



# **NATIONAL TRANSPORTATION SAFETY BOARD**

**Office of Aviation Safety  
Western Pacific Region**

## **AIRFRAME & ENGINE EXAMINATION**

**NTSB Accident: WPR18FA112  
Accident Date: March 26, 2018**

**Examination Date: May 4, 2018**

This document contains 27 embedded images

## **A. ACCIDENT**

Location: Marina, California  
Date: March 26, 2018  
Aircraft: Mooney M20E, N213EJ, Serial # 939  
NTSB IIC: Michael Huhn

## **B. EXAMINATION PARTICIPANTS:**

Michael Huhn  
Air Safety Investigator  
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## **C. BACKGROUND**

On March 26, 2018, about 1053 Pacific daylight time, a Mooney M20E, N213EJ, was destroyed by ground impact and fire shortly after takeoff from runway 29 at Marina Municipal Airport (OAR), Marina, California. The wreckage was documented and partially examined on scene, and then recovered to Plain Parts, Pleasant Grove, California for detailed examination. This report documents that second examination.

All components were accounted for on scene. No evidence of any mechanical deficiencies or failures that would have precluded normal operation was discovered.

## **D. AIRFRAME INFORMATION**

### **1.0 General**

- The steel-tube fuselage structure exhibited substantial impact crush damage
- Fire consumed most of the cabin/cockpit and its contents
- Flight and engine instruments and controls were significantly damaged by impact and fire
- Flight control continuity in all 3 axes was confirmed on scene
- The stall vane assembly was present in the leading edge of the wing but was impact damaged
  - Damage prevented accuracy or functionality determination
  - The remainder of the system was destroyed by impact and fire
  - No useful information regarding the stall warning system was able to be determined



**Figure 1 - Cockpit Engine Controls**



**Figure 2 - Instrument Panel Segment**





Figure 3 - Stall Warning Vane

## 2.0 Pitch Trim

- The manually actuated pitch trim system integrity was confirmed
  - The airplane was not equipped with electric pitch trim
- Several different measurements to potentially determine the pitch trim setting were obtained. These included:
  - Distance between the LE of the vertical stabilizer and the TE of the fin fairing: 1"
  - Distance between the empennage hinge points at the fuselage and empennage: Left side 3 - 12/16" Right side 3 - 14/32"
  - Distances of under-cockpit trim jackscrew to stop block: 3/8" (~4 threads) from aft stop collar to aft face of stop block; 3/4" (~9 threads) from fwd face of stop block to collar at front of jackscrew
  - Aft jackscrew, threaded shaft exposure aft out of the mounting block: 1 - 4/32" or ~8 threads
- According to a Mooney representative, the measured values indicate that the longitudinal (pitch) trim is set at about the normal takeoff position



**Figure 4 - Fin LE to Fairing Gap**



**Figure 5 - Empennage Hinge Measurement Geometry**





**Figure 6 - Under-Cockpit Pitch Trim Mechanism**



**Figure 7 - Under-Cockpit Pitch Trim Mechanism**





Figure 8 - Aft Trim Jackscrew



Figure 9 - Aft Trim Jackscrew

### 3.0 Flaps

- The flaps are hydraulically actuated and positioned
- Impact and fire damage prevented determination of the impact flap setting

### 4.0 Seat Position

- The seat was longitudinally manually adjustable, and locked into place via a retractable pin on the seat assembly which fit into one of several holes in a longitudinal mounting rail/track
- 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 5<sup>th</sup> hole back from the front



Figure 10 - Seat Track (with pin assembly)





**Figure 11 - Seat Track (with pin assembly)**



**Figure 12 - Seat Track (less pin assembly)**



**Figure 13 - Seat Track (less pin assembly)**



## E. ENGINE INFORMATION

### 1.0 General

Model	Serial Number	Total Time
IO-360-A1A	RL-1866-51A	~800 Hours Since Unknown
Above engine Information taken from: <input checked="" type="checkbox"/> Dataplate <input checked="" type="checkbox"/> Maintenance Records <input type="checkbox"/> Other		
Dataplate Attached/Found? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Experimental Engine? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Case Match # 7154	Engine S/N on Case: L-1866-51A	Crankshaft S/N: Unknown

The powerplant is a four cylinder, air cooled, direct drive, horizontally opposed, normally aspirated (fuel-injected), internal combustion engine rated at 200hp @ 2700rpm.

The engine remained attached to the airframe by the impact damaged engine mount. The engine had sustained significant impact damage that displaced the fuel injection servo and muffler. A post impact fire encompassed the rear of the engine, which resulted in the thermal destruction of the fuel pump, magnetos, vacuum pump and oil filter. Visual examination of the engine revealed no evidence of pre-impact catastrophic mechanical malfunction or fire.



