Date of Accident: April 7, 2015

Location: Bloomington, IL

NTSB File No.: CEN15FA190

Aircraft: Cessna 414A

Registration No.: N789UP

Serial No.: 414A0495

Operator: per the FAA registry:
Make It Happen Aviation LLC.
[redacted]
Towanda, IL 61776

Written by: Dan Boggs – Air Safety Investigation Manager
Revision 2, Les Doud – Air Safety Investigator

Date: May 5, 2015
Revision 2 – February 11, 2016

NOTE: All changes are indicated by a black vertical line along the left margin.

Contents:

ACCIDENT SYNOPSIS

According to the NTSB preliminary report: "On April 7, 2015, about 0006 central daylight time (all referenced times will reflect central daylight time), a Cessna model 414A twin-engine airplane, N789UP, was substantially damaged when it collided with terrain following a loss of control during an instrument approach to Central Illinois Regional Airport (BMI), Bloomington, Illinois. The airline transport pilot and six passengers were fatally injured. The airplane was owned by and registered to Make It Happen Aviation, LLC, and was operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 while on an instrument flight rules (IFR) flight plan. Night instrument meteorological conditions prevailed for the cross-country flight that departed Indianapolis International Airport (IND), Indianapolis, Indiana, at 2307 central daylight time.

According to preliminary Federal Aviation Administration (FAA) Air Traffic Control (ATC) data, after departure the flight proceeded direct to BMI and climbed to a final cruise altitude of 8,000 feet mean sea level (msl). According to radar data, at 2344:38 (hhmm:ss), about 42 nautical miles (nm) south-southeast of BMI, the flight began a cruise descent to 4,000 feet msl. At 2352:06, the pilot established contact with Peoria Terminal Radar Approach Control, reported being level at 4,000 feet mean sea level (msl), and requested the Instrument Landing System (ILS) Runway 20 instrument approach into BMI. According to radar data, the flight was located about 21 nm south-southeast of BMI and was established on a direct course to BMI at 4,000 feet msl. The approach controller told the pilot to expect radar vectors for the ILS Runway 20 approach. At 2354:18, the approach controller told the pilot to make a right turn to a 330 degree heading. The pilot acknowledged the heading change. At 2359:16, the approach controller cleared the flight to descend to maintain 2,500 feet msl. At 2359:20, the pilot acknowledged the descent clearance.

At 0000:01, the approach controller told the pilot to turn left to a 290 heading. The pilot acknowledged the heading change. At 0000:39, the approach controller told the pilot that the flight was 5 nm from EGROW intersection, cleared the flight for the ILS Runway 20 instrument approach, issued a heading change to 230 degrees to intercept the final approach course, and told the pilot to maintain 2,500 feet until established on the inbound course. The pilot correctly read-back the instrument approach clearance, the heading to intercept the localizer, and the altitude restriction.

According to radar data, at 0001:26, the flight crossed through the final approach course while on the assigned 230 degree heading before it turned to a southerly heading. The plotted radar data showed the flight made course corrections on both sides of the localizer centerline as it proceeded inbound toward EGROW. At

0001:47, the approach controller told the pilot to cancel his IFR flight plan on the approach control radio frequency, that radar services were terminated, and authorized a change to the common traffic advisory frequency (CTAF). According to radar data, the flight was 3.4 nm outside of EGROW, established inbound on the localizer, at 2,400 feet msl. At 0002:00, the pilot transmitted over the unmonitored CTAF, "twin Cessna seven eight nine uniform pop is coming up on EGROW, ILS Runway 20, full stop." No additional transmissions from the pilot were recorded on the CTAF or by Peoria Approach Control.

According to radar data, at 0003:12, the flight crossed over the locator outer marker (EGROW) at 2,100 feet msl. The flight continued to descend while tracking the localizer toward the runway. At 0003:46, the airplane descended below available radar coverage at 1,500 feet msl. The flight was about 3.5 nm from the end of the runway when it descended below radar coverage. Subsequently, at 0004:34, radar coverage was reestablished with the flight about 1.7 nm north of the runway threshold at 1,400 feet msl. The plotted radar data showed that, between 0004:34 and 0005:08, the flight climbed from 1,400 feet msl to 2,000 feet msl while maintaining a southerly course. At 0005:08, the flight began a descending left turn to an easterly course. The airplane continued to descend on the easterly course until reaching 1,500 feet msl at 0005:27. The airplane then began a climb while maintaining an easterly course. At 0005:42, the airplane had flown 0.75 nm east of the localizer centerline and had climbed to 2,000 feet. At 0005:47, the flight descended below available radar coverage at 1,800 feet msl. Subsequently, at 0006:11, radar coverage was reestablished at 1,600 feet msl about 0.7 nm southeast of the previous radar return. The next two radar returns, recorded at 0006:16 and 0006:20, were at 1,900 feet msl and were consistent with the airplane continuing on an easterly course. The final radar return was recorded at 0006:25 at 1,600 feet msl about 2 nm east-northeast of the runway 20 threshold."

