National Transportation Safety Board
Aviation Accident Preliminary Report

Location:	Lake Havasu City, AZ	**Accident Number:**	WPR21FA340
Date & Time:	September 12, 2021, 16:09 Local	**Registration:**	N2085Q
Aircraft:	Cessna 177RG	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

On September 12, 2021, about 1609 mountain standard time, a Cessna 177RG, N2085Q, was substantially damaged when it was involved in an accident near Lake Havasu Airport, Lake Havasu, Arizona. The pilot was fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* (CFR) Part 91 personal flight.

The pilot was planning on making a long cross-country to Reno, Nevada in the next several days and the purpose of the accident trip was for him to get fuel at Lake Havasu for the flight to Reno. The airplane was based in at Eagle Airpark in Bullhead City, Arizona and the pilot performed maintenance there earlier in the day including replacing the bushings on the nosewheel because he was experiencing a vibration on takeoff and landing. After finishing the maintenance, he departed about 1530 and landed at Lake Havasu about 1545. The pilot then purchased 24.8 gallons of fuel at the self-serve fuel tank which presumably topped-off the fuel tanks to full fuel onboard as he had intended.

Investigators reviewed video recordings, audio recordings, and flight track data covering the area of the accident during the time surrounding the accident using Federal Aviation Administration (FAA) provided Automatic Dependent Surveillance-Broadcast (ADS-B) data. The airplane taxied to runway 14 and after performing a run-up, departed about 1608. Witnesses report that they observed the airplane takeoff down the runway at a slow groundspeed and noted that the engine sounded rough as though it was making partial power. The airplane did not ascend as expected and veered to the right of the centerline reaching 100-150 feet agl (see Figure 1 below). The ADB data shows the airplane accelerating down the runway up to a derived airspeed of 65 kts. The

Figure 1: Security Camera Footage Showing Initial Right Turn

The airplane then pitched up to a nose-high attitude and made an aggressive left bank consistent with pilot attempting to make 180-degree turn back to the runway (see Figure 2 below). Witnesses observed the airplane's wingspan turn nearly perpendicular to the horizon and then stall with the left wing dropping toward terrain.

Figure 2: Security Camera Footage of Bank to the Left

At an undetermined time during the takeoff, the pilot made a transmission on the airport common frequency where he stated, “Lake Havasu traffic Cardinal 2085Q making a uh…” The next transmission was less than a second and all that could be heard is a high-pitch tone akin to a stall-warning horn.

The accident site was located in the desert terrain about 830 ft from the end of runway 14 at an elevation of 790 feel msl. In character, the terrain was composed of dry, soft dirt with sparse brush. The wreckage was found distributed over a 200 ft distance on a median magnetic bearing of about 60°. The main wreckage consisted of a majority of the airframe and engine, which had been consumed by fire with the exception of the right wing. The first identified points of contact consisted of disrupted dirt on the flat desert terrain making up the far east-southeast end of the debris field. The markings started as an indentation dirt with shards of red lens fragments imbedded within the soil consistent with the left-wing tip impacting first. The crater was continuous toward the main wreckage with the end of the crater having blue/green lens fragments imbedded (see Figure 3 below). A larger center indentation was found in between the red lens fragments and the green/blue lens fragments and had a large arc-shaped disruption of dirt consistent with a rotating propeller blade.

