



National Transportation Safety Board Aviation Accident Final Report

Location:	Las Vegas, NV	Accident Number:	LAX08FA286
Date & Time:	08/28/2008, 1434 PDT	Registration:	N212HB
Aircraft:	PIPER PA-31-350	Aircraft Damage:	Substantial
Defining Event:	Sys/Comp malf/fail (non-power)	Injuries:	1 Fatal, 1 Minor
Flight Conducted Under:	Part 91: General Aviation - Other Work Use		

Analysis

During climb a few minutes after takeoff, a fire erupted in the airplane's right engine compartment. About 7 miles from the departure airport, the pilot reversed course and notified the air traffic controller that he was declaring an emergency. As the pilot was proceeding back toward the departure airport witnesses observed fire beneath, and smoke trailing from, the right engine and heard boom sounds or explosions as the airplane descended. Although the pilot feathered the right engine's propeller, the airplane's descent continued. The 12-minute flight ended about 1.25 miles from the runway when the airplane impacted trees and power lines before coming to rest upside down adjacent to a private residence. A fuel-fed fire consumed the airframe and damaged nearby private residences.

The airplane was owned and operated by an airplane broker that intended to have it ferried to Korea. In preparation for the overseas ferry flight, the airplane's engines were overhauled. Maintenance was also performed on various components including the engine-driven fuel pumps, turbochargers, and propellers. Nacelle fuel tanks were installed and the airplane received an annual inspection. Thereafter, the broker had a ferry pilot fly the airplane from the maintenance facility in Ohio to the pilot's Nevada-based facility, where the ferry pilot had additional maintenance performed related to the air conditioner, gear door, vacuum pump, and idle adjustment. Upon completion of this maintenance, the right engine was test run for at least 20 minutes and the airplane was returned to the ferry pilot.

During the following month, the ferry pilot modified the airplane's fuel system by installing four custom-made ferry fuel tanks in the fuselage, and associated plumbing in the wings, to supplement the existing six certificated fuel tanks. The ferry pilot held an airframe and powerplant mechanic certificate with inspection authorization. He reinspected the airplane, purportedly in accordance with the Piper Aircraft Company's annual inspection protocol, signed the maintenance logbook, and requested Federal Aviation Administration (FAA) approval for his ferry flight. The FAA reported that it did not process the first ferry pilot's ferry permit application because of issues related to the applicant's forms and the FAA inspector's workload. The airplane broker discharged the pilot and contracted with a new ferry pilot (the accident pilot) to immediately pick up the airplane in Nevada and fly it to California, the

second ferry pilot's base. The contract specified that the airplane be airworthy. In California, the accident pilot planned to complete any necessary modifications, acquire FAA approval, and then ferry the airplane overseas.

The discharged ferry pilot stated to the National Transportation Safety Board (NTSB) investigator that none of his airplane modifications had involved maintenance in the right engine compartment. He also stated that when he presented the airplane to the replacement ferry pilot (at most 3 hours before takeoff) he told him that fuel lines and fittings in the wings related to the ferry tanks needed to be disconnected prior to flight. During the Safety Board's examination of the airplane, physical evidence was found indicating that the custom-made ferry tank plumbing in the wings had not been disconnected.

The airplane wreckage was examined by the NTSB investigation team while on scene and following its recovery. Regarding both engines, no evidence was found of any internal engine component malfunction. Notably, the localized area surrounding and including the right engine-driven fuel pump and its outlet port had sustained significantly greater fire damage than was observed elsewhere. According to the Lycoming engine participant, the damage was consistent with a fuel-fed fire originating in this vicinity, which may have resulted from the engine's fuel supply line "B" nut being loose, a failed fuel line, or an engine-driven fuel pump-related leak. The fuel supply line and its connecting components were not located.

The engine-driven fuel pump was subsequently examined by staff from the NTSB's Materials Laboratory. Noted evidence consisted of globules of resolidified metal and areas of missing material consistent with the pump having been engulfed in fire. The staff also examined the airplane. Evidence was found indicating that the fire's area of origin was not within the wings or fuselage, but rather emanated from a localized area within the right engine compartment, where the engine-driven fuel pump and its fuel supply line and fittings were located. However, due to the extensive pre- and post-impact fires, the point of origin and the initiating event that precipitated the fuel leak could not be ascertained.

