



Aviation Investigation Final Report

Location:	Ravenswood, West Virginia	Accident Number:	ERA09FA429
Date & Time:	July 30, 2009, 21:49 Local	Registration:	N581DS
Aircraft:	Cirrus SR-22	Aircraft Damage:	Destroyed
Defining Event:	Loss of control in flight	Injuries:	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot of the single-engine, non-pressurized airplane in cruise flight at 25,000 feet above mean sea level requested and was issued a descent clearance to 12,000 feet. The pilot acknowledged the clearance, but the airplane did not descend. Air traffic control (ATC) noted that the pilot sounded "in distress and out of breath." The pilot was issued the clearance multiple times, but the airplane never descended. The last radio transmission received from the airplane was the pilot's labored breathing. Approximately 1 hour later, the airplane crossed directly over the destination airport at 25,000 feet, and maintained its on-course heading. National Guard aircraft scrambled to intercept the airplane were unable to gain the pilot's attention. The intercepting pilots observed an "unresponsive individual who appeared to be unconscious." The airplane continued in cruise flight at 25,000 feet for another hour after passing the destination airport before it slowed, departed controlled flight, and descended into terrain. All major components of the airplane were accounted for at the accident site. Examination of non-volatile memory from the accident airplane revealed that the onboard oxygen system had 29 percent of its total oxygen capacity remaining when the accident occurred. The airplane was equipped with a factory-installed oxygen system that the pilot had augmented by installing a supplemental pulse-demand oxygen system several months prior to the accident. The manufacturers of both systems explicitly advised against the use of non-original components with their respective systems. The pilot routinely used masks from the airplane's original oxygen system with components from the supplemental system he installed, and even noted the occurrence of a previous encounter with hypoxia in his pilot logbook as a result of this practice.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The pilot's improper modification of the certified, on-board oxygen system, which resulted in incapacitation due to hypoxia, and the airplane's subsequent uncontrolled descent into terrain.

Findings

Aircraft	(general) - Incorrect use/operation
Personnel issues	Hypoxia/anoxia - Pilot

Factual Information

History of Flight

Enroute-cruise	Pressure/environ sys malf/fail
Enroute-cruise	Miscellaneous/other
Enroute-cruise	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

HISTORY OF FLIGHT

On July 30, 2009, at 2149 eastern daylight time, a Cirrus SR-22, N581DS, was destroyed when it impacted terrain in Ravenswood, West Virginia. The certificated airline transport pilot, the sole occupant, sustained fatal injuries. Instrument meteorological conditions prevailed, and an instrument flight rules (IFR) flight plan was filed for the Title 14 Code of Federal Regulations Part 91 personal flight. The flight originated at York Municipal Airport (JYR), York, Nebraska, about 1840, and was bound for Eagle Creek Airpark (EYE), Indianapolis, Indiana.

According to the owner of the airplane, who did not hold any pilot certificates, he hired the accident pilot to fly him between JYR and EYE for business during the week. It was their custom to fly at lower altitudes from EYE to JYR, in order to minimize the effects of headwinds. On the return flight to EYE, they would normally fly at 25,000 feet to take advantage of tailwinds. On the day of the accident, he and the accident pilot completed the flight from EYE to JYR at 6,000 feet, and the pilot then departed on the return flight to EYE. The oxygen system was not serviced prior to departure, but was scheduled to be serviced at EYE the following week.

Approximately 7 miles northeast of JYR, the pilot contacted Minneapolis Air Route Traffic Control Center and requested an IFR clearance to EYE. The airplane was incrementally cleared to 25,000 feet. Data downloaded from the airplane's Recoverable Data Module (RDM) indicated that the pilot activated the oxygen system at 1852, at 12,160 feet. At 1857, the airplane was cleared to climb from 22,000 feet to 23,000 feet. The pilot acknowledged the instruction, but the controller noted that the pilot's voice had changed, and had taken on a "helium/Mickey Mouse" quality.

At 1905, the controller noted that the pilot was "climbing to the wrong altitude" and "stepping all over himself." Later, the airplane was given a vector to avoid traffic, which the pilot acknowledged, but when instructed to proceed on course, the pilot's response was "unreadable." At 1916, the pilot was instructed by air traffic control (ATC) to turn 15 degrees right for traffic. The pilot acknowledged and complied. At 2320, ATC instructed the pilot to proceed on course. The pilot again acknowledged and complied with the instruction.

