

NTSB Piston Engine Examination (100-Hour Inspection) Guidance N1957P - Model O300D SN – 33010-3-5-D

Visual Documentation:

- Overall Engine Damage (cylinder damage, crankcase damage, pre-impact fire, etc.)
- Engine Mount(s) Condition
- Engine Accessories (what is separated, what is still attached, and are they 100% secure to their mount?) – **Carburetor ripped from mounts**
- Verify all fuel/oil lines are secure
- Verify Throttle/Mixture/Carb heat/Propeller Governor control positions on the engine and obtain continuity to the cockpit controls (if able) – **Carb heat duct from exhaust appears to be insufficient for proper air flow. Carb Heat arm was rotating on Carb Heat butterfly valve shaft.**
- Verify engine oil level (if the engine/oil supply tank is level)

Remove Items Prior to Rotating Crankshaft:

- Disconnect all spark plug wire ignition leads (top and bottom)
- Remove and label all top spark plugs (label what cylinder they came from!)
- Inspect spark plug electrode for mechanical damage. Damaged electrodes could be an indicator of foreign object ingestion or internal mechanical malfunction of the engine. – **Sparkplugs were in good condition and appear to be properly gapped.**
- Remove the engine-driven fuel pump (Continental fuel injected engines) to document the drive coupling prior to crankshaft movement. – **N/A**
- Remove the vacuum pump (if equipped) and document the drive coupling prior to crankshaft movement. – **N/A**
- Remove propeller if needed to facilitate crankshaft rotation (Lycoming's are timed using the starter ring gear, so be mindful of this if you want to obtain engine to magneto timing. Mark flywheel/crankshaft flange orientation with sharpie for reference)
- Disconnect the magneto primary "P" ignition leads – **Electric conductivity between P lead and ignition switch were intermittent while goggling ignition switch in all positions.**
- Remove all cylinder rocker box covers

Internal Continuity:

- Examine all cylinders with a borescope (if able).
- Rotate the crankshaft in the direction of normal rotation by hand using the propeller or a hand tool attached to an accessory drive pad. If you are unable to rotate the crankshaft successfully, remove all engine accessories that are attached to the engine and try again. If you are still unable to rotate the crankshaft, it is possible you will need to remove cylinders and the accessory case to examine the issue further. Ultimately this could result in you completely disassembling the engine. Be mindful of preserving any potential internal fracture surfaces. Continued attempts to rotate the crankshaft may obliterate or alter evidence. – **Engine rotated freely**
- While rotating the crankshaft, verify all pistons are moving within the cylinders and each of the accessory gears are moving. -
- While rotating the crankshaft, observe the rocker arm movement on all cylinders for the intake and exhaust (should be equal movement up and down). Any asymmetrical movement could be an indicator of worn camshaft lobes requiring further examination. – **Rocker arms and valves moved freely. Movement was free and appeared to be normal.**
- Obtain "THUMB" compression and suction on all cylinders by placing thumb lightly over the top sparkplug hole and rotating the crankshaft through by hand. Make sure your thumb is over the spark plug holes lightly and not sticking inside them. This could result in an injury! – **"Thumb" compression appeared to be normal**
- If you do not obtain thumb compression on a cylinder, you may need to stake the valve. Following visual inspection of the valve springs, rocker arms, etc., you'll need to use a dead blow hammer (large rubber hammer) and hit the portion of the rocker arm that is connected to the valve stem/springs. The reason for this is usually carbon and/or debris can get between the valve and the valve seat during the accident

- sequence, which would prevent it from closing all of the way.
- While rotating the engine crankshaft, verify spark on all ignition harness leads if magnetos are impulse coupler equipped. If there is damage to the leads, cut the harness at the damaged area, and obtain spark to that point. If no spark is produced, further examination of the mags may be necessary. Depending on the magneto or ignition system, removal and further testing may be needed. – **Spark plugs produced sparks when rotating magneto by hand.**
- If both magnetos remained attached to their mounts, verify engine to magneto timing if able.

Induction / Exhaust System:

- Document the air intake tubes/ air filter-screen for overall condition, damage, blockages, and leaks. – **Air filter was damaged, and dirt filled from impact with ground.**
- Document the exhaust system for overall condition, damage, ductile bending. Also be sure to inspect the exhaust gas path for possible oil film, soot. Attempt to inspect internal exhaust baffles to see if they are in place (they can separate and restrict air flow, thus reducing engine performance).
- If equipped with a turbocharger, inspect the associated tubes/clamps to and from the waste gate to the turbo charger to the exhaust for security. – **N/A**
- Verify rotation of the turbocharger. – **N/A**
- Inspect turbocharger impellers (compressor/turbine) for damage. – **N/A**
- Inspect the waste gate to document the condition and position of the valve and that all linkages are intact. – **N/A**

Accessories:

Ignition System / Magnetos:

