

SUPPLEMENTAL INVESTIGATIVE MATERIAL

HISTORY OF FLIGHT

On November 27, 2022 about 1345 mountain standard time, a Cessna 177, N2994X, was substantially damaged when it was involved in an accident near Willow Spring, Arizona. The pilot and passenger sustained minor injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot stated that the purpose of the flight was to go to Sedona, Arizona for lunch. He departed Lake Havasu, Arizona, his home base, with a calculated 34 gallons of fuel. He had made the same flight on previous occasions and remembered that the airplane used about 12 gallons, which would leave a reserve of about 21 gallons upon his arrival; he planned to refuel in Sedona.

After departing about 1245, the airplane climbed to about 9,600 feet mean sea level (msl) for the en route portion of the flight. The airplane continued at that altitude for about ten minutes and then the engine experienced a total loss of power. The pilot attempted to troubleshoot the engine failure while preparing for an off-airport landing. He estimated the airplane had about 23 gallons of fuel at this time. The airplane came to rest inverted adjacent to a remote dirt road.



Figure 1: The Airplane at the Accident Site

RECORDS

The Cessna 177 single engine airplane was manufactured in 1967 (serial 17700394). It was equipped with a Lycoming O-360-A4M (serial L-32510-36A).

The tachometer at the accident showed 730.1 hours, though the pilot reported that it had been replaced and the that airplane had amassed a total time of 3,804.96 hours. A review of the airplane's logbooks revealed that the engine was overhauled in June 2022, equating to about 38 flight hours prior to the accident. In August the engine was inspected after the pilot encountered an overspeed. The records indicated that the last maintenance performed was in October 2022 with the installation of an autopilot system and an upgraded engine monitoring system.

The fuel receipts indicate that the pilot refueled at Cable Airport, Upland, California the pilot added 17.3 gallons, which according to the pilot was full fuel tanks. Thereafter the pilot made a 1.8 hour flight

FUEL SYSTEM

Fuel is supplied to the engine from two integral fuel bays, one in each wing with a vented fuel cap. Usable fuel in each bay, for all flight conditions, is 24 gallons when completely filled. Fuel from each wing fuel bay flows through a selector valve, small reservoir, and fuel shut-off valve to the fuel strainer. From here, it is routed to an engine-driven pump which delivers the fuel under pressure to the carburetor. An electric auxiliary fuel pump parallels the engine-driven pump and is used when fuel pressure drops below 2 psi.

