National Transportation Safety Board
Aviation Accident Final Report

Location:	SPRINGFIELD, MO	**Accident Number:**	CHI97FA220
Date & Time:	07/20/1997, 1630 CDT	**Registration:**	N3359P
Aircraft:	Beech B-60	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	4 Fatal
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

The pilot and passengers departed the Spirit of St. Louis Airport and flew to Springfield Regional Airport, a 50 to 60 minute flight. The fuel on board was about 25 to 30 gallons in the left wing tanks, and 75 to 80 gallons in the right wing tanks. Each engine burned about 25 to 30 gallons per hour. The airplane was not fueled prior to the return flight. About five minutes after takeoff, the airplane had reached 4,300 feet msl (3,033 feet agl) and began a 402 fpm descent. The airplane continued the descent away from the airport for about 7 nm before turning 180 degrees to the left. The airplane had descended to 2,200 feet msl (933 feet agl) and was 10 miles from the airport. The pilot reported to the controller that he had a '...partial engine failure on the left side.' The airplane impacted the ground in an inverted, vertical nose down attitude. The landing gear were down at impact. Neither propeller was feathered. The right wing, right engine, fuselage, and empennage received extensive fire damage. The left wing was consumed by fire between the nacelle and the wing root. The remaining left wing, left nacelle, and engine were not destroyed by fire. Examination of the engines and airframe did not reveal any pre-existing anomalies that prevented normal operation. The Airplane Flight Manual did not contain procedures which explained fuel crossfeeding procedures in case of fuel exhaustion to a wing's fuel tanks.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's fuel mismanagement and his failure to maintain adequate airspeed which resulted in fuel exhaustion followed by the loss of power in one engine and the loss of aircraft control. Contributing was the pilot's failure to refuel the aircraft, the pilot's failure to feather the propeller of the non-operating engine, and his extension of the landing gear.

Findings

Occurrence #1: LOSS OF ENGINE POWER
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. 1 ENGINE
2. (F) REFUELING - NOT PERFORMED - PILOT IN COMMAND
3. FUEL SYSTEM,TANK - STARVATION
4. (C) FUEL MANAGEMENT - INADEQUATE - PILOT IN COMMAND
5. CONDITION(S)/STEP(S) NOT LISTED - MANUFACTURER
6. (C) IN-FLIGHT PLANNING/DECISION - DELAYED - PILOT IN COMMAND

Occurrence #2: FORCED LANDING
Phase of Operation: DESCENT - EMERGENCY

Occurrence #3: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
7. (C) STALL/SPIN - INADVERTENT - PILOT IN COMMAND
8. (C) AIRSPEED(VMC) - NOT MAINTAINED - PILOT IN COMMAND
9. (F) GEAR EXTENSION - PERFORMED - PILOT IN COMMAND
10. (F) PROPELLER FEATHERING - NOT PERFORMED - PILOT IN COMMAND

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

Factual Information

History of Flight

On July 20, 1997, at 1630 central daylight time (All times CDT), a Beech B-60, N3359P, was destroyed when it impacted terrain two miles northeast of the Springfield/Branson Regional Airport, Springfield, Missouri. The pilot reported that he was having engine problems and he attempted to return to the airport. The airline transport pilot, a pilot rated passenger, and two passengers received fatal injuries. The 14 CFR Part 91 flight departed the Springfield/Branson Regional Airport en route to the Spirit of St. Louis Airport, Chesterfield, Missouri. Visual meteorological conditions prevailed and a VFR flight plan had been filed.

The airplane had departed the Spirit of St. Louis Airport about 0930 and landed at the Springfield/Branson Regional Airport about 1020. The pilot did not request aircraft servicing or fuel. Later that day the pilot and passengers returned and prepared for departure.

An aircraft service lineman at the Springfield/Branson Airport reported that the pilot in the left seat "could have been heavy set" and was wearing a dark tee shirt. The autopsy indicated that the pilot was wearing a knit navy blue and green shirt and weighed over 250 pounds.

At 1610, the pilot called the ground controller and obtained taxi instructions for a VFR flight back to the Spirit of St. Louis Airport. The pilot received taxi instructions for a runway 22 takeoff.

At 1615, the airplane departed and turned on course to the Spirit of St. Louis Airport.

