National Transportation Safety Board
Aviation Accident Final Report

Location:	KETCHIKAN, AK	**Accident Number:**	ANC97FA159
Date & Time:	09/29/1997, 1747 AKD	**Registration:**	N4787C
Aircraft:	de Havilland DHC-2	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General Aviation - Positioning		

Analysis

The float equipped airplane was observed taking off in light winds and calm water, and obtaining a steep climb and nose high attitude. Witnesses described hearing no reduction of engine noise from takeoff power to climb power. The airplane entered a steep left bank about 200 feet above the water, then rolled rapidly to the right and impacted at a steep angle into the water. The airplane had been modified with a Short Take Off and Landing (STOL) kit. Certification flight tests had determined that this modification eliminated aerodynamic warning of impending stalls, and therefore required an audible stall warning. Test results also required the addition of both a ventral fin, and horizontal stabilizer finlets, to meet directional stability certification. These tests determined that the least stable condition was in the takeoff flap configuration, during climb. The Supplemental Type Certificate (STC) for the modification required the ventral fin, and an audible stall warning system be installed. The manufacturer provided a marketing video, produced prior to the STC approval, which stated the stall warning system was not required in the U.S. The company indicated this tape was used for training, and was a basis for pilots routinely disabling the stall warning horn by pulling the circuit breaker. At the time of the accident, the airplane did not have the ventral fin installed, a takeoff flaps setting was selected, and the audible stall warning circuit breaker was in the pulled (disabled) position. The local FAA Flight Standards Office had inspected the accident airplane 14 times in the previous 29 months, and made no mention of the ventral fin not being installed.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's excessive climb and turning maneuver at low altitude, the pilot's inadvertent stall, and the intentional operation of the airplane with the required stall warning system disabled. Factors associated with this accident were the pilot's overconfidence in the modified airplane's ability, the uninstalled ventral fin, inadequate compliance with the STC by the company, unclear information by the manufacturer, and inadequate surveillance by the FAA.

Findings

Occurrence #1: ABRUPT MANEUVER
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. (C) CLIMB - EXCESSIVE - PILOT IN COMMAND
2. LOW ALTITUDE FLIGHT/MANEUVER - PERFORMED - PILOT IN COMMAND
3. (F) OVERCONFIDENCE IN AIRCRAFT'S ABILITY - PILOT IN COMMAND

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: MANEUVERING - TURN TO REVERSE DIRECTION

Findings
4. (C) STALL WARNING SYSTEM - DISABLED
5. (F) INFORMATION UNCLEAR - MANUFACTURER
6. (F) VERTICAL STABILIZER SURFACE - NOT INSTALLED
7. (F) ACFT/EQUIP,INADEQUATE COMPLIANCE DETERMINATION - COMPANY/OPERATOR MANAGEMENT
8. (F) INADEQUATE SURVEILLANCE OF OPERATION - FAA(ORGANIZATION)
9. (C) STALL/SPIN - INADVERTENT - PILOT IN COMMAND

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

Factual Information

HISTORY OF FLIGHT

On September 29, 1997, at 1747 Alaska daylight time, a float equipped DeHavilland DHC-2 airplane, N4787C, was destroyed when it impacted the water after takeoff from Ketchikan, Alaska. The solo commercial pilot sustained fatal injuries. The airplane was operated by Promech, Inc., of Ketchikan, as a positioning flight after the last leg of Flight 89. The flight was conducted under 14 CFR Part 91, and had departed the Ketchikan International Airport seaplane dock, to reposition to the downtown seaplane base. The downtown seaplane base is located two miles to the east, on the opposite side of Tongass Narrows from the airport dock. Visual meteorological conditions prevailed at the time of the accident, and a company VFR flight plan was on file.

Witnesses described seeing the airplane takeoff westbound, enter a steep climb, and make a sharp left turn at 200 feet above the water, to the east toward downtown. Witnesses then described the airplane roll rapidly the opposite direction, and impact the water at a steep angle. None of the witnesses described hearing a reduction in engine power after takeoff.

INJURIES TO PERSONS

The pilot sustained head injuries, and was submerged for approximately one hour prior to recovery.

DAMAGE TO AIRCRAFT

The airplane was destroyed by impact forces when it impacted the water in about a 90 degrees nose down attitude. Both floats separated and were recovered. The right wing separated at the wing root and was not recovered.

PERSONNEL INFORMATION

The pilot held a commercial pilot certificate with single engine land, sea, and instrument ratings. He held a valid second class medical certificate with no restrictions. At the time of the accident he had accumulated approximately 2,071 hours of flight experience, with 1,200 in float equipped DHC-2 airplanes. In the last 90 and 30 days, he had flown 306, and 83 hours respectively, all in the DHC-2. He had flown 7.3 hours on the day of the accident.