Aircraft Damage: Destroyed

Injuries: 7 on board, 7 fatal

SUMMARY AND ANALYSIS OF PROPELLER FINDINGS

Both propellers had similar damage. They were both fractured off the engine at the engine shaft. On each propeller one blade was bent aft, one blade appeared straight and one blade exhibited forward bending near the tip. Both propellers were on the start locks when received. Both propellers had the spinner domes formed around the propeller hub and counterweights. The spinner domes also exhibited a spiral/twisting deformation pattern.

Start locks are centrifugal devices used to keep propeller blade angle low – and thus aerodynamic drag low – to minimize the starting torque required to start the engine. Once an engine has started and the RPM's increase above approximately 700-900 RPM, the centrifugal start lock will disengage and allow the propeller to move into higher blade angles as required by the flight condition and/or pilot control via the propeller governor. During normal engine shutdown when the engine RPM decreases below approximately 700-900 RPM, the centrifugal start locks engage and keep the propeller at a low blade angle for the next engine start.

If there is a complete engine failure and/or the pilot commands the propeller to feather, the feathering spring, counterweights and aircharge will move the propeller blades into the feather position. The propeller blade angle must be higher than the start lock angle or the engine RPM must remain above approximately 700-900 RPM until blade angle increases above the start lock angle for the propeller to reach the feathered position.

In order for both propellers to be found on the start locks, the propeller blade angle at impact was either at or below the start lock angle when the RPM decreased below 700-900 RPM, or the impact forces moved the blade angle into a start lock position after RPM decreased below 700-900 RPM.

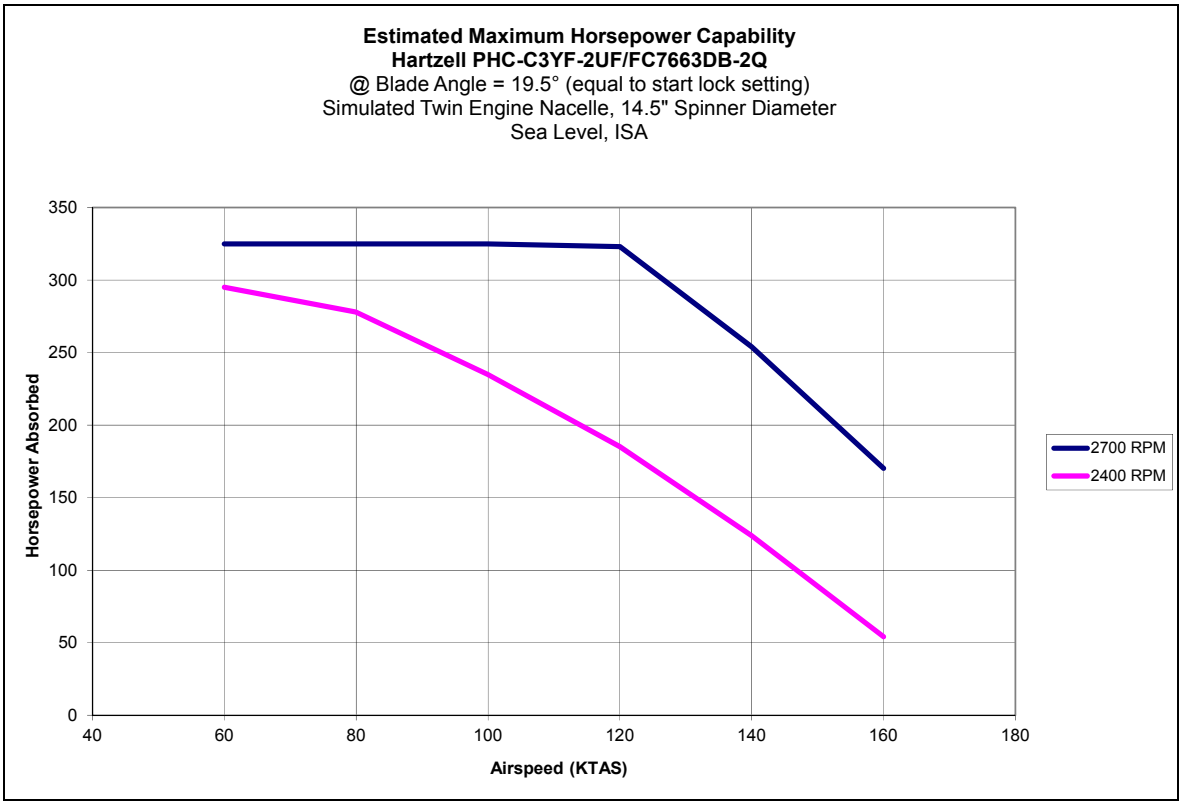
The propeller model on the accident aircraft has a start lock angle specification of 19.5° +/- 1.5. Estimated propeller performance with a blade angle setting of 19.5° is shown in Figure 1. This chart represents a maximum horsepower possible with the blade angle at 19.5° and RPM 2700 or 2400. Therefore power on the engines at time of impact could have been as high as maximum rated depending on aircraft speed and RPM.

