Aviation Investigation Final Report

Location:	San Manuel, Arizona	**Accident Number:**	WPR13LA190
Date & Time:	April 13, 2013, 12:21 Local	**Registration:**	N6841Q
Aircraft:	Beech 35-B33	**Aircraft Damage:**	Substantial
Defining Event:	Fuel starvation	**Injuries:**	1 Serious
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot overflew the airport and performed a 360-degree descending left turn to join the downwind leg for landing. As the pilot began the turn to final, the airplane's engine did not respond when he attempted to increase power. With limited time to troubleshoot, the pilot turned on the auxiliary fuel pump; the engine did not respond, and he performed a forced landing short of the runway.

The pilot intended to land at the airport to refuel. The left fuel tank quantity indicator gauge was inoperative, so he could not provide an accurate assessment of its quantity. The left fuel tank was selected during the entire approach sequence, and although 10 gallons of fuel were present in that tank after the accident, it had been breached, so an accurate assessment of the quantity before the accident could not be made. The right tank contained 12 gallons of fuel. The pilot surmised that fuel flow may have been restored if he had switched to the right fuel tank when the engine lost power, as was required by the emergency checklist.

The Pilot's Operating Handbook required that the fuel tanks contain a minimum of 10 gallons each to perform basic aerobatic maneuvers. While such maneuvers were not performed, the sweeping nature of the 360-degree descending left turn prior to landing may have forced fuel away from the tanks' supply line, resulting in fuel starvation. The engine monitor revealed that power was actually lost during that turn rather than on the base leg, further supporting this theory. Additionally, residual quantities of fuel were noted in the remaining fuel supply lines to the firewall, and no fuel was present in the lines forward of the engine driven fuel pump, bolstering the likelihood that fuel starvation occurred. A postimpact examination did not reveal any mechanical anomalies with the airframe or engine that would have precluded normal operation.

The airplane was equipped with lap belt restraints, which did not have provisions for a shoulder harness. The pilot sustained injuries to his upper body during the accident sequence, which would likely have been less severe had the airplane been equipped with either a shoulder or multi-point harness.

Probable Cause and Findings

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

A loss of engine power due to fuel starvation during the landing approach. Contributing to the accident was the pilot's failure to follow the emergency checklist and switch tanks. Contributing to the severity of the pilot's injuries was the lack of a shoulder harness restraint.

Findings

Aircraft	Fuel - Fluid management
Personnel issues	Use of checklist - Pilot
Aircraft	Flight compartment equipment - Not installed/available

Factual Information

History of Flight

Approach	Fuel starvation (Defining event)
Approach	Loss of engine power (total)
Approach-VFR pattern final	Off-field or emergency landing

HISTORY OF FLIGHT

On April 13, 2013, about 1221 mountain standard time, a Beech 35-B33, N6841Q, collided with a ditch during a forced landing near San Manuel Airport, San Manuel, Arizona. The pilot was operating the airplane under the provisions of 14 Code of Federal Regulations Part 91. The airline transport pilot sustained serious injuries. The airplane sustained substantial firewall and fuselage damage just aft of the cabin, as well as both wings during the accident sequence. The cross-country flight departed Pegasus Airpark, Queen Creek, Arizona, about 1150, with a planned destination of San Manuel. Visual meteorological conditions prevailed, and no flight plan had been filed.

The pilot reported that the flight was part of a round-robin trip initiating from Tucson International Airport, and then onwards to Pegasus Airpark, with a stop at San Manuel for fuel, and a return to Tucson. He stated that the flight was uneventful, and upon approaching San Manuel he overflew the airport heading north at an elevation of 5,000 feet, and initiated a left turn to enter the right downwind leg for runway 29. He reduced engine power, and descended to 4,100 feet, extended the landing gear, and deployed full flaps. He initiated the base turn while increasing engine power, but the engine did not respond. He immediately turned on the auxiliary fuel pump with no effect. The airplane was not sufficiently high enough to reach the runway, so he performed a forced landing in rough rising terrain short of the field.

The pilot reported that the left fuel tank quantity indicator gauge was inoperative, and that it was his understanding that the left fuel tank contained more fuel than the right during the landing approach. He surmised that fuel flow may have been restored if he had switched to the right fuel tank when the engine lost power.

