

EXAMINATION NOTES

Investigators from the Safety Board, Cessna, and Continental Motors examined the wreckage on May 05, 2019, at the recovery facility, Plain Parts in Pleasant Grove, California.

The main wreckage came to rest inverted in a dry river bed. The accident site was located about 1,650 feet from the departure end of runway 07. The front seat had a control quadrant on the left side; the levers were all bent and folded over to the right. The throttle was positioned in the mid-position and the mixture and propeller controls were full forward. The fuel boost pump was on selected on with both “hi” and “low” switches activated.



Figure 1: Main Wreckage

The aircraft is a Cessna T210G, serial number T210-0234, and was manufactured in 1966. According to the owner, an annual inspection was endorsed as completed on March 27, 2018, at which time the airframe had accumulated a total time in service of 8,745.6 hours. The tachometer time at the wreckage indicated 8,829.3 (Hobbs 4121.6 hours).

FUEL SYSTEM

An examination of the fuel system revealed that the fuel selector handle was positioned on “BOTH.” The fuel gascolator contained a liquid consistent in odor and appearance with 100 LL Avgas. The fuel line from the fuel pump to the gascolator was removed and no fuel was present. Disassembly of the fuel manifold revealed a liquid that was brown in color and had an odor and appearance similar with a mixture of engine oil and Avgas.

In an attempt to determine the source of oil located in the fuel manifold, the fuel inlet hose was removed from the fuel manifold valve. No fuel or oil was present. The nose gear doors were opened and the airframe boost pump outlet fitting b-nut was released. No fuel or oil was found. The engine driven fuel pump dry-bay outlet pipe was removed and a trace amount of oily film was present. Fuel injectors from cylinders 1 and 5 were removed. When the air reference tubes were released from the fuel injectors bodies, dark oil began to escape from the fuel injectors. The fuel injectors were removed and inspected. Fuel injector #1 was saturated with oil while # 3 was open.

