# Aviation Investigation Final Report

| | | | |
|---|---|---|---|
| **Location:** | New Bedford, Massachusetts | **Accident Number:** | ERA20FA031 |
| **Date & Time:** | November 4, 2019, 15:32 Local | **Registration:** | N714LK |
| **Aircraft:** | Cessna 150 | **Aircraft Damage:** | Destroyed |
| **Defining Event:** | Powerplant sys/comp malf/fail | **Injuries:** | 1 Fatal |
| **Flight Conducted Under:** | Part 91: General aviation - Personal | | |

## Analysis

The 74 year-old private pilot departed in his airplane during day visual meteorological conditions for a local flight. The airplane climbed to about 2,500 ft mean sea level after departure and tracked in a southwesterly direction for about 20 minutes. The airplane then began a gradual descent, turned to the northeast, flew along the shoreline, and turned toward the airport. The airplane descended to around 250 ft agl over a golf course fairway less than 3 nm from the Class D airport without communicating with the air traffic control as required. The airplane then commenced a steep, climbing right turn to an altitude of about 4,000 ft msl, when the airplane then descended rapidly in a left circular pattern. A witness near the accident site reported seeing the airplane descend like it was going to land, then climb very high, pivot on its left wing, and descend straight down. Other witnesses reported that the pilot seemed to be performing aerobatics. According to family members and close friends, this was highly unusual behavior for this pilot whom they all considered to be a “very conservative pilot.”

The pilot’s failure to communicate with air traffic control as required, his low-level flight over a fairway, and the erratic flight track and altitude changes that subsequently occurred in the absence of any meteorological conditions that could have restricted visibility are inconsistent with the pilot’s familiarity with the local airspace and his reported capabilities and are consistent with acute impairment.

The cause of the pilot’s impairment could not be identified from available medical evidence. Coronary artery disease was present on autopsy but whether it contributed to impairment could not be determined. Due to the severity of the pilot’s injuries, there was no available autopsy information about his brain. A negative result of a qualitative carboxyhemoglobin test of cavity blood by diffusion was the only available toxicological information about carbon monoxide (CO) exposure. However, a limitation of diffusion testing is that it may produce a false negative result if blood is contaminated with other body fluids, as sometimes occurs in cavity blood; that possibility could not be evaluated from available toxicological information.

However, the likelihood of CO impairment was also indicated after examination of the airplane, which revealed internal deterioration of the left muffler. The muffler metal was corroded and thin, and pin holes were observed on the sides of the muffler. The condition of the muffler would have allowed exhaust gasses, a common source of CO exposure, to leak into the cabin through the cabin heating system, which was found selected ON. CO poisoning can result from sufficient exposure, causing a wide variety of impairing effects, which may include serious neurocognitive and cardiac problems.

The muffler's corrosion and thinning of the muffler wall, along with the holes in the muffler, were likely present at the time of the last inspection, which occurred about 5 months before the accident; however, due to damage from impact, it could not be determined if the extent that the muffler was degraded was readily visible at the time of inspection.

No other preimpact anomalies or malfunctions were identified during the examination that would have prevented normal operation.

Based on available operational and physical evidence, it is likely that the pilot was impaired due to CO exposure via the corroded muffler.

## Probable Cause and Findings

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

Pilot impairment due to exposure to carbon monoxide as a result of undetected corrosion and holes in the engine's left exhaust muffler.

### Findings

| | |
|---|---|
| **Aircraft** | (general) - Fatigue/wear/corrosion |
| **Personnel issues** | Carbon monoxide - Pilot |
| **Personnel issues** | Scheduled/routine inspection - Maintenance personnel |

# Factual Information

## History of Flight

| | |
|---|---|
| **Enroute-cruise** | Powerplant sys/comp malf/fail (Defining event) |
| **Enroute-cruise** | Aerodynamic stall/spin |
| **Enroute-cruise** | Collision with terr/obj (non-CFIT) |

On November 4, 2019, at 1532 eastern standard time, a Cessna 150M, N714LK, was destroyed when it was involved in an accident near New Bedford, Massachusetts. The pilot was fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

According to an employee of the fixed based operator at the New Bedford Regional Airport (EWB), New Bedford, Massachusetts, where the owner/pilot based his airplane, the pilot was “cheerful and happy to be flying” the morning of the accident. He reported that the pilot spent about 10 to 15 minutes performing a preflight inspection of his airplane before departing.