CONCLUSIONS OF PROPELLER EXAMINATION

A definitive power setting could not be determined. Neither propeller was in the feathered position. Blade damage was consistent with rotation at impact and one blade indicated ground impact at a positive angle of attack.

There were no discrepancies noted that would prevent or degrade normal operation. All damage was consistent with high impact forces.

Figure 1



Propeller Teardown Report

Date of Investigation: April 9, 2015 &
December 10, 2015

Location: Bloomington, IL

Propeller Model: PHC-C3YF-2UF with FC7663DB-2Q blades

Representatives:

Dan Boggs	Hartzell Propeller Inc.
Eric Hall	Textron
Chris Lang	Continental Motors
Todd Fox	NTSB

Second Examination on December 10, 2015

Les Doud	Hartzell Propeller Inc.
Todd Fox	NTSB Investigator In Charge
David Slaybaugh	FAA Springfield, IL FSDO
Ernest Hall	Textron Air Safety Investigator
Rick Roper	RAM Aircraft Director of Operations

General Comments:

This type propeller is a 3-blade single-acting, hydraulically operated, constant speed model with feathering capability. Oil pressure from the propeller governor is used to move the blades to the low pitch (blade angle) direction. A spring, counterweights, and an air charge move the blades to the high pitch/feather direction in the absence of governor oil pressure. The blades and hub are of aluminum construction. Propeller rotation is clockwise as viewed from the rear.

Installation Data: Refer to Installation Data Sheet No. 433
(Data reference the 30-inch station)

Low Pitch:	14.0 ± 0.1 degrees
Start lock:	19.5 ± 1.5 degrees
Feather:	84.0 ± 1.0 degrees

Service History:

	S/N	Date of manufacture	TTSN	TSO
Left Hub	EB1994	08/30/1983	6936.4	165.3
Blades	F40860	08/30/1983	6936.4	165.3
	F40847	08/30/1983	6936.4	165.3
	F40854	08/30/1983	6936.4	165.3
Right Hub	EB1993	08/22/1983	6936.4	691.3
Blades	F40490	08/22/1983	6936.4	691.3
	F40471	08/22/1983	6936.4	691.3
	F40466	08/22/1983	6936.4	691.3

Position: **LEFT**

Hub Serial Number: EB1994 **Factory No.:** A3086

Blade Model: FC7663DB-2Q

S/N L1:	F40860
S/N L2:	F40847
S/N L3:	F40854

As Received Condition: (see Photos #1 and #2)

The propeller was fractured off the engine at the engine shaft. The NTSB stated it was approximately 2 feet down in the mud. The propeller was received on the start locks. One blade was bent aft, one blade appeared straight and one blade exhibited forward bending near the tip. The spinner dome was formed around the counterweights.

Spinner Dome & Counterweights:

The spinner dome was crushed around all sides and formed around the counterweights. The spinner dome exhibited a spiral/twisting deformation pattern. The counterweights were in the start lock position.

Spinner Bulkhead:

The bulkhead was crushed around the entire circumference.

Propeller Cycling:

The cycling of the propeller was not possible due to impact damage.

Engine/Propeller Mounting:

The engine to propeller mounting was intact and all bolts were safety wired, however the propeller was fractured off the engine at the engine shaft.

Cylinder:

The cylinder was intact and unremarkable. The air valve was fractured off.

Piston:

The piston was intact and unremarkable.

