



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: January 15, 1998

In reply refer to: A-98-1 and -2

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On April 3, 1997, about 1948 eastern standard time, a Cessna 650 (Citation III), N553AC, operated by Mercury Communications, experienced an in-flight fire while on approach to the Greater Buffalo International Airport in Buffalo, New York. While descending through 4,000 feet, the crew smelled smoke, a navigation display went blank, and radio communications were lost. After an emergency landing, ground personnel saw flames burning through a hole in the aft fuselage and informed the crew. The flightcrew and passenger evacuated with no injuries; however, the airplane was substantially damaged. The flight was being conducted under the provisions of Title 14 Code of Federal Regulations Part 91 as a corporate flight from Wellsville, New York, to Buffalo.

The Safety Board's investigation revealed that the fire was caused by arcing between 115VAC electrical wiring and the hydraulic pump suction line in the area above the baggage compartment. A fleetwide inspection of Cessna 650s found that nine airplanes had electrical wiring chafing against the same hydraulic line and were at risk of a similar in-flight fire. A subsequent Federal Aviation Administration (FAA) airworthiness directive (AD) required all Cessna 650s to be modified with the installation of an additional clip and five clamps with associated hardware to ensure positive separation between the electrical wires and the hydraulic line.

The Safety Board is aware of other recent incidents caused by inadequate clearance between electrical wiring and adjacent components. On June 25, 1996, Delta Air Lines flight 148, a Boeing 767-300ER (767), experienced a flight control malfunction after taking off from John F. Kennedy International Airport, Jamaica, New York. While climbing through 5,000 feet, the captain heard a loud pop, and the airplane banked sharply to the left. The flightcrew had to deflect the control wheel 25° to the right to maintain a level attitude; a successful emergency landing was made back in New York. The Safety Board's investigation revealed that an aileron flight control cable failed as a result of arcing when it contacted adjacent electrical wiring. Several days later, an aileron cable failure occurred on a 767 operated by Lan-Chile Airlines under similar circumstances. The FAA

issued a telegraphic AD for a fleetwide inspection to ensure that 1 inch of clearance existed between the flight control cable and the electrical wiring.

The Safety Board also learned of a 1995 incident aboard a Japan Air Lines (JAL) 767 in which inadequate clearance led to arcing between electrical wiring and an oxygen line fitting near the captain's oxygen mask. This incident was followed by a Boeing service bulletin and an FAA AD mandating the installation of protective sleeving over the wiring within 2 inches of the oxygen lines as an interim protective measure. A July 2, 1997, proposed AD calls for permanent modifications to ensure adequate clearance between oxygen equipment and adjacent wiring.

Based on these accidents/incidents, the Safety Board performed a review of the FAA guidelines for safe wire routing practices. Guidelines were found in two references, Advisory Circular (AC) 43.13-1A, "Acceptable Methods, Techniques, and Practices-Aircraft Inspection And Repair," and AC 65-15, "Airframe and Powerplant Mechanics Airframe Book." (The Safety Board recognizes that these advisory circulars provide general wire routing guidelines and that more specific guidelines may be provided by the manufacturer.) These references state that no electrical wire should be located within 1/2 inch of any combustible fluid or oxygen line, and if the separation is less than 2 inches, back-to-back clamps or a polyethylene sleeve should be installed to ensure positive separation. They also state that electrical wiring should be routed to maintain clearance of at least 3 inches with any control cable. If this clearance cannot be maintained, mechanical guards should be installed to prevent contact between the wiring and the control cables.

The Safety Board reviewed the current company standards and practices used by several manufacturers and found that they do not always provide for the clearance around electrical wiring recommended in the FAA guidelines. For example, Cessna's process specification, "Wiring Installation for Commercial Aircraft," states that wiring shall not be attached to hydraulic lines, and that wiring within 6 inches of hydraulic lines must be firmly supported. However, it does not mention using back-to-back clamps or a polyethylene sleeve to ensure positive separation if the separation is less than 2 inches. Design drawings for the Cessna 650 specify 1/2 inch of clearance between the hydraulic line and electrical wiring but provide no means to ensure positive separation. The Safety Board recognizes that after the Buffalo, New York, accident, the FAA issued an AD to mandate the installation of additional clamps on all Cessna 650s to ensure positive separation. However, the Board is concerned that Cessna's design drawings for the Cessna 650 were not consistent with Cessna's process specifications nor the FAA's guidance.

The Boeing Standard Wiring Practices Manual states that electrical wiring should be routed at least 3 inches away from control cables, if possible. If this cannot be done, rigid support of the wiring must be specified, and if necessary, special mechanical or electrical protection between wiring and control cables should be specified. However, design drawings for the 767 specify only 1 inch of separation between the aileron flight control cable and adjacent electrical wiring, with no mechanical or electrical protection specified; this 1 inch separation did not prevent arcing in the Delta Air Lines and Lan-Chile Airlines incidents. A Boeing service letter and subsequent AD

issued after these incidents still require only 1 inch of clearance in this area, with no mechanical guards to prevent contact as recommended in the referenced FAA guidelines.

Finally, the original design of the 767 flightcrew oxygen mask stowage box allowed for electrical wiring to be within 2 inches of oxygen lines, with no protective sleeving over the wiring, as recommended in the referenced FAA guidelines. However, following the 1995 JAL incident, a service bulletin and AD were issued requiring the installation of protective sleeving over the electrical wiring.

The Safety Board concludes that, although not mandated, the FAA guidelines provide adequate protection from the hazards associated with inadequate clearance between electrical wiring and adjacent components. However, the Board is concerned that manufacturers do not always provide this level of protection through their design standards or manufacturing and inspection processes. In some cases, manufacturers are required to modify designs to bring them in line with the FAA guidelines only after an in-service problem or an accident or incident has occurred. To minimize the risks associated with inadequate clearance around electrical wiring, the Safety Board believes that the FAA should review the design, manufacturing, and inspection procedures of aircraft manufacturers, and require revisions, as necessary, to ensure that adequate clearance is specified around electrical wiring, in accordance with published FAA guidelines. In addition, the FAA should review the existing designs of all transport-category airplanes to determine if adequate clearance is provided around electrical wiring, in accordance with published FAA guidelines. If deviations are found, require that modifications be made to ensure adequate clearance.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Review the design, manufacturing, and inspection procedures of aircraft manufacturers, and require revisions, as necessary, to ensure that adequate clearance is specified around electrical wiring, in accordance with published FAA guidelines. (A-98-1)

Review the existing designs of all transport-category airplanes to determine if adequate clearance is provided around electrical wiring, in accordance with published FAA guidelines. If deviations are found, require that modifications be made to ensure adequate clearance. (A-98-2)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By:


Jim Hall
Chairman