Radar data indicated that the airplane departed to the northeast after takeoff. The first radar "hit" was at 1619:58 and the airplane was about 3.5 nm to the southeast of the field at 2,800 feet mean sea level (msl) and climbing at a rate of 750 fpm.

At 1621, the airplane was about 5 nm east of the airport at 4,300 feet msl. The airplane was about 3,033 feet above ground level (agl).

Witnesses reported that they heard a twin engine airplane with engine problems at about 1615. The location of the witnesses when they observed the airplane was about three miles east of the Springfield Regional Airport. The witnesses reported hearing the airplane's engine/s sputtering, cutting out, or backfiring. They reported seeing the airplane flying, wings level, to the northeast.

At 1621:34, the radar data indicated that the airplane had started a descent on a northeasterly heading. The average rate of descent was about 402 fpm.

At 1624:59, the airplane's altitude was 2,800 feet msl and about 12 nm to the northeast of the airport, about 7 nm further to the northeast from the initial descent point.

At 1624:59, the airplane started a left hand descending turn. The radar data indicated that the airplane made a 180 degree turn and was heading to the southwest.

At 1626.35, the last radar hit on the airplane indicated that it was at 2,200 feet msl and about 10 miles to the northeast of the airport. The airplane was about 933 feet agl.

At 1626:38, the pilot contacted the Springfield local air traffic controller. At 2126:41 the pilot reported, "Yes, sir, we need to return to the airport."

At 2126:54, the controller directed the pilot to fly a 210 degree heading and informed the pilot

that he would sequence the airplane in for landing behind a Beech 1900 that was fifteen miles out from the airport.

At 2127:13, the pilot responded, "Okay, ah, we may, ah, not be able to do that. We're going to let you know here in just a minute."

At 2127:18, the controller asked, "Are you experiencing any difficulties?" The pilot responded, "Yes, sir."

At 2127:21, the controller asked, "Can you give me any, ah, information right now?"

At 2127:23, the pilot responded, "Ah, negative. Stand by a minute."

At 2148:49, the pilot informed the controller that, "...ah, we've got a partial engine failure on the left side. We're going to have to limp it on in."

At 2128:54, the controller told the pilot, "Okay, go straight in to runway two zero, sir." The pilot acknowledged landing runway 20.

At 2129:22, the controller asked, "Duke, ah five niner poppa, you want the equipment?"

At 2129:25, the pilot responded, "Ah, not at this point. We're gonna see if we can't make the airport here."

At 2129:36, the controller cleared the airplane to land on runway 22.

At 2129:39, the pilot responded, "Okay, we don't have the airport."

At 2129:41, the controller asked, "Okay, what's your heading?"

At 2129.42, the pilot said, "Isn't going to work. We're gonna have to put it down."

At 2129:44, the controller asked, "Your landing at your present position?"

At 2129:46, the pilot responded, "Ah yeah. We're looking for a field down here."

At 2129:49, the controller responded, "All right, sir. Thank you very much."

There were no further communications from the pilot.

Witnesses reported seeing a twin engine airplane flying to the southwest at a low altitude at about 1630. The location of the witnesses was about .5 to 1.5 miles to the northeast of the accident site. The witnesses reported that they did not hear any backfiring or sputtering noises from the airplane's engines. They reported that both propellers were turning.

A witness reported that he saw the airplane flying through a valley about 1/8 mile to the east of his farmstead. He reported that the airplane was flying north to south "straight down the road." He reported that the airplane was flying 50 to 100 feet below the tree line but above the telephone poles. He reported that the airplane was level, the props were turning, the flaps and gear were up, and the noise sounded like full power. He reported that the engines were not sputtering. He reported that the airplane climbed 50 to 100 feet in order to clear the trees at the south end of the valley where the terrain was higher. The airplane went out of his field of view.

He reported that his wife saw the airplane momentarily. He reported that she saw the airplane get over the trees. She did not see any abrupt maneuvers.

A third witness reported he saw the airplane climb over the trees. He reported that the

airplane missed the powerlines but was, "struggling to get over the powerlines." He reported that everything went up in flames. He reported that a little wind was blowing to the northeast. He reported that the local firefighters put out the grass fire, and that the airport firefighters put out the aircraft fire.

