# Aviation Investigation Final Report

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| **Location:** | Pierre, South Dakota | **Accident Number:** | CEN24LA020 |
| **Date & Time:** | October 23, 2023, 16:11 Local | **Registration:** | N92884 |
| **Aircraft:** | Piper PA 46-350P | **Aircraft Damage:** | Substantial |
| **Defining Event:** | Fuel starvation | **Injuries:** | 1 Fatal, 1 Serious |
| **Flight Conducted Under:** | Part 91: General aviation - Personal | | |

## Analysis

The pilot reported that before takeoff on the cross-country flight, the airplane contained 100 gallons of fuel, with 11 gallons in the header fuel tank, and the airplane's automatic fuel transfer system was configured as per the checklist. No anomalies were noted during the engine start, takeoff, and initial climb. About 7 minutes into the flight and climbing through 12,000 ft mean sea level (msl), the engine sustained an abrupt loss of power that was confirmed by the loss of torque and engine compressor turbine rpm (Ng) speed. The pilot noted no cockpit warning or abnormal indications before the loss of engine power. The pilot declared an emergency and then executed a 180° turn back to the departure airport.

The pilot attempted two engine restarts, and both were unsuccessful. Unable to make it back to the airport, the pilot executed an off airport forced landing. During the forced landing, the airplane sustained substantial damage to the fuselage and both wings.

A postaccident examination of the airframe, fuel system components, and functional engine test revealed no evidence of mechanical malfunctions or failures that would have precluded normal operation. The fuel transfer pump switch was found in the manual position. The engine's fuel was provided by the airframe header tank. Avionics data indicated that during the short flight, the header fuel tank quantity consistently decreased, and the airplane's automatic fuel system did not continually resupply fuel to the header tank.

Based on the available data, a functional engine test, and functional testing of the airplane's fuel system, it is likely the pilot improperly configured the airplane's fuel transfer system, which prevented the header fuel tank from automatically refilling during the flight and resulted in fuel starvation and total loss of engine power. Although the pilot reported that he had configured the airplane's automatic fuel transfer system per the checklist, it is likely that the fuel transfer

switch was in the manual or OFF position during the flight. In addition, the pilot did not properly monitor the header tank's fuel quantity.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The total loss of engine power due to fuel starvation as a result of the pilot's improper configuration of the automatic fuel transfer system. Contributing to the accident was the pilot's failure to adequately monitor the header tank's fuel quantity.

### Findings

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| **Personnel issues** | Fuel planning - Pilot |
| **Personnel issues** | Incorrect action performance - Pilot |
| **Personnel issues** | Monitoring equip/instruments - Pilot |
| **Aircraft** | Fuel transfer valve - Incorrect use/operation |
| **Aircraft** | Fuel - Fluid management |
| **Aircraft** | Fuel - Fluid level |

# Factual Information

## History of Flight

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| **Initial climb** | Fuel starvation (Defining event) |
| **Emergency descent** | Collision with terr/obj (non-CFIT) |

On October 23, 2023, at 1611 central daylight time, a Piper PA-46-350P airplane, N92884, sustained substantial damage when it was involved in an accident near Pierre, South Dakota. The pilot sustained serious injuries, and the passenger sustained fatal injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

According to the pilot, before takeoff from the Pierre Regional Airport (PIR), Pierre, South Dakota, the airplane was fueled with 10 gallons of fuel for a total of 100 gallons on board for the planned flight to Steamboat Springs, Colorado. The pilot reported that before takeoff, the header fuel tank contained 11 gallons of fuel, fuel boost pump No. 1 was selected, the fuel transfer switch was in the AUTO position, and the fuel selector was in the right fuel tank position. No anomalies were noted during the engine start, takeoff, and initial climb.

About 11,000 ft mean sea level (msl), air traffic control cleared the pilot to flight level 220. While climbing through 12,000 ft msl, the engine sustained an abrupt loss of power that was confirmed by the loss of torque and engine compressor turbine rpm (Ng) speed. The pilot noted no cockpit warning or abnormal indications before the loss of engine power. The pilot declared an emergency and then executed a 180° turn back to PIR (see Figure 1).

