National Transportation Safety Board
Aviation Accident Final Report

Location:	Atlantic City, AO	**Accident Number:**	ERA15LA349
Date & Time:	09/10/2015, 1448 EDT	**Registration:**	N370MM
Aircraft:	MOONEY AIRPLANE CO INC M20TN	**Aircraft Damage:**	Substantial
Defining Event:	Miscellaneous/other	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

The commercial pilot departed Michigan on a personal cross-country flight in the autopilot-equipped airplane destined for New Jersey. Air traffic control records indicated that after the airplane departed, about 1200, a controller instructed the pilot to climb to 25,000 ft mean sea level (msl). At 1216, the pilot read back the assigned altitude and continued toward the destination. About 23 minutes later, the controller attempted to contact the pilot; however, the pilot did not respond. Controllers' repeated attempts to contact the pilot throughout the remainder of the flight were unsuccessful as the airplane continued flying a straight course toward the destination.

According to radar data, about 2 hours 22 minutes after the pilot's last transmission and while about 5 miles northwest of the destination, the airplane began descending out of 25,000 ft msl while on a southeast heading until it impacted the Atlantic Ocean about 8 minutes later. Given that the pilot refueled the airplane several days before the flight and filed a flight plan that indicated that the airplane's fuel onboard would allow for 6 hours of flight, it is likely that both fuel tanks had 51 gallons of fuel onboard. Fuel consumption calculations indicate that the airplane would consume up to 22.6 gallons of fuel per hour at cruise flight at 25,000 ft. Therefore, it is likely that the amount of fuel consumed on the day of the flight, given initial takeoff and climb consumption in addition to the 2 hours 22 minute cruise flight, would have been equivalent to the fuel available in one tank. Without pilot action to switch fuel tanks, the engine became starved of fuel and the airplane began its descent to the ocean.

An examination of the airframe and engine revealed no preimpact anomalies that would have precluded normal operation.

During an examination of the oxygen system on the airplane, a fitting, which connected an oxygen line to a regulator on the tank, was found loose and could be moved in both directions by hand without resistance. The oxygen system was serviced with oxygen 5 flight hours before the accident and had a capacity of at least 11 hours of oxygen for pilot-only operations; however, it is likely that the loose oxygen line allowed oxygen to escape and drained the oxygen

canister more quickly than the pilot expected. Therefore, although the pilot was found wearing an oxygen mask, given the high altitude the airplane was at for the duration of the flight, the pilot's failure to respond to controller contact, and evidence indicating that he would have had reduced availability of supplemental oxygen, it is likely that the pilot became incapacitated due to hypoxia. The airplane's continued flight at 25,000 ft msl and its descent profile were consistent with the airplane operating under autopilot control and then descending to water impact due to fuel starvation.

The servicing of the oxygen system was performed at the time of an annual inspection, which should have included an inspection of the oxygen system for leaks.

Toxicology testing of specimens from the pilot detected 26 mg/dL ethanol in the blood; given that no ethanol was detected elsewhere, the low level of ethanol detected in pilot's blood was likely due to postmortem production not from ingestion; therefore, ethanol likely did not contribute to the accident. Diphenhydramine, an impairing medication that causes sedation, altered mood, and impaired cognitive and psychomotor performance, was detected in the liver and cavity blood. Because diphenhydramine undergoes postmortem distribution, levels may have been significantly lower than the detected postmortem levels ; therefore, it could not be determined whether the pilot's use of diphenhydramine contributed to the accident.

Probable Cause and Findings

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

A loose oxygen line, which was not detected by maintenance personnel during a recent annual inspection, that allowed oxygen to escape and drain the oxygen canister more quickly than the pilot expected. This reduced the pilot's availability of supplemental oxygen and led to his experiencing hypoxia and the airplane subsequently flying on autopilot until it eventually lost power due to fuel starvation.

