

- Document engine in general condition as received
 - Engine received was in good condition except for damage to case and #4 cylinder.
- Measure run-out, deflection, and end play
 - Crank runout; .0005, .002 and .0015. End play .005.
- Document condition of accessories, intake/exhaust tubes
 - Engine accessories were in good condition visually.
 - Fuel pump was appeared to be in good condition and arm actuated using hand pressure. No abnormal wear noted.
 - Oil filter adapter was removed with no abnormal indications noted.
 - Vacuum pump was removed. No abnormal were noted, shaft rotated freely. Vacuum pump drive adapter showed no abnormal wear.
 - Oil cooler was removed and visually inspected. Did not have facility to flush for debris, but engine had metal debris throughout. (No record of oil cooler being flushed or overhauled at engine overhaul, not sure if this was done? Additional records maybe?)
 - Accessory drive gears showed no abnormal wear.
 - Carburetor was visually inspected, no anomalies noted.
 - Exhaust and intake runners were inspected during engine removal, no anomalies noted.
- Remove spark plugs and notate condition
 - Plugs contained metal debris but did not have abnormal indications or wear.
- I think the engine is seized, so rotation and mag timing are out
 - Did not validate mag timing due to condition of engine.
- Remove each accessory from case; document its condition of the unit, its drive shaft and the internal accessory gear and notate if accessory itself turns freely by hand
 - See above for accessory documentation.
- If you have a test bench for mags, test mags with their respective ignition harnesses and notate if leads fire and their firing order
 - Noted that both mags have impulse couplings. Need to determine if this is correct installation for this engine model.
 - Both mags were bench tested and worked satisfactorily.
 - Harness was not tested, but not suspect for failure.
- Cut open oil filter and notate condition
 - Oil filter was removed, mechanic noted that filter “felt loose” but did not show signs of leaking.
 - Filter was cut open and found to contain metallic debris in large quantity.
- Condition of suction screen and oil sump – any metallic particles?
 - Oil pump screen had metal debris and a piece of case thread.
 - Sump had a large amount of metal debris (chunks)
 - Sump had water mixed with oil.
- Case and Cylinders (engine case separation; **NOTE:** Please placard cylinder no. for each photo after case has been split)
- Notate external and internal condition of each cylinder (indicate color and pattern – if any)
 - #1, #2 and #3 cylinders show no abnormal wear.
 - #4 cylinder has piston lodged in upper half and has a tear in the barrel from the connecting rod.
 - #4 cylinder had 3 ea broken hold down studs. 1 large and 2 small. Both aft mount studs were bent towards rear of engine.
 - Noted 1 ea #4 cylinder exhaust valve keeper is missing.

- o Noted #4 cylinder had piece of piston ring in exhaust and intake ports.
- Separate case and record condition of case halves (unremarkable or is there fretting)
 - o Case failed around #4 cylinder along with part of accessory case in adjacent area.
 - o Noted larger than normal amount of case sealant and believe that sealant used may be incorrect for the application?
 - o Noted water came out of propeller seal when removed from case, similar to water noted in sump. (Engine was pointed prop shaft down during disassembly)
- Condition of connecting rods, bearing races, pistons and piston faces
 - o #1, #2 and #3 rods, bearings and pistons showed no unusual signs of wear.
 - o #4 cylinder has piston stuck near top of cylinder.
 - o Piston is rotated off plane of piston pin and connecting rod aligning.
 - o Piston pin was no longer installed in piston and skirt was broken in numerous areas.
 - o Connecting rod is bent and twisted. Connecting rod wrist pin bushing was found in engine, deformed and separate from connecting rod.
 - o Noted piston ring poking past one valve into exhaust port.
 - o Connecting rod side clearances for #1 - .005, #2 - .010 and #3 - .009 were in service limits of .004-.016 and were free to rotate.
 - o #4 connecting rod would not rotate until bolts were loosened.
 - o (Could not validate if pistons were new or used during cylinder overhaul based on records given?)
- Clogged oil journals? None noted
- Signs of detonation? None noted
- Condition of crankshaft
 - o Crankshaft showed no signs of heating, oil starvation or scoring outside of minor fretting on #4 journal.
 - o Crank runout; .0005, .002 and .0015. End play .005.
- Condition of camshaft lobes and lifters
 - o Several camshaft lifter bodies showed signs of wear parallel to the cam lobe indicating it was not rotating correctly. (Possible indication of cam being "flat"?)
 - o Camshaft has some damage that appear to be from debris in engine.
 - o Several lifter bodies are broken.
- Break away torques: All values in inch pounds
 - o Oil filter "felt loose" by technician removing filter.
 - o Oil pan; 85, 98, 72, 92, 101, 107, 95, 89, 90, 84, 85, 91, 92, 88, 94, 97, 100, 87, 103, 101.
 - o Accessory housing right side; 63, 62, 91, 57, 60, 80, 63
 - o Accessory housing left side; 2 broken, 3 missing, 50 and, 45.
 - o Spark plugs; #1 Top 415, Bot 315, #2 Top 470, Bot 415, #3 Top 490, Bot 370, #4 Top "loose", Bot "loose".
 - o Cylinder bolt- small 300 in/lbs, big 600 in In/lbs per manual;
 - #1 Small TA 450 , TF 450 , BA 550 , BF 450
Big TA 1000 , TF 900 , BA 1100 , BF 950
 - #2 Small TA 550, TF 600 , BA 450 , BF 450
Big TA 950, TF 1000 , BA 950 , BF 900
 - #3 Small TA 550 , TF 500 , BA 500, BF 500
Big TA 1000, TF 950 , BA 1000 , BF 1000
 - #4 Small TA Broken , TF Broken , BA Missing , BF Missing

Big TA Missing , TF Missing , BA Loose , BF Loose

NOTE: Conducted sampling of cylinder bolt torques by marking bolt prior to break away torque check performed. When re-torqued, witness marks did line up again indicating fasteners were most likely torqued correctly.

- o Connecting rod bolts:
 - #1 450, 500
 - #2 450, 500
 - #3 500, 500
 - #4 Could not perform due to damaged rod
- Possible scenarios for engine failure:
 - o Piston failed at wrist pin?
 - o Connecting rod failed at wrist pin end?