Figure 14 - Engine and Propeller





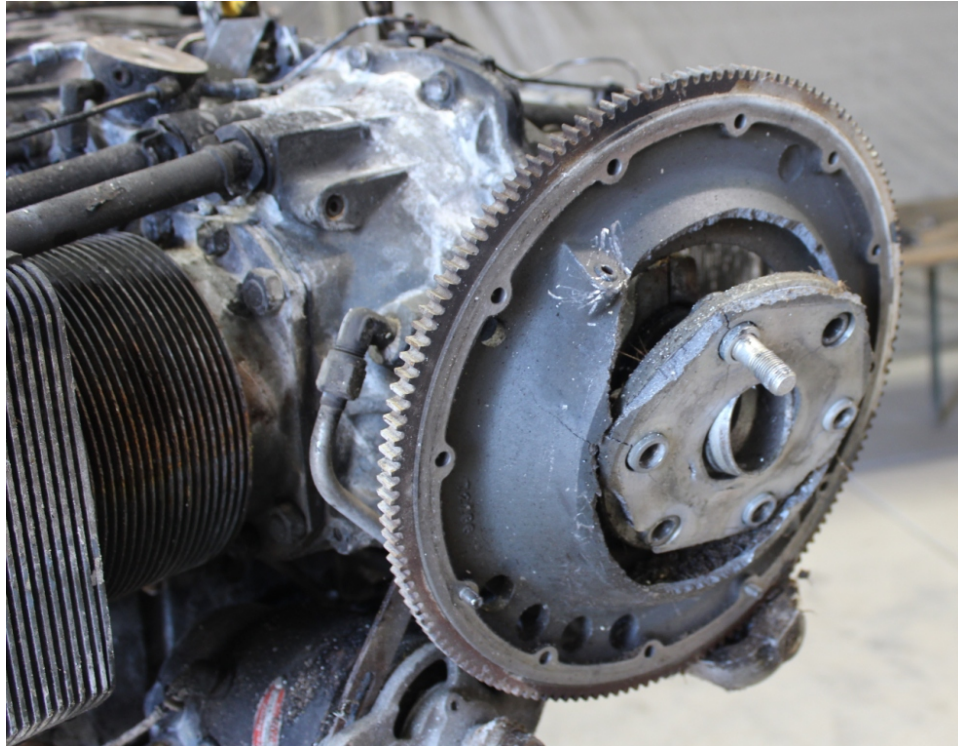
**Figure 15 - Top of Engine**



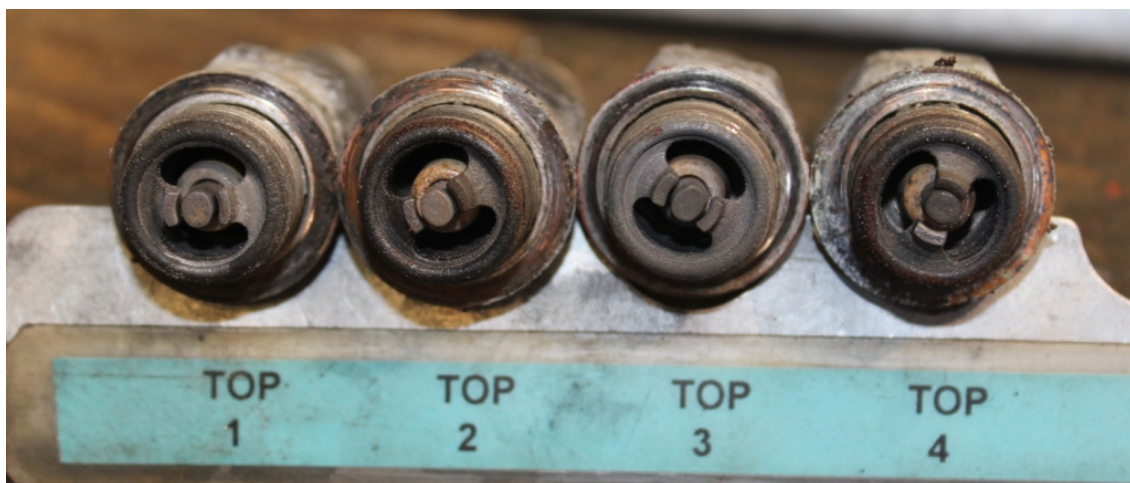
**Figure 16 - Engine Accessory Face**



The propeller was removed to facilitate the examination. The top spark plugs were removed, examined. The crankshaft was rotated by hand at the flange utilizing a pry-bar. The crankshaft was free and easy to rotate in both directions. "Thumb" compression was observed in proper order on all four cylinders. The complete valve train was observed to operate in proper order, and appeared to be free of any pre-mishap mechanical malfunction. Normal "lift action" was observed at each rocker assembly. Clean, uncontaminated oil was observed at all four rockerbox areas. Mechanical continuity was established throughout the rotating group, valve train and accessory section during hand rotation of the crankshaft. The bottom spark plugs were not removed.



