Aviation Investigation Final Report

Location:	RENO, Nevada	**Accident Number:**	LAX00GA158
Date & Time:	April 17, 2000, 10:35 Local	**Registration:**	N7046U
Aircraft:	Grumman US-2C	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	3 Fatal
Flight Conducted Under:	Public aircraft		

Analysis

During the takeoff climb, the airplane turned sharply right, went into a steep bank and collided with terrain. The airplane began a right turn immediately after departure and appeared to be going slow. A witness was able to distinguish the individual propeller blades on the right engine, while the left engine propeller blades were indistinguishable. The airplane stopped turning and flew for an estimated 1/4-mile at an altitude of 100 feet. The airplane then continued the right turn at a steep bank angle before disappearing from sight. Then the witness observed a plume of smoke. White and gray matter, along with two ferrous slivers, contaminated the chip detector on the right engine. The airplane had a rudder assist system installed. The rudder assist provided additional directional control in the event of a loss of power on either engine. The NATOPS manual specified that the rudder assist switch should be in the ON position for takeoff, landing, and in the event of single-engine operation. The rudder boost switch was in the off position, and the rudder boost actuator in the empennage was in the retracted (off) position. The owner had experienced a problem with the flight controls the previous year and did not fly with the rudder assist ON. The accident flight had the lowest acceleration rate, and attained the lowest maximum speed, compared to GPS data from the seven previous flights. It was traveling nearly 20 knots slower, about 100 knots, than the bulk of the other flights when it attempted to lift off. The airplane was between the 2,000- and 3,000-foot runway markers (less than halfway down the runway) when it lifted off and began the right turn. Due to the extensive disintegration of the airplane in the impact sequence, the seating positions for the three occupants could not be determined. One of the occupants was the aircraft owner, who held a private certificate with a single-engine land rating, was known to have previously flown the airplane on contract flights from both the left and right seats. A second pilot was the normal copilot for all previous contract flights; his certificates had been revoked by the FAA. The third occupant held an airline transport pilot certificate and had never flown in the airplane before. Prior to the accident flight, the owner had told an associate that the third occupant was going to fly the airplane on the accident flight.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: the flying pilot's failure to maintain directional control following a loss of engine power. Also causal was the failure of the flight crew to follow the published checklist and use the rudder assist system, and the decision not to abort the takeoff.

Findings

Occurrence #1: LOSS OF ENGINE POWER
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. 1 ENGINE
2. (C) REASON FOR OCCURRENCE UNDETERMINED

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
3. (C) ABORTED TAKEOFF - NOT PERFORMED - PILOT IN COMMAND
4. (C) CHECKLIST - NOT COMPLIED WITH - PILOT IN COMMAND
5. (C) EQUIPMENT,OTHER - NOT USED - PILOT IN COMMAND
6. (C) AIRSPEED(VYSE) - NOT OBTAINED/MAINTAINED - PILOT IN COMMAND

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Findings
7. TERRAIN CONDITION - GROUND

Factual Information

1.1 HISTORY OF FLIGHT

On April 17, 2000, about 1035 Pacific daylight time, a Grumman US-2C, N7046U, collided with terrain 1 minute after departure from runway 26 at the Stead Airport, Reno, Nevada. The airplane remained within the boundaries of the airport. Advance Aviation Services, Inc., owned the airplane. They operated it under contract to the Desert Research Institute, a unit of the University and Community College System of Nevada, as a public-use flight. The three crewmembers sustained fatal injuries; the airplane was destroyed. The airplane was on an instrument flight rules (IFR) flight plan, and was to return to Stead after seeding clouds to enhance snowfall in the local mountains. Visual meteorological conditions prevailed. The primary wreckage was at 39 degrees 40.62 minutes north latitude and 119 degrees 52.26 minutes west longitude.

Witnesses reported that the airplane began a right turn immediately after departure and appeared to be going slow. One witness reported that he was able to distinguish the individual propeller blades on the right engine, while the left engine propeller blades were indistinguishable. The airplane stopped turning and flew for an estimated 1/4-mile at an altitude of 100 feet. The airplane then continued the right turn at a steep bank angle before disappearing from sight. Then the witness observed a plume of smoke.

1.2 PERSONNEL INFORMATION

Due to the destruction of the airplane in the accident sequence, the seating positions of the three crewmembers could not be established with certainty. No one observed the crew board the airplane or their positions as they taxied for takeoff.

