

Sequence VH Test Development Group

Meeting Notes of May 18, 2017 teleconference

2:00 PM to 5:30 PM Eastern

Attendees: Al Lopez, Ed Altman, Cole Hudson, Amol Savant, Ron Romano, Andy Ritchie, Gordon Farnsworth

Meeting objective: Review the Sequence VH precision matrix tests uncontrolled operational parameters and used oil data trends to determine if there were any deviations that could be sufficient to invalidate any of the tests.

Overview: Cole presented data plots for Fuel flow, Lambda, crankcase pressure, coolant-in temperature, crankcase pressure, fuel pressure, oil pump pressure, oil pressure for both left and right head, oil out temperature, and torque. Some variability was noted for some of these parameters but nothing was deemed to be reason to invalidate any of the tests. However significant discussion resulted in several requests for further data analysis. Cole will send note to Doyle Boese (VH statistical group leader). Also several items were identified for further study by the test engineers to enhance test control.

Statistical analysis request:

Review Lambda versus test results (AES, RACS, PSV, AEV) to determine if there is any significant correlation.

Review Crankcase pressure for test Phases 1 and 2 versus test results (AES, RACS, PSV, AEV) to determine if there is any significant correlation.

Fuel flow: Flow level at one lab were more variable than others. This was explained by the fact that the data recordings were instantaneous snapshots. It was noted that average of fuel flow recordings was similar to other labs. All laboratories indicated that they use micro motion flow meters.

Lambda: Deviations were noted between the left and right exhaust banks for some tests. Also some differences were noted between tests. It was noted that it is not uncommon to require lambda sensor replacement during a test. Also just

powering down the PCM often corrects the left/right deviation. One lab suggested that maybe the PCM should be de-energized at each 24 hour oil level.

Coolant-in: No significant deviations were detected.

Crankcase Pressure: A few tests were observed to have negative pressure. Discussion ensued regarding what the cause is -- PCV flow rate differences, Crankcase ventilation system design, liquid in lines, etc. It was agreed that the development team or surveillance panel should examine this area for future test improvement. There was also discussion about possible Crankcase feedback control valve instead of PCV valve.

Fuel Pressure: No significant issues discussed.

Oil pump pressure: Some differences seen but likely due to different oil viscosities, fuel dilution, etc. so no action proposed.

Oil pressure at left and right cylinder head: Some tests noted to have directionally lower pressure than the majority. Amol reviewed that he had seen this and believes that leakage at the cam end cap passage may be the cause for lower oil pressure. He stated that he now uses a sealant around the orifice on engine assembly. Amol will send note to the group detailing the sealant used with an explanation of the process used during engine assembly. **NOTE: action item Amol.**

Oil temperature out: A few test from one lab appeared low but after review it is believed that the incorrect data was reported. The lab will check this. **Note action item Ed.**

Torque: There appears to be a difference in torque readings among the laboratories and several ideas were suggested as possible reasons for this. The group agreed that piston to bore clearance, ring gapping, and bore finish should be investigated for effects. To accomplish this activity the labs were requested to send the following information to Cole so he can tabulate the information and distribute to the group. Information for matrix tests completed – piston to bore clearance, ring gaps for first and second rings, bore finish (RA and if available RK, RVK, RPK, RZ). Also surface finish after initial bore sizing info is desired. Obtain during a future engine build. **NOTE: action item (Amol, Cole, Al, Ed).**

Used oil data review: The plots of several used oil parameters versus test time were reviewed – fuel dilution, Fe, Sn, Al, TBN, Pentane insoluble,Vis@40. There was some data reported as 0 that was obviously missing data but disregarding this the plots looked rather similar for each reference oil. Amol noted that he receives three values for TBN analysis (Buffer, Inflection, Fixed). The procedure may need clarification of what to report. The consensus was Buffer I believe.