Pitch Change Rod:

The pitch change rod was intact and unremarkable.

Fork:

The fork was intact and unremarkable.

Spring/Spring Guides:

The spring and guides could not be fully examined as they were stuck inside the cylinder. What was observed was intact and unremarkable.

Pitch Stops:

Low Pitch Stop: The low pitch stop was intact.

Feather Stop: The feather stop could not be observed due to being stuck inside the cylinder.

Start Lock: The start lock was intact.

Photo #1, left propeller as received.

Photo #2, left propeller as received.

Hub Assembly:

The hub was intact. The L2 and L3 preload plate flange was damaged from impact.

Preload Plates: NOTE: For this propeller model, when the blade knob is aligned with the hub parting line, the blade angle at the reference station is 48° (knob 12° + 36 = 48°).

L1 and L2 preload plate was intact and showed normal wear. L3 preload plate was fractured on the aft/bottom side where it contacted the inner hub web, and also had an impression mark near the start lock angle position.

Propeller Blades: (See Photos #3 through #5)

L1 blade
paint, camber side - intact.
paint, flat side - intact.
bend - none.
twist - none.
lead edge damage - none.
trail edge damage - none.
knob condition - intact and unremarkable.
counterweight - intact and unremarkable.

L2 blade
paint, camber side - intact.
paint, flat side - intact.
bend - forward near tip.
twist - none.
lead edge damage - none.
trail edge damage - none.
knob condition - intact and unremarkable.
counterweight - intact and unremarkable.

Blade L2 had distinct ball bearing impression marks on the face side bearing races consistent with a thrust force at impact. Blade L2 also exhibited forward bending near the tip consistent with force in thrust direction. The bearing and blade bending was similar to that on blade R2.

L3 blade
paint, camber side - intact.
paint, flat side - intact.
bend - aft.
twist - leading edge down/lower pitch.
lead edge damage - none.
trail edge damage - none.
knob condition - fractured off.
counterweight - intact and unremarkable.

Photo #3, left propeller blades.

Photo #4, left propeller blades.

Photo #5, edge view of left propeller blades.

Position: **RIGHT**

Hub Serial Number: EB1993

Blade Model: FC7663DB-2Q

S/N R1: F40490
S/N R2: F40471
S/N R3: F40466

As Received Condition: (see Photos #6 and #7)

The propeller was fractured off the engine at the engine shaft. The NTSB stated it was approximately 2 feet down in the mud. The propeller was received on the start locks. One blade was bent aft, one blade appeared straight and one blade exhibited forward bending near the tip. The spinner dome was formed around the counterweights.

Spinner Dome & Counterweights:

The spinner dome was crushed around all sides and formed around the counterweights. The spinner dome exhibited a spiral/twisting deformation pattern. The counterweights were in the start lock position.

Spinner Bulkhead:

The bulkhead was crushed around the entire circumference.

Propeller Cycling:

The propeller cycling was not possible due to impact damage.

The air valve was fractured off.

Engine/Propeller Mounting:

The engine to propeller mounting was intact and all bolts were safety wired, however the propeller was fractured off the engine at the engine shaft.

Cylinder:

The cylinder was intact, however the piston, feathering springs, guides and start locks were jammed inside the cylinder due to impact damage.

Photo #6, right propeller as received.

Photo #7, right propeller as received.

Piston:

The piston was not observed due to being jammed inside the cylinder.

Pitch Change Rod:

The pitch change rod was not fully examined due to being jammed inside the cylinder. What was observed was intact and unremarkable.

Fork:

The fork was intact and unremarkable.

Spring/Spring Guides:

The springs and guides were not observed due to being jammed inside the cylinder.

Pitch Stops:

Low Pitch Stop: The low pitch stop was not observed.

Feather Stop: The feather stop was not observed.

Start Lock: The start lock was not observed.

Hub Assembly:

The hub was intact, however the preload plate flange was damaged due to impact damage.

Preload Plates: NOTE: For this propeller model, when the blade knob is aligned with the hub parting line, the blade angle at the reference station is 48° (knob 12° + 36 = 48°).

R1 and R2 preload plates were intact and unremarkable. R3 preload plate was damaged/deformed at the aft/bottom of the plate by impact forces.

Propeller Blades: (See Photos #8 through #10)

R1 blade
paint, camber side - intact.
paint, flat side - intact.
bend - none.
twist - none.
lead edge damage - none.
trail edge damage - none.
knob condition - intact and unremarkable.
counterweight - intact and unremarkable.

