

REPORT ON ENGINE DAMAGE TO CAT 990 SERIES 2 LOADER

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INTRODUCTION

The loader was purchased second-hand from Force Equipment in Kalgoorlie in late 2015. At purchase date the total hours were 36,652. A full oil drop and oil analysis was completed which indicated no problems. The engine, a Cat 3412, was about 4,000 hours old at that point

Sandstone has accumulated about 800 hours on the loader since then. Engine oil and filter changes have been completed 3 times since purchase at approximately 250 incremental hours each time. No oil analysis was completed for the last oil change about 60 hours ago

In late 2016 the machine was seriously bogged in a drained vat, but the machine went down badly. A number of attempts to extricate the machine using a Volvo 40 tonne excavator we had on-site failed. A Cat D10 was brought in and it took the combined power of the 3 machines to get the loader out – see images

After extraction the employee operator decided to take the machine to the site wash-down area, and the machine was pressure washed. After wash-down the engine refused to crank. The starter was engaging, but was unable to turn over the engine. At that time we did not have a tool to engage the starter ring-gear and attempt to rotate the engine by hand

NO ENGINE ROTATION

After this attempt to turn the engine over, a very small weep at the block/head face was noted. Looking at the machine from the rear looking forward, the weep appeared to come from the radiator end of the left hand bank

In a series of steps the following operations were carried out –

1. Change the engine oil filters, cut open and inspect for metal – no problems noted
2. Replace the starter-motor – no change
3. Replace the batteries with new - no change
4. Completely renovate the sealed box on the right side of the engine containing the various relays associated with the starting sequence, and replace the key-start unit - no change
5. Boost the amps to the starter by combining new and old batteries

When #5 was tried the engine cranked at about 1300 amps which was considered excessive

The engine partially started, white pre-start smoke from the stacks, but a very loud mechanical noise from the upper engine was noted, and the start operations were suspended, although for a very short while the engine ran on a reduced number of cylinders

It was decided to remove the engine bonnet, and investigate the engine more closely. The injectors were pulled and minor rust was noted on some of the injector nozzles. The coolant was then dropped, and a closer investigation of the engine valley was made after some pressure cleaning of this location which collects dust and shit, and is hard to clean with the engine covers in place

The air entry plenum was closely inspected and a hole was noted at the base of the plenum which was below the level of standing valley water from washing, and it is suspected that at some time during washing/start sequences the engine had ingested water through this hole

During cranking operations it is considered that at least one cylinder ingested water and when the piston ascended during the power stroke the head was lifted a little starting the weep. The 3412 has an unusual air path from the plenum to the cylinders via the inlet valves. This routing makes the engine very susceptible to water ingestion

The hydraulic pumps were all checked to make sure that it was not a damaged pump that was making the engine difficult to crank – all appeared to be fine

I was able to acquire another plenum box

At today's date the loader has been sitting for about 14 months

PROGNOSIS

I think the following prognosis is possible given that the heads have not been removed

1. Possible bent con-rod(s)
2. Rusting of engine internals – maybe not serious and could be rectified by finishing all of the engine bores, and cleaning injectors
3. Possible valve damage, although this is considered unlikely. The engine has been cranked only, and only run at very low rpm on reduced cylinders, and there is no reason to suspect a timing problem

METHOD OF WORK

I think the following method of work should be considered –

1. Remove the cylinder heads and inspect for damage – consider a cylinder head refurbishment program
2. Dial-gauge all piston TDC positions to see if any piston is not reaching TDC, and noting the cylinder condition of all 12 cylinders. Very minor TDC discrepancies may indeed indicate a very slight bend in rods, but unless the TDC position on any cylinder is markedly out of whack, I think we can live with small damage
3. If seriously bent rods are noted, replace the individual cylinders with Cat 'Power-Pack' complete liners, pistons, rings and rod sets, and inspect the big-ends and main bearings. Carry out a manual rotation of the engine for a full crankshaft rotation on completion of repair
4. Re-charge the batteries, drop all engine oil and replace. Replace all engine coolant, and try a re-start
5. If a start is successful, allow the engine to run for about 2 hours until at operating temperature, and again drop the oil and change the filters – inspect the filters for metal
6. If all OK, button-up and return the loader to the compound

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