HARTZELL PROPELLER INC.

Aircraft Accident/Incident Report No.: 110308

Date of Accident:	March 8, 2011
Location:	Hampton, Georgia
NTSB File No.:	ERA11FA183
Aircraft:	DeHavilland DHC-6-100 Twin Otter
Registration No.:	N157KM
Serial No.:	057
Operator:	per FAA registry: Desert Sand Aircraft Leasing Co. inc. 711 S Carson St. Ste 6 Carson City, NV 89701

Written by:	Tom McCreary Air Safety Investigation Manager
Date:	March 21, 2011

Contents:

ACCIDENT SYNOPSIS

The NTSB preliminary report stated that the aircraft crashed during its first flight after an engine change. The aircraft crashed while in the landing pattern at low speed in a very steep nose down attitude.

Aircraft Damage: Substantial
Injuries: Two persons on board, two fatal

SUMMARY AND ANALYSIS OF FINDINGS

Both propellers had indications of being harshly driven toward extreme low/reverse pitch during impact. One clear evidence of this was damage to the guide collars caused by contact with the blade link arms and links screws.

Impact marks on the right propeller piston indicated that the propeller blade angle was at 18 degrees or higher prior to impact. Otherwise, there were no blade angle witness marks to suggest a pre-impact blade angle.

The blades of both propellers had remarkably similar damage. All six blade tips were torn off. Blades from both propellers had a similar amount of bending and twisting. This indicates that they were being operated at similar power at the time of impact. Such blade damage is characteristic of being operated at moderate or high power. Assessment of power output is made solely from observation of the blade damage.

The flight idle adjustment nuts (3 per propeller) were set at the same position on both propellers. There was no evidence to suggest an improper set-up of the propeller beta mechanism.

CONCLUSIONS

Both propellers were rotating and not feathered at the time of impact. Blade damage indicates that both propellers were being operated with power ON at the time of impact and that both were being operated at similar power.

There were no discrepancies noted that would preclude normal operation. All damage was consistent with impact damage.

PROPELLER TEARDOWN REPORT

Date of Investigation: March 10 & 11, 2011

Location: Atlanta Air Recovery
Griffin, GA

Propeller Model: HC-B3TN-3 with T10173B+1 blades

Representatives:

Tom McCreary	Hartzell Propeller Inc.
Luke Schiada	NTSB.
Tom Berthe	Pratt & Whitney

General Comments:

This type 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 blades are of aluminum construction. The hub and blade clamps are steel.
Propeller rotation is clockwise as viewed from the rear.

Installation Data: (Data reference the 30-inch station)

Reverse:	-14.0 ± 0.5 degrees
Flight idle:	20.0 ± 0.2 degrees
Feather:	87.0 ± 0.5 degrees
Counterweight	-1.5 to positive

Service History:

Logbook information and service history was not available.

	S/N	Date of manufacture	TTSN	TSO
Left Hub	BUA20233	7/22/1997	unknown	unknown
Blades	B12917	3/14/1967	unknown	unknown
	B13022	3/14/1967	unknown	unknown
	B13000	3/14/1967	unknown	unknown
Right Hub	BUA20234	7/22/1997	unknown	unknown
Blades	B15125	4/26/1967	unknown	unknown
	B10079	4/26/1967	unknown	unknown
	B8637	1/25/1967	unknown	unknown

Position: LEFT

Hub Serial Number: BUA20233 **Factory No.:** B169A

Blade Model: T10173+1

S/N L1: B12917
S/N L2: B13022
S/N L3: B13000

Blade Orientation:

The blades were identified as L1-L2-L3 clockwise as viewed from the rear of the propeller. The hub serial number was between the L1 and L2 blades.

"As Received" Condition:

See photos on Pages 5 & 6.

The spinner dome had not been removed. The propeller had separated from the engine due to a fractured engine shaft. L1 blade was disconnected due to link screw separation; the blade could be manually turned. L2 blade had separated from its clamp. L3 blade remained connected to its linkage and was at a high blade angle.

The beta feedback collar had separated and was missing. The tips of all three blades were torn off, only one of the blade tips was recovered.

The piston/cylinder assembly had separated from the hub at the cylinder/hub attachment threads. The piston was in the feather position with respect to the cylinder (due to lost oil pressure and feather spring force).

