



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 12, 2011

In reply refer to: A-11-79 through -81

The Honorable J. Randolph Babbitt
Administrator
Federal Aviation Administration
Washington, DC 20591

On May 16, 2010, about 2117 eastern standard time, the flight crew of United Airlines flight 27, a Boeing 757-200, N510UA, declared an emergency because of a fire at the windshield heat terminal connection in the cockpit. En route from John F. Kennedy International Airport, Queens, New York, to Los Angeles International Airport, Los Angeles, California, the flight crew diverted to Washington Dulles International Airport, Chantilly, Virginia, and landed without further incident. No evacuation was conducted, and none of the 7 crewmembers or 105 passengers sustained injuries. The scheduled, domestic passenger flight was being conducted under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 on an instrument flight rules flight plan. Night visual meteorological conditions prevailed at the time of the incident.

In addition to the factors that led to the fire,¹ the National Transportation Safety Board's (NTSB) investigation of this incident revealed a safety issue concerning 14 CFR Part 121 flight crews' ability to readily access fire extinguishing equipment while wearing the oxygen masks and goggles that they are instructed to don at the first indication of smoke, fire, or fumes. During postincident interviews, the flight crewmembers of flight 27 indicated that they immediately donned oxygen masks and smoke goggles in accordance with the United Airlines Boeing 757 Smoke, Fire or Fumes checklist.² The captain stated that the smoke quickly rose to the ceiling

¹ The National Transportation Safety Board (NTSB) determined that the probable cause of this incident was "the ignition of the J5 power terminal located on the captain's No. 1 windshield due to a loose electrical connection between the terminal connector lug and its respective terminal block. The loose connection resulted from a missing lock washer that allowed the resistance in the electrical path to increase sufficiently to generate high enough temperatures to ignite the terminal block. Contributing to the probable cause was the lack of instructions to ensure the lock washer was installed in the J5 power terminal block in the Boeing 757 aircraft maintenance manual (AMM). Additionally, contributing to the incident was the deferral of the related maintenance write-up before the incident, which resulted from information in the United Airlines AMM that stated, 'When bus bar(s) show signs of blackening or burning, the condition is acceptable for continued service, although the window must be replaced within 50 flight-hours.'" Additional information about this incident, NTSB case number ENG10IA029, is available at <<http://www.nts.gov/aviationquery/index.aspx>>.

² Items 2 and 3 of the checklist state "don oxygen masks, as needed" and "don smoke goggles, as needed." Item 1 of the checklist states, "diversion may be needed."

and dissipated but that an acrid odor was in the cockpit and his eyes began to burn before he donned his oxygen mask and smoke goggles.

The captain reported that he left his seat because the flames were in front of him and he needed to immediately reach the fire extinguisher, located on the back wall of the cockpit next to the jumpseat.³ The captain stated that, as he moved toward the fire extinguisher, his oxygen mask and smoke goggles were “torn off” because he had reached the end of the hose attached to the oxygen mask. He removed the fire extinguisher, put the mask and goggles back on, and discharged the extinguisher until it was empty. The captain reported that the fire was suppressed but reignited within seconds and that, as he moved toward the cockpit door to retrieve a second extinguisher from the cabin crew, his mask and goggles came off again. He retrieved the extinguisher, put his mask and goggles back on, and discharged the extinguisher, fully extinguishing the fire.

The NTSB is concerned that the length of the hose attached to the captain’s oxygen mask was insufficient to allow him access to needed emergency equipment located in the cockpit without having the mask inadvertently removed from his face. As a result, the captain was needlessly exposed to smoke and fumes. The length of the oxygen mask hose also limited the captain’s access to additional equipment provided by the cabin crew, which was needed to fully extinguish the fire.

This issue had been previously identified in a letter dated June 12, 2007, to the Federal Aviation Administration (FAA) from the Air Line Pilots Association, International (ALPA), which stated:

It is our understanding that the Delta POI [principal operations inspector] contacted the Seattle Aircraft Certification Office in August 2006 and recommended an extension of the crew oxygen mask supply hose length or a relocation of the flight deck fire extinguisher to allow each flight crewmember the ability to reach an extinguisher without removing their oxygen masks. ...ALPA strongly agrees with the POI’s safety recommendation and appreciates his efforts to address the issue.

