



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 20, 2011

In reply refer to: A-11-87 through -91

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

On September 3, 2010, about 1941 local time (1541 coordinated universal time), United Parcel Service (UPS) flight 6 (UPS6), a Boeing 747-400F,¹ N571UP, crashed inside an Emirati army post about 9 miles from Dubai International Airport (DXB), Dubai, United Arab Emirates (UAE). The flight crew encountered a “Fire Main Deck” master warning about 22 minutes into the flight at a cruise altitude of 32,000 feet, declared an emergency, and initiated a return to DXB.² The two flight crewmembers were fatally injured; there were no ground injuries. The airplane was destroyed by impact and postcrash fire. The airplane was registered to and operated by UPS under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 as a cargo flight. Visual meteorological conditions prevailed for the flight, which operated on an instrument flight rules flight plan. The flight had departed DXB about 45 minutes earlier en route to Cologne, Germany.

The UAE General Civil Aviation Authority is investigating this accident with the assistance of an accredited representative from the National Transportation Safety Board (NTSB) under the provisions of Annex 13 to the International Convention on Civil Aviation.³ Although the accident investigation is ongoing, preliminary findings have revealed safety issues related to the training for and use of oxygen masks; communicating with oxygen masks donned; and oxygen mask stowage and the smoke, fire, or fumes checklists.

¹ The 747-400F is a 747-400 freighter.

² This information was taken from the April 3, 2011, UAE General Civil Aviation Authority (GCAA) Air Accident Preliminary Report, Boeing 747-400F/N571UP, GCAA Accident Report No. 13/2010, which can be found online at <<http://www.gcaa.gov.ae/en/ePublication/admin/iradmin/Lists/Incidents%20Investigation%20Reports/Attachments/16/2010-GCAA%20Accident%20Preliminary%20Report%20B747%20DXB%20.pdf>> (accessed May 4, 2011).

³ Technical advisors to the U.S. accredited representative included the Federal Aviation Administration (FAA), Boeing Aircraft, UPS, and the Independent Pilots Association.

Oxygen Mask Operation

The oxygen mask/goggle sets available to the UPS6 flight crewmembers included diluter-demand oxygen masks⁴ with mask-mounted regulators (see figure 1). This type of mask, which is common for air carrier operations with pressurized cabins, has two selectable regulator switches. The first is the normal/100% oxygen switch, which allows selection of diluted oxygen with ambient air (depending upon cabin pressure altitude) when set to normal or 100% oxygen regardless of cabin altitude. The second is the normal/emergency flow switch, which allows selection of normal flow rate into the mask upon demand and emergency flow rate that provides constant pressurized air flow. Separate goggles were provided for smoke and fire conditions requiring eye protection. Donning an oxygen mask/goggle set involves removing the mask from the stowage container, inflating the harness, installing the harness on the head, adjusting the mask as required, removing the smoke goggles from their container, and securing the goggles over the head and on top of the oxygen mask.

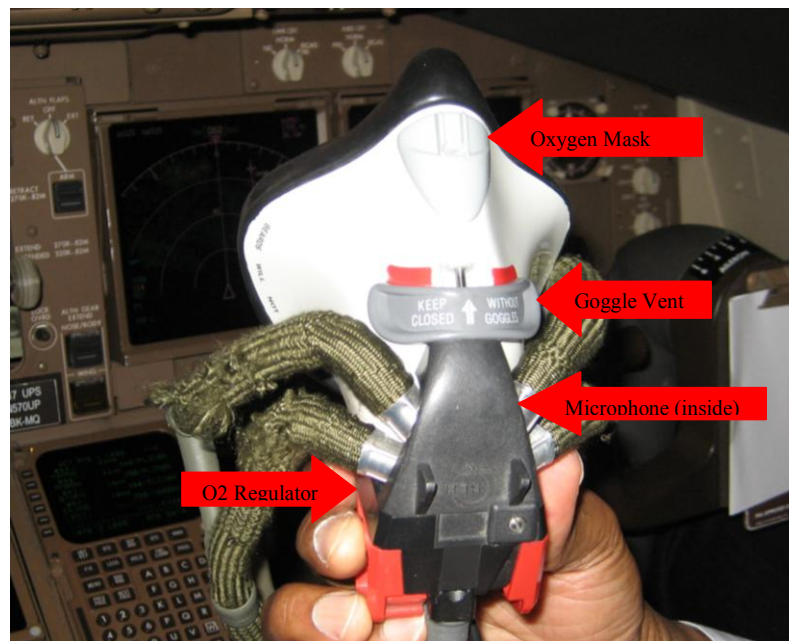


Figure 1. Flight crew oxygen mask.

