



NATIONAL TRANSPORTATION SAFETY BOARD

**Office of Aviation Safety
Western Pacific Region**

GYRO INSTRUMENT AIR PRESSURE SYSTEM

**NTSB Accident: WPR16FA158
Accident Date: August 2, 2016**

This document contains 4 embedded images
(sources: Continental Motors, FAA, NTSB & Piper)

A. ACCIDENT

Location: Flagstaff, Arizona
Date: August 2, 2016
Aircraft: Piper Seneca II, N82806, Serial # 34-8170021
NTSB IIC: Michael Huhn

B. ACCIDENT SUMMARY

On August 2, 2016, about 2122 Mountain Standard time, a Piper Seneca II, N82806, was destroyed when it impacted trees and terrain shortly after takeoff from Flagstaff Pulliam Airport (FLG), Flagstaff, Arizona. The airline transport pilot received fatal injuries. The personal flight was being conducted as a medical delivery mission for the volunteer organization Flights for Life (FFL), under the provisions of Title 14 Code of Federal Regulations Part 91. Night visual meteorological conditions prevailed at FLG at the time of the accident.

C. SYSTEM INFORMATION

The following two paragraphs are the verbatim extracts of the POH system description of the air pump system:

The directional gyros and attitude indicators are driven by positive air pressure. The pressure system (Figure 7-17) consists of a pressure pump on each engine, plus plumbing and regulating equipment. Air for the system is taken from the engine nacelle area through inlet filters and passed through pressure pumps installed on the engines. Pressure regulators mounted on the fire walls maintain the air at constant pressure to prevent damage to the instruments. An inline filter is located in each nacelle. Check valves and a pressure air manifold are mounted in the cabin at the forward bulkhead. The check valves close to allow pressure instruments to function during single-engine operation or in the event of malfunction of one of the pressure pumps. The instruments receive air from the manifold. A pressure gauge on the instrument panel, to the left of the copilot's control wheel shaft, is connected to the manifold and indicates the pressure the gyros are receiving. After air has passed through the gyro instruments, it is exhausted overboard through the forward bulkhead.

The operating limits for the gyro pressure system are 4.5 to 5.2 inches of mercury for all operations. Operation of the gyro pressure system can be monitored through a gyro pressure gauge mounted to the left of the copilot's control wheel. The two warning indicators mounted on the gauge serve to alert the pilot should one of the engines be producing less than sufficient pressure to operate the gyro instruments. Additional warning of a possible malfunction in the gyro pressure system is provided by a light in the annunciator panel.

The Piper Service Manual for the airplane contained the following pump description:

10-15. GENERAL. The pneumatic pump is a rotary vane, positive displacement dry type pump. The pump is mounted on the accessory section of each engine and rotates counterclockwise on the left engine and clockwise on the right engine. The drive ratio to the crankshaft is 1.545:1.

As seen in Fig 3, the upper portion of the gyro pressure instrument was equipped with an indicating scale and needle, and two button indicators (one each per L & R pump system) situated on the lower portion of the instrument. The indicators were normally white/neutral, but changed to red when pressure from the respective pump or system side was lost.