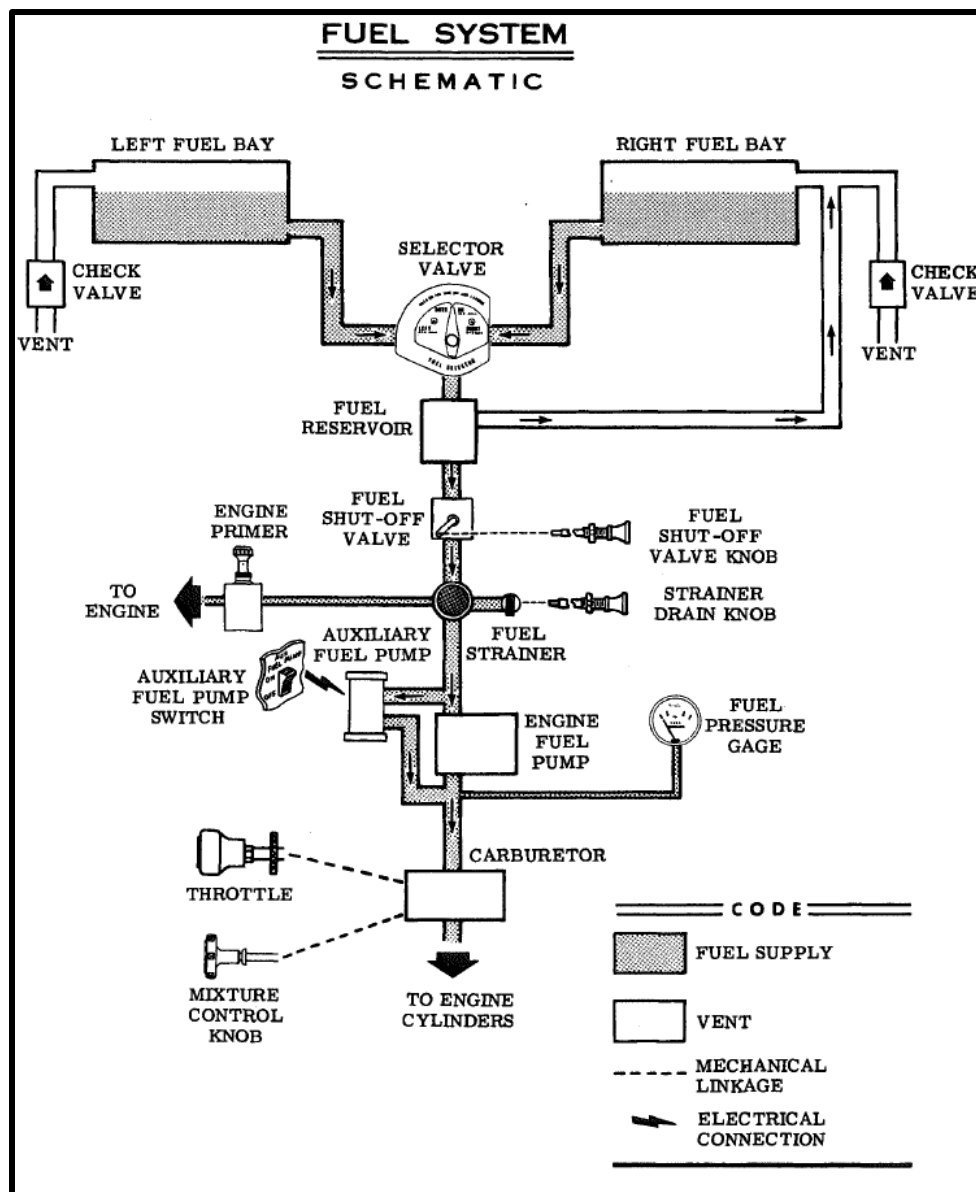


Figure 2: Fuel System Schematic (provided by Cessna)

Fuel from the wing fuel bay areas is gravity-fed through a selector valve located on the floor board between the seats with a "LEFT", "BOTH", and "RIGHT" selection. From the selector the fuel is routed to a small reservoir tank and shut-off valve to the fuel strainer. From the strainer, fuel is routed to an engine-driven pump which delivers fuel under pressure to the carburetor. An electric auxiliary fuel pump parallels the engine-driven pump and is used when the fuel pressure drops below 2 psi. The fuel is individually vented overboard through vent lines extending to the wing tips with a check valve located just outside of each fuel bay. The reservoir is vented to the right fuel vent line.

The wings were removed from the airframe for recovery. The fuel strainer sump was opened and about three ounces of liquid was captured in a clean glass jar. The liquid was consistent in color (blue) and odor with that of 100LL Avgas. The fuel line at the strainer was removed and pressurized air was directed from the right and left wing fuel ports. Air would flow through the selector, the reservoir, the fuel shut-off, and the strainer escaping out the disconnected line. The selector position was changed and to “right”, “both” and “left” all of which directed air from the appropriate wing(s). Investigators disassembled the fuel selector and left detent did not have a solid feel in the position due to a large amount of debris found that prohibited it. The detent plate was worn; the balls and valve were intact. From selector, the fuel went to a reservoir that was crushed in floorboards. Fuel was then routed to shutoff valve and then through the firewall to the strainer. The shutoff valve was controlled with a knob on the panel; it was not saftied. The shutoff valve was tested and found to be operational. The strainer was attached to the firewall and the screen was clean.

Taking off the fuel lines through the system resulted in fuel leaking out. The electric fuel pump remained attached to the firewall. Investigators connected an auxiliary battery the pump and could hear the pump audibly clicking coinciding with feeling light puffs of air on the outlet consistent with normal operation. At the electric pump, the fuel was routed to the mechanical fuel pump; the outlet of the electric pump went to a manifold. The mechanical pump was removed and disassembled. When the pump’s lever was manipulated up and down suction could be felt in the inlet and pressure could be felt on the outlet. When rotating the engine by the propeller, the pin that depresses the pump’s lever could be felt moving. From the mechanical pump, the fuel was routed to the tee. From the electric pump, fuel was routed to the tee. The tee also contained a smaller line to the cockpit; when that line was removed fuel that was inside contained debris.