The airplane's "Pilot Operator's Handbook" (POH), provides the procedures for responding to an in-flight fire and securing an engine. It also provides single-engine climb performance data. The POH indicates that the pilot should move the firewall fuel shutoff valve of the affected engine to the "off" position, feather the propeller, close the engine's cowl flaps to reduce drag, turn off the magneto switches, turn off the emergency fuel pump switch and the fuel selector, and pull out the fuel boost pump circuit breaker. It further notes that unless the boost pump's circuit breaker is pulled, the pump will continuously operate.

During the wreckage examination, the Safety Board investigators found evidence indicating that the right engine's propeller was feathered. However, contrary to the POH's guidance, the right engine's firewall fuel shutoff valve was not in the "off" position, the cowl flaps were open, the magneto switches were on, the emergency fuel pump switches and the fuel selector were on, and the landing gear was down. Due to fire damage, the position of the fuel boost pump circuit breaker could not be ascertained.

Calculations based upon POH data indicate that an undamaged and appropriately configured

airplane flying on one engine should have had the capability to climb between 100 and 200 feet per minute and, at a minimum, maintain altitude. Recorded Mode C altitude data indicates that during the last 5 minutes of flight, the airplane descended while slowing about 16 knots below the speed required to maintain altitude.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A loss of power in the right engine due to an in-flight fuel-fed fire in the right engine compartment that, while the exact origin could not be determined, was likely related to the right engine-driven fuel pump, its fuel supply line, or fitting. Contributing to the accident was the pilot's failure to adhere to the POH's procedures for responding to the fire and configuring the airplane to reduce aerodynamic drag.

Findings

Aircraft

Fuel distribution - Not specified (Cause)
Airspeed - Not attained/maintained
Fuel selector/shutoff valve - Not used/operated (Factor)

Personnel issues

Use of checklist - Pilot (Factor)
Aircraft control - Pilot

Factual Information

HISTORY OF FLIGHT

On August 28, 2008, at 1434 Pacific daylight time, a Piper PA-31-350 (twin engine airplane), N212HB, experienced a loss of right engine power during en route climb a few minutes after departing from runway 7 at North Las Vegas Airport (VGT), Las Vegas, Nevada. Thereafter, the pilot terminated his intended flight to Palo Alto, California (PAO), and attempted an emergency landing back at VGT. While descending on short final approach, the airplane collided with several objects and ultimately crashed in a residential area about 1.25 miles from the departure runway. The airplane was substantially damaged by fire. The airline transport pilot, who was the sole occupant in the airplane, was fatally injured. Of the five persons who were located at the impacted private residence, one received minor injuries, and four were not injured. The flight was performed under the provisions of 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed, and no flight plan was filed. The airplane was owned and operated by Aeronet Supply, an airplane brokerage company based in Gardena, California. The flight originated from VGT about 1422.

According to Aeronet's owner, the recently hired contract ferry (accident) pilot was intending to fly the airplane to Palo Alto (PAO), where the connection of previously installed ferry tanks and avionics would be completed. Thereafter, upon obtaining Federal Aviation Administration (FAA) approval, the accident pilot was to ferry the airplane to Korea for delivery to its prospective new owner.

The National Transportation Safety Board investigator's review of recorded radar and audio data indicated that after the pilot took off from VGT's runway 7 (elevation 2,205 feet mean sea level (msl)), he commenced a counterclockwise left climbing turn to a westerly course. By 1427, the airplane had passed abeam and north of VGT and was climbing on a westerly track through 3,400 feet, as indicated by its altitude encoding Mode C transponder. By 1429, the airplane was about 5 miles west of VGT and had climbed to 3,900 feet, which was the maximum altitude gained during the accident flight.

During the next minute, the airplane commenced a left turn to a southwesterly heading and descended to 3,600 feet. By 1431, the airplane had descended to 3,500 feet and was about 7 miles west of VGT, which was the location farthest west of the airport that was reached during the flight. The pilot reversed course, and while tracking in an easterly direction (toward VGT) at 1431:29, the pilot advised the Las Vegas Terminal Radar Approach Control (TRACON) facility that he was declaring an emergency and desired to immediately return to VGT. By this time, the airplane had descended to 3,100 feet. Without delay, the TRACON controller cleared the pilot as requested.

At 1432:05, the pilot broadcast that he had an "engine failure rough engine." At this time, the airplane's altitude was 2,800 feet, and the airplane continued tracking toward runway 7. Its last recorded position was at 1433:48. At this time, the airplane had descended to 2,400 feet and was within about 400 feet of the initial point of impact (IPI).

