

LAND CRUISER 2F HEAD REPLACEMENT

Notes on Mark Dixon's '79 2F engine

Symptoms:

Noticed the engine was running roughly.

Exhaust smelled unusual – a rich smell from unburned gas.

After checking the spark plugs, one was noticed it was saturated with oil cylinder #1.

Diagnosis

Several issues could cause the symptoms above.

- No spark present in the cylinder.

- No spark present in the cylinder at the correct time.

- Low compression due to worn piston rings.

- Exhaust valve remaining open.

The following actions were taken in order of time needed to perform them...

Verified that the plug wire was transferring energy to the #1 plug by removing (from the spark plug, not the distributor) it and holding it close to the engine block. The presence of a spark at regular intervals demonstrated that the wire was acceptable. Also the ignitor and distributor were OK because the other 5 cylinders were firing normally.

After changing the #1 spark plug, the symptom remained. This verifies the presence of a spark in the cylinder.

The timing was checked using a timing light pointed at the flywheel inspection port on the passenger side of the vehicle. More details of this procedure later.

The valve cover was taken off to view the valve stems. The valves for cylinder #1 were seen moving up and down with the rest of the valves. This verified that the valves were not open due to the rocker arm. A feeler gage verified that there was some clearance between the rocker arm and valve stem when the valve was supposed to be closed. The actual measurement was not important at this time because the inspection was to only verify that the valve was closed.

A pressure gage was purchased (about \$30) to check compression on all 6 cylinders. The following procedure was used:

- Remove all spark plugs.

- Remove coil to distributor wire.

- Removed electric fuel pump fuse (vehicle does not have mechanical fuel pump).

- Put accelerator in full throttle.

- Connect gage to spark plug opening (screws in).

- Crank engine for 3 seconds and monitor max pressure reading.

- Do this on all 6 cylinders.

Results for the engine were as follows (in PSI):

 - 6 – 150

 - 5 - 140

 - 4 - 140

 - 3 - 150

2 - 140

1 - 30 !?!?!

Once the low compression was identified, the cause can be determined with some certainty by performing a “wet” test. This is done by adding a few squirts of oil in the cylinder and rerunning the compression test. The results did not show an increase in pressure in cylinder #1. Logically, low compression happens when air escapes from the combustion chamber abnormally. By performing the wet test, the piston rings feature extra sealing capability. Because air would not “blow by” the piston rings during the wet test (unless the rings were damaged severely), there is confidence in stating that the air/gas mixture is escaping through one of the valves or between the head and head gasket.

Through the process of elimination, it was determined that the head needed replacement. Dixon had a head machined (ground valves and seats, new valve guides, and new valve stem seals). The date was set to perform the replacement 6/12/04.

REPLACEMENT DAY...

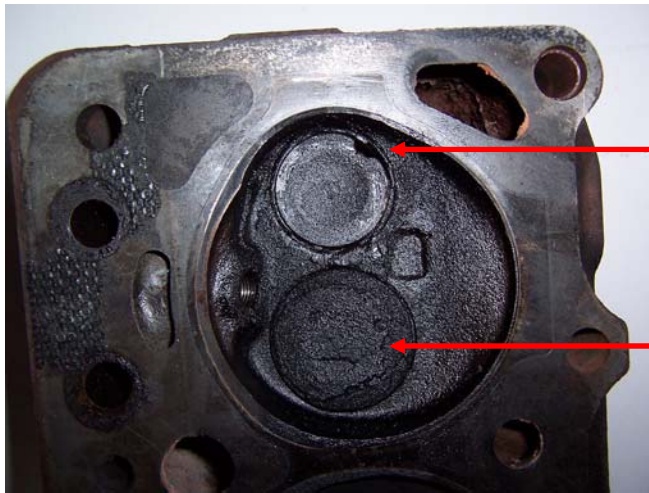
The cruiser was towed to John Darrows house so that it wasn't hot when it arrived.

The coolant was drained before we started, as it would have made it pretty messy during the removal of the head.

The valve cover was removed, followed by the rocker assembly, then the head bolts. The last 2 bolts were very difficult to remove (the last 2 on the drivers side, near the firewall). Upon removal, there was oxidation present.

The head was pried loose and lifted carefully from the block. Because the 2F head is very heavy, 3 people were needed to safely lift it off the block. Upon inspection, the exhaust valve for cylinder 1 was burned through, resulting in the loss of compression. All other valves looked to be in good shape (just some minor carbon buildup).





Valve burned completely through exhaust valve.

Heavy carbon buildup on intake valve.

To prepare the block for the new head, the old gasket material was completely removed by scraping with a chisel. It was important that all material be removed or the head would not seat well. Carb cleaner was used to aid the gasket removal process and to insure all grease and oil was eliminated. Carb cleaner was also used to remove the carbon buildup on the piston of cylinder 1, and to prepare the mating surface of the new head...



The mating surface was cleaned to remove all contaminants.

When the new head was installed, it did not seat correctly. There is a feature on the block and head (a small tube) that allow them to be mated accurately. This small tube was present in the new head – there was also one in the block. After that was discovered and one of them was removed, it went together nicely.

The head bolts were cleaned, oiled, and then inserted into the same location that they were removed. They were tightened in 2 stages, starting from the center and working outward (as shown in the service manual).

The rocker asm was installed in position that insured that all rockers were aligned with their respective valves. The gap between the rocker and valve (when closed) was adjusted to the following: Intake – 0.20mm, exhaust – 0.35mm. The service manual indicates that these are “hot” measurements. They would have to all be adjusted again after the engine was warm.

Used a feeler gage to check valve stem to rocker gap (valve lash). Intake – 0.20mm, exhaust – 0.35mm. This was done by opening the flywheel inspection cover, engaging 4th gear, and moving the vehicle until the fixed indicator was aligned with the line on the flywheel (not the ball). Once aligned, valves 1,2, 3, 5, 7, and 9 were adjusted (note that it was verified that all of these valves were in fact closed. If not, the motor would have needed to be rotated around another single turn). The motor was rotated around 1 time until the line and indicator were aligned again. The remaining valves were then adjusted. The engine was started and allowed to reach operating temperature. The procedure was repeated to ensure that the valves were adjusted “hot”.

After this activity, two other engine checks were performed...

Timing: The distributor clamp was loosened, then the distributor body was rotated so that the fixed indicator on the bell housing inspection port lined up with the ball on the flywheel with each engine rotation as the engine was running. (A timing light was used, connected to the spark plug wire from cylinder 1. The vacuum lines were also removed and plugged).

The carburetor mixture screws were adjusted with the assistance of a vacuum gage.

FINAL THOUGHTS...

Although the procedure took only one day, diagnosis and preparation was the key to success. Several tools were needed to correctly identify the fault of the engine (timing light, compression gage, feeler gages, and vacuum gage) before the process could be started. In this case the head was machined long ago (in anticipation that it would need to be replaced at some point), but it could take a few weeks for this to be done at a machine shop. Parts for the head are not cheap (valve seals alone were over \$75!).

Not mentioned during the head replacement procedure was a modification to the exhaust manifold. The manifold had originally had a flapper that would be open when the engine was cold to allow the carburetor to warm up (located inside the exhaust manifold). This part had been worn long ago and left a large hole on each side of the manifold. John was kind enough to plug these holes by taping and inserting pipe plugs. This eliminated the exhaust leak that was noticeable to the driver (and dangerous).

Many thanks to all who attended the tech session. I'm fortunate to find myself in the company of good people.