



Aviation Investigation Final Report

Location:	Glendale, California	Accident Number:	WPR17LA212
Date & Time:	September 22, 2017, 21:57 Local	Registration:	N34BE
Aircraft:	Mooney M20E	Aircraft Damage:	Substantial
Defining Event:	Fuel exhaustion	Injuries:	2 Minor
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The private pilot and passenger had planned a round trip personal flight in the pilot's single-engine airplane. According to the pilot, he had wanted to service the airplane with fuel before the return leg, but he did not do so due to the passenger's desire to arrive home before a certain time. During the initial descent of the return leg, the engine lost total power. The pilot conducted a series of troubleshooting steps to no avail and then conducted a forced landing onto a residential street and struck trees.

Postaccident wreckage examination revealed that both fuel tanks were empty, and although the right fuel tank sustained a small breach during impact, there was no fuel odor at the accident site. A series of brown streaks were observed trailing from an area adjacent to the right-wing fuel sump drain. The sump valve sealant was badly degraded, and it is possible that a small fuel leak had developed at an undetermined time; however, blue streaking would have been more likely if a significant and recent fuel loss had occurred. Further examination revealed no leaks in the fuel supply system or engine. The engine tachometer was tested for accuracy, and no anomalies were noted. During an engine test run, the engine started normally and operated through its full speed range with no evidence of a mechanical anomaly.

The pilot had purchased the airplane 5 months before the accident and had been tracking fuel consumption since his purchase. He determined a representative fuel burn rate based on fuel purchases and engine tachometer hour-meter readings. The pilot reported that he did this because the fuel gauges were unreliable, and he did not possess a calibrated dipstick to measure the actual fuel quantities. Using his calculated fuel burn and tachometer reading method, the pilot estimated that he had enough fuel remaining to complete the flight and land with the Federal Aviation Administration-required 45-minute fuel reserve. However, he had performed multiple flights since the last fill up, which included one go-around and a full runway-length taxi earlier in the day. The total time for those flights was near the airplane's fuel endurance limit when measured by tachometer time, but the fuel consumption was likely higher due to the increased consumption demanded by the engine during the multiple takeoffs. It is likely that the pilot miscalculated the amount of fuel on board before the flight, which resulted in fuel

exhaustion and a subsequent total loss of engine power.

Probable Cause and Findings

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

The pilot's inadequate preflight fuel planning and improper decision to not refuel before the flight, which resulted in fuel exhaustion and the subsequent total loss of engine power.

Findings

Personnel issues	Decision making/judgment - Pilot
Personnel issues	Fuel planning - Pilot
Aircraft	Fuel - Fluid level
Environmental issues	Tree(s) - Contributed to outcome
Personnel issues	Motivation/respond to pressure - Pilot

Factual Information

History of Flight

Prior to flight	Aircraft servicing event
Enroute-descent	Loss of engine power (total)
Enroute-descent	Fuel exhaustion (Defining event)
Enroute-descent	Attempted remediation/recovery
Emergency descent	Collision with terr/obj (non-CFIT)
Landing	Off-field or emergency landing

On September 22, 2017, about 2157 Pacific daylight time, a Mooney M20E airplane, N34BE, collided with the ground on a densely populated street in Glendale, California, following a loss of engine power during en route cruise. The private pilot and passenger sustained minor injuries and the airplane sustained substantial damage to the left wing and fuselage. The airplane was registered to Cleared Direct Aviation LLC., and operated by the pilot under the provisions of Title 14 *Code of Federal Regulations* (CFR) Part 91, as a personal flight. Night visual meteorological conditions prevailed, and no flight plan had been filed. The cross-country flight originated from Redlands Municipal Airport (REI), Redlands, California, about 2130 and was destined for Bob Hope Airport (BUR), Burbank, California.

Earlier in the evening the pilot departed from his base at Santa Monica (SMO) to pick up his passenger from a Fixed Base Operator (FBO) in Burbank. They then both flew to Redlands for an event, and the accident flight was the return leg of the trip. The pilot stated that ordinarily he would have serviced the airplane with fuel in Redlands, but the passenger needed to get back to Burbank before the FBO closed at 2200. The pilot calculated the fuel onboard based on the engine tachometer time, and was sure that he had enough for the 30-minute flight and a 45-minute reserve.

After departing Redlands, the pilot climbed to and then configured the airplane for level cruise at 4,500 ft mean sea level (msl), direct to Burbank. The flight was uneventful, and as the airplane approached Burbank, the pilot began to initiate a descent to about 3,000 ft msl. He reached the Rose Bowl (11 miles east of Burbank) at 2152 and made the first radio call to the Burbank air traffic control tower. The controller directed him to enter the left traffic pattern for a landing on runway 15.

About 90 seconds later, at an altitude of about 2,500 ft msl (1,800 ft above ground level) the engine began to lose power. The pilot declared an emergency, and unable to maintain altitude, he pitched the airplane for best glide speed and began to perform trouble shooting procedures, which included turning on the auxiliary fuel pump and switching to the opposing fuel tank. The engine did not respond, and after referring to the display of his handheld electronic navigation device (which provided a glide distance radius) he concluded that he would not be able to make the runway. He then began to look for a suitable landing site, and because all highways and major streets were congested, he elected to land on the darkest street he could see. As he approached the street, the left wing struck a tree, and the airplane spun around, coming to rest upright on the pavement at the entrance to an apartment complex parking lot (Photo 1).