The position of the flight idle stop nuts was measured and found to be 2-3/32 inches from the outer end of the beta rod on all three blades. The beta feedback collar was missing and all three beta rods were disconnected.

Spinner Assembly:

The spinner dome had mild damage with no significant damage. The spinner bulkhead was unremarkable.

Propeller Cycling:

Cycling of the pitch change mechanism was not possible.

Engine/Propeller Mounting:

The engine flange and mounting bolts were intact. The engine shaft was fractured just aft of the propeller mounting flange.

Photo 1. Left Propeller

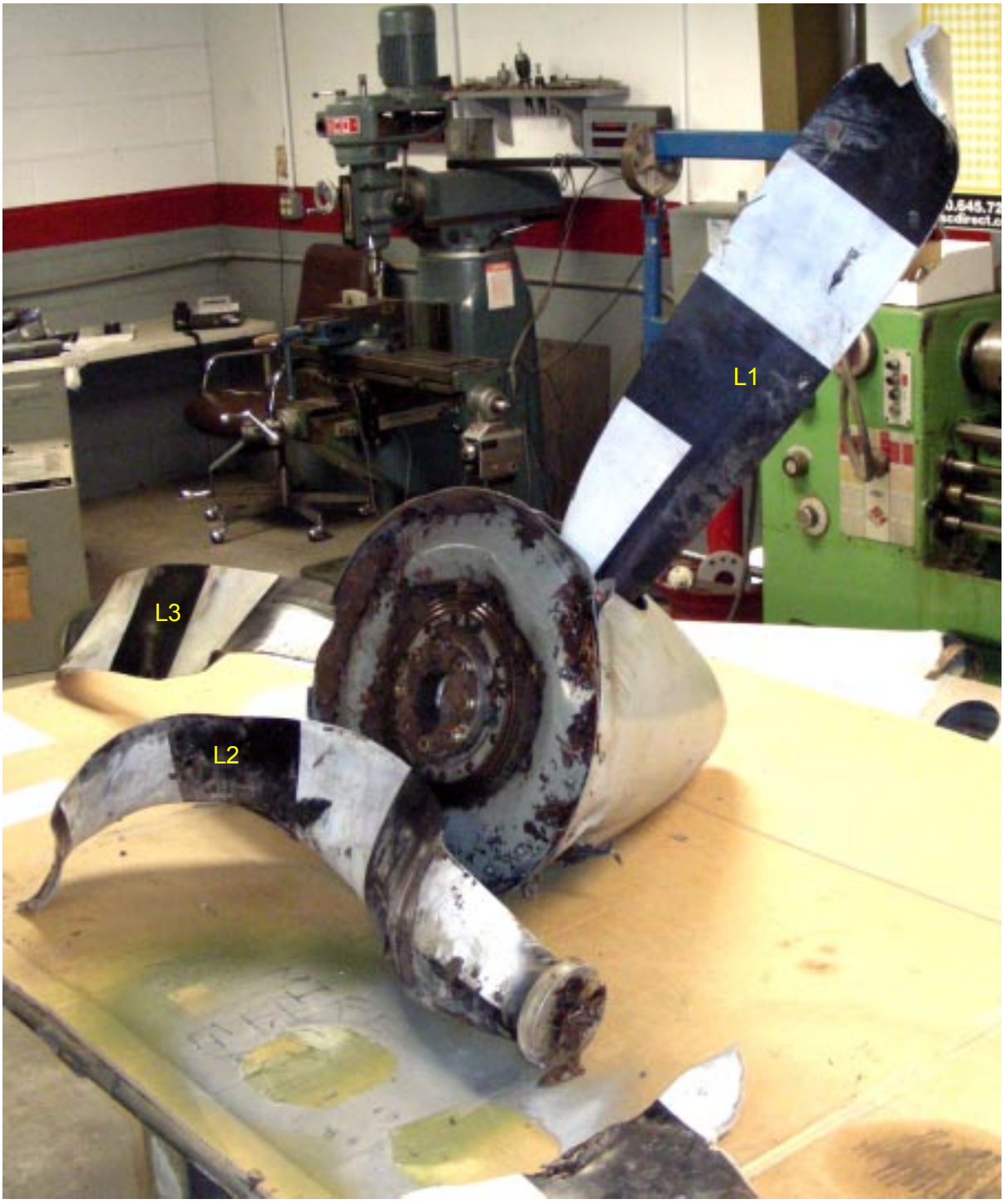

Photo 2. Left Propeller

Blade/Clamp Rotation:

L1 and L3 blades had not turned in their clamps. L2 blade had separated from its blade clamp.