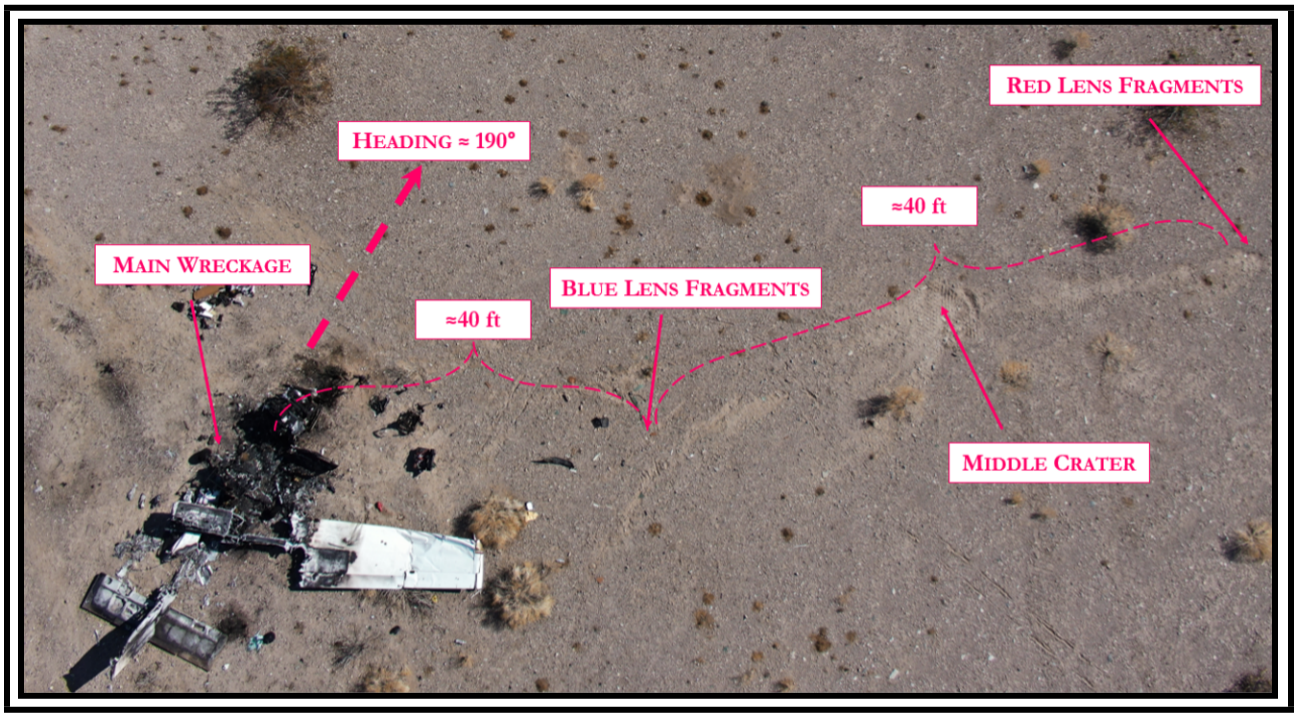

Figure 3:Main Wreckage in Reference to First Identified Point of Impact

As part of the post-accident examination, a majority of the engine and its respective components were completely disassembled. In pertinent part, the Nos. 1 and 4 top compression piston-rings were fragmented (see Figure 4 below). On all the piston skirts there was evidence of corrosion and wear with light scuffs/grooves oriented from the base to the crowns. There was additionally evidence of blow-by with heat signatures on the piston skirts on all cylinders, but the least damage was on the No. 3 cylinder.

