Aviation Investigation Final Report

Location:	Ellendale, Minnesota	**Accident Number:**	CEN17LA101
Date & Time:	February 2, 2017, 19:55 Local	**Registration:**	N9149V
Aircraft:	Mooney M20C	**Aircraft Damage:**	Substantial
Defining Event:	Miscellaneous/other	**Injuries:**	1 Serious
Flight Conducted Under:	Part 91: General aviation		

Analysis

The accident occurred during the commercial pilot's third flight of the day in the accident airplane. The pilot reported that he used the airplane's heater throughout the day. The pilot reported having a headache and experiencing "butterflies" in his stomach during the end of first flight. The headache subsided after the flight, and he felt fine during the second flight, but the headache returned after he landed. Before the third flight, the pilot expedited his time on the ground because he was concerned about getting the engine started in the cold weather. The pilot started the engine and sat in the airplane while he filed his flight plan and got organized for the flight. The pilot added that, while taxiing to the runway, he still had the headache, and he experienced another episode of "butterflies." He stated that the symptoms were more intense at that time than they had been in the morning but that they subsided by time he reached the runway, and he felt "good" but became "hyper focused." He performed an engine run-up and repeated the takeoff checklist three or four times until the controller asked if he was ready to take off, which "snapped" him out of repeating the takeoff checklist. The pilot was in the airplane with the engine running for about 12 minutes before takeoff.

The pilot remembered being cleared to a heading of 240° and setting the autopilot heading bug before taking off. He stated that, while climbing out, he experienced another case of the "butterflies." He added that he began a turn and activated the autopilot during the turn. The last thing he remembered was being cleared to 6,000 ft on a heading of 240°. After the pilot attempted to check in twice with departure control (he was still on the tower control frequency), air traffic controllers repeatedly attempted to contact the pilot without success. Radar data showed that the airplane climbed higher than 12,000 ft and was off course. The airplane continued to fly until it ran out of fuel and crashed in an open field. The pilot was not conscious until after the airplane impacted the field. He stated he was very confused and had loud ringing in his ears at this point. The pilot freed his legs from the wreckage and exited the airplane. He stated he was very weak and had difficulty with his balance and ability to walk as he made his way to a nearby house.

A postaccident examination revealed that the both fuel tanks were empty. The cabin heat was found on,

and the cabin vent control was found off. The exhaust muffler had several cracks, one of which contained soot/exhaust deposits on the fractured surfaces, indicating it existed before impact. The crack would have allowed exhaust gases to enter the cockpit/cabin. The pilot reported that the airplane was not equipped with a carbon monoxide (CO) detector. A review of maintenance records showed that a new exhaust system was installed on the airplane on January 25, 2007, at a tachometer time of 2,343 hours. The last annual inspection was conducted on February 2, 2016, at a tachometer time of 2998.0 hours. The tachometer time at the time of the accident was 3,081 hours.

The pilot's CO level, when tested over 4 1/2 hours after the accident, was 13.8%. Given the half-life of CO in the blood stream over 4 to 5 hours while breathing ambient air, the pilot's CO level at the time of the accident was at least 28% and likely significantly higher because oxygen was administered in varying amounts during the first few hours of his postaccident medical care. The pilot's high CO level led to his incapacitation due to CO poisoning and the airplane's continued flight until it ran out of fuel and impacted terrain.

Probable Cause and Findings

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

The pilot's incapacitation from carbon monoxide poisoning in flight due to cracks in the exhaust muffler, which resulted in the airplane's continued flight until it ran out of fuel and its subsequent collision with terrain.

Findings

Aircraft	(general) - Fatigue/wear/corrosion
Personnel issues	Carbon monoxide - Pilot

Factual Information

History of Flight

Enroute	Miscellaneous/other (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On February 2, 2017, about 1955 central standard time, N9149V, a Mooney M20C, collided with a field in Ellendale, Minnesota, after the pilot became incapacitated during the flight. The pilot was seriously injured and the airplane was substantially damaged. The airplane was registered to and operated by the pilot under the provisions of 14 *Code of Federal Regulations* Part 91 as a business flight. Visual meteorological conditions prevailed and an instrument flight rules flight plan was filed. The flight originated from the Duluth International Airport (DLH), Duluth, Minnesota, at 1808, with an intended destination of the Winona Municipal Airport (ONA), Winona, Minnesota.