Personnel Information

The pilot was an airline transport rated pilot with single and multi-engine land ratings. He held a First Class medical certificate. He had a total of about 10,734 hours of flight time. 7,643 hours were in multi-engine aircraft. In the last 12 months he had logged 46 hours in the accident aircraft. The aircraft operator reported that the pilot initially began flying a B-60 in 1980, but logbooks covering that time period were not obtained.

The pilot was an employed pilot of the aircraft operator. The operator reported that the pilot was meticulous and conscientious in his approach to flying. He reported that the pilot had checked-out the four company pilots in the B-60.

The pilot rated passenger in the right seat of the airplane was an airline transport rated pilot with single and multi-engine land ratings. He held a First Class medical certificate. He had over 20,500 total flight hours.

The operator reported that the pilot rated passenger was a friend of the pilot. He reported that the pilot and pilot rated passenger were planning a fishing trip to Canada for the following week. He reported that the purpose of the flight to Springfield, Missouri, was a pleasure flight in order to purchase fishing equipment. The operator reported that the flight to Springfield was not an instructional flight or an indoctrination flight.

Aircraft Information

The airplane was a twin engine Beech B-60, Duke, serial number P400. The airplane seated six and had a gross weight of 6,775 pounds. The engines were 380 horsepower Lycoming TIO-541-E1C4 engines. The last annual inspection was conducted on September 6, 1996. The airplane had flown 40 hours since the last inspection and had a total time of 3,358 hours.

The engine logbooks indicated that both engines were overhauled on September 30, 1988. The time since overhaul was about 887 hours. The engine teardown revealed that Superior Air Parts pistons (p\n SL 10545) were installed on both engines during the overhaul. The engine teardown revealed that the #3 and #5 pistons in the left engine had SL 10545 Revision AF pistons installed. SL 10545 Revision AF pistons were not produced until February 1990. There were no logbook entries indicating when they had been installed. The #1, #2, and #5 pistons in the right engine had been replaced since overhaul. Logbook entries indicated the dates they had been installed.

The operator of the aircraft reported that they had purchased the airplane in 1996. The operator reported that they did not replace any pistons in the left engine. A logbook entry indicated the operator had replaced the #1 and #5 cylinders on the right engine with chrome reconditioned cylinders on April 1, 1996.

The left engine turbocharger had been replaced on June 30, 1997. Time since replacement was about 3 hours.

The aircraft logbook indicated that maintenance had been performed on the right wing fuel tank on July 10, 1997. The logbook entry read, "Repair fuel seepage right wing by tightening

leading edge fuel cell interconnect nipple. Fuel right wing and confirm repair." The aircraft operator reported that fuel had started seeping out of the right wing. To locate the leak, fuel was transferred manually from the right tank to the left tank. The mechanics determined that the fuel was leaking at the interconnect nipple. After the leak was fixed, the fuel in the left tank was pumped back into the right tank utilizing the aircraft's fuel pump and a hose. The operator reported that all the fuel from the left tank was pumped into the right tank, and that only residual fuel remained in the left tank. He reported that the left fuel gauge read zero fuel. He reported that the right fuel tank had about 50 to 60 gallons.

The operator reported that the airplane was not fueled or flown between July 11 and July 20, 1997. The operator reported that on July 20, 1997, the pilot ordered 50 gallons of fuel and had 25 gallons put in each wing. A fuel receipt indicated that 50 gallons of fuel were put on the airplane on July 20, 1997.

The operator reported that the left fuel tank had about 25 to 35 gallons of fuel and the right tank had about 75 to 80 gallons of fuel when it departed for Springfield, Missouri, on July 20, 1998. The operator reported that the fuel gauges worked and were accurate. A Hoskins fuel totalizer was installed on the airplane. The operator reported the totalizer indicated the total fuel on board but it did not indicate how much fuel was in each tank.

The operator reported that each engine's fuel consumption was normally about 30 gallons per hour for the first hour, and 25 gallons per hour after the first hour. The flight from the Spirit of St. Louis Airport to the Springfield Regional Airport required about 50 to 60 minutes of flight time.

The airplane departed Springfield Regional Airport at 1615. At 1621:22, about 5.4 minutes after takeoff, the airplane started descending from 4,300 feet msl. At 2128:49, 11.8 minutes after takeoff, the pilot reported to the controller that he had a "...partial engine failure on the left side... ."