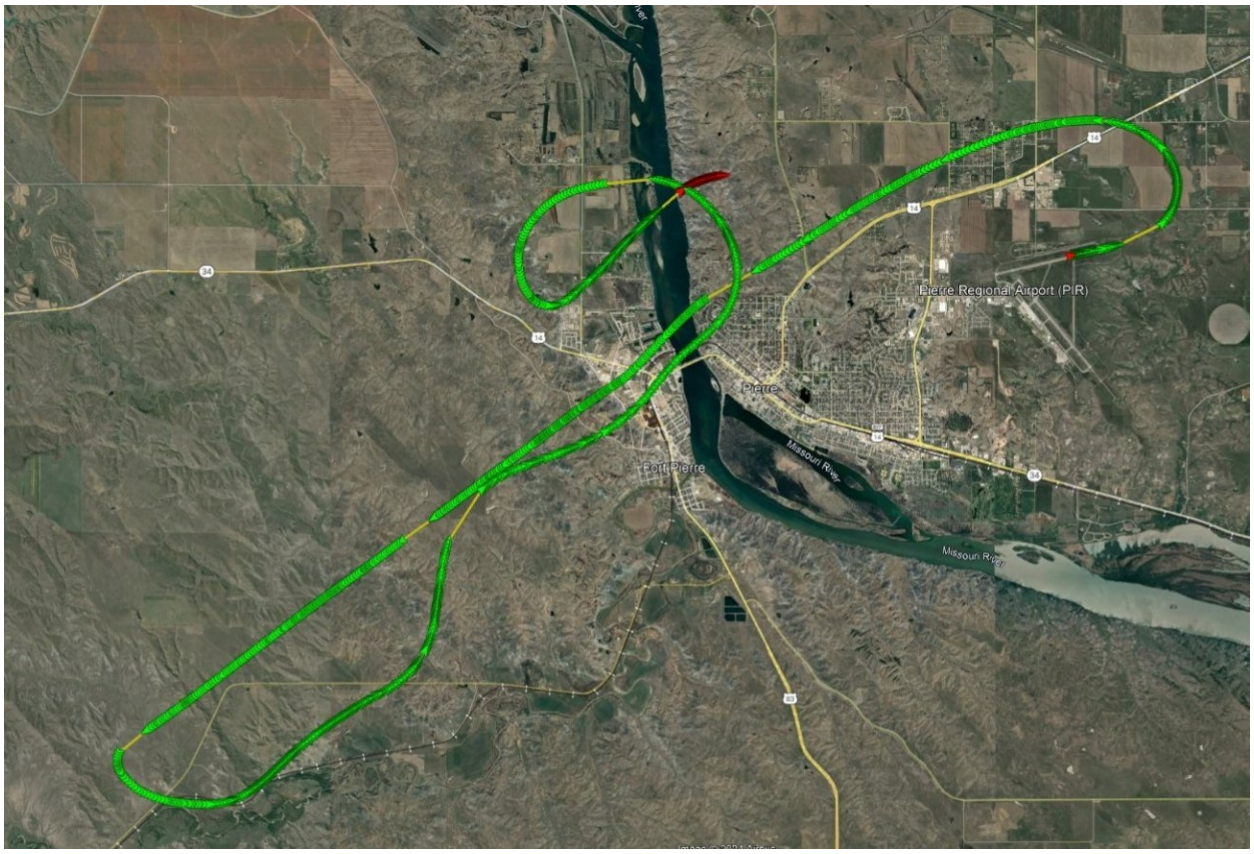


Figure 1. Overhead view of the flight track.

During the emergency descent, the pilot attempted to restart the engine by switching boost pumps, switching the fuel tank selector, and activating the emergency header tank pump, but the restart was unsuccessful. The pilot declared an emergency and intended to return to PIR. The pilot attempted another engine restart procedure with the fuel at cutoff, boost pump on, igniters at AUTO, generator off, and starter on. At this time, Ng was about 15%, the fuel condition lever was advanced, and a “pop” was heard with a puff of smoke from the right exhaust. The engine torque did not increase, so the pilot closed the fuel condition lever. The pilot reported he did not use the manual override fuel switch during the emergency descent.

The pilot also reported that while maneuvering back toward PIR, the airplane also lost electrical power, which resulted in a loss of the primary flight display, both GPS displays, and annunciator panel. The condition resulted in the pilot becoming disorientated in the descent to the airport. He realized he was going to be unable to make PIR and attempted a forced landing to bluffs and rolling terrain (see Figure 2).