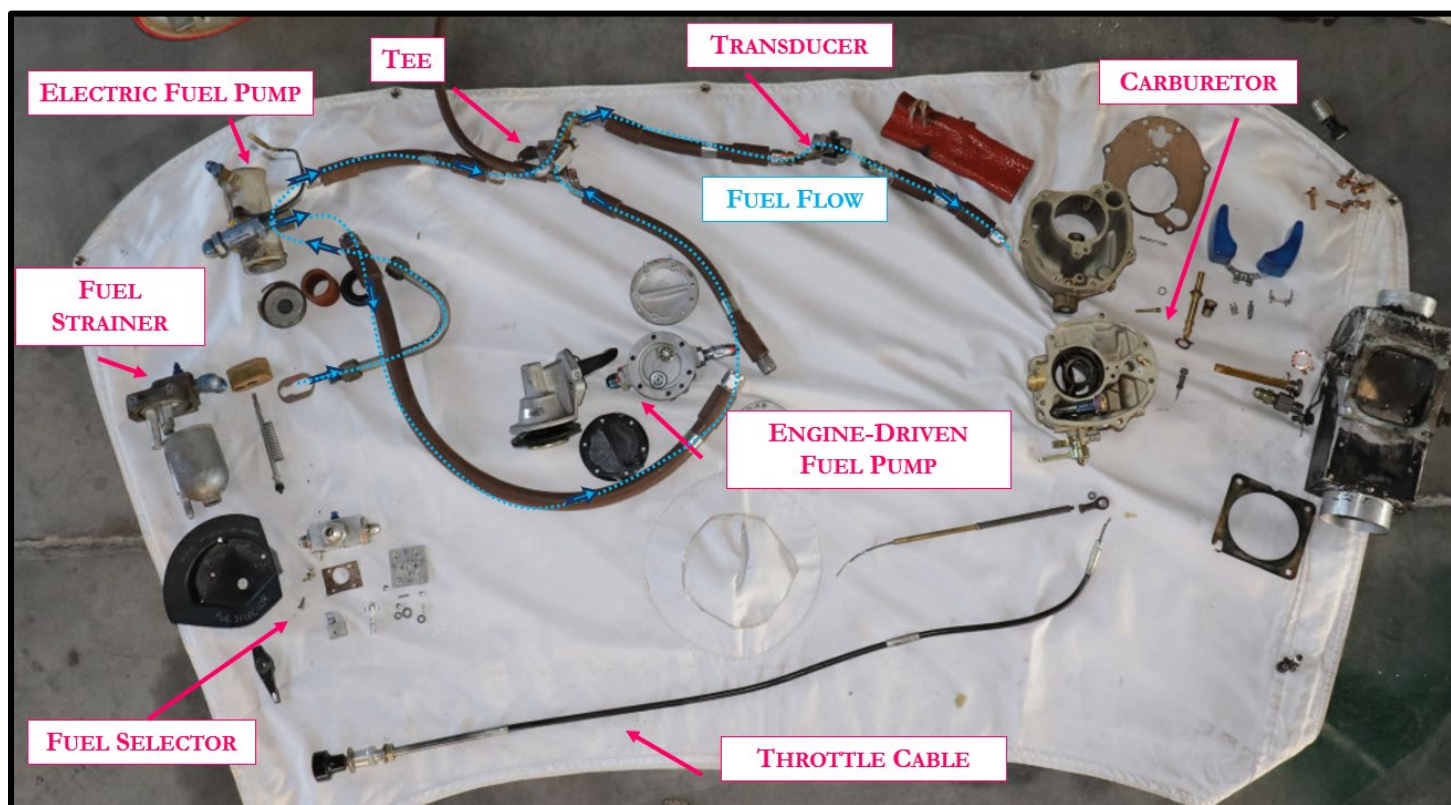


Figure 3: Fuel System Disassembled

From the manifold the fuel was routed in one line to a transducer FloScan 201 that was wrapped in fire sleeve. The fitting was both stained blue consistent with leaking, The inside of the fire sleeve has one small area of blue staining. The transducer was removed an application of air produced a sound consistent with the paddle wheel inside spinning. The fuel then continued to the carburetor, which was attached and intact. Disassembly of the carburetor revealed that it contained trace amounts of fuel. The composite floats were removed and floated when placed in water. There was some small debris in the carb. The airbox was jammed in the open position and carburetor heat cable would not function.