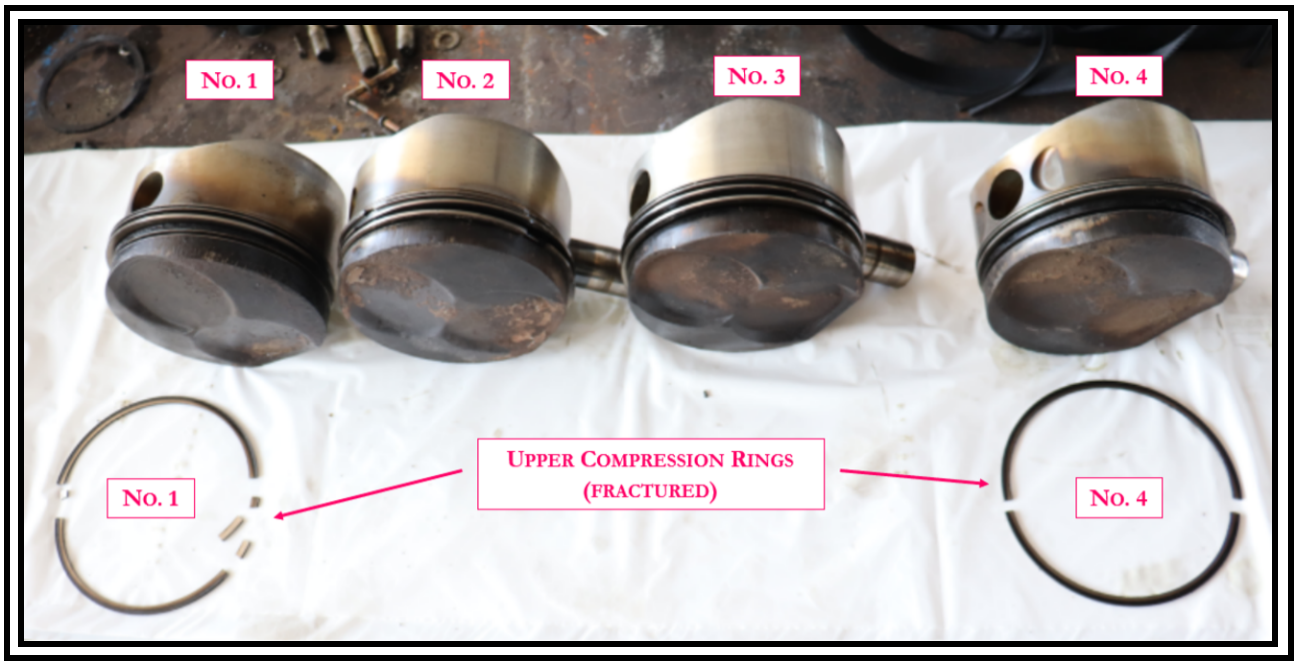

Figure 4: All Pistons (Showing Fractured Rings)

Separation of the crankcase halves revealed that there was severe spalling on the faces of all the intake lifters and the No. 3 exhaust lifter; there was also evidence of galling noted. On the remaining lifters there was evidence of wear with a circular pattern and pitting (see Figure 5 below) The camshaft revealed signatures of excessive wear on the cam lobes including rounding of the lobes, pitting and material deformation observed on the lobes.

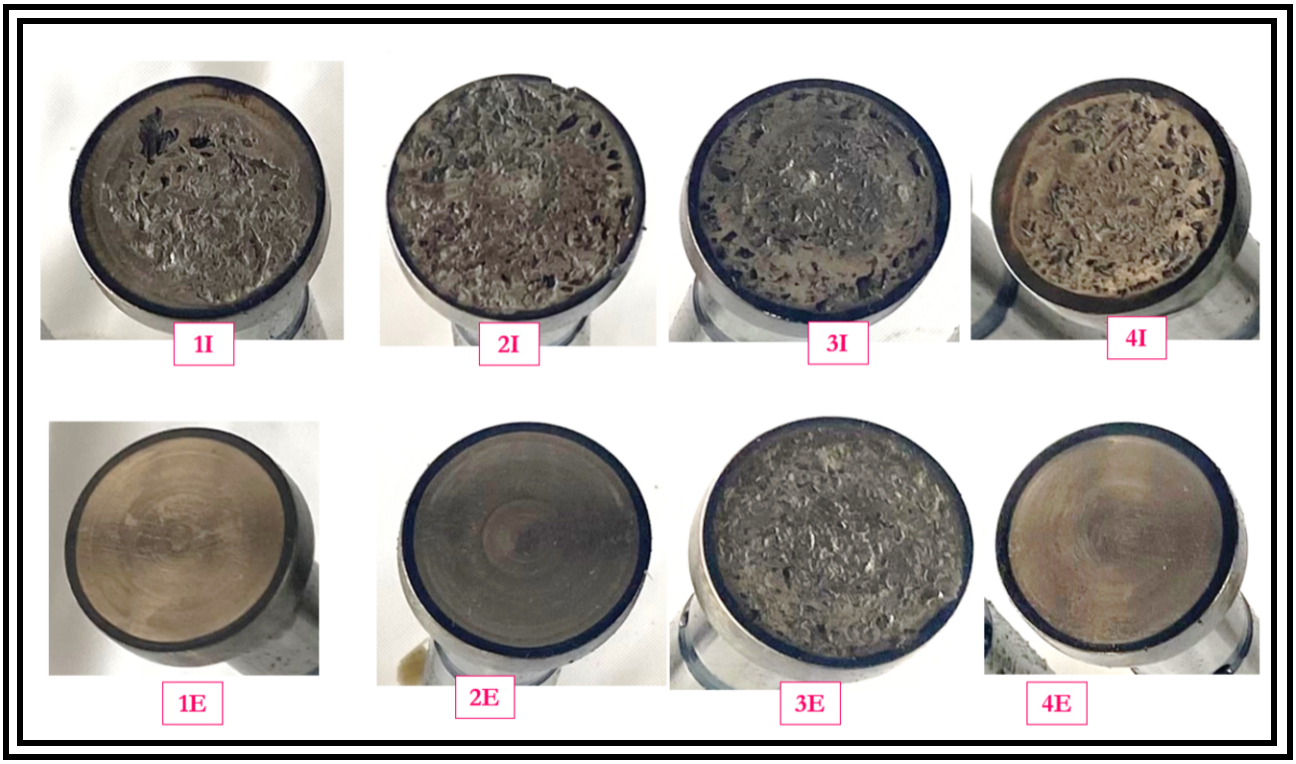

Figure 5: Lifter Face Wear Signatures (intake lifters above and exhaust below)

The lifter on the No. 4 exhaust valve had a tear in the base of the body, consistent with contact with the hydraulic socket; the pushrods did not show evidence of being bent. The bearings showed light wear and the crankshaft had light rotational scoring.