Figure 2. Airplane as it came to rest in the rolling terrain.

The airplane impacted the terrain, came to rest upright, and sustained substantial damage to the fuselage and both wings.

After the accident, the pilot observed that the passenger, who was seated in a rear forward-facing seat, was barely conscious. After checking the passenger's vital signs, the pilot performed cardiopulmonary resuscitation until first responders arrived on scene.

Initial postaccident examination of the airplane at the accident site revealed no preimpact external anomalies or malfunctions, and the airplane was retained for further examination.

## Pilot Information

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| **Certificate:** | Commercial; Private | **Age:** | 59,Male |
| **Airplane Rating(s):** | Single-engine land; Multi-engine land | **Seat Occupied:** | Left |
| **Other Aircraft Rating(s):** | None | **Restraint Used:** | 3-point |
| **Instrument Rating(s):** | Airplane | **Second Pilot Present:** | No |
| **Instructor Rating(s):** | None | **Toxicology Performed:** | |
| **Medical Certification:** | Class 2 Without waivers/limitations | **Last FAA Medical Exam:** | August 13, 2023 |
| **Occupational Pilot:** | No | **Last Flight Review or Equivalent:** | September 21, 2023 |
| **Flight Time:** | 2810 hours (Total, all aircraft), 680 hours (Total, this make and model), 2630 hours (Pilot In Command, all aircraft), 10 hours (Last 90 days, all aircraft), 10 hours (Last 30 days, all aircraft) | | |

## Aircraft and Owner/Operator Information

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| **Aircraft Make:** | Piper | **Registration:** | N92884 |
| **Model/Series:** | PA 46-350P | **Aircraft Category:** | Airplane |
| **Year of Manufacture:** | 1997 | **Amateur Built:** | |
| **Airworthiness Certificate:** | Normal | **Serial Number:** | 4636107 |
| **Landing Gear Type:** | Retractable - Tricycle | **Seats:** | 6 |
| **Date/Type of Last Inspection:** | August 1, 2023 100 hour | **Certified Max Gross Wt.:** | 4317 lbs |
| **Time Since Last Inspection:** | | **Engines:** | 1 Turbo prop |
| **Airframe Total Time:** | 3653 Hrs at time of accident | **Engine Manufacturer:** | Pratt and Whitney Canada |
| **ELT:** | C126 installed, not activated | **Engine Model/Series:** | PT6A-35 |
| **Registered Owner:** | On file | **Rated Power:** | 550 Horsepower |
| **Operator:** | On file | **Operating Certificate(s) Held:** | None |

A review of the airplane's maintenance records revealed that in 2003 the airplane was modified to a JetProp DLX per a supplemental type certificate, which included the installation of a Pratt and Whitney Canda (PWC) PT6A-35 turboprop engine.

The pilot reported that he purchased the airplane in 2014.

On August 22, 2023, an airframe logbook entry indicated that a Garmin G500TXi system and other avionics were installed, and an Aspen Avionics primary and multifunction flight display system was removed. According to the pilot, due to delays in available avionics components,

the airplane was out of service in maintenance for about 1 year and 4 months. According to the airplane HOBBS indicator, at the time of the accident, the airplane had accumulated about 11 hours of total time since the avionics installation.

## Meteorological Information and Flight Plan

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| **Conditions at Accident Site:** | Visual (VMC) | **Condition of Light:** | Day |
| **Observation Facility, Elevation:** | | **Distance from Accident Site:** | |
| **Observation Time:** | 16:11 Local | **Direction from Accident Site:** | |
| **Lowest Cloud Condition:** | Clear | **Visibility** | 10 miles |
| **Lowest Ceiling:** | None | **Visibility (RVR):** | |
| **Wind Speed/Gusts:** | 9 knots / | **Turbulence Type Forecast/Actual:** | None / None |
| **Wind Direction:** | 10° | **Turbulence Severity Forecast/Actual:** | N/A / N/A |
| **Altimeter Setting:** | | **Temperature/Dew Point:** | |
| **Precipitation and Obscuration:** | | | |
| **Departure Point:** | Pierre, SD | **Type of Flight Plan Filed:** | IFR |
| **Destination:** | Steamboat Springs, CO (SBS) | **Type of Clearance:** | IFR |
| **Departure Time:** | | **Type of Airspace:** | Class D |