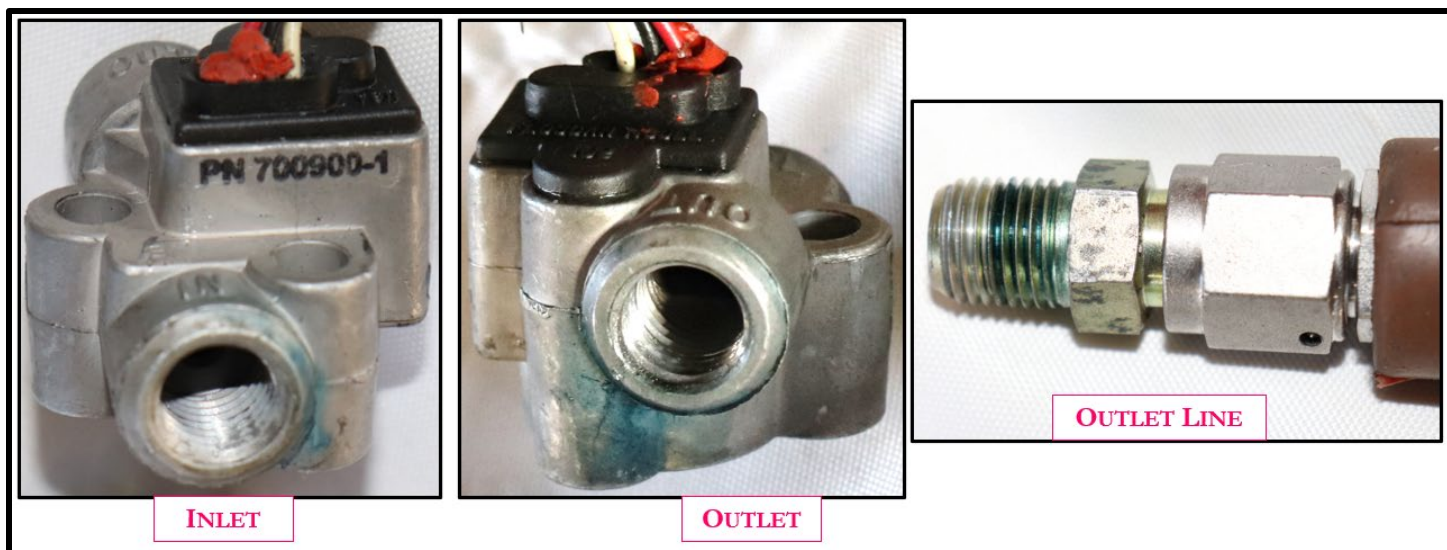


Figure 4: Fuel Transducer

The throttle cable was frayed and had stretched out of its housing (inner wire pulled from the swage). It was attached to the carburetor arm and moved slightly when manipulating the control knob in the cockpit (full travel was not possible). It appeared that the coils had been stretched, but it could not be determined if it was done at impact. The airframe was missing the required bracket needed to attach it to the airframe; instead it was attached in an indirect route. The mixture control arm was separated from the mixture shaft and the shaft was bent.