Automatic dependent surveillance-broadcast (ADS-B) data obtained from the Federal Aviation Administration (FAA) indicated that the airplane departed EWB around 1450 and climbed to about 2,500 ft mean sea level (msl) while tracking in a southwesterly direction for about 20 minutes. The airplane then began a gradual descent, turned to the northeast, and flew along the shoreline. It then proceeded to fly north toward EWB, descending to around 250 ft above ground level over a golf course fairway less than 3 nm from EWB. The airplane then commenced a climbing right turn at increasing pitch attitudes to an altitude of about 4,000 ft msl, when the airplane then descended rapidly in a left circular pattern.

According to a witness who had exited his car in a parking lot near the accident site, he heard a sound "like a motor revving up high." He looked up and saw an airplane "swoop down like it was going to land,” climb very high, and then “pivot on its left wing” before “coming straight down.” He thought the airplane was “doing tricks.”

Examination of the accident site and wreckage revealed that the airplane impacted a tree in a cemetery in a near vertical nose-down attitude.

## Pilot Information

| | | | |
|---|---|---|---|
| **Certificate:** | Private | **Age:** | 74,Male |
| **Airplane Rating(s):** | Single-engine land | **Seat Occupied:** | Left |
| **Other Aircraft Rating(s):** | None | **Restraint Used:** | 3-point |
| **Instrument Rating(s):** | None | **Second Pilot Present:** | No |
| **Instructor Rating(s):** | None | **Toxicology Performed:** | Yes |
| **Medical Certification:** | Class 3 With waivers/limitations | **Last FAA Medical Exam:** | November 1, 2018 |
| **Occupational Pilot:** | No | **Last Flight Review or Equivalent:** | |
| **Flight Time:** | 1323 hours (Total, all aircraft), 1209 hours (Total, this make and model), 1281.5 hours (Pilot In Command, all aircraft), 9 hours (Last 90 days, all aircraft), 0 hours (Last 30 days, all aircraft) | | |

Interviews with friends and acquaintances of the pilot revealed that it was highly unusual and uncharacteristic behavior for the pilot to perform aerobatics. They considered him to be a very conservative pilot.

According to a friend of the pilot who flew with him regularly, the pilot often flew toward Newport, Rhode Island, and then along the shoreline back toward West Island, Massachusetts, where the pilot would typically contact the EWB air traffic control tower when inbound for landing.

According to the president of the EWB fixed based operator, the business staff monitored the tower frequency for incoming airplanes and did not hear the pilot make any radio transmissions, adding that the pilot "would never enter the airspace without calling."

## Aircraft and Owner/Operator Information

| | | | |
|---|---|---|---|
| **Aircraft Make:** | Cessna | **Registration:** | N714LK |
| **Model/Series:** | 150 M | **Aircraft Category:** | Airplane |
| **Year of Manufacture:** | 1977 | **Amateur Built:** | |
| **Airworthiness Certificate:** | Utility | **Serial Number:** | 15079256 |
| **Landing Gear Type:** | Tricycle | **Seats:** | 2 |
| **Date/Type of Last Inspection:** | June 7, 2019 Annual | **Certified Max Gross Wt.:** | 1601 lbs |
| **Time Since Last Inspection:** | 14 Hrs | **Engines:** | 1 Reciprocating |
| **Airframe Total Time:** | 5064.6 Hrs at time of accident | **Engine Manufacturer:** | Continental |
| **ELT:** | C91 installed | **Engine Model/Series:** | O-200-A (48) |
| **Registered Owner:** | On file | **Rated Power:** | 100 Horsepower |
| **Operator:** | On file | **Operating Certificate(s) Held:** | None |