ALPA’s letter also indicated that the Seattle Aircraft Certification Office’s response to the recommendation was that flight crew oxygen masks are meant to be used in the event of decompression rather than while fighting an in-flight fire. In an undated response to ALPA, the FAA reiterated this position, stating that the “stationary flight crew oxygen system is not intended for use when manually combating fires” and that the “portable PBE [protective breathing equipment⁴]...is the recommended breathing apparatus to be used when manually combating a fire.” The FAA’s response is in line with 14 CFR 121.337, “Protective Breathing Equipment,” which states, in part, the following:

³ Hand fire extinguishers are located on the rear wall of the cockpit or in a storage compartment in most transport-category airplanes. A hand fire extinguisher is mounted on the rear cockpit wall in all United Airlines 757s.

⁴ Smoke hoods or portable oxygen bottles equipped with masks are the most common portable PBE used by Part 121 flight crews.

Fire Combating. Except for nontransport-category airplanes type certificated after December 31, 1964, protective breathing equipment with a portable breathing gas supply meeting the requirements⁵ of this section must be easily accessible and conveniently located for immediate use by crewmembers in combating fires.

The NTSB clearly recognizes that portable PBE is necessary equipment in combating an in-flight cabin fire but, as discussed below, believes that it may be of limited use while fighting an in-flight cockpit fire when oxygen masks are available and likely already donned, in accordance with operator and FAA guidance. The regulation, however, does not make a distinction between a cockpit or cabin fire. Although related guidance to flight crews—Advisory Circular (AC) 120-80, “In-Flight Fires”—does differentiate cockpit and cabin fires, it almost exclusively addresses flight crew actions in the event of an in-flight cabin fire.⁶ In reference to a fire in the cockpit, the AC states only that “pilots should notify the flight attendant(s) to prepare the cabin occupants for an emergency landing and evacuation in accordance with company procedures and, if appropriate, assist in fighting the fire.”

In the absence of clear guidance about what kind of breathing apparatus to don when combating an in-flight cockpit fire, Part 121 flight crews are very likely going to adhere to the FAA-approved emergency checklist for smoke, fire, or fumes, resulting in the immediate donning of oxygen masks and goggles and their continued use as the pilots attempt to extinguish the fire. With this likelihood in mind, the NTSB concludes that flight crews’ removing oxygen masks and goggles to don portable PBE to combat cockpit fires, as suggested by the FAA regardless of a fire’s location, could needlessly expose pilots to hazardous smoke and fumes. Although it could be argued that oxygen masks are to be used for the purposes of decompression events only, smoke goggles are part of the full face oxygen mask system, indicating that masks are to be used for smoke events, as well.

As noted, portable PBE has some characteristics that may limit its usefulness while fighting an in-flight cockpit fire, such as its required 15-minute oxygen supply; though subject to the same 15-minute requirement, the oxygen supply for full face masks is typically greater, and the system has a mechanism to extend the supply if needed.⁷ In addition, federal regulations require that donning portable PBE can be accomplished within 11 seconds versus 5 seconds for a flight crew oxygen mask—a difference that significantly increases the time that a crewmember could be exposed to smoke or fumes. A portable PBE must also supply oxygen to flight crewmembers at a pressure altitude of only 8,000 feet or less, as required in section 121.337. This limitation is problematic in the event of an in-flight fire on a cargo aircraft because, in some situations, emergency procedures instruct flight crews to bring the airplane cabin altitude to

⁵ Section 121.337 requires that “protective breathing gas duration and supply system equipment...must supply breathing gas for 15 minutes at a pressure altitude of 8,000 feet for...[c]rewmembers while combating an in-flight fire.”

⁶ The AC states that in the event of a cabin fire, “flight crewmembers must don smoke goggles and oxygen masks at the first indication of smoke or fumes and before accomplishing any abnormal or emergency procedures” and that if they have to leave the cockpit to assist in fighting a cabin fire, “the FAA recommends ...[donning] a PBE before leaving the flight deck.”