Flight crewmember oxygen masks such as those on UPS6 have two purposes. First, during a cabin depressurization event, the mask provides supplemental oxygen to protect pilots from the effects of hypoxia.⁵ The second purpose of the mask is to provide protective breathing

⁴ Diluter-demand oxygen masks supply oxygen only when the user inhales through the mask.

⁵ According to the FAA's *Pilot's Handbook of Aeronautical Knowledge*, FAA-H-8083-25A, Chapter 16, "Aeromedical Factors," hypoxia means "reduced oxygen," or "not enough oxygen." Although any tissue will die if deprived of oxygen for a period of time, the brain is particularly vulnerable to oxygen deprivation; any reduction in mental function while flying can result in life-threatening errors. Symptoms of hypoxia commonly include headache, decreased reaction time, impaired judgment, euphoria, visual impairment, and drowsiness.

at 100% oxygen during a smoke, fire, or fumes event. For the oxygen mask to be a fully compliant protective breathing device as defined in 14 CFR 121.337(b)(7),⁶ the mask must be set to 100% and the regulator set to the emergency setting (see figure 2). In addition, the goggles must be donned, and the smoke vent selector on the mask must be opened to vent the goggles of any smoke⁷ (see figures 3 and 4). When the oxygen mask/goggle set is donned, the locations of the normal/100% switch and the emergency selector on the regulator, in addition to the smoke vent selector on the mask, are not visible to the pilot and, therefore, must be located and activated only by feel.

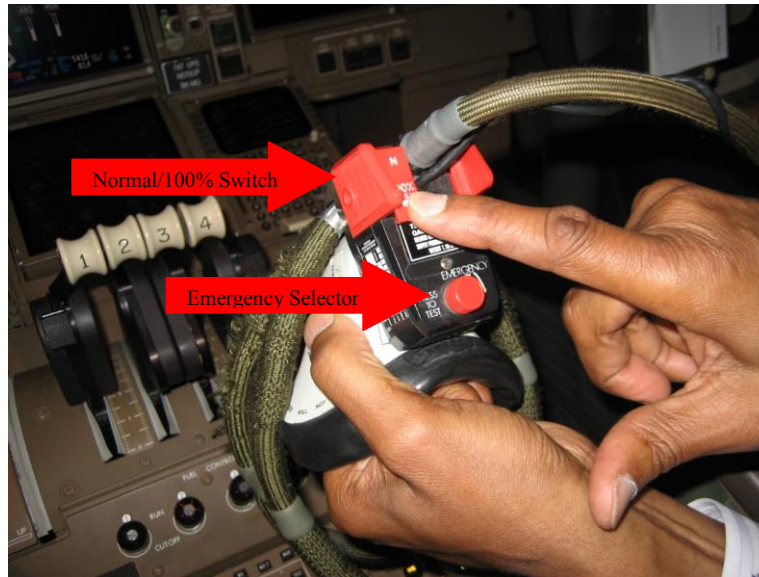


Figure 2. Location of normal/100% switch and emergency selector.

⁶ Title 14 CFR 121.337(b)(7) states, in part, the following: “(i) The equipment must supply breathing gas for 15 minutes at a pressure altitude of 8,000 feet for the following: (A) Flight crewmembers while performing flight deck duties; and (B) Crewmembers while combating an in-flight fire. (ii) The breathing gas system must be free from hazards in itself, in its method of operation, and in its effect upon other components.”

⁷ According to the Boeing 747-400 Flight Crew Operating Manual (FCOM), pages 1.30.28 and 1.30.29, the “up” position indicates that the vent valve is closed. The “down” position indicates that the vent valve is open, allowing oxygen flow to the smoke goggles.



Figure 3. Smoke vent selector (closed).



Figure 4. Smoke vent selector (open).

