



National Transportation Safety Board Aviation Accident Final Report

Location:	GRAND CANYON, AZ	Accident Number:	LAX99FA136
Date & Time:	04/01/1999, 1136 MST	Registration:	N992UC
Aircraft:	Bell 206B	Aircraft Damage:	Destroyed
Defining Event:		Injuries:	1 Fatal, 1 Serious

Flight Conducted Under: Part 91: General Aviation - Instructional

Analysis

Shortly after takeoff and transition to forward flight, the helicopter's engine stopped. During the ensuing autorotative landing glide, a main rotor blade struck a tree about 30 feet above ground level and the helicopter fell to the ground. This was the first flight of the day and the helicopter had been stored outside overnight in conditions of cold temperatures and light snowfall without engine air inlet covers installed. Prior to the flight the engine was difficult to start. There were five aborted starts before the engine was successfully started. During the first three start attempts, fuel was introduced, ignition occurred, the engine acceleration hung at 30 percent, and the starts were aborted. After the third start attempt a mechanic noted that the engine inlets were approximately half blocked by snow and cleared the snow from the inlets using a towel. He did not check the plenum chamber aft of the particle separator and forward of the engine inlet for snow. In the wreckage, the plenum chamber inspection window was found to be opaque. After the accident, another company mechanic who had dealt with the same starting difficulty on another helicopter of the same type parked under the same circumstances without inlet covers, reported finding the plenum chamber of that helicopter contained several cups of snow. The engine manufacturer reported that tests of the engine had shown that ingestion of as little as 6 ounces of snow/slush could flame out the engine. The operator's procedure requiring that the last flight crew at the end of the day install the inlet covers on aircraft stored outside had not been followed.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The failure of the flight crew to properly preflight the helicopter and to detect and remove accumulated snow from the engine inlets and plenum chamber. Factors in the accident were the clouded plenum chamber inspection window and the failure of preceding flight crew to install the engine inlet covers in accordance with the operator's procedure.

Findings

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - NONMECHANICAL
Phase of Operation: CLIMB - TO CRUISE

Findings

1. ENGINE INLET ASSEMBLY - FOREIGN MATERIAL/SUBSTANCE
2. ENGINE INLET ASSEMBLY - ICE INGESTION
3. ENGINE INLET ASSEMBLY - CONTAMINATION, WATER
4. (F) WINDOW, INSPECTION/OBSERVATION - DIRTY (FOGGY)
5. (C) AIRCRAFT PREFLIGHT - INADEQUATE - FLIGHTCREW
6. (C) ICE/FROST REMOVAL FROM AIRCRAFT - INADEQUATE - FLIGHTCREW
7. (F) AIRCRAFT PROTECTIVE COVERING - NOT USED - OTHER PERSON

Occurrence #2: FORCED LANDING
Phase of Operation: EMERGENCY LANDING AFTER TAKEOFF

Findings

8. AUTOROTATION - PERFORMED - COPILOT/SECOND PILOT

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: DESCENT - EMERGENCY

Findings

9. OBJECT - TREE(S)

Occurrence #4: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Factual Information

HISTORY OF FLIGHT

On April 1, 1999, at 1136 hours mountain standard time, a Bell 206B, N992UC, was destroyed when it collided with a tree and fell to the ground during an autorotative emergency landing following loss of engine power shortly after takeoff from the Grand Canyon, Arizona, airport. Fatal injuries were sustained by the commercial pilot under instruction and serious injuries were sustained by the airline transport instructor pilot. Visual meteorological conditions prevailed for the 14 CFR Part 91 instructional flight. The helicopter was operated by Papillon Grand Canyon Helicopters and the flight was originating at the time for a local area flight.

The operator reported that the trainee pilot had recently been hired and was receiving initial new-hire training. The accident flight was the pilot's second flight in the operator's training program.

According to witnesses, the helicopter lifted off from the operator's helipad located about 800 feet northeast of the airport terminal building and transitioned to forward flight over the (public) curbside access road in front of the terminal while traveling southwest-bound parallel to runway 21. When the aircraft was over the south end of the terminal building, at 150 feet agl and flying about 50 knots, the witnesses reported that the sound of the helicopter changed. The aircraft descended straight ahead, impacted a tree with the rotor, pitched nose down, and fell to the ground near the base of the tree and along side the terminal access road.

According to the operator, the instructor pilot said that the engine had failed and the trainee pilot had entered an autorotation but struck the tree with the rotor while they were trying to reach a suitable landing site.