**Figure 17 - Starter Gear and Propeller Flange**



**Figure 18 - Spark Plugs**





Figure 19 - No. 2 & 4 Cylinder Rocker Assemblies



Figure 20 - No. 1 & 3 Cylinder Rocker Assemblies



The combustion chamber of each cylinder was examined through the spark plug holes utilizing a lighted borescope. The combustion chambers and bottom spark plug electrodes remained mechanically undamaged, and there was no evidence of foreign object ingestion or detonation. The valves were intact and undamaged. There was no evidence of valve to piston face contact observed. The gas path and combustion signatures observed at the spark plugs, combustion chambers and exhaust system components displayed coloration consistent with normal operation. There was no oil residue observed in the exhaust system gas path.

The accessory case was removed. The accessory gears including the crankshaft gear, bolt and dowel were intact and remained undamaged by any pre-impact malfunction.



**Figure 21 - Accessory Face**



**Figure 22 - Interior of Accessory Face**

The left and magneto had sustained fire and impact damage, and were slightly displaced from the mounting pad. The fracture surface signatures at the magneto-mounting flange were consistent with overload forces. The pieces of magneto flange that remained at the mounting pad were securely clamped. Magneto to engine timing could not be ascertained. Fire damage rendered the magnetos inoperative and unable to be functionally tested. The drives of each magneto remained intact and undamaged.

There was significant ductile bending of the exhaust system components. The exhaust system was found free of obstructions.

The oil suction screen was found secure and uncontaminated by any pre-mishap debris. The oil filter was destroyed by fire. There was no evidence of any pre-mishap lubrication system contamination observed during the examination.

There was no evidence of pre-impact mechanical malfunctions observed during the examination of the engine.



## **2.0 Fuel System**

The fuel supply lines at the engine and firewall were subjected to impact and fire, which had become displaced at their respective fittings, thus compromising the fuel system. There was no fuel observed.

The fuel injection servo was displaced from the engine and the portion that remained attached at the mounting pad was secure. The fracture surface signatures were consistent with overload. The throttle/mixture controls were found securely attached at their respective control arms of the servo. The castellated nut and cotter pin remained secure and the serrated interface at the throttle/mixture arm remained securely mated. The plug on the side of the injector body was secure with the safety wire in place. The servo fuel inlet screen was found properly installed and free of contamination. The fuel injection servo and induction system were examined and observed to be free of pre-impact obstruction. The fuel injection servo was disassembled, examined and photographed. The internal diaphragms were destroyed by fire.

The fuel flow divider (spider) remained secure at the mounting bracket situated at the top of the engine. The fuel lines remained secure at each flow divider fitting and fuel injector at each cylinder. The flow divider was disassembled. There was no evidence of internal mechanical malfunction or obstruction to fuel flow. The diaphragm remained intact and undamaged. The top of the diaphragm had been contaminated from the effects of fire suppression activities via the vent hole on the flow divider cover.

The fuel injection nozzles remained secure at each cylinder with the respective fuel line attached. The nozzles were removed and examined. The nozzles remained free of visible contamination or obstruction to flow.

The fuel pump was partially consumed by the post impact ground fire. The fuel pump mounting flange remained attached at the mounting pad. The two mounting bolts remained in place and properly safety wired.

<b>Fuel System</b> <input checked="" type="checkbox"/> Injection <input type="checkbox"/> Carburetor <input type="checkbox"/> Electronic <input type="checkbox"/> Destroyed			
Manufacturer: Precision		Model: RSA-5AD1	Setting: 2524054-11
Serial. No: 41123	Floats: <input type="checkbox"/> Metal <input type="checkbox"/> Composite <input type="checkbox"/> Plastic <input checked="" type="checkbox"/> N/A		

<b>Fuel Screens</b>	Carburetor/Injector Inlet: <input checked="" type="checkbox"/> Clean <input type="checkbox"/> Contaminated <input type="checkbox"/> Destroyed <input type="checkbox"/> Unknown
	Aircraft Main Fuel Strainer: <input type="checkbox"/> Clean <input type="checkbox"/> Contaminated <input checked="" type="checkbox"/> Destroyed <input type="checkbox"/> Unknown

<b>Control Positions</b>	
Throttle: Full open	Carburetor Heat: N/A
Mixture Control: Full rich	Alternate Air: Destroyed

