Aviation Investigation Final Report

Location:	TOMS RIVER, New Jersey	**Accident Number:**	NYC00LA144
Date & Time:	May 25, 2000, 09:00 Local	**Registration:**	N910X
Aircraft:	Grumman G-164-A	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 None
Flight Conducted Under:	Part 137: Agricultural		

Analysis

After the third aerial application pass, the airplane's engine developed a severe vibration, then seized. The pilot dropped the chemical load, turned the airplane into the wind, and made a forced landing into a cranberry bog. Afterwards, the pilot reported that had he had felt no binding when he pulled the propeller through, to check for hydraulic lock during the preflight. He also stated that the airplane hadn't seemed to be developing full power for about a week prior to the accident. During the post-accident engine teardown, an upper (number 9) cylinder was removed, and a broken connecting rod was found. Metallurgical examination of the connecting rod fragments revealed well-defined crack arrest positions, indicative of fatigue, on the smaller fragment. The fracture features within the fatigue region were relatively uneven, and in several locations, the fatigue crack appeared to have extended in overstress. There were no visible metallurgical defects in the initiation area. The larger fragment contained features typical of an overstress. According Advisory Circular 65-12A, a partial hydraulic lock could cause a 'slightly bent connecting rod,' which could go unnoticed, but would be 'sure to fail later.' Upper cylinders on high wing aircraft have been known to be susceptible to hydraulic lock due to a leaking fuel primer.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The failure of the number 9 cylinder connecting rod, due to a primer leak initiation of a partial hydraulic lock. A factor in the accident was the unsuitable terrain, to which the forced landing had to be made.

Findings

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation: MANEUVERING - AERIAL APPLICATION

Findings
1. (C) ENGINE ASSEMBLY,CONNECTING ROD - FRACTURED
2. (C) MISC, ENGINE HYDRAULIC LOCK - OTHER
3. (C) FUEL SYSTEM,PRIMER SYSTEM - LEAK

Occurrence #2: FORCED LANDING
Phase of Operation: DESCENT - EMERGENCY

Occurrence #3: LOSS OF CONTROL - ON GROUND/WATER
Phase of Operation: EMERGENCY LANDING

Findings
4. (F) TERRAIN CONDITION - NONE SUITABLE

Factual Information

On May 25, 2000, about 0900 Eastern Daylight Time, a Grumman G-164-A Ag Cat, N910X, was substantially damaged during a forced landing in Toms River, New Jersey. The certificated commercial pilot was not injured, and visual meteorological conditions prevailed at the time of the accident. No flight plan had been filed for the local flight, from a farmer's airstrip. The aerial application flight was conducted under 14 CFR Part 137.

According to the pilot, after the third application pass, and with 30 inches of manifold pressure (36 inches was maximum), the airplane's engine developed a severe vibration. It "quit making power, and emitt[ed] black smoke." The pilot dropped the chemical load, turned the airplane into the wind, then made the forced landing into a cranberry bog.

The pilot further stated that earlier, during the preflight, he had pulled the propeller through 11 times, and felt no binding. He also noted that the airplane had not seemed to be developing full power for about a week prior to the accident, and that four different pilots normally flew the airplane.

According to a Federal Aviation Administration (FAA) inspector, after touchdown, the airplane flipped over, and the tail broke, just behind the cockpit. During the post-accident examination, the Pratt & Whitney R-1340-AN engine could not be rotated. It was subsequently removed, and forwarded to the facility which had overhauled it in 1989, for teardown under FAA supervision. During the engine's removal, it was not noted whether there had been leakage from the fuel primer.

The FAA inspector present during the teardown reported that the number 9 cylinder (one of the upper ones) was removed, and a broken connecting rod was found. A large piece of the connecting rod was lodged between the other connecting rods and the crankcase. In addition, the broken portion of the rod that was still attached to the crankshaft, had been jammed into the crankcase, between cylinders 1 and 9.

Further inspection of the number 9 cylinder showed no abnormalities, other than those caused by the broken connecting rod. The cylinder walls were not scored. The rockers and valve springs were removed, and both valves operated smoothly. Both rockers, the lifters and the cam assembly revealed no discrepancies, and the pushrods were straight. Additional inspection of the engine revealed no other damage, except that which was documented from the rod failure.

