

T-13 Build Workshop notes. Intertek Automotive, November 18, 2013

Various labs input in different colors. **Task Force recommendations in bold.**

- EXMO during cleaning of their block uses a large nylon bristle brush to clean the liner bores, especially in the liner O-ring area. (Removing liner seal residue is critical, however it is accomplished)
- When installing the liners, some place the TEI serial # in sequential order towards the front of engine. EXMO place all 6 liners before installing the O-rings to measure their liner protrusion. Note: take the highest reading/point on liners outer flat edge. (This procedure was confirmed during our Mack certified engine build class)
- Top liner O-ring is installed dry, the others use Volvo P/N 1698135-8 Lubricating Oil. According to EX/MO the most current procedure states that no lube is used. **Task Force says to use the fluid that comes with the o-rings.**
- Prior to installing the main bearings and crankshaft, EXMO install the front and rear main bearings only with crankshaft and main caps torqued approx. 60 ft.lbs. to check crankshaft run out on center main journal. Specification is 0.002-0.006". Typically see ~0.002". (Maximum acceptable run out is 0.006". We have seen crank run out measurements below 0.002" on new cranks.)
- Thrust washers P/N 21267838, TEI P/N 33873, 0.125" thickness. Do not use 0.129" thickness washers.(The Mack and TEI part numbers listed here need to be updated to the following:
We are currently listing P/N 21267844 as the correct thrust washer (4 to a pack) for the T-13 build. This will give you the necessary 0.125" thickness washer. **DO NOT use P/N 21267847 thrust washers as they measure 0.129" and will lock up a stock crankshaft!** The best practice is to measure the thrust washers and confirm 0.125" just before installation. Average crankshaft end play is around 0.006" with 0.125" thrust washer.)
- Internal bolts, main bolts, con rod bolts, head bolts, injector hold down bolts, etc. Should we replace every build, follow the shop manual or leave it to the labs discretion? Matrix Tests should all be performed the same? (Currently, we replace all hardware during every re-build. Main bolts and con rod bolts are cycled twice during our build in order to confirm bearing clearance with Plastigage (P/N SPR-1) Typical clearances are as follows: Mains 0.0035" to 0.0040" (Spec.=.0019" to .0047" Lubricated).....Rods 0.0028" to .0032" (Spec.= 0.004" Max. Lubricated)
Task Force recommendation is to leave it to lab discretion.
- TEI Test Kits have incorrect snap rings provided. I talked to Mark Sutherland and he said he'd have this resolved. There have been 2 types of snap rings provided, but has been resolved. (Part number for correct snap rings listed as 914531)
- Lubrizol uses Loctite, "Form A Thread" on stripped bolt holes in most of their aluminum front and rear engine housings instead of using a Heli Coil. Loctite claims its good to 125 ft.lbs.(Another option would be Lawson Keenserts. We install these on the upper rear timing cover (3 positions) before placing the part in service as we have had many strip

out after repeated cycles of valve cover removal and installation. We have also used these inserts on the front seal cover where the 2 front oil pan bolts thread, and on the gear case/flywheel housing where the 2 rear pan bolts thread.)

- Afton mentioned that their engine came with a different part number for the piston cooling jets? It might the part number they have has been superseded? Everyone should be using P/N 3155151

- Top piston ring has a number from the manufacture that is not a part number or TEI laser etched number. Mark Sutherland said the vender says it's a date code? Between our TEI parts for the two engines built and EXMO, there must have been 3 to 4 different dates?(Our part numbers are as follows:

Top Ring : P/N 610081170

2nd Ring: P/N 20590309 Etching # 6100811513

Oil Ring: P/N 6100828327

The etching numbers are on the top side of the ring.)

- After installing all the con rods check the side clearance to the crankshaft. Couldn't find a spec? Intertek engines were 0.008-0.009"(Spec. is 0.014" Max. Typically we see 0.007" to 0.009".)
- The MP8 has a crankshaft gear seal and two bolts that should be replaced every build. EXMO says they will leak like a rear crankshaft seal would.(We replace both bolts P/N 984738 and O-ring seal P/N 948977 each test. O-ring can harden and leak oil over time.)
- Exhaust Valve Protrusion Specifications need to be clarified. Brand new cylinder heads and most everyone's rebuilt heads the exhaust valve protrusion is out of spec, 0.60"+. Specifications: 0.053-0.059". Afton says the US07 MP8 has the correct specification? (We are still awaiting clarification on this. We measure valve recession both pre and post test. All parts in cylinder head are replaced each test.) **Possible cylinder head change explains the protrusion spec differences. With full head rebuild, the specs aren't that important. 2013 head will replace the 2010 head.**
- Build engine using PVD Coated Rocker shaft and Exhaust Rocker Arms. SwRI has been testing and reusing uncoated parts with no wear? SwRI said they ran a total of 7 test with same parts 3 test on 1 engine, 2 test on 2nd engine, and 2 test on 3rd engine. We are running the PVD coated rocker shaft P/N 21809012 . We check for any unusual wear between runs.) SwRI has been running with PVD exhaust rocker arms. Injector and intake arms have been replaced, shaft has started to show signs of wear following third test. The PVD coated shaft are now being used.
- Coolant thermostat modification. The thermostats all need to be blocked the same and to prevent and coolant bypass in the block. If this occurred, this would reduce the Delta T and flow, however maintaining the same controlled coolant out temp. A suggestion would be to use a manufactured tube Volvo P/N 21474103. This tube replaces the thermostat while blocking the engine bypass and the thermostat and water pump is relocated for different vehicle coolant applications. See attachment. (We just received 2 P/N 21474103 inserts. We will wait for industry consensus on the potential use of

