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# Aviation Investigation Final Report

<b>Location:</b>	Marina, California	<b>Accident Number:</b>	WPR18FA112
<b>Date &amp; Time:</b>	March 26, 2018, 10:53 Local	<b>Registration:</b>	N213EJ
<b>Aircraft:</b>	Mooney M20E	<b>Aircraft Damage:</b>	Destroyed
<b>Defining Event:</b>	Loss of control in flight	<b>Injuries:</b>	1 Fatal
<b>Flight Conducted Under:</b>	Part 91: General aviation - Personal		

## Analysis

About 7 months before the accident flight, the private pilot had resumed flying his single-engine airplane following an approximate 3-year hiatus. He flew seven flights and then successfully completed a flight review with an instructor. On the morning of the accident, the pilot had his airplane refueled and departed on a visual flight rules flight to a nearby airport.

Surveillance video and witness reports indicated that the pilot took off from the nearby airport and the airplane climbed out in a nose-high attitude and on an unusually steep flight path before entering an aerodynamic stall and spin. The airplane was destroyed, and the pilot was fatally injured.

It could not be determined how many previous landings and takeoffs the pilot conducted on that flight, or whether the accident takeoff followed a touch-and-go or a full-stop landing.

Examination of the wreckage did not reveal any evidence of mechanical deficiencies or failures that would have prevented continued normal engine and airplane operation.

Because the pilot successfully departed from his home airport and flew to the accident airport, it is unlikely that there was a static center of gravity (CG) problem with the airplane. No evidence of any large mass in the cabin (other than the pilot) that could significantly alter the CG in flight was observed during the wreckage examination. The airplane's pitch trim was found set in the takeoff range, and no mechanical flight control deficiencies were observed, making it unlikely that the airplane configuration or a control problem resulted in the steep climb.

It is possible that the pilot's seat inadvertently slid aft during the accident takeoff, and either caused the pilot to pull back on the control yoke and/or prevented him from applying appropriate control inputs to lower the nose to prevent the stall and spin, however, there was insufficient evidence to determine the pilot's seat position either before or at the time of impact.

Given that the airplane was within CG, and there were no anomalies with the trim or flight controls, it is likely that the pilot exceeded the airplane's critical angle of attack. The airplane's low altitude at the time of the stall and the rapid spin development likely prevented the pilot from being able to affect a recovery prior to ground impact.

## Probable Cause and Findings

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

The pilot's exceedance of the airplane's critical angle of attack during takeoff, which resulted in an aerodynamic stall/spin.

### Findings

<b>Aircraft</b>	Pitch control - Not attained/maintained
<b>Personnel issues</b>	Aircraft control - Pilot
<b>Aircraft</b>	Seat/cargo attach fitting - Not specified

# Factual Information

## History of Flight

Initial climb	Aerodynamic stall/spin
Initial climb	Loss of control in flight (Defining event)
Initial climb	Collision with terr/obj (non-CFIT)

On March 26, 2018, about 1053 Pacific daylight time, a Mooney M20E airplane, N213EJ, was destroyed when it impacted terrain shortly after takeoff from runway 29 at Marina Municipal Airport (OAR), Marina, California. The private pilot was fatally injured. The airplane was registered to and operated by the pilot as a Title 14 *Code of Federal Regulations* Part 91 personal flight. Visual meteorological conditions prevailed, and no flight plan was filed for the flight, which had originated from Watsonville Municipal Airport (WVI), Watsonville, California.

The pilot kept his airplane in a hangar at WVI. According to WVI operations personnel, the pilot parked his car just outside the airport operations office about 0954 and came into the office to request a fuel top off for his airplane, which was in his hangar. The operations supervisor noticed that the pilot's ability to walk had significantly deteriorated since he last saw the pilot a few months prior, but that the pilot appeared to be in good spirits. The airplane was subsequently serviced with 25.4 gallons of fuel. A WVI surveillance camera recorded the airplane taking runway 20 for departure at 1035:54.

The airplane landed at OAR, which is located about 15 miles south of WVI. No radio communications to or from the airplane were recorded at WVI, en route, or OAR. No witnesses were identified who could provide information about the pilot's activities at OAR in the minutes preceding the accident, including whether the accident takeoff was part of a touch-and-go landing, or was preceded by a full-stop landing. However, two witnesses observed the takeoff before the accident.

One witness at OAR, who was located about midfield, reported that he saw the accident airplane lift off, and stated that the landing gear retracted immediately after the airplane became airborne. That witness and another witness reported that they saw the airplane begin an unusually steep climb in an unusually high nose-up attitude. The airplane then pitched over to an approximately level attitude and began to yaw to the left. During that nose-left yaw, the nose and left wing dropped, and the airplane began a spin.