At 1925, the pilot requested a descent to 12,000 feet. The controller stated that the airplane's call sign was "unreadable." After several attempts, the controller verified the airplane as N581DS, and issued a clearance to descend to 24,000 feet. The pilot acknowledged the clearance by responding, "two four zero one delta sierra;" but did not begin a descent. The controller remarked that the pilot sounded "in distress and out of breath."

At 1927, the airplane was instructed to descend to 12,000 feet and was issued the altimeter setting. The pilot acknowledged the call and repeated the altimeter setting. However, the airplane maintained cruise flight at 25,000 feet.

ATC attempted to contact the airplane for approximately 6 minutes before the pilot responded, at 1934, with, "Go ahead." The airplane was again issued a clearance to 12,000 feet and instructed to "start your descent." An airline pilot on the frequency commented that the accident pilot sounded "incoherent."

The last radio transmission received from the airplane, at 1937, was the pilot's labored breathing. At 2051, the airplane crossed directly over EYE at 25,000 feet, and maintained its on-course heading.

Data from the RDM revealed that the airplane continued in cruise flight at 25,000 feet until 2146. At that time, after fluctuating for about 30 seconds, engine power and fuel flow parameters dropped to zero, and engine cylinder head and exhaust gas temperatures dropped significantly. The airplane then began to pitch nose-up pitch while decelerating at 25,000 feet, until a sharp, descending left turn was entered. The airplane then continued a string of spiraling left and right turns with changes in nose pitch, both up and down, until the data stream was lost. RDM data also indicated that the oxygen tank was at 29 percent capacity at the time of the accident.

The Ohio Air National Guard scrambled aircraft to intercept the accident airplane, but once alongside, the intercepting pilots were unable to gain the pilot's attention visually or by radio. A North American Aerospace Defense Command spokesman stated that the intercepting pilots observed an "unresponsive individual who appeared to be unconscious." The intercepting aircraft remained with the airplane until it departed controlled flight and descended into terrain.

PERSONNEL INFORMATION

The pilot, age 66, held an airline transport pilot certificate with ratings for airplane single engine and multiengine land; a flight instructor certificate with ratings for airplane single engine, airplane multiengine, and instrument airplane; and a commercial pilot certificate with ratings for rotorcraft and single engine seaplanes. Additionally, he held a Learjet type rating. The pilot reported 18,500 hours of total flight experience on his most recent application for a Federal Aviation Administration (FAA) first-class medical certificate, which was issued on July 14, 2009.

On an insurance renewal form dated July 23, 2009, the pilot reported 18,700 total hours of flight experience, 500 hours of which were in the accident airplane make and model.

AIRCRAFT INFORMATION

The airplane was manufactured in 2008 as a single-engine, unpressurized, composite construction, low-wing airplane. It was equipped with a turbo-normalized, 310-horsepower Teledyne Continental Motors IO-550-N engine.

Review of the airplane's maintenance records revealed that the airplane and engine had accrued 445.6 flight hours at the time of the accident. The most recent 100-hour inspection was conducted on July 22, 2009, at a total time of 433.5 hours.

Review of the airplane's warranty records revealed an entry dated December 9, 2008, at 145.7 total hours, which stated, "oxygen leaks down to 1600 psi." The work performed entry stated, "Removed tail panel, leak check all fittings found service line at oxygen bottle leaking. Removed line and inspected, no damage to line noted. Reinstalled line secured fittings and serviced oxygen [bottle]."

An entry in the airplane's maintenance log, dated January 29, 2009, stated, "Serviced and inspected oxygen fill line for leaks. Tightened line in accordance with aircraft maintenance manual. Serviced oxygen."

The most recent oxygen servicing took place on June 10, 2009.

METEOROLOGICAL INFORMATION

At 2153, the weather reported at Mid-Ohio Valley Regional Airport (PKB), Parkersburg, West Virginia, located approximately 30 miles northeast of the accident site, included winds from 170 degrees at 3 knots, and 2 ½ statute miles visibility in mist. There were scattered clouds at 1,600 feet and 2,600 feet, and a broken ceiling at 3,800 feet. The temperature was 22 degrees Celsius (C), the dew point was 21 degrees C, and the altimeter setting was 29.93.

