

# CONCLUSIONS

## Findings

1. Study analyses of aircraft accident and activity data showed a decrease in total accident rates but an increase in fatal accident rates for the selected group of glass cockpit aircraft when compared to similar conventionally equipped aircraft during the study period. Overall, study analyses did not show a significant improvement in safety for the glass cockpit study group.
2. Pilots must be able to demonstrate a minimum knowledge of primary aircraft flight instruments and displays in order to be prepared to safely operate aircraft equipped with those systems, which is necessary for all aircraft but is not currently addressed by Federal Aviation Administration knowledge tests for glass cockpit displays.
3. Pilots are not always provided all of the information necessary to adequately understand the unique operational and functional details of the primary flight instruments in their airplanes.
4. Generalized guidance and training are no longer sufficient to prepare pilots to safely operate glass cockpit avionics; effective pilot instruction and evaluation must be tailored to specific equipment.
5. Simulators or procedural trainers are the most practical alternative means of training pilots to identify and respond to glass cockpit avionics failures and malfunctions that cannot be easily or safely replicated in light aircraft.

6. Identification and tracking of service difficulties, equipment malfunctions or failures, abnormal operations, and other safety issues will be increasingly important as light aircraft avionics systems and equipment continue to increase in complexity and variation of design, and current reporting to the Federal Aviation Administration's Service Difficulty Reporting system does not adequately capture this information for 14 *Code of Federal Regulations* Part 23 certified aircraft used in general aviation operations.
  
7. The Federal Aviation Administration's current review of the 14 *Code of Federal Regulations* Part 23 certification process provides an opportunity to improve upon deficiencies in the reporting of equipment malfunctions and defects identified by the FAA and aviation industry representatives in the July 2009 Part 23 *Certification Process Study* report.
  
8. Some glass cockpit displays include recording capabilities that have significantly benefited accident investigations and provide the general aviation community with the ability to improve equipment reliability and the safety and efficiency of aircraft operations through data analyses.

# RECOMMENDATIONS

As a result of this safety study, the National Transportation Safety Board makes the following recommendations to the Federal Aviation Administration:

Revise airman knowledge tests to include questions regarding electronic flight and navigation displays, including normal operations, limitations, and the interpretation of malfunctions and aircraft attitudes. (A-10-XXX)

Require all manufacturers of certified electronic primary flight displays to include information in their approved Aircraft Flight Manual and Pilot's Operating Handbook supplements regarding abnormal equipment operation or malfunction due to subsystem and input malfunctions, including but not limited to pitot and/or static system blockages, magnetic sensor malfunctions, and attitude-heading reference system alignment failures. (A-10-XXX)

Incorporate training elements regarding electronic primary flight displays into Federal Aviation Administration training materials and aeronautical knowledge requirements for all pilots (A-10-XXX)

Incorporate training elements regarding electronic primary flight displays into its initial and recurrent flight proficiency requirements for pilots of 14 Code of Regulations Part 23 certified aircraft equipped with those systems, that address variations in equipment design and operations of such displays. (A-10-XXX)

Develop and publish guidance for the use of equipment-specific electronic avionics display simulators and procedural trainers that do not meet the definition of flight simulation training devices prescribed in 14 *Code of Federal Regulations* Part 60, to support equipment-specific pilot training requirements. (A-10-XXX)

Inform aircraft and avionics maintenance technicians about the critical role of voluntary Service Difficulty Reporting system reports involving malfunctions or defects associated with electronic primary flight, navigation, and control systems in 14 *Code of Federal Regulations* Part 23 certified aircraft used in general aviation operations.. (A-10-XXX)