The pilot was hired by the operator as a seasonal dock worker in 1992. He obtained his commercial pilot certificate on May 15, 1994. He was hired as a seasonal pilot in 1996. This was his second season as a pilot for the company.

He was approved to fly all the DHC-2 airplanes operated by the company. The pilot's training record indicated that on April 12, 1997, during annual recurrent training, he received 'differences' training on the "DHC-2 4787C Baron STOL," and for "995WA Wipaire." This record showed 0.3 hours of ground training, and no flight training. According to the company, 'differences' for the STOL equipped airplane consisted of a review of a manufacturer's videotape. Initial training, received one year earlier, included flight training, to include stalls.

One witness to the accident described the airplane depart in "a near vertical climb, then bank to the left." A second witness described the airplane takeoff at a "steep angle of attack."

A third witness interviewed by the NTSB stated that approximately 1 to 1 1/2 weeks prior to the accident, he witnessed the same airplane and pilot depart the dock at Ketchikan airport, do

an aggressive high rate of climb, and then a hard, left hand turn, to return to the direction of downtown.

AIRCRAFT INFORMATION

The airplane was a DHC-2 Mark-I "Beaver" manufactured by DeHavilland in June 1959. It was equipped with EDO 4930 nonamphibious floats. The airplane had always been operated on floats while owned by the company. The airplane had been modified with a Baron / STOL (Short Take Off and Landing) kit on May 10, 1993. This modification was approved under U.S. Supplemental Type Certificate (STC) number SA-1070NE, and Canadian Supplemental Type Approval (STA) number SA92-45.

This STOL modification consisted of a full span contoured leading wing edge, drooped wing tips, upper wing surface stall fences, and trailing edge flap gap seals. Additionally, an electrically powered, aural stall warning horn was installed as a mandatory component in the modification kit.

The company stated that the stall warning horn was not required to be operable, and that it was routinely disabled to prevent the horn from continually activating at slow speeds. The system was disabled by pulling the electrical circuit breaker located in the cockpit. The company indicated that they obtained the information that the system was not required from a training and marketing video tape provided by the manufacturer.

Company personnel told the NTSB IIC that during 100 hour maintenance inspections, the stall warning system was tested to ensure it was operable.

The airplane was configured with vertical "Kenmore" seaplane finlets on the horizontal stabilizer ends. The airplane was not equipped with a lower surface ventral fin.

METEOROLOGICAL INFORMATION

The weather at the time of the accident was clear, with winds from 300 degrees magnetic at 5 knots, favoring departures to the west from the water. The water surface was calm.

AERODROME INFORMATION

The seaplane dock and waterway at Ketchikan International Airport is at the western end of the airport facility. The waterway is part of Tongass Narrows, and parallels the airport's paved runway 11-29. The seaplane traffic was departing and landing to the west at the time of the accident.

WRECKAGE AND IMPACT INFORMATION

The airplane impacted the water about one mile west of the International Airport seaplane dock. Several boats operating in the harbor responded to the accident, and towed the airplane to a beach. The airplane was initially examined by FAA inspectors, then disassembled. The stall warning circuit breaker in the cockpit was observed in the pulled, or open, position. The airplane was loaded on a truck, and relocated to the airport for further examination.

The wreckage was examined by the NTSB investigator-in-charge on October 22 and 23, 1997, after relocation to the Ketchikan airport.

The right wing was not recovered. Inspection of the right wing attachment fitting revealed shiny, jagged, fractures, all deformed in an aft direction. The entire left wing leading edge exhibited aft crushing which ended at the forward spar. The hydraulic flap actuator was found

extended to the "takeoff" position.

Both floats forward compartments were ruptured. The damage to both floats extended aft to the forward spreader bars. The float attachment fittings were fractured in a fuselage forward / floats aftward direction.

No indications of preimpact damage to the airframe were noted.

The three propeller blades exhibited torsional twisting toward the blade faces. All three blades had disconnected from their respective pitch guides at the propeller dome arms. The presence of fuel was found in the carburetor and lines. No preimpact engine anomalies were noted.

The stall warning electrical circuit breaker located in front of and to the right of the pilot was observed in the pulled, or "open circuit," position

MEDICAL AND PATHOLOGICAL INFORMATION

A postmortem examination was not performed. Hospital records indicate that the pilot sustained severe head and facial injuries. Toxicological tests provided positive results which were consistent with hospital treatment. No evidence of pretreatment substances was noted.