The operator reported that the aircraft had been stored outside overnight without engine inlet covers installed, and this was its first flight of the day. Approximately 2 to 3 inches of snow fell overnight. There were no maintenance discrepancies on the aircraft and it was flown on training flights the 3 prior days.

A mechanic's helper, who was assigned to take an auxiliary power unit (APU) to the aircraft to assist starting it, reported that there were four attempts to start the helicopter's engine using three different battery carts (APU's). After two unsuccessful attempts with the first APU, the mechanic's helper got a second APU. While he and the pilots were waiting for the batteries to charge up on the second APU, the mechanic's helper noted there was an accumulation of snow in both engine inlets. He reported to the operator that the two inlets were each one-third to one-half obstructed with snow, and that he removed approximately two handfuls of snow from each inlet and wiped snow off the particle separator with a rag. The third start attempt was also unsuccessful due to low batteries in the second APU. A third APU was then brought out and the engine start was normal. The aircraft then remained on the pad with the engine operating prior to departing.

In a telephone interview, the instructor pilot reported that he had worked for the operator since 1995 and his cold weather (snow) operating experience is limited to this time. This was his fourth winter there and he characterized the snowfall present preceding the accident as common for the Grand Canyon in winter.

Regarding the difficulty starting the helicopter, the pilot said they used three different APU's

on the day of the accident for a total of six start attempts. All three APU's were battery carts, not engine driven generator type GPU's. The first three start attempts were made with the first APU. On all three attempts the engine was accelerated to 13 - 14 percent, fuel was introduced, the engine lit, acceleration hung about 30 percent, and the starts were aborted. A 30-minute wait ensued for starter motor cool down after the third attempt. The fourth and fifth start attempts used the second APU, identified as the 4X4. The batteries on the 4X4 were low and only about 10 percent N1 could be attained. No fuel was introduced on the fourth or fifth start attempt. The third APU, identified as the "Superbee," was pushed out to the meadow and the sixth start was normal. The pilot recalled that it was after the third start attempt that the mechanic's helper removed snow from the inlets.

The instructor pilot said he was aware of the flight manual limitations on operating in snow and the importance of keeping the inlets clear; however, he didn't think he nor the student pilot checked the plenum aft of the particle separator and forward of the engine inlet for snow accumulation. He definitely recalled that the inlets were clear and, after starting the engine, he checked that the swirl tubes in the particle separator were clear. He said that when the engine quit, it just went silent, there was no surge or bang.

Following the accident, another one of the operator's mechanics reported finding an accumulation of snow behind the particle separator and forward of the engine inlet on another Bell 206 on the morning of the accident. The second helicopter, like the accident helicopter, was parked in the meadow overnight without inlet covers installed. This mechanic used two heat guns to melt and dissipate the snow.

AIRCRAFT INFORMATION

The aircraft had received a 100-hour/annual inspection on February 10, 1999, and had flown 27 hours since that time. Additionally, 12-month inspection items were accomplished on March 28, 1999, and the aircraft had flown 4.5 hours since that time.

WRECKAGE AND IMPACT INFORMATION

At the Grand Canyon airport, the terminal access road passes in front of the terminal on a northeast-southwest heading parallel to the airport's single runway, 3-21. The aircraft boarding ramp is on the opposite side of the terminal. The accident site was on the shoulder of the terminal access road on the side opposite the terminal and approximately 200 feet southwest of the terminal at the intersection with the crossroad forming the south entrance/exit for the airport. The latitude at the accident site is approximately 35 degrees 57.56 minutes north and the longitude is 117 degrees 8.10 minutes west. The airport elevation is 6,606 feet msl. The entire aircraft was present at the accident site and there was no fire.

Approximately 20 feet northeast of the accident site on the same shoulder of the road was a pine tree, which had been severed about 30 feet above ground level. The severed top of the tree was lying on the ground at the base of the tree and was about 10-inches diameter at the point where it was severed. The fracture surface was aligned 45 degrees to the axis of the tree trunk.

All of the helicopter was present in proximity of the main wreckage except the red (dot) main rotor blade, which was separated from the root section outboard of the root reinforcement doublers. The red blade was laying approximately 50 feet east of the main wreckage in the traffic lane of the south entrance/exit road that formed the intersection. The tip end 12-inches of the red blade was shattered and had small wood particles embedded in it. The trailing edge of the red blade exhibited small compression buckles along its span. The white (dot) rotor

blade was laying on the ground adjacent to the fuselage and remained attached to the hub, but was bent and broken outboard of the root doublers. There were two gouges in the lower surface of the white blade, each about 6-inches long (chordwise) and 1-inch wide. The gouges were about 2 feet inboard from the tip of the blade.