An alternative to the oxygen mask/goggle set and smoke vent is a full-face oxygen mask (see figure 5). The difference between a full-face oxygen mask and the mask/goggle set is that the full-face mask is a single mask/regulator unit that does not require separate donning of the mask and goggles.

Oxygen Mask and Regulator

N580UP, N581UP

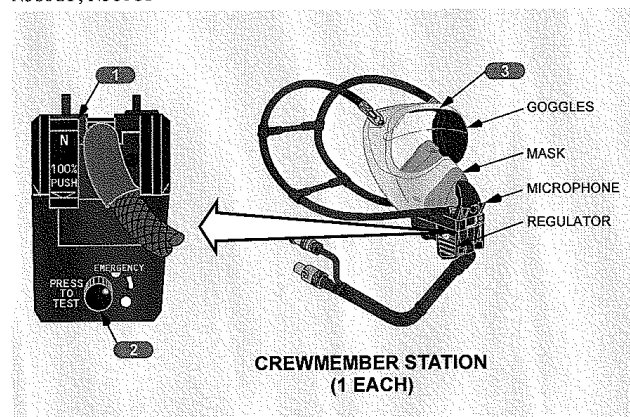


Figure 5. Full-face oxygen mask and regulator.⁸

Flight crewmembers communicate with each other while full-face oxygen masks or oxygen mask/goggle sets are donned via mask microphones and the cockpit speaker system. When the pilot retrieves the oxygen mask from its stowage box, oxygen flow becomes available to the oxygen mask, the oxygen mask microphone is enabled, and the boom microphone is disabled when the left (captain's) oxygen mask stowage box door is open.⁹ The oxygen mask microphone is disabled and the boom microphone is enabled when the left oxygen mask stowage box door is closed and the RESET/TEST switch on the mask stowage box is pushed.

⁸ This sketch is from the Boeing 747-400 FCOM, page 1.30.26.

⁹ The first officer's oxygen mask stowage box is identical to the captain's oxygen mask stowage box. The right door on the stowage box has no function other than being open or closed.

Donning of Oxygen Masks

When the UPS6 pilots received the cargo fire warning about 22 minutes after departure from DXB, both pilots donned their oxygen mask/goggle sets during the initial phases of the emergency in accordance with the UPS Quick Reference Handbook (QRH) Fire Main Deck checklist and the UPS 747-400 Pilot Training Manual.¹⁰ The flight crewmembers indicated to air traffic control (ATC) that they experienced smoke in the cockpit and were unable to see their radios. During the UPS6 accident investigation, investigators visited the UPS 747-400 Training Center¹¹ in Anchorage, Alaska, and the Boeing Training Facility¹² in Seattle, Washington, to observe scenarios in a full-flight simulator (FFS). Multiple scenarios involving a simulated main deck fire, similar to what the UPS6 flight crew encountered, were conducted and observed with pilots donning oxygen mask/goggle sets (see figure 6) and full-face oxygen masks (see figure 7). Regarding the oxygen mask/goggle sets, the participating pilots had difficulty ensuring the mask was fitted properly, comfortably donning the mask/goggle set, using two hands to don the mask/goggle set, determining the oxygen mask setting (100% versus normal), and locating the emergency selector on the regulator and the smoke vent selector on the mask. Participants told investigators that changing the selector position on the mask from a predetermined position to an alternate position (for instance, from normal to 100%) in an emergency condition was only possible with practice, if all other tasks were terminated, and if the crewmember concentrated on the specific task of manipulating the selector. In addition, one participant stated that he would not have thought to vent the goggles in the oxygen mask/goggle set if he had not practiced the scenario before entering the simulator. In 1978, the Federal Aviation Administration (FAA) published a summary of research and testing evaluating protective breathing equipment (PBE) that noted problems similar to those observed during this investigation.¹³

¹⁰ The UPS 747-400 Pilot Training Manual, Chapter 7, page 1, states, “Pilots should don oxygen masks and establish communications any time oxygen deprivation or air contamination is suspected, even though an associated warning has not occurred.”

¹¹ On September 13, 2010, the operations/human performance group participated in an observational study to familiarize the group with checklists and procedures related to smoke, fire, or fumes scenarios that may occur in flight. Three pilots who were type-rated, current, and qualified on the 747-400 participated in this study. In addition, a simulator instructor and four observers from the operations/human performance group were present.

