

Whereas nearly 87 percent of the fuel starvation accidents in this study were attributed to operational problems, these problems are not independent of the factors which influenced or caused them. Therefore, remedial action must be directed at the primary factors which influence fuel system operation. These factors are as follows:

Design-Associated Factors

- Owner manuals which often lack detailed information on fuel management and fuel system purging operations.
- Fuel systems which require tank switching in order to manage the fuel supply properly.
- Fuel selector valves with handle design, mode of operation, or tank display which may be conducive to mispositioning.
- Placement of engine controls and similarity of appearance which may be conducive to improper use.

Pilot-Associated Factors

- Instructional techniques for emergency simulation by deliberate fuel starvation at low altitude.
- Lack of knowledge or concern for good fuel management procedures and techniques, including the need for thorough preflight fuel system inspection and purging.

RECOMMENDATIONS

The National Transportation Safety Board believes that the number of U. S. General Aviation fuel starvation accidents can be substantially reduced by constructively changing the above conditions. Accordingly, the Safety Board recommends that the Federal Aviation Administration:

1. Issue an Advisory Circular, which augments the information presented in Federal Aviation Administration Advisory Circular No. 20-43B "Aircraft Fuel Control," (a) to alert general aviation pilots of the primary difficulties causing fuel starvation; and (b) to warn certificated flight instructors of the danger associated with simulation of emergency engine failure by positioning the fuel selector valve to "off" or the mixture control to "idle cutoff."
(Recommendation A-74-35)
2. Amend 14 CFR 23.1581 so that an approved Airplane Flight Manual is required for all airplanes regardless of weight,

thereby assuring greater consistency and attention to detail than is currently available in most owner manuals for airplanes which weigh less than 6,000 pounds.
(Recommendation A-74-36)

3. Promote awareness of fuel starvation problems among those individuals who are beginning careers as student pilots by:
 - a. Requiring a written test as part of student pilot flight requirements in 14 CFR 61.63, similar to that required for private pilots in 14 CFR 61.87.
 - b. Structuring written tests so that an applicant's knowledge of fuel system operating principles and factors which cause fuel starvation can be determined.
(Recommendation A-74-37)
4. Amend 14 CFR 23.777 through 23.781 to include specifications for standardizing powerplant control location, visual and tactile appearance, and mode of actuation, similar to the specifications for transport category airplanes appearing in 14 CFR 25.777 through 25.781. (Recommendation A-74-38)
5. Amend 14 CFR 23 to include specifications for standardizing fuel selector valve handle designs, displays, and modes of operation. (Recommendation A-74-39)

In addition, the Safety Board recommends that the General Aviation Manufacturers Association (GAMA) establish industry-wide recommended design practices for fuel systems of future general aviation airplanes, and where practicable apply these same practices to existing models through system modifications. Application of these practices to all existing airplanes may be impossible for reasons of cost or physical constraints; however, the following practices could be applied to the design of future airplanes at a minimum cost: (Recommendation A-74-40)

- a. Specifications for a low fuel warning device which operates independently of the fuel gage system.
- b. Specifications for a water contamination warning system.
- c. Specifications for more accurate type of fuel quantity gaging system.
- d. Specifications for multiple fuel tank vents and nonicing tank vents to minimize the possibility of vent obstruction.
- e. Simplification of the fuel system through the use of the balanced, single-tank design concept.