The left wing sustained a leading edge gouge 24 inches outboard of the root, which had breached the fuel tank bladder. Recovery crew stated that at the accident site the right fuel tank contained about 12 gallons of fuel, and the left tank contained about 10 gallons.

TESTS AND RESEARCH

The engine and airframe were examined at a recovery facility by the NTSB investigator-in-charge, with engine assistance provided by a representative from Continental Motors, Incorporated.

The following is a partial summary of the airframe, engine, and fuel pump/metering unit examinations. No anomalies were noted to any of the engine, airframe, or fuel control components that would have precluded normal operation. See the public docket for full examination reports.

The fuel selector valve was examined, and moved through the "OFF", "LEFT TANK", and "RIGHT TANK" positions. The detents were positive, with an audible click heard as the selector handle was rotated through each position. The fuel lines from the firewall through to each wing fuel tank were free of obstruction, and about 8 ounces of fuel was drained from the selector valve sump. Disassembly of the valve revealed that its screen was free and clear of debris and corrosion. Blue-colored fuel was present in the line from the selector valve to the engine driven and auxiliary fuel pumps.

The engine sustained minimal damage, and remained partially attached by its mounts on the right side. The inlet air filter and box were crushed, and the fuel injection control assembly had broken away from the sump and throttle control body.

The fuel lines between the pump and metering unit, along with the metering unit through to the manifold valve, had broken off at their respective fittings. The flow divider was opened, and its diaphragm was pliable and free of cracks. No fuel was observed within the divider cavity, or any fuel lines forward of the engine driven fuel pump.

The engine driven fuel pump was removed, and the drive shaft was intact. The pump's input drive was rotated by hand, was stiff to turn, and made a squeaking sound.

The engine driven fuel pump and fuel injection control assembly were subsequently retained and examined at the facilities of Pacific Continental Engines (PCE), Pacoima, California, in the presence of the NTSB investigator-in-charge.

Disassembly of both units revealed no internal blockages, or debris to be present within any internal cavity or passage, and all internal components were free of corrosion. The inner walls of the fuel pump body assembly were shiny and free of gouges. The fuel pump shaft, and associated plate end and blades were intact, and the blade contact surfaces and plate end exhibited light scoring, which according to representatives from PCE was consistent with normal service. The representative further stated that rotational resistance by hand at the input shaft was not unusual, and there were no indications of a catastrophic internal failure.

GPS and Turn Performance

The airplane was equipped with a Garmin GPSMap handheld GPS receiver. The unit was configured to record track data, which was downloaded by the NTSB investigator-in-charge. Examination of the data revealed that after departing Pegasus Airpark the airplane began a gradual 25-minute climb from airport elevation (1,450 feet) to 6,067 feet while continuing on a southeast heading. Having reached this altitude about 9 miles northwest of San Manuel, the airplane immediately began a descent, overflying the airport about 3 minutes later at an altitude of 5,246 feet (1,975 feet agl). Over the course of the next 3 minutes, the airplane began a series of four segmented left turns ultimately resulting in one complete circle north of the airport. The airplane then joined the right downwind leg for runway 29 about midfield at an altitude of 4,200 feet. Having reached the end of the downwind leg, the airplane began a descending right turn through base to final, with the last position report occurring at an elevation of 3,192 feet, about 2,600 feet short of the runway 29 threshold.

The airplane's turning performance as it circled north of the airport was calculated utilizing the GPS data in conjunction with Aerodynamics for Naval Aviators (NAVWEPS 00-80T-80), Figure 2.29, General Turning Performance (Constant Altitude, Steady Turn). The most aggressive turn was to the left, lasted about 35 seconds, and occurred about 45 seconds before the airplane joined the right downwind leg. The radius of the turn was about 2,500 feet, with an average ground speed of 140 knots. Utilizing these values, the bank angle during the turn would have been about 35 degrees.

The limitations section of the Beechcraft Pilot's Operating Handbook applicable to the accident airplane model defined the following maneuvering limits with respect to certain flight operations:

"MANEUVER LIMITS
This is a utility category airplane. Spins are prohibited. No acrobatic maneuvers are approved except those listed below. Maximum slip duration is 30 seconds for airplanes with baffled main fuel cells in both wings and 20 seconds for airplanes with unbaffled main fuel cells in either wing.