¹² On December 1, 2010, the operations/human performance group, along with the GCAA, participated in an observational study regarding checklist procedures and oxygen mask use in a reduced-visibility environment. One private pilot from the GCAA, who was not type-rated on the 747-400, and one line pilot, who was type-rated, current, and qualified on the 747-400, participated in this study.

¹³ The study states, in part, that “Problems encountered with the combination (oxygen mask/goggles) are: (i) the fit of the goggles to the outside surfaces of the oxygen mask; (ii) mating the goggles with the suspension system of the oxygen mask; (iii) the possibility of incompatible mask/goggles combinations because of the large variety of both items; (iv) fitting a wide variety of facial contours with a standard size and shape of mask and goggles; (v) the requirement that the protective equipment function for an individual wearing corrective eyeglasses; (vi) the possibility of having to provide the goggles with internal positive pressure or venting as a means to purge and control inbound leakage around eyeglass frames, mask/goggles and goggles/masks interfaces; and (vii) the possibility that, once donned by a crewmember, the protective equipment will cause displacement of corrective eyeglasses.” See D. DeSteiguer and others, *Aircrew and Passenger Protective Breathing Equipment Study* FAA-AM-78-4 (Oklahoma City, Oklahoma: FAA Civil Aeromedical Institute, 1978).



Figure 6. Donned oxygen mask/goggle set.



Figure 7. Donned full-face oxygen mask.

Investigators also noted that, in comparison to the full-face oxygen mask, the oxygen mask/goggle set took longer to don and begin to use and was much more difficult to adjust since adjusting either the mask or goggles in the mask/goggle set required an adjustment of the other item. Participants in the Seattle simulator tests stated that the full-face oxygen mask was more comfortable, had a better seal, and offered superior vision, including peripheral vision, when compared to the separate goggle unit in the oxygen mask/goggle set. Interviews with UPS line pilots, instructors, and management pilots who had previous experience with full-face oxygen masks indicated that they preferred the full-face oxygen mask over the mask/goggle set because it was quicker to don and did not require the additional, time-consuming step of donning a separate set of goggles and the required manipulation of the goggle vent.

The NTSB is concerned that oxygen mask/goggle sets are difficult for flight crewmembers to don and adjust, particularly during a smoke, fire, or fumes event when time is limited. The NTSB concludes that a full-face oxygen mask would be a safer alternative to the oxygen mask/goggle set during a smoke, fire, or fumes event because the full-face oxygen mask is easier to don, adjust, and use than the mask/goggle set, allowing the flight crew more time to respond to an in-flight smoke, fire or fumes event. UPS has indicated that it will retrofit the cockpits of its airplanes with full-face oxygen masks with integrated smoke goggles; the NTSB commends this commitment to safety and believes that other operators should take similar action. Therefore, the NTSB recommends that the FAA require operators to install full-face oxygen masks on aircraft used for 14 CFR Part 121, 135, and 91 subpart K operations and provide training on their use.

The NTSB acknowledges that installing full-face oxygen masks on Part 121, 135, and 91 subpart K aircraft may take time to accomplish. In the meantime, the NTSB is concerned that pilots using oxygen mask/goggle sets on Part 121, 135, and 91 subpart K flights may not be adequately trained to operate those oxygen mask/goggle sets if a smoke, fire, or fumes event occurs. During the UPS6 investigation, investigators received comments from several UPS line pilots regarding pilot training on the use of oxygen mask/goggle sets. These pilots indicated that they received very little tactile, hands-on training for the actual use of the oxygen mask/goggle set and smoke vent, and the training that they did receive occurred during initial training for the aircraft in the form of computer-based training slides. (UPS does not have a recurrent training module to instruct pilots on the use of the oxygen mask/goggle sets and smoke vents.) The line pilots also stated that they were never taught about the relationship between the emergency selector on the regulator and the need to simultaneously open the smoke vent to clear contaminants from inside the goggles or how to locate the switches on the oxygen regulator after the oxygen mask was donned. Further, they were never required to practice these actions in the presence of an instructor or check airman.