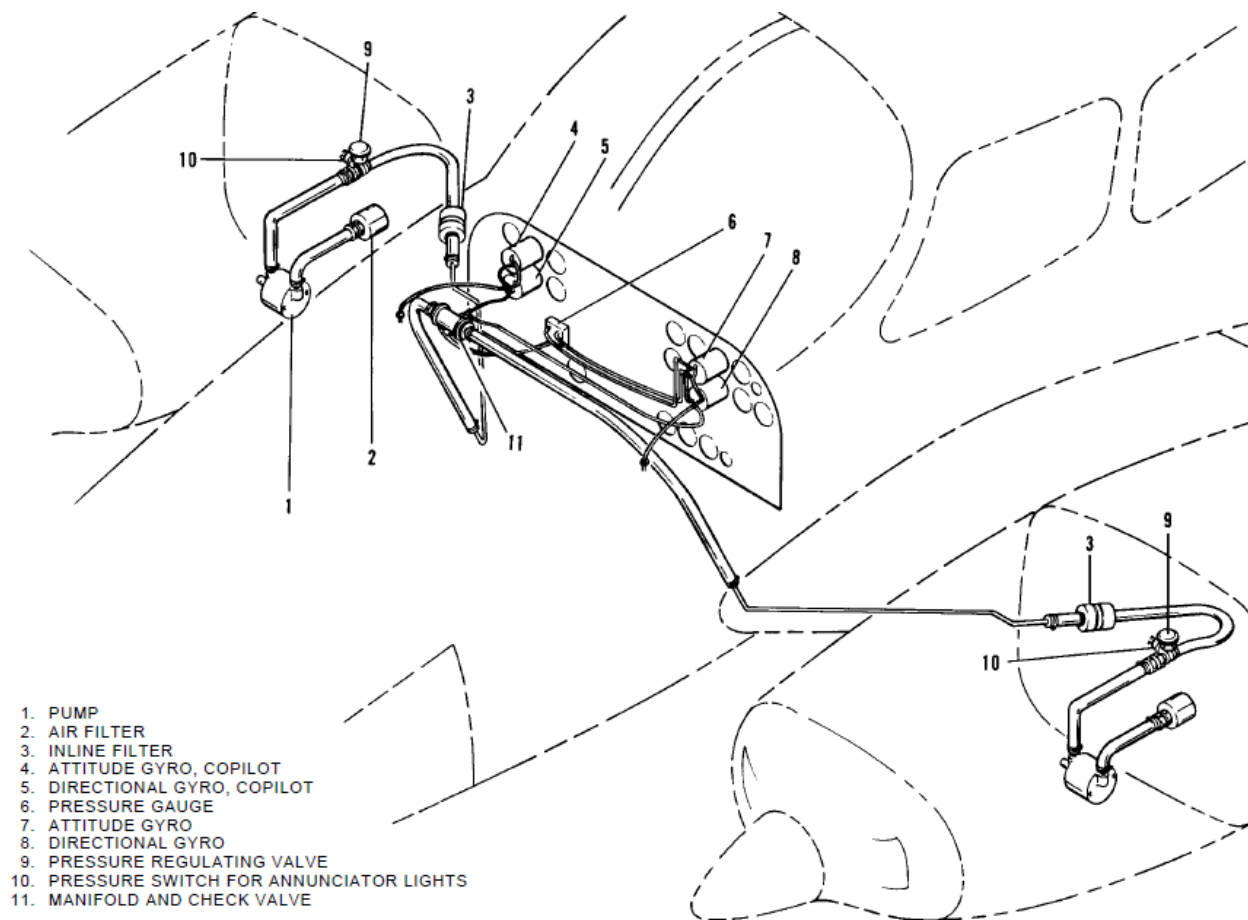


Figure 1 - Instrument Air Pressure System

The POH description of the annunciator panel included the following information

- The annunciator panel was located to the upper left of the radios [item 11 below]
- It included a discrete annunciator light for "gyro pressure"
- The illumination of these lights in flight is an indication of a possible system malfunction. The pilot should closely monitor instrument panel gauges to check the condition of a system whose corresponding light on the annunciator panel illuminates.
- When an engine is feathered, the alternator, gyro air and engine oil pressure annunciator lights will remain illuminated.
- The annunciator panel incorporated a press-to-test feature
- During preflight, the operational status of the annunciator panel should be tested by use of the press-to-test button. When the button is depressed, all annunciator panel lights, except auxiliary fuel pump lights, should illuminate.

