National Transportation Safety Board
Aviation Accident Final Report

Location:	Clinton, CT	**Accident Number:**	ERA15LA053
Date & Time:	11/15/2014, 1606 EST	**Registration:**	N4548S
Aircraft:	BEECH F33A	**Aircraft Damage:**	Substantial
Defining Event:	Fuel starvation	**Injuries:**	1 Minor
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

According to the commercial pilot, earlier on the day of the accident, she had flown the airplane from her home airport to the airport from which the accident flight departed. Before departing on the return flight to her home airport, she noted about 20 gallons of fuel in each main wing tank for the 45-minute flight. After taking off and establishing the airplane on course, she climbed the airplane to 4,500 ft mean sea level; trimmed the airplane for cruise flight; and set engine rpm to 2,300, manifold pressure to 23 inches of mercury, and fuel flow to 13 gallons per hour. Sometime later, she heard "a loud explosive bang - like a gunshot." She immediately checked her instruments and noted that the rpm had risen to over 2,500. She then reduced the propeller control with no effect. The airplane started to "shudder." The rpm dropped to 2,000, the airspeed had dropped off, and the airplane began to lose altitude. She then checked her propeller setting and aggressively advanced the propeller, but there was no increase in rpm. She contacted air traffic control, reported engine problems, and declared an emergency; the controller advised her to land at a nearby airport. The pilot turned toward the airport but was unable to see it. When she realized that she was not going to find the airport or an open area, she decided not to put the landing gear down because she was aiming to land the airplane on top of the trees. She reached down to shut the fuel selector off because she was afraid there might be a fire once she crashed. Because she was approaching the trees, she did not look at the fuel selector handle to check its setting. She knew she turned the handle but was not sure if she had fully turned it to the off position from the right tank position. The airplane then collided with the trees and sustained substantial damage.

Postaccident examination of the propeller and engine revealed no evidence of preexisting malfunctions or failures that would have precluded normal operation. An engine run in a test cell revealed that it operated normally with no anomalies noted. Further examination of the airplane revealed that it had not been configured by the pilot per the manufacturer's published guidance in the pilot's operating handbook and Federal Aviation Administration-approved airplane flight manual for a loss of engine power, maximum glide configuration, or landing without power.

First responders did not report evidence of a fuel spill, although both wing tip tanks and wing fuel bladders were breached. The tip tanks were totally devoid of fuel, but fuel was in the undamaged portion of each of the wing tank's fuel bladders. About 17 gallons of fuel were recovered from the right-wing

tank, and less than 1 gallon of fuel was recovered from the left-wing tank. The fuel selector was in the left tank position. The fuel strainer was clean, free of debris, and devoid of fuel. No fuel was recovered from the fuel supply line to the engine-driven fuel pump.

Examination of the electronic fuel-flow indicator, which presented information to the pilot about the fuel usage and could display the total fuel used and the remaining fuel on board, revealed that it had not been initialized by the pilot in quite some time. An accurate fuel-remaining value relied on the pilot to initialize the device when refueling. A review of fueling information revealed that the pilot had not refueled the airplane at her home airport earlier that day; further, she did not refuel before departing on the accident flight. Because the pilot had not refueled before either flight on the day of the accident and had not initialized the fuel-flow indicator, it is likely that she did not perform adequate preflight fuel planning and improperly managed the fuel in flight, which led to fuel starvation.

Probable Cause and Findings

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

The pilot's inadequate fuel planning and improper fuel management, which resulted in a total loss of engine power due to fuel starvation. Contributing to the accident was the pilot's failure to follow proper procedures in response to the loss of engine power.

