Aviation Investigation Final Report

Location:	Lakeway, Texas	**Accident Number:**	CEN23LA107
Date & Time:	February 12, 2023, 09:58 Local	**Registration:**	N304MA
Aircraft:	MOONEY AIRCRAFT CORP. M20	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	1 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

Before purchasing the airplane, the pilot had an inspection performed. One of the findings on the inspection stated that, “spark plugs are worn past limits.” There were no indications that the magneto timing was checked during the inspection. The pilot reported that the airplane had been run with a lean mixture in the past.

After the pilot purchased the airplane, he flew the airplane on a cross-country flight to relocate it to his home base. While in flight, the engine had a low manifold pressure reading and then the engine sustained a total loss of power. The pilot attempted to fly to the nearest airport, but instead performed a forced landing to a golf course. During the forced landing sequence, the airplane impacted trees and a wood fence, and came to rest near a diesel generator. The airplane sustained substantial damage to the fuselage and to both wings.

Examination of the airframe revealed no mechanical anomalies. Examination of the engine revealed a hole in the corner of the No. 6 piston; however, the No. 6 cylinder was intact. The No. 6 piston had eroded crown material and a darkened periphery. The engine case was found intact. The top spark plugs from the Nos. 3, 5, and 6 cylinders and the bottom spark plugs from the Nos. 3 and 5 cylinders were found in a “worn out - normal condition.” The right magneto timing was found at 22°, when it is supposed to be at 20°. The left magneto timing was found at 15°, when it is supposed to be at 20°. The oil breather tube was found intact, and the slot was not blocked. Engine oil was found splattered in and around the oil breather tube area, including traveling rearward on the area underneath the oil breather tube. No anomalies were noted with the turbocharger system or the propeller.

It is likely a total loss of engine power occurred when the No. 6 piston developed a hole from burn through, consistent with detonation and preignition signatures consisting of combustion

deposits and excessive temperature exposure. The hole in the piston likely allowed exhaust gases, caused by the detonation and preignition, to force engine oil out of the oil breather tube.

The combination of the engine being previously run with a lean mixture, worn spark plugs, and incorrect magneto timing, likely lead to the preignition and detonation 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:

A total loss of engine power due to detonation and preignition in the No. 6 cylinder.

Findings

Aircraft	(general) - Failure
Aircraft	(general) - Incorrect use/operation

Factual Information

History of Flight

Enroute	Loss of engine power (partial)
Enroute	Attempted remediation/recovery
Approach-VFR pattern downwind	Loss of engine power (total) (Defining event)
Approach-VFR pattern downwind	Attempted remediation/recovery
Approach-VFR pattern final	Off-field or emergency landing
Post-impact	Evacuation

On February 12, 2023, about 0958 central standard time, a Mooney Aircraft Corporation M20K Encore airplane, N304MA, sustained substantial damage when it was involved in an accident near Lakeway, Texas. The pilot sustained no injury. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal cross-country flight.

The pilot reported that he had recently purchased the airplane and he was relocating the airplane to his home base at the Outlaw Field Airport (CKV), Clarksville, Tennessee. During the preflight inspection, the pilot did not observe any anomalies. He reported that the airplane had 57 gallons of fuel onboard at takeoff and the engine oil was at a sufficient level for flight operations.

A review of ADS-B data showed that the airplane departed from the Kestrel Airpark (1T7), Spring Branch, Texas, and traveled to the northeast. The pilot reported that while in flight, the engine had a low manifold pressure reading and then the engine sustained a total loss of power. The ADS-B data showed that the airplane performed a 180° turn as it approached the Colorado River just to the north of Bee Cave, Texas. The pilot then maneuvered the airplane north toward the Lakeway Airpark (3R9), Lakeway, Texas.

Unable to make the airport, the pilot performed a forced landing to a golf course just to the north of 3R9. During the forced landing, the airplane impacted trees and a wood fence, and came to rest upright near a diesel generator. The pilot was able to egress from the airplane without further incident. The airplane sustained substantial damage to the fuselage and to both wings.

A Federal Aviation Administration (FAA) inspector responded to the accident site. A large amount of engine oil was observed trailing rearward on the underside of the fuselage. The engine oil level was checked at the accident site and oil was not observed on the dipstick.

Examination of the airframe revealed flight control continuity. Both wing fuel tanks were found breached and no anomalies were noted with the airframe.

Examination of the engine revealed a hole in the corner of the No. 6 piston; however, the No. 6 cylinder was intact. The No. 6 piston had eroded crown material and a darkened periphery. The engine case was found intact. The top spark plugs from the Nos. 3, 5, and 6 cylinders and the bottom spark plugs from the Nos. 3 and 5 cylinders were found in a "worn out - normal condition." The right magneto timing was found at 22°; according to the engine manufacturer, it is supposed to be at 20°. The left magneto timing was found at 15°, rather than 20°. The oil breather tube was found intact and the slot was not blocked. Engine oil was found splattered in and around the oil breather tube area, including traveling rearward on the area underneath the oil breather tube. No anomalies were noted with the turbocharger system or the propeller.

