



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: November 24, 1989

In reply to: A-89-106 and-107

Honorable James B. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20594

On February 19, 1988, about 2130 EST, a Boeing 757, operated by Eastern Airlines as flight 215, en route from Atlanta, Georgia, to Tucson, Arizona, with 6 crewmembers and 131 passengers on board, experienced an in-flight fire caused by a ruptured solid-state oxygen generator in the forward galley. There was no damage to the airplane and there were no injuries.

The senior flight attendant stated that approximately 2 1/2 hours into the flight, a passenger requested oxygen for shortness of breath. The flight attendant consulted with a physician on board, who agreed that oxygen could be administered to the passenger. A second flight attendant brought a Duo-Pac Aviox portable oxygen unit, manufactured by Scott Aviation, and activated one of the two chemical oxygen generator canisters in the unit. The generator activated but the flight attendant detected no flow of oxygen into the mask. A single-canister oxygen unit was obtained, and it initiated properly and oxygen was administered to the passenger.

The Duo-Pac Aviox unit was placed on its side on the second shelf of a beverage cart and was covered with a damp linen napkin for cooling; reportedly, the unit was very hot to the touch. The cart was placed into its forward galley storage cabinet and the cabinet door was left open. Several minutes later, a fire erupted in the forward galley. Flight attendants used three Halon fire extinguishers to extinguish the fire which was on the galley floor. The flight attendants cleaned the galley and placed debris from the Aviox unit into a plastic bag. The flight continued to its destination without further incident.

Solid-state oxygen generators are chemically operated pyrotechnic devices used for medical, passenger, and flight attendant supplemental oxygen on several commercial aircraft. The primary component used to fuel the oxygen generator is a sodium chlorate candle which, when burned, produces oxygen as

its chief by-product. As the oxygen is produced, it is exhausted through an outlet tube into the airway system to a mask(s). As long as oxygen is allowed to flow freely through the system, there is no significant buildup of pressure inside the generator; however, if the outlet tube is blocked or partially obstructed, pressure will increase inside the generator. In addition to increased pressure, a more oxygen-rich environment increases the burn temperature significantly, which can result in structural damage to the generator. The Scott Aviation Aviox oxygen system is packaged in a portable carrying case with either one or two generators. The Duo-Pac Aviox unit has an overpressure relief valve in the oxygen distribution manifold rather than valves on each generator.

On March 2, 1988, Safety Board investigators, assisted by engineers from Scott Aviation and Eastern Airlines, photographed and examined the Aviox unit (ID 802502-15, LAC Part No. 673459-103) involved in this incident. The outer case of the canister had a hole of approximately 3 inches diameter in its lower left quadrant caused by excessive heat or fire. The copper jacket which housed the sodium chlorate candle was separated at the canister's end cap. The separation appeared to have been caused by internal pressure, in excess of the design limits of the copper jacket.

At the request of the Safety Board, additional examinations of the Aviox unit were conducted by the Federal Bureau of Investigation (FBI) metallurgical laboratory in Washington, D.C. Radiographs of the unit's airway manifold system showed no evidence of blockage or obstruction.

Further examinations and operational tests were conducted on April 7 and 8, 1988, at the Federal Aviation Administration (FAA) Technical Center in Atlantic City, New Jersey. Several instrumented tests conducted on Aviox generators with unobstructed airway manifolds resulted in no abnormally high generator operating temperatures or internal pressures and no generator overpressures. The Aviox unit from flight 215 was disassembled with the technical assistance of Scott Aviation personnel and members of the FAA Fire Safety Branch (ACT-350). All of the airway manifold components and the overpressure relief valve were found unobstructed, and they functioned normally. However the damaged canister's outlet cap had imprint damage that corresponded to a 1-inch hex nut, which secured the outlet tube to the center of the outlet cap. Additional 1/8-inch circular impressions were found on the hex nut support bracket; the impressions matched the size and shape of the tip of the canister's oxygen outlet tube.

Based on this evidence, the Safety Board concludes that the outlet tube of the generator's canister from the Aviox unit on flight 215 was fully or partially blocked by the misaligned outlet tube, which prevented oxygen from flowing into the airway manifold. This blockage caused pneumatic overpressure which, in turn, caused the sodium chlorate candle to be expelled from its copper jacket. The chlorate candle continued to burn in an oxygen-rich environment through the copper jacket and ignited the linen napkin and other material in the galley. Because the overpressure relief valve was located in the oxygen distribution manifold, it was useless in relieving the pressure in the generator canister.

The Society of Automotive Engineer's (SAE) Aerospace Standard 1303, "Portable Chemical Oxygen," states that each oxygen generator that is a component of an oxygen system should be equipped with "relief valve(s) on each cartridge, preferably on the opposite end from the oxygen outlet."

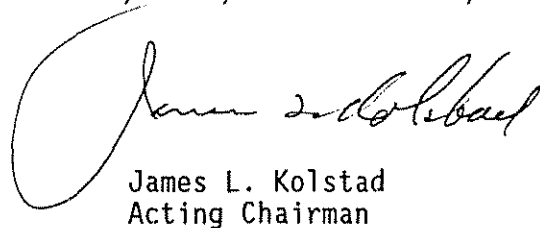
Currently, FAA regulations in 14 CFR 23.1450 and 14 CFR 25.1450 concerning oxygen systems specify that "means must be provided to relieve any internal pressure that may be hazardous," but the regulations do not define which component of the complete system is required to be equipped with a relief valve. The Safety Board believes that these regulations need to be made more precise and specify that each oxygen generator canister have overpressure protection. Also, the Board believes that existing Scott Aviation Aviox dual units that have only one common pressure relief valve should be modified to provide an overpressure relief device for each generator canister. Had the oxygen generator involved in this incident been equipped with an overpressure relief valve that met the intent of the SAE standard, the internal pressure would have been vented and the fire would have been prevented.

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

Amend 14 CFR 23.1450(b)(2) and 14 CFR 25.1450(b)(2) to require that each oxygen generator canister containing the sodium chlorate candle be equipped with an over pressure relief valve or similar overpressure protection. (Class II, Priority Action)(A-89-106)

Require Scott Aviation to modify existing stocks of Aviox generators to include an overpressure relief device for each oxygen generator canister or remove them from service. (Class II, Priority Action)(A-89-107)

KOLSTAD, Acting Chairman, BURNETT, LAUBER, NALL, and DICKINSON, Members, concurred in these recommendations.



James L. Kolstad
Acting Chairman