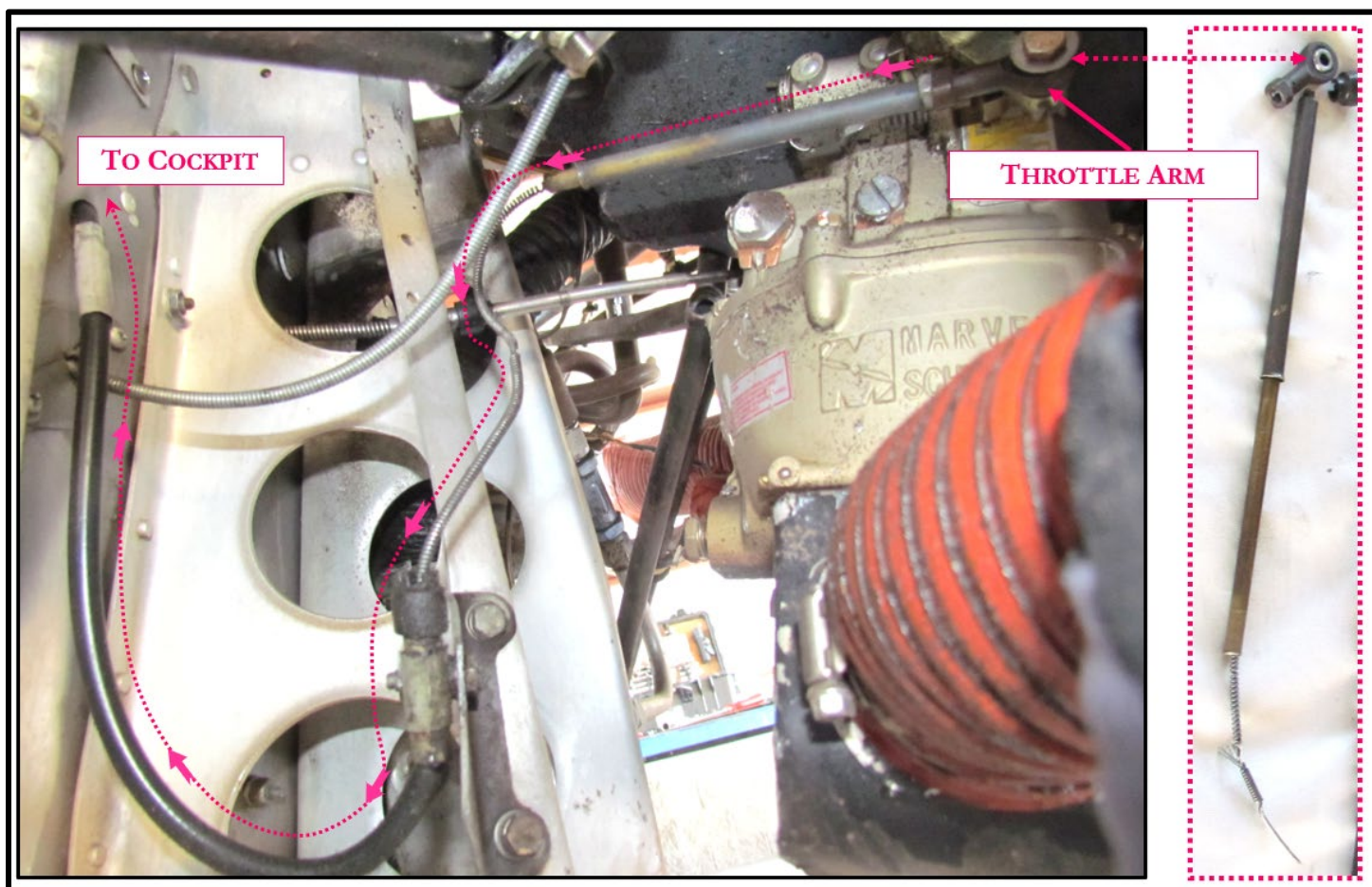


Figure 5: Throttle Cable from Arm to Cockpit

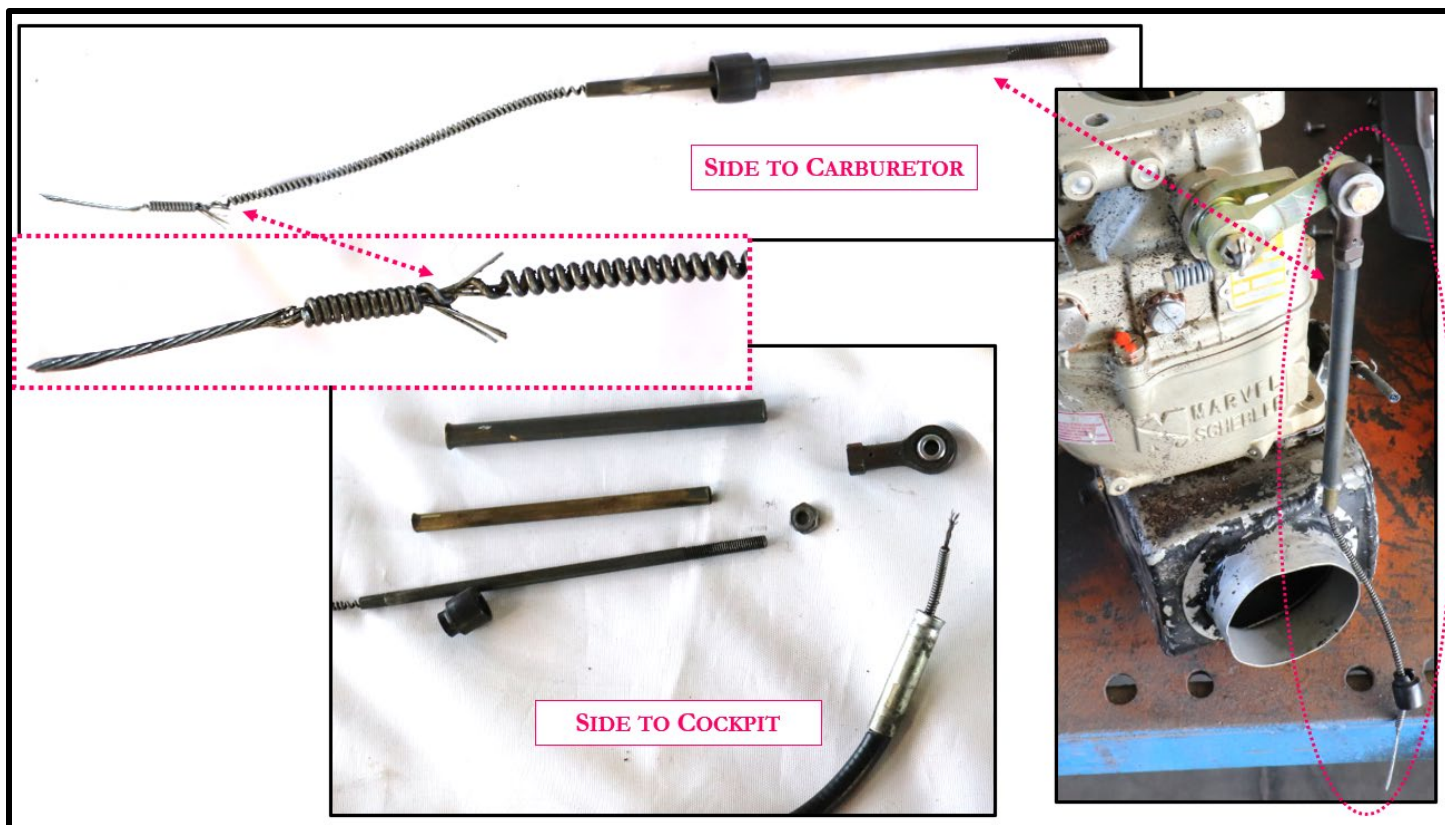


Figure 6: Throttle Cable

ENGINE

The cylinders' combustion chambers were examined through the upper spark plug holes utilizing a lighted borescope. The combustion chambers remained mechanically undamaged, and there was no evidence of foreign object ingestion or detonation. There was no evidence of valve to piston face contact observed. The gas path and combustion signatures observed at the spark plugs, combustion chambers, and exhaust system components displayed coloration that the Lycoming representative said was consistent with normal operation. There was no oil residue observed in the exhaust system gas path.

Investigators achieved manual rotation of the crankshaft by rotation of the crankshaft propeller flange. Thumb compression was established in all cylinders. Valve train continuity was observed, with approximately equal lift action at each rocker assembly. The accessory gears were undamaged and had a light residue of oil.

The magnetos remained attached to their mounting flanges. The magnetos were both timed to about 26-degrees. The left magneto leads were removed and upon rotation of the propeller, spark was observed at each lead. The right magneto was removed. Manual rotation of the magneto produced spark at every lead.

The oil filter and suction screen were secure at their respective mountings. The oil filter and suction screen were removed and examined. The oil filter was cut open to expose the filter media. Visually there was no evidence of pre-mishap metal contamination observed in the filter pleats. There was small sliver of fibrous material in the suction screen.