Findings

Aircraft	Fuel - Fluid level (Cause)
	Fuel - Fluid management (Cause)
	Fuel selector/shutoff valve - Incorrect use/operation (Cause)
Personnel issues	Fuel planning - Pilot (Cause)
	Decision making/judgment - Pilot (Cause)
	Lack of action - Pilot (Factor)

Factual Information

History of Flight

Prior to flight	Preflight or dispatch event
Enroute-cruise	Fuel starvation (Defining event)
	Loss of engine power (total)
Emergency descent	Landing area overshoot
Landing	Off-field or emergency landing
	Collision with terr/obj (non-CFIT)

On November 15, 2014, about 1606 eastern standard time, a Beech F33A, N4548S, was substantially damaged when it impacted trees during a forced landing, after a loss of power during cruise near Clinton, Connecticut. The pilot received minor injuries. Visual meteorological conditions prevailed, and no flight plan was filed for the personal flight conducted under Title 14 Code of Federal Regulations Part 91, which departed Groton-New London Airport (GON), Groton, Connecticut, destined for Orange County Airport (MGJ), Montgomery, New York.

According to the pilot, earlier in the day she had flown the airplane from MGJ to GON. She had approximately 20 gallons of fuel in each wing tank prior to departure. She did not refuel at GON.

At approximately 1555, she departed on her return flight to MGJ. After takeoff she made a left turn and established herself on course. She then climbed to 4,500 feet above mean sea level and trimmed for cruise flight, set 2,300 revolutions per minute (rpm), manifold pressure to 23 inches of mercury, and fuel flow to 13 gallons per hour.

Sometime later, air traffic control (ATC) pointed out traffic to the pilot however, the sun was directly ahead of her, and very bright, making it difficult for her to see. She then advised ATC that she was looking for traffic, and shortly afterwards, she heard "a loud explosive bang - like a gunshot." She immediately checked her instruments. The rpm had risen to "over 2,500 rpm – over redline." She then reduced the propeller control back with no effect. The airplane started to "shudder – physically shaking me." The rpm on her tachometer had now dropped to 2,000. Her airspeed had also dropped off and she began to lose altitude. She then checked her propeller setting and aggressively advanced the propeller, but there was no increase in rpm.

She contacted ATC and told them she had engine problems and declared an emergency. ATC advised her to land at Chester Airport (SNC), Chester, Connecticut, which was the nearest airport. She then requested vectors to SNC. They advised her to turn to a heading of 180° which she did. She advised ATC that she did not see the airport, nor did she see any other clearing or road. All she saw were trees, and she continued to lose altitude. She flew the airplane straight and level, as best she could, trying to maintain the airplane's best glide speed. She called ATC again requesting the location of the airport. They advised her that it was about 2 miles at her 12 o'clock position. However, she still could not see it. She realized at this point

that she was not going to find the airport or any other open area before she hit the trees.

She continued to fly the airplane straight and level and decided not to put the landing gear down as she was aiming to land the airplane on top of the trees, hoping they would cushion the airplane as it descended to the ground. She reached down to shut the fuel selector off because she was afraid there might be a fire once she crashed. She knew there was still plenty of fuel on board. However, since she did it as she was approaching the tree tops, she could not look at the fuel selector handle to check its setting. She knew she turned the handle, but she was not sure if she had fully turned it to the left to the "OFF" position from the right tank before the airplane then collided with the trees.

Pilot Information

Certificate:	Commercial; Private	**Age:**	62, Female
Airplane Rating(s):	Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With Waivers/Limitations	**Last FAA Medical Exam:**	08/25/2014
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	12/27/2013
Flight Time:	1549 hours (Total, all aircraft), 827 hours (Total, this make and model), 1018 hours (Pilot In Command, all aircraft), 13 hours (Last 90 days, all aircraft), 5 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

The pilot held a Federal Aviation Administration (FAA) commercial pilot certificate with ratings for airplane single-engine land, and instrument airplane. Her most recent FAA second-class medical certificate was issued on August 25, 2014. She reported that she had accrued approximately 1,549 total flight hours, 827 of which, were in the accident airplane make and model.

Aircraft and Owner/Operator Information

Aircraft Make:	BEECH	**Registration:**	N4548S
Model/Series:	F33A	**Aircraft Category:**	Airplane
Year of Manufacture:	1975	**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	CE-601
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	02/22/2014, Annual	**Certified Max Gross Wt.:**	3400 lbs
Time Since Last Inspection:	39 Hours	**Engines:**	1 Reciprocating
Airframe Total Time:	3016.02 Hours at time of accident	**Engine Manufacturer:**	Continental
ELT:	C91 installed, not activated	**Engine Model/Series:**	IO-550-B
Registered Owner:	SHIRLEYS EXPRESS LLC	**Rated Power:**	300 hp
Operator:	On file	**Operating Certificate(s) Held:**	None

On November 4, 1999, in accordance with FAA Supplemental Type Certificate SA2200SW, the installed Continental IO-550-BA engine was replaced with a 300 horsepower, air cooled, 6-cylinder, horizontally opposed, Continental IO-550-B equipped with a Hartzell 3-bladed, variable pitch, constant speed propeller.

