

T13 Task Force Meeting Minutes

San Antonio, TX January 9, 2013

Roll Call: See Attachment 1

The presentation, Attachment 2, was presented to the task force.

Test Scope

Previous runs have shown that liner wear is unlikely to be a measureable parameter for this test. Volvo would like to continue measuring liner and ring wear even though the test scope has been changed to an oxidation test. A discussion ensued about including oil consumption as a test parameter. Testing at ExxonMobil had oil consumption ranging from 25-30 g/hr which Ken Goshorn indicated is likely within the noise and showed no differentiation. The updated scope letter can be found in Attachment 3.

Timeline

The original timeline for test development that has been shown previously in the NCDT was briefly discussed. Timeline calls for the test procedure to be finalized by 1Q 2013. It was agreed that this was an aggressive timeline but did not need to be changed at this time. Chris Castanien pointed out that it was unlikely that matrix funding would be in place for the end of 2013.

Test Setup

External Cooling

ExxonMobil has implemented external cooling for the VGT Actuator. The actuator has a separate loop of uncontrolled process water which is approximately 80 F. This cooling was added because of an engine de-rate when the coolant temperature was increased to 112 C. The external cooling solved the de-rate issue.

Engine Side Cover Modifications

ExxonMobil showed the engine side cover modifications made on their test engine and it was noted that IAR and SwRI have a different approach. There was a question about any impact these differences could have on coolant flow around the liners but it was agreed that the next test could proceed as planned. ExxonMobil, IAR and SwRI will meet to agree on a consistent modification.

External Oil Circulation System

The engine stand orientation impacts the setup of the oil circulation system. Currently, the ExxonMobil engine is canted 4° to the left (intake manifold side) and inclined 4° from front to back. The IAR and SwRI engines are also canted 4° to the left but are flat from front to back. ExxonMobil is using an adjustable oil suction tube until the temperatures and engine set-ups are fixed.

Sensors and Part Lists

ExxonMobil has provided a document to the independent labs describing sensor and their placement on the engine. Jim Gutzwiller provided a draft of the parts list (Attachment 4). The Mack Parts Catalog list is

currently only available to Mack dealers, Volvo will work to gain access to the lists for the labs. The part list will be kept on the TMC website but until then Jim will ensure that labs are sent any updates of the list. A part number for coolant is currently required.

IAR has been using a Caterpillar cooler instead of the standard Modine initially due to availability issues from TEI. TEI has secured a supply of Modines but the Caterpillar coolers appear to be cheaper, approximately \$7k. Are there any advantages to using the Caterpillar cooler? Ken Goshorn agreed to provide engineering specs to see if we can establish equivalency as part of the development work.

Wear

The wear results for the previous tests were shown. As the current hardware does not appear likely to show differentiable wear, should non-standard rings and liners be used to generate wear? Volvo did not feel this was the right path to a healthy test. Bob Campbell asked if Volvo expects any hardware changes for 2014-2015. Ken Goshorn indicated that liners would get a bit smoother with a slightly changed oil ring with lower tension. The new hardware should be introduced into the test ASAP to improve the part availability later in the life of the specification. Volvo indicated that we may be able to get the new hardware a quarter early but the hardware is not available yet. In addition, Volvo will move to lead free bearings in 2014 but lead bearings should be available up until 2020.

New Test Cycle

The next test to run needed to be defined. Bob Campbell pointed out that a number of the previous runs have had outlier bearings which may indicate that the engine is operating at the edge of durability. This is rarely a good place to operate a reproducible engine test. The last ExxonMobil test had piston scuffing, bowl erosion and a cracked piston. The fuel injectors were inspected by Volvo to see if they were the cause of the engine failure or the elevated coolant and oil temperatures. The injector for cylinder 4 was consistently lower in flow tests but still within engineering specs. The comment was made that the injectors had flow rates consistent with >100k miles. These were new injectors, so the degradation of the injectors will need to be monitored. Ken Goshorn pointed out that all six pistons exhibited bowl erosion, indicating operating conditions are most likely the cause. Volvo has had issues with bowl erosion in Europe but not in the US.

The issue of PCP level was revisited. The T-13 experience has had 4 tests run at 110° C coolant, 125° C oil and 3500 PCP with two bearing outliers. This contrasts with Volvo's experience successfully running 1000 hour tests at 3300 PCP at lower temperatures. Based on this, Greg Shank would like to keep the PCP set to 3300 and a lower temperature. The trade-off between higher temperatures for a shorter test length and engine durability. Jim Moritz pointed out that dropping the PCP should drop the exhaust temperature and reduce the amount of heat in the top end of the engine. After much discussion and a coin flip, the test conditions were agreed as follows:

- 1 Phase Steady State 1100-1300 RPM (Peak Torque)
- Air-To-Fuel Ratio 19:1
- 3300 PSI (228 bars) Peak Cylinder Pressure
- EGR Rate 16%

Oil Temperature – 135 C Main Gallery (142 C Oil Sump)
Coolant temp – 110 C
28 qt Oil Charge

It was agreed to increase the sampling rate late in the test to avoid a catastrophic oil failure. With the increased sampling, should more fresh oil be added? It was decided to keep the oil charge and additions consistent but Chris Castanien felt that redesigning the oil pan can give us more of a safety margin without changing the severity of the test.

AOB

TEI will work with Jim Gutzwiller to get parts for the engines since the independent labs are on the verge of running.

SwRI is addressing the issues they had getting sufficient power out of the engine and have moved all measurements to metric and absolute pressure units.

IAR expects to start their engine in about two weeks.

Attachments



T-13 Task Force
Attendance.pdf

Attachment 1 Attendance Sheet



Task Force.pptx

Attachment 2 Task Force Presentation



Mack T-13 Scope
Objectives 2013.doc

Attachment 3 Test Scope Letter



MACK T13partslist
20130109.xlsx

Attachment 4 Test Part List