## Wreckage and Impact Information

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| **Crew Injuries:** | 1 Serious | **Aircraft Damage:** | Substantial |
| **Passenger Injuries:** | 1 Fatal | **Aircraft Fire:** | None |
| **Ground Injuries:** | | **Aircraft Explosion:** | None |
| **Total Injuries:** | 1 Fatal, 1 Serious | **Latitude, Longitude:** | 44.398414,-100.37172(est) |

Examination of the airframe revealed the cockpit battery display indicated 24.7 volts, the fuel selector was in the right tank position, the fuel transfer pump switch was in the manual position, and the emergency fuel transfer switch was off. The header tank contained about 2.4 gallons of fuel consistent with Jet A.

The fuel line between the oil/fuel heater and the engine fuel pump was opened and no fuel drained from the fuel line. The airframe fuel filter and bowl contained about 1 pint of fuel that was clear of contaminants. The airframe fuel system, to include the right-wing fuel transfer

pump, fuel selector valve, emergency transfer fuel pump, header tank Nos. 1 and 2 boost pumps, header tank float switch, header tank pressure transducer, firewall shutoff valve, and annunciator panel lights were tested, and no anomalies were noted. The fuel lines, from the wings to the engine fuel pump, were clear of obstructions when blown with compressed air.

The left-wing fuel transfer pump wiring was damaged during the recovery process, and the pump was removed for further examination. The transfer pump was bench tested at Piper Aircraft, Inc, Vero Beach, Florida, and no anomalies were noted.

All four propeller blades were bent aft and found secure in the propeller hub. The blades were in the low pitch position and displayed minor cambered face scratching.

Following an airframe examination, the engine was removed from the airframe and shipped to PWC for a functional test. The engine was installed in the test cell and serviced with oil. The engine was functionally tested, which included a dry motoring check, engine start, engine warm up at ground idle setting, normal acceleration, normal deceleration, and shut down. A second engine start was done to perform engine handling tests, slam acceleration, and slam deceleration checks. According to PWC, during both engine functional test runs, the engine performance and behavior was within specifications with no limits exceeded.

The Garmin G500 TXi system primary flight display was removed and sent to the National Transportation Safety Board's Recorders Laboratory for data extraction. According to the data, about 7 minutes after takeoff, the engine sustained a loss of fuel flow, engine torque, and Ng, consistent with the reported loss of engine power. Before takeoff, the header fuel tank quantity indicated 10.8 gallons, and during the flight, the header tank fuel quantity continually decreased to 5.7 gallons until the engine power loss. About 1 minute after the power loss, the header fuel tank quantity began to increase, and about 4 minutes later, the header tank fuel quantity reached 11.1 gallons and remained at that quantity until the accident impact.

## Medical and Pathological Information

An autopsy was not performed on the passenger.

## Additional Information

The following are excerpts and procedures from the JetProp DLX Pilot's Operating Handbook and Federal Aviation Administration Approved Airplane Flight Manual:

Section 3 Emergency Procedures

Engine Power Loss in Flight – Engine Flame Out

A flameout will be noticed by a drop in InterTurbine temperature (ITT), torquemeter pressure, and Ng. The engine may be restarted in the manner described under Air Starts.

Air Start

The best air start technique is to initiate the re-light procedure immediately after a flameout occurs, provided the pilot is certain that the flameout was not the result of some malfunction which might make it dangerous to attempt a re-light.

If Ng drops below 50%, ignition switch off and proceed with normal air start procedures.

**(3b) Normal Air-Start**

**The recommended pre-air-start check procedure is:**

Fuel Condition Lever.....OFF
Propeller Control Lever.....If in feather, leave FEATHERED
.....otherwise FULL INCREASE
Power Control Lever..... IDLE
Generator, Alternator, non essential electrical equipment .....OFF
Battery Master Switch.....ON
Firewall Shutoff Valve.....CHECK Open
Fuel Boost Pump .....ON
Check Fuel Pressure.....5 psi, minimum
Airspeed..... 90 KIAS minimum
Altitude.....PT6A-34 & -35: 20000 ft max (Prop Feathered)
.....PT6A-34 & -35: 24000 ft max (Prop Windmilling)
.....PT6A-21: 18000 ft (Prop Feathered or Windmilling)

**NOTE**
If the engine has flamed out or is shut down, the propeller will eventually feather automatically with loss of oil pressure.

