Aviation Investigation Final Report

Location:	STANWOOD, Washington	**Accident Number:**	SEA00FA061
Date & Time:	April 2, 2000, 11:50 Local	**Registration:**	N3377H
Aircraft:	Bell 47G-3B-1	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	1 Fatal, 1 Serious, 1 Minor
Flight Conducted Under:	Part 91: General aviation		

Analysis

The pilot and two passengers were engaged in a sightseeing flight eastbound over a river in the Bell 47G helicopter when they heard a 'clunk,' the engine began to overspeed, and rotor RPM began to decay. The pilot executed an autorotation to a nearby field. Just prior to touchdown, the helicopter snagged the wires of two low profile, four-foot high electrical fences which he did not see. The helicopter then rolled/yawed to the right and made a hard landing, coming to rest on its right side. Post-crash examination of the engine and transmission revealed no mechanical malfunctions. However, the oil jet (a threaded, hollow plug which screwed into the forward end of the engine crankshaft) was found lying loose beneath the clutch housing. The interior surfaces of the clutch housing displayed a large amount of oil. The clutch assembly was found to be without mechanical disparities and within normal wear limits. The release of the oil jet would have allowed engine oil to flow through the 3/8 inch threaded orifice into the lower transmission and clutch housing at a significantly higher rate than through the small diameter orifice in the end of the oil jet, resulting in disengagement of the clutch. The orifice in the jet was intended to allow a mist or light spray of oil to reach the lower mast bearing for lubrication purposes.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The disengagement of the oil jet fitting from its threaded receptacle at the forward end of the engine crankshaft. This resulted in excessive oil within the clutch assembly, the subsequent slipping of the clutch, and ultimately the disengagement of the rotor drive system from the engine. Contributing factors were the pilot's not maintaining clearance from the electric fences which were also hidden objects against the grass landing surface.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: CRUISE

Findings
1. (C) MISCELLANEOUS,BOLT/NUT/FASTENER/CLAMP/SPRING - DISENGAGED
2. FLUID,OIL - EXCESSIVE FLOW/OUTPUT
3. ROTOR DRIVE SYSTEM,CLUTCH ASSEMBLY - SLIPPED

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

Findings
4. ROTOR DRIVE SYSTEM - DISENGAGED

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings
5. (F) OBJECT - FENCE

Occurrence #4: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings
6. (F) TERRAIN CONDITION - HIDDEN OBSTRUCTION(S)
7. (F) CLEARANCE - NOT MAINTAINED - PILOT IN COMMAND

Occurrence #5: HARD LANDING
Phase of Operation: LANDING - FLARE/TOUCHDOWN

Factual Information

HISTORY OF FLIGHT

On April 2, 2000, approximately 1150 Pacific daylight time, a Bell 47G-3B-1 helicopter, N3377H, registered to and being operated by a commercial pilot, was destroyed when it struck a fence and terrain following a rotor RPM loss while in cruise approximately three nautical miles southeast of Stanwood, Washington. The pilot, occupying the left seat, sustained minor injuries. The center passenger sustained serious injuries and her husband, occupying the right seat, sustained fatal injuries. A post-crash fire consumed a portion of the helicopter. Visual meteorological conditions prevailed and no flight plan had been filed. The trip was a sightseeing flight which was to have been conducted within 25 nautical miles of the departure airport, in accordance with 14 CFR 135.1(a)(5). The flight departed Arlington, Washington, approximately 1105 after picking up the two passengers.

The pilot was telephonically interviewed on April 3, 2000, and reported that after departing Arlington and flying towards the coast and then north to the mouth of the Stillaguamish River he turned inland to follow the river (refer to CHART I provided by the pilot). He reported that he was flying about 60-70 mph. Shortly after crossing the bridge (refer to CHART II) he heard a little "clunk" sound and then the engine started to race (RPM increased above what he normally saw for this type of flight regime). There was no vibration, coughing, sputtering or other engine indications. As the engine RPM increased the (main) Rotor RPM began to decay. This all occurred in a very short time (2 seconds). He maneuvered the helicopter toward a field along the north side of the River and never saw the electric fence. He reported that he landed hard in a little right roll and the helicopter came to rest on its right side.