Its most recent annual inspection was completed on February 22, 2014. At the time of the accident, the airplane had accrued 3,016.02 total hours of operation, and the engine had accrued 866.72 total hours of operation since major overhaul.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	SNC, 416 ft msl	**Distance from Accident Site:**	4 Nautical Miles
Observation Time:	1555 EST	**Direction from Accident Site:**	8°
Lowest Cloud Condition:	Clear	**Visibility**	10 Miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	320°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30.27 inches Hg	**Temperature/Dew Point:**	3°C / -11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Groton, CT (GON)	**Type of Flight Plan Filed:**	None
Destination:	Montgomery, NY (MGJ)	**Type of Clearance:**	VFR Flight Following
Departure Time:	1555 EST	**Type of Airspace:**	Class E

The recorded weather at Chester Airport (SNC), Chester, Connecticut, located 3.7 nautical miles north of the accident site, at 1555, included: winds 320° at 7 knots, 10 miles visibility, sky clear, temperature 3° C, dew point -11° C, and an altimeter setting of 30.27 inches of mercury.

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor	**Latitude, Longitude:**	41.319167, -72.528333

Examination of the accident site and wreckage revealed that the airplane came to rest inverted, in a nose and left wing down position, wedged between trees, about 6 feet above ground level.

Airplane Examination

Examination of the airplane revealed that the wings, fuselage, engine, and empennage were impact damaged. Control continuity was established to the ailerons, elevators, and rudder. The wing flaps were retracted, and the flap selector switch was in the up (retracted) position. The elevator trim position indicator displayed about a 6° nose up trim position.

The landing gear was retracted, the landing gear selector was in the up (retracted) position,

and the emergency gear extension handle was stowed. The magnetos switch was in the left magneto position. The battery master and alternator switches were on, the auxiliary instrument air switch was in the on position, the pitot heat switch was in the off position. The strobes, electronic flight instrumentation, and navigation lights switches, were in the on position.

The throttle control was in the full open position, the mixture control was in the full rich position, and the propeller was in the high rpm position. The auxiliary fuel pump was off, and the cowl flaps were open.

First responders did not report an evidence of a fuel spill though both the left, and right, wing tip tanks, and the left, and right, wing fuel bladders were breached. The tip tanks were totally devoid of fuel, but fuel was discovered to be trapped in the undamaged portion of each of the wing tank's fuel bladders. About 17 gallons of fuel was recovered from the right-wing tank. Less than 1 gallon of fuel was recovered from the left-wing tank. The fuel selector was in the "LEFT TANK" position. The fuel strainer was clean, free of debris, and devoid of fuel. No fuel was recovered from the fuel supply line to the engine driven fuel pump.

Propeller Examination

The propeller had remained attached to the engine; and the blades had remained secured in the hub.

On January 27, 2015, the propeller was examined at Hartzell Propeller Incorporated.

During the examination it was discovered that the spinner dome was crushed on one side and was still attached to the spinner bulkhead, which was intact, but was bent around the edges. The engine to the propeller mounting was intact and unremarkable.

One propeller blade was unremarkable, the tip of the other two propeller blades were bent aft. None of the blades displayed leading edge impact damage.

The cylinder, piston, pitch change rod, fork, spring, and low and high pitch stops, were all intact and unremarkable. The hub assembly was also intact and unremarkable, and the preload plates displayed normal wear.

The blade bearings were all intact and unremarkable. Two of the pitch change knobs were fractured off. Metallurgical examination indicated that they had failed by ductile overload under shear or tearing stresses, with no indication of fatigue cracking.

Engine Examination

On March 24, 2015 the engine was examined at Continental Motors Incorporated (CMI).