1.2.1 Aircraft Owner

A review of Federal Aviation Administration (FAA) airman records revealed that the owner held a private pilot certificate with a rating for airplane single-engine land. He did not hold an instrument rating. No personal flight records were located for the owner. The National Transportation Safety Board investigator-in-charge (IIC) obtained the aeronautical experience listed in this report from a review of the airmen records on file in the FAA's Airman and Medical Records Center located in Oklahoma City, Oklahoma. These records indicated a total time of 3,700 hours.

A pilot who had flown with the owner the previous year, and the first four flights this year, said that the owner flew in the left seat the first year and in the right seat for the four flights this year.

The owner/pilot held a third-class medical certificate that was issued on October 14, 1997. It had the limitation that the pilot must have glasses available for near vision.

1.2.2 Second Pilot

The second pilot did not hold a current pilot certificate; his certificate had been revoked by the FAA. Prior to the revocation action, he had held an airline transport pilot (ATP) certificate with a multiengine land rating and an SA-227 type rating. He also had held a commercial pilot certificate with a single-engine land rating. He had held a certified flight instructor certificate with a rating for airplane single-engine land. No personal flight records were located for the second pilot. The IIC obtained the aeronautical experience listed in this report from a review of the airmen records on file in the FAA's Airman and Medical Records Center located in Oklahoma City. These records indicated a total time of 8,170 hours.

Another pilot, who had been flying the airplane this year as the primary pilot, was not able to make this flight. The primary pilot had flown about eight or nine flights with this second pilot as his copilot in the right seat. He estimated that the second pilot had 20,000 hours. He estimated that the second pilot had flown with the owner an estimated total time of 20 hours in this airplane.

The second pilot held a medical certificate that was issued on January 5, 2000. It had the limitations that the pilot must wear lenses for distant vision and possess glasses for near vision.

1.2.3 Third Pilot

The third pilot held an ATP certificate with ratings for airplane single-engine land, multiengine land, and rotorcraft-helicopter. He was type rated in the BH-47, BH-204, BH-206, and BH-212. He held a commercial pilot certificate with an SD-3 type rating. He held a certified flight instructor (CFI) certificate with ratings for airplane single-engine land, multiengine land, and instrument airplane. He also held a CFI certificate with a rating for rotorcraft-helicopter. He was an instrument ground instructor. He held a mechanic certificate with ratings for airframe and powerplant. He held a flight engineer certificate with a rating for turbojet-powered aircraft. He also held an aircraft dispatcher certificate.

No personal flight records were located for the third pilot. The IIC obtained the aeronautical experience listed in this report from a review of the airmen records on file in the FAA's Airman and Medical Records Center located in Oklahoma City. These records indicated a total time of 12,000 hours.

The third pilot held a second-class medical certificate that was issued on November 3, 1999. It had the limitations that the pilot must wear corrective lenses for near and distant vision.

This was the third pilot's first flight in the airplane. He was an acquaintance of the airplane's owner, and had expressed an interest in going on a flight. The owner called him about an hour before the flight, and asked if he would like to go on the flight. The owner had indicated to the primary pilot that he expected this third pilot to fly that morning. A retired FAA inspector, who had flown the S-2 in the Navy, knew the third pilot very well. The inspector said that this pilot would not fly an airplane that he was unfamiliar with, and he certainly would not fly this model without talking to the inspector first. The inspector spoke with the third pilot the day before the accident. The third pilot did not mention that he was going flying in the S-2 or that he had been studying the flight manuals.

Public-use aircraft are exempt from Federal Air Regulation (FAR) Part 61, which establishes pilot and medical certification requirements.

1.3 AIRCRAFT INFORMATION

The airplane was a Grumman US-2C, serial number 133355. Investigators did not recover logbooks for either the airframe or engines. Public-use aircraft are exempt from FAR 91.7, which describes civil airworthiness requirements. They are also exempt from FAR 91.401 aircraft maintenance requirements.

The left engine was a Wright R-1820-82 engine, serial number BL-E 516742.

The right engine was a Wright R-1820-82, serial number BLE516824. Maintenance records from a repair facility disclosed that they completed a major repair of the right engine on October 22, 1998. Procedures accomplished included: disassembly and cleaning; magnetic inspection of steel parts; and ultrasonic inspection and replating. They overhauled the magneto and carburetor. They replaced the crankshaft, rods, bearings, pistons, ignition harness, and cylinder stud assemblies. They ran the engine in a test cell for 2.8 hours and estimated that the time since overhaul was 402.8 hours.

