NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

June 20, 2016

AIRWORTHINESS

Group Chairman's Factual Report

ANC15MA041

Attachment 4 – Hartzell Propeller Report No. 150625
(15 pages)

HARTZELL PROPELLER INC.

Aircraft Accident/Incident Report No.: 150625

Date of Accident: **June 25, 2015**

Location: **Ketchikan, AK**

NTSB File No.: **ANC15MA041**

Aircraft: **DeHavilland DHC-3 Otter with Vazar PT6A-135A Conversion**

Registration No.: **N270PA**

Serial No.: 270

Operator: Promech Air Inc.
1515 Tongass Ave.
Ketchikan, AK 99901

Owner (per FAA Registry): Pantechnicon Aviation Ltd.
2207 Bellanca St.
Minden, NV 89423-8625

Written by: Les Doud
Air Safety Investigation Manager

Date: November 23, 2015

Contents:

ACCIDENT SYNOPSIS

Aircraft Damage: Destroyed
Injuries: Nine persons on board, nine fatal

The following is excerpted from the NTSB Preliminary Report:

"On June 25, 2015, about 1215 Alaska daylight time, a single-engine, turbine-powered, float-equipped de Havilland DHC-3 (Otter) airplane, N270PA, sustained substantial damage when it impacted mountainous tree-covered terrain, about 24 miles northeast of Ketchikan, Alaska. The airplane was being operated under the provisions of 14 Code of Federal Regulations (CFR) Part 135, as an on-demand visual flight rules (VFR) sightseeing flight when the accident occurred. The airplane was owned by Pantechnicon Aviation, of Minden, Nevada, and operated by Promech Air, Inc., of Ketchikan. The commercial pilot and eight passengers were fatally injured. Marginal visual meteorological conditions were reported in the area at the time of the accident. The flight departed a floating dock located in Rudyerd Bay about 44 miles northeast of Ketchikan about 1200 for a tour through Misty Fjords National Monument Wilderness. A company VFR flight plan was in effect. At the time of the accident, the flight was returning to the operator's base at the Ketchikan Harbor Seaplane Base, Ketchikan."

"When the airplane failed to return to Ketchikan, the operator initiated a search for the missing airplane and heard an emergency locator transmitter (ELT) signal along the accident pilot's anticipated route of flight. A helicopter from Temsco Helicopters, Inc., of Ketchikan…located the wreckage about 1429."

"The airplane impacted trees and a near vertical rock face in a nose high, wings level attitude at an elevation of about 1,600 feet mean sea level and came to rest upright on top of its separated floats, in an area of heavily forested, steep terrain."

"The accident airplane was equipped with an avionics package known as automatic dependent surveillance-broadcast (ADS-B), which is also known as "Capstone." ADS-B technology provides pilots with situational awareness by displaying the airplane's position over terrain, while using GPS technology, coupled with an instrument panel mounted, moving map display. The ADS-B equipment installed in the accident airplane included two Chelton multifunction display (MFD) units. One MFD provides the pilot with a moving map with terrain awareness information, and the other provides primary flight display information. The two MFD units were removed from the wreckage and shipped, to the NTSB vehicle recorder laboratory, Washington, D.C."

"The closest weather reporting facility is Ketchikan Airport (KTN), Ketchikan, AK, about 24 miles southwest of the accident site. At 1153, an aviation routine weather report (METAR) at KTN reported in part: wind 130 degrees at 15 knots, gust 23 knots; visibility 6 statute miles, rain and mist, runway 11 visual range 4,000 variable to greater than 6,000 feet; few clouds 800 feet, broken clouds 1,200 feet, overcast clouds 2,700 feet; 61 degrees F; dew point 57 degrees F; altimeter 29.91 in Hg."

SUMMARY OF FINDINGS

The accident aircraft's propeller was examined between August 17 through 19, 2015 in a hangar at Temsco Helicopters in Ketchikan, AK. All three blades and pilot tubes remained attached to the hub. All three blades were bent aft in varying degrees.
A field teardown examination of the propeller was performed by removing and disassembling the spinner fragments, blades, clamps and the propeller piston-cylinder assembly.