⁷ Most oxygen mask systems on transport-category airplanes are equipped with tanks that provide more than the required 15-minute supply of oxygen. If just a 15-minute supply were available, the oxygen supply can be extended by switching the mask to “normal” mode, which provides a mix of ambient air and oxygen.

25,000 feet, rendering the use of a portable PBE unfeasible. Cargo flight crewmembers' only option in this case is to use the oxygen mask system. Finally, portable PBE hinders communication between flight crewmembers because it is not connected to any cockpit communications equipment. Although a flight crewmember could use the interphone to talk to another crewmember while wearing portable PBE, doing so is an extra step in a time-sensitive situation.

The NTSB has conducted or participated in the investigation of several similar events of smoke or fire at the windshield heat terminal connection in Boeing airplane models since 2004 and is aware of many more events.⁸ Although Boeing and the FAA have taken corrective action concerning smoke or fire in this location,^{9,10} all susceptible aircraft have yet to be inspected or their windshields replaced. Therefore, other Part 121 flight crews could face a similar event and the same difficulties as the captain of flight 27 when trying to access firefighting equipment while wearing an oxygen mask and goggles, possibly leading to hazardous exposure to smoke and fumes. Because Part 121 flight crews are likely to continue wearing oxygen masks, once donned, to combat a fire in the cockpit, the NTSB concludes that the oxygen mask hose should be of sufficient length to allow flight crews access to emergency equipment located in the cockpit or provided by cabin crew without inadvertent removal of their oxygen masks. Therefore, the NTSB recommends that the FAA require that the length of oxygen mask hoses in the cockpits of airplanes used in Part 121 operations be increased, as necessary, to allow flight crews access to all required emergency equipment in the cockpit, as well as to additional emergency equipment provided by the cabin crew via the cockpit door, while oxygen masks are donned. The NTSB also recommends that the FAA amend AC 120-80 to provide clear guidance to flight crews concerning the type of breathing equipment to wear when combating a cockpit fire, taking into consideration the limitations of portable PBE in both passenger and cargo operations.

Title 14 CFR 121.309, "Emergency Equipment," contains regulations concerning the condition and accessibility of emergency equipment to crews and passengers. Section 121.309(b)(2) states in part that "each item of emergency and flotation equipment listed

⁸ In June 2010, Boeing informed the NTSB that, from January 2001 through May 2010, it had received 35 reports of smoke or flame events associated with the windshield heat terminal connections on Boeing 747, 757, 767, and 777 airplanes. In some cases, the initiating cause of the event was determined to be related to a cross-threaded screw at the J5 terminal block. In other cases, the initiating cause was undetermined.

⁹ Boeing Service Bulletins (SB) 757-30-0019, revision 2, dated April 19, 2010, and 757-30-0020, revision 2, dated March 31, 2010, provide for initial and repetitive inspections of the terminal blocks or, alternately, replacement of the windshield and shipside wire to use pin-socket type power connections on all 757 airplanes. At the time of the May 2010 incident, United Airlines had not performed the actions specified in SB 757-30-0019 on the incident airplane nor was it required to do so.

¹⁰ In response to NTSB Safety Recommendation A-07-50, which asked the FAA to issue an airworthiness directive (AD) to replace the windshield heat terminal blocks on all Boeing 747, 757, 767, and 777 airplanes in accordance with their respective Boeing SBs, the FAA issued AD 2010-15-01 on July 13, 2010. The AD mandates repetitive inspections for damage (including arcing, loose terminal, or heat damage) of the J5 terminal at the No. 1 left and right cockpit windows and corrective actions if necessary for certain model Boeing 757, 767, and 777 series airplanes. The AD also allows for replacing the No. 1 cockpit window with a new and improved cockpit window equipped with different electrical connections, which terminates the repetitive inspections for that cockpit window. The FAA is currently working on an AD to mandate inspections at the No. 1 left and right cockpit windows for Boeing 747 series airplanes. Safety Recommendation A-07-50 is classified "Open—Acceptable Response."