WRECKAGE AND IMPACT INFORMATION

The airplane impacted a hill about 6 miles north of the town of Ravenswood, at 39 degrees, 2.07 minutes north latitude, 081 degrees, 44.30 minutes west longitude. The airplane was examined at the site on July 31, 2009. There was an odor of fuel, and all major components were accounted for at the scene. The wreckage path was oriented approximately 115 degrees magnetic, was about 550 feet long, and widened along its length to a width of approximately 150 feet. The first 200 feet of the wreckage path was on the down slope of an open pasture, at the top of a wooded ridgeline. The remainder of the wreckage path was distributed down a steep, heavily wooded incline to a creek bed.

A large area of grass just beyond the initial ground scar, and trees along the wood line, exhibited browning of the foliage consistent with exposure to fuel. The airplane was significantly fragmented and scattered over the entire area. Fragments associated with the engine, propeller blades, and flight control system were accounted for along the entire length of the wreckage path. The primary flight and multi-function displays were destroyed and impossible to identify. The Cirrus Airframe Parachute System (CAPS) was deployed due to impact forces.

The oxygen system components recovered at the accident site included, one Precise Flight 77.1 cubic-foot capacity oxygen cylinder, four Precise Flight nasal cannulas, two Precise Flight clear oxygen masks, one Precise flight blue oxygen mask with microphone, and one blue mask of undetermined origin. The oxygen cylinder was found intact, with the regulator and pressure transducer still attached. All other oxygen system components were substantially damaged or destroyed.

MEDICAL AND PATHOLOGICAL INFORMATION

The Office of the Chief Medical Examiner, State of West Virginia, Charleston, West Virginia, performed an autopsy on the pilot. The autopsy report noted the cause of death as "multiple blunt force injuries."

The FAA's Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed toxicological testing on the pilot. No traces of carbon monoxide, cyanide, or drugs were detected. No ethanol was detected in the liver, but 27 (mg/dl, mg/hg) ethanol was detected in the muscle. The report noted that the ethanol was "from sources other than ingestion."

ADDITIONAL INFORMATION

The airplane was equipped with a factory-installed Precise Flight fixed oxygen system, consisting of a 77-cubic foot capacity oxygen cylinder and pressure regulator assembly mounted in the aft fuselage, a four-place distribution manifold located in the cabin headliner, a control panel located in the cockpit center console, and a filler port and manual pressure gauge located in the aft wall of the baggage compartment. The Precise Flight system also included a "Breathing Station Kit," including four in-line oxygen flowmeters, two clear plastic oxygen masks, two blue rubber oxygen masks with microphones, four nasal cannulas, and one fingertip pulse oximeter. All Precise Flight oxygen masks were equipped with diluter bags.

Oxygen flow was controlled by a switch located in the cockpit, which electronically actuated the regulator. The cockpit control was equipped with light-emitting diode (LED) indicators, displaying oxygen capacity measured in psi increments of 400 psi from "EMPTY" (0 psi) to "FULL" (2,000 psi). The LED indicators flashed red if the oxygen bottle pressure fell below 400 psi.

The cockpit control included two additional LED indicators; one labeled "O2 REQ'D" and the other labeled "FAULT." The "O2 REQ'D" LED illuminated if the airplane was above approximately 12,000 feet pressure altitude and the oxygen system was not selected ON. System faults were indicated by the "FAULT" LED.

On February 25, 2009, the pilot ordered a Mountain High EDS-O2D2 Pulse Demand oxygen system manufactured by Mountain High Equipment and Supply. The owner of the airplane stated that the pilot later installed the system himself in early March.

The O2D2 components included a small, AA-battery-powered unit equipped with a power on/off and mode control switch, one oxygen regulator inlet, two breathing device outlets, one red/green LED indicator for each outlet, two static ports, and one audio port. The O2D2 also included two nasal cannulas, two clear plastic oxygen masks, and adapter oxygen tubing. The oxygen masks included in the O2D2 system were not equipped with diluter bags.

The O2D2 system was installed downstream of, and operated with the airplane's existing oxygen system by means of an in-line regulator. According to Mountain High, the in-line regulator was necessary to ensure correct flow pressure to the masks. The O2D2 was designed to provide a short burst of oxygen when it detected inhalation, rather than provide a continuous flow of oxygen through the mask.

An entry in the pilot's logbook for a flight dated March 12, 2009, conducted in the accident airplane on the intended route of the accident flight, stated, "EPIC!! Near Payne Stewart repeat at FL250 due to O2D2."

In telephone interviews, the owner of the airplane stated that he was not familiar with this specific incident. However, he was aware that the pilot experienced problems with proper fitment of the oxygen mask to his face, and had experienced symptoms of hypoxia on prior flights. He said the pilot attempted to resolve the issue by tightening the lower straps of the mask to secure the mask's seal around his chin.