Blade #3 showed a blade butt contact mark indicating impact forces in the lead-to-trail direction. Blades #1 and #3 showed blade butt contact marks indicating impact force in the aft direction. When blade butt contact marks were matched with corresponding blade arm contact marks on the hub arm flange, all three blades were in the low pitch range. The piston-cylinder assembly showed internal contact marks providing some blade angle information. The limit of travel on the pitch change rod approximated the dimensions of some internal piston marks and was approximately equivalent to a blade angle of 26° which is in the normal range of operation for cruise flight.

PROPELLER TEARDOWN REPORT

Date of Investigation: August 17-19, 2015

Location: Temsco Helicopters
5411 N Tongass Hwy, Ketchikan, AK 99901

Propeller Model: HC-B3TN-3DY with T10282N+4 blades

Representatives: Les Doud – Hartzell Propeller Air Safety Investigator
Brice Banning – NTSB Investigator In Charge
Clint Crookshanks – NTSB Structures Engineer
Emily Gibson – NTSB Survivability
Shaun Williams – NTSB Anchorage Field Investigator
Roy Dunn – FAA Juneau FSDO Inspector
Bob Grace – Promech Air Director of Maintenance
Kevin Wyckoff – Alaska Claims Services

General Comments:

This model propeller is a 3-blade, single-acting, hydraulically operated, constant speed model with feathering and reversing capabilities. Oil pressure from the propeller governor is used to move the blades to the low pitch (blade angle) direction. Blade mounted counterweights and feathering springs actuate the blades towards the high pitch direction in the absence of governor oil pressure. The propeller incorporates a Beta mechanism that actuates when blade angles are lower than the flight idle position. The propeller also incorporated start locks to facilitate starting the engine with the propeller in the low pitch position. The blades are of aluminum construction. The hub and blade clamps are steel.
Propeller rotation is clockwise as viewed from the rear.

Installation Data: Refer to Installation Data Sheet #1147 and
STC SA3777NM
(Angles referenced at the 30-inch radius)

Reverse:	-15.0 $\pm$ 0.5	degrees
Start Lock	1.0 $\pm$ 1.0	degrees
Flight idle:	21.0 $\pm$ 0.1	degrees
Feather:	87.0 $\pm$ 1.0	degrees
Counterweight	-1.5 to Pos.	degrees

Propeller Serial Number: BUA30604 **Factory No.:** C9640A (840-60 Rev. K)

Blade Model: T10282N+4

S/N Blade #1: K42166
S/N Blade #2: K42165
S/N Blade #3: K42164

Service History: (propeller TTSN and TSO at aircraft inspection on 6/10/15)

	S/N	Date of manufacture	TTSN	TSO
Hub	BUA30604	6/28/2006	3656.7	793.6
Blades	K42166	6/26/2006	3656.7	793.6
	K42165	6/26/2006	3656.7	793.6
	K42164	6/26/2006	3656.7	793.6

Last overhaul: According to the propeller logbooks the propeller was overhauled on 12/5/12 at a TTSN of 2863.1 by A.C. Propeller Service Inc. in Seattle, WA.

Blade Orientation:

The blades were identified as 1-2-3 clockwise as viewed from the rear of the propeller. The propeller serial number was between the #3 and #1 blades.

"As Received" Condition:

The propeller fractured off the engine at the propeller shaft flange during impact and was found near the airframe wreckage as shown in Photo #1. The propeller was relocated from the crash scene to Temsco Helicopter for examination (see Photo #2). All three blades remained attached to the propeller hub. Approximately 5" of tip fractured from two blades during impact and the tip fragments were recovered at the crash scene. Approximately 95% of the spinner dome had fractured/torn from the spinner bulkhead. Approximately one-third of the spinner bulkhead was torn from the propeller assembly. All blade clamps and counterweights were intact. Impact forces fractured/pried the piston-cylinder assembly off the hub mounting but it remained attached to the propeller assembly by two link arms and two beta rods (see Photo #3). The propeller assembly had tree debris (bark and sawdust type material) and dirt packed into the hub and around the blades. The beta ring was pulled forward and crushed, crimping a piece of fiberglass in the ring channel; the beta ring remained attached to two of three beta rods. The feathering springs remained intact and retained by the spring keepers. The aft two inches of the pitch change rod was bent approximately 30 degrees off the rotation axis. All three blades exhibited chordwise scoring and leading edge (LE) impact gouges indicating rotation. One blade exhibited spanwise scoring suggesting sliding/scraping after rotation stopped. All three blades exhibited bending aft. All three start lock assemblies were NOT engaged suggesting the clamp/counterweight angle at impact and/or rotation stoppage was at minimum higher than the start lock setting. The as-received counterweight angles were measured to be 51.5°, 27.8° and 40.3° (measured from the horizontal, plane of rotation).

Spinner Dome: The spinner dome was crushed, fractured and deformed aft. Approximately 95% of the spinner dome separated from the spinner bulkhead/propeller assembly.

Spinner Bulkhead: The outer portion of the spinner bulkhead was bent forward and approximately 60% of the dome mounting flange was folded aft. Approximately 30-40% of the spinner bulkhead was torn/fractured adjacent to blade #2.

Propeller Cycling: Propeller cycling was not possible due to impact damage.

Engine/Propeller Mounting: The engine propeller mounting flange fractured from the propeller shaft and remained attached to the propeller. Seven of the eight mounting bolts were in place, the eighth bolt fractured at the bolt head in a pattern opposite direction of rotation.

Photo #1

Photo #2

Photo #3

Blade/Clamp Rotation:

#1: The blade clamp could be rotated by hand, and the blade could be rotated/slipped in the clamp but required considerable physical effort. The witness tape indicated there was approximately 10° slippage between the blade and clamp (towards low pitch) when received.

#2: The blade clamp could not be rotated by hand; it was jammed by debris and/or the spinner bulkhead deformation. The blade was tight in the clamp and the witness tape indicated there was no slippage between the blade and clamp.

#3: The blade clamp could be rotated by hand. The witness tape indicated there was approximately 35° slippage between the blade and clamp (towards low pitch) when received. Additionally, the blade could be slipped by hand with moderate effort within the clamp.

Pitch Stops:

Start Locks: The start lock on all three blades was not engaged; the plunger was retracted and the start lock plate notch was beyond the start lock blade angle.

Low Pitch Stop: The low pitch stop nuts on the beta rods were present; the beta rods were bent.

Feather Stop: The feather stop screws on top of the spring retainer cup were present with no remarkable damage.

Beta ring/rods: The beta ring was pulled forward against the spinner bulkhead and an approximate 60° segment of the aft wall and bottom surface was fractured. The ring channel was crushed captivating a piece of composite material. All beta rods were bent due to impact. Two of the three beta rods were cut between the beta guide collar and piston to facilitate piston removal. The third beta rod pulled out of the beta ring and through the spinner bulkhead during impact.

Piston: The piston was still in place on the cylinder/pitch change rod assembly. The cylinder assembly separated at the hub attachment threads and bent towards blade #3 during the impact sequence. The piston forward end was dented and deformed adjacent to blade #1 where it impacted the object that forced the assembly towards blade #3. It was also dented and deformed adjacent to blade #3 where it had contacted the #3 clamp and clamp bolt with corresponding impact marks on the clamp. There was damage along the bottom of the piston where it contacted the blade clamps adjacent to blades #1 and #2 during impact (see Photo #4). Scuffing marks on the internal surface where noted and measured as referenced to the bottom edge ranging from approximately 2-2.9" which correspond to the normal range of operation.

Link Arms: See Photo #5

#1: The #1 link arm was still attached at the clamp link pin (plastic bushing smashed) and at the piston attach points. There was visible elongation of the link pink hole and the link arm showed visual evidence of compression bending and lateral bending in the direction of blade #3.

#2: The #2 link arm detached from the clamp link pin but remained attached to the piston. There was visible elongation of the link pin hole similar to link arm #1 and the arm showed visual elongation.