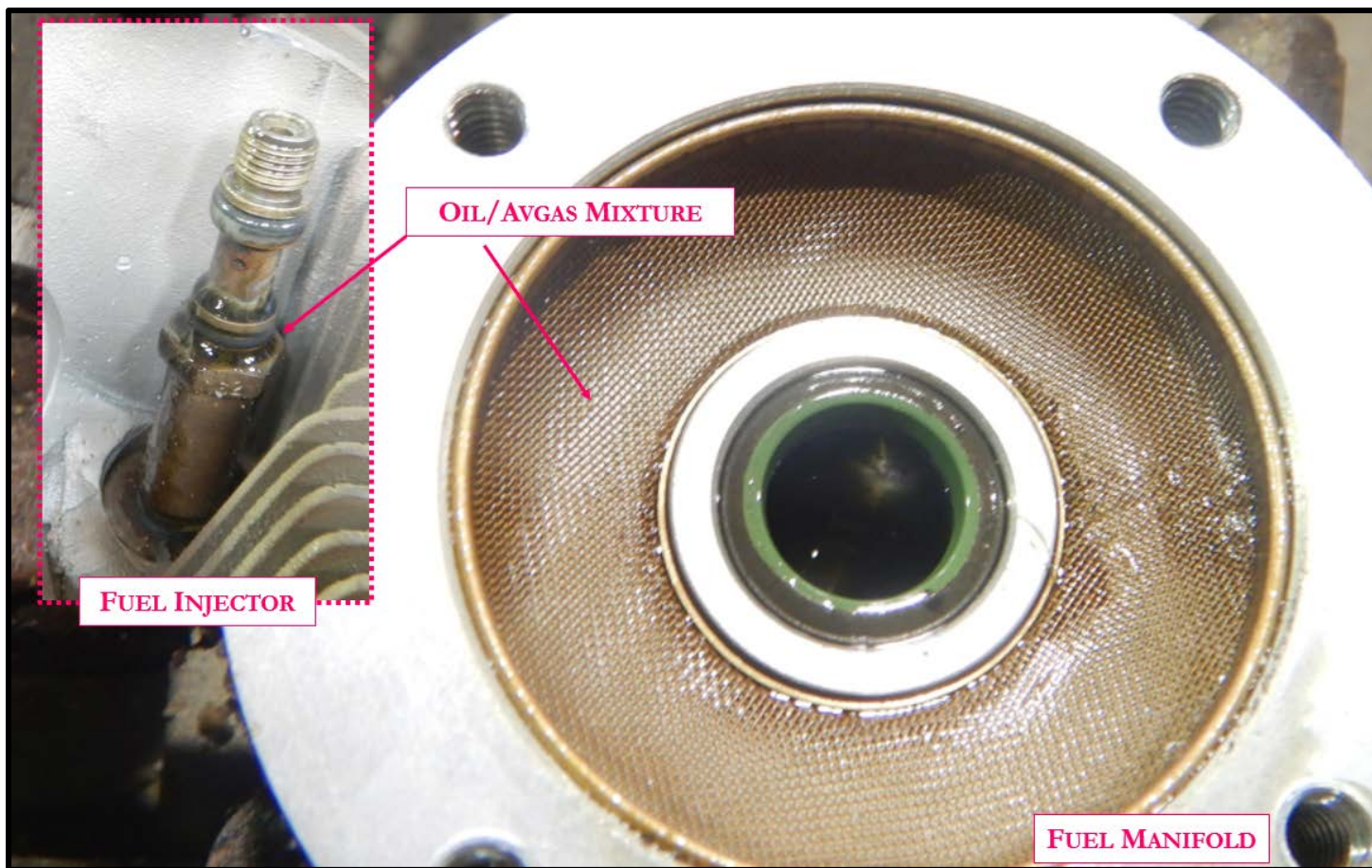


Figure 2: Fuel Manifold and a Fuel Injector (showing substance coating)

ENGINE

The airplane was equipped with a TSIO-520-C(2B), six-cylinder Continental Motors engine, serial number 178652-R. The owner stated that the engine had accrued a total time in service of 1,130 hours.



Figure 3: Engine Data Plate

An external examination of the engine revealed that the crankcase was intact with no evidence of premishap catastrophic mechanical malfunction or fire. There was a light oil film around the engine case around the lower right firewall and accessory gearbox area.

The upper sparkplugs were removed and examined. All sparkplugs were dark in color, but the engine manufacturer's representative stated that they were consistent with normal wear. A lighted borescope was used to perform an internal examination of each cylinders' combustion chamber, all of which displayed light combustion deposits. All piston domes exhibited normal combustion deposits except the No.4 cylinder, which exhibited a shiny, gritty substance across a portion of the piston dome. A sample of the substance was obtained and placing a magnet

near the sample revealed that the gritty compound was non-ferrous material. The intake and exhaust valves were unremarkable; the cylinder walls did not display any scoring or evidence of heat distress.



Figure 4: Spark Plugs

Investigators achieved manual rotation of the crankshaft by turning the propeller blades that remained affixed to the crankshaft flange. Thumb compression was established in all cylinders. Valve train continuity was observed, with equal lift action at each rocker assembly; oil was found in the rocker box areas on all cylinders. Upon rotation of the engine, the magnetos and their respective ignition harnesses produced a spark in the proper firing order; the magneto impulse couplings were heard to release.

TURBOCHARGER

SYSTEM DESIGN

The turbocharger converted wasted energy, in the form of hot exhaust gases from the engine exhaust, into increased manifold pressure to increase power available from the engine. After air and fuel were burned in the cylinders, the exhaust gases from combustion were used to spin a turbine wheel at high speeds. The turbine wheel was connected to a compressor wheel that compressed induction air supplied through an opening in the lower cowl, that was ducted through a filter and into the compressor, increasing the air density. The pressurized induction air would then pass through the discharge duct to the throttle body and induction manifold into the engine cylinders, completing the cycle.

The controller sensed manifold pressure to maintain sea level horsepower at altitude, without over-speeding the turbocharger or over-boosting the aircraft's engine. It did this by controlling pressurized engine oil to hydraulically actuate the wastegate. The wastegate (exhaust bypass valve), used speed or compressor discharge pressure (boost) during certain conditions of a flight. Managed through the controller, the wastegate opened to allow exhaust gas to bypass the turbocharger, limiting speed and boost.

