Aviation Investigation Final Report

Location:	Alamogordo, New Mexico	**Accident Number:**	CEN16LA234
Date & Time:	June 24, 2016, 10:15 Local	**Registration:**	N91137
Aircraft:	North American Navion	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The commercial pilot stated that, while in cruise flight, the engine began to run rough and that he noted that the Nos. 1 and 5 cylinders were indicating significantly cooler temperatures than the other cylinders. About 12 minutes later, the pilot noticed an "acrid metallic smell" in the cabin. The pilot turned the airplane toward the closest airport as the engine continued to run rough and produce a "metallic clanking" sound. Unable to reach the airport, the pilot made a forced landing in a field about 100 yards short of a road. The airplane continued into a drainage culvert and came to rest on the road.

A postaccident examination of the engine revealed that the engine crankcase was cracked at the base of the No. 5 cylinder and the cylinder's rocker box cover exhibited multiple holes. The oil sump contained a large amount of metal debris and damaged components from the No. 5 cylinder. The No. 5 cylinder exhaust valve spring key was worn and damaged. The exhaust valve guide was fragmented and the valve guide bore was worn beyond the specified size, which indicated the valve guide was moving inside the guide bore. The No. 5 piston and cylinder damage were a result of the valve being released into the cylinder during engine operation. It is likely that the valve spring key failed and allowed the valve to release into the cylinder.

Probable Cause and Findings

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

The failure of the No. 5 exhaust valve key spring, which resulted in a total loss of engine power.

Findings

Aircraft	Recip eng cyl section - Failure

Factual Information

History of Flight

Enroute	Loss of engine power (partial)
Landing	Loss of engine power (total) (Defining event)
Landing	Off-field or emergency landing

On June 24, 2016, about 1015 mountain daylight time, a North American Aviation Navion airplane, N91137, made a forced landing near Alamogordo, New Mexico. The pilot and one passenger were not injured and the airplane sustained substantial damage. The airplane was registered to and operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Visual meteorological conditions prevailed at the time of the accident and no flight plan had been filed. The cross-country flight departed Sierra Blanca Regional Airport (SRR), Ruidoso, New Mexico, at 0938.

The pilot stated that he and his passenger were flying in a planned proficiency competition with several other airplanes. The objective of the competition was to predict a time en route and total fuel consumption for a predetermined four-leg route, then fly the route as close as possible to the predicted time and fuel consumption (Figure 1).

