National Transportation Safety Board
Aviation Accident Final Report

Location:	Woodruff, WI	**Accident Number:**	CHI03FA138
Date & Time:	05/25/2003, 1754 CDT	**Registration:**	N36DR
Aircraft:	Piper PA-31P	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	4 Fatal
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

The twin-engine airplane was destroyed when it impacted trees and terrain shortly after takeoff. The airplane was consumed in a post-impact fire. Witnesses reported seeing the airplane climbing at a lower than normal rate just after takeoff. One witness did not hear the airplane. Another witness reported that the airplane sounded labored and this is what drew his attention to the airplane. The airplane came to rest in a wooded area about 3,500 feet from the departure end of the runway, and 700 feet left of the extended runway centerline. The wreckage path through the trees was about 65 degrees left of the runway heading. The first piece of wreckage along the wreckage trail was the left wingtip. Examination of the right propeller revealed chordwise scratching, leading edge damage, and bending and twisting opposite to the direction of rotation. In addition, several tree cuts were observed that were predominately on the right side of the wreckage path. No evidence of rotation was noted with respect to the left propeller, propeller blades, or propeller spinner. On-scene examination revealed no pre-impact anomalies with respect to the airframe, right engine, or right propeller. Follow-on examination of the left engine and propeller revealed no pre-impact anomalies. Calculations based on the power setting table, airspeed chart and en-route distance showed that the airplane would have burned a total of 56 to 71 gallons (28 to 35.5 gallons per side) of fuel for the previous leg of the round-trip flight. The main fuel tanks held a total of 112 gallons of fuel (56 gallons per side). Based on the fuel burn calculations, this quantity of fuel would not have been sufficient to complete the round-trip flight on the main fuel tanks alone. The outboard auxiliary fuel tanks held 40 gallons per side. The left fuel selector was found positioned to the inboard main fuel tank and the right fuel selector was found positioned to the outboard auxiliary fuel tank. The airplane flight manual for the airplane stipulates that only the main fuel tanks be used for takeoff and landing. No fuel was obtained for the return flight.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's failure to follow the before take-off checklist which led to an improper selection of the auxilliary fuel tanks for the takeoff leading to the subsequent fuel starvation of the left engine. Additional causes were the pilot not maintaining minimum controllable airspeed

which resulted in a loss of control of the ariplane. The trees and the pilot's unsuccessful attempt to restart the engine by selecting the main fuel tank were contributing factors in the accident.

Findings

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - NONMECHANICAL
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. 1 ENGINE
2. (C) CHECKLIST - NOT FOLLOWED - PILOT IN COMMAND
3. (C) FLUID,FUEL - STARVATION
4. (C) FUEL TANK SELECTOR POSITION - IMPROPER - PILOT IN COMMAND
5. (F) REMEDIAL ACTION - NOT SUCCESSFUL - PILOT IN COMMAND

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
6. (C) AIRSPEED(VMC) - NOT MAINTAINED - PILOT IN COMMAND
7. (C) AIRCRAFT CONTROL - NOT MAINTAINED - PILOT IN COMMAND

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: DESCENT - UNCONTROLLED

Findings
8. (F) OBJECT - TREE(S)

Occurrence #4: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Findings
9. TERRAIN CONDITION - GROUND

Factual Information

HISTORY OF FLIGHT

On May 25, 2003, at 1754 central daylight time, a Piper PA-31P, N36DR, piloted by an airline transport pilot, sustained substantial damage when it impacted trees and terrain after takeoff from runway 36 (5,150 feet by 100 feet, asphalt), at the Lakeland Airport/Noble F. Lee Memorial Field (ARV), near Woodruff, Wisconsin. The airplane was consumed by fire subsequent to the impact. The 14 CFR Part 91 flight was operating in visual meteorological conditions and an instrument rules flight plan had been filed but not activated. All four occupants of the airplane were fatally injured. The flight was originating at the time of the accident. The DuPage Airport (DPA), West Chicago, Illinois, was the intended destination.

The airplane was reported to have been flown from DPA to ARV by the pilot and pilot rated passenger in order to pick up two passengers and return to DPA.

The airplane impacted into level wooded terrain about 1/2 mile north of the departure end of the runway and left of the extended runway centerline.

A witness who is a pilot reported seeing the airplane "hardly climbing at 60+- feet just above the [runway] 18 threshold. At this point he was making some power and no engine abnormalities or prop sounds were heard. The plane was very slow with a 5 [degree] pitch up then I saw the nose leveled and I knew he was in serious trouble. I saw the plane going straight for a few more seconds then lost sight. I listened as I ran to my truck. I then heard it hit the trees and impact."