EXAMINATION

The turbocharger compressor outlet pipe/hoses (discharge duct) were disassembled, and oil was present in the conduit. The rubber connector nearest the turbo compressor inlet was removed and a lighted electronic borescope was used to inspect the inlet tube. A yellow terry cloth towel was discovered blocking the turbo inlet tube and the towel had become entangled with the turbo charger compressor wheel.

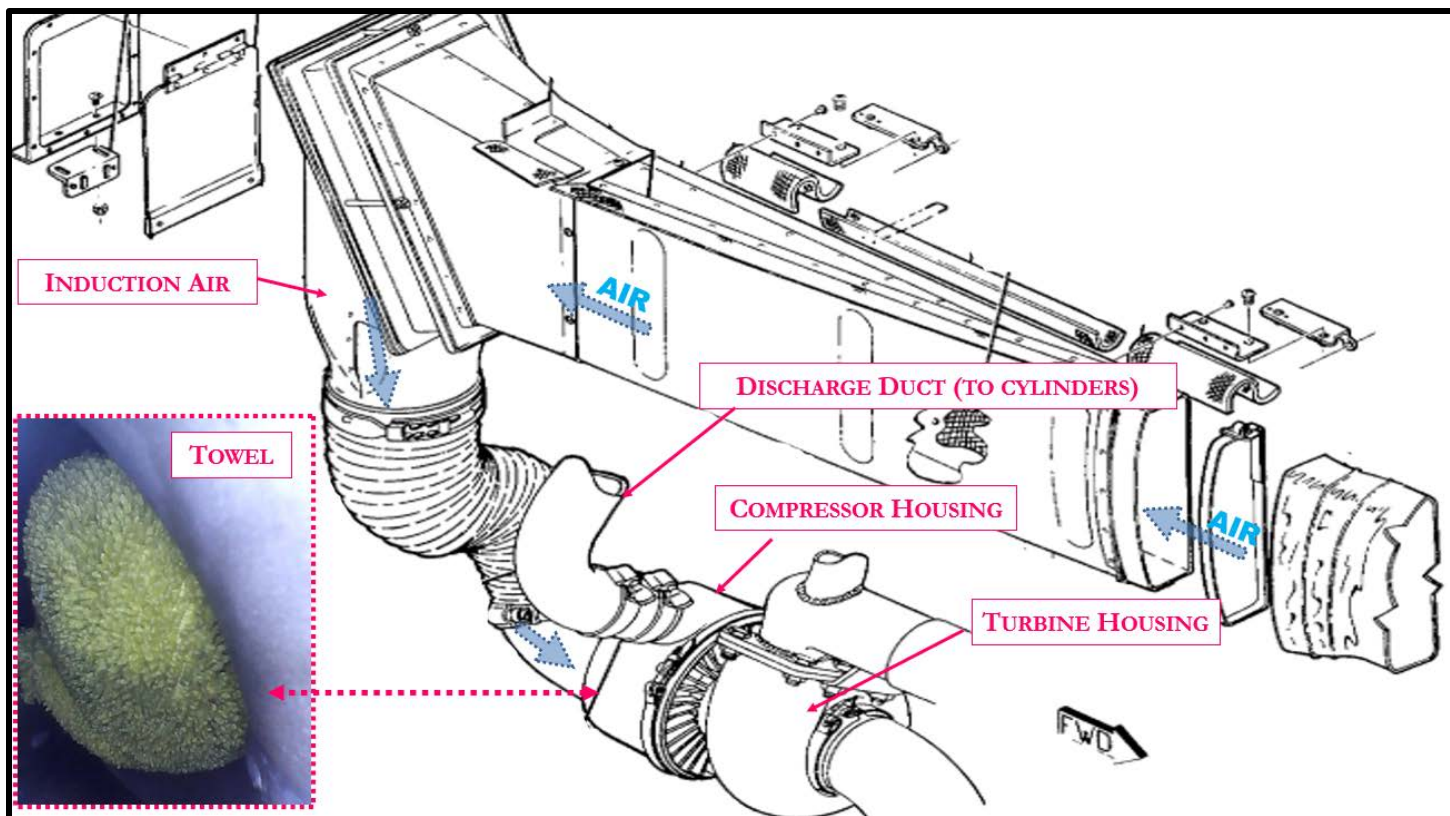


Figure 5: Towel Found in Compressor Housing



Figure 6: Compressor Wheel (with broken blades and towels residue)



Figure 7: Towel Found

The compressor wheel was damaged, and several blades were distorted. Once the towel was removed, the compressor wheel was free to rotate.