Findings

Aircraft	Oxygen system - Malfunction (Cause)
	Oxygen system - Inadequate inspection (Cause)
	Fuel - Fluid level (Cause)
Personnel issues	Hypoxia/anoxia - Pilot (Cause)
	Scheduled/routine maintenance - Maintenance personnel (Cause)

Factual Information

History of Flight

Prior to flight	Aircraft maintenance event
Enroute-cruise	Miscellaneous/other (Defining event)
	Loss of control in flight
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On September 10, 2015, about 1448 eastern daylight time, a Mooney M20TN airplane, N370MM, impacted the Atlantic Ocean off the coast of Atlantic City, New Jersey. The commercial pilot was fatally injured, and the airplane sustained substantial damage. The airplane was owned by the pilot and the flight was being conducted as a 14 *Code of Federal Regulations* Part 91 personal flight. Day visual meteorological conditions existed near the accident site about the time of the accident, and an instrument flight rules flight plan had been filed. The flight originated from Gaylord Regional Airport (GLR), Gaylord, Michigan, about 1200 and was destined for Atlantic City International Airport (ACY), Atlantic City, New Jersey.

According to the pilot's logbook and a fuel receipt, he flew the accident airplane for 1 hour on September 7, 2015, and then fueled the airplane with 11.4 gallons of 100LL aviation fuel. There were no other fuel transactions or flights between that time and the day of the accident. The pilot reported in his flight plan that there was sufficient fuel onboard the airplane for 6 hours of flight.

According to Federal Aviation Administration (FAA) Minneapolis Air Route Traffic Control Center (ARTCC) records, the airplane departed GLR about 1200, and at 1214:04, the pilot checked in and informed the controller that he was climbing from 17,600 to 21,000 ft mean sea level (msl). The controller then instructed the pilot to climb to 25,000 ft msl, and the pilot read back the assigned altitude and continued toward the destination.

About 23 minutes later, while the autopilot-equipped airplane was in cruise flight, the ARTCC controller attempted to contact the pilot with a frequency change; however, the pilot did not respond. The controllers' repeated attempts to contact the pilot throughout the remainder of the flight were unsuccessful as the airplane continued flying a straight course toward ACY at 25,000 ft msl. According to radar data, at 1438 and while about 5 miles northwest of ACY, the airplane began descending from 25,000 ft msl and continued to descend at an average descent rate of about 1,600 ft per minute on a southeast heading until it impacted the Atlantic Ocean about 8 minutes later. As the airplane was descending, two F-16 airplanes departed ACY to relay search and rescue information, and the pilots subsequently found debris.

Pilot Information

Certificate:	Commercial	**Age:**	68, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Without Waivers/Limitations	**Last FAA Medical Exam:**	10/26/2013
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	09/14/2013
Flight Time:	4900 hours (Total, all aircraft), 2.5 hours (Last 90 days, all aircraft), 1.75 hours (Last 30 days, all aircraft)		

According to the pilot's logbook, he held a commercial pilot certificate with airplane single-engine land, multiengine land, and instrument airplane ratings. His most recent FAA third-class medical certificate was issued on October 26, 2013, with no limitations. He recorded 4,900 hours of total flight experience, 2.5 hours of which were in the 90 days before the accident.

Aircraft and Owner/Operator Information

Aircraft Make:	MOONEY AIRPLANE CO INC	**Registration:**	N370MM
Model/Series:	M20TN NO SERIES	**Aircraft Category:**	Airplane
Year of Manufacture:	2007	**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	31-0071
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	06/12/2015, Annual	**Certified Max Gross Wt.:**	3369 lbs
Time Since Last Inspection:	5 Hours	**Engines:**	1 Reciprocating
Airframe Total Time:	477.2 Hours at time of accident	**Engine Manufacturer:**	CONT MOTOR
ELT:	C126 installed	**Engine Model/Series:**	TSIO-550-G
Registered Owner:	On file	**Rated Power:**	310 hp
Operator:	On file	**Operating Certificate(s) Held:**	None

According to FAA records, the airplane was manufactured in 2007 and registered to the pilot in December 2007. The most recent annual inspection was performed on June 12, 2015, at which

time it had accumulated 472.2 total hours of time in service.