- If you are unable to obtain spark on the ignition leads, remove the magnetos and ignition harness once magneto to engine timing has been determined, if able. – **Magnetos timing was found to be correct at 26 degrees on the right magneto and 28 degrees on the left magneto.**
- Examine the magneto drive shaft and associated gears for security/damage/wear. **Magnetos drive shaft appeared to be normal.**
- Rotate the magneto drive shaft in direction of normal operation, and if equipped, note how the impulse coupling works. If the magneto is not equipped with an impulse coupling, you may need to use a hand drill to rotate the drive shaft. If the magnetos do not produce spark, examine them further by removing the harness cap and partially disassembling the magneto to verify the internal component condition. – **Magnetos produced a good hot spark on all harnesses.**
- Note: You can also use a paperclip inserted into the magneto cap posts to get spark from the paperclip to the cap housing or utilize 2 screwdrivers to do so. Also, most of the time, a local maintenance shop will have a magneto test bench and will test magnetos for less than \$50. You'll probably need to see a shop to test magnetos with shower of spark, retard breakers, etc.
- Document the ignition harness. Check for impact or any preexisting damage. – **Cylinder #1 lower spark plug end of harness insulation broken at ignition tip. Cylinder #5 protective ground sheathing worn at spark plug -top of cylinder.**
- Document all of the spark plugs (top and bottom). This includes coloration within the electrode area, electrode wear and gap. Inspect for mechanical damage at the electrode. – **Spark plugs appear to be normal and gapped correctly.**
- For those engine equipped with an electronic ignition system, typically the timing/ref sensor is located on the forward part of the engine at the crankshaft. It varies per system. In order to test this, you'll most likely need to remove the entire system after documenting the installation and send it to the manufacturer. – **N/A**

Carburetor Equipped Engines:

- Verify fuel lines to the carburetor are secure. – **Fuel gasculator was found to have what appeared to be paint chips in the bottom of the bowl but no debris observed on top of the screen.**
- Remove carburetor from the engine (if still attached) – **Carburetor broke away from engine upon impact.**
- Actuate the throttle arm from stop to stop and verify that the accelerator pump functions (if equipped).
- Verify the mixture arm moves stop to stop (if equipped). Also, it is fairly typical on Stromberg carburetors

to either not have a mixture arm or it'll be safety wired full rich.

- Remove the fuel inlet screen and verify it is free of debris. – **Inlet screen was clean.**
- Disassemble the carburetor –
- Note the condition of the floats, needle valve, needle valve seat, float bowl – **Floats appear to be normal and not deteriorated.**
- Inspect for visible contaminants and water within float bowl. Utilize water finding paste as needed. - **No contaminants were found.**
- Check the fuel primer system (lines/plunger) for leaks and general function.
- Verify the fuel pump and fuel lines to and from it are secure (if equipped. Some engines have a low pressure fuel pump to supply fuel to the carburetor. These are usually work with an arm which rides on the camshaft.)

Fuel Injected Engines: - **N/A**

- Verify all fuel lines to the fuel pump, throttle body fuel control unit, fuel flow divider/manifold valve, and fuel injectors are intact and secure.
- Remove the fuel screen from the throttle body fuel control unit (servo) and look for potential debris.
- Verify throttle plate moves when the throttle arm is actuated from stop to stop and that all linkages are intact and secure.
- Verify mixture arm movement from stop to stop.
- When examining an engine with an engine driven fuel pump (Continental's), pay attention to the fuel pump drive coupling. This coupling has a shear point and if it is not removed prior to rotation of the engine, it could shear when the crankshaft is rotated. This is specifically common with engines that are fire damaged or water submerged. It's also nice to know if it failed prior to you rotating the engine or not. Lycoming's are a different setup.
- Remove the fuel nozzles from the cylinders and inspect for blockages.
- Remove the fuel flow divider or fuel manifold valve and disassemble as needed. Depending on the system, you could have an internal diaphragm and spring to inspect the condition of. Others may just feature internal cavities for fuel transfer.
- Be mindful of any potential water contamination within the fuel system components and lines.

Miscellaneous Accessories / Systems:

- Remove propeller governor (if equipped), rotate the drive shaft, actuate the lever, and document the oil screen for debris. A governor overhaul shop can run the propeller governor throughout all ranges of operation on a test bench if needed. – **N/A**
- If equipped, remove oil filter and cut open to examine the internal oil filter element. Note any metallic debris, etc. Also note that Tempest oil filters have a built in magnet to collect metallic debris.
- If the engine is not equipped with an oil filter, it should have an oil screen located within the system. Remove the screen and inspect for metallic debris. – **No contaminants were found on the fuel screen however metal non-ferrous particles were found in the oil**
- If oil pressure issues have been part of the engine's operational history, check the oil pressure relief spring assembly and the vernatherm. The engine manufacturer can assist with providing additional details.
- Document the propeller assembly (hub, blades, spinner). – **Propeller impacted the ground and fractured blade tips.**
- Examine the vacuum pump and disassemble if needed. – **N/A**