The air intake filter was dirt filled consistent with impact. The Scelet tubing (intake tube) extending from the air filter housing to the carburetor exhibited partial crushing. Additionally, wear marks and red sealant were observed on both the tubing and the cowling. Corresponding marks were identified on the #2 exhaust tube. Notably, modifications were evident on the air filter box, specifically involving the relocation of the tubing attaching flange.

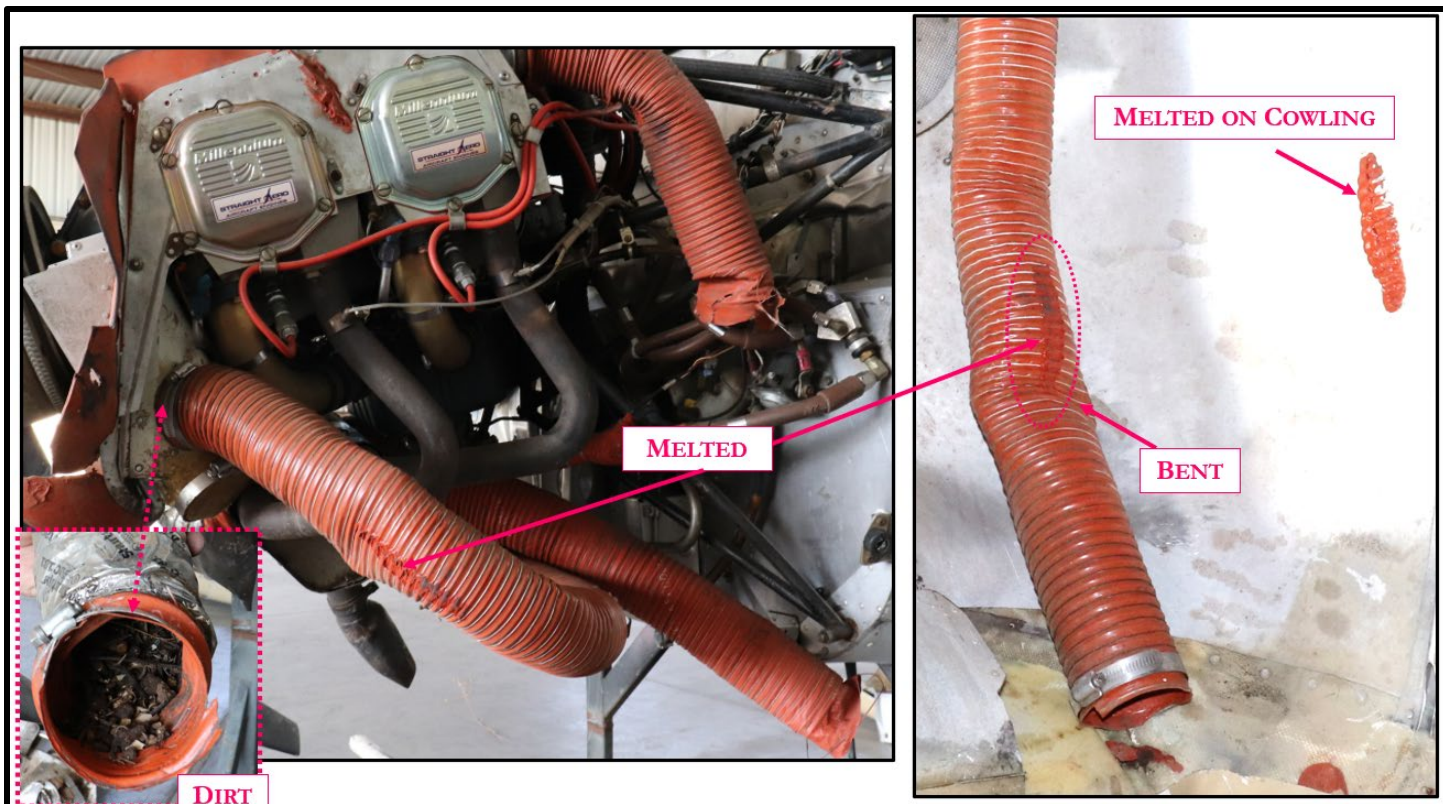
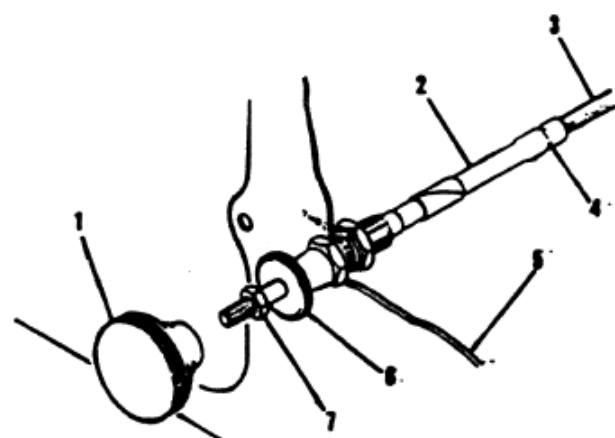


