

**NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

**Attachment 42 - FAA Oxygen Requirements Responses**

**OPERATIONS/HUMAN PERFORMANCE SUPPORT TO  
THE U.S. ACCREDITED REPRESENTATIVE**

**DCA10RA092**

## A. FAA Response 11.003



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of Accident Investigation and Prevention

800 Independence Avenue SW  
Washington DC 20591

DEC 08 2010

David Lawrence  
National Transportation Safety Board, AS-30  
490 L'Enfant Plaza East, SW  
Washington, DC 20594

Dear Mr. Lawrence:

The Federal Aviation Administration Flight Standards and Aircraft Certification Services, in response to your accident investigation information support request 11.003, are providing the following information regarding the accident involving United Parcel Service on September 10, 2010, in Dubai, United Arab Emirates. Specifically you asked:

1. Request history and research associated with FAR 121.333(b), including:
  - a clarification of the 2 hours minimum oxygen and if this includes protective breathing (100% oxygen) capability,
  - Basis for the 2 hour rules,
  - Was protective breathing or smoke/fire/fumes considered for this regulation.
2. Request history and research associated with FAR 25.1439, including:
  - Basis for the 15 minute supply and 8000 foot altitude.
  - Clarification of whether cockpit crew oxygen is included as “protective breathing equipment” and if so is this at 100% oxygen,
  - If not protective and 100% O<sub>2</sub>, were smoke/fire/fumes considered for this regulation?

### **FAA Response:**

#### **General Oxygen System Description**

There are two types of flight crew oxygen equipment with two distinct purposes: supplemental oxygen equipment and protective breathing equipment (PBE). Supplemental oxygen equipment is provided to protect the user from the effects of hypoxia in the event of

cabin depressurization and only needs to cover the nose and mouth. There are two types of PBE, which have different purposes, and different requirements:

1. Stationary PBE protects the flight crew in the flight deck from smoke or other harmful gases and allows them to continue their flight deck duties.
2. Portable PBE protects the user while fighting a fire.

Stationary PBE covers the nose, mouth and eyes and typically meets the minimum performance standards in Technical Standards Order TSO-C99 and Aerospace Standard (AS) 8031. Equipment to cover the eyes is either built into the mask (a full face mask) or is separate (goggles). Portable PBE typically covers the entire head and seals around the user's neck. As well as providing a protective breathing environment, portable PBE also protects the user from other dangers while fighting a fire, such as radiant heat, flames and hot drippings. Portable PBEs are typically designed to meet the minimum performance standards in TSO-C116 and AS-8047.

Typically for the cockpit crew, the same oxygen equipment is used for either a supplemental supply, or a protective breathing supply. We understand that the UPS accident airplane under investigation was equipped with diluter-demand oxygen masks with integral mask mounted regulators. This type of equipment is common for air carrier operations with pressurized cabins. This oxygen equipment has 3 regulator settings; Normal, 100% and Emergency. The masks are stowed in the 100% setting. In the event of a decompression, the mask is donned providing the necessary 100% oxygen supply to protect the user from hypoxia. Following descent to a lower altitude when 100% oxygen is no longer necessary, the mask is often switched to the Normal setting. This setting provides supplemental oxygen diluted (mixed) with ambient air. Since a mixture of oxygen and ambient air is provided, the oxygen supply is conserved to support longer usage durations. In the event of smoke or other harmful gases, the flight crew dons the mask as well as protective eyewear if necessary and will be breathing a 100% oxygen supply. When the mask is switched to the Emergency setting, a positive pressure of 100% oxygen is added inside the mask to keep smoke from penetrating into the mask. There is also a vent used to purge the protective eyewear of harmful gases.

#### **Response for Item 1.**

The rules associated with supplemental oxygen were amended on December 31, 1964 to add part 121 and to replace Civil Air Regulations (CAR) parts 40, 41, and 42 and certain Special Civil Air Regulations. This amendment completed the Agency recodification. Section 121.333 was amended from the CAR 4b375 to read:

*" the required two hour supply is that quantity of oxygen necessary for a constant rate of descent from the airplane's maximum certified operating altitude to 10,000 feet in ten minutes and followed by 110 minutes at 10,000 feet."*

The amount of supplemental oxygen required for a particular operation is determined on the basis of flight altitudes and flight duration, consistent with the operation procedures established for each operation and route.

Section 121.333(b) provides requirements for the use of supplemental oxygen, not protective breathing, in the event of smoke or other harmful gases in the flight deck. Section 121.333(b) provides requirements to protect the flight crew from hypoxia in the event of a high altitude decompression. The 2 hour minimum supply duration is the time expected to descend and land at a suitable airport following a high altitude decompression. Protective breathing was not considered for this regulation.

Although § 121.333 is not considered a protective breathing requirement, § 121.337 is. Section 121.337 is the operational regulation for air carriers which is similar to § 25.1439. Section 121.337(b)(7) contains a minimum 15 minute protective breathing supply. PBEs are used to meet the supplemental oxygen only in cases where the oxygen equipment meets the standards of § 121.335. The basis for the 15 minute supply is described in the FAA's response to #2.

#### **Response for Item 2.**

The requirement for a 15 minute protective breathing supply was initially added to CAR section 4b.651, at amendment 4b-6 which was effective in January of 1952. When the CARs were codified into the Code of Federal Regulations, the 15 minute requirement was originally only in the certification rules (§ 25.1439) and has remained unchanged. A description of how the 15 minutes was initially derived was not provided. However, when the operational rule § 121.337 was amended to include the 15 minute duration, a short discussion was provided to address comments suggesting that the duration should be changed to 30 minutes. To address the comment, the FAA stated that PBE is not intended to provide protection for the entire period required to land and evacuate an airplane in the event of an in-flight fire. Rather it is designed to protect the crew long enough to allow them to take measures to combat the fire. We still believe this statement to be true and do not have data to suggest that a longer duration would be appropriate. The 8000 foot cabin altitude is used because that is the maximum equivalent altitude of a pressurized airplane under normal operations. PBE is not intended to be used as a supplemental oxygen supply during a decompression.