Earlier on the day of the accident the pilot flew the airplane from ONA to Thunder Bay (CYQT), Ontario (CYQT). The weather was cold so he had the airplane heater on for the entire trip. The pilot stated he had a slight headache during the last 10 to 15 minutes of the 2 hour 30-minute flight. After landing, while in the fixed base operator, the headache remained and he felt "butterflies" in his stomach which he likened to a feeling of anxiety. The pilot attributed his headache to not having any caffeine in the morning and having possibly picked up an illness from a family member and he attributed the anxiety to his concern about following proper customs procedures.

The pilot stated the headache continued during the morning until he drank coffee which seemed to help. The pilot had the airplane preheated and departed CYQT about 1600 for the 1 hour 20-minute flight to DLH. The pilot reported he did not have a headache during the flight, but the headache returned after he landed at DLH. The pilot expedited his time on the ground at DLH because he was concerned about getting the engine started in the cold weather. He stated he started the airplane and sat in it while he filed his flight plan and "took my time getting the cockpit organized for the flight." The pilot received his IFR clearance to fly as filed to ONA at 6,000 ft above mean sea level (msl) and to expect a clearance to 9,000 ft msl, 10 minutes after takeoff. The pilot read back the clearance and requested to taxi.

The pilot still had a headache and experienced another episode of "butterflies" while taxiing to the runway. He stated the symptoms were more intense than they were in the morning. He stated the symptoms subsided by time he reached the runway, and he felt "good" but became "hyper focused." He performed an engine runup and performed the takeoff checklist 3 or 4 times and repeatedly checked the avionics and instruments, which was not his normal routine. The airport tower controller asked him if he was ready to takeoff, which he stated "snapped" him out of repeating the takeoff checklist. Air traffic control (ATC) recordings show the pilot was in the airplane with it running for at least 12 minutes prior to taking off.

The pilot stated he remembers being cleared to a heading of 240° and setting the autopilot heading bug prior to taking off. While climbing out, he experienced another case of the "butterflies". He stated he began the turn and activated the autopilot during the turn. The last thing he remembers is being cleared

to 6,000 ft msl on a heading of 240°. ATC transcripts recordings show the pilot communicated with ATC for the first four minutes of the flight. About three minutes after takeoff, the DLH tower controller instructed the pilot to contact departure control. The pilot acknowledged the instruction and attempted to check in with departure control while still on the tower control frequency. The controller informed the pilot that he was still on the tower frequency. At 1812:18, the pilot once again attempted to contact departure control without having changed the frequency. This was the last communication from the pilot.

Both the DLH controller and controllers in the Minneapolis Air Route Traffic Center made numerous attempts to contact the pilot, including having other pilots attempt to make radio contact. Radar data showed the airplane flew a ground track of 190 to 200 degrees at altitudes that exceeded 12,000 ft msl. The last radar contact was at 1952:47 at an altitude of 2,300 ft msl about 1 mile north-northeast of the accident site, which was about 80 miles west of ONA.

The pilot remained unresponsive until after the airplane impacted a field in a relatively level attitude. The pilot recalled waking up and thinking that he fell asleep for a few minutes. He stated he keyed the microphone to let air traffic control know that he was alright and noticed that the windscreen was "clear." He reached his hand out the hole in the windscreen which is when he realized that he was no longer flying. He stated he was very confused and had loud ringing in his ears at this point. The pilot freed his legs from the wreckage and he exited the airplane. He stated he was very weak and had difficulty with his balance and ability to walk. The pilot eventually made his way to a house about 500 ft from the accident site. It is unknown how long the pilot was unconscious after the impact. However, the last radar contact was at 1955 and the 911 call from the house was placed at 2107.