Pitch Stops:

Reverse Pitch Stop: The reverse pitch stop was not observed.

Feather Stop: The feather stop was intact and unremarkable.

Beta rods: All three beta rods were loose and had separated from the feedback collar (which was missing). All three beta rods were mildly bent. The flight idle stop nuts (3) were measures to be 2-3/32 inches from the outer end of the beta rods.

Photo 3. Left Flight Idle Stop Nut

Piston:

The piston was intact and unremarkable.

Link Arms:

L1 and L3 link arms had elongated link screw holes and had separated from the clamps. L1 link arm was twisted. L2 link arm was slightly bent and remained attached to its clamp.

Cylinder and Guide Collar:

The cylinder threads (attaching to hub) were damaged, the cylinder was otherwise unremarkable. The guide collar had deep gouges caused by contact with link arms/links screws when they were in an extreme reverse position.

Feathering Spring Assembly:

The spring assembly appeared intact and unremarkable. It was not disassembled for detailed examination.

Pitch Change Rod:

Intact and unremarkable

Clamps and Counterweights:

L1 clamp and counterweight was intact, the link screw hole was deformed and the link screw was missing.
L2 clamp had split apart one inner clamp screw was fractured, one outer bolt was bent and the nut was missing.
L3 clamp and counterweight was intact, the link screw hole was deformed and the link screw was missing. One counterweight slug bolt was fractured.

Clamp serial numbers:
- L1: W3949
- L2: W3929
- L3: W3978

Hub Unit:

The mounting flange was unremarkable. The cylinder attachment threads were damaged.

L2 pilot tube was fractured. The fractured portion remained inside L2 blade butt. The characters "TE" from L2 blade butt had transferred to L2 hub arm. With the characters aligned, L2 blade was at an extreme reverse position when the mark was created.

Blades:

See photos on Page 9.

Blade L1 was fractured diagonally across the blade chord approximately 12 inches from the tip. The leading edge was bent aft and twisted toward lower pitch in the area of the fracture. The fractured portion had multiple bends with two harsh impacts on the leading edge.

Blade L2 had separated from its clamp. Its retention shoulder was rounded/deformed. The blade was bent aft approximately 30° at 1/4 radius. The outer 2/3 of the blade had a large radius bend, greater than 90°. The tip was curled aft and torn off approximately 9 inches from the tip. The fractured portion was not recovered.

Blade L3 had multiple wavy bends with several bends along the trailing edge. Overall, it was slightly bent forward. The outer 3 inches of the tip was torn off and missing.