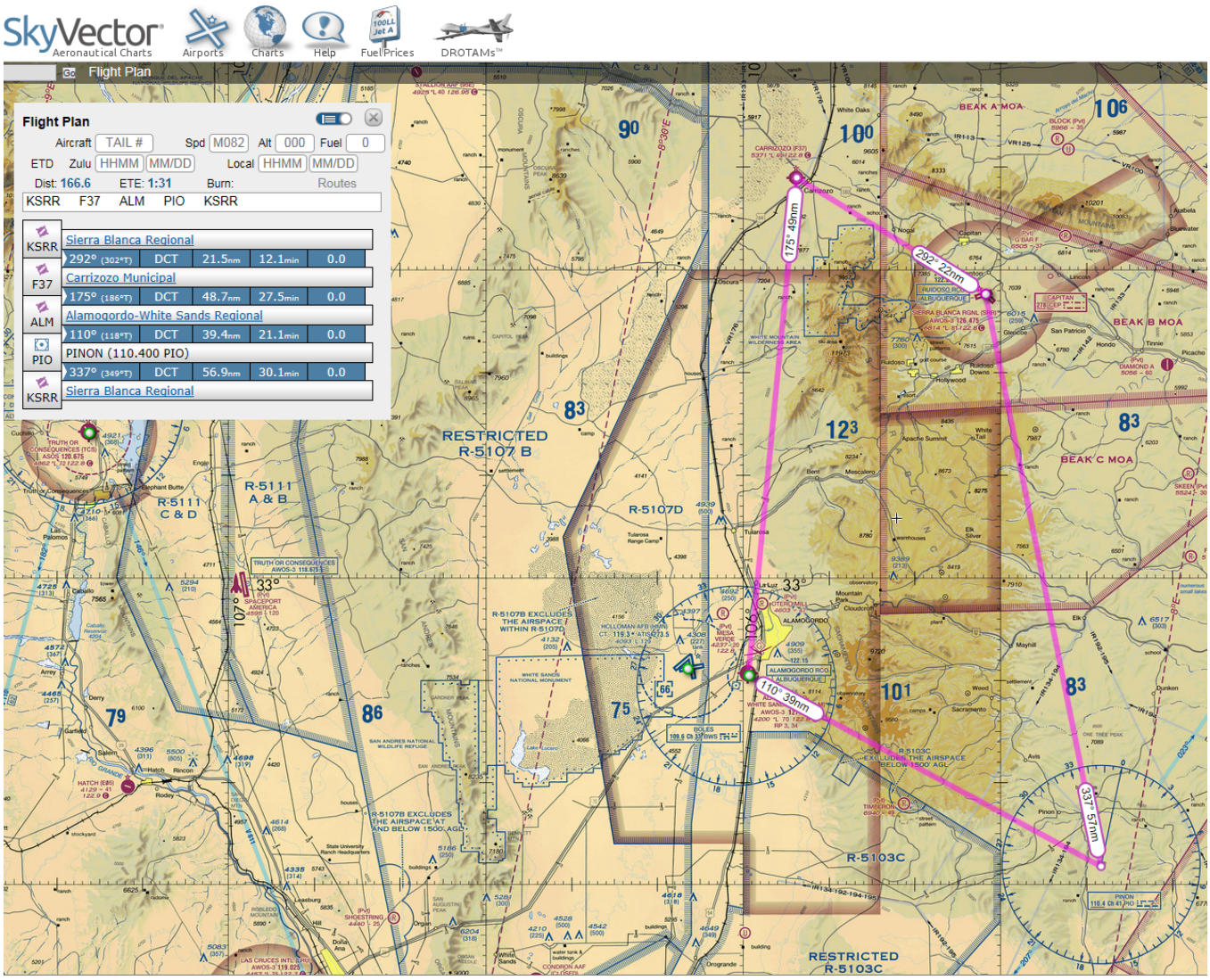

Figure 1 – Aeronautical Chart with Flight Route

The airplane was in cruise flight and level at 7,500 ft mean sea level (msl) when the pilot noticed the engine was "running rough." At 0958, the Nos. 1 and 5 cylinders were significantly cooler than the other 4 cylinders; No. 1 cylinder head temperature (CHT) was 350° and the exhaust gas temperature (EGT) was 990° while No. 5 CHT was 305° and EGT was 1320°. In contrast, the No. 6 CHT was 398°. At 1010, the airplane reached 8,000 ft msl over mountainous terrain when they noticed an "acrid metallic smell" in the cabin. The pilot made a distress call on the radio, then a right turn towards an airport. About 13 nautical miles (nm) southeast of Alamogordo-White Sands Regional Airport (ALM), the engine was "running very rough" and the pilot heard a "metallic clanking" sound. He reduced the engine power and descended. About 5 to 6 nm from ALM, the engine continued to operate with reduced power and the airplane continued to descend. The pilot setup for an emergency landing on a residential road, but with no engine power available the airplane landed in a field about 100 yards short of the road. The airplane continued into a drainage culvert and then came to rest on the road. The airplane sustained substantial damage to the engine mounts, firewall, wing spar, fuselage, and empennage (Figure 2).

Figure 2 – Airplane on Road

The responding Federal Aviation Administration (FAA) inspector conducted a postaccident examination at the accident site with the pilot. They removed the engine cowling to examine the Continental Motors IO-520-B engine. The No. 5 cylinder appeared damaged and the engine crankcase was cracked in the same area (Figure 3).

