

APPENDIX B
Pre-Test Inspections
8/31/11 – 9/1/11



T/S STATE OF MICHIGAN

Pre-Test Inspection

8/31/11 - 9/1/11

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Caterpillar Pre-test Worklist

8/31/11

1. #4 engine: Pull out the fuel injectors and test for opening pressure and leakage.
Reinstall the injectors.
2. #4 engine: Test/calibrate the fuel pumps on the engine.
3. #4 engine: Adjust inlet & exhaust valve timings.
4. #4 engine: Inspect the cylinders with boroscope when the injectors are removed for testing. Note the conditions.
5. #4 engine: Install fuel oil meters inlet and outlet to the engine. The meters should be recently calibrated by a recognized lab. with the calibration sticker affixed. The meter should preferably be accurate with a few % of the full flow rate of the fuel. Note: Need details on make, model, etc. of flow meters.
6. #4 engine: Install air mass flow/differential meter – not available, however, will install differential pressure and temperature gauges. Per Cat this is not entirely possible – does Tim have any thoughts
7. #4 engine: If possible, perform visual inspection of turbocharger (hot end) blades.
8. #4 engine: Change fuel filters
9. #4 engine: Take lube oil sample and send out for analysis.
10. #4 engine: Provide written details of results of Items 1, 2,3, 4, and 7. Also provide results of Item 9.

Also plan for on board support for one day of testing per ChEng guidance:

Services for a Caterpillar representative to accompany the tests, approximately 8 hrs per day for 2 days

Valve lash measurement

Cylinder	Valve Lash (in)	
	Intake	Exhaust
1	0.024	0.042
2	0.022	0.042
3	0.024	0.041
4	0.026	0.047
5	0.01	0.03
6	0.01	0.031
7	0.012	0.03
8	0.01	0.034
9	0.022	0.042
10	0.022	0.048
11	0.02	0.039
12	0.023	0.042

fuel injection nozzle pressure test

Cylinder	Valve opening pressure (psi)	Spray pressure (psi)	Spray pattern	Pressure held for 30 seconds (psi)
1	450	500	good	300
2	450	475	good	300
3	475	500	good	400
4	475	500	good	350
5	475	500	good	350
6	475	500	good	350
7	475	500	good	450
8	525	550	good	400
9	500	525	good	350
10	490	525	good	300
11	480	500	good	300
12	475	500	good	300



Fuel Nozzles - Pre-Test Inspection



Fuel Nozzles - Pre-Test Inspection



Fuel Nozzles - Pre-Test Inspection

BORESCOPE INSPECTION

Inspected all twelve cylinders through the injector bore. Visually seen typical cross hatch all the way to the top of the cylinder liner. The top keystone piston ring wear was minimal on the liner and was hard to see where it began. The liners had a light brown oil stain more noticeable at the top of the liner from normal oil coating. The exhaust valves were clean on the stem side and had a very clean seating mark. The inlet valve stems are gummed from the crankcase fumes disposed into the intake system. Some of the stems are very wet looking. The seating area is hard to see. The piston tops had a very black and dry soot covering. All findings were typical of normal engine operation.



Turbocharger - Pre-Test Inspection



Turbocharger - Pre-Test Inspection



Turbocharger - Pre-Test Inspection