Engine maintenance records did not indicate that there had been any replacement of the number 9 cylinder since overhaul, and the cylinder hold-down nuts had a build-up of rust and dirt. The engine had 1,022 hours of operation since overhaul, in 1989.

The Safety Board Materials Laboratory performed metallurgical examination of two connecting rod pieces. According to the factual report, "The fracture surfaces of the two pieces did not mate, indicating that a portion of the I-beam was missing...and presumed to be lost."

The report further stated,

"The fracture face of the smaller piece contained well defined crack arrest positions indicative of fatigue. The fracture features within the fatigue region were relatively uneven, and in several locations, the fatigue crack appeared to have extended in overstress. The rest of the fracture contained overstress fracture features emanating from the terminus of the fatigue fracture. The examination noted no visible metallurgical defects at the fracture initiation area."

In addition,

"The larger separated piece of the rod was subjected to post-fracture damage, which almost completely destroyed the fracture features on this piece. Undamaged portions of the fracture contained no evidence of progressive cracking and contained features typical of an overstress."

Advisory Circular (AC) 65-12A, the FAA's airframes and powerplants mechanics' handbook, described the dynamics of hydraulic lock, as occurring in a radial engine's lower cylinders and intake pipes only. However, according to a report provided by the engine teardown facility, "Upper cylinders have [also] been known to be susceptible to hydraulic lock due to a leaking fuel primer on high wing aircraft."

According to AC 65-12A,

"Whenever a radial engine remains shut down for any length of time beyond a few minutes, oil or fuel may drain into...combustion chambers...or accumulate in...intake pipes when the engine starts. As the piston approaches top dead center of the compression stroke (both valves closed), this liquid, being incompressible, stops piston movement. If the crankshaft continues to rotate, something must give. Therefore, starting or attempting to start an engine with a hydraulic lock of this nature...may result in a bent or broken connecting rod.

A complete hydraulic lock - one that stops crankshaft rotation - can result in serious damage to the engine. Still more serious, however, is the slight damage resulting from a partial hydraulic lock which goes undetected at the time it occurs. The piston meets extremely high resistance but is not completely stopped. The engine falters but starts and continues to run as other cylinders fire. The slightly bent connecting rod resulting from the partial lock also goes unnoticed at the time it is damaged but is sure to fail later. The eventual failure is almost certain to occur at a time when it can be least tolerated, since it is during such critical operations as takeoff and go-around that maximum power is demanded of the engine and maximum stresses are imposed on its parts."

Pilot Information

Certificate:	Commercial	**Age:**	39,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Center
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	March 1, 2000
Occupational Pilot:	UNK	**Last Flight Review or Equivalent:**	
Flight Time:	1700 hours (Total, all aircraft), 1150 hours (Total, this make and model), 1575 hours (Pilot In Command, all aircraft), 25 hours (Last 90 days, all aircraft), 20 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Grumman	**Registration:**	N910X
Model/Series:	G-164-A G-164-A	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Restricted (Special)	**Serial Number:**	502
Landing Gear Type:	Tailwheel	**Seats:**	1
Date/Type of Last Inspection:	February 25, 2000 100 hour	**Certified Max Gross Wt.:**	6100 lbs
Time Since Last Inspection:	24 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	6268 Hrs	**Engine Manufacturer:**	P&W
ELT:	Not installed	**Engine Model/Series:**	R-1340
Registered Owner:	DOWNSTOWN AIRPORT, INC.	**Rated Power:**	600 Horsepower
Operator:		**Operating Certificate(s) Held:**	None
Operator Does Business As:		**Operator Designator Code:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	NEL ,103 ft msl	**Distance from Accident Site:**	8 Nautical Miles
Observation Time:	08:55 Local	**Direction from Accident Site:**	300°
Lowest Cloud Condition:	Unknown	**Visibility**	5 miles
Lowest Ceiling:	Broken / 11000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	12 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	250°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	20°C / 16°C
Precipitation and Obscuration:	N/A - None - Haze		
Departure Point:	CHATSWORTH (NONE)	**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	09:15 Local	**Type of Airspace:**	Class G

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	Water-calm
Runway Used:	0	**IFR Approach:**	
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	Cox, Paul
Additional Participating Persons:	DAVID GRASSO; PHILADELPHIA , PA
Original Publish Date:	May 18, 2001
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=49292