Examination revealed that the engine had sustained impact damage during the accident sequence, and all the fuel lines going to the fuel metering assembly had broken free from the assembly. The fuel inlet fitting going to the engine driven fuel pump had broken free from the

fuel pump. The ignition harness displayed tearing in several locations; however, none of the ignition lines were severed. All four engine mounts were broken consistent with impact damage. The right-side exhaust displayed bending deformation consistent with impact damage and the intake balance tube was crushed.

The fuel pump was disassembled, and the internal components were inspected. There were no anomalies noted with the engine driven fuel pump. The cylinders were examined using a lighted borescope and the pistons, cylinder bore, and valve heads displayed normal operating and combustion signatures.

The magneto-to-engine timing was then checked and compared to the specified magneto to engine timing of 22° before top dead center (BTDC) with the following results:

Left Magneto: 25° BTDC
Right Magneto: 23° BTDC

A cylinder leakage test was then performed in accordance with the latest revision of CMI Service Bulletin SB03-3 with the engine at room temperature with the following results (master orifice reading – 39 PSI):

Cylinder No.1 - 26/80 PSI
Cylinder No.3 - 6/80 PSI
Cylinder No.5 - 10/80 PSI

Cylinder No.2 - 36/80 PSI
Cylinder No.4 - 39/80 PSI
Cylinder No.6 - 50/80 PSI

The leakage source for all 6 cylinders were the exhaust valves and piston rings.

Engine Run

After the examination, the engine was prepared for an engine run by removing the propeller governor, along with various airframe related hoses. Due to damage that the engine sustained, the following parts were installed in preparation for the engine run:

Engine driven fuel pump (the fuel pump housing was damaged while attempting to remove remains of the fuel inlet fitting)

The right-side exhaust system

All four engine mounts

All three AN fittings going into the fuel metering assembly

The No.6 top spark plug

The engine was not disassembled prior to the engine run. The crankshaft end-play measured 0.01" and the run-out was 0.002". Deflection was measured at .003."

The engine was then prepared for operation by installation of thermocouples, pressure lines and test pads for monitoring purposes. The engine was then moved to a test cell, mounted for operation, and fitted with a club propeller.

During the engine run, the engine started on the first attempt without hesitation. The engine RPM was brought to 1,000 rpm to warm up the engine to normal operating temperatures. The engine was then run at 1,200 rpm for five minutes to stabilize. The engine throttle was then advanced to 1,600 rpm and held there for five minutes to stabilize. The engine throttle was then advanced to 2,100 rpm and held there for five minutes to stabilize. The engine throttle was then advanced to 2,450 rpm and held there for five minutes to stabilize. The engine throttle was then advanced to the full open position and held there for five minutes to stabilize.

The engine throttle was then rapidly advanced from idle to full throttle six times, where it performed normally without any hesitation, stumbling, or interruption in power. Throughout the engine run, the engine operated normally and there were no anomalies noted.

Flight Recorders

The airplane was equipped with a JP Instruments, JPI FS-450 Electronic Fuel-Flow Indicator, and a Garmin International, GPSMAP 496.

JPI FS-450 Device

The JPI FS-450 electronic fuel-flow indicator in the airplane was a cockpit panel mounted computerized display device that presented information to the pilot about the fuel usage of the airplane. The indicator had two modes, one mode displayed the total fuel used and the remaining fuel on-board the airplane. An accurate fuel remaining value relied on the pilot to initialize the device when refueling. The second mode displayed, in real-time, the engine fuel-flow. In addition to the display, the JPI unit could provide fuel information to the airplane's navigational systems to allow them to calculate and display fuel at various waypoints along the programmed flight track. The JPI unit could retain in its memory, fuel used and fuel remaining values after electrical power was removed.

Data extraction from the unit's memory indicated that the pilot had not initialized the device in quite some time, as the Fuel Used and Remaining values were recorded as:

Fuel Used: 285.3 Gallons
Remaining: 0 Gallons

GPSMAP 496 Device

Data extracted from the unit included 37 flights from May 11, 2014 through November 15, 2014.

