



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: January 4, 2002

In reply refer to: A-01-83 through -87

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

Recent In-Flight Fires

Delta Air Lines Flight 2030

On September 17, 1999, about 2230 eastern daylight time, a McDonnell Douglas MD-88, N947DL, operated by Delta Air Lines as flight 2030, experienced an in-flight fire and made an emergency landing at the Cincinnati and Northern Kentucky International Airport in Covington, Kentucky.¹ After landing, an emergency evacuation was performed. The airplane sustained minor damage, and none of the 2 flight crewmembers, 3 flight attendants, 3 off-duty flight attendants, or 113 passengers were injured.

Shortly after takeoff, several flight attendants detected a sulphurous or "lit match" smell and reported it to the flight crew. Following the captain's instructions, flight attendants checked the lavatories, but were unable to locate the cause of the smell. Two off-duty flight attendants retrieved Halon fire extinguishers when flight attendants noticed smoke in the forward section of the coach cabin.² Flight attendants reseated a passenger in row 11 to another row when he stated that his feet were hot. This individual's carry-on bag, which had been on the floor beside him, next to the right sidewall and above the floor vent, was scorched. Flight attendants also reported seeing an orange or red, flickering glow beneath the vent at that location.

¹ The description for this accident, NYC99IA231, can be found on the Safety Board's Web site at <<http://www.ntsb.gov>>.

² In comparison, on March 17, 1991, a Delta Air Lines L-1011 experienced a fire below the aft cabin floor that produced visible flames in the cabin. According to an August 14, 1991, Safety Board letter, "a flight attendant promptly discharged a Halon fire extinguisher into an opening in the base of the sidewall from which the flames appeared to originate. The fire was extinguished and a precautionary landing was made at Goose Bay."

Flight attendant No. 1 went to the cockpit to inform the flight crew of these observations and asked the captain whether to spray Halon into the vent where she had seen the glow. The captain instructed her not to use the Halon extinguisher, indicating he was concerned about spraying Halon in the cabin. Meanwhile, another flight attendant had already discharged a Halon fire extinguisher into the vent and observed that the glow was no longer visible. Thereafter, the smoke began to dissipate and did not return, indicating that the fire had been extinguished by the Halon. When flight attendant No. 1 returned from the flight deck, she became alarmed that a Halon fire extinguisher had been discharged because the captain had instructed her not to do so.

During its investigation of this incident, Safety Board staff discovered that the source of the smoke in the cabin was a smoldering insulation blanket in the cargo compartment adjacent to a static port heater. Electrical arcing from the heater ignited the blanket, and the smoldering became a self-sustaining fire that grew in size.³

AirTran Flight 913

On August 8, 2000, about 1544 eastern daylight time, a McDonnell Douglas DC-9-32, N838AT, operated by AirTran Airways (AirTran) as flight 913, experienced an in-flight fire and made an emergency landing at the Greensboro Piedmont-Triad International Airport in Greensboro, North Carolina.⁴ An emergency evacuation was performed. The airplane was substantially damaged from the effects of fire, heat, and smoke. Of the 57 passengers and 5 crewmembers on board, 3 crewmembers and 2 passengers received minor injuries from smoke inhalation, and 8 other passengers received minor injuries during the evacuation.

Shortly after takeoff, flight attendants No. 1 and No. 2, who were seated on the forward jumpseat, both smelled smoke. Flight attendant No. 1 went to the cockpit, where she saw smoke “everywhere” and noticed that the crew had donned their oxygen masks. The captain told her that they were returning to Greensboro. She closed the cockpit door and returned to the cabin. She and flight attendant No. 2 resealed themselves in empty seats in business class because of the rapidly accumulating smoke in the galley area around their jumpseats.