Three witnesses were located at their residences within approximately 1.5 miles of each other and 6 to 7 miles west of VGT. The witnesses reported observing the accident airplane as it flew past their locations, and they provided statements of their observations.

The first witness stated that the airplane flew over her house. The witness stated "I heard

several pops so I looked out my back window and saw the right side engine putting out black smoke." Thereafter, the airplane made a hard left turn and headed in an easterly direction toward VGT.

The second witness reported that he observed the airplane flying in a southerly direction past his home. Thereafter, the airplane turned toward the east. The witness stated that he initially observed puffs of smoke, and then there was a continuous stream of smoke coming from the airplane's right engine. No smoke was seen coming from the left engine. The smoke was white. As the airplane proceeded east of his location (toward VGT) flames were noted beneath the airplane's right engine. He stated that the flames were orange. Then, there was a "ball of flame" below the area of the engine. There were no flames anywhere else beneath the airplane. The witness stated that he heard three "boom" sounds that were like a backfire as the airplane descended.

The third witness provided the Safety Board investigator with a sketch documenting his observations regarding the airplane's flight track, fire, and smoke. The witness reported observing the airplane flying in a southerly direction over his residence. The witness stated that he lost sight of the airplane for a few seconds, and when he reacquired visual contact with it, the airplane was about 1 mile south of his location and was heading in an easterly direction toward VGT. The witness stated that he saw a "continuous stream" of white smoke streaming from the right engine of the airplane as it was descending in an easterly direction. The witness further reported that he observed fire and flames beneath the right engine. No fire was present beneath the right wing tip area. When the flames increased in size, he heard a couple of explosions and saw a fireball that got larger.

The third witness also stated that the left engine produced two or three quick puffs of smoke. One smoke stream was about 20 feet long, and then the smoke stopped. At no time did he observe fire coming from the left engine. During the entire time the witness observed the airplane, he heard a continuous engine running sound, and at no time did he hear "sputtering." The witness also stated that the airplane's landing gear was retracted.

As the airplane approached the airport, a witness driving on the street several houses away from the crash site observed it. The witness stated that as the airplane descended, she saw smoke and flames emanating from its right side. The airplane impacted power lines, nosed over, and crashed into a house in an inverted attitude. Thereafter, an explosion, fireball, and smoke were observed.

The Safety Board investigator's examination of the accident site revealed evidence of a severed tree top, downed power lines, and the airplane's right wing tip in the street, yards west of the main wreckage. The airplane's fuselage came to rest in an inverted attitude on a concrete block wall between two houses.

Several unidentified first responders reported to the Safety Board investigator that the airplane was engulfed in flames immediately upon impacting the ground.

PERSONNEL INFORMATION

The 38-year-old pilot held an airline transport pilot certificate. He had commercial privileges for single engine land and sea airplanes. The pilot also held an airframe and powerplant mechanic certificate with inspection authorization.

According to the pilot's resume, dated August 26, 2008, his total flight time was 3,195.3 hours.

He had 2,733.1 hours as pilot-in-command, and 797.7 hours in airplanes. The pilot reported to the airplane's owner that he had 100 hours of flying experience in the PA-31 model of airplane.

In May 2007, the pilot was issued a first-class aviation medical certificate with the restriction that he wear corrective lenses. On this date, the pilot reported that his total flight time was 2,510 hours. A review of the pilot's initial flight training logbooks revealed no evidence of military flight training.

The pilot had no reported previous flying experience in the accident airplane. The pilot was not familiar with the specific ferry tank installation in the accident airplane.

AIRPLANE INFORMATION

The Piper PA-31-350 "Chieftain," serial number 31-8152072, was manufactured in 1981. The FAA issued the airplane a standard airworthiness certificate in the normal category. The airplane was equipped with Lycoming model TIO- and LTIO-540-J2B (left and right) 350 horsepower engines, Garrett turbochargers, and Hartzell propellers. At the time of the accident flight, the airplane's total time was about 6,373 hours. The engines' total time since last major overhaul was about 26 hours.

The operator reported that the airplane's weight during the accident flight was 6,600 pounds. The airplane's FAA certificated maximum gross weight is 7,000 pounds.