#3: The #3 link arm was still attached at the clamp link pin and at the piston (plastic bushing smashed and cotter pin damaged). The link arm was bent laterally in the direction the piston toward blade #3. There was visible elongation of the link pink hole but less than that seen on #1 and #2 link arms. This arm showed the highest amount of compression bending.

Cylinder: The cylinder was forced off the hub mounting threads during impact. The threads on the cylinder were damaged with some thread whiskers visible on the hub. There were three distinct impact dents in the cylinder corresponding to impact with the #3 clamp, clamp bolt and piston. There was an indentation/cut corresponding to the edge of the clamp, a crease corresponding to the bottom edge of the piston, and a dent corresponding to impact with the outboard clamp bolt (see Photo # 6)

Feathering Spring Assembly: The feathering spring assembly was intact and captive on the pitch change rod in the as-received condition. The feathering springs (inner and outer) were cut off for safety reasons and to provide access to the pitch change rod. The pitch change rod had bent and fractured such that the springs could not be removed with a press. The outer spring support sleeve was bent and torn near the bend in the pitch change rod; it was cut to facilitate removal.

Photo #4

Photo #5

Photo #6

Pitch Change Rod: (P/N D-5862, S/N (A)6236) The pitch change rod was cut near the bend/fracture to facilitate spring removal. The rod could not be removed from the forward spring cup due to bending and inability to remove the reverse stop sleeve. The rod could be extended from the top of the spring cup approximately 1.9" before stopping (see Photo #7).

Clamps and Counterweights:

Clamp serial numbers: (P/N C-1301-9S)

#1 S/N EM19321 Counterweight was intact and attached to clamp.
#2: S/N EM19307 Counterweight was intact and attached to clamp.
#3: S/N EM19297 Counterweight was intact and attached to clamp.

Photo #7

Hub Unit: (Factory S/N C9640A)

The engine propeller shaft flange remained attached to the propeller hub and was removed with the dowels remaining in the engine flange. The propeller mounting flange face appeared undamaged and had one propeller mounting bolt shank (bolt head fractured) remaining threaded in a hole.

All three blade arms, pilot tubes and hub-side bearing races remained intact and unremarkable.

Cylinder attachment: The cylinder was forced off its hub mounting threads. The beta rod guide collar was also forced off and fractured around one of the beta rod guide ears.

Impression marks from blade butts: There were discernible blade butt impression marks on blade arm flanges #1 and #3. The #1 flange had a contact mark approximately 78.5° from the plane of rotation and #3 had two marks; one at approximately 14-15° and one at approximately 65° from the plane of rotation (see Photo #8).

Photo #8

Blades: (See Photos #9 through #11)

Blade #1

Paint, camber side	- Chordwise scoring.
Paint, flat side	- Chordwise scoring 12-24" from butt.
Bend	- Bending aft starting at approximately 12" from butt.
Twist	- LE down near tip.
Lead edge damage	- ½" gouge 35-37 from butt. Outboard 5" of tip fractured, LE curled down.
Trail edge damage	- None.
Butt impression	- Face side.

Blade #2

Paint, camber side	- Chordwise scoring. Brown chordwise abrasion.
Paint, flat side	- Chordwise scuffing. Brown chordwise abrasion.
Bend	- Bend aft starting 12" from tip.
Twist	- LE down but less deflection compared to #1 and #3.
Lead edge damage	- No damage except for outboard 5" tip torn/fractured, LE curled down.
Trail edge damage	- None
Butt impression	- None

Blade #3 (See Photo #6)

Paint, camber side	- Chordwise scoring and spanwise scoring. Brown chordwise abrasion.
Paint, flat side	- Chordwise scuffing/abrasion 12" from butt.
Bend	- Bend aft 12" and 36" from butt.
Twist	- LE down near tip.
Lead edge damage	- 1" deep gouge 28" from butt, both LE up and down deformation.
Trail edge damage	- Spanwise scoring.
Butt impression	- Circular impression mark due to blade arm flange centered approximately along trailing edge and another impression mark on the face side.

Photo #9 (Camber Side)

Photo #10 (Camber Side)

Photo #11 (Face Side)