Cabin Heat System

According to the Cessna 150 Pilot Operating Handbook, “the temperature and volume of airflow into the cabin can be regulated to any degree by manipulation of the push-pull CABIN HT and CABIN AIR control knobs.” The left engine muffler was constructed with a shroud around the outside, which forms a heating chamber for the cabin heater air. The heated air from the muffler shroud is then routed to the cabin when the CABIN HT knob is pulled out.

Maintenance and Muffler History

A logbook entry indicated that the muffler was last replaced June 1, 2004, at tachometer time 4,321.5 hours, or 742.9 hours before the accident flight; however, the maintenance entry did not specify which muffler was replaced.

The mechanic who performed the most recent annual inspection stated that he opened each muffler shroud to inspect the muffler, looking for stains, soot or cracks, which would indicate the need to change the muffler. He stated that he found no anomalies during the muffler inspections.

The airplane was not equipped with any type of carbon monoxide (CO) detector.

The inspection chart contained in the Model 150 Series (1977) Service Manual indicates that a general inspection of the exhaust system should be conducted every 50 hours and references a more detailed procedure later in the manual for an inspection every 100 hours. The 100-hour inspection information starts by stating, “Inspection of the exhaust system shall be thorough because the cabin heating system uses air heated by the heat exchangers of the exhaust system. Since exhaust systems of this type are subject to burning, cracking, and general deterioration from alternate thermal stresses and vibration, inspection is very important and should be accomplished every 100 hours of operation. The airplane was generally inspected on an annual basis, and not a 100-flight hour basis. A review of the maintenance records indicated that the annual inspections occurred at flight hour intervals ranging from 39 hours to 55 hours in the 10 years preceding the accident flight.

## Meteorological Information and Flight Plan

| | | | |
|---|---|---|---|
| **Conditions at Accident Site:** | Visual (VMC) | **Condition of Light:** | Day |
| **Observation Facility, Elevation:** | EWB,792 ft msl | **Distance from Accident Site:** | 35 Nautical Miles |
| **Observation Time:** | 14:53 Local | **Direction from Accident Site:** | 16° |
| **Lowest Cloud Condition:** | Clear | **Visibility** | 10 miles |
| **Lowest Ceiling:** | None | **Visibility (RVR):** | |
| **Wind Speed/Gusts:** | 9 knots / 17 knots | **Turbulence Type Forecast/Actual:** | Unknown / Unknown |
| **Wind Direction:** | 180° | **Turbulence Severity Forecast/Actual:** | Unknown / Unknown |
| **Altimeter Setting:** | 30.34 inches Hg | **Temperature/Dew Point:** | 11°C / -2°C |
| **Precipitation and Obscuration:** | No Obscuration; No Precipitation | | |
| **Departure Point:** | New Bedford, MA (EWB ) | **Type of Flight Plan Filed:** | None |
| **Destination:** | New Bedford, MA (EWB ) | **Type of Clearance:** | None |
| **Departure Time:** | 14:50 Local | **Type of Airspace:** | Class D |

## Airport Information

| | | | |
|---|---|---|---|
| **Airport:** | New Bedford Regional Airport EWB | **Runway Surface Type:** | Asphalt |
| **Airport Elevation:** | 792 ft msl | **Runway Surface Condition:** | Dry |
| **Runway Used:** | 23 | **IFR Approach:** | None |
| **Runway Length/Width:** | 5400 ft / 150 ft | **VFR Approach/Landing:** | None |