The airplane spun to the ground, and a fire erupted immediately.

A surveillance camera was mounted on a building near the southwest corner of the airport about 1,500 ft west of the accident location. The airplane entered the camera field of view near the upper frame edge appeared to be on a descending flight path on a heading of about 160° in an approximate 15° nose down pitch attitude. The airplane continued to yaw left, the pitch attitude continued to decrease, and the trajectory became increasingly steep. By the time the airplane was about 3 airplane lengths above the ground, the nose-down pitch attitude was nearly vertical, the top of the airplane was facing the runway 11 threshold, and the trajectory appeared to be near vertical. The airplane impacted the ground in a near-vertical nose-down attitude, and a fire began immediately. The vertical distance from the top of the

image frame to the impact point was about 10 airplane lengths, or about 230 ft. The elapsed time from the first image of the airplane to impact was about 3.5 seconds.

Because the climb was not captured, climb speed or climb angle information could be obtained from the imagery.

### Pilot Information

<b>Certificate:</b>	Private	<b>Age:</b>	85, Male
<b>Airplane Rating(s):</b>	Single-engine land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Unknown
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	No
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	Yes
<b>Medical Certification:</b>	BasicMed Unknown	<b>Last FAA Medical Exam:</b>	
<b>Occupational Pilot:</b>	No	<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>	2650 hours (Total, all aircraft), 14 hours (Last 90 days, all aircraft), 3 hours (Last 30 days, all aircraft)		

Federal Aviation Administration (FAA) records indicated that the pilot, age 85, held a private pilot certificate with an instrument-airplane rating. Review of the pilot's logbook revealed that he had a total flight experience of about 2,650 hours. He ceased flying in mid-2014 due to a family illness and resumed in August 2017. The logbook indicated that he had accrued about 22.6 hours since then, all of which were in the accident airplane. The first 8.1 of those hours were dual instruction with a flight instructor, including a flight review on November 22, 2017.

The flight instructor owned and operated a Mooney M20E similar to the accident airplane, and the pilot was referred to the instructor by their common maintenance facility.

Between August 25 and November 22, the instructor flew with the pilot a total of 8 times and then conducted and endorsed the pilot's flight review. All flights were in the accident airplane, and all originated at WVI.

The instructor noted that, at first, the pilot was "rusty" but that he regained his proficiency in the airplane. At some point early in the re-currency training, the pilot had difficulty extending the landing gear, but he did eventually master that procedure. The pilot preferred to not conduct touch-and-go landings, and when flying with the instructor, the pilot always preferred full-stop landings with a taxi back for takeoff. The instructor stated that the pilot's "go-arounds were well-managed."

## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	Mooney	<b>Registration:</b>	N213EJ
<b>Model/Series:</b>	M20E NO SERIES	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>	1965	<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Normal	<b>Serial Number:</b>	939
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	4
<b>Date/Type of Last Inspection:</b>	September 22, 2017 Annual	<b>Certified Max Gross Wt.:</b>	2575 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	1 Reciprocating
<b>Airframe Total Time:</b>	3518 Hrs as of last inspection	<b>Engine Manufacturer:</b>	LYCOMING
<b>ELT:</b>	Installed	<b>Engine Model/Series:</b>	IO 360 SER
<b>Registered Owner:</b>	On file	<b>Rated Power:</b>	200 Horsepower
<b>Operator:</b>	On file	<b>Operating Certificate(s) Held:</b>	None

### General

The airplane was manufactured in 1965 and was equipped with a Lycoming IO-360 series engine. The pilot purchased the airplane in 1990 and had kept it hangared at WVI since 1999. Maintenance records indicated that the most recent annual inspection was completed on September 22, 2017. As of that date, the airplane had a total time (TT) in service of about 3,517 hours, and the engine had a TT of about 792 hours.

The airplane was not approved for intentional spins.

### Landing Gear

The M20E has a manual landing gear retraction/extension system activated by a large lever (sometimes referred to as a "Johnson bar") located between the two front seats. The lever pivots about 90° at a point on the floor below the instrument panel. The motion of the lever is through an arc parallel to the longitudinal axis of the airplane. When the lever is up/vertical, the landing gear is extended; when lever is down/horizontal, the landing gear is retracted. Gear retraction requires the lever to be pivoted aft and down; gear extension is accomplished via the opposite motion. The lever has a locking button and a slide collar for activation and locking for both the gear-extended and gear-retracted positions.