The pilot's spouse stated that the pilot did a majority of his own maintenance and that he regularly flew the airplane since they purchased it in 2013. A review of the logbook revealed that the airplane had a total time of 3,487.3 hours and the engine had 1,219.4 hours since it was remanufactured at Lycoming. The logbooks showed that the camshaft and lifters were replaced with new parts in December 2004, equating to 682 hours prior to the accident. The logbook indicated that the No. 1 cylinder was replaced with an overhauled assembly in March 2020, equating to 75.1 hours prior to the accident. The last recorded oil change was at the last annual inspection recorded as being completed on July 16, 2021, 25.7 hours prior the accident.

The pilot had sent samples of the engine oil for Spectrometer analysis on multiple occasions, the most recent of which was September 09, 2021 at an engine time of 1,216.7 hours equating to 3 days prior to the accident or 2.7 flight hours. The sample had not been run before the accident occurred; in pertinent part, it showed elevated levels of Aluminum, Chromium, Iron, Silicon and Nickel (see Figure 6 below). On the report prior to the most recent, taken in September 2019, the laboratory commented that there was elevated levels of metal. The report stated that if work had not been done recently on the engine, the amount of aluminum, chrome, and iron would indicate piston, ring, and steel wear. The analysis further stated that there was "even enough chrome to show a ring problem."

ELEMENTS IN PARTS PER MILLION								
	MI/HR on Oil	68	UNIT / LOCATION AVERAGES	34	30	5	5	6
	MI/HR on Unit	1,217		1,141	1,006	622	604	575
	Sample Date	9/9/2021		9/15/2019	6/24/2017	10/8/2012	10/29/2010	12/19/2007
	Make Up Oil Added	10 qts		3 qts	5 qts			
	ALUMINUM	23	3	32	12	2	2	1
	CHROMIUM	61	2	64	35	2	2	2
	IRON	148	12	43	26	9	6	10
	COPPER	35	4	19	3	3	3	3
	LEAD	3606	1385	1921	3468	798	651	522
	TIN	2	1	1	0	0	1	2
	MOLYBDENUM	2	0	0	0	0	0	0
	NICKEL	5	0	1	1	0	0	0
	MANGANESE	2	0	1	0	0	0	0
	SILVER	0	0	0	0	0	0	0
	TITANIUM	0	0	0	0	0	0	0
	POTASSIUM	0	0	0	1	0	0	1
	BORON	0	0	2	0	1	0	0
	SILICON	10	6	23	4	9	7	9
	SODIUM	2	0	1	2	1	0	0
	CALCIUM	40	0	64	69	0	0	0
	MAGNESIUM	0	0	1	2	0	0	0
	PHOSPHORUS	28	102	36	75	137	116	118
	ZINC	4	6	4	4	2	0	1
	BARIUM	0	0	0	0	0	0	0

Figure 6: Oil Analysis Report Showing Six Samples One of Which was Three days prior to the Accident

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N2085Q
Model/Series:	177RG	**Aircraft Category:**	Airplane
Amateur Built:			
Operator:	On file	**Operating Certificate(s) Held:**	None
Operator Designator Code:			

Meteorological Information and Flight Plan

Conditions at Accident Site:	VMC	**Condition of Light:**	Day
Observation Facility, Elevation:	KEED,914 ft msl	**Observation Time:**	15:56 Local
Distance from Accident Site:	17 Nautical Miles	**Temperature/Dew Point:**	44°C /4°C
Lowest Cloud Condition:	Clear	**Wind Speed/Gusts, Direction:**	14 knots / , 190°
Lowest Ceiling:	None	**Visibility:**	10 miles
Altimeter Setting:	29.77 inches Hg	**Type of Flight Plan Filed:**	None
Departure Point:	Lake Havasu City, AZ	**Destination:**	Bullhead City, AZ (A09)

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	34.557952,-114.34983

Administrative Information

Investigator In Charge (IIC):	Keliher, Zoe
Additional Participating Persons:	Leon Kelly; Federal Aviation Administration; Scottsdale, AZ Troy Helgeson; Lycoming Engines; Williamsport, PA Henry Solderlund; Textron (Cessna); Wichita, KS
Note:	