Modifications to Airframe

The airplane's flight performance characteristics had been modified by, in part, installation of Boundary Layer Research, Inc., vortex generators, and Colemill Enterprises, Inc., Panther conversion winglets.

According to the Boundary Layer Research's flight manual supplement included in the airplane's "Pilot's Operating Handbook" (POH), at the accident weight the single engine climb speed is about 105 knots (indicated airspeed).

Fuel System Design and Fuel Pumps

In an unmodified PA-31-350, fuel is routed from the wing fuel cells to the selector valve, the fuel filter, the fuel boost pump, the emergency fuel pump, the firewall shutoff, the engine driven fuel pump, and then to the fuel injectors. The engine driven fuel pump and its associated fuel line are located in the engine compartment forward of the turbocharger.

According to the Piper Aircraft Company, each engine is equipped with an engine driven fuel pump, an emergency fuel pump, and a fuel boost pump. The engine driven fuel pumps run continuously, and they are not controllable by the pilot.

The emergency fuel pumps are installed for emergency use in case the engine driven pumps fail. The emergency fuel pumps are also used for takeoff and landing and, when necessary, to prime the engines. Control switches for the emergency fuel pumps are located in the cockpit's overhead switch panel.

The fuel boost pumps operate continuously and are provided to maintain fuel under pressure to the other fuel pumps. There are no fuel boost pump control switches. Each fuel boost pump is controlled by a separate circuit breaker, located in the circuit breaker control panel. The fuel boost pumps are activated when the master switch is turned on, and they continue to operate until the master switch is turned off or the fuel boost pump circuit breakers are pulled to the off

position.

Each wing contained an inboard main, outboard (auxiliary), and a nacelle fuel tank, which was located aft of the engine. The main and auxiliary tanks were standard Piper Aircraft components. The nacelle fuel tanks were installed prior to completion of the airplane's June 2008 annual inspection.

Fuel System Tank Modification

The original ferry pilot indicated that he had modified the fuel system to accommodate ferry fuel tanks. (The original ferry pilot was not the accident pilot. See the "Maintenance History" and the "Ferry Flight Arrangements" sections for additional information regarding the original ferry pilot.) This modification involved installing three ferry fuel tanks into the passenger cabin, and one ferry tank into the airplane's nose. These four tanks supplemented the existing six wing fuel tanks.

The original ferry pilot stated that the connections between his ferry tanks and the airplane's fuel system required fabrication and installation of a flexible fuel line to the tee fitting he placed in each wing. These fuel lines and tee fittings were located between the wing's fuel selector valve and the fuel strainer. To restore the airplane to its original Piper factory design, these fabricated fuel lines would have to be removed. The pilot further stated that none of his modifications involved fuel line connections within the engine compartment.

Pilot's Operating Handbook (POH) Information, Securing an Engine

Regarding in-flight fires, the POH states, in part, that the pilot should move the firewall shutoff valve of the affected engine to the off position. Then, he should close the throttle, feather the propeller, place the mixture control in the idle cutoff position, close the engine's cowl flaps to reduce drag, and secure the engine. To secure the engine, the pilot should turn off the magneto switches, the emergency fuel pump switch, and the fuel selector. The pilot should also pull out the fuel boost pump circuit breaker. The landing gear should be extended when landing is assured.

METEOROLOGICAL INFORMATION

During the airplane's approach to VGT at 1433, a controller advised the pilot that the local wind was "variable at four." At 1442, the following weather observation was taken at VGT: Wind calm; visibility 10 miles; sky clear; temperature 40 degrees Celsius; dew point 1 degree Celsius; and altimeter 29.77 inches of mercury.

Several photographs of the accident scene were taken before and after arrival of local fire department personnel. The photographs show a column of smoke rising vertically upward above the accident site.

WRECKAGE AND IMPACT INFORMATION

During an examination of the accident site and airplane wreckage, evidence was found indicating the airplane initially collided with and severed the top of a tree, at a height estimated between 50 and 75 feet above ground level. This initial point of impact (IPI) occurred about 1.25 miles west-southwest (251 degrees magnetic) from runway 7's threshold (elevation 2,204 feet msl), and about 650 feet south of the runway's extended centerline. Felled tree branches and Plexiglas airplane fragments were located a few yards from the branches.

There was evidence that the airplane next collided with residential power lines suspended

between poles. Downed power lines were located on the west side of a north-south oriented city street. The impacted lines were located about 150 feet east of the IPI.

