



Log# 2584

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: February 26, 1997

In reply refer to: A-97-13 through -15

Honorable Barry L. Valentine
Acting Administrator
Federal Aviation Administration
Washington, D C. 20591

On November 29, 1996, about 1850 hours Pacific standard time, the captain on Skywest Airlines flight 5410 sustained an eye injury and was incapacitated when he was irradiated by what is believed to be a laser beam during approach to the Los Angeles International Airport, Los Angeles, California. The airplane, an Embraer EMB-120, was operated by Skywest Airlines as a regularly scheduled domestic passenger flight from Bakersfield, California, to Los Angeles. The event occurred during darkness in visual meteorological conditions (VMC).

The airplane was on a right base leg, level at 6,000 feet mean sea level (msl), when the incident occurred. The captain stated that he was looking for downwind traffic through the right cockpit window when a bright light shined in his right eye. The captain reported that as the flight continued, it became increasingly difficult for him to see from that eye because of a burning sensation and tearing. By the time the flight was established on final approach, the captain was experiencing increased discomfort, and he relinquished control of the aircraft to the first officer, who completed the landing. The airplane was not damaged, and none of the passengers or other crewmembers were injured. The National Transportation Safety Board's investigation of this incident is ongoing.

On October 30, 1995, about 1830 Pacific standard time, the first officer on Southwest Airlines flight 1367 sustained an eye injury and was incapacitated when he was irradiated by a laser beam during the airplane's departure from the Las Vegas/McCarran International Airport, Las Vegas, Nevada.¹ The airplane was operated as a regularly scheduled domestic passenger flight from Las Vegas to San Antonio, Texas; VMC prevailed. The airplane was not damaged,

¹ Although the source of the laser beam was not located with certainty, separate radar track studies by the Safety Board's Vehicle Performance Division and Armstrong Laboratory determined that the most likely source was an entertainment laser at one of the large hotels. Because the laser generation equipment is adjustable in both beam divergence and power output, but does not have any output level recording devices, the investigation could not determine if the beam output was in compliance with FDA standards (described in greater detail in the text of this recommendation letter).

and none of the passengers or other crew members were injured. The Safety Board's investigation of this incident is ongoing.

Flight 1367 was climbing through 7,000 feet msl on a standard instrument departure route when the incident occurred. The first officer, who was the flying pilot, told the Safety Board that a laser beam swept past the cockpit from left to right and he immediately experienced pain and was completely blinded in his right eye. The after-image effects he experienced also induced a blinding condition in his left eye. He stated that he was unable to see for about 30 seconds and that for an additional 2 minutes, he could not focus on or interpret any instrument indications. In addition to his vision problems, the first officer said that for several minutes he was completely disoriented. Fortunately, the captain was not irradiated by the beam and was able to assume control of the airplane, and he continued the climb. The first officer sustained no apparent permanent eye damage and has resumed flight duties.

These were the only incidents involving lasers on which the Board has records. However, the Las Vegas Air Traffic Control Tower (ATCT) manager had recorded 51 incidents between October 1993 and October 1995 involving pilots who were irradiated by laser beams in the Las Vegas Airport area². Additionally, according to the National Aeronautics and Space Administration's (NASA) Aviation Safety Reporting System (ASRS), there have been incidents involving lasers in Florida, Hawaii, New York, Ohio, Mississippi, and Tennessee. The circumstances of the laser encounters ranged from various levels of crewmember annoyance to startle and flash blindness effects experienced by one or more members of the flightcrews. Although most pilots have reported laser beam irradiation as having occurred during the arrival and departure phases of flight, several air carrier and military pilots who were in cruise flight above 30,000 feet have reported encountering laser beams so bright that their cockpits were illuminated.