PERSONNEL INFORMATION

The pilot held a commercial certificate and reported a total of 5,777 hours of flight experience, of which 1,187 were in the Bell 47 rotorcraft.

AIRCRAFT INFORMATION

Airframe and engine logbooks, as well as a computer printout provided by the pilot/owner for N3377H's trip log, were reviewed. The rotorcraft was equipped with a Lycoming O-435-25A engine (the military equivalent of the TVO-435-B1A), a 270 horsepower engine. The engine was installed in N3377H on March 2, 2000, having been previously removed from another Bell 47 rotorcraft on March 10, 1993, at a total time since last major overhaul (TSMOH) of 507.8 hours, (refer to ATTACHMENT EL-I). There was no evidence within the logbook that the engine had been installed in any rotorcraft or operated during the time interval between March 10, 1993, and March 2, 2000.

The overhaul had been signed off on December 17, 1984. The total engine time (TSMOH) on the day before the accident was 540.0 hours (32.2 hours since installation). The last inspection conducted on N3377H was logged as an "annual" on April 2, 1999. The total airframe time at that time was recorded as 6,471.8 hours (refer to ATTACHMENT AF-I), however, the trip log showed 6,468.2 hours on the same date. The following (and final) airframe log entry was the previously described engine installation and no total airframe time was recorded. The trip log showed a total time of 6,568.2 hours on April 2, 2000.

The Lycoming aircraft engine assembly parts list manual contained a diagram of the crankshaft for the TVO-435-B1A engine showing the installation of an "Oil Jet" (refer to ATTACHMENT LYC-I). The jet, which was a 1/8-27 National Pipe Thread (NPT) standard fitting, was a threaded plug (hollow bolt) with a small orifice drilled thorough the bolt cap designed to allow oil to pass out of the end of the crankshaft and up into the transmission so as to provide lubrication to the lower mast bearing. The orifice was not greater than 0.025 inch in diameter. With the jet not screwed in place within its threaded insert, a greater amount of oil would have been allowed to flow into the transmission and clutch chamber from the 3/8 inch inside diameter threaded hole at the end of the crankshaft. The Overhaul Manual - AVCO Lycoming Vertical Helicopter Engines stated on page 9-14:

"9-85. Oil Jet or Pipe Plug. Install either the oil jet or pipe plug in the threaded opening in the front crankshaft oil plug and tighten to specified torque. See figure 9-18." (refer to ATTACHMENT OM-I).

The jet was to have been torqued to a minimum of 40 inch-pounds, as shown in the Lycoming Service Table of Limits (refer to ATTACHMENT LYC-II).

Refer to DIAGRAM A-A which is a copy of the airspeed versus altitude chart taken from the flight manual of the Bell 47G-3B-1 rotorcraft.

WRECKAGE AND IMPACT INFORMATION

On-site examination was conducted by an inspector from the Federal Aviation Administration's (FAA) Renton Flight Standards District Office. The rotorcraft was observed to have come to rest in a flat, green, grassy field a short distance north of the east/west oriented Stillaguamish River (refer to CHART II). Two sets of electric fencing, separated by an approximate 10 foot wide tractor path, were observed to run east/west just north of the river. The southernmost fence consisted of metal stakes painted green with an approximate eight inch white section at the top of each stake. Two strands of un-insulated wire were attached to the fence and the top wire was observed to be broken. The northernmost fence consisted of rust colored stakes and the tops of this fence was approximately two feet higher than the former fence due to a general upslope in the terrain toward the north. Two strands of un-insulated wire were attached to the fence and both wires were observed to be broken. One of the wires was observed entangled in one of the helicopter's skids at its final resting place.

