



Aviation Investigation Final Report

Location:	Worcester, Massachusetts	Accident Number:	ERA16FA023
Date & Time:	October 24, 2015, 07:53 Local	Registration:	N243CW
Aircraft:	Mooney M20M	Aircraft Damage:	Substantial
Defining Event:	Loss of engine power (total)	Injuries:	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The airline transport pilot was departing on a personal local flight in his airplane when the airplane's engine lost total power. Review of airport security video revealed that, after takeoff, the airplane reached an altitude of about 200 ft before turning right and reversing direction. The airplane subsequently stalled, rolled to the right, and descended uncontrolled into trees. It is likely that the pilot reversed direction to return to the airport but failed to maintain adequate airspeed while maneuvering, which resulted in the airplane exceeding its critical angle of attack, an aerodynamic stall, and loss of control. Examination of the engine revealed that the crankshaft had failed due to fatigue cracking between the No. 5 and No. 6 cheeks. The cracking pattern suggested that numerous overstress conditions of relatively short durations acted to initiate the fatigue cracks, but the cause for this overstress could not be determined.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A total loss of engine power during the initial climb due to a fatigue failure of the engine's crankshaft. Contributing to the accident was the pilot's failure to maintain control of the airplane, which resulted in an aerodynamic stall.

Findings

Aircraft	Recip engine power section - Failure
Aircraft	Angle of attack - Not attained/maintained
Personnel issues	Aircraft control - Pilot

Factual Information

History of Flight

Initial climb	Loss of engine power (total) (Defining event)
Emergency descent	Loss of control in flight
Emergency descent	Aerodynamic stall/spin
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On October 24, 2015, at 0753 eastern daylight time, a Mooney M20M, N243CW, was substantially damaged when it impacted terrain shortly after taking off from Worcester Regional Airport (ORH), Worcester, Massachusetts. The airline transport pilot was fatally injured. The airplane was registered to and operated by the pilot under the provisions of 14 *Code of Federal Regulations* Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the local personal flight.

There was no radar coverage of the area. Airport security cameras captured partial segments of the flight and showed that the airplane took off from runway 11. One camera showed the airplane in flight, climbing over the intersection of runway 15 about 1,500 ft from the departure end of the 7,000-ft-long takeoff runway. Using the height of the airplane's tail as a reference, the estimated altitude of the airplane was about 80 to 90 ft above the runway surface at that point, climbing in a slight right turn.

The airplane then flew out of view and reappeared about 16 seconds later headed in the roughly the opposite direction of takeoff. Based on the approximate height of the control tower, the airplane appeared to be about 200 ft above the ground in a shallow, climbing right turn. The airplane's nose then began dropping, and the right bank angle increased. The airplane continued to turn to the right in an increasingly nose-down attitude as it descended into a stand of trees.

Pilot Information

Certificate:	Airline transport; Flight engineer	Age:	66, Male
Airplane Rating(s):	Single-engine land; Multi-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:	July 11, 2014
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:	(Estimated) 7230 hours (Total, all aircraft)		

According to Federal Aviation Administration (FAA) records, the pilot held an airline transport pilot

certificate with ratings for airplane single- and multi-engine land, as well as a flight engineer certificate. He held an FAA third-class medical certificate, issued July 11, 2014. On the application for this medical certificate, the pilot reported a total flight experience of 7,217 hours. The pilot's logbook was not recovered.

Aircraft and Owner/Operator Information

Aircraft Make:	Mooney	Registration:	N243CW
Model/Series:	M20M	Aircraft Category:	Airplane
Year of Manufacture:	1996	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	27-0212
Landing Gear Type:	Retractable - Tricycle	Seats:	4
Date/Type of Last Inspection:	April 24, 2015 Annual	Certified Max Gross Wt.:	3369 lbs
Time Since Last Inspection:	25 Hrs	Engines:	1 Reciprocating
Airframe Total Time:	2872.8 Hrs as of last inspection	Engine Manufacturer:	LYCOMING
ELT:	Installed	Engine Model/Series:	TIO-540
Registered Owner:	On file	Rated Power:	310 Horsepower
Operator:	On file	Operating Certificate(s) Held:	None

The four-seat, low-wing airplane was manufactured in 1996. It was powered by a 310-horsepower Lycoming TIO-540 engine and equipped with a three-blade, constant-speed McCauley propeller.

A review of maintenance records revealed that the airplane's most recent annual inspection was completed on April 14, 2015. At that time, the airframe had accumulated 2,872.8 total flight hours.

The engine logbooks could not be located. According to engine manufacturer data, the engine was manufactured in 1993 and returned once to their facility where it was overhauled in December 2001. According to the manufacturer's records, the engine was placed in service on the accident airplane on March 1, 2002. The investigation could not determine if the engine received a subsequent overhaul at another facility. The manufacturer recommended that the engine be overhauled every 2,000 hours or 12 years, whichever occurred first.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	ORH,1009 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	07:54 Local	Direction from Accident Site:	0°
Lowest Cloud Condition:		Visibility	10 miles
Lowest Ceiling:	Overcast / 2700 ft AGL	Visibility (RVR):	
Wind Speed/Gusts:	8 knots /	Turbulence Type Forecast/Actual:	/ None
Wind Direction:	350°	Turbulence Severity Forecast/Actual:	/ N/A
Altimeter Setting:	30.38 inches Hg	Temperature/Dew Point:	1°C / -3°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Worcester, MA (ORH)	Type of Flight Plan Filed:	None
Destination:	Worcester, MA (ORH)	Type of Clearance:	None
Departure Time:	07:53 Local	Type of Airspace:	

The 1154 recorded weather observation at ORH included wind from 350° at 8 knots, visibility 10 miles, overcast skies at 2,700 ft, temperature 1°C, dew point -3°C, and altimeter 30.39 inches of mercury.