According to Title 21 Code of Federal Regulations (CFR) 1040, the U.S. Food and Drug Administration's (FDA) Center for Devices and Radiological Health is responsible for approving and regulating commercial lasers used for entertainment and promotional outdoor visible demonstrations. The FDA requires that laser manufacturers provide written notification to the Federal Aviation Administration (FAA), which approves the proposed license after determining the effect of laser beams on navigable airspace. The FAA Flight Standards and Airspace Procedures personnel evaluate these requests based on FAA Order 7400.2D, "Procedures for Handling Airspace Matters," which provides guidance for determining or verifying the effects of an outdoor laser demonstration on the safe and efficient utilization of the navigable airspace. Order 7400.2D states, in part, "The eye-safe distances... are based on exposure limits for a maximum irradiance value of 2.6 milliwatts per square centimeter (2.6 mW/cm²). This irradiance value is the maximum at which a person, unaided by viewing devices, such as binoculars or

² Obtained through pilot reports to the Las Vegas ATCT. The number does not include laser incidents that have been reported by the Nellis Air Force Base, Las Vegas Metropolitan Police, or "Flight for Life" helicopters that operate in the Las Vegas area.

cameras, can typically react quickly enough to avoid an exposure that would exceed the limits of Class I."³

The U.S. Air Force's Armstrong Laboratory at Brooks Air Force Base in San Antonio, Texas, employs acknowledged experts in the field of flightcrew laser irradiation and is the current focal point for a combined military service research project studying the effects of laser irradiation. Based on their study of the radar track for Southwest flight 1367, laboratory personnel calculated that the maximum exposure to the first officer would have been slightly under 1 microwatt per square centimeter.⁴ Based on this information and the adverse effects reported by the pilots in both incidents, the Safety Board is concerned about the adequacy of the maximum irradiance limits (as set by the FAA in Order 7400.2D) in precluding permanent biological damage. The Safety Board is also concerned that these existing limits relate primarily to the prevention of permanent biological damage and do not address the issue of potentially incapacitating transient visual effects.

During the initial stages of the Safety Board's investigation of the flight 1367 incident, the FAA reported that it was considering initiating a simulator study in January 1996 to validate the limits specified in Order 7400.2D. However, the Safety Board is concerned that the project has been repeatedly delayed for unspecified reasons. The Safety Board believes that the FAA should expedite initiation and completion of the simulator study to determine acceptable maximum laser beam power/radiation levels and then should revise FAA Order 7400.2D accordingly. Also, upon completion of the study, the Safety Board believes that the FAA should provide all Flight Standards and Airspace Procedures personnel with information that describes the laser beam power divergence levels to be used when approving the location and use of laser beams.

The Safety Board has also found that currently, there is no readily available information to the aviation community, especially pilots, regarding laser beams. The logical source of this information would be the Aeronautical Information Manual (AIM), which provides the aviation community with basic flight information and air traffic control procedures for use within the National Airspace System. The manual also addresses subjects that may affect flight safety, such as FAA weather services, wake turbulence, and medical information. The Safety Board is concerned about the lack of information available to pilots on how to identify the location of laser show activity and possible hazards of laser beams, and how to avoid being irradiated by laser beams. Therefore, the Safety Board believes that the FAA should revise the AIM to include information to assist pilots in identifying the location of laser activity, describing the possible hazards of the laser beams and how to avoid the affected area.

Therefore, the Safety Board recommends the following to the Federal Aviation Administration.

³ According to FAA Order 7400.2D, Class I laser projectors produce levels of radiation that have not been found to cause biological damage. Class I visible radiation laser projectors emit less than 0.39 microwatts (0.39 millionths of a watt) continuous output.

⁴ Equates to .001 milliwatt.

Expedite completion of the simulator study to determine acceptable maximum laser beam power/radiation levels and then revise FAA Order 7400.2D accordingly (A-97-13)

Upon completion of the simulator study, provide all Flight Standards and Airspace Procedures personnel with information that describes the laser beam power divergence levels to be used when approving the location and use of laser beams (A-97-14)

Revise the Aeronautical Information Manual to include information to assist pilots in identifying the location of laser activity, describing the possible hazards of the laser beams and how to avoid the affected area (A-97-15)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations

A handwritten signature in black ink, appearing to read "Jim Hall", is written over a circular stamp. The stamp contains the text "By: Jim Hall" and "Chairman" below it.

By: Jim Hall
Chairman