The rotorcraft was observed approximately 65 feet north-northeast of the initial ground impact marks located at the northern edge of the northernmost electric fence (refer to photograph 1). The aircraft was observed at rest on its right side and all major components were located at the final resting place or within a short distance thereof (refer to photograph 2). A post-crash fire had destroyed the cockpit/cabin area, including the cockpit instrumentation.

FIRE

The pilot reported that he observed a small fuel-fed post-crash fire under the right saddle tank about 15 seconds after the aircraft came to rest. The occupants were all removed from the aircraft before they sustained any fire injury.

TESTS AND RESEARCH

Post-crash examination and disassembly of the transmission revealed that the oil jet (hollow bolt) which screws into the forward end of the engine crankshaft was not within its threaded hole. The threaded oil jet was observed lying loose within the cavity forward of the crankshaft (refer to photograph 3). Examination of the oil jet revealed random mechanical damage to the bolt's threads characteristic of the bolt having vibrated/bounced around within the cavity. The overall appearance of the threads was clean and unworn. The clutch assembly was examined and dimensionally checked with no discrepancies noted. The clutch pads were checked for thickness and found to be within acceptable tolerances and without excessive wear (refer to photograph 4). The pads displayed their diagonal grooving and a slight satin-like sheen (refer to photograph 5). Additionally, the pads as well as the interior of the clutch housing had a moderate coating of oil on their surfaces (refer to photograph 6).

Post-crash examination revealed no other anomalies within the transmission assembly. The engine was examined with continuity of the crankshaft, camshaft and accessory drive gears being verified. The engine oil filter was clear of particulates and debris, and compression on all six cylinders was established during manual rotation of the crankshaft.

ADDITIONAL INFORMATION

On-site examination of the wreckage was conducted on April 2, 2000, after which the wreckage was moved to the Arlington airport and secured. Post-crash examination of the wreckage was conducted April 11, 2000, and the wreckage was then released to Mr. Jim Stiger, representative of the insurance company (refer to NTSB form 6120.15 enclosed).

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	54,Male
Airplane Rating(s):	Single-engine land; Single-engine sea	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	June 10, 1999
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	5777 hours (Total, all aircraft), 1187 hours (Total, this make and model), 5577 hours (Pilot In Command, all aircraft), 13 hours (Last 90 days, all aircraft), 13 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N3377H
Model/Series:	47G-3B-1 47G-3B-1	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	3391
Landing Gear Type:	Skid	**Seats:**	3
Date/Type of Last Inspection:	April 2, 1999 Annual	**Certified Max Gross Wt.:**	2950 lbs
Time Since Last Inspection:	100 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	6569 Hrs	**Engine Manufacturer:**	Lycoming
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	O-435-25A
Registered Owner:	GABLE, STEPHEN, L.	**Rated Power:**	270 Horsepower
Operator:	GABLE, STEPHEN, L.	**Operating Certificate(s) Held:**	None
Operator Does Business As:	CASCADE WEST HELICOPTERS	**Operator Designator Code:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	AWO ,137 ft msl	**Distance from Accident Site:**	5 Nautical Miles
Observation Time:	11:55 Local	**Direction from Accident Site:**	96°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	330°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	13°C / 8°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	ARLINGTON , WA (AWO)	**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	11:05 Local	**Type of Airspace:**	Class G

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Destroyed
Passenger Injuries:	1 Fatal, 1 Serious	**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Serious, 1 Minor	**Latitude, Longitude:**	48.210441,-122.279411(est)

Administrative Information

Investigator In Charge (IIC):	Mccreary, Steven
Additional Participating Persons:	OVE S LARSEN; RENTON , WA KEVIN MCKEE; RENTON , WA BILL SHINN; RENTON , WA JEFF POSCHWATTA; KENT , WA
Original Publish Date:	November 30, 2000
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=51315