### Pitch Trim and Flaps

The pitch trim is manually controlled and actuated by a handwheel on the cockpit floor between the two front seats. The wheel rotates in the vertical plane parallel to the airplane longitudinal axis. Rotation of the trim wheel operates a chain that operates a jackscrew that changes the angle of incidence of the empennage, and concurrently actuates the pitch trim position indicator. The pitch trim position indicator is located on a central subpanel that is below the primary instrument panel. The pitch trim position indicator is situated above the flap position indicator.

The hydraulic flaps are manually controlled and actuated. Flap extension is a two-step process; first, the flap lever is set to the desired flap position, and then the flaps are extended by manually pumping the flap handle. Flap retraction is commanded via the flap lever and actuated by springs and airloads; the pilot does not need to pump the flap handle. The flap position indicator is on the central subpanel just below the pitch trim position indicator. Both the trim and flap indicator systems used mechanically driven pointers moving relative to fixed scales.

Takeoffs in the airplane are typically conducted with half flaps, and landings are typically conducted with full flaps. In flight, flap extension results in an airplane-nose-down (AND) moment, which requires airplane-nose-up (ANU) trim to reduce or alleviate control forces. With landing flaps extended, the airplane typically requires significant ANU trim. Go-arounds, therefore, require significant AND re-trimming to reduce or alleviate adverse ANU control forces.

### Takeoff and Stall Speeds

According to the manufacturer's owner's manual (OM), takeoff is accomplished by applying back pressure on the yoke "at about 65-75 mph airspeed." The airplane will adopt a nose-high attitude until back pressure is released. Best angle climb speed is 94 mph, and best rate of climb speed is 113 mph at sea level. Once airborne and placed in the proper pitch attitude, the airplane will accelerate rapidly to a speed well above the liftoff speed.

The OM lists the zero-bank stall speeds for the zero, half, and full flap positions as 67, 64, and 57 mph, respectively.

### Pilot Seat Fore-Aft Position

The pilot's seat was mounted on rollers that rode on two longitudinal rails or tracks on the floor to provide for adjustment in longitudinal position. The design enabled the pilot to select a position and lock the seat in that position via a retractable, spring-loaded pin on the seat assembly that fit into one of several holes in the seat tracks. Several factors, including seat pin and/or track hole wear, improper adjustment, debris, damage, or mispositioning by the pilot could result in improper or incomplete pin engagement, which in turn could result in seat slippage (travel) during airplane maneuvers. In such cases, acceleration forces on takeoff could result in uncommanded and unexpected aft seat travel.

According to a Mooney representative, if the seat were to come unlatched and roll aft in flight, it is possible for it to move fully aft beyond the last track hole until stopped by a pin at the aft end of each seat track. The representative also stated that, during impact, an unlatched seat would travel forward and then either latch in an intermediate position or travel to the forward-most position.

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Visual (VMC)	<b>Condition of Light:</b>	Day
<b>Observation Facility, Elevation:</b>	MRY, 15 ft msl	<b>Distance from Accident Site:</b>	7 Nautical Miles
<b>Observation Time:</b>	10:54 Local	<b>Direction from Accident Site:</b>	215°
<b>Lowest Cloud Condition:</b>	Clear	<b>Visibility</b>	10 miles
<b>Lowest Ceiling:</b>	None	<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	10 knots /	<b>Turbulence Type Forecast/Actual:</b>	/
<b>Wind Direction:</b>	270°	<b>Turbulence Severity Forecast/Actual:</b>	/
<b>Altimeter Setting:</b>	30.15 inches Hg	<b>Temperature/Dew Point:</b>	6°C / 4°C
<b>Precipitation and Obscuration:</b>	No Obscuration; No Precipitation		
<b>Departure Point:</b>	Marina, CA (OAR )	<b>Type of Flight Plan Filed:</b>	None
<b>Destination:</b>		<b>Type of Clearance:</b>	None
<b>Departure Time:</b>	10:35 Local	<b>Type of Airspace:</b>	Unknown

The 1054 automated weather observation at Monterey Regional Airport (MRY), Monterey, California, located 7 miles southwest of OAR, included wind from 110° at 3 knots, visibility 10 miles, clear skies, temperature 6°C, dew point 4°C, and an altimeter setting of 30.16 inches of mercury.

One pilot/witness at OAR reported that the wind at the time of the accident appeared to be from about 260° to 270° at about 10 knots.

## Airport Information

<b>Airport:</b>	Marina Municipal Airport OAR	<b>Runway Surface Type:</b>	Asphalt
<b>Airport Elevation:</b>	137 ft msl	<b>Runway Surface Condition:</b>	Dry
<b>Runway Used:</b>	29	<b>IFR Approach:</b>	None
<b>Runway Length/Width:</b>	3483 ft / 75 ft	<b>VFR Approach/Landing:</b>	Unknown

OAR was situated at an elevation of 137 ft mean sea level and was equipped with a single paved runway designated 11/29. The runway measured 3,843 ft by 75 ft. OAR was not equipped with an air traffic control tower.