in this section...must be readily accessible to the crew...” and, for the cockpit, section 121.309(c)(4) states that “at least one hand fire extinguisher must be conveniently located on the flight deck [cockpit] for use by the flight crew.” Regarding the legal interpretation of the phrases “readily accessible” and “conveniently located,” the FAA stated the following in a memorandum dated November 12, 2008:

The flight crew compartment on the aircraft must contain at least one fire extinguisher. That fire extinguisher must be reachable by at least one flight crew member from that crew member’s seated position at all times, to include those instances when flight crew members have donned oxygen masks.

In response to the NTSB’s request for clarification of the preceding interpretation, the FAA provided a memorandum dated March 30, 2011, stating that:

The use of ‘conveniently located’ in § 121.309(c)(4)...does not expressly require an ability to reach a fire extinguisher from a pilot’s seat. It is reasonable to conclude that the regulation was drafted to allow for differing cockpit designs in locating fire extinguishers on the flight deck.

The memo concludes that, “as long as the hand fire extinguisher is located on the flight deck and clearly marked with unobstructed access for retrieval by the flight crewmembers, it would meet the requirements of § 121.309.”

Several related ACs reflect the FAA’s most recent interpretation of section 121.309. AC 25-22, “Certification of Transport Airplane Mechanical Systems,” section 25.851(a)(2) states, “at least one hand fire extinguisher must be conveniently located in the pilot compartment.” The same statement appears in AC 25-17A, “Transport Airplane Cabin Interiors Crashworthiness Handbook,” Amendment 25-74 (effective May 16, 1991). AC 20-42D, “Hand Fire Extinguishers for Use in Aircraft,” chapter 5, section 2(a) states, “each hand fire extinguisher should be conveniently located, readily accessible, and its location obvious.”

As the FAA’s differing interpretations of section 121.309 suggest, the terms “conveniently located” and “readily accessible” can be construed in many ways. Based on the circumstances of the flight 27 event, the NTSB believes that the salient portion of the FAA’s 2008 interpretation is the focus on flight crews’ ease of access to fire extinguishers while oxygen masks are donned. To make sure that Part 121 flight crews can reach fire extinguishers in the cockpit while wearing oxygen masks, regardless of the length of the hose, the NTSB concludes that ACs 20-42D, 25-22, and 25-17A should be amended to clearly state this intent. Therefore, the NTSB recommends that the FAA amend ACs 20-42D, 25-17A, and 25-22 to indicate that hand fire extinguishers in the cockpit must be reachable by at least one flight crewmember while wearing an oxygen mask.

Therefore, the National Transportation Safety Board makes the following recommendations to the Federal Aviation Administration:

Require that the length of oxygen mask hoses in the cockpits of airplanes used in 14 *Code of Federal Regulations* Part 121 operations be increased, as necessary, to allow flight crews access to all required emergency equipment in the cockpit, as

well as to additional emergency equipment provided by the cabin crew via the cockpit door, while oxygen masks are donned. (A-11-79)

Amend Advisory Circular 120-80, "In-Flight Fires," to provide clear guidance to flight crews concerning the type of breathing equipment to wear when combating a cockpit fire, taking into consideration the limitations of portable protective breathing equipment in both passenger and cargo operations. (A-11-80)

Amend Advisory Circulars 20-42D, "Hand Fire Extinguishers for Use in Aircraft"; 25-17A, "Transport Airplane Cabin Interiors Crashworthiness Handbook"; and 25-22, "Certification of Transport Airplane Mechanical Systems" to indicate that hand fire extinguishers in the cockpit must be reachable by at least one flight crewmember while wearing an oxygen mask. (A-11-81)

In response to the recommendations in this letter, please refer to Safety Recommendations A-11-79 through -81. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our secure mailbox. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Chairman HERSMAN, Vice Chairman HART, and Members SUMWALT, ROSEKIND, and WEENER concurred in these recommendations.

[Original Signed]

By: Deborah A.P. Hersman
Chairman