SURVIVAL ASPECTS

The pilot was submerged in 50 degree Fahrenheit water for approximately one hour prior to being recovered by divers. He was resuscitated and transported to Ketchikan General Hospital for treatment. He was further transported to Seattle, Washington. The pilot did not regain consciousness, and died one day later.

TESTS AND RESEARCH

Examination at the NTSB metallurgical laboratory of the float attachment flying wires revealed no preimpact damage.

Certification approval of the "Baron STOL" kit was conducted initially in Canada. Follow on certification was received from the FAA on the basis of a bilateral agreement between Canada and the U.S. In order to assist in achieving both Canadian and U.S. certifications, Transport Canada reviewed the modification for compliance with the three applicable airworthiness standards for the DHC-2. These were the British Civil Airworthiness Requirements (BCAR) for Canada, the U.S. Civil Air Regulations Part-03 (CAR-03), and the U.S. Civil Aeronautics Manual 3 (CAM-3).

Civil Aeronautics Regulations (CAR) 03 of May 15, 1956, paragraph 3.120(f) states: "A clear and distinctive stall warning shall precede the stalling of the airplane...The stall warning shall begin at a speed exceeding that of stalling by not less than 5 but not more than 10 miles per hour and shall continue until the stall occurs."

Civil Aeronautics Manual (CAM) 3, dated May 1962, paragraph 3.120-2, Indications of Stall Warnings, states: "(a)(1)Satisfactory items include: "Buffeting... Stall warning instrument, either visual or aural."

The Transport Canada Flight Test Inspection / Evaluation for STA # SA92-45, dated May 23, 1990, for a DHC-2 configured with EDO 4930 floats, Kenmore finlets, and the complete "Baron STOL" kit, stated in part: "Stall Warning... did not comply with BCAR section D with the Flap Gap Seal installed. Approval of the gap seal would require changes to enhance stall warning or installation of a stall warning system." "Stability... The static directional stability tended to be

marginal and under some circumstances the rudder would not tend to re-center...The tendency to "overbalance" was most pronounced with the gap seal installed; The worst case was in the climb condition with flap up, or in the climb position... When both the ventral fin and finlets were installed the overbalance condition was rectified, and in the climb configuration the pedals would tend to re-center, albeit slowly." "...with or without the gap seal and Kenmore finlets only installed the aircraft did NOT comply with CAR 03; With the Kenmore finlets and DHC ventral fin installed the aircraft satisfied the CAR 03 requirements." "Conclusions and Recommendations. Approval...is recommended...provided that...For Canada (STA) - if the flap gap seal is installed the aircraft must be fitted with both ventral fin and finlets and in addition a stall warning system must be installed and approved. For the USA (STC) - the aircraft must be fitted with both Kenmore finlets and DHC ventral fin, or equivalent."

The manufacturer then added a stall warning system to the modification package, and further certification tests were conducted.

The Transport Canada Flight Test Inspection / Evaluation for STA # SA92-45, dated August 14, 1991, after testing of a stall warning system installation stated: "The volume of the warning horn was inadequate... The warning could not be considered clear and distinctive. The warning tended to fire at a relatively high speed (stall plus 10-15 mph IAS). It would be much better if the system 'fired' somewhere between 5 and 10 mph in advance of the stall."

Corrections were made, and Canadian approval of STA # SA92-45 was received on July 23, 1992.

A review of the correspondence from Transport Canada, to the FAA New York Aircraft Certification Office on December 18, 1992, applying for U.S. Supplemental Type Certification (STC) # SA1070NE, revealed that all drawings and installation instructions included a stall warning system, with no mention that it was optional. U.S. approval for STC # SA1070NE was received on March 23, 1993.

STC # SA1070NE contains the exact language as Canadian STA number SA92-45, and requires that the stall warning system be installed. The kit installation Drawing # AOG-01-001-1, dated May 25, 1992, include the following components: Full span contoured leading edge, drooped wing tips, wing fences, Flap gap seals, and an audible stall warning system.

The Flight Manual Supplement #1, revision B, dated Feb 25, 1993, Section IV - Operating Limits specifies: "Approved Configurations 1/ The Baron Stol kit is comprised of: (a) - Full span contoured leading edge, drooped wing tips, wing fences, Flap gap seals, and an audible stall warning system, ...installed in accordance with AOG Air Support inc., installation Drawing # AOG-01-001-1, Dated May 25/92 or later DOT approved revision. (b)- If... floats equal or exceed EDO model 4930 size, ...an approved ventral fin and approved horizontal stabilizer auxiliary finlets."

AOG Drawing # AOG-01-002-4, reference "D" Leading Edge Skins Installation, includes installation of wiring for the stall warning.