The NATOPS manual (US Navy equivalent of a Pilot Operating Handbook) described the S-2 systems and operating procedures.

Normal takeoff procedure was to release the brakes, advance the throttles to maximum allowable power, lift the nose off between 80 and 85 knots, and fly off at not less than 95 knots.

The airplane had a rudder assist system installed. The rudder assist provided additional directional control in the event of a loss of power on either engine. The NATOPS manual specified that the rudder assist switch should be in the ON position for takeoff, landing, and in the event of single-engine operation. Normal rudder trim operated 5 degrees left and right electrically. With rudder assist on, the rudder trim operated 20 degrees left and right hydraulically.

An examination of a portion of the instrument panel revealed that the rudder boost switch was in the off position, and the rudder boost actuator in the empennage was in the retracted (off) position. A pilot who had flown with the owner all of the previous year and the first four flights this year, indicated that the owner had experienced a problem the previous year and did not fly with the rudder assist ON. The primary pilot said that there was a checklist glued to the instrument panel that called for the assist to be ON. The owner taught him to use the checklist, and he always flew with the rudder assist ON as required. The owner used the checklist infrequently.

1.4 AIRPORT INFORMATION

The Airport/ Facility Directory, Southwest U. S., indicated runway 26 was 7,600 feet long and 150 feet wide. The runway surface was composed of asphalt.

1.5 WRECKAGE AND IMPACT INFORMATION

Investigators from the Safety Board and the FAA examined the wreckage at the accident scene. All distances are from the first identified point of contact (FIPC) and left or right of the debris path centerline.

The FIPC was a crater that was 5 feet long, 3 feet wide, 12 inches deep, and contained green lens fragments. The right wing tip was 9 feet past the end of the crater. The airplane fragmented over a distance of 258 feet, and the debris path centerline was along a magnetic bearing of 080 degrees. The empennage longitudinal axis was on a magnetic heading of 220 degrees. Fire consumed the fuselage.

1.6 MEDICAL AND PATHOLOGICAL INFORMATION

The Washoe County Coroner completed an autopsy on all three victims. The FAA Toxicology and Accident Research Laboratory performed toxicological testing of specimens of all three victims. The results of analysis of the specimens were negative for carbon monoxide, cyanide, and volatiles for all three victims. The tests were negative for tested drugs for two victims; the owner tested positive for atenolol in blood and urine.

1.7 TESTS AND RESEARCH

Investigators completed an examination of the wreckage at Stead Airport facilities. The number 1 needle on the rpm indicator was at 2,900, and the number 2 needle was at 950.

1.7.1 Right Engine

The right engine was charred, and fire consumed the accessory section on the aft side of the engine. The engine was distorted in the propeller mounting area, and the case fractured along both sides of the governor. Most of the cylinders' push rods were bent.

Investigators removed and examined the front spark plugs. Several plugs were bent; their porcelain insulators were fractured, and their ground electrodes contacted the center electrode. The other plugs displayed no mechanical damage, and all had similar gaps and coloration.

The side screen on the oil sump was clean and white, and the bottom sump screen was clean and moist. The transfer tube from the sump to the bottom of a valve cover was unobstructed. White and gray matter contaminated the chip detector, along with two ferrous slivers.

Investigators could only rotate the propeller approximately 90 degrees. They removed cylinders No. 4 and 9, and found an intake lifter out of its track. They moved it into position and were able to rotate the propeller more than 180 degrees. The NAVAIR O2A-35GN-503 airplane operating (NATOPS) manual noted that the propeller to engine ratio was 0.5625 to 1. The propeller rotation computed to over 300 degrees of engine rotation. All valves moved, the pistons moved up and down in their respective cylinders, and no mechanical damage was on the pistons' faces. Investigators obtained thumb compression on two cylinders. The retention nut on the back of the crankshaft and the internal gears rotated freely.

1.7.2 Left Engine

Investigators removed the spark plugs from the front of the left engine. The plugs displayed similar gaps and coloration. The propeller rotated freely through 360 degrees. All valves rotated and investigators obtained thumb compression on all cylinders. They turned the left engine magneto with a wrench and detected voltage with a voltmeter. Investigators drained several ounces of a clear blue fluid that smelled like aviation gasoline out of the carburetor.

1.7.3 Airframe

Control continuity could not be established due to cabin distortion and fragmentation. All control surface cables were found fractured in broom straw patterns in multiple locations. Both control wheels separated and split into two sections. Push rods in the rudder control system were bent or fractured along planes at a 45-degree angle to their longitudinal axis.