The duration of the first flight on the day of the accident from MGJ to GON was recorded to be about 1 hour and 3 minutes long, starting at 10:20:03 and ending at 11:23:07. The accident flight was recorded as departing from GON about 4 hours and 18 minutes later. The airplane was then airborne for about 26 minutes with the recorded data starting at 15:41:27 and ending at 16:07:52.

Review of the data indicated that after the pilot reported the engine problem, the airplane's flight path also continued past SNC and passed within 2,373 ft from the end of runway 35, before the airplane turned to the southeast towards the area where the airplane came to rest after striking trees during the emergency landing.

Tests And Research

Fueling Information

A review of fueling information from MGJ airport revealed that the airplane was not fueled from either the full-service or self-service fuel pumps at the airport prior to departure to GON. Records indicated that the last recorded fuel transaction at MGJ for the airplane was on July 19, 2014.

Fuel System

The fuel cell installation consisted of a 40-gallon capacity fuel cell (37- gallon usable) and filler cap in each wing leading edge. The filler neck for each fuel cell contained a visual measuring tab to permit partial filling of the fuel cell. Filling the fuel cell until the fuel touched the bottom of the tab indicated 27 gallons of usable fuel, and filling to the slot in the tab indicated 32 gallons of usable fuel.

The airplane was also equipped with a 15-gallon fiberglass tip tank on each wing. Fuel in the tip tanks could be transferred to each respective main tank in cruise flight by transfer pumps mounted in the wheel wells. Sufficient fuel from the main tanks was required to be used from the main tanks prior to activating the transfer pumps to prevent fuel from being vented overboard.

Fuel System Guidance

According to the Beechcraft Bonanza F33A Pilot's Operating Handbook and FAA Approved Airplane Flight Manual (POH/AFM), The pilot was required to preplan all aspects of their flight including a proper weather briefing and adequate fuel reserves and to assure that they had enough fuel for takeoff, plus the trip, and an adequate reserve.

The POH/AFM also instructed that the pilot should preplan the fuel and fuel tank management before the actual flight, to utilize auxiliary tanks only in level cruise flight, to take off and land only on the fullest main tank, and to never use auxiliary tanks for takeoff or landing.

It also instructed to not take off with less than minimum recommended fuel plus adequate reserves, to not run the tank dry before switching tanks, to takeoff on the main tank that is more nearly full, and that when operating fuel selector, and to feel for the detent position. It also instructed to not take off when the fuel quantity gages indicate in the yellow band, or with less than 13 gallons in each main tank.

Engine Failure and Engine Discrepancy Guidance

According to the POH/AFM, in the event of an engine failure after liftoff and in flight, if sufficient altitude was available for maneuvering, to accomplish the following emergency procedures:

Fuel Selector Valve – SELECT OTHER TANK (Check to feel detent)
Auxiliary Fuel Pump – ON
Mixture – FULL RICH, then LEAN as required
Magnetos – CHECK LEFT and RIGHT, then BOTH

The POH/AFM also contained a "NOTE" that stated:

"The most probable cause of engine failure would be loss of fuel flow or improper functioning of the ignition system."

If no engine restart occurred, the POH/AFM directed the pilot to:

Select most favorable landing site.
See EMERGENCY LANDING procedure.
The use of landing gear is dependent on the terrain where landing must be made.

The POH/AFM also under "ENGINE DISCREPANCY CHECKS," instructs the pilot in the event of a rough running engine to accomplish the following actions:

Mixture – FULL RICH, then LEAN as required
Magneto/Start Switch – CHECK LEFT and RIGHT, then BOTH

Also, if a loss of engine power occurs to:

Fuel Flow Gage – CHECK

Or if fuel flow is abnormally low to:

Mixture – FULL RICH
Auxiliary Fuel Pump – ON (Lean as required)
Auxiliary Fuel Pump – OFF if performance does not improve in a few moments

Fuel Quantity Indicator – CHECK for fuel supply in tank being used

If tank being used is empty:

Fuel Tank Selector Valve – SELECT OTHER FUEL TANK (feel for detent)

Maximum Glide Configuration Guidance

Further review of the POH/AFM also revealed that it contained guidance for maximum glide configuration to increase glide distance in the event of a loss of engine power. It instructed the pilot to accomplish the following:

Landing Gear – UP
Flaps – UP
Cowl Flaps – CLOSED
Propeller – PULL for LOW RPM
Airspeed – 105 kts/121mph

Use of the procedure would increase the glide distance about 1.7 nautical miles (2 statute miles) per 1,000' of altitude above the terrain.