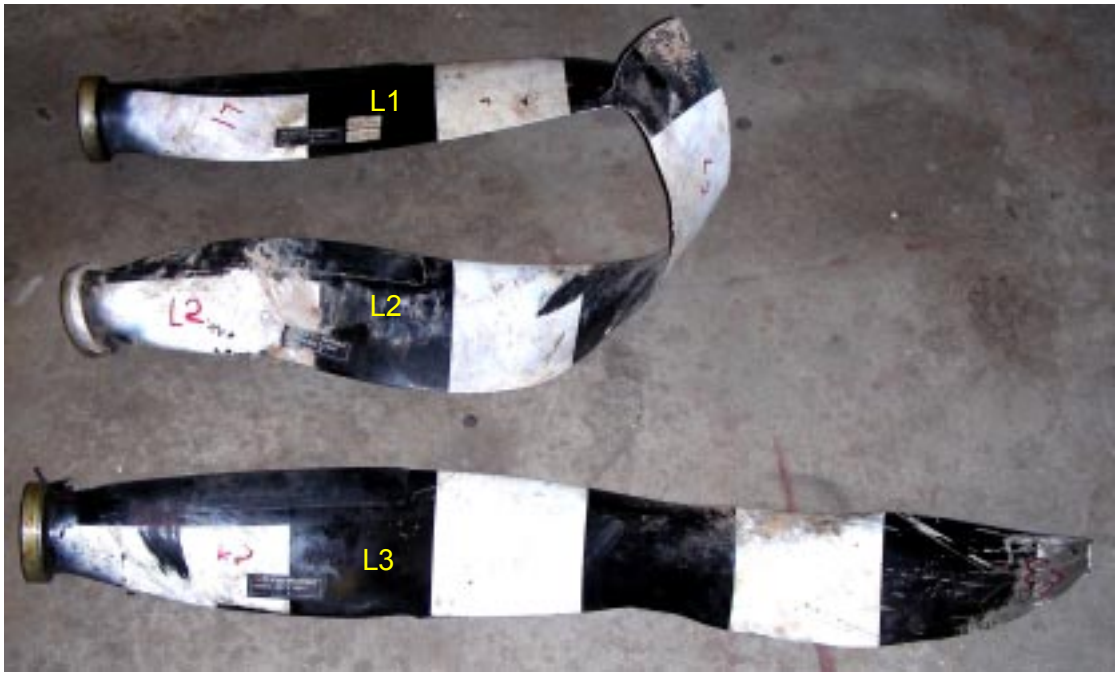

Photo 4. Left Propeller Blades

Photo 5. Left Propeller Blades

Position: RIGHT

Hub Serial Number: BUA20234 **Factory No.:** B173A

Blade Model: T10173+1

S/N R1: B15125
S/N R2: B10079
S/N R3: B8637

Blade Orientation:

The blades were identified as R1-R2-R3 clockwise as viewed from the rear of the propeller. The hub serial number was between the R2 and R3 blades.

"As Received" Condition:

See photos on Pages 11 & 12.

The spinner dome had not been removed and the propeller remained attached to the engine. One blade counterweight was protruding through the spinner dome; the blade/counterweight was in a reverse pitch position.

The pitch change mechanism was jammed in a reverse pitch position. The feather spring and two link arms had to be disconnected and the mechanism actuated to the feather position in order to facilitate removal from the engine.

Each of the three blades had a portion of the tip torn off; all three tips were missing.

The beta mechanism was intact and unremarkable.

The position of the flight idle stop nuts (all 3) was measured to be 2-3/32 inches from the end of the beta rods (which is the same position as the Left propeller).

Spinner Assembly:

The spinner dome was significantly crushed and had to be cut apart to facilitate removal

Propeller Cycling:

Manual cycling of the pitch change was accomplished with the spring and two damaged link arms disconnected.

Engine/Propeller Mounting:

The propeller mounting flange and bolts were intact and unremarkable.