## Wreckage and Impact Information

| | | | |
|---|---|---|---|
| **Crew Injuries:** | 1 Fatal | **Aircraft Damage:** | Destroyed |
| **Passenger Injuries:** | N/A | **Aircraft Fire:** | None |
| **Ground Injuries:** | N/A | **Aircraft Explosion:** | None |
| **Total Injuries:** | 1 Fatal | **Latitude, Longitude:** | 41.621112,-70.938331 |

Examination of the accident site and wreckage revealed that the airplane impacted a tree in a near vertical nose down attitude about 3.5 nautical miles and about 164° magnetic from EWB. The debris field extended about 240 ft from the tree on a heading of about 220°. The left wing with the strut attached was located about 10 ft from the tree, followed by the empennage, cabin and engine at 30 ft, the right wing at 40 ft, the carburetor at 87 ft, a ruptured fuel tank at 122 ft, and the main wheels and directional gyro at 240 ft. All major components of the airplane were present at the accident site.

The fuselage was significantly fragmented. Both wings were impact fractured, bent on all surfaces, and exhibited leading edge damage consistent with tree impact. The empennage was impact fractured and bent. The instrument panel was largely fragmented. The engine controls were in the full forward position. The cabin heat control was in the full aft (ON) position.

The engine was examined, and no pre-impact anomalies were noted that would have prevented normal production of power.

The propeller remained attached to the engine crankshaft propeller flange. Examination of the propeller blades revealed aft bending and twisting along the length of both blades with leading-edge gouging and chordwise rotational scoring on the camber sides. Control continuity was established from the flight controls through overload fractures to the control surfaces.

The left muffler outer casing was impact crushed exposing the end plate which exhibited an erosion hole and several other smaller pin holes. The cabin heat shroud was removed from the muffler, and additional evidence of internal deterioration was present. The muffler metal was corroded and thin, and pin holes were observed on the sides of the muffler. The right muffler was crushed and compacted, and the shroud, which provides heated air to the carburetor heat control, remained intact around the muffler.

## Medical and Pathological Information

The pilot had his last aviation medical examination on November 1, 2018. At that time, he reported having prostate cancer and using no medications. He was issued a third-class medical certificate limited by a requirement he wear corrective lenses.

The Commonwealth of Massachusetts Office of the Chief Medical Examiner performed the pilot's autopsy. According to the autopsy report, the pilot's cause of death was multiple blunt force injuries. The autopsy identified coronary artery disease, including up to 80% stenosis of the left anterior descending coronary artery. Due to the severity of the pilot's injuries, there was no available autopsy information about his brain. The autopsy did not identify any other significant natural disease.

Toxicological testing by two laboratories identified only the non-impairing prescription prostate medication tamsulosin, in the pilot's liver and muscle. One laboratory used a qualitative test by diffusion to screen pooled/cavity blood for carboxyhemoglobin, reporting a result of "none detected at 12%." The other laboratory was unable to test carboxyhemoglobin as the available blood specimen had become unsuitable.

Carboxyhemoglobin is formed when carbon monoxide (CO) binds to hemoglobin in blood, impairing the blood's ability to deliver oxygen to body tissues (hypemic hypoxia). CO is an odorless, tasteless, colorless, nonirritating gas that can be produced during hydrocarbon combustion. Exposure to CO

usually occurs by inhalation of smoke or exhaust fumes. Nonsmokers normally have carboxyhemoglobin levels of less than 1-3%. Heavy smokers may normally have levels as high as 10-15%. Symptoms of low-level CO exposure are nonspecific and variable, and may include headache, nausea, and tiredness. Increasing levels of exposure may become impairing or incapacitating, causing more serious neurocognitive, cardiac, and/or vision problems, progressing to fatality as blood carboxyhemoglobin surpasses about 40-50% (possibly lower in elderly people or those with serious co-existing medical conditions). As with other causes of tissue hypoxia, CO poisoning may be insidious and difficult for an exposed person to recognize; there is no reliable physical sign of exposure.