Figure 7; Saeet Tubing

ADDITIONAL INFORMATION

According to the Cessna Maintenance manual:



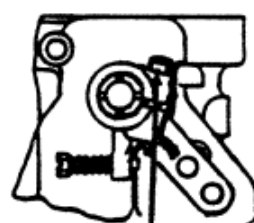
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|----------------------|---------------------|
| 1. Knob | 5. Instrument Panel |
| 2. Rigid Conduit | 6. Friction Lock |
| 3. Flexible Conduit | 7. Jamnut |
| 4. Staked Connection | |

NOTE

As required or during carburetor overhaul, Avco Lycoming Service Instruction No. 1265 which consists of a new serrated throttle lever and shaft may be installed on the carburetor. The serrated feature of the new lever and shaft ensures positive locking and eliminates the safety wire and torque requirements specified in Service Bulletin No. 330A.

NOTE

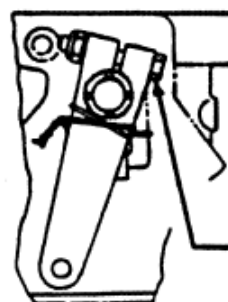
Although sequence and direction of tying may vary, idle stop arm, throttle arm and clamping screw must all be tied together.



10-32 Bolt and locknut,
torque to 20 - 25 lb-in.



AIRCRAFT SERIALS 17700001
THRU 17701164



10-24 Screw, torque
to 35 - 40 lb-in.



BEGINNING WITH AIRCRAFT
SERIALS 17701165

Figure 11-5. Throttle Control

CESSNA® MODEL 177 SERIES SERVICE MANUAL

COMPONENT	REPLACEMENT TIME	OVERHAUL
Engine Air Filter	500 hours or 36 months, whichever occurs first (Note 9)	NO
Engine Mixture, Throttle, and Propeller Controls	At engine TBO	NO

11-69. THROTTLE CONTROL.

NOTE

Before rigging throttle control shown in figure 11-5, check that staked connection (4) between rigid conduit (2) and flexible conduit (3) is secure. If any indication of looseness or breakage is apparent, replace the throttle control before continuing with the rigging procedure.

- a. Pull throttle control out (idle position) and remove throttle control knob (1).
- b. Screw jam nut (7) all the way down (clockwise) and install throttle knob. Screw the knob securely against the jam nut. Do not back jam nut out. This will prevent bottoming and possible damage to the staked connection.
- c. Disconnect throttle control at the carburetor throttle arm, push throttle control in until jam nut hits friction lock (6) while the friction lock is loose, then pull control out approximately 1/8 inch for cushion. Note position of large washer at carburetor end of control. Install washer in same position when connecting control to arm.
- d. Tighten friction lock (6), being careful not to change position of the throttle.
- e. Move throttle arm on carburetor to full open, adjust rod end at end of throttle control to fit and connect to arm on carburetor.
- f. Release friction lock and check full travel of arm on carburetor. If further adjustment is required, make all adjustment at the carburetor end of control. DO NOT change jam nut (7) setting.
- g. Tighten rod end locknuts at carburetor end of control. Be sure to maintain sufficient thread engagement between rod end and control.

NOTE

Refer to the inspection chart in Section 2 for inspection and/or replacement interval for the throttle control.