About 90 feet farther east, a few feet from a fire hydrant on the street's east curb, green navigation light lens fragments were located along with the airplane's partially burned right wing tip (winglet).

The main wreckage was located about 70 feet east of the right winglet. This location was adjacent to a driveway on which there was a crushed automobile containing the airplane's right propeller assembly. The fragmented and melted main wreckage was next to a two story residence that had been partially consumed by fire. Remnants of the airplane's fuselage were found on the ground in this area, a few yards south of the house. The cockpit, associated components, and portions of the fuselage were also observed in this area. Some components were leaning against the north and south face of a block wall in an inverted attitude and were melted.

In the main wreckage area, fragmented and melted airplane components were located comingled with the homeowner's property. This property was also destroyed by fire and included various pipes, fittings, and machinery amid other debris.

The magnetic bearing and distance between the IPI and the main wreckage was about 095 degrees and 280 feet. The main wreckage elevation was about 2,260 feet msl.

The global positioning system coordinates of the main wreckage were: 36 degrees 12.683 minutes north latitude by 115 degrees 13.479 minutes west longitude.

MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy on the pilot was performed by the Clark County Coroner, Las Vegas. The autopsy report lists the cause of death as extensive thermal injury and multiple blunt force trauma.

The FAA's Civil Aerospace Medical Institute performed forensic toxicology on specimens from the pilot. No evidence of carbon monoxide, cyanide, or ethanol was detected. In addition, no drugs of abuse were detected.

TESTS AND RESEARCH

Performance Data, Climb and Airspeed

The radar data indicates that about 1429, the airplane began reversing course and descending below the 3,900-foot maximum altitude it had attained during the flight. At this time, the airplane's ground speed was 125 knots. By 1434, the airplane had descended to 2,400 feet, and it had slowed to 100 knots.

The Safety Board investigator examined the Boundary Layer Research's flight manual supplement in the airplane's POH. Under the atmospheric conditions that prevailed at the time of the accident, an undamaged appropriately configured and properly flown PA-31-350 airplane should have had the capability to climb between 100 and 200 feet per minute with an inoperative engine. At the minimum, with one secured engine, an airplane should have had the capability to maintain altitude. Recorded Mode C altitude and flight track data indicates that the airplane descended from the time it reversed course until it impacted terrain.

To achieve the aforementioned climb performance, the airplane must be flown at 105 knots,

indicated airspeed (IAS). The radar data indicates that the airplane's speed decreased to a ground speed of 100 knots. (Note: assuming zero wind, ground speed equals true airspeed (TAS).) Under the existing atmospheric conditions, an airplane flying at a TAS of 100 knots would have an IAS of 89 knots. This IAS is 16 knots slower than the required 105 knots IAS specified in the POH to achieve maximum single engine climb performance.

Maintenance History

In June 2008, an annual inspection was performed on the airplane by a FAA certified repair station located in Ohio. According to logbook entries, at the time the airplane's total time was 6,352.4 hours (Hobbs meter 2,364.7 hours), and the engines' total time since major overhaul was 5.2 hours. Part of the maintenance accomplished involved installing nacelle fuel tanks and overhauled engine driven fuel pumps, engines, propellers, and turbochargers. Upon the repair station's completion of its maintenance, the original ferry pilot picked up the airplane and flew it to VGT.

At VGT, after flying the airplane several hours, the original pilot had a VGT-based FAA certified repair station perform additional maintenance in part related to the air conditioner, gear door, vacuum pump and idle adjustment. This maintenance was accomplished in preparation for the airplane's export ferry flight. On July 28, 2008, at an airplane Hobbs meter time of 2,383.9 hours, the repair station recorded in the airplane's maintenance records that it had performed an engine run and leak check. The results were good. The VGT-based repair station personnel reported that it had test run the right engine between 20 and 30 minutes with its cowling removed. At the time of their maintenance, the ferry tanks had not been installed in the airplane. Also on July 28, 2008, the VGT repair station personnel returned the airplane to the original ferry pilot, and they did not see the airplane again.

Thereafter, the original ferry pilot modified the airplane by installing the four additional fuel tanks in the fuselage to supplement the airplane's existing six tanks, and he also connected the ferry tanks to the airplane's existing FAA certificated fuel system. The connections involved installation of custom made fuel lines and fittings. (See "Fuel System Design and Fuel Pumps" for details.)