Flight attendant No. 1 reported that the smoke became so dense she could no longer see the forward galley. However, neither flight attendant made any effort to locate the source of the smoke or to use any of the firefighting equipment available to them. Flight attendant No. 1 saw a large amount of electrical “arcing and sparking” and heard “popping noises” at the front of the cabin. She told investigators that she “debated whether to use the Halon” fire extinguisher but was unsure where to aim it. She decided not to use the Halon fire extinguisher because she “did not see a fire to fight.” As discussed later in this letter, AirTran’s flight attendant training program does not include any drill involving hidden fires but does include a drill that uses a

³ As a result of this incident, on February 6, 2001, the Safety Board issued to the FAA three recommendations (A-01-003, A-01-004, and A-01-005) regarding the inspection and design of static port heaters and the possible replacement of existing insulation blankets with an alternate that would be less likely to propagate a fire. The FAA response is currently under Safety Board review.

⁴ The description for this accident, DCA00MA079, can be found on the Safety Board’s Web site at <<http://www.nts.gov>>.

visible, open flame. An off-duty AirTran pilot seated in first class considered using a Halon fire extinguisher but decided against it because he was concerned that the Halon “would take away more oxygen.”

The Safety Board investigation of this accident is ongoing, but preliminary findings indicate that the smoke in the forward cabin was caused by electrical arcing in the bulkhead behind the captain’s seat. The arcing ignited interior panels, which continued burning after the airplane landed and the passengers were evacuated. The fire was eventually extinguished by airport rescue and firefighting personnel.

American Airlines Flight 1683

On November 29, 2000, about 1753 eastern standard time, a McDonnell Douglas DC-9-82 (MD-80), N3507A, operated by American Airlines as flight 1683, was struck by lightning and experienced an in-flight fire that began shortly after takeoff from Reagan National Airport in Washington, D.C.⁵ The flight crew performed an emergency landing and ordered a passenger evacuation at Dulles International Airport. The airplane sustained minor damage. None of the 2 pilots, 3 flight attendants, or 61 passengers were injured.

After takeoff, the three flight attendants saw a flash of light and heard a boom on the right side of the airplane. Flight attendant No. 1, who was seated on the forward jumpseat, saw white smoke coming from a fluorescent light fixture in the forward entry area. She shut the light off and called the cockpit. The captain told her to “pull the breaker” for the fluorescent light. She pulled the circuit breaker, and smoke stopped coming out of the fixture.

When flight attendant No. 1 went aft to check on the passengers, she observed “dark, dense, black” smoke coming from the ceiling panels above rows 7 and 8. She went to the cockpit and notified the flight crew while the other two flight attendants retrieved Halon fire extinguishers and brought them to the area near rows 7 and 8. The smoke detectors in the aft lavatories sounded. The smoke worsened in the midcabin area, and a ceiling panel above row 9 began to blister and turn yellow.

A flight attendant began discharging a Halon extinguisher toward the blistered ceiling panel. Flight attendant No. 1 asked the passengers if anyone had a knife that could be used to cut the ceiling panel. A passenger produced a knife and cut a circular hole in the blistered area of the ceiling panel. Flight attendant No. 1 then fully discharged a Halon fire extinguisher into the hole, assessed the results, and found that the smoke appeared to be diminishing. Before taking her seat for the emergency landing, another flight attendant gave the passenger in seat 9E a Halon fire extinguisher, instructed him on its use, and told him to “use it if it was needed.” However, the smoke did not recur.

⁵ The description for this accident, IAD01IA017, can be found on the Safety Board’s Web site at <<http://www.nts.gov>>.

The Safety Board investigation of this incident is ongoing, but preliminary findings indicate that a lightning strike caused arcing in the airplane wiring above the cabin ceiling panels, which ignited adjacent materials.