Photo 6. Right Propeller

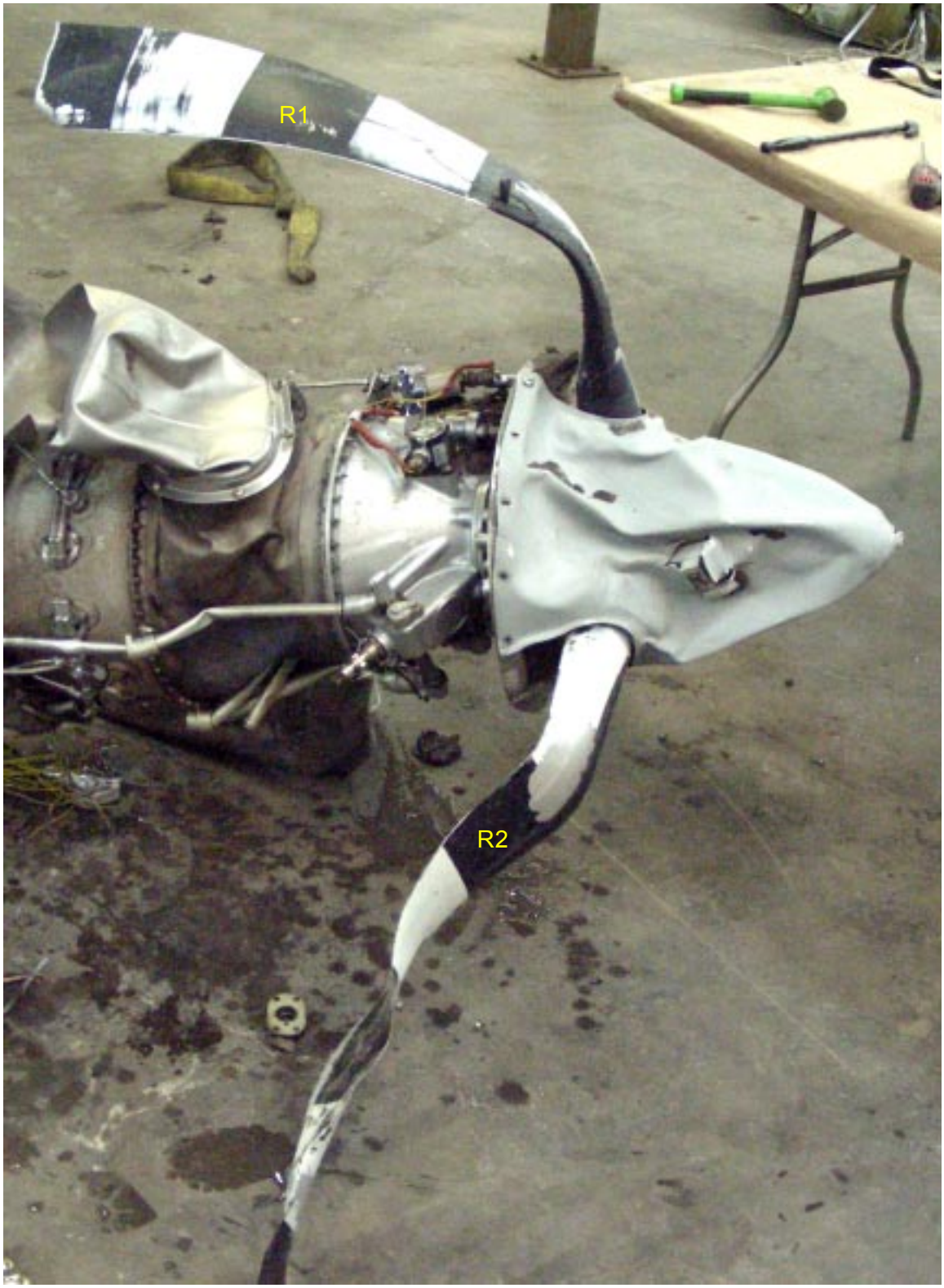

Photo 7. Right Propeller

Blade/Clamp Rotation:

None of the blades had rotated in their clamps.

Pitch Stops:

Reverse Pitch Stop: The reverse pitch stop was not observed.

Feather Stop: The feather stop was intact and unremarkable.

Beta Rods: The beta rods and beta mechanism was intact and unremarkable. The flight idle stop nuts (3) were measures to be 2-3/32 inches from the outer end of the beta rods.

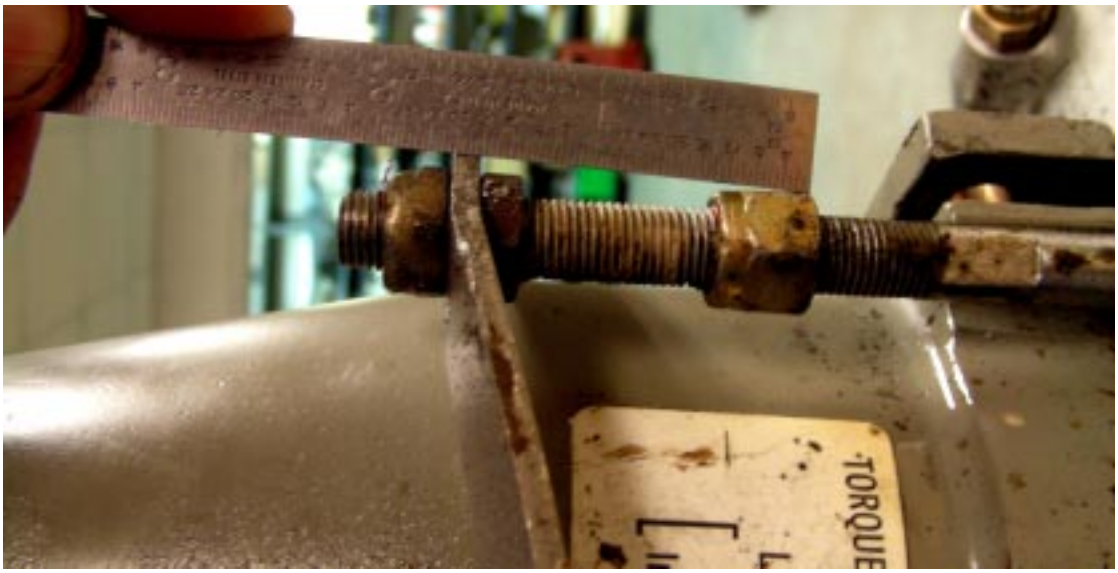

Photo 8. Right Flight Idle Stop Nut

Piston:

See photo on Page 14.