Part of the ferry flight preparations to export the airplane to Korea involved acquiring FAA approval from the Las Vegas Flight Standards District Office (FSDO). The original ferry pilot submitted his export request to the FSDO for its approval.

On August 10, 2008, the original ferry pilot recorded in the airplane's maintenance logbook the following statement: "I have reviewed all the current AD's for this aircraft and no further action is required at this time.... I certify that I have completed an inspection of this aircraft in accordance with the Piper PA31-350 Service Manual Annual Inspection Checklist and have found the aircraft to be in airworthy condition...." The original ferry pilot signed and dated the logbook with his Airframe and Powerplant mechanic certificate number and indicated that he had inspection authorization (IA). The airplane's Hobbs meter time was listed as 2,384.9 hours, and the airplane's total time was listed as 6,372.6 hours. The engines' and propellers' listed total time since overhaul was 25.4 hours. Having completed this maintenance, tank installations, and export document preparation, the original ferry pilot approached the Las Vegas FSDO with a request for ferry flight authorization.

Ferry Flight Arrangements

FSDO personnel did not issue ferry flight approval to the original ferry pilot. Additionally, the original pilot was informed that, if the airplane was to be flown to another FSDO (to acquire ferry flight approval), prior to flight the installed ferry tanks had to be disconnected from the airplane's Piper factory fuel system thereby returning the airplane to its original FAA approved configuration.

The original ferry pilot then notified the airplane's owner-operator (Aeronet) that he was unable to acquire FSDO approval to export the airplane to Korea in the desired time frame. As a result, Aeronet discharged the original ferry pilot and hired another ferry pilot (the accident pilot). The accident pilot was to pick up the airplane in VGT and fly it to PAO, where the accident pilot opined the FAA would be more responsive to the request for export.

On August 26, 2008, the newly hired accident pilot signed a contract with Aeronet to fly the accident airplane from VGT to Korea, via PAO. The flight was to occur on or after August 28, 2008. In part, the contract specified that Aeronet "...shall provide aircraft in airworthy condition and in compliance with aircraft type certificate..." The owner of Aeronet and the original ferry pilot reported to the Safety Board investigator that the accident pilot was aware his flight from VGT to PAO was not considered a ferry flight.

The accident pilot advised the original ferry pilot that he would fly on an airline to Las Vegas, arriving there at 1040 on August 28, 2008. Thereafter, he would proceed to VGT to pick up the accident airplane. He planned to fly the airplane from VGT to PAO, whereupon he would obtain the required export/ferry flight authorization from the FAA. The accident pilot informed the original ferry pilot that he planned to depart VGT (on the accident flight) at 1400. The original ferry pilot asserted to the Safety Board investigator that he had informed the accident pilot of the requirement to disconnect the ferry tanks from the airplane's fuel system prior to his flight to PAO.

Airframe Examination, Fire Evidence

The airplane wreckage was initially examined at the accident site. Additional examinations of the airframe, engines, and propellers were performed following the airplane's recovery. In addition, maintenance records were reviewed regarding the installation of the fuel tanks and related plumbing.

During the on scene investigation, the Safety Board investigator noted that the left engine was found in an exposed area of the crash site, whereas the right engine was located beneath debris and was somewhat shielded from fire.

Most of the airplane's structure was consumed by fire. Portions that remained were laid out and examined. They principally consisted of right wing segments and its nacelle fuel tank, the right horizontal stabilizer and elevator, a portion of the cockpit roof, a portion of a passenger cabin interior fuel tank, and engine and propeller assemblies. Also, fractured and partially melted components (fuel system fittings) were found in the wreckage.

A fire and explosion investigator from the Safety Board's Office of Research and Engineering, Materials Laboratory Division, Washington, D.C., also examined the wreckage. The investigator noted that the thermal damage to the left engine was uniform on its inboard and outboard sides.

The investigator reported that the right wing's nacelle fuel tank exhibited evidence of having

been over pressurized, as demonstrated by the outward bowing of its aluminum structure in all directions and split weld seams. In the airplane, the nacelle tank was installed aft of the right engine's firewall.

The fire and explosion investigator further reported that the right engine sustained more thermal damage on its inboard side than on its outboard side. As photographically documented, severe thermal damage was observed in the vicinity of the turbocharger and engine driven fuel pump, which was partially melted on the inboard side of its circumference.