1983 In-Flight Fire on Air Canada Flight 797

On June 2, 1983, about 1920 eastern daylight time, a McDonnell Douglas DC-9, C-FTLU, operated by Air Canada as flight 797, experienced an in-flight fire and made an emergency landing at the Greater Cincinnati International Airport (since renamed Cincinnati and Northern Kentucky International Airport) in Covington, Kentucky.⁶ The fire was initially detected when a passenger noticed a strange smell and a flight attendant saw smoke in one of the lavatories. Another flight attendant saw that the smoke was coming from the seams between the walls and ceiling in the lavatory. Although neither flight attendant saw any flames, the second flight attendant discharged a CO₂ fire extinguisher into the lavatory, aiming at the paneling and seams and at the trash bin. He then closed the door. When the first officer came back to assess the situation, he found that the lavatory door was hot, and he instructed the flight attendants not to open it. The first officer then informed the captain that they “better go down,” and an emergency descent was initiated.

During the descent, the smoke increased and moved forward in the cabin. After the airplane landed, flight attendants initiated an emergency evacuation. Of the 41 passengers and 5 crewmembers on board, 23 passengers were unable to evacuate and died in the fire. The airplane was destroyed.

In its final report, the Safety Board determined that the flight attendant’s discharge of fire extinguishing agent into the lavatory “had little or no effect on the fire,” noting that “[i]n order for the extinguishing agent to be effective, it must be applied to the base of the flames.” The Board determined that the probable cause of the accident was “a fire of undetermined origin, an underestimate of fire severity, and conflicting fire progress information provided to the captain. Contributing to the severity of the accident was the flight crew’s delayed decision to institute an emergency descent.”⁷

As a result of the Air Canada accident, the Safety Board issued several recommendations to the Federal Aviation Administration (FAA), including Safety Recommendation A-83-70, which asked the FAA to expedite actions to require smoke detectors in lavatories; Safety Recommendation A-83-71, which asked the FAA to require the installation of automatic fire extinguishers adjacent to and in lavatory waste receptacles; and Safety Recommendation A-83-72, which asked the FAA to require that the hand-operated fire extinguishers carried aboard transport category airplanes use a technologically advanced agent, such as Halon. Recommendations A-83-70 and -72 were classified “Closed – Acceptable Action” and A-83-71

⁶ The description for this accident, DCA83AA028, can be found on the Safety Board’s Web site at <<http://www.nts.gov>>.

⁷ National Transportation Safety Board, *Air Canada Flight 797, McDonnell Douglas DC-9-32, C-FTLU, Greater Cincinnati International Airport, Covington, Kentucky, June 2, 1983*, Aircraft Accident Report NTSB/AAR-84/09 (Washington, D.C.: NTSB, 1984).

was classified “Closed – Acceptable Alternate Action” on January 15, 1986, after the FAA completed rulemaking to require that all airplanes operated under 14 *Code of Federal Regulations* (CFR) Part 121 be equipped as follows: each lavatory and galley has a smoke or fire detector system that provides a warning light in the cockpit or an audio warning in the passenger cabin that would be readily detected by the flight attendant; each lavatory trash receptacle is equipped with a fire extinguisher that discharges automatically if a fire occurs in the receptacle; and, of the required hand-held fire extinguishers installed in the airplane, at least two contain Halon 1211 or equivalent as the extinguishing agent.

In its final report on the Air Canada accident, the Safety Board also issued Safety Recommendation A-84-76, which recommended that the FAA:

Require that air carrier principal operations inspectors [POIs] review the training programs of their respective carriers and if necessary specify that they be amended to emphasize requirements: for flight crews to take immediate and aggressive action to determine the source and severity of any reported cabin fire and to begin an emergency descent for landing or ditching if the source and severity of the fire are not positively and quickly determined or if immediate extinction is not assured; for flight attendants to recognize the urgency of informing flight crews of the location, source, and severity of fire or smoke within the cabin; for both flight crews and flight attendants to be knowledgeable of the proper methods of aggressively attacking a cabin fire by including hands-on-training in the donning of protective breathing equipment, the use of the fire ax to gain access to the source of the fire through interior panels which can be penetrated without risk to essential aircraft components, and the discharge of an appropriate hand fire extinguisher on an actual fire.