Pressurized aircraft are typically equipped with a single crew oxygen system that meets supplemental oxygen requirements as well as the stationary protective breathing requirements in § 25.1439. To protect the user from smoke or other fumes, the equipment must cover the mouth, nose and eyes. The equipment must also be able to provide a 100% oxygen supply and be designed to prevent any inward leakage. The

prevention of inward leakage is typically accomplished by using the Emergency setting located on the oxygen mask regulator.

If you require additional information, please contact Ms. Kimberly Burtch, Accident Investigation Division, [REDACTED]

Sincerely,

[REDACTED]  
B. Hooper Harris  
Manager, Accident Investigation Division

## B. FAA Response 11.082



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of Accident Investigation and Prevention

800 Independence Avenue SW  
Washington DC 20591

MAR 24 2011

David Lawrence  
National Transportation Safety Board (NTSB), AS-30  
490 L'Enfant Plaza East, SW  
Washington, DC 20594

Dear Mr. Lawrence:

The Federal Aviation Administration (FAA) Flight Standards Service, with input from the Aircraft Certification Service, is providing the following response to your accident investigation information support request 11.082 in support of the NTSB investigation of the United Parcel Service accident that occurred on September 3, 2010, in Dubai, United Arab Emirates. Specifically you asked:

### NTSB Question:

1. Request clarification of FAR 121.337: Does a PBE (Protective Breathing Equipment) as defined in FAR 25.1439(a)(5) (certified to 8,000 for 15 minutes) installed in a Class E cargo compartment on the B747-400 freighter during a main deck fire comply with Part 121.337 requirements when the B747-400 requires the aircraft to be depressurized to 25,000 feet?

### FAA Response:

#### **General Oxygen System Description**

There are two types of flight crew oxygen equipment with two distinct purposes: supplemental oxygen equipment and protective breathing equipment (PBE). Supplemental oxygen equipment is provided to protect the user from the effects of hypoxia in the event of cabin depressurization and only needs to cover the nose and mouth. There are two types of PBE, which have different purposes and different requirements:

1. Stationary PBE protects the flight crew in the flight deck from smoke or other harmful gases and allows them to continue their flight deck duties.
2. Portable PBE protects the user while fighting a fire.

The most common form of portable PBE used on aircraft are often referred to as smoke hoods. Smoke hoods cover the entire head and seal around the user's neck. As well as providing a protective breathing environment, smoke hoods protect the user from other dangers while fighting a fire, such as radiant heat, flames, and hot drippings. Smoke hoods are typically designed to meet the minimum performance standards in Technical Standard Order (TSO) C116 and Aerospace Standard (AS) 8047, which provide minimum performance requirements up to a cabin pressure altitude of 8,000 feet. As such, smoke hoods are not typically intended to be used or certified for use as a supplemental oxygen supply following a decompression.

Although smoke hoods are not typically certified for use as a supplemental oxygen supply to protect the user from hypoxia, such as for use at a cabin pressure altitude of 25,000 feet, it is likely that they will offer some hypoxia protection once the oxygen concentration increases within the smoke hood. However, the FAA is unsure how effective they would be at cabin pressure altitudes above 8,000 feet. Since smoke hoods are not intended for use as a supplemental oxygen supply to protect the user from hypoxia at high cabin pressure altitudes, applicants do not provide substantiation data to the FAA to demonstrate that smoke hoods comply with the regulations for use as a supplemental oxygen supply.

The Transport Airplane Directorate considers a fire event and a decompression event to be two separate failure scenarios. We do not evaluate a combination of these failure scenarios in a single event. As a result, we do not have regulations which specifically require equipment to meet performance requirements for use as a protective breathing and a supplemental oxygen supply. It is common for stationary crew oxygen equipment to be certified for use as both a supplemental oxygen supply and a protective breathing supply. However, portable oxygen equipment is not typically certified to meet both supplemental oxygen requirements and protective breathing requirements on transport category airplanes because it is not typically intended for dual use. Although such dual use equipment is not specifically required, existing FAA regulations allow applicants the opportunity to demonstrate performance of portable PBE for additional use as a supplemental oxygen supply.

Fire suppression procedures for Class E cargo compartments involve depressurizing the aircraft thus starving the fire of oxygen and do not typically involve manual fire fighting. If an applicant has procedures to manually fight a fire in a Class E cargo compartment following depressurizing the airplane, then the applicant should demonstrate performance of the equipment that will be used in accordance with existing regulations.

With respect to this accident, the Boeing Aircraft Flight Manual asserts that the PBE stowed on the main deck Class E cargo compartment of the 747-400 is not intended for use during a decompression. Additionally, the main deck on this freight aircraft is not to be occupied in-flight.

Three U.S. B747 freight operators were contacted to evaluate their approved training program and aircraft operating manual reference to smoke, fire or fumes (SFF). Their

procedures are consistent with the manufacturers' recommendations. Only those operators of the B747-100/200 series could have a crewmember designated to fight a main deck fire.

If you require additional information, please contact Ms. Kimberly Burtch, Accident Investigation Division, [REDACTED]

Sincerely,

[REDACTED]

B. Hooper Harris  
Manager, Accident Investigation Division