Airframe Examination, Components

Components from remnants of the airplane's electrical system, left and right wing fuel system, instrument panel, and landing gear assembly were examined. In pertinent part, the following observations were noted:

Switches

The two left engine magneto switches and the two right engine magneto switches were found in the "ON" position. Both the left and right engine emergency fuel pump switches were found in the "ON" position.

Fuel System, Right and Left Wings

The right and left wing root areas each contained a fuel shutoff valve and two electric fuel pumps. Also found at the crash site were two tee fittings that were not components of the manufactured Piper airplane.

Specifically, at the crash site a tee fitting was identified by the original ferry pilot as being the tee fitting that was installed in the wing between the right wing's fuel selector valve and the fuel filter assembly. It was the fuel system component that connected a flexible fuel line to the ferry tanks. The fractured surfaces of the tee fitting component and the fuel selector component visually matched each other, which was consistent with the tee fitting having been connected to the airplane's fuel system at the time of the accident.

According to the Piper participant, under the FAA approved fuel system configuration for the airplane, the tee fitting would not be installed, and a flexible fuel line would connect the fuel selector valve engine port to the fuel filter assembly. Installation of the tee fitting component was not a Piper approved design modification.

During the on-scene wreckage examination, a 6-inch-long braided fuel line was found in an area of congealed aluminum material. No fittings were connected to either end of the fuel line. The fuel line was identified by the original ferry pilot as being the original fuel line for the airplane's fuel system, and he indicated that it should have been connected to the airplane's fuel system in lieu of the tee fitting.

The right engine's fuel shutoff valve was found in the open position. The fuel tank selector valve was found in an open position, allowing fuel to flow from a wing tank to the engine.

Landing Gear & Flight Controls

The landing gear selector lever was found in the gear up position. The section of cockpit panel

in which the control column and landing gear selector were located was fire damaged. Also, the panel was bent and was separated from adjacent structure.

The landing gear's left main down lock was found engaged, and the up lock was present. The up lock was not distorted. The gear actuator was found extended, and this is consistent with the gear being down and locked, according to the Piper participant.

The rudder trim position was measured, and it was found in the full left rudder trim setting. The actuators were found for both the left and right wing flaps and the engine's cowl flaps. The actuator positions corresponded to the wing flaps being fully retracted (up) and the engine's cowl flaps being open.

Propeller Examination

Under Safety Board investigator observation, the propeller assemblies were examined by personnel at Hartzell Propeller, Inc. In summary, the Hartzell participant indicated that the left propeller exhibited deformation and impact signatures consistent with rotation with power on, as noted by scoring, torsional twisting, and a missing blade tip. Hartzell engineering staff calculated that, based upon blade angle-related witness marks, at impact the left engine was producing its maximum rated horsepower.

The right propeller exhibited signatures consistent with little or no rotational energy at the time of impact. The blades appeared to have been feathered. No discrepancies were noted with either propeller assembly that would have precluded normal operation.

Engine Examination

Both Lycoming engines and all of the accessories were fire damaged. Following the external examination of the left engine, the Lycoming Engine participant opined that no evidence was found that would have precluded it from making power prior to impact. The left engine's fuel pump sustained notably less thermal damage than the right engine's fuel pump.

Regarding the right engine, no evidence of a preimpact mechanical malfunction was found. The right engine's crankshaft was rotated. Thumb compression was noted in all cylinders except cylinder numbers 3 and 6, which were thermally distressed. No evidence of any internal engine component malfunction was observed. The attached engine driven fuel pump had sustained fire damage in the area of the fuel outlet port. A localized area of the pump's housing was missing in this area. According to the Lycoming engine participant, this is consistent with the fuel supply line "B" nut being loose, a failed fuel line, or an engine driven fuel pump anomaly. The fuel supply line and its connecting components were not located.

Turbocharger Examination

Both the left and right engine's Garrett turbochargers were fire damaged. The right engine's turbocharger was found secure to its mountings. No preimpact exhaust system disconnects were observed. The turbocharger compressor and turbine impellers remained intact and appeared undamaged. The turbine was free to hand rotate and was devoid of foreign object ingestion damage. Each exhaust system clamp was found secure. The exhaust bypass valve (wastegate) remained securely attached. No anomalies were noted regarding the turbocharger's installation.