Another witness reported seeing the airplane take-off. He reported that the sound was not normal and that this is what drew his attention to the airplane. He said that the airplane sounded labored. He reported that the airplane was not gaining altitude as expected and the airplane was much lower than he was accustomed to seeing. He stated that he lost sight of the airplane due to obstructions to his view. He stated that from the time the airplane drew his attention, to the time the airplane started hitting the trees, the engine sounds did not change.

PERSONNEL INFORMATION

The pilot held an airline transport pilot certificate with ratings for multi-engine land airplanes with commercial privileges for single engine land airplanes. The pilot was type rated in Boeing 757, Boeing 767, McDonnell Douglas DC-9, and Cessna 500 series aircraft. The pilot also held a flight engineer certificate for turbojet-powered airplanes and a flight instructor certificate with a rating for single engine airplanes. The pilot's flight logbook was not recovered. The pilot served as a chief pilot for a major airline. According to airline records, the pilot had accumulated 8,524 hours of flight time in Boeing 767 and McDonnell Douglas MD-80 aircraft. An airline representative estimated that the pilot also had approximately 4,000 hours in Boeing 727 aircraft. The Boeing 727 flight time was estimated since the airline no longer maintains flight records for that airplane.

The pilot's first class medical certificate was issued on February 3, 2003, with the limitation, "Must wear corrective lenses." The pilot reported having 11,850 hours of flight experience as of the date of his medical certificate.

Training records obtained during the investigation show that the pilot received 11.0 hours of ground training and 3.0 hours of flight training in the accident airplane on October 7, 2002.

The records indicate that engine-out procedures and engine-out approach and landings were performed. The training records indicate that Vmca demonstration was not performed. Vmca refers to the minimum airspeed in flight at which directional control can be maintained, when one engine is made inoperative.

The right seat passenger was also a pilot. The passenger held an airline transport pilot certificate with ratings for multi-engine land airplanes with commercial privileges for single engine land airplanes. The passenger was type rated in Boeing 727, Boeing 757, Boeing 767, and Lockheed L-382 series aircraft. The passenger also held a flight engineer certificate for turbojet-powered airplanes. The passenger's flight logbook was not recovered. The passenger had previously served as a chief pilot for a major airline prior to his retirement in 1999. According to airline records, the passenger had accumulated 2,473 hours of flight time in Boeing 767 aircraft. An airline representative estimated that the passenger also had approximately 7,000 hours in Boeing 727 aircraft and 3,000 hours in Boeing 707 aircraft. The Boeing 727 and Boeing 707 flight time was estimated since the airline no longer maintains flight records for those airplanes. The airline representative also indicated that the passenger had an additional 500 hours in Boeing 727 airplanes as a result of flight activity for a travel club after his employment with the airline.

The passenger's first class medical certificate was issued on April 25, 2003, with no restrictions. The passenger reported having 15,682 hours of flight experience as of the date of his medical certificate.

AIRCRAFT INFORMATION

The airplane was a 1975 Piper PA-31P, pressurized Navajo, serial number 31P-7530025. The airplane was a twin-engine low-wing monoplane of aluminum construction. Two Lycoming TIGO-541-E1A engines powered the airplane. Each engine was rated for 425 horsepower.

A review of the aircraft maintenance records shows that the airplane received an annual inspection on December 11, 2002, at 5,384.2 total airframe hours. The records show that an overhauled engine, serial number RL-321-62, was installed on the right side of the airframe on August 7, 2002. The right engine had accumulated 15.6 hours since the overhaul as of the date of the annual inspection. The left engine, serial number L-259-62, had accumulated 638.8 hours since overhaul as of the date of the annual inspection.

METEOROLOGICAL INFORMATION

The departure airport automated weather observation system recorded the weather at 1753 as: Wind 020 degrees magnetic at 7 knots gusting to 15 knots; Visibility 10 statute miles; Sky condition clear; Temperature 19 degrees Celsius; Dew point -8 degrees Celsius; Altimeter setting 30.09 inches of mercury.

COMMUNICATIONS

No records of communications were found relating to the accident flight.

AIRPORT INFORMATION

ARV is located about 3 miles northwest of the town of Woodruff, Wisconsin. The airport has two intersecting runways. Runway 10/28 is a 3,062 foot by 75 foot asphalt runway. Runway 18/36 is a 5,150 foot by 100 foot asphalt runway. North of the departure end of runway 36 is a clearing that extends about 2,900 feet from the departure end of the runway to a forest with

trees standing about 70 feet tall.

WRECKAGE AND IMPACT INFORMATION

The airplane impacted the trees and terrain about 3,500 feet north and 700 feet west of the departure end of runway 36. A global positioning system receiver was used to determine the coordinates of the accident site as 45-degrees 56.836-minutes north latitude, 89-degrees 44.162-minutes west longitude. Several tree breaks were observed leading to the main wreckage site. The magnetic direction from the first observed tree break to the main wreckage was 295 degrees.