In its November 2, 1984, response to the Safety Board, the FAA explained that 14 CFR 121.417 required crewmembers to be trained for fire emergencies and further required them to perform emergency drills and “actually operate the emergency equipment during initial and recurrent training for each type aircraft in which the crewmember is to serve.” The FAA concluded that the regulations were adequate, stating that “the safety record of U.S. carriers is a testimony to the adequacy of the current regulations.” In its April 12, 1985, letter, the Board disagreed, stating that “current firefighting training is directed primarily toward ‘exposed’ fires which are relatively easy to control. This does not prepare crews to assess effectively the hazard of or to fight hidden fires.” The Board also reiterated its belief that crew training programs should emphasize that if the source of a fire cannot be immediately identified or cannot be extinguished immediately, the aircraft should be landed immediately. In its March 7, 1986, letter, the FAA responded that “due to requirements of 14 CFR 121.417, the various Air Carrier Operations Bulletins (ACOBs), and the guidance in the Air Carrier Operations Inspector’s Handbook,”⁸ further action by the FAA was unwarranted. The Safety Board disagreed and on May 12, 1986, classified Safety Recommendation A-84-76 “Closed – Unacceptable Action,” stating that, “[a]lthough we have closed this recommendation, our concern for the safety issue

⁸ See FAA Order 8430.6, *Air Carrier Operations Inspector’s Handbook*.

involved has not diminished and we will continue to voice our concern in future accident investigations.”

The Safety Board recognizes that the FAA’s response to the Air Canada recommendations resulted in some changes that improved aircraft fire safety; in particular, requirements for smoke detectors and Halon-type fire extinguishers have provided crewmembers with better methods of locating and suppressing fires. However, the recent in-flight fires cited in this letter renew the Safety Board’s interest in this issue and its concern that the FAA has not issued additional advisory material emphasizing the importance of training crewmembers to recognize, locate, and fight hidden fires on airplanes.

Safety Issues

Training

Title 14 CFR 121.417 requires that crewmembers receive training on firefighting equipment and procedures for fighting in-flight fires. The regulation specifies that airlines must provide individual instruction on, among other things, the location, function, and operation of portable fire extinguishers, with emphasis on the type of extinguisher to be used for different classes of fires and instruction on handling emergency situations, including fires that occur in flight or on the ground. As part of their initial training, each crewmember must accomplish a one-time emergency drill while fighting an actual fire⁹ using the type of fire extinguisher that is appropriate for the type of fire being demonstrated in the drill.

Although 14 CFR 121.417 also requires crewmembers to perform certain drills biannually during recurrent training, including one that demonstrates their ability to operate each type of hand-operated fire extinguisher found on their airplanes, the regulation does not require recurrent training in fighting an actual or simulated fire. As a result, crewmembers are required to fight an actual or simulated fire during initial training only.

Further, although the emergency training requirements specified in 14 CFR 121.417 require instruction in fighting in-flight fires, they do not explicitly require that crewmembers be trained to identify the location of a hidden fire or to know how to gain access to the area behind interior panels. The Safety Board has evaluated the firefighting training programs of several air carriers and found that the actual “fire” crewmembers fight during initial training is typically an open flame that requires little effort to extinguish and that does not demonstrate the problems inherent in fighting a hidden fire on an airplane. AirTran’s initial training program for flight attendants, for example, includes a firefighting drill in which students are required to extinguish an actual fire consisting of a visible, open flame. The accident and incident descriptions in this letter demonstrate that in-flight fires on commercial airplanes can present themselves not as visible, localized flames, but in less obvious ways, such as smoke or heat from hidden locations. Crewmembers must be trained to quickly identify the location of the fire, which may require

⁹ Title 14 CFR 121.417 provides a definition of an actual fire: “An *actual fire* means an ignited combustible material, in controlled conditions, of sufficient magnitude and duration to accomplish the training objectives.”

removing interior panels or otherwise accessing the areas behind the panels before they can use fire extinguishers effectively.