Engine Driven Fuel Pump Examination

The engine driven fuel pumps were also examined by the Safety Board's Office of Research and

Engineering, Materials Laboratory Division. Noted evidence consisted of globules of resolidified metal and areas of missing material consistent with the pumps having been engulfed in fire. As observed and photographed in side-by-side comparisons, there was more fire damage, distortion and missing material to the right pump than to the left pump.

ADDITIONAL INFORMATION

Responding to In-Flight Fires

As published in the FAA's "Airplane Flying Handbook," (FAA publication H-8083-3A , Chapter 16) "A fire in flight demands immediate and decisive action. The pilot therefore must be familiar with the procedures outlined to meet this emergency contained in the AFM/POH for the particular airplane." If the engine compartment fire is oil-fed, thick black smoke may be evident. A fuel-fed fire may produce bright orange flames.

"An in-flight engine compartment fire is usually caused by a failure that allows a flammable substance such as fuel, oil or hydraulic fluid to come in contact with a hot surface. This may be caused by a mechanical failure of the engine itself, an engine driven accessory, a defective induction or exhaust system, or a broken line. Engine compartment fires may also result from maintenance errors, such as improperly installed/fastened lines and/or fittings resulting in leaks."

"By the time a pilot becomes aware of an in-flight engine compartment fire, it usually is well developed. Unless the airplane manufacturer directs otherwise in the AFM/POH, the first step on discovering a fire should be to shut off the fuel supply to the engine by placing the mixture control in the idle cut off position and the fuel selector shutoff valve to the OFF position."

History of Flight

Enroute-climb to cruise	Sys/Comp malf/fail (non-power) (Defining event) Fire/smoke (non-impact)
Approach-VFR pattern final	Loss of engine power (total) Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Airline Transport; Flight Instructor	Age:	38, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land; Single-engine Sea	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	Yes
Medical Certification:	Class 1 With Waivers/Limitations	Last FAA Medical Exam:	05/31/2007
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	
Flight Time:	(Estimated) 3195 hours (Total, all aircraft), 100 hours (Total, this make and model), 2733 hours (Pilot In Command, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	PIPER	Registration:	N212HB
Model/Series:	PA-31-350	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	31-8152072
Landing Gear Type:	Retractable - Tricycle	Seats:	4
Date/Type of Last Inspection:	08/10/2008, Annual	Certified Max Gross Wt.:	7000 lbs
Time Since Last Inspection:	1 Hours	Engines:	2 Reciprocating
Airframe Total Time:	6373 Hours at time of accident	Engine Manufacturer:	Lycoming
ELT:	Installed, not activated	Engine Model/Series:	TIO-540-J2BD
Registered Owner:	Aeronet Supply	Rated Power:	350 hp
Operator:	Aeronet Supply	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	VGT, 2205 ft msl	Distance from Accident Site:	2 Nautical Miles
Observation Time:	1453 PDT	Direction from Accident Site:	78°
Lowest Cloud Condition:	Clear	Visibility	10 Miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	4 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	Variable	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29.77 inches Hg	Temperature/Dew Point:	40° C / 1° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Las Vegas, NV (VGT)	Type of Flight Plan Filed:	None
Destination:	Palo Alto, CA (PAO)	Type of Clearance:	VFR
Departure Time:	1422 PDT	Type of Airspace:	

Airport Information

Airport:	North Las Vegas (VGT)	Runway Surface Type:	Asphalt
Airport Elevation:	2205 ft	Runway Surface Condition:	Dry
Runway Used:	07	IFR Approach:	None
Runway Length/Width:	5004 ft / 75 ft	VFR Approach/Landing:	Forced Landing; Full Stop; Straight-in

Wreckage and Impact Information

Crew Injuries:	1 Fatal	Aircraft Damage:	Substantial
Passenger Injuries:	N/A	Aircraft Fire:	In-Flight
Ground Injuries:	1 Minor	Aircraft Explosion:	In-Flight
Total Injuries:	1 Fatal, 1 Minor	Latitude, Longitude:	36.211389, -115.224722

Administrative Information

Investigator In Charge (IIC):	Wayne R Pollack	Report Date:	07/18/2011
Additional Participating Persons:	Martin Kay; Federal Aviation Administration; Las Vegas, NV Charles Little; Piper Aircraft, Inc.; Vero Beach, FL Mark Platt; Lycoming Engines; Williamsport, PA John Butler; Lycoming Engines; Williamsport, PA Thomas McCreary; Hartzell Propellers; Piqua, OH		
Publish Date:	07/22/2011		
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

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