The piston had multiple impact marks caused by contact with the forward end of the cylinder. The mark at the highest blade angle position was 2-9/32 inches from the aft end of the piston. This equates to approximately 18 degrees blade angle.

The aft end of the piston was 2/32 inch from the guide collar with the piston in the feather position.

Photo 9. Right Cylinder Impact Marks on Piston

Link Arms:

R1 and R3 link arms were bent. R2 link arm was unremarkable.

Cylinder and Guide Collar:

The cylinder was intact and unremarkable. Distance from guide collar to outer shoulder of cylinder is 4-17/32 inches. The guide collar had gouges caused by contact with link arms/links screws when they were in an extreme reverse position.

Feathering Spring Assembly:

The spring assembly appeared intact and unremarkable. It was not disassembled for detailed examination.

Pitch Change Rod:

Intact and unremarkable

Clamps and Counterweights:

All three clamps, counterweights and link screws were intact and unremarkable.

Clamp serial numbers:

R1: W1881
R2: W2214
R3: W1952

Hub Unit:

The hub, mounting flange, cylinder attachment, and pilot tubes were intact and unremarkable. There were no impact marks that could be used to calculate a blade angle.

Blades:

See photos on Pages 15 & 16.

Blade R1 was bent aft approximately 70° at 1/4 radius. It had rotational scoring in the paint on the camber side. The outer 7 inches of the tip was torn off and missing. The leading edge of the blade was twisted toward low pitch near the fracture.

Blade R2 was bent aft approximately 20° at 1/4 radius. The outer 6 inches of the tip was torn off and missing. The blade was bent forward and twisted toward higher pitch near the fracture. The blade had multiple fore and aft bends and the trailing edge had wavy bends on the outer 1/2 of the blade.

Blade R3 was bent aft approximately 30° at 1/4 radius. The outer 18 inches of the tip was torn off and miss

Photo 10. Right Propeller Blades

Photo 11. Right Propeller Blades

Photo 12. All Six Propeller Blades

PHOTOGRAPHIC SUMMARY

NOTE: The following digital photographs are original and unedited and available on compact disc. The numbering sequence may not be chronological as some may have been deleted if out-of-focus, too dark, redundant, etc. Photos used in the text of this report are taken from photos on this list but may have been adjusted from the original. Modifications to images used in the report are limited to cropping, magnification, file compression, or enhancement of color, brightness, or contrast for the sole purpose to improve clarity of the report. No other alterations are permitted.

PHOTOGRAPH NUMBER	DESCRIPTION
	RIGHT PROPELLER
Dscn5609.jpg	right engine and propeller, as received
Dscn5610.jpg	right engine and propeller
Dscn5611.jpg	right propeller spinner
Dscn5612.jpg	right propeller spinner
Dscn5613.jpg	right propeller and spinner
Dscn5614.jpg	counterweight protruding through spinner
Dscn5615.jpg	spinner crushing
Dscn5616.jpg	right engine and propeller
	LEFT PROPELLER
Dscn5617.jpg	left propeller, as received
Dscn5618.jpg	left propeller, as received
Dscn5619.jpg	left propeller, as received
Dscn5620.jpg	left propeller, as received
Dscn5621.jpg	left propeller, as received
Dscn5622.jpg	left propeller, as received
Dscn5623.jpg	blade serial number decal
Dscn5624.jpg	blade serial number decal
Dscn5625.jpg	blade serial number decal
Dscn5626.jpg	blade serial number decal
Dscn5627.jpg	mounting flange, as received
Dscn5628.jpg	mounting flange, engine shaft removed
Dscn5629.jpg	mounting flange, engine shaft removed
Dscn5630.jpg	propeller after spinner dome removal
Dscn5631.jpg	propeller after spinner dome removal
Dscn5632.jpg	propeller after spinner dome removal
Dscn5633.jpg	propeller after spinner dome removal
Dscn5634.jpg	spinner dome
Dscn5635.jpg	spinner dome
Dscn5636.jpg	flight idle nut position
Dscn5637.jpg	flight idle nut position
Dscn5639.jpg	hub bore
Dscn5640.jpg	hub and clamps
Dscn5641.jpg	miscellaneous parts
Dscn5642.jpg	miscellaneous parts
Dscn5643.jpg	fractured engine shaft
Dscn5644.jpg	fractured engine shaft

