Balance between including data for the matrix; protecting candidate data, and being practical for the test labs.
- Adjust only if the shutdown is after 33 hours

Caterpillar proposals:

- For the Matrix analysis, eliminate A04 from the analysis due to the late shutdown. Other matrix oils with shutdowns will be included. Note that other tests have been removed from the Matrix due to operational and other reasons.
- For the commercial oils during the tech demo: no shutdowns are allowed in the last 20 hours of the test

SWRI: status of the rerun of the oil, control valve and heated line were changed. The test will be done tomorrow.

Discussions:
Needed data for NCDT:

> Should the data be shared ahead of time? This was not clear.
> Analysis to generate means and SD for all the tests.

LTMS limits for all the stands.
Calculate lab severity adjustment.
How many tests in the bands does it take?

Action: Availability of the various technologies for use as a reference. Hind will follow up.
Action: labs to re-submit the data in the LTMS files.
Action: Elisa will finalize analysis with and without additional data point; calculate targets (RMS error) with engine hours and without corrections for engine hours or other parameters. Elisa will put together LTMS file together with Yi, Zi and other statistical elements by engine.

Constraints may need to be added to the procedure due to the influence of multiple operational parameters. Excursions can happen and can impact the aeration results.

Discussions:
Elisa reviewed the various models for the data analysis.
Models reviewed included with and without engine hours. The effect of engine hours is significant but remain confounded with other parameters.

Model needs to be done with and without the adjustment for engine hours.
However, operational parameters have been confounding factors. Should there be corrections?

Initiate LTMS: include estimates for the oil and for the test variability
Q: are we going to control the test operational variability? Later tests were more controlled, but there were other operational changes that were still changing

Referencing:
Are test stands ready?
How many reference oils?
How many reference tests for new stands?
Should the reference oils alternate testing: one each 5 tests?
This test can use two reference oils. Per above points, one oil (tending to use the higher aeration oil) every 5 to 10 tests (need to be finalized) and the second oil can be used in conjunction with the first reference for test stands and then at longer hour intervals.

Rebuild of engine:
When the engine should be rebuilt? This can be up to the labs. The labs can rebuild if they cannot calibrate. Alternative is to specify the time to rebuild.

Discussion whether severity adjustment should apply to the candidate tests.

Next meeting: Tuesday, 12:00 CST. Need to finalize the NCDT input.

From the prior meeting, reminder of the action items.

Summary of action items

Parameter	Action	Comment
RPM	Need tighter control for future tests	Impact on aeration is not well understood
Blow by		Different JTEC devices used
Fuel pressure	Determine fuel filter change interval	
Intake air pressure (96 kPa)	Add one decimal point to LTMS average. Review LZ test 5 (@35 hrs): change in intake air and manifold.	Impact on aeration is not well understood
Oil Gallery Pressure	Different among labs (lower at SwRI): Need to determine root cause through focused tests. Issue will be discussed in a separate call.	hardware changes for testing can include: shimming valves to increase pressure; springs replacement; oil pumps; etc.
Pre-filter pressure is not in LTMS	Pump output will be added to the data dictionary Oil filter date code will be added: 6 characters	
Pressure regulator	Bring the values close among all labs. SWRI will remove and inspect the research valve and follow it with a shakedown test.	Pressure valves are partially open or partially closed among the labs. Pump control (speed or controller output) should be the same among labs.
Oil sample pressure (84 kPa)	Control the band width (Now controlled to +/- 1 kPa)	SWRI and EG to work with LZ to tighten the control of this parameter.
Crankcase pressure (103 abs. +/- 1)	Test 4 at EG has higher CCP and appears to show higher aeration.	Note that CCP is confounded with engine hours.
Exhaust restriction control (104 kPaA)	Test 6 of SWRI has initial high values for this parameter.	
Temperatures	Most need to be better controlled Add one decimal point Cooler size needs to be appropriate	Fuel (40C), intake (25C), Manifold (40C), coolant out (90C)
Box temperatures	Needs tighter control	Aeration appears to follow changes in this Temp.
Oil sample temp	Need to be better controlled (90C)	Measured across MM
Oil sample density	Predicted value will be used R^2 value has to be >0.9999. R2 will be added to the data dictionary	

Critical parameter