A friend of the pilot, who was familiar with the O2D2 system, stated that the pilot mentioned the incident, but did not provide details about what occurred. The pilot did state that he was nearly incapacitated, and learned to watch more closely for the signs of hypoxia. The friend was also aware that the pilot had problems with proper fitting due to the small size of his face, and strongly encouraged the pilot to purchase a child-sized mask.

The owner stated that he flew with the accident pilot at 25,000 feet "many times." When asked if the pilot utilized the pulse oximeter, he stated that they would use it "randomly" and then "put it back in the box." The owner stated that he used the clear Precise Flight oxygen mask, and the pilot used the blue Precise Flight oxygen mask with the microphone. Both the pilot and owner were aware that the O2D2 pressure sensor did not function correctly when used in conjunction with a mask equipped with a diluter bag, so they tied the bag in a knot or

constricted the diluter bag at the mask attach point with rubber bands.

The "Troubleshooting" section of the O2D2 Operating Manual stated, "Use only face masks provided by Mountain High Equipment and Supply. NOTE: EDS face masks do not have a dilution bag attached."

The Precise Flight pilot's operating handbook and airplane flight manual supplement stated, "The FAA, under 14 CFR Part 23 Regulations, require the complete Oxygen System (including the breathing stations, flowmeters, cannulas, and masks) be certified as a complete System. The use of other breathing equipment in conjunction with the built-in portion of the System has not been tested, nor is it FAA-Approved."

The O2D2 modification to the existing built-in oxygen system was installed without the use of FAA-approved installation data. Title 14 Code of Federal Regulations Part 21, Subpart K, lists the requirements by a manufacturer or individual to obtain an FAA Parts Manufacturing Approval (PMA). In addition, a letter available from the Mountain High website stated, "...we do not have any supplemental type certificates (STC) or currently manufacture under a PMA at this time".

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	Age:	66, Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	Helicopter	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	Toxicology Performed:	Yes
Medical Certification:	Class 1 With waivers/limitations	Last FAA Medical Exam:	July 14, 2009
Occupational Pilot:	UNK	Last Flight Review or Equivalent:	July 2, 2009
Flight Time:	18700 hours (Total, all aircraft), 500 hours (Total, this make and model), 200 hours (Last 90 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cirrus	Registration:	N581DS
Model/Series:	SR-22	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	3164
Landing Gear Type:	Tricycle	Seats:	4
Date/Type of Last Inspection:	July 22, 2009 Annual	Certified Max Gross Wt.:	3400 lbs
Time Since Last Inspection:	12 Hrs	Engines:	1 Reciprocating
Airframe Total Time:	446 Hrs at time of accident	Engine Manufacturer:	Teledyne Continental
ELT:	Installed, not activated	Engine Model/Series:	IO-550-N
Registered Owner:	Sequoia Airways, LLC	Rated Power:	310 Horsepower
Operator:	Sequoia Airways, LLC	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	Condition of Light:	Night/dark
Observation Facility, Elevation:	PKB,806 ft msl	Distance from Accident Site:	30 Nautical Miles
Observation Time:	21:53 Local	Direction from Accident Site:	35°
Lowest Cloud Condition:	Scattered / 1600 ft AGL	Visibility	2 miles
Lowest Ceiling:	Broken / 3800 ft AGL	Visibility (RVR):	
Wind Speed/Gusts:	3 knots / None	Turbulence Type Forecast/Actual:	/
Wind Direction:	170°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29.93 inches Hg	Temperature/Dew Point:	22°C / 21°C
Precipitation and Obscuration:	N/A - None - Mist		
Departure Point:	York, NE (JYR)	Type of Flight Plan Filed:	IFR
Destination:	Indianapolis, IN (EYE)	Type of Clearance:	IFR
Departure Time:	18:40 Local	Type of Airspace:	Class A

Wreckage and Impact Information

Crew Injuries:	1 Fatal	Aircraft Damage:	Destroyed
Passenger Injuries:		Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Fatal	Latitude, Longitude:	39.034442,-81.738334

Administrative Information

Investigator In Charge (IIC):	Rayner, Brian
Additional Participating Persons:	Charles Monola; FAA/FSDO; Charleston, WV Bradley Miller; Cirrus Aircraft; Duluth, MN Jason Lukasik; Teledyne Continental; Mobile, AL
Original Publish Date:	December 20, 2010
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=74411

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The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).