The first airframe component located along the wreckage trail was the left winglet/wingtip. The winglet/wingtip was found about 40 feet from the main wreckage. A post-impact fire consumed most of the airframe. Pieces of each major airframe component were identified in the immediate vicinity of the main wreckage.

The post-impact fire consumed most of the fuselage structure. No instrument readings could be determined due to the extent of the fire damage.

The tail surfaces were fire damaged. The horizontal stabilizer and elevator spars were identified. The outer stabilizer and elevator skins were mostly consumed by fire. The elevator push-pull tube was broken between the elevator attach point and the sector bellcrank. The upper and lower elevator control cables each had one break in the aft fuselage section. Both cable breaks exhibited signatures consistent with overstress. The forward portions of these cables were found attached to the forward elevator control sector.

Pieces of the rudder and vertical stabilizer were identified. Two rudder control cable breaks were identified. One break was located in the aft fuselage section and the other was located in the cockpit area. Both breaks exhibited signatures consistent with overstress.

The left wing was damaged by impact and fire. The majority of the wing structure was consumed by fire. The aileron and flap were identified. The aileron control sector was found with both cables attached. Both cables were continuous to the center fuselage area where both cables were broken. Both of the cable breaks exhibited signatures consistent with overstress. The flap actuator was found in the fully retracted position. The left fuel selector valve was found positioned to the inboard main fuel tank. The crossfeed selector valve was found in the off position. The remainder of the left wing fuel system had extensive fire damage.

The right wing was damaged by impact and fire. The majority of the wing structure was consumed by fire. The aileron and flap were identified. The aileron control sector was found and the control cables identified. Both cables were continuous to the center fuselage area where the balance cable was broken. The cable break exhibited signatures consistent with overstress. The control cable was continuous from the aileron sector to the control wheel chain. The right fuel selector valve was found positioned to the outboard auxiliary fuel tank. The remainder of the right wing fuel system had extensive fire damage.

The right engine received impact and fire damage. The right propeller remained attached to the drive gear from the engine. The propeller blades exhibited leading edge damage and chordwise scratching. The blades also exhibited bending and twisting opposite to the direction of rotation. The propeller spinner was crushed and twisted opposite to the direction of rotation.

The left engine received impact and fire damage. The fire destroyed the lower portion of the

crankcase. Internal engine components were found separated from the engine during the recovery process. The left propeller remained attached to the drive gear from the engine. No evidence of rotation was noted with respect to the propeller, propeller blades, or propeller spinner. The left engine and propeller were retained for further examination. (See "Tests and Research" section of this report.)

Several tree limbs and tree trunks were found in the immediate vicinity of the wreckage that exhibited diagonal cuts. The cut pieces of trees were found predominately on the right side of the wreckage path.

On-scene examination revealed no anomalies with respect to the airframe, right engine, or right propeller that could be attributed to a pre-impact discrepancy.

MEDICAL AND PATHOLOGICAL INFORMATION

Autopsies were performed on the pilot and the pilot rated passenger by the Milwaukee County Medical Examiner's Office, Milwaukee, Wisconsin.

Final Forensic Toxicology Fatal Accident Report's were prepared for both the pilot and pilot rated passenger by the Federal Aviation Administration (FAA). The results were negative for all tests performed.

TESTS AND RESEARCH

Examination of the left engine was conducted at the manufacturer's facility under the direct supervision of a National Transportation Safety Board (NTSB) specialist. Due to the extent of the damage to the engine from impact and fire, a complete evaluation was not possible. During the examination, it was determined that the engine exhibited thermal damage which included the complete destruction of the oil pan and much of the crankcase accessory section. The propeller drive shaft and drive gear were separated from the engine and were not present at the engine examination. The camshaft, tappets, pushrods, turbocharger and additional parts were shipped loose. The propeller governor, governor line, ignition harness, and both magnetos were thermally damaged. The alternator, vacuum pump and external oil system were thermally destroyed. Examination of the engine's internal components revealed no mechanical discrepancies that could be attributed to a pre-existing condition. No evidence of a pre-impact failure was found.