Meteorological Conditions

At 1630, weather conditions reported at Springfield/Branson International Airport were VFR. The sky was clear with 10 miles visibility. The temperature was 89 degrees Fahrenheit and the winds were 270 at 3 knots.

Wreckage and Impact Information

The airplane wreckage was located about 2 nautical miles to the northeast of the Springfield Regional Airport. The approximate heading to the airport was 220 degrees.

The airplane impacted in a hard gravel and clay ravine that was within a pasture. The pasture's terrain was characterized by rolling hills with some open flat areas. The pasture contained some tree clusters, but was mostly covered with grass. The terrain surrounding the pasture contained rolling hills covered with woods and small pastures or clearings.

The airplane impacted in the ravine on about a 210 degree heading. The wreckage path indicated that the airplane hit the ground inverted and was at or near a nose down, vertical flight path. The left and right propellers, hubs, and spinners separated from the engines and remained imbedded in the ravine at the point of impact. The left propeller was located on the right side of the wreckage path, and the right propeller was located on the left side of the wreckage path. Fragments of the left wingtip position light were located about 16 feet to the right of the left propeller.

The wreckage path indicated the airplane continued on a 210 degree heading before coming to rest on the edge of a grassy slope next to the ravine, right side up, and about 60 feet from the initial point of impact. Both wings remained attached to the fuselage. The nose of the wreckage was headed 330 degrees.

The left wingtip (with a wingtip fuel tank installation) and the nose landing gear separated and landed about 85 feet and 90 feet from the initial point of impact, respectively. The left wingtip exhibited no fire damage. The left wing tip leading edge exhibited diagonal and chordwise crushing.

The majority of the fuselage and empennage were consumed by fire. The left horizontal stabilizer, vertical stabilizer, and about one half the right horizontal stabilizer were consumed by fire.

The majority of the right wing was consumed by fire from the wing root out to about four feet from the wingtip. The right engine remained partially attached to the right nacelle and exhibited extensive fire damage. The fire consumed part of the engine's aft accessory section.

The left wing area between the wing root and left engine nacelle exhibited extensive fire damage and melting. The rest of the left wing, left engine, and nacelle were not destroyed by the fire.

The left engine and nacelle separated from the wing.

The leading edge of the left wing outboard of the engine nacelle exhibited leading edge crushing and upward bending.

The flight control system exhibited continuity from the flight controls to the cockpit area.

The left wing flap actuator exhibited a fully retracted (flap up) position. The right wing flap actuator extension was not obtained due to extensive fire consumption. The left aileron trim tab actuator extension indicated a three degrees up trim tab deflection (left wing up trim). The rudder trim tab actuator indicated a left trim tab deflection (nose trim right). The left elevator trim tab actuator was beyond the normal limit of actuator travel. The right elevator trim tab actuator extension was not obtained due to extensive fire consumption.

The cables from the power quadrant to the engines had severed and the power quadrant was destroyed by fire.

The remains of the landing gear actuator and the landing gear indicated that the landing gear was in the down position at impact.

The remains of the left and right fuel selectors indicated that the left fuel selector was in the OFF position, and the right fuel selector was in the ON position.

The left and right fuel boost pump switches were destroyed by fire.

Medical and Pathological Information

Autopsies were performed on the pilot and pilot rated passenger at Tri-Lakes Pathology, Branson, Missouri.

Forensic Toxicology Fatal Accident Reports were prepared by the FAA Civil Aeromedical Institute. The report concerning the pilot indicated the following results:

No Carboxyhemoglobin detected in blood.

No Cyanide detected in blood.

No Ethanol detected in vitreous fluid.

Atenolol was detected in blood and kidney fluid.

Pseudoephedrine was detected in blood and kidney fluid.

Ephedrine was detected in blood and kidney fluid.

Phenylpropanolamine was detected in blood and kidney fluid.

Pseudoephendrine, ephedrine, and phenylpropanolamine are common ingredients in over-the-counter decongestants and diet pills. Atenolol is a prescription medication commonly used to control high blood pressure, but which also is used to decrease the risk of a second heart attack, and more rarely to control symptoms of migraine headache or anxiety.