Emergency Landing Guidance

When landing without power, the POH/AFM, instructed the pilot on final approach to accomplish the following actions:

Airspeed – 83 kts/96 mph
Fuel Selector Valve - OFF
Mixture – IDLE CUT - OFF
Magneto/Start Switch - OFF
Flaps – AS REQUIRED
Landing Gear – DOWN OR UP, DEPENDING ON TERRAIN
Battery and Alternator Switches - OFF

Additional Information

According to the Airplane Flying Handbook (FAA-H-8083-3B), there are several factors that may interfere with a pilot's ability to act promptly and properly when faced with an emergency. Some of these factors are listed below:

Reluctance to accept the emergency situation—a pilot who allows the mind to become paralyzed at the thought that the airplane will be on the ground in a very short time, regardless of the pilot's actions or hopes, is severely handicapped in the handling of the emergency. An unconscious desire to delay the dreaded moment may lead to such errors as: failure to lower the nose to maintain flying speed, delay in the selection of the most suitable landing area within reach, and indecision in general. Desperate attempts to correct whatever went wrong at the expense of airplane control fall into the same category.

Undue concern about getting hurt—fear is a vital part of the self-preservation mechanism. However, when fear leads to panic, we invite that which we want most to avoid. The survival records favor pilots who maintain their composure and know how to apply the general

concepts and procedures that have been developed through the years. The success of an emergency landing is as much a matter of the mind as of skills.

The Airplane Flying Handbook also advised that, the key to successful management of an emergency situation, and/ or preventing a non-normal situation from progressing into a true emergency, is a thorough familiarity with, and adherence to, the procedures developed by the airplane manufacturer and contained in the POH/AFM.

Preventing Similar Accidents

Flying on Empty

Prevent the Preventable With Careful Fuel Management

The problem

Within fuel-related accidents, fuel exhaustion and fuel starvation continue to be leading causes. From 2011 to 2015, an average of more than 50 accidents per year occurred due to fuel management issues. Fuel exhaustion accounted for 56% of fuel-related accidents while fuel starvation was responsible for 35% of these accidents.

Fuel *exhaustion* is running out of fuel whereas fuel *starvation* is having fuel onboard but it doesn't reach the engine for reasons such as a blockage, improperly set fuel selector, or water contamination.

- More than 66% of fuel management accidents occurred on flights when the intended destination airport was different than the departure airport. About 80% of all fuel management accidents occurred during the day in visual meteorological conditions; only 15% occurred at night.
- Almost half of pilots involved in fuel management accidents hold either a commercial or air transport pilot certificate (48%); pilots holding private or sport pilot certificates make up 50%. Only 2% of accidents involved student pilots.
- Pilot complacency and overestimation of flying ability can play a role in fuel management accidents.

Running out of fuel or starving an engine of fuel is highly preventable. An overwhelming majority of our investigations of fuel management accidents—95%—cited personnel issues (such as use of equipment, planning, or experience in the type of aircraft being flown) as causal or contributing to fuel exhaustion or starvation accidents. Prudent pilot action can eliminate these issues. Less than 5% of investigations cited a failure or malfunction of the fuel system.