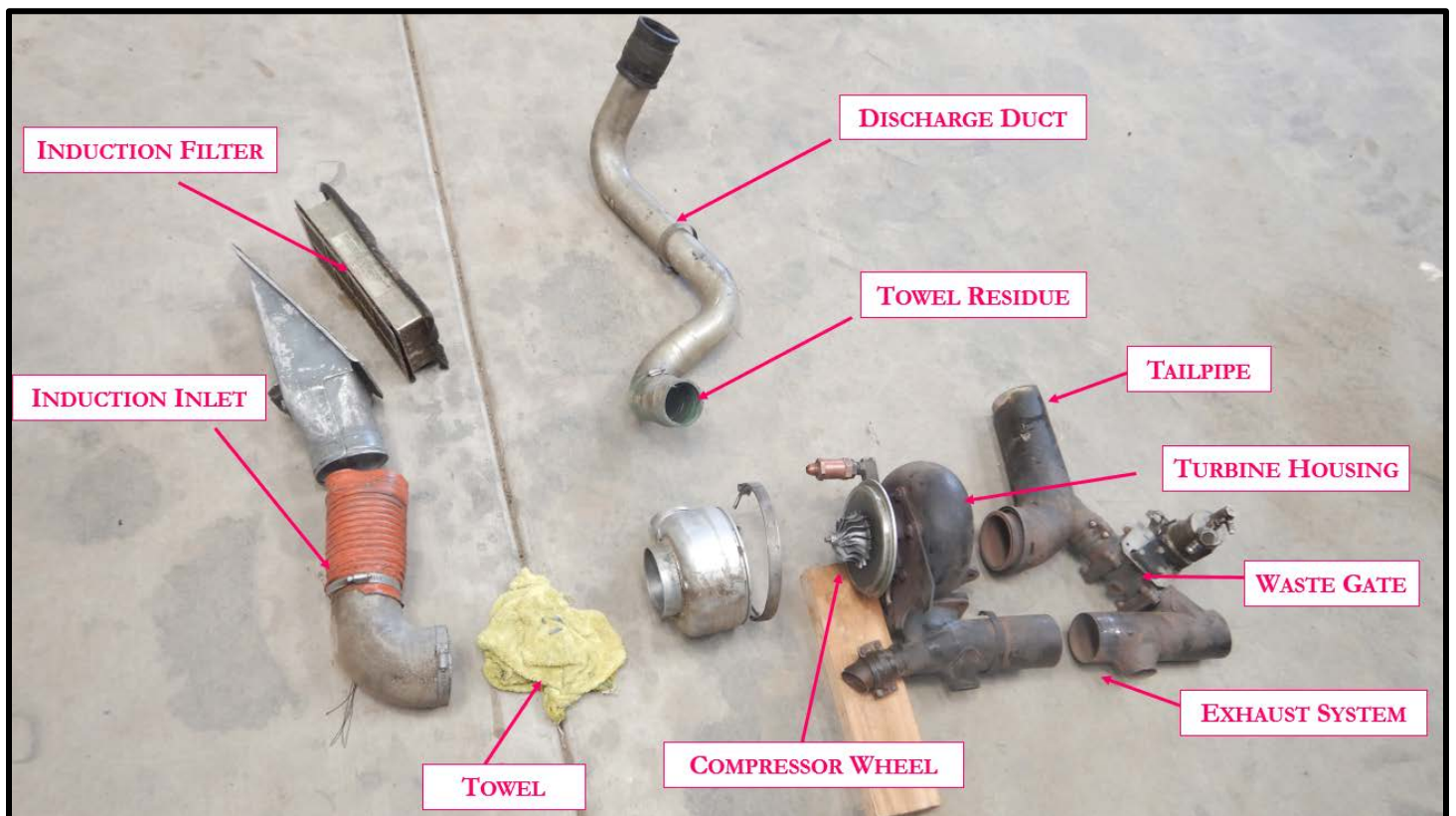


Figure 8: System as Removed

It was determined that when the turbocharger was unable to rotate normally, ring seals which are used to seal the turbo charger shaft will allow oil to escape the shaft bearing area and enter the compressor section allowing oil to migrate to the upper deck pressure plumbing, then to the fuel injectors. From injectors the oil could build in the cylinders and, when inverted, drain into the fuel manifold. This migration of oil likely occurred while the airplane was inverted after impact with the sandy riverbed.