<b>Flow Divider</b> <input type="checkbox"/> N/A <input type="checkbox"/> Destroyed			
Manufacturer: Unknown		Part No: Unknown	Serial No: Unknown
Evidence of Fuel Found?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Contamination Observed? None	
Diaphragm Condition?	<input checked="" type="checkbox"/> Intact <input type="checkbox"/> Compromised <input type="checkbox"/> Destroyed <input type="checkbox"/> Unknown <input type="checkbox"/> See Remarks		

<b>Injector Nozzles</b> <input type="checkbox"/> N/A <input type="checkbox"/> Destroyed		
GAMIjectors <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Unknown	Type: Two Piece	Condition: Unobstructed
Lines secure: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Compromised <input type="checkbox"/> Destroyed <input type="checkbox"/> Unknown <input type="checkbox"/> See Remarks		

<b>Fuel Pump</b> <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Destroyed		
<input checked="" type="checkbox"/> Diaphragm <input type="checkbox"/> Geared <input type="checkbox"/> Electric <input type="checkbox"/> Gravity Fed <input type="checkbox"/> See Remarks <input type="checkbox"/> Unknown		
Manufacturer: Unknown	Part No.: Unknown	Serial # / Date Code: Unknown





**Figure 23 - Fuel Servo**



**Figure 24 - Fuel Distribution Manifold Valve**



**Figure 25 - Fuel Valve Diaphragm**

### **3.0 Ignition System**

The spark plugs were secure at each position with their respective spark plug lead attached. The top spark plugs were removed, examined and photographed. The spark plug electrodes remained



mechanically undamaged, and according to the Champion Spark Plugs Check-A-Plug chart AV-27, the spark plug electrodes displayed coloration consistent with normal operation.

The ignition harness had been subjected to the ground fire and had sustained thermal damage. The harness appeared to have been attached at each spark plug lead.

#### Magnetos:

<input checked="" type="checkbox"/> <b>Left</b> <input type="checkbox"/> <b>Dual Magneto</b> <input type="checkbox"/> <b>Electronic</b> <input type="checkbox"/> <b>Destroyed</b>			
Manufacturer:: Slick	Model: 4345	P/N: 66GR15SANN	S/N: 94080014
Impulse Coupling? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Functioning? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	
Timing Checked? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Results:	
Drive Secure? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown		Sparks at all leads <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Unknown	
Damage: Destroyed by fire			

<input checked="" type="checkbox"/> <b>Right Magneto</b> <input type="checkbox"/> <b>Electronic</b> <input type="checkbox"/> <b>Destroyed</b>			
Manufacturer:: Slick	Model: 4370	P/N: 66GP0SANN	S/N: 94070216
Impulse Coupling? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Functioning? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	
Timing Checked? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Results:	
Drive Secure? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown		Sparks at all leads <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Unknown	
Damage: Destroyed by fire			

#### F. PROPELLER INFORMATION

The metal, two bladed constant speed propeller remained attached at the crankshaft flange. The metal spinner was attached to the propeller and crushed aft over the propeller dome. The propeller blades remained attached to the propeller hub.

The propeller blades were marked “A” & “B” for narrative purposes. The propeller blade marked as “A” exhibited moderate leading edge and blade burnishing near the tip area. There was an impression and a circular through-hole about the size of a quarter on the face of the blade about 5 inches from the tip, near the blade trailing edge. The damage was consistent with a puncture in the aft to forward direction.

The propeller blade marked as “B” exhibited significant leading edge burnishing and chordwise burnishing across the cambered surface of the blade.

The propeller governor was securely attached at the mounting pad and had sustained significant fire damage, rendering the unit unsuitable for testing. The control rod appeared to have been attached to the control arm.

<b>Propeller</b> <input type="checkbox"/> Rotorcraft		
<b>Manufacturer</b>	<b>Part Number</b>	<b>Serial Number</b>
Hartzell	HC-C2YK-1B	CH288E
Propeller Type: <input checked="" type="checkbox"/> Metal <input type="checkbox"/> Wood <input type="checkbox"/> Composite <input type="checkbox"/> Unknown		
Propeller Blade Serial Numbers:	Blade 1 Unknown	Blade 2 Unknown
	Blade 3 N/A	Blade 4 N/A

<b>Propeller Governor</b> <input type="checkbox"/> Rotorcraft <input type="checkbox"/> N/A		
<b>Manufacturer</b>	<b>Part Number</b>	<b>Serial Number</b>
Hartzell	Undetermined	1342V
Governor Control Position: Undetermined		Gasket Screen Condition: Undetermined
Governor Oil Line: Steel	Properly Secured?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Unknown <input type="checkbox"/> N/A
	Correct Line Nuts?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Unknown <input type="checkbox"/> N/A
	Correct Fittings?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Unknown <input type="checkbox"/> N/A



Figure 26 - Blade "A"



Figure 27 - Blade "B"