According to the Pilot's Operating Handbook (POH), the airplane was equipped with extended range tanks where fuel was "carried in two integrally sealed sections of the forward, inboard area of the wing." The total usable fuel capacity was 102 gallons, 51 gallons per side. The pilot could set the fuel selector valve to the "left" tank, "right" tank, or "off" position via a recessed three-position handle aft of the console on the floor.

The airplane was also equipped with a four-place oxygen system that provided supplementary oxygen necessary for continuous flight at high altitude. Four oxygen outlets were provided in the overhead panel between the pilot and copilot seats. Oxygen would flow from the outlets only when a mask hose was connected. The pilot's mask was a permanent rebreathing-type mask with a vinyl plastic hose and a built-in microphone for radio communication while using oxygen. The oxygen cylinder filler valve was located under a spring-loaded door aft of the baggage door. When in service, the 77.1 cubic-ft tank could supply at least 11 hours of oxygen for a pilot-only operation depending on flight altitude. The airplane was equipped with an oxygen system quantity indicator in the pilot's arm rest. According to a receipt from the most recent annual inspection, the oxygen bottle was serviced at that time. Further, according to stickers placed on the oxygen regulator and the tank, they were both overhauled in May 2013.

Review of the Mooney 100 Hour-Annual Inspection Guide revealed that it included an inspection of the "oxygen system for leaks, proper ON/OFF valve operation & filler for safety of operation..."

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	ACY, 67 ft msl	**Distance from Accident Site:**	14 Nautical Miles
Observation Time:	1454 EDT	**Direction from Accident Site:**	293°
Lowest Cloud Condition:	Few / 700 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	Variable	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.75 inches Hg	**Temperature/Dew Point:**	24°C / 22°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	GAYLORD, MI (GLR)	**Type of Flight Plan Filed:**	IFR
Destination:	ATLANTIC CITY, NJ (ACY)	**Type of Clearance:**	IFR
Departure Time:	1200 EDT	**Type of Airspace:**	

At 1454, the weather reported at ACY indicated variable wind at 4 knots, 10 miles visibility, few clouds at 700 and 3,400 ft above ground level, temperature 24°C, dew point 22°C, and an altimeter setting of 29.75 inches of mercury.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	39.354444, -74.281667 (est)

The airplane was located by the United States Coast Guard off the coast of Atlantic City, New Jersey, in about 45-ft-deep water. On September 12, 2015, the airplane was recovered and moved to a salvage facility to facilitate further examination.

The fuselage was severely impact damaged. The inboard 2-ft-long section of the left wing remained attached to the fuselage. The outboard section of the left wing was impact separated and not recovered. The empennage was impact separated from the fuselage. The vertical stabilizer and rudder remained attached to the empennage. The bottom 1-ft-long section of the rudder exhibited impact damage. The left horizontal stabilizer and elevator remained attached to the empennage at all attachment points. The left and right elevator counterweights were impact separated and not recovered. The right horizontal stabilizer and elevator remained attached to the empennage but was impact damaged in the positive direction. The right wing was impact separated from the fuselage and not recovered. Control cable continuity was confirmed from the rudder and elevator to the cockpit through control tube fractures and separations. In addition, control continuity was established from the yoke to both wing roots through control tube fractures and separations.

Both front seats remained attached to the fuselage. Two oxygen lines were secured to the top portion of the cabin. An oxygen pulse oximeter was located in the cabin area of the wreckage, and the pilot was found wearing an oxygen mask. A Hobbs meter was located in the aft section of the fuselage and indicated 477.2 hours of flight time.