## Wreckage and Impact Information

<b>Crew Injuries:</b>	1 Fatal	<b>Aircraft Damage:</b>	Destroyed
<b>Passenger Injuries:</b>		<b>Aircraft Fire:</b>	On-ground
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	1 Fatal	<b>Latitude, Longitude:</b>	36.675556,-121.756942(est)

The airplane impacted and came to rest just southwest of the intersection of runway 29 and taxiway C, offset about 300 ft from the runway centerline. The impact site was located on a flat grassy area between the runway and a parallel taxiway. The only ground scars were a small crater from the propeller and engine, and two shallow impressions from the two wing leading edges. The upright wreckage was primarily confined to an area slightly larger than the length and wingspan of the airplane.

The wreckage was documented on scene and in additional detail after recovery. Significant portions of the cockpit and cabin and their contents were heavily damaged or consumed by fire. No evidence of any large or heavy baggage or other cabin contents was observed. The wings and the steel-frame fuselage structure exhibited substantial impact crush damage. The outboard wing sections and the empennage were not significantly damaged by the fire. All major components were accounted for on scene.

Both wings bore full-span leading edge crush damage in the aft direction. All flight control panels/surfaces remained attached to their respective primary structures. The ailerons, elevators, and rudder were intact. The left flap was impact damaged and slightly fire damaged. The right flap was partially consumed by fire.

Flight control continuity in all 3 axes, including pitch trim, was confirmed between the respective aerodynamic surfaces and their cockpit controls. The airplane was equipped with an aftermarket deployable spoiler assembly on each wing; both the left and right spoiler panel sets were found in their retracted positions.

The pitch trim was found set to the takeoff position. The flap setting at impact could not be determined. The landing gear was found in the retracted position.

Although impact and fire damage precluded a complete determination of the pre-accident integrity and functionality of all engine and propeller components, no evidence of pre-impact mechanical deficiencies or failures that would have precluded continued operation was observed.

The outboard seat track for the left (pilot's) forward seat remained partially intact and was examined to determine the possible longitudinal position of the seat during the accident. The track contained seven holes. The seat was found set with the pin in the 5th hole back from the front of the track.

## Medical and Pathological Information



The Monterey County Sheriff's Office, Coroner Division, autopsy report indicated that the cause of death was "multiple blunt force trauma," and that alcohol and drug test results were all negative. Forensic toxicology on specimens from the pilot was performed by the FAA Forensic Sciences Laboratory; results were negative for carbon monoxide, ethanol, and tested-for drugs.

## **Additional Information**

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### **Aerodynamic Stall**

The FAA publication H-8083-25A Pilot's Handbook of Aeronautical Knowledge, (PHAK) stated that an aerodynamic stall results from a rapid decrease in lift caused by the separation of airflow from the wing's surface brought on by exceeding the critical angle of attack (AOA). AOA is defined as the acute angle between the chord line of the airfoil and the direction of the relative wind. An aerodynamic stall can occur when the airplane flies too slowly, or when higher wing loads are imposed due to maneuvers such as pull-ups or banked flight.

An airplane can be caused to fly too slowly when the commanded vertical flight path requires more engine power than is available. Both the commanded flight path and the available power can be pilot, design, or circumstantially induced. Circumstantial inducements include mechanical anomalies or failures, and center of gravity location.

### **Pilot Seat Fore-Aft Position and Adjustment**

The investigation was unable to determine which seat position the pilot normally used. The pilot was reported to be about 5 ft 8 inches tall. The Mooney representative was about 6 ft tall; he reported that positioning the seat with the pin in the 5th hole was a "comfortable" position for flying the airplane. The representative also reported that two other Mooney pilots, one who was 6 ft tall and one who was 5 ft 10 inches tall, both used a seat positioned with the pin in the 4th hole.

## Administrative Information

<b>Investigator In Charge (IIC):</b>	Huhn, Michael
<b>Additional Participating Persons:</b>	Wilbert J Robinson; FAA; San Jose, CA Mark Platt; Lycoming Engines; Williamsport, PA Robert Collier; Mooney Aircraft; Kerrville, TX
<b>Original Publish Date:</b>	April 8, 2020
<b>Last Revision Date:</b>	
<b>Investigation Class:</b>	<a href="#">Class</a>
<b>Note:</b>	The NTSB traveled to the scene of this accident.
<b>Investigation Docket:</b>	<a href="https://data.nts.gov/Docket?ProjectID=96933">https://data.nts.gov/Docket?ProjectID=96933</a>

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