The tail boom with the tail rotor assembly attached was laying about 5 feet northeast of the fuselage. The tailboom and tail rotor driveshaft were separated at the fuselage juncture with tension tearing on the lower skin and compression buckling in the upper skin. There was a 45-degree bend upward and counterclockwise in the boom at the base of the vertical stabilizer fin. Both tail rotor blades remained attached to the hub and the hub was undamaged. One blade was bent inboard approximately 15 degrees and the other blade was undamaged. There were no chordwise striations on the blades.

The cabin section of the fuselage was laying inverted approximately 135 degrees to the right with the nose pointing north. The fuselage was broken in two along a line through the top of the windshield, through the top of the "broom closet" and through the floor of the cabin at the aft cabin wall. The two sections remained connected by the electrical wiring bundle in the windshield center post. The control push-pull tubes at the top of the "broom closet" were severed and the fractures were accompanied by bending. The aircraft's fuel tank bladder was torn open near where the fuselage separated and there was a strong fuel smell at the site. The interior of the fuel bladder was clean and free of contamination. The main rotor transmission was displaced from its aft attachment and the transmission and mast were angled approximately 15 degrees forward. The collective flight controls were in the full up position.

The engine fuel supply system was examined at the site. All B-nuts were tight and all lines were intact except where the flexible fuel line from the tank mounted boost pumps connect to the fuselage bulkhead fitting. The fitting there was broken and exhibited a uniform bright gray appearance at the fracture surface.

The aircraft was further examined at Air Transport in Phoenix, Arizona, on April 3, 1999.

The aircraft was not equipped with ignition auto re-light capability nor reverse flow inlets.

The engine was externally undamaged except for a small puncture hole in the combustion chamber outer case and a broken electrical terminal on the igniter box. The anti-ice valve servo actuator was separated from its mounting bracket. Two of the four servo actuator mounting screws were present. The threads of the two screws present contained bright gray metal in the root of the threads. The servo arm position corresponded to the anti-ice "on" position. All pneumatic and fuel lines connections were tight. The throttle linkage was in the full open position at the fuel control unit and the governor was at 70 percent. The gas generator turbine and compressor turned freely by hand. The oil sump chip detector was clear. The Plexiglas plenum chamber inspection window was opaque.

The main rotor transmission turned freely and smoothly by hand. The transmission chip detector was clear.

About 2 cups of fuel were present in the airframe fuel filter and smaller amounts were present in the fuel control screen and the line from the fuel control to the fuel nozzle. The fuel was clear and visually uncontaminated and the fuel filter element was free of foreign debris. The fuel nozzle was externally clear and undamaged. The engine driven fuel pump drive shaft was intact.

Flight and engine control and drive train continuity was verified. All fractures were accompanied by bending and fracture surfaces exhibited a uniform, bright gray appearance.

MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy was performed on the second pilot by the Coconino County (Arizona) Medical Examiners Office (case number 99-0105). Toxicological testing was performed by the Federal Aviation Administration Civil Aeromedical Institute in Oklahoma City, Oklahoma.

TESTS AND RESEARCH

The engine was removed from the aircraft and placed in an engine test cell on April 5, 1999, at Arizona Rotorcraft, Inc. Prior to running the engine it was necessary to replace the outer combustion case, which was punctured in the accident, and to replace the ignition control unit which had impact damage on the input terminal. Three configuration irregularities were noted while installing the engine in the test cell which are listed on the attached "Test Cell Activity Report"; however, later research revealed that two of the "irregularities" were, in fact, the correct configuration and the third was operationally insignificant. In the test cell, without altering the configuration, the engine started promptly on the first attempt and met or exceeded the manufacturer's specifications for in-service engines. Attempts to induce compressor stalls or other power interruptions by rapid movement of the power lever or governor control lever resulted in uninterrupted power output from the engine. Attempts to simulate abrupt movement of the helicopter's collective control by releasing and reapplying the fluid dynamic brake also resulted in uninterrupted power from the engine.