this part. We are currently running a modified stock T/Stat.) There was discussion on having one supplier/lab modify all the thermostats. Task Force agreed to use plastic tube.

- Some labs remove the timing gear plate to better clean the engine block and oil galleries every build and some don't? Should the oil galleries be cleaned using a rifle brush? (We rifle brush and Bore scope oil galleries to confirm cleanliness.) **Complete disassembly and cleaning is required.**
- Oil Gallery Thermocouple Insertion Depth was determined to be in the middle of oil gallery at 2.5265 inches from base of engine block.
- Coolant Out Thermocouple needs to be located in the 4 bolt flange (midstream) of the coolant outlet pipe.(We are in the process of re-configuring our coolant out housing.)
- List the size and length of steel braided hoses to (inlet) and from OFH (outlet) and external oil cooler. Note: OFH (inlet) is on the right side of OFH, and OFH (outlet) is on the left side of OFH. Standardize on a min/max and or the total length of the two lines?
- Intertek – (ranges), OFH (inlet) size #16, length 5.5 – 13” OFH (outlet) size #16, 10” – 11”
- SWRI – (Ranges), OFH (inlet) size #16 length 14-10” OFH (outlet) 12.5-8.5”
- All SwRI OFH outlets include a tee fitting which is included as part of the overall hose length.
- LZ – (Ranges), OFH (inlet) OFH (outlet)
- EXMO – (Ranges) OFH (inlet)Size #16, length=10.5 - 11.5” OFH (outlet)Size #16, 8-8.5”
- Afton – (Ranges) OFH (inlet) Total of 44 inches OFH (outlet)
- Determine which valve cover everyone should use, Mack or Volvo? The covers are not identical in size. Most everyone favors the Mack cover! (We have used the Mack cover exclusively for all of our T-13 test development.)
- Oil Level Sensor in Oil Pan. Should we all remove it and if need be add a resistor to the sensor? (It would be good to remove it from the pan. We change these out frequently, as we have seen deterioration of the wire insulation due to the elevated oil temps. A resistor may be needed to satisfy Vision, or you could choose to run with that code.) **The engine will run without the sensor. It can be removed.**
- Power Steering Pump/Fuel pump, remove gear/vane from power steering pump and fill with Bulldog Oil to lubricate bearings.(We remove all internal P/S parts and lube with Bulldog.)
- Oil Pump Suction Tube is made of plastic. EXMO replaces it every third test. (Three to four tests on average.)
- EGR Venturi Pipe replaced every test. (We, Venturi, D/P valve and EGR valve each test.) **EGR Valve replacement at lab discretion. Replace the EGR Venturi every test.**
- Afton mentioned their engine wiring harness cracking and exposing copper wire? (We change out our wiring harnesses when we notice insulation cracking(injector wiring.) The part number for the correct US'10 T-13 engine wiring harness is 21443770. The correct D/P valve P/N to mate to this harness properly is 21713917.)

SwRI has had this problem and MACK has requested that these harness be return to them.

- Except for the graphite paste used in the cylinder head injector cup installation, Bulldog oil was the only assembly lube recommended. **CJ-4 15W-40 Bulldog oil is to be used.**
- The topic of reusing connecting rods was discussed. SwRI has reused their connecting rods for three consecutive runs. EX/MO has been instructed to run their rod for four builds.
- EX/MO gave a demonstration on confirming the engine timing by installing a dial indicator on the # one intake adjusting screw, then rotating the engine 366 degree to confirm timing, a total lift of 0.060" indicates proper timing. (procedure is located in the '07 rebuild manual).
- EX/MO explained the importance of using engine oil on the hot pipe flanges when installing; this prevents the clamp and flange from binding and allows the clamp to seat properly.
- Jim Moritz from IAR demonstrated the software that is under development for allowing the control of VGT and EGR without the Vision program running on a separate computer.