**CAUTION**
**Except for immediate relights with Ng>50%, Do not use the "AUTO" feature (if so equipped) for engine starts**

**The recommended air-start procedure is:**
Ignition Switch .....ON
Battery Select Switch.....SELECT Highest Voltage System
.....or BOTH, if equipped
Starter.....ON
Fuel Condition Lever.....RUN, after 5 sec of stabilized $N_G$>12%
CHECK rise in $N_G$ to 52% and increase in ITT

FAA Approval Date: 7 Jul 2003
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Figure 3. Jet Prop DLX air start procedures.

**(3b) Normal Air-Start (Continued)**

**When engine attains idle rpm.**

Starter.....OFF
Ignition Switch.....OFF
Propeller Control Lever.....Operating Range

**Note**

If the engine was started with the prop feathered, move the prop very slowly out of feather (approximately ½ inch forward) and allow time for the prop to unfeather and stabilize. Continue to very slowly advance the lever to the desired prop RPM

Power Control Lever.....As Desired
Land as soon as practical and investigate cause of power loss.

**Note**

If a satisfactory start is not obtained, discontinue the air start. Repeat the engine air-start procedure if another starting attempt is to be made.

**Caution**

If normal engine operation and fuel flow are not reestablished, it could indicate a leak in the fuel system. If a fuel system leak is verified, switch the Firewall Fuel Shutoff to the Off position, fuel boost pumps to off, and fuel selector to off to stop fuel flow and minimize the possibility of a fire.

**If power is not restored:**

Prepare for power off landing.

**(3c) Air Start – Windmilling Engine and Propeller (No Starter Assist)**

This procedure should only be used if starter assistance is not available. If the engine and propeller are windmilling and the Ng has not fallen below 12%, the engine can be started without use of the starter. Proceed as follows.

**The recommended pre-air-start check procedure is:**

Fuel Condition Lever.....OFF
Propeller Control Lever.....FULL INCREASE
Power Control Lever..... IDLE
Generator, Alternator, non essential electrical equipment .....OFF
Battery Master Switch.....ON
Firewall Shutoff Valve.....CHECK Open
Fuel Boost Pump .....ON
Check Fuel Pressure.....5 psi, minimum

**The air-start procedure without starter assistance is:**

PT6A-34 & -35 With Ice Door Off:
Airspeed/Altitude .....160 KIAS min and 24000 ft max
OR, if below 18000 ft, .....140 KIAS min
PT6A-34 & -35 With Ice Door On:
Airspeed/Altitude.....160 KIAS min and 21000 ft max

PT6A-21 With Ice Door Off:.....140 KIAS min and 18000 ft max
PT6A-21 With Ice Door On:.....160 KIAS min and 18000 ft max

Ng.....12% minimum
Ignition Switch .....ON
Fuel Condition Lever.....RUN, after 5 seconds of stabilized Ng
Power Control Lever.....As Desired after start
LAND as soon as practical and investigate cause of power loss.



Manual Override Operation

The manual override switch should only be used to modulate engine power to allow the pilot to continue flight to the nearest airport should one of the following conditions occur:

- Uncommanded engine power roll back to idle and unable to recover with the Power Control lever.
- No response to the Power Control lever when starting from or around idle.
- Power Control lever becomes stuck at or around idle.

Manually control fuel to the engine with short toggles of the switch. Forward increases fuel to the engine and aft reduces fuel to the engine.

Loss of Fuel Flow

If a loss of fuel flow is experienced, turn the other fuel boost pump on and ensure the firewall fuel shutoff is on/open. If fuel flow does not return to normal, turn the transfer pump to manual or the emergency transfer pump on to help provide pressure to the engine.

Section 7 Description and Operation

Fuel System

The JetProp uses the standard PA-46-350P aircraft fuel system with the addition of outboard wing fuel filler caps, enabling the wing tanks to each be filled with 10 additional gallons of fuel, and a header tank which accumulates fuel from the selected wing tank. The header tank prevents the possibility of interruption of fuel supply to the engine during the selection of an alternate wing tank. The total usable fuel was 140 gallons in the wing tanks and 11.1 gallons in the header tank. The unusable fuel quantity is 1 gallon in each wing tank and 1.1 gallons in the header tank.