APPROVED MANEUVERS (3000 POUNDS)

MANEUVER ENTRY SPEED (CAS)

Chandelle 128 kts/147 mph
Steep Turn 128 kts/147 mph
Lazy Eight 128 kts/147 mph
Stall (Except Whip) Use slow deceleration

Minimum fuel for above maneuvers - 10 gallons each main tank."

Emergency Procedures

The Emergency Section of the pilot's operating handbook calls for the following procedure during an in-flight loss of engine power:

1. Fuel Selector Valve - SELECT OTHER MAIN TANK (Check to feel detent)
2. Auxiliary Fuel Pump - ON
3. Mixture - FULL RICH, then LEAN as required
4. Magnetos - CHECK LEFT and RIGHT, then BOTH

ADDITIONAL INFORMATION

Fuel Tanks

The airplane was equipped with two "baffled" wing-cell fuel tanks, each with a 37 gallons usable capacity, installed in December 2011.

Engine Monitor

The airplane was equipped with an Electronics International UBG-16 engine monitor, which was capable of displaying and recording exhaust (EGT) and cylinder head temperatures (CHT). The unit was sent to the NTSB Vehicle Recorder Division for data extraction. The unit had been configured to record

EGT and CHT temperatures for all six cylinders at 1-minute intervals. The entire flight segment was recorded. Analysis of the data revealed that EGT's for cylinder one and three were between 300 and 600 degrees F lower than all other cylinders for both the accident flight and all flights in the prior 12 months. The lack of a corresponding reduction in CHT's for the respective cylinders meant that the EGT reduction was most likely an error in the monitoring system rather than an actual temperature reduction in the cylinders.

The data for the remaining cylinders presented an average EGT and CHT rise to about 1,600 degrees F and 400 degrees F, respectively, across all cylinders for the first 5 minutes of flight, with a reduction to 1,500 degrees F and 350 degrees F for most of the remaining flight. The last 3 minutes of recorded data displayed a precipitous drop in EGT to 400 degrees F, with a corresponding drop of EGT to 250 degrees F.

Seat Belts

The airplane was equipped with lap-belt restraints, which did not have provisions for a shoulder harness. During the impact sequence, the pilot's upper body pivoted forwards, and he sustained a concussion along with multiple lacerations and punctures to his face and forehead as a result of him striking the instrument panel. As the airplane continued into the terrain, the control yoke moved forwards, striking his chest and breaking his right hand.

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	66
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Lap only
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	April 2, 2013
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	June 11, 2011
Flight Time:	7385 hours (Total, all aircraft), 103 hours (Total, this make and model), 4485 hours (Pilot In Command, all aircraft), 2 hours (Last 90 days, all aircraft), 2 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N6841Q
Model/Series:	35-B33	**Aircraft Category:**	Airplane
Year of Manufacture:	1964	**Amateur Built:**	
Airworthiness Certificate:	Utility	**Serial Number:**	CD-767
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	July 13, 2012 Annual	**Certified Max Gross Wt.:**	3000 lbs
Time Since Last Inspection:	56 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1862 Hrs as of last inspection	**Engine Manufacturer:**	Continental Motors
ELT:	C91A installed, not activated	**Engine Model/Series:**	IO-470
Registered Owner:	On file	**Rated Power:**	200 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KDMA,2704 ft msl	**Distance from Accident Site:**	30 Nautical Miles
Observation Time:	12:55 Local	**Direction from Accident Site:**	200°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	310°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.84 inches Hg	**Temperature/Dew Point:**	26°C / -6°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Queen Creek, AZ (5AZ3)	**Type of Flight Plan Filed:**	None
Destination:	San Manuel, AZ (E77)	**Type of Clearance:**	None
Departure Time:	11:50 Local	**Type of Airspace:**	Class E

Airport Information

Airport:	San Manuel E77	**Runway Surface Type:**	Asphalt
Airport Elevation:	3271 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	29	**IFR Approach:**	None
Runway Length/Width:	4207 ft / 75 ft	**VFR Approach/Landing:**	Forced landing;Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Serious	**Latitude, Longitude:**	32.630832,-110.634162(est)

Administrative Information

Investigator In Charge (IIC):	Simpson, Eliott
Additional Participating Persons:	Troy W Lent; Federal Aviation Adminstration FSDO; Scottsdale, AZ Kurt Gibson; Continental Motors Incorperated; Mobile, AL
Original Publish Date:	June 2, 2014
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=86642