Dscn5645.jpg	cylinder, guide collar, and feather spring assembly
Dscn5646.jpg	piston, inside
Dscn5647.jpg	piston, inside
Dscn5648.jpg	L3 link arm
Dscn5649.jpg	L1 link arm
Dscn5650.jpg	L2 link arm
Dscn5651.jpg	all three blade clamps
Dscn5652.jpg	all three blade clamps
Dscn5653.jpg	all three blade clamps
Dscn5654.jpg	all three blade clamps
Dscn5655.jpg	L1 hub arm
Dscn5656.jpg	L1 hub arm
Dscn5657.jpg	L2 hub arm
Dscn5658.jpg	L2 hub arm
Dscn5659.jpg	L2 hub arm
Dscn5660.jpg	L3 hub arm
Dscn5661.jpg	hub
Dscn5662.jpg	spinner, inside
Dscn5663.jpg	all three blades, camber side
Dscn5664.jpg	all three blades, camber side
Dscn5665.jpg	all three blades, camber side
Dscn5666.jpg	all three blades, camber side
Dscn5667.jpg	all three blades, lead edge
Dscn5668.jpg	all three blades, lead edge
Dscn5669.jpg	L1 blade, fractured tip
Dscn5670.jpg	L2 blade, fractured tip
Dscn5671.jpg	L3 blade, fractured tip
Dscn5672.jpg	all three blades, flat side
Dscn5673.jpg	all three blades, flat side
	RIGHT PROPELLER
Dscn5674.jpg	right propeller, spinner dome removed
Dscn5675.jpg	right propeller, spinner dome removed
Dscn5676.jpg	right propeller, spinner dome removed
Dscn5677.jpg	R1 blade/clamp
Dscn5678.jpg	R2 blade/clamp
Dscn5679.jpg	R3 blade/clamp
Dscn5680.jpg	mounting flange, beta feedback collar
Dscn5681.jpg	mounting flange, beta feedback collar
Dscn5682.jpg	flight idle nut position
Dscn5683.jpg	flight idle nut position
Dscn5684.jpg	all three blades, flat side
Dscn5686.jpg	R1 blade butt
Dscn5687.jpg	R2 blade butt
Dscn5688.jpg	R3 blade butt
Dscn5689.jpg	R1 hub arm
Dscn5690.jpg	R2 hub arm
Dscn5691.jpg	R3 hub arm
Dscn5692.jpg	feather spring assembly
Dscn5693.jpg	piston, external

Dscn5694.jpg	piston, internal
Dscn5695.jpg	piston, internal
Dscn5696.jpg	piston, internal
Dscn5697.jpg	hub and cylinder
Dscn5698.jpg	miscellaneous parts
Dscn5699.jpg	all three blade clamps, link arms
Dscn5700.jpg	all three blade clamps, link arms
Dscn5701.jpg	all three blade clamps, link arms
Dscn5703.jpg	right spinner, after removal
Dscn5704.jpg	right spinner, after removal
Dscn5706.jpg	right spinner, after removal
Dscn5707.jpg	right spinner, after removal
Dscn5708.jpg	all three blades, flat side
Dscn5709.jpg	all three blades, flat side
Dscn5710.jpg	all three blades, flat side
Dscn5711.jpg	all three blades, leading edge
Dscn5712.jpg	all three blades, camber side
Dscn5713.jpg	R1 blade tip
Dscn5714.jpg	R2 blade tip
Dscn5715.jpg	R3 blade tip
	Miscellaneous Photos
Dscn5716.jpg	L1 fractured blade tip
Dscn5717.jpg	right piston, internal measurement
Dscn5718.jpg	right piston, internal measurement
Dscn5719.jpg	right piston, internal measurement
Dscn5720.jpg	all six blades
Dscn5721.jpg	all six blades
Dscn5722.jpg	right engine governor
Dscn5723.jpg	left engine governor
Dscn5724.jpg	aircraft throttle quadrant