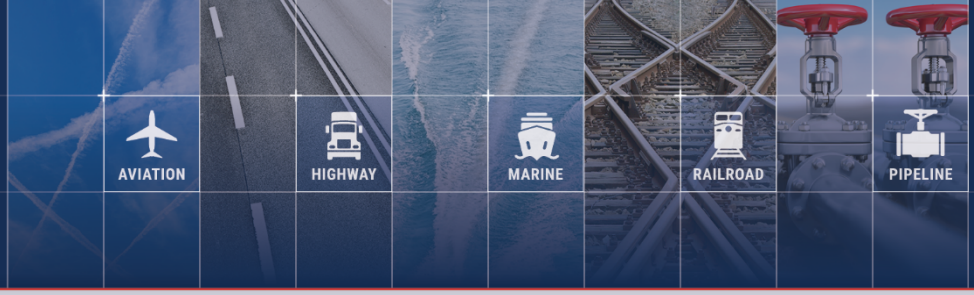

Aviation Investigation Final Report

Location:	Farmington, Pennsylvania	**Accident Number:**	ERA18LA072
Date & Time:	January 29, 2018, 16:50 Local	**Registration:**	N34VF
Aircraft:	Cessna P210N	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	1 Minor
Flight Conducted Under:	Part 91: General aviation		

Analysis

During cruise flight in instrument meteorological conditions, the engine lost total power and the commercial pilot performed a forced landing to a field after emerging from the clouds about 300 ft above ground level; the airplane struck trees and a power line, resulting in a loss of control, impact with the ground, and subsequent post-impact fire.

Examination of the engine revealed that the crankshaft drive gear was missing teeth, the camshaft gears were damaged, and each of the six pistons displayed valve impact damage. It is likely that the missing teeth from the drive gear caused an out-of-alignment condition that led to a cascade of additional damage to the mating timing gear on the camshaft. The improper engagement of the crankshaft drive gear to the camshaft compromised the timing of the entire valvetrain, which resulted in the loss of engine power.

Review of the five most recent oil analysis results conducted during the 13 months before the accident revealed elevated levels of iron, chromium, silicon and nickel; elements present in the alloy steel drive gear. These levels were considered elevated relative to the initial oil analysis sample taken about 15 months before the accident. It is likely that the fatigue cracking had begun or become severe enough to alter the composition of the oil; however, there were no material anomalies or significant findings to indicate the gear was deficient. In addition, there were no irregularities discovered with the maintenance history, tolerances, or timing that would preclude eventual failure of the gear, therefore, no definitive cause of the gear failure could be determined.

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 fatigue failure of the crankshaft drive gear teeth.

Findings

Aircraft	Recip engine power section - Damaged/degraded
Aircraft	Recip engine power section - Failure

Factual Information

History of Flight

Enroute-cruise	Powerplant sys/comp malf/fail
Enroute-cruise	Loss of engine power (total) (Defining event)
Landing	Collision with terr/obj (non-CFIT)
Post-impact	Fire/smoke (post-impact)

On January 29, 2018, about 1650 eastern standard time, a Cessna P210N airplane, N34VF, was substantially damaged when it was involved in an accident near Farmington, Pennsylvania. The commercial pilot received minor injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 business flight.

The pilot reported that, while in cruise flight at 8,000 ft mean sea level in snowy conditions, the airplane suddenly felt "heavy," the airspeed decreased, and the tachometer indicated 0 rpm. The pilot declared an emergency, switched fuel tanks, turned on the fuel pump, and attempted to restart the engine, but engine power was not restored. He stated that the propeller did not "budge" and was not windmilling. The controller provided vectors to Nemacolin Airport (PA88), Farmington, Pennsylvania, but the pilot stated that he had no chance of reaching the airport.

The pilot stated that the airplane broke out of the clouds about 300 ft above ground level over a valley. He turned the airplane toward a small field and attempted to land, but while on final approach, the airplane contacted several trees and a power line, shearing off part of the left wing before the airplane impacted the ground and skidded to a stop. The fuel tanks were breached during the impact, which resulted in a fire that enveloped the airplane as the pilot egressed.

Pilot Information

Certificate:	Commercial	**Age:**	79,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	June 15, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	June 22, 2016
Flight Time:	5840 hours (Total, all aircraft), 4620 hours (Total, this make and model), 5840 hours (Pilot In Command, all aircraft), 42 hours (Last 90 days, all aircraft), 13 hours (Last 30 days, all aircraft), 0.4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N34VF
Model/Series:	P210N N	**Aircraft Category:**	Airplane
Year of Manufacture:	1979	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	P21000307
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	November 17, 2017 Annual	**Certified Max Gross Wt.:**	4250 lbs
Time Since Last Inspection:	21 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	4169.7 Hrs as of last inspection	**Engine Manufacturer:**	CONT MOTOR
ELT:	Installed, activated, aided in locating accident	**Engine Model/Series:**	TSIO-520-P5B
Registered Owner:	ROMAG AIR SERVICES INC	**Rated Power:**	325 Horsepower
Operator:	ROMAG AIR SERVICES INC	**Operating Certificate(s) Held:**	None

At the time of the accident, the airplane had flown 21 hours since its most recent annual inspection, which was completed on November 17, 2017. During the last annual, the Nos. 1 and 2 cylinder assemblies were removed and replaced with new units, including new valves and rings. No irregularities were noted in the logbook and the airplane was returned to service.