Before purchasing the airplane, the pilot had an inspection performed by a mechanic. One of the findings on the undated inspection list stated that, "spark plugs are worn past limits." Additionally, all cylinders were borescoped and the cylinders were listed as, "all appear normal." The pilot reported that there were no indications that the magneto timing was checked during the prebuy inspection. The pilot further reported that the airplane had been run with a lean mixture in the past. A review of the engine maintenance records showed that the most recent time the spark plugs were cleaned and gapped, and the magneto timing was checked was during a 100-hour inspection on October 8, 2022, at 2,732.4 hours.

A review of data obtained from a J.P. Instruments EDM-700 unit onboard the airplane at the time of the accident showed an excessively high No. 6 cylinder head temperature reading about 17 minutes before the unit stopped recording data.

The FAA has published the Pilot's Handbook of Aeronautical Knowledge FAA-H-8083-25C. This document discusses detonation and states in part:

Detonation is an uncontrolled, explosive ignition of the fuel-air mixture within the cylinder's combustion chamber. It causes excessive temperatures and pressures which, if not corrected, can quickly lead to failure of the piston, cylinder, or valves. In less severe cases, detonation causes engine overheating, roughness, or loss of power.

Detonation is characterized by high cylinder head temperatures and is most likely to occur when operating at high power settings.

A common operational cause of detonation is listed as:

Operation of the engine at high power settings with an excessively lean mixture.

This document discusses preignition and states in part:

Preignition occurs when the fuel-air mixture ignites prior to the engine's normal ignition event. Premature burning is usually caused by a residual hot spot in the combustion chamber, often

created by a small carbon deposit on a spark plug, a cracked spark plug insulator, or other damage in the cylinder that causes a part to heat sufficiently to ignite the fuel-air charge.

Preignition causes the engine to lose power and produces high operating temperature. As with detonation, preignition may also cause severe engine damage because the expanding gases exert excessive pressure on the piston while still on its compression stroke.

The document further discusses both detonation and preignition and states in part:

Detonation and preignition often occur simultaneously and one may cause the other. Since either condition causes high engine temperature accompanied by a decrease in engine performance, it is often difficult to distinguish between the two. Using the recommended grade of fuel and operating the engine within its proper temperature, pressure, and rpm ranges reduce the chance of detonation or preignition.

Continental Motors has published Mandatory Service Bullet MSB94-8D Magneto to Engine Timing on February 17, 2010. This document discusses the importance of maintaining correct magneto timing and states in part:

Incorrect timing, in addition to producing a rough running engine, can lead to detonation, preignition and internal engine damage or failure.

Failure to properly maintain the magneto, harness and spark plugs will lead to internal engine damage and failure.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	52,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane single-engine; Helicopter; Instrument helicopter	**Toxicology Performed:**	
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	December 7, 2022
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	April 14, 2022
Flight Time:	(Estimated) 5377.8 hours (Total, all aircraft), 7 hours (Total, this make and model), 3337.5 hours (Pilot In Command, all aircraft), 27.1 hours (Last 90 days, all aircraft), 12.7 hours (Last 30 days, all aircraft), 6.5 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	MOONEY AIRCRAFT CORP.	**Registration:**	N304MA
Model/Series:	M20 K	**Aircraft Category:**	Airplane
Year of Manufacture:	1997	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	25-2004
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	October 8, 2022 Annual	**Certified Max Gross Wt.:**	3130 lbs
Time Since Last Inspection:	31.3 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	2763.7 Hrs at time of accident	**Engine Manufacturer:**	Continental Motors
ELT:	C91A installed, not activated	**Engine Model/Series:**	TSIO-360-MB
Registered Owner:	On file	**Rated Power:**	210 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None
Operator Does Business As:	On file	**Operator Designator Code:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KRYW,1231 ft msl	**Distance from Accident Site:**	8 Nautical Miles
Observation Time:	09:55 Local	**Direction from Accident Site:**	10°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots / None	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	250°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30.21 inches Hg	**Temperature/Dew Point:**	8°C / 0°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Spring Branch, TX (1T7)	**Type of Flight Plan Filed:**	VFR
Destination:	Clarksville, TN (CKV)	**Type of Clearance:**	None
Departure Time:	09:32 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	30.363162,-97.995269(est)

Administrative Information

Investigator In Charge (IIC):	Hodges, Michael
Additional Participating Persons:	Daniel Bonilla; FAA San Antonio FSDO; San Antonio, TX Kevin Kammer; Mooney International Corporation; Kerrville, TX Les Doud; Hartzell Propeller / Hartzell Engine Technologies; Piqua, OH
Original Publish Date:	September 11, 2024
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=106726