1.7.4 Right propeller shaft

The IIC sent the propeller shaft for the right engine to the Safety Board Materials Laboratory Division, Washington, D.C., for examination. The shaft separated perpendicular to the shaft centerline, forward of the splines, and intersected two threaded holes. Almost all of the mating surfaces appeared uniformly rough and matte gray in color. A portion of the fracture intersected a longitudinal crack. Portions of the crack were on both the forward and aft pieces.

A Safety Board specialist sectioned a forward piece of the propeller shaft in order to separate

the longitudinally cracked surfaces. A portion of the surface appeared darker and had a smooth, wrinkled appearance, consistent with a cold shut. A cold shut is a discontinuity that forms during casting when flowing molten material converges, but does not bond completely. The adjacent area also appeared darker and had numerous voids. The specialist observed no evidence of progressive crack growth.

The IIC contacted Hamilton Sundstrand, the manufacturer of the propeller shaft, regarding the effects of the crack on the propeller shaft. They stated that the blade angles would have remained at the low pitch, positive blade angle stop. This blade angle would have been capable of producing forward thrust.

1.7.5 Recorded Flight Track Data

The principal research technician for Desert Research Institute retrieved flight data for the accident flight and previous flights, and then incorporated the information into graphical format. He retrieved the data from an onboard global positioning system (GPS) that the organization used for flight tracking purposes.

Seven separate takeoffs occurred between January 27, 2000, and April 17, 2000. The accident flight had the lowest acceleration rate, and attained the lowest maximum speed. The average liftoff point for the airplane varied with each flight. Aside from flights on January 30 and April 17, the takeoff speed was consistent at 118 to 120 knots. On January 30, the technician estimated that it was about 110 knots. On April 17, he estimated that it was traveling nearly 20 knots slower, about 100 knots, than the bulk of the other flights when it attempted to lift off. The airplane was between the 2,000- and 3,000-foot runway markers (less than halfway down the runway) when it lifted off and began a right turn.

1.8 ADDITIONAL INFORMATION

The IIC released the wreckage to a family representative.

Pilot Information

Certificate:	Airline transport; Commercial; Flight engineer; Flight instructor	**Age:**	55,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Unknown
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Helicopter; Instrument airplane; Instrument helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	November 3, 1999
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	12000 hours (Total, all aircraft)		

Other flight crew Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	47,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Unknown
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane single-engine	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	January 5, 2000
Occupational Pilot:	UNK	**Last Flight Review or Equivalent:**	
Flight Time:	8170 hours (Total, all aircraft)		

Other flight crew Information

Certificate:	Private	**Age:**	66,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Unknown
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Expired	**Last FAA Medical Exam:**	October 14, 1997
Occupational Pilot:	UNK	**Last Flight Review or Equivalent:**	
Flight Time:	3700 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Grumman	**Registration:**	N7046U
Model/Series:	US-2C US-2C	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Restricted (Special)	**Serial Number:**	133355
Landing Gear Type:	Retractable - Tricycle	**Seats:**	3
Date/Type of Last Inspection:	Unknown	**Certified Max Gross Wt.:**	26000 lbs
Time Since Last Inspection:		**Engines:**	2 Reciprocating
Airframe Total Time:		**Engine Manufacturer:**	Wright
ELT:		**Engine Model/Series:**	R-1820-82
Registered Owner:	Advance Aviation Services, Inc.	**Rated Power:**	
Operator:	DESERT RESEARCH INSTITUTE	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	4SD	**Distance from Accident Site:**	
Observation Time:	10:41 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Scattered / 4600 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 10000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	0°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	12°C / -1°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	RENO, NV (4SD)	**Type of Flight Plan Filed:**	IFR
Destination:		**Type of Clearance:**	None
Departure Time:	10:35 Local	**Type of Airspace:**	Class G

Airport Information

Airport:	RENO/STEAD 4SD	**Runway Surface Type:**	Asphalt
Airport Elevation:	5050 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	26	**IFR Approach:**	None
Runway Length/Width:	7608 ft / 150 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	3 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Fatal	**Latitude, Longitude:**	39.667221,-119.876113

Administrative Information

Investigator In Charge (IIC):	Plagens, Howard
Additional Participating Persons:	Clarence Bohartz; Federal Aviation Administration; Reno, NV
Original Publish Date:	June 2, 2004
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=51201