

## Fire Protection of Cargo Compartments

### BACKGROUND

On 11 May 1996, a McDonnell Douglas DC-9 operated by ValuJet Airlines, Inc. as Flight 592 crashed into the Everglades approximately ten minutes after take-off from Miami International Airport. The accident occurred as Flight 592 was attempting to return to Miami and was the result of an uncontrolled fire in the airplane's forward Class D cargo compartment.

At the time of the ValuJet accident, five cargo compartment classifications were available in the United States: Classes A, B, C, D, and E. Lower lobe cargo compartments on large passenger airplanes, which would be inaccessible in flight and used mostly for passenger baggage, could be Class C or Class D compartments. As mentioned above, the ValuJet fire occurred in a Class D compartment.

The fire protection approaches for Classes C and D differ. Class C relies on active fire control through fire detection and suppression systems, whereas Class D relied on passive control through oxygen starvation. Class C requirements are essentially unchanged since the accident. Following the accident, the U.S. Federal Aviation Administration (FAA) modified their certification rules to remove the Class D classification. In addition, operators of aeroplanes with Class D compartments were required under operational regulations to upgrade these compartments to the Class C standard.

Class C fire protection relies on detecting the fire early and suppressing it for the duration of the flight. The fire suppression system releases an extinguishing agent like Halon into the compartment at a concentration level that inhibits combustion. The fire resistant liner helps prevent leakage of the extinguishing agent so that an effective concentration can be maintained and protects adjacent structure and systems. Ventilation to the compartment following fire detection is also limited to maintain extinguishing agent concentrations.

Class D fire protection relied on passive oxygen starvation, ie the compartment being small and sealed enough so that a fire would quickly expend available oxygen and extinguish, or remain so small that it would not threaten the airplane. This was accomplished by limiting the size of and ventilation to the compartment. Class D compartment did not require fire detection or suppression systems, so fires occurring therein were expected to stay at a non-threatening level for the duration of the flight to its destination. As part of the lessons learned after the ValuJet accident, the FAA removed the Class D cargo compartment classification.

Class E fire protection relies on oxygen starvation by aircraft depressurization. Class E compartments are main deck compartments on all-cargo aircraft. There are cargo compartment liner requirements, but they are not as rigorous as Class C requirements, except where protection of critical structure and systems is concerned. Where not protecting non-critical aircraft systems and structure, there is often no separate cargo liner installed since the existing insulation or wall material can satisfy existing liner requirements.

Class F compartments were originally envisioned to replace Class B compartments, but are now considered by some as a means to enhance fire protection when used in Class C, D, or E compartments. For example, if a shipment is deemed not suitable for a Class E compartment due to flammability, a special Class F compartment might be deemed appropriate for transport if located inside a Class E compartment due to special fire containment capabilities of the Class F compartment. Some examples are fire containment covers, fire resistant containers, and main deck (Class E) fire suppression systems.

## ICAO PROVISIONS

Currently, ICAO Annex 8 (11th Ed, inc Amdt 104, Nov 2013) does not define or specify Classes of cargo compartments, but does specify (Part IIIB, para. 4.2 g) that *each cargo compartment not accessible to a crew member should be equipped with a built-in fire detection system and a built-in fire suppression system*. But the Annex does not include two other components found in Class C compartments: means to exclude hazardous quantities of smoke, flames, or extinguishing agent from any occupied compartment, and means to control ventilation. Most importantly, the above Standard only applies to *aeroplanes over 5 700 kg for which application for certification was submitted on or after 2 March 2004*. Consequently, there are aeroplanes currently in commercial air transport that have Class D cargo compartments. These aeroplanes do not have an equivalent level of safety that exists on aeroplanes with Class C cargo compartments.

## POSITION

IFALPA believes the following cargo compartment fire protection requirements should be applied to all aircraft engaged in commercial air transport:

1. There should be a separate approved smoke detector or fire detector system for each cargo compartment that provides a warning at the pilot station.
2. All cargo compartments, regardless of size, should be lined with insulating material capable of containing the maximum fire intensity associated with the cargo being carried during all operating conditions.
3. Requirements for Class E compartment cargo liners should be similar to those for Class C compartments.
4. Each cargo compartment should have an approved fire suppression system.
5. Current Class D cargo compartments should be upgraded to at least a Class C standard.
6. Class F compartments should be tested to demonstrate the capability of suppressing any fire likely to occur given the type of cargo to be transported in the compartments.
7. Each cargo compartment should have a means to exclude hazardous quantities of smoke, flames, or extinguishing agent, from any compartment occupied by the crew or passengers.
8. Each cargo compartment should have a means to control ventilation and drafts within the compartment so that the extinguishing agent used can control any fire that may start within the compartment.
9. When cargo is placed within a Unit Load Device (ULD) in a cargo compartment, there should be a means to detect a fire within the ULD. Extinguishing systems should be designed to extinguish a fire within a ULD before it spreads to other cargo.
10. There should be a means for the flight crew to monitor the affected compartment's condition following activation of the fire extinguishing system.