The Forensic Toxicology Fatal Accident Report concerning the pilot rated passenger indicated the following results:

Carbon monoxide analysis was not performed due to a lack of suitable specimen.

No Cyanide was detected in the blood.

No Ethanol was detected in the urine.

Quinine was detected in urine.

Quinine is found in tonic water, and is used to treat severe malaria. It is also commonly used to reduce the frequency of nocturnal leg cramps, and was available over-the-counter for this purpose until 1995.

Tests and Research

The left and right TIO-541-E1C4 engines were examined at Textron Lycoming. The inspection of the right engine revealed that it had received extensive fire damage. No pre-existing engine deficiencies were noted after examination of the portions of the engine that were not destroyed by fire.

The left engine crankshaft was rotated and there was thumb compression and valve action on all six cylinders. The left and right magnetos produced spark on all six leads. The #1, #4, and #6 piston skirts were broken. Pieces of piston material were found in the oil sump. The chemical composition of the failed pistons conformed to the engineering drawing which specified material composition. No other pre-existing engines discrepancies were noted. (See Textron Lycoming Accident Investigation Report)

The left and right propeller governors were examined and bench tested at the Woodard Governor Company. No anomalies were exhibited that would prevent proper operation of the units. (See Woodard Engineering Analytical Report)

The left and right engine turbochargers were examined at Allied Signal Aerospace. The left engine turbocharger exhibited rotational score marks on the compressor housing and wheel.

The right turbocharger received extensive fire damage. The compressor wheel exhibited rotational scoring on several blades. There were also rotational score marks on the turbine wheel and turbine housing. (See Allied Signal Teardown Report of Two Model T1879 Turbochargers)

The left and right propellers were examined at Hartzell Propeller, Inc. The blade damage signatures indicated that neither propeller was feathered. Both propellers exhibited chordwise scratching. Neither propellers exhibited significant blade twist. One of six blade pitch change knobs were broken off. The L1, R1, and R2 pitch change knobs were bent towards the low pitch direction. No discrepancies were noted which would have precluded normal propeller operation. (See Hartzell Propeller Teardown Report)

The six pistons from the left engine and the six pistons from the right engine were sent to the National Transportation Safety Board's Material Laboratory for examination. The examination revealed that the L1, L4, and L6 pistons were fractured in the piston skirt area. The fractures were similar on all three pistons with an approximate 2 3/4 inch by 1/2 inch triangular section of the skirt being fractured out. Also the fractures were all on the more scored section of the piston wall. The examination of the L4 piston disclosed surface markings indicative of fatigue cracking. The fractures on the L1 and L6 were similar to the fracture on the L4 piston. The L6 piston skirt fracture had dark discoloration. The R3 piston from the right engine contained a small crack that appeared to emanate from within the circumferentially machined cut out.

The microstructure of the L4 piston appeared normal for a forged aluminum alloy having a chemical composition per AMS 4145 (material specification indicated on the engineering drawing). (See NTSB Materials Laboratory Factual Report)

The left engine's cylinder barrels were measured to determine if the bores were oversized. The measurements indicated that the maximum barrel diameters were within specified limits.

Additional Information

The B-60 Airplane Flight Manual (AFM) required a minimum of 25 gallons of fuel in each wing at takeoff.

The AFM stated the following procedure for MAXIMUM GLIDE (FORCED LANDING): "Feather propellers, retract the wing flaps, landing gear, and cowl flaps. The glide ratio in this configuration is slightly over 2 nautical miles of gliding distance for each 1,000 feet of altitude at an airspeed of 127 mph/110 knts."

The AFM Single-Engine Climb Chart indicates the following information:

Single-Engine Climb

Max Gross Weight 6,775 Pounds Power Maximum
Continuous Gear Up Flaps Up
Cowl Flaps Open Inoperative Propeller
Feathered Climb Speed 110 knots OAT
89 degrees F/33 degrees C Pressure Altitude 4,000 feet Rate of Climb
About 125 ft/min (Calculated)

The AFM specifies the following emergency procedures in case of engine failure after lift-off or in flight:

ENGINE FAILURE AFTER LIFT-OFF OR IN FLIGHT

"The most important aspect of engine failure is the necessity to maintain lateral and directional control, and to achieve and maintain normal take-off airspeed or above. If practicable, an immediate landing should be made. The following procedures provide for minimum diversion of attention while flying the airplane.