The engine was impact separated from the airframe. The rocker box covers were removed, and engine continuity was confirmed from the propeller through the aft section of the engine. All three propeller blades were bent; two of the blades were bent in the same direction, and the third blade was bent in the opposite direction. The fuel line from the fuel manifold valve to the fuel metering unit was removed, and a drop of fluid was noted coming out of the line. The fluid had an odor similar to 100 LL aviation fuel. There were no preimpact anomalies noted with the engine that would have precluded normal operation.

An oxygen tank was located aft of the aft bulkhead. An elbow fitting that was connected to the

oxygen regulator assembly, which connected an oxygen line to the tank, was found loose. The fitting could be moved in both directions by hand without resistance.

Three Garmin G1000 SD cards were removed from the wreckage and sent to the NTSB Recorders Laboratory for data download. The G1000 SD cards contained firmware versions and navigation databases that did not record data. No accident data were recovered from the SD cards.

Medical And Pathological Information

The Office of the State Medical Examiner for the State of New Jersey performed an autopsy on the pilot. The autopsy report indicated that the pilot died due to "multiple blunt injuries."

The FAA's Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed toxicological testing of fluid and tissue specimens from the pilot. The specimens tested negative for carbon monoxide, and 26 mg/dL ethanol was detected in the blood. No ethanol was detected in muscle and brain tissue specimens. Diphenhydramine was detected in the liver, and 0.071 ug/ml diphenhydramine was detected in the blood. In addition, chlorthalidone was detected in the liver and blood.

Ethanol can be produced in tissues by postmortem microbial activity, which can result in considerable variations in levels in different tissues. Ingested alcohol is generally distributed throughout the body and levels in different postmortem tissues are usually similar.

Diphenhydramine is a sedating antihistamine used to treat allergy symptoms and as a sleep aid and carries the following Federal Drug Administration warning: "May impair mental and/or physical ability required for the performance of potentially hazardous tasks (e.g. driving, operating heavy machinery)." Diphenhydramine may also result in altered mood and impaired cognitive and psychomotor performance.. In fact, in a driving simulator study, a single dose of diphenhydramine impaired driving ability more than a blood alcohol concentration of 0.100%. The therapeutic range for diphenhydramine is 0.0250 to 0.1120 ug/ml. Diphenhydramine undergoes postmortem redistribution, which can result in central postmortem levels being about two to three times higher than peripheral levels. Chlorthalidone is a diuretic prescription blood pressure medication that may decrease the recurrence of kidney stones and is not considered impairing.

Additional Information

Performance Calculations

According to the POH, the fuel consumption for the flight using best-power performance data at 25,000 ft pressure altitude, depending on the selected manifold pressure and outside air temperature, would have been between 12.0 and 22.6 gallons of fuel per hour.

Pilot's Handbook of Aeronautical Knowledge – Hypoxia

According to the Pilot's Handbook of Aeronautical Knowledge, Chapter 17, "Aeromedical Factors,"

Hypoxia means 'reduced oxygen' or 'not enough oxygen.'... Hypoxia can be caused by several factors, including an insufficient supply of oxygen, inadequate transportation of oxygen, or the inability of the body tissues to use oxygen...High-altitude flying can place a pilot in danger of becoming hypoxic. Oxygen starvation causes the brain and other vital organs to become impaired...the symptoms of hypoxia vary with the individual....As altitude increases above 10,000 feet, the symptoms of hypoxia increase in severity, and the time of useful consciousness rapidly decreases.

According to the time of useful consciousness chart in the handbook, a pilot has 3 to 5 minutes of useful consciousness at 25,000 ft msl.

Administrative Information

Investigator In Charge (IIC):	Heidi Kemner	**Report Date:**	10/18/2017
Additional Participating Persons:	Stephen Koza; FAA/FSDO; Philadelphia, PA Nicole Charnon; Continental Motors Inc.; Mobile, AL		
Publish Date:	10/17/2017		
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=91956		