Figure 3 – Engine Cylinder No. 5 Damage

A postaccident examination, conducted by the NTSB and Continental Motors, revealed that the No. 5 cylinder rocker box cover had been previously removed by the FAA inspector and was found in the engine compartment with an inner exhaust valve spring, an outer exhaust valve spring, a damaged valve guide, portions of a roto coil assembly, damaged valve spring keys, and six machine screws and lock washers. The rocker box cover contained a hole directly over the exhaust valve assembly. The engine crankcase was cracked at the base of the No. 5 cylinder, which measured about 2 inches. The No. 5 top spark plug exhibited mechanical damage. The rest of the engine's spark plugs displayed 'normal' to 'worn out normal' patterns when compared to a Champion Aviation Check-A-Plug chart. The oil filter safety wire was found attached to the fuel pump hose fitting. The oil filter was opened and contained metal debris. The oil sump was removed and contained a large amount of metal debris and damaged pieces of engine components, to include the No. 5 piston, piston rings, exhaust guide, and exhaust valve head. The No. 5 cylinder was removed and damage was observed to the cylinder head, cylinder wall, intake push rod and piston connecting rod. The rod was twisted and its pin displayed deformation on both ends. The rod bearing exhibited normal wear patterns. The No. 5 cylinder and associated components were retained and sent to Continental Motors for further examination.

The No. 5 cylinder was disassembled (Figure 4) and examined at the Continental Motors Analytical Department under the auspices of the NTSB. The examination revealed that the exhaust valve guide was fragmented; some of the valve guide fragments were not recovered for examination. The valve guide was marked with "FAA-PMA" on one of the fragments, which indicated that it was not a Continental Motors part. FAA Parts Manufacturer Approval (PMA) are third-party manufactured replacement or modification parts sold for installation on a type-certificate product. The valve guide bore (Figure 5) was worn beyond the specified size and showed signs of the value guide moving in the guide bore. The exhaust valve head hardness was checked and met the appropriate specification. Only one valve key spring was found with the parts and it was worn.