NOTE

If airspeed is below 98 mph/85 kts reduce power on the operative engine as required to maintain lateral and directional control.

1. Landing Gear and Flaps - UP 2. Throttles (inoperative engine) - CLOSE 3. Propeller (inoperative engine) - FEATHER 4. Power (operative engine) - AS REQUIRED 5. Airspeed - AT OR ABOVE NORMAL TAKE-OFF SPEED

After positive control of the airplane is established:

6. Secure inoperative engine:

a. Mixture - IDLE CUT-OFF b. Fuel Selector - OFF c. Fuel Boost Pump - OFF d. Magneto/Start Switch - OFF e. Generator Switch - OFF f. Cowl Flap - CLOSED

7. Electrical Load - MONITOR

The AFM stated the following concerning the MINIMUM SINGLE-ENGINE CONTROL SPEED, 98 MPH/85 KTS:

"The minimum single-engine control speed is the airspeed below which the airplane cannot be controlled laterally and directionally in flight with one engine operating at take-off power and the other engine with its propeller windmilling."

The B-60 AFM states the following concerning the fuel system:

FUEL SYSTEM

The fuel system is a simple ON-OFF-CROSSFEED arrangement.

FUEL CELLS

The fuel system installation consists of an inboard main fuel cell and an outboard cell in the leading edge, a nacelle tank, and a wing panel fuel cell in each wing. All of the fuel cells in each wing are interconnected in order to make all of the useable fuel in each wing available to its engine when the fuel selector valve is turned ON. The interconnecting fuel cells are serviced through a single filler on each wing.

FUEL CROSSFEED

The separate identical fuel supplies for each engine are interconnected by crossfeed lines. During normal operation, each engine uses it own fuel pumps to draw fuel from its respective fuel tank arrangement. However, on crossfeed operations, the entire usable fuel supply of both wings can be consumed by either engine. The procedure for using the crossfeed system is described in the Normal Procedures Section.

The fuel crossfeed system cannot be employed to transfer fuel from one wing to another during flight.

The Normal Procedures Section of the B-60 AFM refers to the fuel crossfeed system only in the BEFORE TAKE-OFF checklist. Step 4 and 5 of the checklist state:

4. Fuel Selectors - CROSSFEED. (For 10-15 seconds) 5. Fuel Selectors - RETURN BOTH TO ON

The Emergency Procedures Section of the B-60 AFM provides the following procedures for single-engine crossfeed operation:

SINGLE-ENGINE OPERATION ON CROSSFEED

Left engine inoperative and fuel being supplied from left side.

1. Left Fuel Boost Pump - ON 2. Left Fuel Selector - OFF 3. Right Fuel Selector - CROSSFEED 4. Left Fuel Boost Pump - OFF

Right engine inoperative and fuel being supplied from right side.

1. Right Fuel Boost Pump - ON 2. Right Fuel Selector - OFF 3. Left Fuel Selector - CROSSFEED 4. Right Fuel Boost Pump - OFF

CAUTION

Continuous operation of Fuel Boost Pump may be required if excessive fuel flow fluxuations are encountered.

The emergency procedure for SINGLE-ENGINE OPERATION ON CROSSFEED specified procedures if an engine was inoperable. The procedures explained how the operable engine could draw (crossfeed) fuel from the opposite wing's fuel tank.

The crossfeed procedures did not explain how to crossfeed fuel in case a wing fuel tank experienced fuel exhaustion. In such a scenario, the wing's fuel tanks would be exhausted, but the corresponding engine would be able to operate if it were able to receive fuel.

A representative of the aircraft manufacturer reported that the following concerning the fuel crossfeed system:

"The fuel crossfeed system is not intended for simultaneously supplying fuel to both engines when the right and left fuel selector valves are positioned to OFF and CROSSFEED, respectively (or vise-versa). Therefore, the "Single-Engine Operation on Crossfeed" procedures noted on the B60 Duke Airplane Flight Manual, Page 3-6, are intended only for operating one engine from the opposite side fuel tanks (e.g., with the right fuel selector valve positioned to CROSSFEED, and the left fuel selector valve positioned to OFF, only the right engine is being supplied fuel from the left fuel tanks)."