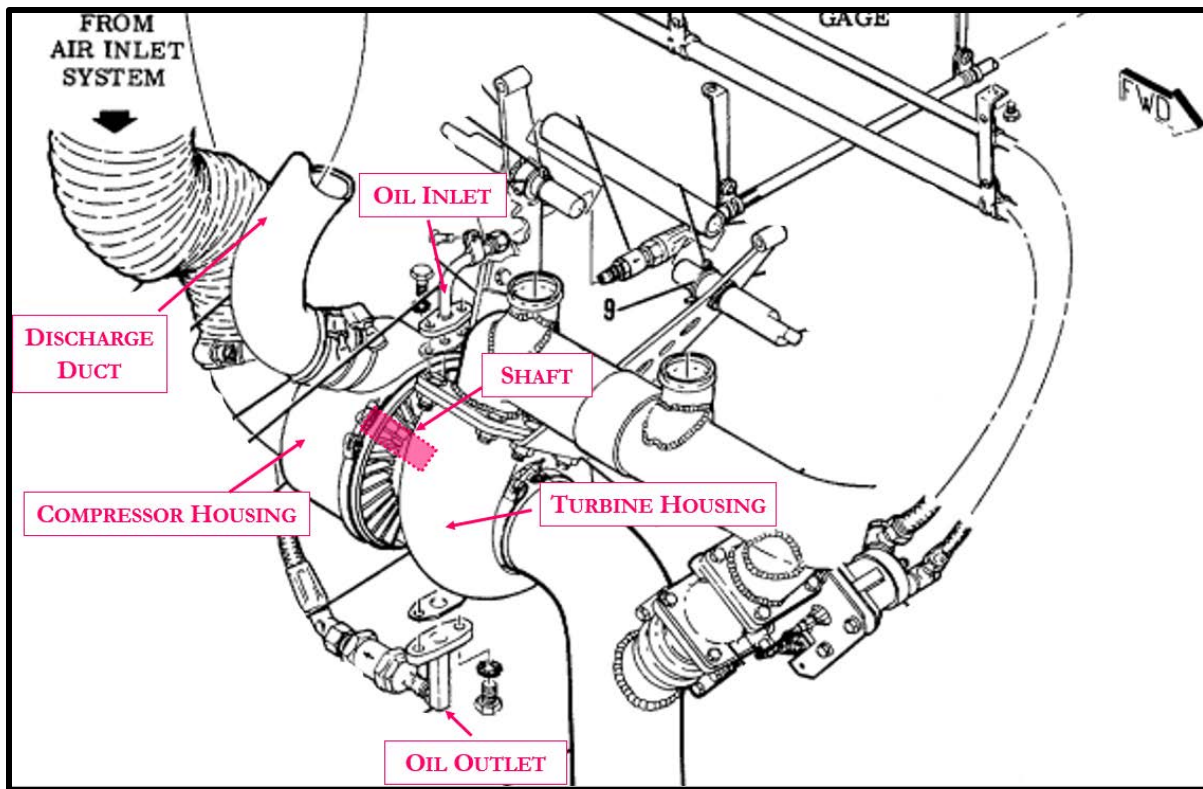


Figure 9: Turbocharger System (showing oil)