Figure 4 – No. 5 Cylinder Parts Disassembled

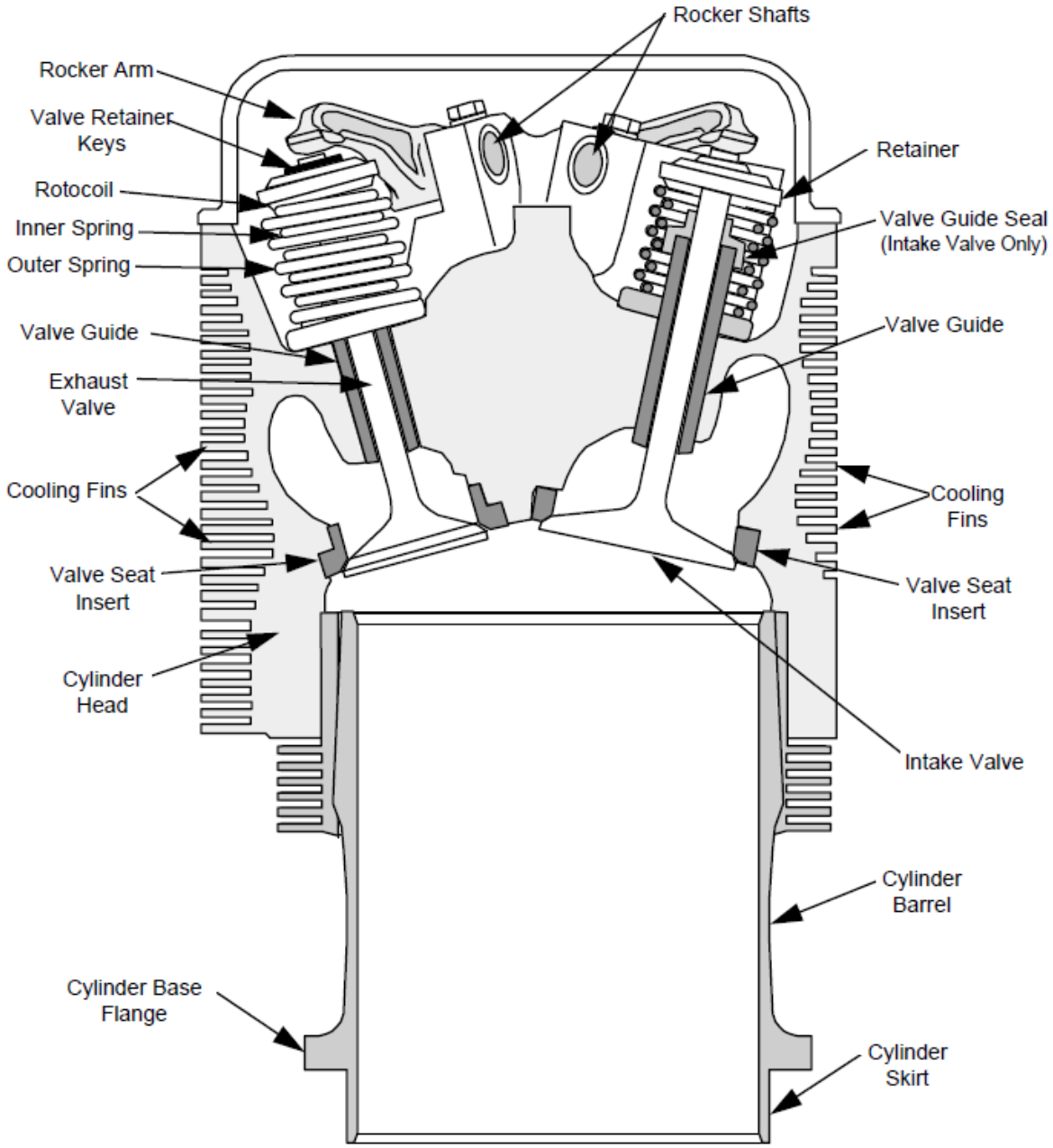

Figure 5 – Cylinder Diagram

A review of the airplane maintenance logbooks revealed that on January 20, 2006, at an engine total time (TT) of 358.3 hours, the No. 5 cylinder was replaced with an overhauled Engine Components International Division (ECi) cylinder. A 100-hour engine inspection was complete on March 23, 2016 at an engine TT of 1,089.9 hours. At the time of the accident the engine had accumulated 1,099 hours TT.

Pilot Information

Certificate:	Commercial	**Age:**	53,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
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:**	May 11, 2015
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	March 4, 2016
Flight Time:	1193 hours (Total, all aircraft), 1061 hours (Total, this make and model), 1061 hours (Pilot In Command, all aircraft), 42 hours (Last 90 days, all aircraft), 17 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	North American	**Registration:**	N91137
Model/Series:	Navion A	**Aircraft Category:**	Airplane
Year of Manufacture:	1946	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	NAV-4-31
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	March 23, 2016 Annual	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	3600 Hrs at time of accident	**Engine Manufacturer:**	Continental Motors
ELT:	C91 installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-520-B
Registered Owner:	On file	**Rated Power:**	285 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KALM,4200 ft msl	**Distance from Accident Site:**	4 Nautical Miles
Observation Time:	09:55 Local	**Direction from Accident Site:**	200°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	230°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.12 inches Hg	**Temperature/Dew Point:**	30°C / 9°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	RUIDOSO, NM (SRR)	**Type of Flight Plan Filed:**	None
Destination:	RUIDOSO, NM (SRR)	**Type of Clearance:**	None
Departure Time:	09:38 Local	**Type of Airspace:**	Class E

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	32.895,-105.967224(est)

Administrative Information

Investigator In Charge (IIC):	Lindberg, Joshua
Additional Participating Persons:	Geary Monckton; Federal Aviation Administration; Albuquerque , NM Mike Council; Continental Motors; Mobile, AL
Original Publish Date:	June 20, 2017
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=93467