Photo 1 – Airplane at Accident Site

The airplane was examined at the accident site about 90 minutes later by the NTSB investigator-in-charge. There was no fuel odor, and no fuel was observed in either tank when viewed through their respective filler necks. The fuel selector valve had been switched to the "OFF" position by first response personnel, and its pre-accident position could not be verified. Following recovery of the airplane, damage was observed to the underside of the right tank, which had caused a breach (Photo 2) at the inboard rib and lower spar cap adjacent to the drain valve. The left fuel tank was undamaged.

Pilot Information

Certificate:	Private	Age:	40,Male
Airplane Rating(s):	Single-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	Lap only
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 3 Without waivers/limitations	Last FAA Medical Exam:	January 15, 2017
Occupational Pilot:	No	Last Flight Review or Equivalent:	September 15, 2016
Flight Time:	389.7 hours (Total, all aircraft), 78 hours (Total, this make and model), 300.7 hours (Pilot In Command, all aircraft), 45.2 hours (Last 90 days, all aircraft), 12.1 hours (Last 30 days, all aircraft), 1.3 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Mooney	Registration:	N34BE
Model/Series:	M20E NO SERIES	Aircraft Category:	Airplane
Year of Manufacture:	1966	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	1031
Landing Gear Type:	Retractable - Tricycle	Seats:	4
Date/Type of Last Inspection:	January 21, 2017 Annual	Certified Max Gross Wt.:	2575 lbs
Time Since Last Inspection:	105 Hrs	Engines:	1 Reciprocating
Airframe Total Time:	4066 Hrs at time of accident	Engine Manufacturer:	LYCOMING
ELT:	Installed, activated, did not aid in locating accident	Engine Model/Series:	IO-360
Registered Owner:		Rated Power:	200 Horsepower
Operator:	On file	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Night/bright
Observation Facility, Elevation:	KBUR,732 ft msl	Distance from Accident Site:	4 Nautical Miles
Observation Time:	04:53 Local	Direction from Accident Site:	296°
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	4 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	150°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29.8 inches Hg	Temperature/Dew Point:	18°C / 6°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	REDLANDS, CA (REI)	Type of Flight Plan Filed:	None
Destination:	BURBANK, CA (BUR)	Type of Clearance:	VFR flight following
Departure Time:	21:30 Local	Type of Airspace:	Class C

Wreckage and Impact Information

Crew Injuries:	1 Minor	Aircraft Damage:	Substantial
Passenger Injuries:	1 Minor	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Minor	Latitude, Longitude:	34.174446,-118.293052

Additional Information

The FAA Pilots Handbook of Aeronautical Knowledge contained the following guidance regarding cockpit fuel gauges: "Aircraft certification rules require accuracy in fuel gauges only when they read "empty." Any reading other than "empty" should be verified. Do not depend solely on the accuracy of the fuel quantity gauges. Always visually check the fuel level in each tank during the preflight inspection, and then compare it with the corresponding fuel quantity indication."

According to CFR Part 91.151, "Fuel requirements for flight in VFR conditions", no person may begin a flight in an airplane under VFR conditions unless (considering wind and forecast weather conditions) there is enough fuel to fly to the first point of intended landing and, assuming normal cruising speed - (1) During the day, to fly after that for at least 30 minutes; or (2) At night, to fly after that for at least 45 minutes.

Tests and Research

The pilot purchased the airplane 5 months before the accident and had been tracking fuel consumption at each top off. He incorporated the engine tachometer time as part of his calculations, (the airplane was not equipped with a Hobbs-hour meter, totalizer, or similar) and concluded that the airplane consumed, on average, 9.5 gallons per hour (gph). He used a consumption figure of 10.5 gph for planning purposes, and on average, he refueled after about 32 gallons had been consumed. He stated that the fuel gauges were generally not accurate and typically indicated a level of 3/4 when the tanks were full. The gauge needles tended to bounce in flight and this prevented him from accurately judging fuel quantity while en route. He did not "dip" the tanks during preflight inspections because he had been unable to find a dip gauge for the Mooney, however he reported always visually looking into the tanks before each flight to confirm the presence of fuel. For the accident flight, he visually confirmed there was fuel in the tanks, and utilized his calculations of prior flight time to estimate how much was available.

The pilot reported that he last serviced the airplane with 34.7 gallons of fuel at San Gabriel Valley Airport (EMT), El Monte, California on September 16, 2017 at a tachometer time of 1,528.41 hours (the tachometer at the accident site indicated 1,532.64 hours, 4.23 hours elapsed). He stated that he supervised the fueling and confirmed that both tanks had been filled to capacity. He was especially vigilant that the tanks were full and made sure there was no air gap between the fuel and the top of the tank.

