SAFETY ALERT 067

NTSB National Transportation Safety Board

August 2017

AVIATION
HIGHWAY
MARINE
RAILROAD
PIPELINE

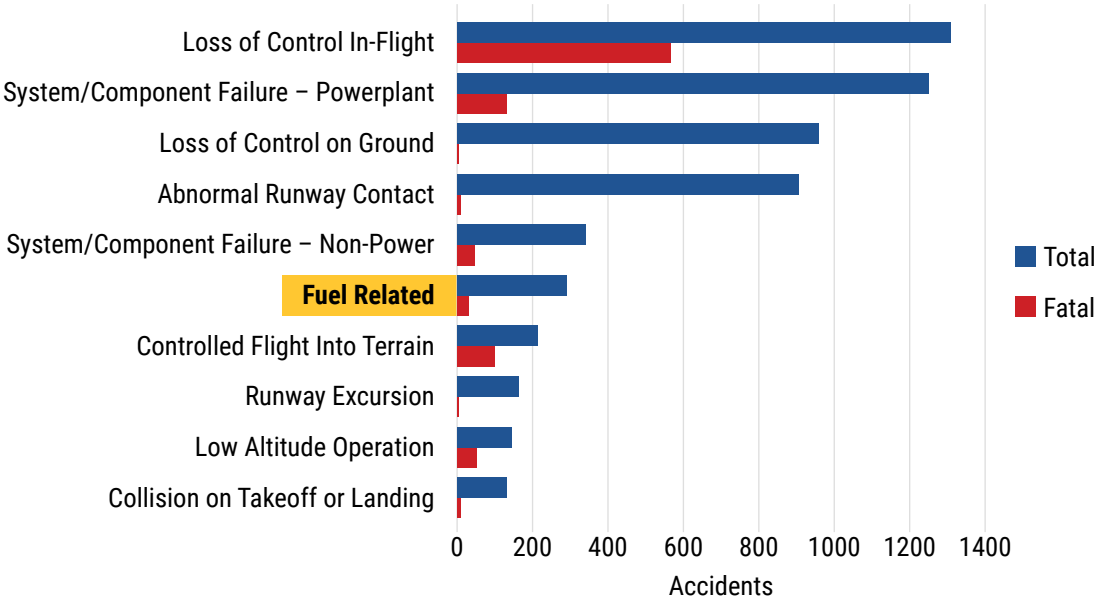
Flying on Empty

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.

Figure 1. Top Ten General Aviation Accident Occurrence Categories, 2011–2015



- **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.

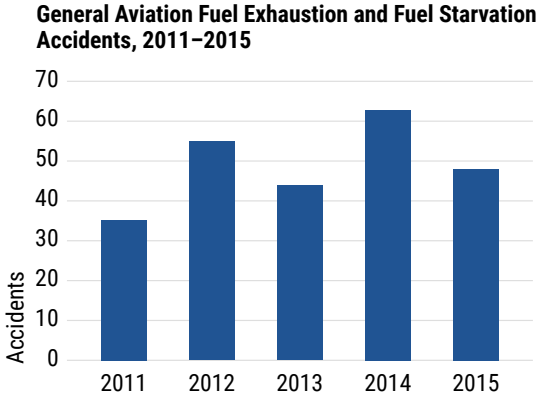


Figure 2. Accidents Involving Fuel Management from 2011 to 2015

- **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)

Figure 3. Exemplar fuel gauges and postaccident fuel samples

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 reports for the accidents referenced in this safety alert are accessible by NTSB accident number from the Aviation Accident Database link, and each accident's public docket is accessible from the Accident Dockets link for the Docket Management System.

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

www.**twitter**.com/**ntsb**
www.**facebook**.com/**ntsbgov**
www.**youtube**.com/**user**/**ntsbgov**
www.**instagram**.com/**ntsbgov**
www.**flickr**.com/**photos**/**ntsb**

The NTSB is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in other modes of transportation—highway, marine, railroad and pipeline. The NTSB determines the probable cause of the accidents and issues safety recommendations aimed at preventing future accidents. For more information, visit **www.ntsb.gov**