

NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.

ISSUED: February 10, 1981

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Forwarded to:  
Mr. Charles E. Weithoner  
Acting Administrator  
Federal Aviation Administration  
Washington, D.C. 20591  
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SAFETY RECOMMENDATION(S)

A-81-12 through 13

The National Transportation Safety Board sent a U. S. Accredited Representative and accompanying advisors to participate in the investigation of the Saudi Arabian Airlines Lockheed L-1011 accident at Riyadh, Saudi Arabia, on August 19, 1980. The accident involved an in-flight fire in the aft area of the aircraft. Even though the aircraft was landed successfully, the fire spread and all 301 occupants died as a result. The investigation, conducted in accordance with the provisions of International Civil Aviation Organization Annex 13, is continuing and a report of the investigation will be issued by the Kingdom of Saudi Arabia upon completion. As part of U.S. assistance in the investigation, tests and research were conducted at the Lockheed California Company and at the Federal Aviation Administration (FAA) Technical Center, Atlantic City, New Jersey.

The fire ignition source and exact area in which the in-flight fire originated have not yet been determined. The aft baggage compartment (C-3), among others, where bulk baggage is carried beneath the aft cabin floor, is being investigated as a possible origination area. Among the tests conducted to evaluate certain hypotheses regarding fire propagation were fire penetration tests of the C-3 compartment lining materials. One test showed that a 5-inch diameter, 12-inch-high propane burner flame (1,800° F) placed beneath the C-3 compartment ceiling penetrated the ceiling liner in less than 1 minute and then penetrated the cabin floor and carpet material in less than 2 minutes. A second test using the same burner showed that a 3- to 4-foot-high flame (1,160° F, fuel rich) penetrated the ceiling liner in 25 seconds, and then the cabin floor and carpet material in 4.5 minutes.

The C-3 compartment of the L-1011 is certificated as "Class D" under the provisions of 14 CFR 25.857(d). That rule states, A Class D cargo or baggage compartment is one in which--

- (1) A fire occurring in it will be completely confined without endangering the safety of the airplane or the occupants;
- (2) There are means to exclude hazardous quantities of smoke, flames, or other noxious gases from any compartment occupied by the crew or passengers;

(3) Ventilation and drafts are controlled within each compartment so that any fire likely to occur in the compartment will not progress beyond safe limits;

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(5) Consideration is given to the effect of heat within the compartment on adjacent critical parts of the airplane. For compartments of 500 cu. ft. or less, an airflow of 1,500 cu. ft. per hour is acceptable.

The Safety Board notes that its predecessor, Civil Air Regulation 4B.383, "Cargo Compartment Classification," contained the following regarding Class D compartments: "Note: For compartments having a volume not in excess of 500 cu.ft. an airflow of not more than 1,500 cu.ft. per hour is acceptable. For larger compartments lesser airflow may be applicable." This guideline at least suggested more conservative criteria should be followed for larger compartments while the existing rule does not address the airflow allowance in compartments larger than 500 cu.ft.

The volume of the C-3 compartment of the L-1011 is 700 cu. ft. Safety Board investigators have been advised by FAA that the L-1011 C-3 compartment was approved as "Class D" by "extrapolations" from the 500 cu. ft. volume and 1,500 cu. ft. per hour airflow guidelines in 14 CFR 25.857(d)(5). However, the theoretical concept of a Class D compartment is that a fire within the compartment would be extinguished by oxygen depletion, preventing its propagation. This concept apparently has been successfully applied in narrow-bodied aircraft with limited volume compartments. However, the Safety Board is concerned that it may not be a valid concept for larger volume compartments, such as the L-1011 C-3 compartment, because much greater volumes of oxygen are available to support combustion prior to depletion and "snuffing." The additional air supply can readily support a fire for sufficient time to allow penetration of the compartment lining, thereby providing access to an unlimited oxygen supply to support propagation of the fire. In fact, preliminary tests conducted at the FAA Technical Center, using a 770 cu.ft. simulated Class D compartment, illustrated that a fire of sufficient intensity to penetrate the L-1011 C-3's ceiling liner in less than 1 minute burned for more than 10 minutes after the compartment airflow was shut off.

The Safety Board is aware that the type of flames used in the tests at Lockheed and at the FAA Technical Center do not duplicate the type of flame (bunsen burner) used to certify flammability characteristics of cargo and baggage compartment interior materials (14 CFR 25.855). However, the Safety Board believes that a small fire in a piece of baggage could generate localized intense heat similar to that from the propane burner used in the recent tests and that the fire could penetrate the ceiling before the oxygen supply is depleted.

The penetration of the L-1011 C-3 compartment ceiling carries extremely hazardous consequences because numerous major aircraft components are routed between the ceiling of the compartment and the floor of the cabin. Among these items are the No. 2 engine throttle cables, the No. 2 fuel line, and flight control cables. Fire reaching these components could easily endanger the entire aircraft, and therefore, the design does not comply with the intent of 14 CFR 25.857(d)(5). Moreover, once such a fire reaches the cabin, the cabin furnishings will become involved, and the fire will be difficult to extinguish.

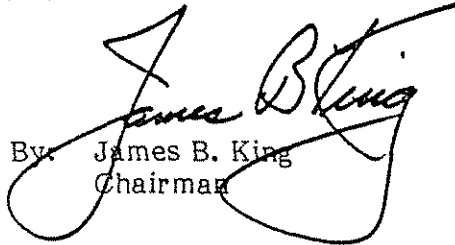
The Safety Board is aware of several instances of fire in checked baggage from ignition of matches and other items. In most of these instances, fires ignited while the aircraft were on the ground and the aircraft were not damaged. However, the possibility of such a fire while in-flight and the questionable capability of the L-1011 C-3 compartment to contain a fire by "snuffing" it to keep it from spreading suggest that the "Class D" certification of the C-3 compartment should be reevaluated.

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

Reevaluate the "Class-D" certification of the L-1011 C-3 cargo compartment with a view toward either changing the classification to "C," requiring detection and extinguishing equipment, or changing the compartment liner material to insure containment of a fire of the types likely in the compartment while in-flight. (Class I, Urgent Action) (A-81-12)

Review the certification of all baggage/cargo compartments (over 500 cu. ft.) in the "D" classification to insure that the intent of 14 CFR 25.857(d) is met. (Class II, Priority Action) (A-81-13)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN and BURSLEY, Members, concurred in these recommendations.

  
By: James B. King  
Chairman