AOG Drawing # AOG-01-002-6, reference "F," Stall Warning System Installation is required by AOG Drawing # AOG-01-001-1. Additionally, the stall warning vane and structural opening in the contoured leading edge is a standard in all kits produced by the manufacturer. There is no mention in these instructions that the stall warning is optional.

A review of the manufacturer's marketing videotape produced in May of 1992, revealed an

opening statement that "Transport Canada approval was received on May 23, 1992, and U.S. approval is expected by midsummer of 1992." A second statement was made during narration of stall demonstrations that "the loud background noise is a stall warning horn, required by Transport Canada, but not needed by the Federal Aviation Authority for American certification." This tape was in use by the operator for pilot training in the performance of the STOL equipped DHC-2. During interviews by the NTSB investigator, company managers stated that this videotape was a basis for allowing pilots to intentionally disable the stall warning system by pulling the circuit breaker. Company personnel interviewed said that the stall warning horn would continually activate in flight at speeds 10 to 15 miles per hour above stall.

Correspondence dated December 8, 1997, from the Transport Canada certification flight test pilot who performed the flight tests, to the NTSB investigator, noted the following:

Testing was performed using a Baron STOL modified DHC-2 mounted on EDO 4930 floats, at weights from 5100 to 5400 pounds. The power used for power on stalls was that required for level flight at 1.4Vs and maximum continuous power (MCP) of 30 inches manifold pressure. There was no record of stall testing being performed at takeoff power (TOP) of 36.5 inches manifold pressure and 2300 rpm. The test pilot wrote, "Stall testing conducted did not highlight significant adverse stall characteristics. I would assess the stall characteristics of the Beaver as docile, although... if the a/c is stalled with the ball displaced from the center, there is a tendency to roll off (slowly) as compared to dropping the nose slightly... ."

The test pilot further stated in his correspondence, "In the configuration you describe [that of the accident airplane] I would expect that there was little, if any, clear and distinct stall warning."

ADDITIONAL INFORMATION

A review of the FAA inspection history of the accident airplane revealed that since April 24, 1995, 14 inspections (6 ramp, 7 spot, and 1 en route) had been performed by FAA inspectors. None of these inspections made mention of the ventral fin not being installed as required by the STC. All inspections were noted "satisfactory."

The wreckage was released to the owner's representative at Ketchikan on October 23, 1997.

Pilot Information

Certificate:	Commercial	**Age:**	27, Male
Airplane Rating(s):	Single-engine Land; Single-engine Sea	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	11/01/1996
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	2071 hours (Total, all aircraft), 1200 hours (Total, this make and model), 1921 hours (Pilot In Command, all aircraft), 306 hours (Last 90 days, all aircraft), 83 hours (Last 30 days, all aircraft), 7 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	de Havilland	**Registration:**	N4787C
Model/Series:	DHC-2 DHC-2	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	1330
Landing Gear Type:	Float	**Seats:**	8
Date/Type of Last Inspection:	09/17/1997, 100 Hour	**Certified Max Gross Wt.:**	5370 lbs
Time Since Last Inspection:	32 Hours	**Engines:**	1 Reciprocating
Airframe Total Time:	24267 Hours	**Engine Manufacturer:**	P&W
ELT:	Installed, not activated	**Engine Model/Series:**	R-985
Registered Owner:	KEVIN HACK	**Rated Power:**	450 hp
Operator:	PROMECH AIR, INC.	**Operating Certificate(s) Held:**	Commuter Air Carrier (135); On-demand Air Taxi (135)
Operator Does Business As:		**Operator Designator Code:**	PJMA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	KTN, 10 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	1753 ADT	**Direction from Accident Site:**	270°
Lowest Cloud Condition:	Clear / 0 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	None / 0 ft agl	**Visibility (RVR):**	0 ft
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	300°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	10°C / 6°C
Precipitation and Obscuration:			
Departure Point:	KETCHIKAN IAP, AK (KTN)	**Type of Flight Plan Filed:**	Company VFR
Destination:	KETCHIKAN HARBR, AK (5KE)	**Type of Clearance:**	None
Departure Time:	1745 ADT	**Type of Airspace:**	Class G; FAR 93

Airport Information

Airport:	KETCHIKAN INTERNATIONAL (KTN)	**Runway Surface Type:**	Water
Airport Elevation:	0 ft	**Runway Surface Condition:**	Water--calm
Runway Used:	29	**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

Wreckage and Impact Information

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

Administrative Information

Investigator In Charge (IIC):	MATTHEW L THOMAS	**Report Date:**	04/15/1999
Additional Participating Persons:	JEFF S PRITCHARD; JUNEAU, AK MARK EASTERLY; KETCHIKAN, AK		
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.ntsb.gov/pubdms/.		