The results of a series of experiments conducted by the FAA Technical Center¹⁰ to evaluate the ability of flight attendants to extinguish cargo fires in small Class B cargo compartments also demonstrate that the FAA's current training requirements are inadequate. Technical Center staff conducted 13 tests in which trained crewmembers attempted to extinguish cargo fires located in a cabin-level compartment using firefighting equipment identical to the types on which they had been trained. The report noted that, although the fires could have been extinguished using proper techniques, in most cases the crewmembers did not act quickly or aggressively enough to successfully extinguish the fires. The report concludes that "improved and more realistic training procedures would better prepare flight attendants to more effectively fight in-flight fires."

The Safety Board is concerned that as a result of limited training, crewmembers may fail to take immediate and aggressive action in locating and fighting in-flight fires, as demonstrated in the events cited in this letter. In the Delta flight 2030 incident, the flight attendant asked for the captain's permission before discharging a fire extinguisher. This delayed an immediate firefighting response. Further, if the captain's order not to use the fire extinguisher had been carried out, the fire would likely have progressed and could have resulted in death or serious injury, as well as possible loss of the airplane. In the AirTran flight 913 accident, flight attendants made no effort to locate the source of the smoke or to use any of the firefighting equipment available to them. In the American flight 1683 incident, a flight attendant, working with a passenger, successfully extinguished the fire by cutting a hole in the overhead panel and applying extinguishing agent. Although this action was successful, the Board notes that the flight attendant took the action on her own initiative, not because she was trained to do so. In the Air Canada accident, flight attendants did not apply extinguishing agent directly to the flames, either because they had not been trained to do so or because they could not access the area behind the interior panels.

The Safety Board concludes that current training programs still do not adequately prepare crewmembers to fight the type of hidden in-flight fires likely to occur on airplanes. Therefore, the Board believes that the FAA should issue an advisory circular (AC) that describes the need for crewmembers to take immediate and aggressive action in response to signs of an in-flight fire. The AC should stress that fires often are hidden behind interior panels and therefore may require a crewmember to remove or otherwise gain access to the area behind interior panels in order to effectively apply extinguishing agents to the source of the fire. Further, the Board believes that the FAA should require POIs to ensure that the contents of the AC are incorporated into crewmember training programs. Finally, the Board believes that the FAA should amend 14 CFR 121.417 to require participation in firefighting drills that involve actual or simulated fires during crewmember recurrent training and to require that those drills include realistic scenarios on recognizing potential signs of, locating, and fighting hidden fires.

¹⁰ See U.S. Department of Transportation, Federal Aviation Administration, *Effectiveness of Flight Attendants Attempting to Extinguish Fires in an Accessible Cargo Compartment*, DOT/FAA/AR-TN99/29 (April 1999).

Access to Areas Behind Interior Panels

The Safety Board is also concerned that the interior panels of airplanes are not designed so that crewmembers are able to easily and quickly locate and extinguish hidden in-flight fires. The Board addressed this problem in 1983 after the Air Canada accident, in which one flight attendant discharged a CO₂ extinguisher into the lavatory, aiming at the seams between the walls and the ceiling where smoke had been observed. The Board found that this action had little effect on the fire because the extinguishing agent was not applied to the source of the fire. In the American incident, the flight attendant did access the area behind the ceiling panel, but the method used (that is, having a passenger cut a hole in the ceiling) risked damage to electrical wiring and other cables that may have been covered by the paneling. In addition, although the flight attendant's action successfully extinguished the fire, access to the area behind the panel should not have been dependent on the actions of a passenger, either to provide a sharp instrument for cutting or to cut the hole itself.

Therefore, the Safety Board believes that the FAA should develop and require implementation of procedures or airplane modifications that will provide the most effective means for crewmembers to gain access to areas behind interior panels for the purpose of applying extinguishing agent to hidden fires. As part of this effort, the FAA should evaluate the feasibility of equipping interior panels of new and existing airplanes with ports, access panels, or some other means to apply extinguishing agent behind interior panels.