On the Caution Annunciator light panel there are 11 segments, each operated by one light bulb. The Safety Board investigator examined the filaments of each light bulb and noted the following about the filaments (left to right): 1) "SPARE", filament intact, coils uniform; 2) "TRANS CHIP", filament intact, coils uniform, filament wrapped over on itself; 3) "T/R CHIP", filament intact, coils uniform; 4) "A/F FUEL FILTER", filament intact, coils uniform; 5) "FUEL PUMP", filament broken, coils uniform, filament wrapped over on itself; 6) "SPARE", filament intact, coils uniform; 7) "TRANS PRESS", filament intact, coils uniform; 8) "TRANS TEMP", filament broken, coils uniform; 9) "LOW ROTOR RPM", filament intact, shape distorted, coils locally stretched (not uniform); 10) "ENG CHIP", filament intact, coils uniform; and 11) "ENG OUT", filament broken, shape distorted, coils locally stretched (not uniform).

The helicopter was equipped with turbine outlet temperature (TOT) and torque instruments which record exceedances of limit parameters. The two instruments were sent to the manufacturer for readout and the manufacturer reported there were no exceedances in the previous 316 start cycles.

According to the Rolls-Royce Allison party representative, testing conducted in 1968 by Allison showed that as little as 30 grams of snow/slush (25 percent water) ingested in the engine inlet can induce a flameout in the Allison 250- series engine.

The operator's party representative reported that it is their company procedure to install inlet covers on helicopters stored outdoors.

ADDITIONAL INFORMATION

The aircraft wreckage was released to the owner, Monarch Enterprises, on May 5, 1999.

Pilot Information

Certificate:	Airline Transport	Age:	34, Male
Airplane Rating(s):		Seat Occupied:	Left
Other Aircraft Rating(s):	Helicopter	Restraint Used:	Seatbelt, Shoulder harness
Instrument Rating(s):	Helicopter	Second Pilot Present:	Yes
Instructor Rating(s):	Helicopter; Instrument Helicopter	Toxicology Performed:	No
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	Last FAA Medical Exam:	05/26/1998
Occupational Pilot:		Last Flight Review or Equivalent:	
Flight Time:	5017 hours (Total, all aircraft), 2319 hours (Total, this make and model), 91 hours (Last 90 days, all aircraft), 19 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	Bell	Registration:	N992UC
Model/Series:	206B 206B	Aircraft Category:	Helicopter
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	421
Landing Gear Type:	Skid	Seats:	5
Date/Type of Last Inspection:	02/10/1999, Annual	Certified Max Gross Wt.:	3200 lbs
Time Since Last Inspection:	28 Hours	Engines:	1 Turbo Shaft
Airframe Total Time:	15860 Hours	Engine Manufacturer:	Allison
ELT:	Installed, activated, did not aid in locating accident	Engine Model/Series:	250C20B
Registered Owner:	MONARCH ENTERPRISES, INC.	Rated Power:	417 hp
Operator:	PAPILLON GRAND CANYON HELICOPT	Operating Certificate(s) Held:	On-demand Air Taxi (135)
Operator Does Business As:		Operator Designator Code:	PGCH

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	GCN, 6606 ft msl	Observation Time:	1141 MST
Distance from Accident Site:	1 Nautical Miles	Direction from Accident Site:	215°
Lowest Cloud Condition:	Scattered / 800 ft agl	Temperature/Dew Point:	-1° C / -9° C
Lowest Ceiling:	Broken / 2500 ft agl	Visibility	10 Miles
Wind Speed/Gusts, Direction:	6 knots, 230°	Visibility (RVR):	0 ft
Altimeter Setting:	29 inches Hg	Visibility (RVV):	0 Miles
Precipitation and Obscuration:			
Departure Point:	(GCN)	Type of Flight Plan Filed:	Company VFR
Destination:		Type of Clearance:	VFR
Departure Time:	1132 MST	Type of Airspace:	Class D

Airport Information

Airport:	GRAND CANYON NATL PARK (GCN)	Runway Surface Type:	
Airport Elevation:	6606 ft	Runway Surface Condition:	Snow--dry
Runway Used:	0	IFR Approach:	
Runway Length/Width:		VFR Approach/Landing:	

Wreckage and Impact Information

Crew Injuries:	1 Fatal, 1 Serious	Aircraft Damage:	Destroyed
Passenger Injuries:	N/A	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Fatal, 1 Serious	Latitude, Longitude:	

Administrative Information

Investigator In Charge (IIC):	RICHARD B PARKER	Adopted Date:	11/30/2000
Additional Participating Persons:	NICHOLAS F HARRINGTON; LAS VEGAS, NV DAVID C DOSKER; FORT WORTH, TX JOHN J SWIFT; INDIANAPOLIS, IN MICHAEL BASHLOR; GRAND CANYON, AZ		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report.