In follow on correspondence, the aircraft manufacturer representative reported the following information concerning the fuel crossfeed system:

"...the fuel crossfeed system is not intended for simultaneously supplying fuel to both engines. The applicable engineering drawings show that the fuel system plumbing will allow both engines to simultaneously feed from one side of the fuel system, however, Raytheon Aircraft does not recommend this practice."

The representative further reported:

Regarding "Scenario One, Left Fuel Tank Empty, Left Engine Operative (What are the procedures for crossfeeding fuel to the left engine to perform an airstart and for continued operation?)" [NTSB Question]

[Manufacturer's Response]

When you want to supply fuel to the left engine from the right fuel tanks (and shut off fuel to the right engine):

1. Right Fuel Boost Pump - ON 2. Right Fuel Selector - OFF 3. Left Fuel Selector - CROSSFEED 4. Right Fuel Boost Pump - OFF

Regarding "Scenario Two, Right Fuel Tank Empty, Right Engine Operative (What are the procedures for crossfeeding fuel to the right engine to perform an airstart and for continued operation?)" [NTSB Question]

[Manufacturer's Response]

When you want to supply fuel to the right engine from the left fuel tanks (and shut off fuel to the left engine):

1. Left Fuel Boost Pump - ON 2. Left Fuel Selector - OFF 3. Right Fuel Selector - CROSSFEED 4. Left Fuel Boost Pump - OFF

The B-60 AFM did not include descriptions of Normal or Emergency Procedures for the use of the crossfeed fuel system in the event that the left or right fuel tank lacked any usable fuel, and the corresponding engine was operable. The AFM did not contain any fuel system descriptions or warnings that the crossfeed fuel system was not intended for simultaneously supplying fuel to both engines, although the engineering drawings showed that the fuel system plumbing allowed both engines to be simultaneously fed from one side of the fuel system.

Parties to the investigation included the Federal Aviation Administration, Raytheon Aircraft, Textron Lycoming, Woodard Governor Company, Hartzell Propeller Inc., Allied Signal Aerospace, and Superior Air Parts.

The aircraft logbooks and maintenance records were released to the United States Aviation Underwriters. The aircraft wreckage was released to Corporate Aircraft Management, Inc. The aircraft wreckage was shipped to Aviation Enterprises, Springfield, Missouri.

Pilot Information

Certificate:	Airline Transport	**Age:**	56, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane Multi-engine; Airplane Single-engine	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim.	**Last FAA Medical Exam:**	06/27/1997
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	10734 hours (Total, all aircraft), 46 hours (Total, this make and model), 9256 hours (Pilot In Command, all aircraft), 101 hours (Last 90 days, all aircraft), 22 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N3359P
Model/Series:	B-60 B-60	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	P400
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	09/06/1996, Annual	**Certified Max Gross Wt.:**	6775 lbs
Time Since Last Inspection:	40 Hours	**Engines:**	2 Reciprocating
Airframe Total Time:	3358 Hours	**Engine Manufacturer:**	Lycoming
ELT:	Installed	**Engine Model/Series:**	TIO-541-E1C4
Registered Owner:	CORPORATE AIRCRAFT MANAGEMENT	**Rated Power:**	380 hp
Operator:	CORPORATE AIRCRAFT MANAGEMENT	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	SGF, 1267 ft msl	**Distance from Accident Site:**	2 Nautical Miles
Observation Time:	1630 CDT	**Direction from Accident Site:**	50°
Lowest Cloud Condition:	Clear / 0 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	None / 0 ft agl	**Visibility (RVR):**	0 ft
Wind Speed/Gusts:	3 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	270°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	32°C / 19°C
Precipitation and Obscuration:			
Departure Point:	(SGF)	**Type of Flight Plan Filed:**	VFR
Destination:	CHESTERFIELD, MO (SUS)	**Type of Clearance:**	VFR
Departure Time:	1610 CDT	**Type of Airspace:**	Class D

Airport Information

Airport:	SPRINGFIELD REGIONAL (SGF)	**Runway Surface Type:**	
Airport Elevation:	1267 ft	**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	
Runway Length/Width:		**VFR Approach/Landing:**	

Wreckage and Impact Information

Crew Injuries:	2 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	2 Fatal	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 Fatal	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	JIM SILLIMAN	**Report Date:**	02/15/2000
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