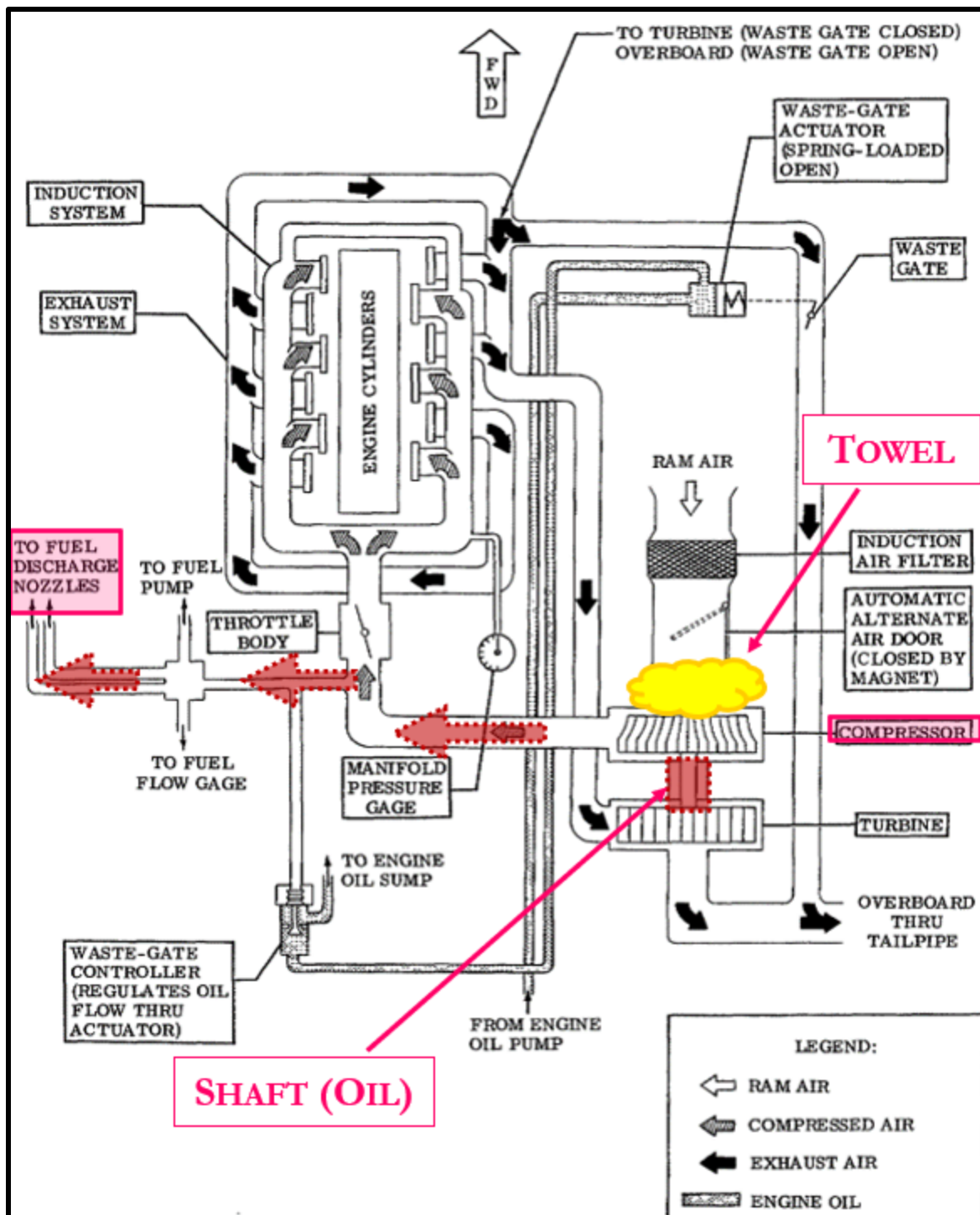


Figure 10: Turbocharger System (showing oil path to fuel nozzles)