The NTSB's review of UPS training regarding pilot guidance on oxygen masks revealed that UPS pilots receive an overview of the oxygen mask during general subjects training in initial ground school, but the syllabus provides no specific hands-on guidance regarding the mask switches and the operation of the mask and regulator.¹⁴ No specific instructions are included in the ground school syllabus for the normal/100% switch, emergency selector, or smoke goggles and vent.¹⁵ Further, UPS does not have oxygen mask/goggle sets installed in its fixed-based simulator. The only hands-on oxygen mask/goggle set training with an operable system that UPS provides is in its FFS, where the mask/goggle sets are fully functional and identical to those found on the 747-400F and BCF¹⁶ aircraft.¹⁷ Pilots in UPS simulator training are introduced to the oxygen masks during the first simulator session but are only taught how to preflight the

¹⁴ A textual explanation of the oxygen mask emergency/test switch and smoke vent valve selector is found in the UPS B747-400 Aircraft Operating Manual (AOM), Chapter 4, page 92.

¹⁵ Investigators conducted an informal poll of other cargo operators and learned that other operators do not offer their pilots detailed instruction on the operation of the oxygen mask and its settings.

¹⁶ BCF, or Boeing Converted Freighter, refers to an aircraft that was originally configured as a passenger aircraft and has subsequently been converted into a cargo configuration.

¹⁷ Oxygen masks available for initial and recurrent emergency equipment training are not connected to an air source; therefore, the mask harnesses do not inflate as they do in the actual aircraft and are not operational.

system.¹⁸ Pilots have the opportunity to don the oxygen mask/goggle sets during the sixth simulator session when a cargo compartment fire/smoke event¹⁹ is introduced, but, according to interviews with the simulator instructor who trained the UPS6 first officer, while students would don the oxygen masks, it was considered “rare” for a student to need to don the smoke goggles during this simulator session.²⁰ Investigators found no reference or requirement to discuss the detailed operation of the mask/goggle sets or smoke vent in any UPS instructor’s manual.

The NTSB concludes that pilots of 14 CFR Part 121, 135, and 91 subpart K flights may not be receiving adequate hands-on training regarding the donning and operation of oxygen mask/goggle sets. During an in-flight smoke, fire, or fumes event, the flight crew has limited time to complete checklist items, attempt to suppress or extinguish the fire, and divert the airplane to a successful landing. Oxygen mask/goggle sets must be donned quickly and with the correct regulator settings so that fire suppression/extinguishing procedures can begin as soon as possible. Any delay in setting the switches could increase the risk of flight crew incapacitation and delay the start of the smoke, fire, or fumes checklist. The NTSB believes that the full-face oxygen masks recommended in Safety Recommendation A-11-87 should ultimately replace oxygen mask/goggle sets in Part 121, 135, and 91 subpart K aircraft. In the meantime, the NTSB recommends that the FAA require operators of 14 CFR Part 121, 135, and 91 subpart K flights to include, during initial and recurrent training, tactile, hands-on training on the use of operable oxygen mask/goggle sets, including the use of the regulator’s emergency selector and the venting of the smoke goggles.

Communication with Oxygen Masks Donned

The investigation also revealed training deficiencies regarding flight crew cockpit communications while wearing oxygen mask/goggle sets and full-face oxygen masks. The process of communicating while wearing oxygen masks is not routine because flight crewmembers are required to physically position a switch to speak to the other crewmember through the intercom system or communicate with ATC, adding another task to an already task-saturated emergency situation.

A review of cockpit voice recorder data revealed that both UPS6 pilots experienced difficulties establishing internal cockpit communications and communicating with each other via the 747-400 communications system after donning their oxygen mask/goggle sets.²¹ The UPS Fire Main Deck checklist states that, after donning the oxygen mask/goggle sets, the flight crew should establish crew communications. The UPS Pilot Training Guide, Chapter 7, Non-Normal,

¹⁸ The procedures for the preflight preparation are detailed in the UPS 747-400 AOM, Chapter 3, Normal Procedures. Preflight of the oxygen mask does not require removing and donning the mask/goggle set.

¹⁹ For more information, see the UPS Flight Operations Training Manual, Chapter 7, page 25.