The pilot provided his fueling and tachometer time records since he purchased the airplane, which indicated consumption values ranging between 7.7 and 11.6 gph. The records indicated that during the 4.23 hours since the last top off, he had flown from El Monte to Santa Monica (SMO) for a total tachometer time of .31 hours; a round trip from Santa Monica to Oceanside (OKB) for a total time of 1.51 hours; Santa Monica to Chino (CNO) for a total time of 1.01 hours; and finally on the day of the accident, flights from Santa Monica to Burbank, and then Burbank to Redlands (times not documented). He stated that during the landing approach into Burbank to pick up the passenger, he performed a go-around and was diverted in the pattern to land on runway 8, after which he needed to taxi the full length of the parallel taxiway to the FBO.

Airplane Cruise Endurance Information

The cruise and range chart (altitude 5,000 ft msl, no reserve) in the Mooney M20E owner's manual, provided endurance at various engine speed and manifold pressure settings. The endurance at 2,500 RPM (The engine speed the pilot reported typically operating the engine at) with 25 inches of manifold pressure was 4.52 hours (11.5 gph). At 22 inches of manifold pressure, the endurance increased to 5.16 hours (10.1 gph).

The manual did not contain any references to fuel burn during taxi or climb, nor did it make any reference to tachometer versus flight time.

Fuel System Examination

The airplane was equipped with two integral fuel tanks, one at each wing root. Each tank held 26 gallons

of usable fuel, which was drawn for the engine through a fuel inlet screen/pickup at the forward inboard end of the tank. A sump drain was included in each tank and was located next to the inlet screens. Aluminum fuel lines routed fuel from each tank to a single selector valve/sump drain, which was equipped with "LEFT TANK", "RIGHT TANK", and "OFF" positions. The pilot could not specifically recall which fuel tank had been selected for the departure, climb, cruise and descent.

Mooney Service Bulletin (SB) M20-188A, issued in January 1980, documents the replacement of the wing tank drain valves. The bulletin recommends replacing the factory-installed drain valve with a "screw in" type valve. The reason given for the bulletin is to allow for faster complete draining of the fuel tank during future repairs. The SB-specified compliance timing was at the owner's option and should be accomplished any time the tank needs to be resealed or the valve replaced.

Examination of the left fuel tank revealed that SB M20-188A had been complied with, and the drain valve was intact at its fitting, and could be opened and closed freely. The underside of the tank was free of streaks or any indication of fuel leak.

SB M20-188A had not been complied to the right tank, and the valve appeared to be original. The valve was found in the closed position, and it opened and closed freely when tested. The valve did not leak when low-pressure air was applied to the valve inlet. The interior tank sealant around the valve was light brown in color, cracked and degraded, and had a dry chalky appearance (Photo 2). A series of brown streaks were observed on the external underside skins of the tank emanating aft from the area of the inboard wing doubler and adjacent to the drain valve (Photo 3). Due to the impact damage, the pre-accident integrity of the tank, particularly around the sump drain valve, could not be confirmed.



Photo 2 – Right Fuel Tank Drain Valve and Tank Breach



Photo 3 – Streaks Under the Right Fuel Tank

Engine Test Run

Because the wings had been removed from the airplane for recovery from the accident site, a temporary fuel supply system was used to test run the engine; A fuel container was plumbed to both the left and right tank feed lines at the fuselage wing roots. The engine started normally, and it operated normally through its full speed range, on each of the two selector valve settings. No fuel leaks were observed anywhere within the fuselage, or forward of the firewall.

Engine Tachometer

The airplane was equipped with a mechanical cable-driven engine tachometer. The tachometer and cable were removed and examined, and no anomalies were noted. The inner drive of the tachometer cable could be rotated freely by hand, and the drive splines at either ends were undamaged.

The engine tachometer was tested and examined at a Federal Aviation Administration-certified repair station utilizing calibrated test equipment.

The Mooney data label had peeled away and was not located, however, the unit appeared to have been manufactured by Stewart Warner. Its dial arc markings, when cross-referenced against Mooney technical documentation, matched the Mooney type 660011-501, which was the correct tachometer for the accident airplane and engine combination.

The Mooney documentation stated that the tachometer was a 2,500 RPM type, designed to measure 1 hour with every 75,000 revolutions of its input shaft.

A series of test runs were performed to determine the accuracy and repeatability of the tachometer's hour-meter. The tachometer was run at a tachometer indicated speed of 2,500 RPM for three one-hour periods. The results indicated the tachometer times had incremented 1.01, 1.01, and 1.02 hours respectively.

A second test was performed to determine the calibration of the tachometer needle. The unit was run at eight different speeds, with the following results:

Tachometer Indicated Speed (RPM)	Actual Speed (RPM)
500	489
1000	1012
1500	1525
2000	2022
2500	2546
2700	2743
3000	3006
3500	3474

Figure 1 – Tachometer Test Results

The tachometer was then disassembled and examined, and no anomalies were noted. A complete examination report is contained within the public docket for this accident.

Administrative Information

Investigator In Charge (IIC):	Simpson, Elliott
Additional Participating Persons:	Ivan Salazar; Federal Aviation Administration FSDO; Van Nuys, CA
Original Publish Date:	November 15, 2018
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=96059

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The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).