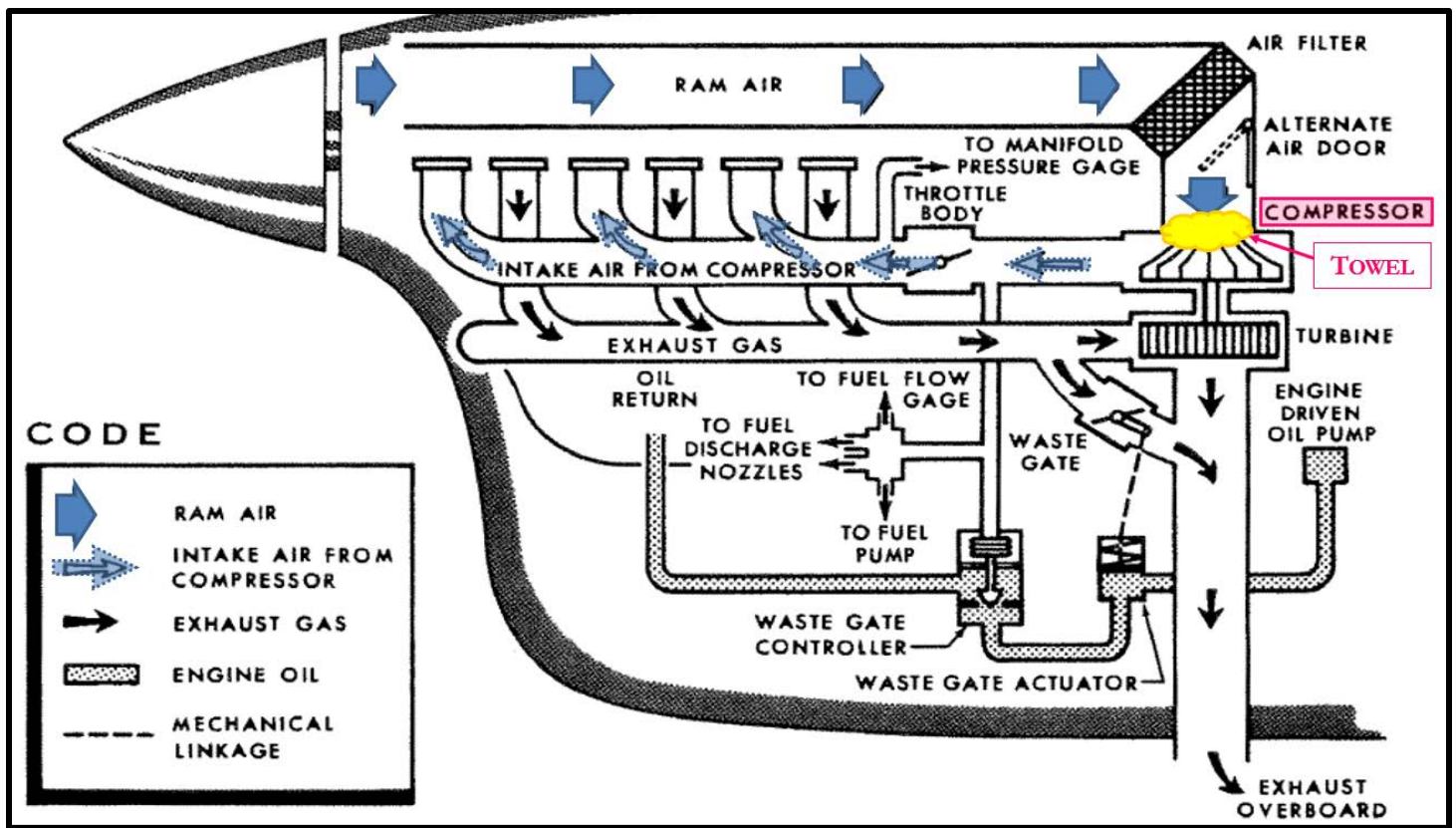


Figure 11: Turbocharger System (showing air path)

RECORDERS

The aircraft was equipped with a J. P. Instruments EDM-700/800, which is a panel mounted gauge that the operator can monitor and record up to 24 parameters related to engine operations.

MAINTENANCE HISTORY

The oil filter had a date of June 08, 2018. The pilot stated that the airplane had amassed the flowing times in the past months: June 3.8 hours; 23 hours in August and September; 7.6 hours in October, equating to about 34 hours since after the oil change.

The pilot stated that at that date he performed an oil change and an airframe and powerplant (A&P) mechanic performed an inspection of the exhaust system for leaks. As part of the maintenance, he removed the airbox (six screws) to have access to the oil filter. He placed a towel in the scat tubing (not disconnected) in an effort to protect the turbocharger from foreign object damage (FOD).