²⁰ According to the UPS6 first officer’s simulator instructor, the sixth simulator session cargo compartment fire/smoke scenario would begin with a cargo fire on approach that would not require donning of the oxygen masks and goggles. The scenario would then progress to a main deck fire to force the flight crew to evacuate the airplane (simulator) upon landing.

²¹ According to the UAE GCAA preliminary report, after the autopilot disconnected, an audible alarm sounded, and “the flight crew put on the oxygen masks and goggles. The crew experienced difficulties communicating via the intercom with the masks on, which interfered with the Cockpit Resource Management (CRM).”

page 6, states, in part, that flight crewmembers should “establish flight deck communications as soon as possible. This may require use of the flight deck interphone system or, in extreme cases of high noise levels, hand signals and gestures in order to communicate effectively.” During initial UPS 747-400 simulator training, the pilots have an opportunity to don the oxygen masks and practice communicating through the intercom system once during smoke, fire, or fumes removal training in the ninth simulator session. However, no specific hands-on training module exists in the UPS ground school or simulator training regarding how to “establish flight deck communications,” nor is there any guidance for UPS instructors on how to teach the subject.

During the Seattle simulator tests, investigators observed that, in a smoke-degraded cockpit without adequate peripheral vision or with smoke-obscured vision, flight crewmember communication was difficult to establish and maintain, even with the audio panels appropriately set for intercom communications when the oxygen mask/goggle sets and full-face oxygen masks were donned. Each pilot participant had difficulty locating the transmit switch in the reduced visibility environment. In addition, participants found it difficult to execute non-normal checklists while simultaneously verbalizing the checklist items. Each pilot reading the checklist had to choose between holding the checklist while verbalizing the specific checklist item and manipulating the system or switch called for in the checklist. During the Anchorage simulator tests, investigators observed a line-qualified 747-400 check airman put the checklist down to answer an ATC radio call. The pilot experienced difficulty returning to the subsequent steps in the non-normal checklist while simultaneously attempting to locate the radio panel.

Previous investigations have also revealed flight crew difficulties with communications while oxygen masks were donned. For example, on July 20, 2009, United Airlines (UAL) flight 949 departed London Heathrow Airport destined for Chicago O’Hare International Airport.²² At 37,000 feet and about 200 miles south-southwest of Keflavik, Iceland, the flight crew encountered smoke in the cockpit and diverted to Keflavik International Airport. During the event, the flight crewmembers donned their oxygen mask/goggle sets and attempted, with difficulty, to establish and maintain crew communications. According to the incident report, the pilots stated that “they felt they had difficulty communicating with each other, [ATC], and the cabin crew.” According to pilot statements provided to the Icelandic Aircraft Accident Investigation Board, the captain stated, “we struggled with the audio panels to communicate with the masks on”; he therefore removed the oxygen mask to communicate with the first officer and relief pilot in the cockpit. The first officer stated the following:

The entire process of donning goggles, the use of oxygen mask [sp], pushing all the different buttons and toggles to communicate with all the people involved was very frustrating at times. Between the goggles scratching my glasses and the smoke film in front of them too, it was hard to see at times. Too many items have to come together for this setup to work.

²² The Icelandic Aircraft Accident Investigation Board (AAIB) investigated this incident with the assistance of an NTSB accredited representative under the provisions of Annex 13 to the International Convention on Civil Aviation. For more information, see AAIB of Iceland, *Aircraft Incident Report: Smoke in the Cockpit*, Report M-01709/AIG-12.

The UAL relief pilot stated, in part, that “crew communications with oxygen masks on was non-effective and increased crew workload significantly. It was made worse with three crew members plus ATC all trying to all communicate.”²³

The NTSB concludes that pilots may experience difficulty establishing communications and communicating with oxygen masks donned, as observed in the UPS6 accident and as demonstrated in the UAL flight 949 cockpit smoke event. Proficiency in communication when oxygen masks are donned could help reduce possible errors associated with the use of oxygen masks or in communication and avoid delays in the initiation of a smoke, fire, or fumes checklist during a time-critical emergency situation. Therefore, the NTSB recommends that the FAA require operators of 14 CFR Part 121, 135, and 91 subpart K flights to include, during initial and recurrent training, aircraft-specific training on establishing and maintaining internal cockpit communications when the oxygen masks are donned.