Related accidents

The NTSB has investigated numerous accidents involving fuel exhaustion or starvation, such as the following:

- The commercial pilot of a Beech 19A reported that, during the initial climb after takeoff for the flight, which was the first flight after completion of an annual inspection, the engine lost power at an altitude of about 500 ft. He made a left turn to return to the airport but instead touched down hard next to the runway. During the annual inspection, maintenance personnel had placed the fuel selector valve in the OFF position and did not return it to the full-ON position before the flight. The pilot reported that he and the owner usually kept the fuel selector valve in the ON position and that he did not use a checklist or confirm that it was in the full-ON position before takeoff. The probable cause of the accident was the pilot's failure to reposition the fuel selector valve to the ON position prior to takeoff resulting in a loss of engine power due to fuel starvation. Contributing to the accident was the pilot's failure to properly complete the pre-takeoff checklist. (WPR16CA145)
- The private pilot of a Piper PA-24-250 reported that, before departure, the airplane's digital cockpit fuel gauges indicated that the two wing tanks contained about 5 gallons of fuel each for the 10- to 15-minute flight. About 4 miles from the destination airport, the engine began to run roughly, and the pilot switched the fuel tank selector from the left-wing tank to the right-wing tank. The engine continued to run roughly and subsequently lost all power. Postaccident examination found that the fuel quantity gauges indicated no fuel remained, and no fuel was observed in either of the wing fuel tanks. Given the fuel consumption rate in the airplane's Pilot Operating Handbook (POH), a 15-minute flight would have consumed about 3.5 gallons, not including the fuel required for engine startup, taxi, and takeoff. The pilot used the digital cockpit fuel gauges as his only indication of the fuel level and did not confirm the displayed quantity either visually or with another fuel measurement device before takeoff. The probable cause of the accident was the pilot's improper preflight inspection, which resulted in fuel exhaustion and a total loss of engine power. (ERA13LA408)
- About 10 minutes into the flight, the private pilot of a Cirrus SR22T reported to an air traffic controller that the engine was running rough and that he needed to return to his departure airport. During a second instrument approach, the engine lost power, and the pilot attempted a forced landing to a field, where the airplane came to rest on its right side. The pilot and one passenger sustained serious injuries, and a second passenger sustained fatal injuries. No evidence of fuel or fuel spillage was observed at the accident site. An examination and operational test of the engine found no defects in engine operation, and the engine produced full-rated power. According to the pilot, the airplane's management company did not fuel the airplane as he had requested. The pilot did not visually verify the fuel level in the tanks during his preflight inspection and departed with his flight displays indicating low fuel alerts. The probable cause of the accident was the pilot's failure to adequately preflight the airplane prior to departure, which resulted in a loss of engine power due to fuel exhaustion. (CEN12FA037)

What can you do?

- Know how much fuel you have onboard AT ALL TIMES.
- During your preflight inspection, measure and/or visually confirm the fuel quantity in your tanks. Do not rely exclusively on fuel gauges.
- Know how much fuel you will need for a given flight.
- Make sure you have a fuel reserve for each flight.

- Know your engine's fuel burn rate and actively monitor the fuel burn rate for the entire time the engine is operating.
- Know your aircraft's fuel system and how it works.
- Review your aircraft's POH and use the appropriate checklists.
- Don't stretch your available fuel supply. Stop and get gas!

Interested in more information?

The following links are to recent articles and other resources about fuel management:

- The March 2017 issue of NASA's newsletter CALLBACK contains an article about complacency in aviation that discusses a pilot who was complacent in using checklist procedures and starved the engine of fuel.
- The fuel management edition of AOPA's Safety Advisor provides pilots detailed information and suggestions to improve fuel awareness and reduce fuel-related incidents.
- The January 2017 issue of Aviation Safety magazine contains an article titled, "Fuel Systems 101," which discusses how most fuel management accidents result from pilots' poor planning or failure to understand how aircraft fuel systems deliver fuel to the engine.

The NTSB's Aviation Information Resources web page, www.ntsb.gov/air, provides convenient access to NTSB aviation safety products. This safety alert and other can be accessed from the Aviation Safety Alerts link.

The NTSB presents this information to prevent recurrence of similar accidents. Note that this should not be considered guidance from the regulator, nor does this supersede existing FAA Regulations (FARs).

Administrative Information

Investigator In Charge (IIC):	Todd G Gunther	**Report Date:**	04/13/2020
Additional Participating Persons:	Jason George; FAA/FSDO; Windsor Locks, CT Steve Miller; Textron Aviation; Wichita, KS Kurt Gibson; Continental Motors Inc.; Mobile, AL Dan Boggs; Hartzell Propeller; Piqua, OH		
Publish Date:	04/13/2020		
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=90391		