Examination of the left propeller was conducted at the manufacturer's facility under the direct supervision of a NTSB specialist. The propeller exhibited blackened surfaces, paint/finish loss, and other evidence consistent with exposure to fire. The outboard end of the number 1 blade was missing. The number one blade was bent forward about 30 degrees at mid span. Approximately one third of the outer span was missing. Blade number 2 was bent aft about 20 degrees with a large radius bend at mid-span. The outboard 2 inches of the blade tip was curled aft. The outboard end of the blade was twisted toward low pitch. Blade number 3 exhibited light fore and aft bending. The outboard 2 inches of the blade tip was curled aft. Equivalent blade angles were determined from the preload plate witness marks. Based on the location of the marks, the blade angles were determined to be 12, 10 and 12 degrees for blades 1,2 and 3 respectively. According to manufacturers specifications, the low pitch stop results in a blade angle of about 17.2 degrees. A mark on the low pitch stop was found that was consistent with the pitch change rod being driven forcefully to low pitch. Inspection found no condition that would have prevented normal propeller operation.

The Powerplant Engineer's Factual Report of the engine and propeller examination is included in its entirety in the public docket associated with this accident report.

The "Before Take-off" checklist contained in the FAA approved Airplane Flight Manual (AFM) for the PA-31P includes a line-item to set the fuel valves to the inboard tanks. The AFM further states in the section titled "Systems Operation And Checks";

10. FUEL MANAGEMENT

a. Inboard tanks must be selected for take-off and landing

b. Inboard tanks may be used for all phases of flight (takeoff, climb, cruise, descent and landing)

NOTE

Since inboard tanks must be used for landing, it is essential that fuel usage be planned to retain a reasonable quantity of fuel in the inboard tanks (in the event of a balked landing) for go-around and subsequent normal landing.

c. Outboard tanks may be used for climb, descent or level flight when outboard tanks are more than 1/2 full. Outboard tanks may be used only for level flight when quantity is 1/2 or less.

The AFM lists the fuel capacity of the inboard, outboard, and nacelle fuel tanks as 56, 40 and 25 gallons respectively. According to the AFM power setting table, the total airplane fuel burn at "High Cruise" power setting is 54 to 58 gallons per hour. Likewise, the total airplane fuel burn at "Intermediate Cruise" is 43 to 45 gallons per hour. The "True Airspeed vs. Density Altitude" chart shows an airspeed of about 234 miles per hour for high cruise power setting at 10,000 feet density altitude. Likewise, the chart shows an airspeed of about 221 miles per hour for intermediate cruise power setting at 10,000 feet density altitude.

The straight line distance from DPA to ARV is 287 statute miles. According to the ARV airport manager, no fuel was obtained for the return flight from ARV to DPA.

ADDITIONAL INFORMATION

The FAA, New Piper Aircraft, and Textron Lycoming were parties to the investigation.

The wreckage was released on January 9, 2004.

Pilot Information

Certificate:	Airline Transport; Flight Instructor; Commercial	**Age:**	53, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane Single-engine	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim.	**Last FAA Medical Exam:**	02/03/2003
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	11850 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	**Registration:**	N36DR
Model/Series:	PA-31P	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	31P-7530025
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	12/11/2002, Annual	**Certified Max Gross Wt.:**	7800 lbs
Time Since Last Inspection:		**Engines:**	2 Reciprocating
Airframe Total Time:	5384 Hours as of last inspection	**Engine Manufacturer:**	Lycoming
ELT:	Installed, not activated	**Engine Model/Series:**	TIGO-541-E1A
Registered Owner:	Navajo, Inc.	**Rated Power:**	425 hp
Operator:	Navajo, Inc.	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	ARV, 1630 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	1753 CDT	**Direction from Accident Site:**	160°
Lowest Cloud Condition:	Clear	**Visibility**	10 Miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots / 15 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	20°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.09 inches Hg	**Temperature/Dew Point:**	19°C / -8°C
Precipitation and Obscuration:			
Departure Point:	Woodruff, WI (ARV)	**Type of Flight Plan Filed:**	IFR
Destination:	CHICAGO/WEST CH, IL (DPA)	**Type of Clearance:**	None
Departure Time:	1750 CDT	**Type of Airspace:**	Class G

Airport Information

Airport:	LAKELAND/NOBLE F. LEE MEMORIAL (ARV)	**Runway Surface Type:**	Asphalt
Airport Elevation:	1630 ft	**Runway Surface Condition:**	Dry
Runway Used:	36	**IFR Approach:**	None
Runway Length/Width:	5150 ft / 100 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	3 Fatal	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	On-Ground
Total Injuries:	4 Fatal	**Latitude, Longitude:**	45.947222, -89.736111

Administrative Information

Investigator In Charge (IIC):	John M Brannen	**Report Date:**	12/28/2004
Additional Participating Persons:	Ray Yank; Milwaukee FSDO; Milwaukee, WI Gregory Erikson; Textron Lycoming; Wayne, IL Michael McClure; The New Piper; Prosper, TX		
Publish Date:			
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.ntsb.gov/pubdms/.		