Oxygen Mask Stowage and the Smoke, Fire, or Fumes Checklist

Flight crews are required to check PBE before each flight for its functioning, serviceability, fit, connection, and supply. If the oxygen mask is a universal-fit type,²⁴ no requirement exists to remove the mask from its compartment; the serviceability of the mask is tested during preflight by pushing a test switch on the oxygen box to verify that oxygen flow is available to the mask. Pilots do not have to don the masks to verify their operation. While airlines have a preflight requirement to ensure that the oxygen mask is set to 100% according to 14 CFR 121.337(c),²⁵ no regulatory requirement exists to physically remove the mask from its container to verify its full operation (mask settings, oxygen flow, inflation of the harness, and proper fit).

Further, no requirement exists that the mask regulator switch be set to 100% while the mask is stowed in its container after its use in flight. Title 14 CFR 121.333(c)(3) states, in part, that “if for any reason at any time it is necessary for one pilot to leave his station at the controls of the airplane when operating at flight altitudes above [flight level (FL)] 250, the remaining pilot at the controls shall put on and use his oxygen mask until the other pilot has returned to his duty station.” Section 121.333(c)(1) also states that “when it is not being used at flight altitudes above [FL] 250, the oxygen mask must be kept in condition for ready use and located so as to be within the immediate reach of the flight crewmember while at his duty station.”

Investigators interviewed UPS line pilots and learned that some line pilots switch the oxygen mask setting from 100% to normal during cruise flight to extend the oxygen supply when one crewmember leaves the cockpit for a physical break. On long flights, particularly those

²³ AAIB of Iceland, *Aircraft Incident Report: Smoke in the Cockpit*, Report M-01709/AIG-12.

²⁴ The UPS6 flight crew oxygen masks were universal-fit PBEs with a harness that would expand and collapse around the flight crewmember’s head.

²⁵ Title 14 CFR 121.337(c) states, in part, the following: “(1) Before each flight, each item of PBE at flight crewmember duty stations must be checked by the flight crewmember who will use the equipment to ensure that the equipment-- (i) For other than chemical oxygen generator systems, is functioning, is serviceable, fits properly (unless a universal-fit type), and is connected to supply terminals and that the breathing gas supply and pressure are adequate for use; and (ii) For chemical oxygen generator systems, is serviceable and fits properly (unless a universal-fit type).”

common to cargo operations, a flight crewmember may be absent from the cockpit numerous times. In those cases, multiple opportunities exist for the mask to be stowed while set to normal and, thus, not in a ready setting for a smoke, fire, or fumes event. The UPS 747-400 Aircraft Operating Manual, Chapter 2, page INTRO 3, states, “the NORMAL position of the regulator must be used if prolonged use is needed and the situation allows.” The NTSB notes that no requirement exists for flight crews to operate the oxygen mask at 100% during these breaks and further notes that, while 14 CFR 121.333(c)(1) states that, when the mask is not being used (at flight altitudes above FL 250), it must be kept in “condition for ready use” and located within the immediate reach of the flight crewmember, the FAA does not define what “condition for ready use” means and does not require that the mask be set to 100% when it is in a condition for ready use.

As indicated above, pilots in the Anchorage and Seattle simulator tests stated that switching the mask setting from normal to 100% during an emergency was only possible with practice and focused concentration. The NTSB concludes that setting the oxygen mask at 100% whenever the mask is stowed will ensure that the mask will supply 100% oxygen when it is donned so that the flight crew can initiate the appropriate smoke, fire, or fumes checklist without delay. The NTSB notes that guidance to stow an oxygen mask at 100% (as opposed to guidance in an operator’s manual requiring the oxygen mask only be preflighted to 100%) does not prevent a flight crew’s decision to use the mask in normal mode when deemed appropriate. Therefore, the NTSB recommends that the FAA require operators of 14 CFR Part 121, 135, and 91 subpart K flights to educate flight crews about the importance of stowing their oxygen masks set to 100%.