The engine was operating under an oil analysis program. An oil and filter change with a subsequent oil analysis was conducted on January 12, 2018. Examination of data from the five the previous oil analyses conducted over the 13 months before the accident showed elevated levels of iron, chromium, silicon,

and nickel when compared to the initial sample, taken on October 6, 2016. A note in the most recent oil analysis report stated that the excess metal was likely coming from the "two cylinders that were just replaced" and there was an assumption that "lingering" metal from poor wear and a "break-in" period may have contributed to the excess metal detected. The metals found are present in the drive gear's alloy steel.

The pilot stated that, several years before the accident, the airplane had a propeller strike and underwent a propeller strike inspection, but no records detailing the maintenance work were found and the maintenance facility that performed the work was no longer in business.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Dusk
Observation Facility, Elevation:	2G4,2933 ft msl	**Distance from Accident Site:**	15 Nautical Miles
Observation Time:	16:35 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Scattered / 6000 ft AGL	**Visibility**	1 miles
Lowest Ceiling:	Overcast	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	190°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.97 inches Hg	**Temperature/Dew Point:**	1°C / -4°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	GAITHERSBURG, MD (GAI)	**Type of Flight Plan Filed:**	IFR
Destination:	WHEELING, WV (HLG)	**Type of Clearance:**	IFR
Departure Time:	16:00 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 Minor	**Latitude, Longitude:**	39.791942,-79.478614(est)

The airplane came to rest about 300 ft from where it initially impacted trees and power lines, and a debris field containing several pieces of the airplane extended to the main wreckage, which was consumed by fire. The engine was separated from the airframe, but remained attached to the firewall and

engine mounts.

The propeller hub remained secured to the crankshaft's propeller flange. All three blades (composite/wood) were fractured about 15 inches out from the propeller hub. The engine sustained thermal damage to the rear accessory section near the firewall, but otherwise remained intact. There were no external anomalies with the engine or engine-related systems that would have precluded normal operation.

The magnetos remained attached to the engine with no slipping noted when manually manipulated. When placed on a test bench, the magnetos produced spark and functioned normally. The top spark plugs appeared to have normal wear with no sign of lead or carbon fouling that would preclude normal operation.

The fuel system, including fuel lines, fuel pump, nozzles, and the throttle body revealed no anomalies; however, when the fuel pump was removed from the engine, damage to the camshaft gear was observed. The oil sump on the bottom of the engine was removed and contained crankshaft gear teeth and metal.

The crankshaft gear was missing most of its teeth and the remaining teeth were damaged. (see Figure 1.) The gear was removed from the crankshaft and there was no sign of fretting between the mating surfaces. There were no additional pre-accident anomalies noted with the crankshaft, counterweights, or connecting rods. All items appeared to be well lubricated with no signs of thermal distress. Removal and examination of the camshaft showed no pre-accident anomalies with the lobes or lifters, but the camshaft gear teeth sustained mechanical damage.


Figure 1. Crankshaft gear damage.

The crankshaft drive gear, camshaft, timing gear, fractured teeth, and metal debris were sent to the NTSB Materials Laboratory for additional examination. The crankshaft drive gear exhibited features such as crack arrest marks and heat tinting, consistent with fatigue cracking before the final fracture. The crack arrest marks and fatigue striations were consistent with inward crack propagation from the tooth edge located near the thread root. There were ratchet marks present near the initiation side of the crack, consistent with multiple fatigue crack initiation sites. Outside of the fatigue cracking region, the fracture surface exhibited a dimpled rupture, consistent with subsequent overstress fracture. A hardness test was

performed, and the results indicated that the crankshaft gear was within the typical limits of case-hardened alloy steel.

The cylinders all remained attached to their respective locations on the crankcase and revealed no external anomalies; however, further examination revealed valve impact marks (scallops) on each of the six pistons, as shown in Figure 2.

Figure 2. Piston No. 3 "scallop" impact marks from the valves at the 9:00 and 3:00 o'clock position. All 6 pistons exhibited similar signatures.

Disassembly of the engine revealed no signs of fretting on the mating surfaces and all main bearings remained in place with their lock tabs engaged within the lock slots. There were no pre-accident

anomalies noted with the case or the main bearings and all the surfaces appeared well lubricated.

Administrative Information

Investigator In Charge (IIC):	Mccarter, Lawrence
Additional Participating Persons:	Vince Nolan; FAA/FSDO; Pittsburgh, PA Nicole Charnon; Continental; Mobile, AL
Original Publish Date:	May 27, 2021
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=96667