Airport Information

Airport:	WORCESTER RGNL ORH	Runway Surface Type:	Asphalt
Airport Elevation:	1009 ft msl	Runway Surface Condition:	Dry
Runway Used:	11	IFR Approach:	None
Runway Length/Width:	7000 ft / 150 ft	VFR Approach/Landing:	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Fatal	Aircraft Damage:	Substantial
Passenger Injuries:		Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Fatal	Latitude, Longitude:	42.26139,-71.869163

The accident site was located in flat, wooded terrain, and the wreckage was confined to an area extending about 100 ft. There was no wreckage path; the airplane came almost straight down through the trees. There was no evidence of smoke or fire.

The propeller and spinner were found together, separated from the main wreckage, and mostly buried in the ground. The spinner exhibited fore-to-aft crushing, and none of the three propeller blades exhibited evidence typical of engine power at impact.

All flight control surfaces were accounted for at the accident site. The left wing was separated from the fuselage about 4 ft from the wing root, and the right wing was mostly still attached. The left horizontal stabilizer was separated from the airplane, and the right horizontal stabilizer remained attached. Flight control continuity was confirmed from the flight control surfaces to the cockpit.

The engine remained attached to the airframe and was subsequently removed and taken to a maintenance garage for further examination. The starter ring did not exhibit any evidence of powered rotation at impact. The crankshaft was rotated by hand at the flange; it rotated a few revolutions before it jammed and could not be rotated in either direction.

The oil suction screen was removed and found to be contaminated with metal fragments. The accessory case housing was removed, and the No. 5 main bearing was found partially extruded out through the crankshaft gear. Holes were also noted in internal portions of the crankcase halves, and the No. 6 connecting rod was broken.

The engine was subsequently disassembled, and the crankshaft was fractured between the No. 5 and No. 6 cheeks. The camshaft was also broken near the crankshaft fracture, and the interiors of the case halves were gouged rotationally, consistent with the damage having occurred while the engine was still operating.

The engine was sent to the manufacturer's materials laboratory for further investigation. According to the manufacturer's report, the metallurgical examination revealed that the crankshaft failed in fatigue, with crack initiation from the rear fillet radius of the No. 5 crankpin journal, followed by stable fatigue crack growth through nearly the entire section thickness of the No. 8 cheek. Fracture surface markings indicated a likelihood of multiple fatigue crack initiation sites. Multiple origins typically indicate high stress conditions; however, the majority of crack growth through the No. 8 cheek occurred under high-cycle fatigue loading, consistent with relatively lower nominal stress conditions. This cracking pattern suggested that overstress conditions of relatively short duration acted to initiate the fatigue cracks. The report stated that the root cause for this overstress was not determined, but it was not related to any material non-conformance.

The crankshaft conformed to engineering drawing requirements for alloy chemistry, case hardness, case depth, and case and core microstructure. It was slightly below the core hardness specification, but this was not considered relevant for this fracture. Charpy impact test bars cut from the undamaged regions of the No. 8 cheek were free of any honeycomb or microcrack features, indicating the steel had not been exposed to excessively high temperatures during billet forging or crankshaft forging. The crankshaft journal diameters conformed to engineering specifications. The crankshaft journals also conformed for roundness, except for the No. 1 and No. 3 crankpin journals, which exceeded the specification tolerance for out-of-round; however, these crankpin journals were undamaged.

The JPI 700 engine monitor was sent to the NTSB Records Laboratory for download. Due to internal

buffering of the data before being written to non-volatile memory, the final portion of the flight was not recorded. The data that was captured, was from the time of the master avionics switch was turned and, after engine start when the oil, cylinder head, turbine inlet, and exhaust gas temperatures were just starting to climb during warm-up. Then the data showed the temperatures climbing, representing the take-off, and an initial power reduction, before ending abruptly.

Medical and Pathological Information

The Office of the Chief Medical Examiner, Commonwealth of Massachusetts, performed an autopsy on the pilot. The cause of death was described as blunt injury. The autopsy also identified mild, focally moderate, atherosclerosis of the coronary arteries, with approximately 40% stenosis of the left anterior descending coronary artery, less than 10% stenosis of the right coronary artery, and no significant stenosis of the left circumflex coronary artery.

The FAA Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed toxicology testing on specimens from the pilot. The toxicology tests detected no carbon monoxide in blood and no cyanide in blood. The test did detect losartan in the liver and blood. Losartan is approved for use by the FAA and is not considered impairing.

Administrative Information

Investigator In Charge (IIC):	Boggs, Daniel
Additional Participating Persons:	James Sapoznik; FAA/FSDO; Windsor Locks, CT Judson Rupert; Lycoming; Williamsport, PA
Original Publish Date:	August 28, 2017
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=92222

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