## Additional Information

FAA Carbon Monoxide and Exhaust System Guidance

On November 24, 1972, the FAA issued advisory circular (AC) 20-32B "Carbon Monoxide (CO) Contamination in Aircraft—Detection and Prevention." The AC provided information on the potential dangers of carbon monoxide contamination from faulty engine exhaust systems or cabin heat exchangers. It also discussed means of detection and procedures to follow when contamination is suspected.

In October 2009, the FAA issued report DOT/FAA/AR-09/49, "Detection and Prevention of Carbon Monoxide Exposure in General Aviation Aircraft." The report documented research on detection and prevention of CO exposure in general aviation aircraft, with the objective of identifying exhaust system design issues related to CO exposure, evaluating inspection methods and maintenance practices with respect to CO generation, and the identification of protocols to quickly alert users to the presence of excessive CO in the cockpit and cabin.

On March 17, 2010, the FAA published Special Airworthiness Information Bulletin (SAIB) CE-10-19 R1. It recommended that owners and operators of general aviation aircraft consider the information in the DOT/FAA/AR-09/49 report and use CO detectors while operating their aircraft. The SAIB also recommended a cabin CO level check during every 100-hour or annual inspection, along with continued inspection of the complete engine exhaust system during 100-hr or annual inspections and at inspection intervals recommended by the aircraft and engine manufacturers in accordance with the applicable maintenance manual instructions.

On August 16, 2010, the FAA also published Special Airworthiness Information Bulletin SAIB CE-10-33R1, which reiterated the recommendation to use CO detectors as documented by SAIB CE-10-19R1. It recommended the replacement of mufflers on reciprocating engine-powered airplanes that use an exhaust system heat exchanger for cabin heat with more than 1,000 hours time in service (TIS) and at intervals of 1,000 hours TIS. It further recommended following guidance for exhaust system inspections

and maintenance provided in SAIB CE-04-22, dated December 17, 2003, and Advisory Circular (AC) 43-16A, Aviation Maintenance Alert, issued October 2006. The FAA also recommended continuing to inspect the complete exhaust system during annual inspections and at intervals recommended by the aircraft and engine manufacturers.

SAIBs are for information only, their recommendations are not mandatory. Likewise, compliance with manufacturer-issued service letters (SLs) is not mandatory.

NTSB CO and Exhaust System Guidance

On June 24, 2004, the NTSB issued Safety Recommendation A-04-028 to the FAA to require installation of CO detectors in all single-engine airplanes with forward-mounted reciprocating engines and enclosed cockpits that are already equipped with systems needed to operate the CO detector. In response, the FAA undertook the creation of the DOT/FAAIAR-09/49 report and recommended the use of CO detectors in SAIB CE-10-33R1. However, in 2011, the FAA concluded that the primary method to prevent CO contamination in the cabin is through proper inspection and maintenance of mufflers and exhaust system components, and CO detectors are a secondary method to prevent CO exposure. The FAA referenced the subsequent publication of SAIB CE-10-19 R1, and further stated that, since a lack of a CO detector alone is not unsafe, installing a CO detector does not correct an unsafe condition as defined by 14 CFR Part 39.

Because the FAA did not require installation of CO detectors, Safety Recommendation A-04-028 was classified by the NTSB as "Closed – Unacceptable Action".

## Administrative Information

| | |
|---|---|
| **Investigator In Charge (IIC):** | Spencer, Lynn |
| **Additional Participating Persons:** | Richard D Fulton; FAA/FSDO; Boston, MA<br>Henry Soderlund; Textron Aviation; Wichita, KS<br>Michael Council; Continental Aerospace Technologies; Mobile, AL |
| **Original Publish Date:** | March 9, 2022 |
| **Last Revision Date:** | |
| **Investigation Class:** | Class 3 |
| **Note:** | The NTSB traveled to the scene of this accident. |
| **Investigation Docket:** | https://data.ntsb.gov/Docket?ProjectID=100526 |

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.