A fuel transfer pump is located in each wing collector sump tank, and the pumps provide fuel from the wing tanks to the header tank. The operation of these pumps is controlled by the fuel selector handle and the transfer pump rocker switch. The position of the fuel selector handle determines which wing tank and respective pump will be used. Automatic or manual operation of the pumps is determined by the transfer pump switch (AUTO/OFF/MAN). In the OFF position, neither tank supplies fuel to the header tank, and neither transfer pump is powered. In AUTO mode, the selected pump is automatically turned on and off to keep the header tank filled. In MAN mode, the selected pump runs continuously. If a wing transfer pump fails, the emergency fuel transfer pump can be used to transfer fuel from either of the wing tanks to the header tank to ensure no fuel is trapped in a wing tank.

Header Tank

All fuel to the engine is supplied from the header tank. Header tank fuel quantity is sensed by a float/capacitance probe and is indicated by a separate cockpit gauge. Float switches independent of the quantity indicator sensor provide inputs for the fuel level controller and the header tank fuel low (HT FUEL LOW) warning light. When the header tank fuel level decreases to approximately 10.5 gallons, the automatic fuel controller is designed to activate the fuel transfer pump and HT FUEL LOW caution light. The caution light is a reminder to the pilot that some action by the automatic system or manually by the pilot to ensure the header tank is refilled. The header tank has two submerged internal fuel boost pumps. The boost pumps are pilot-selectable by a three-position (PUMP 1, OFF, PUMP 2) rocker switch on the instrument panel. These pumps are located in the sump-shaped bottom of the header tank and provide positive fuel pressure to the engine driven fuel pump.

Fuel System Management

The fuel system was designed to require very little pilot action under normal operating conditions. Fuel system management under normal operating conditions consists of monitoring fuel flow and pressure, monitoring header tank fuel level to ensure a full level and controlling wing fuel balance. The header tank must be kept full by either automatic or manual means. Under most cruise and descent conditions, wing fuel is drawn into the header tank by the suction created by the outflow of fuel to the engine. At higher fuel flow rates during periods of high-power operations or steep climb attitudes, the fuel flow out of the header tank will be greater than that being drawn into the tank.

In automatic mode, as selected by the AUTO position on the cockpit fuel transfer switch, the automatic fuel control system utilizes two float switches, one to sense when the fuel level is low and one to signal when the tank is full. The low float switch, internal to the header tank, signals the header tank fuel level controller when the header tank fuel level is about 10.5 gallons. With the fuel transfer pump switch in the AUTO position, the battery or generator/alternator providing power to the main bus, and the fuel selector in the LEFT/RIGHT position, the controller then activates the selected wing tank transfer pump. Any time one of the wing fuel transfer pumps is powered, the “WING FUEL PUMP” annunciator light illuminates. The “HT FUEL LOW” caution light will normally flash on for a few seconds and then extinguish as fuel is pumped into the header tank. The wing transfer pump continues to operate until the header tank is full, activating the upper float switch which signals the controller to shut off the wing transfer pump in the selected wing tank. The cycle is automatically repeated to maintain fuel in the header tank.

If the pilot desires to maintain the fuel level in the header tank manually, the MAN fuel transfer pump position will be used. In the MAN position, the pump in the selected wing tank will run continuously. Normally the pilot would wait until the “HT FUEL LOW” caution light illuminated, or the header tank fuel quantity indicated 10.5 gallons, and then turn the fuel transfer pump to the MAN position. When the header tank is full (gauge indication and/or header tank high pressure light), the transfer pump would then be placed in the OFF position. This process would be repeated as necessary to maintain the desired fuel quantity in the header tank.

## Administrative Information

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| **Investigator In Charge (IIC):** | Sauer, Aaron |
| **Additional Participating Persons:** | Dwight Pladsen; FAA; Rapid City, SD<br>Jon Hirsch; Piper Aircraft, Inc; Vero Beach, FL |
| **Original Publish Date:** | November 7, 2024 |
| **Last Revision Date:** | |
| **Investigation Class:** | Class 3 |
| **Note:** | The NTSB did not travel to the scene of this accident. |
| **Investigation Docket:** | https://data.ntsb.gov/Docket?ProjectID=193291 |