In addition, the UPS6 accident investigation revealed that the UPS Fire Main Deck checklist, as well as every UPS 747-400 non-normal checklist that would require donning of the oxygen mask/goggle set, does not follow guidance from the 2004 Smoke Fire Fumes (SFF) initiative.²⁶ The 2004 SFF initiative developed a smoke, fire, or fumes checklist template to standardize and optimize responses to such events. The proposed checklist guidelines emphasized that flight crews should ensure that their oxygen masks and goggles are donned and properly set so that the flight crew is protected immediately after smoke, fire, or fumes detection. The NTSB notes that the FAA-approved Airplane Flight Manual (AFM)²⁷ 747-400 Fire Main Deck checklist includes “oxygen masks and regulators—On/100%” as its first step, but the UPS Fire Main Deck checklist does not include this step to ensure the mask is set to “100%.”²⁸ UPS training personnel stated to investigators that UPS flight crews are trained and checklists are used to confirm that oxygen be preflighted with the mask position set to 100%.²⁹ However, interviews

²⁶ In October 2004, representatives from the airlines, pilot unions, and manufacturers (hosted by Bombardier in Montreal, Canada) met to review and develop an industry consensus on a philosophy for flight crew responses to the challenge of in-flight smoke, fire, or fumes events and to develop a draft checklist template based on that consensus. The Flight Safety Foundation published the template in 2005.

²⁷ The AFM was approved by an FAA principal operations inspector.

²⁸ The Boeing QRH and UPS QRH for Smoke, Fire, and Fumes also do not include the task of ensuring the oxygen mask is set to 100%. The Boeing QRH states, “Don the oxygen masks, if needed,” and the UPS QRH states, “Oxygen Masks and Smoke Goggles (if required)—On.”

²⁹ The UPS 747-400 AOM, Chapter 3, page 8, Amplified Before Start Checklist—Down to the Line, states, “Oxygen—Set (C/F)” and notes, “verify respective oxygen system has been tested and Normal/100% switch set to 100%.”

with the inbound crew of UPS6 revealed that one of the pilots operated the mask at “normal” during another crewmember’s break before stowing the mask after use, as was his normal custom.³⁰

The NTSB is concerned that, while no requirement exists to operate the mask at 100% in flight during normal conditions, the practice of setting a mask to normal, particularly during extended cruise flight with multiple crewmember breaks, increases the risk that a mask will be restowed in the normal position and not set properly to use for a non-normal event. The NTSB concludes that while guidance to stow the mask at 100% will increase crew awareness, indicating that oxygen masks should be on and set to 100% in the first step of the smoke, fire, or fumes checklist will help flight crewmembers ensure that the mask is properly set. Therefore, the NTSB recommends that the FAA require that operators’ smoke, fire, or fumes checklists include, as the first step, that flight crewmembers don their oxygen masks and verify that the regulator is set to 100%.

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

Require operators to install full-face oxygen masks on aircraft used for 14 *Code of Federal Regulations* Part 121, 135, and 91 subpart K operations and provide training on their use. (A-11-87)

Require operators of 14 *Code of Federal Regulations* Part 121, 135, and 91 subpart K flights to include, during initial and recurrent training, tactile, hands-on training on the use of operable oxygen mask/goggle sets, including the use of the regulator’s emergency selector and the venting of the smoke goggles. (A-11-88)

Require operators of 14 *Code of Federal Regulations* Part 121, 135, and 91 subpart K flights to include, during initial and recurrent training, aircraft-specific training on establishing and maintaining internal cockpit communications when the oxygen masks are donned. (A-11-89)

Require operators of 14 *Code of Federal Regulations* Part 121, 135, and 91 subpart K flights to educate flight crews about the importance of stowing their oxygen masks set to 100%. (A-11-90)

Require that operators’ smoke, fire, or fumes checklists include, as the first step, that flight crewmembers don their oxygen masks and verify that the regulator is set to 100%. (A-11-91)

³⁰ According to notes from interviews with investigators, the captain of the inbound flight stated his normal custom was to remove the oxygen mask for use on a bathroom break and not return it fully to the stowage box because “it was hard to get the mask back in the compartment so on an extended duration...he would coil the hose back in the compartment so it was not in the way and he might have the mask in the compartment but not have the doors as smoothly closed as they would be otherwise. ...Because the crew would get up multiple times, it was easier to do that. He would put the mask back in the housing and close the doors at the end of the flight and always at that time would turn the mask setting back to 100% for the next preflight.”

In response to the recommendations in this letter, please refer to Safety Recommendations A-11-87 through -91. 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