Properties of Halon and the Merits of Halon Extinguishers in Fighting In-Flight Fires

The Safety Board is concerned that, in two of the occurrences described in this letter, crewmembers hesitated to use Halon extinguishers. In the Delta incident, the captain specifically ordered a flight attendant not to use the Halon extinguisher because he was concerned about Halon being sprayed in the cabin. In the AirTran accident, an off-duty crewmember chose not to use the Halon extinguisher because of his concern that it "would take away more oxygen" from the cabin.

FAA AC 20-42C, *Hand Fire Extinguishers for Use in Aircraft*, states that Halon-type extinguishers are three times as effective as CO₂ extinguishers with the same weight of extinguishing agent, have a gaseous discharge and therefore a more limited throw range, leave no chemical residue to contaminate or corrode aircraft parts or surfaces, have fewer adverse effects on electronic equipment, and do not degrade visual acuity. However, AC 20-42C also states the following:

Tests indicate that human exposure to high levels of Halon vapors may result in dizziness, impaired coordination, and reduced mental sharpness. . . . Exposure to undecomposed halogenated agents may produce varied central nervous system effects depending upon exposure concentration and time. Halogenated agents will also decompose into more toxic products when subjected to flame or hot surfaces

at approximately 900° F (482° C). However, unnecessary exposure of personnel to either the natural agent or to the decomposition products should be avoided.

The AC also specifies maximum concentration levels for Halon agents under various conditions that should not be exceeded in ventilated and non-ventilated passenger compartments on aircraft. It appears that air carrier training programs may not be placing enough emphasis on the importance of using Halon extinguishers to fight in-flight fires and may not make it clear that the maximum allowable levels of Halon vapors cannot be achieved by discharging a single hand-held extinguisher in a transport-sized cabin.

Although the AC also states, “generally, the decomposition products from the fire itself, especially carbon monoxide, smoke, heat, and oxygen depletion, create a greater hazard than the thermal decomposition products from Halon,” the Safety Board is concerned that the potential hazards posed by Halon gas are over-emphasized in the AC, especially when compared to the potentially devastating effects of an in-flight fire. Indeed, the statement quoted above is buried in the paragraph warning against exposure to Halon gas.

The Safety Board therefore believes that the FAA should issue a flight standards handbook bulletin to POIs to ensure that air carrier training programs explain the properties of Halon and emphasize that the potential harmful effects on passengers and crew are negligible compared to the safety benefits achieved by fighting in-flight fires aggressively.

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

Issue an advisory circular (AC) that describes the need for crewmembers to take immediate and aggressive action in response to signs of an in-flight fire. The AC should stress that fires often are hidden behind interior panels and therefore may require a crewmember to remove or otherwise gain access to the area behind interior panels in order to effectively apply extinguishing agents to the source of the fire. (A-01-83)

Require principal operations inspectors to ensure that the contents of the advisory circular (recommended in A-01-83) are incorporated into crewmember training programs. (A-01-84)

Amend 14 *Code of Federal Regulations* 121.417 to require participation in firefighting drills that involve actual or simulated fires during crewmember recurrent training and to require that those drills include realistic scenarios on recognizing potential signs of, locating, and fighting hidden fires. (A-01-85)

Develop and require implementation of procedures or airplane modifications that will provide the most effective means for crewmembers to gain access to areas behind interior panels for the purpose of applying extinguishing agent to hidden fires. As part of this effort, the FAA should evaluate the feasibility of equipping

interior panels of new and existing airplanes with ports, access panels, or some other means to apply extinguishing agent behind interior panels. (A-01-86)

Issue a flight standards handbook bulletin to principal operations inspectors to ensure that air carrier training programs explain the properties of Halon and emphasize that the potential harmful effects on passengers and crew are negligible compared to the safety benefits achieved by fighting in-flight fires aggressively. (A-01-87)

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred with these recommendations.

By: Marion C. Blakey
Chairman