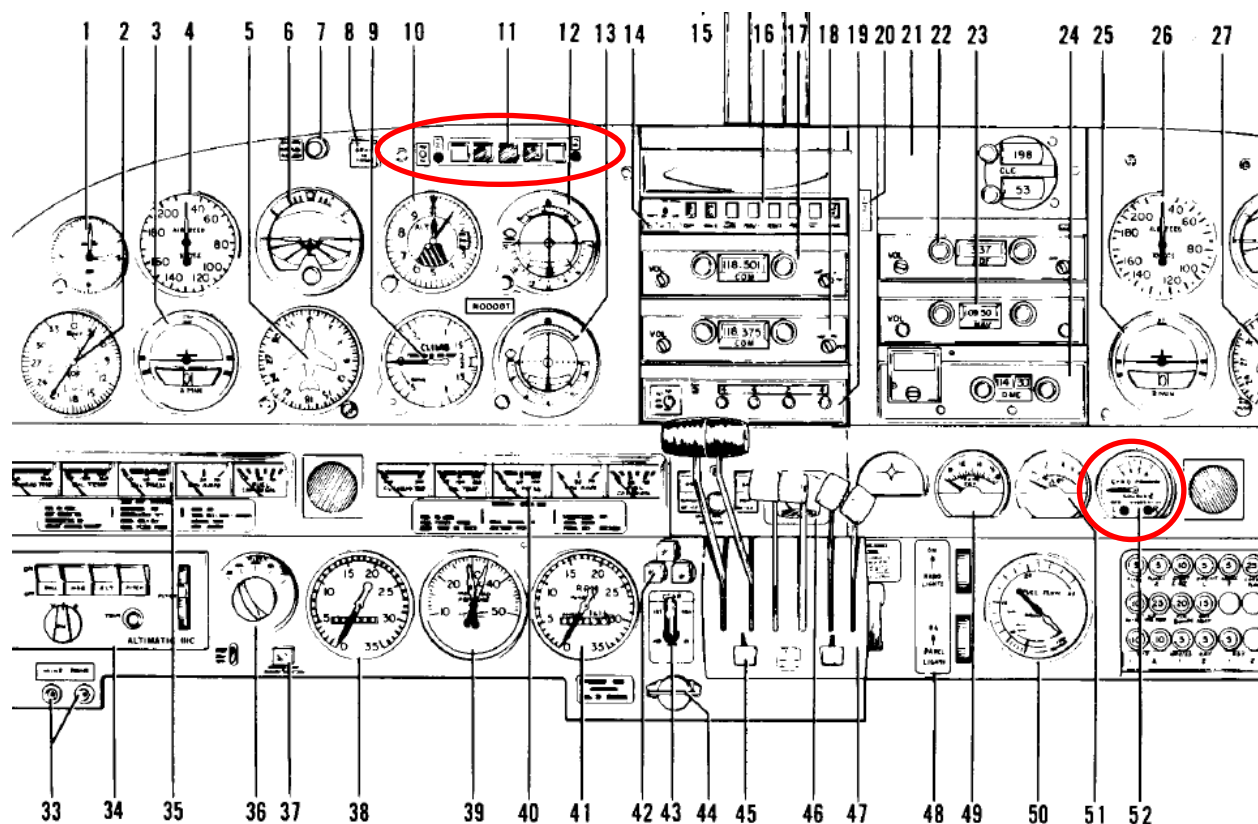


Figure 2 - Instrument Panel (with air pressure system items circled)



Figure 3 - Pressure Gauge



Figure 4 - Annunciator Panel

In the POH "Normal Procedures" checklists, there were discrete steps to check the gyro pressure indications in at least two separate pre-takeoff checklists. The POH "BEFORE TAKEOFF – GROUND CHECK" checklist contained the discrete step "Annunciator panel.....press-to-test."

The "Emergency Procedures" Section of the POH contained the following guidance in the "GYRO PRESSURE FAILURES" subsection:

A malfunction of the instrument pressure system will be indicated by a reduction of the pressure reading on the gauge. A red button annunciator will show in case of a feathered engine or pressure pump failure.

In the event of a pressure system malfunction, (pressure lower than 4.5 inches of mercury) increase engine RPM to 2575. Descend to an altitude at which 4.5 inches of mercury pressure can be maintained, if possible. The electric turn indicator should be used to monitor the performance of the directional and attitude indicators.

According to the pilot's son, who was a commercial airline pilot, and who was also familiar with the accident airplane, the pilot was "a stickler" for ensuring that all equipment on the airplane was properly operational. He also noted that "all annunciators worked normally," and that he was not aware of any problems with the instrument air system.

The annunciator panel, pump air pressure gauge, pressure switch, regulating valves, and check valves were not identified in the wreckage. Therefore, the pre-impact condition and functionality of those components, and the overall switching and alerting system, were not able to be determined. Impact damage precluded the determination of the pre-impact condition and functionality of the gyro instruments, as well as the pre-impact condition and integrity of the pressure system lines.

D. SYSTEM & COMPONENT INSPECTIONS

The Piper Service Manual (SM) cited the following relevant inspection items and intervals.

INSPECTION ITEM	INTERVAL (Hrs) = >	50	100	500	1000
8. Check pressure gauge		0	0	0	0
9. Check gyro for noise and roughness		0	0	0	0

INSPECTION ITEM	INTERVAL (Hrs) = >	L	R	50	100	500	1000
10. Clean engine.....		0	0	0	0	0	0
CAUTION: Use caution not to contaminate pressure pump with cleaning fluid.							
22. Replace pump air inlet filter, left and right (See Note 13).....		0	0		0	0	0
23. Replace gyro air inline filter, left and right (See Note 13).....		0	0			0	0
35. Inspect pressure pumps and lines.....		0	0		0	0	0

36. Overhaul or replace pressure pump (See Note 8)

Pump Note 8: Replace or overhaul as required or at engine overhaul. Refer to the latest revision of Continental Motors Service Bulletin M74-20.

Note 13 refers to the location of the filters in the various model Seneca airplanes

E. LEFT PUMP

The left pump remained attached to the left engine, and was removed by investigators during the examination on 8/5/16. The pump particulars included:

Manufacturer: Tempest
PN AA3215CC
SN ??ML15

F. RIGHT PUMP

The right pump was found fracture-separated from its engine, and was identified as item #14 in the debris field database. The pump particulars included:

Manufacturer: Tempest
PN AA442CW-6
SN N58317

G. WRECKAGE EVALUATION & PUMP EXAMINATIONS

The investigation did not locate any evidence of any recent pre-accident problems or anomalies with the flight instruments. Damage to the flight gyroscopic instruments precluded determination of their functionality or whether they were operating during the flight or impact.

The two air pumps were recovered and shipped to the manufacturer (Tempest) for examination. The pumps were examined in late June 2017 at the Tempest facility with FAA oversight.

According to the pump manufacturer's report, the vanes in the left pump were found to be "worn well beyond" their service limits. Powdery residue found inside that pump indicated that the pump was inoperative at the time of impact.

The internal condition of the right pump was consistent with it operating at the time of impact. Detailed information regarding the pump examinations is contained in the NTSB public docket for this accident.

Based on the above examination findings, the left "button indicator" should have been red. The indicators were not identified in the wreckage, and the pilot's son had reported that to his knowledge there were no abnormal indications or unaddressed maintenance items. Therefore, neither the timing of the pump failure, nor the functionality of the indicator system could be determined.