A postaccident examination of the airplane revealed that both the left and right fuel tanks were empty. The cabin heat control was full out (on) and the cabin vent control was full in (off). The exhaust muffler contained several cracks, one of which contained soot/exhaust deposits on the fractured surfaces. The inside of the exhaust shroud contained sooting as did the scat tubing leading from the muffler. The pilot reported he had the heater "full-on" during all three of the flights on the day of the accident and he did not have a CO detector in the airplane.

A review of maintenance records showed a new exhaust system was installed on the airplane on January 25, 2007, at a tachometer time of 2,343 hours. The last annual inspection was conducted February 2, 2016, at a tachometer time of 2998.0 hours. The tachometer time at the time of the accident was 3,081 hours.

The pilot provided his postaccident medical records for the National Transportation Safety Board (NTSB). The NTSB Chief Medical Officer reviewed the records and reported the pilot was treated for injuries sustained during the accident and for frostbite. At 0018, on the morning following the accident, the pilot's blood was drawn for tests which included carbon monoxide (CO) levels. At that time, the CO level was 13.8%.

Carbon monoxide is an odorless, tasteless, colorless, nonirritating gas formed by hydrocarbon combustion. CO binds to hemoglobin with much greater affinity than oxygen, forming carboxyhemoglobin; elevated levels result in impaired oxygen transport and utilization. Nonsmokers may normally have up to 3% carboxyhemoglobin in their blood; heavy smokers may have levels of 10 to 15%. The pilot was a nonsmoker.

The degree of carboxyhemoglobinemia is primarily related to the relative amounts of CO and oxygen in the environment and the duration of exposure. Once exposure to the CO decreases or ends, oxygen molecules batter the receptor and slowly knock the CO off so it can be exhaled. This process is more efficient when there are more oxygen molecules in the blood. The half-life (the time it takes to get rid of ½ the CO) of CO with a patient breathing ambient air at sea level (21% oxygen) is about 4 – 5 hours; once the person is breathing high flow oxygen, the half-life of CO drops to about 90 minutes. Given the half-life of 4 – 5 hours while breathing ambient air, the pilot's CO level at the time of the accident was at least 28% and most likely significantly higher because oxygen was administered in varying amounts during the first few hours of his postaccident medical care.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	39,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane single-engine	**Toxicology Performed:**	No
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	August 30, 2016
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	2108 hours (Total, all aircraft), 680 hours (Total, this make and model), 2138 hours (Pilot In Command, all aircraft), 20 hours (Last 90 days, all aircraft), 11 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Mooney	**Registration:**	N9149V
Model/Series:	M20C	**Aircraft Category:**	Airplane
Year of Manufacture:	1969	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	690026
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	February 2, 2016 Annual	**Certified Max Gross Wt.:**	2575 lbs
Time Since Last Inspection:	83 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	3081 Hrs at time of accident	**Engine Manufacturer:**	LYCOMING
ELT:	Installed, not activated	**Engine Model/Series:**	O&VO-360 SER
Registered Owner:	On file	**Rated Power:**	0 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	KAEL,1261 ft msl	**Distance from Accident Site:**	15 Nautical Miles
Observation Time:	19:55 Local	**Direction from Accident Site:**	184°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	300°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.37 inches Hg	**Temperature/Dew Point:**	-10°C / -16°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Duluth, MN (DLH)	**Type of Flight Plan Filed:**	IFR
Destination:	Winona, MN (ONA)	**Type of Clearance:**	IFR
Departure Time:	18:08 Local	**Type of Airspace:**	Class D;Class E;Class G

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Serious	**Latitude, Longitude:**	43.898056,-93.348609

Administrative Information

Investigator In Charge (IIC):	Sullivan, Pamela
Additional Participating Persons:	Dave Nelsen; FAA; Minneapolis, MN John Butler; Lycoming; Williamsport, PA
Original Publish Date:	September 6, 2017
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=94693

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

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.