R2 blade
paint, camber side - intact.
paint, flat side - intact.
bend - forward near tip.
twist - none.
lead edge damage - none.
trail edge damage - none.
knob condition - intact and unremarkable.
counterweight - intact and unremarkable.

Blade R2 had distinct ball bearing impression marks on the face side bearing races consistent with a thrust force at impact while at RPM in the normal operating range (see Photo #11). Blade R2 also exhibited forward bending near the tip consistent with impact at a positive angle of attack. The bearing and blade bending was similar to that on blade L2.

R3 blade
paint, camber side - intact.
paint, flat side - intact.
bend - aft.
twist - leading edge down/lower pitch.
lead edge damage - none.
trail edge damage - none.
knob condition - fractured off.
counterweight - intact and unremarkable.

Photo #8, right propeller blades.

Photo #9, right propeller blades.

Photo #10, edge view of right propeller blades.

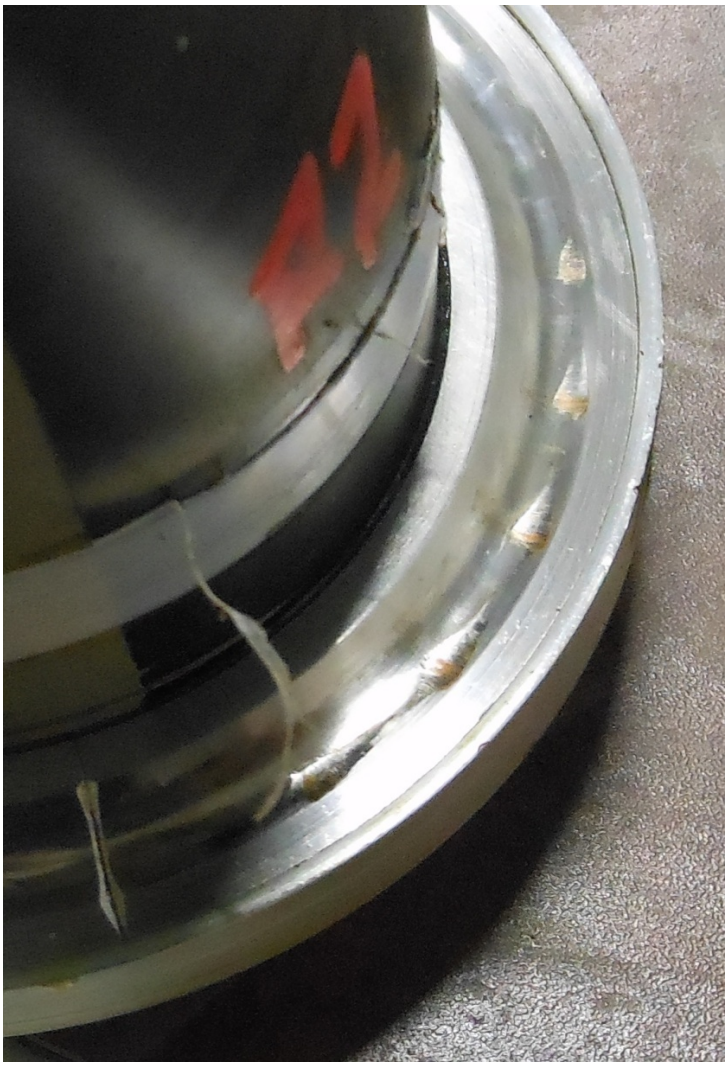


Photo #11, blade R2 bearing race ball bearing impact marks.

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
P1020098.JPG	plane wreckage.
P1020099.JPG	plane wreckage.
P1020100.JPG	turbocharger.
P1020101.JPG	turbocharger.
P1020102.JPG	turbocharger.
P1020103.JPG	turbocharger.
P1020104.JPG	data plate, turbocharger.
P1020105.JPG	turbocharger.
P1020106.JPG	right propeller.
P1020107.JPG	right propeller.
P1020108.JPG	right propeller.
P1020109.JPG	right propeller.
P1020110.JPG	right propeller.
P1020111.JPG	right propeller.
P1020112.JPG	right propeller.
P1020113.JPG	left propeller.
P1020114.JPG	left propeller.
P1020115.JPG	left propeller.
P1020116.JPG	left propeller.
P1020117.JPG	serial number.
P1020118.JPG	pitch change rod.
P1020119.JPG	fork.
P1020120.JPG	preload plates.
P1020121.JPG	blade knob.
P1020122.JPG	blade knob.
P1020123.JPG	L1 preload plate.
P1020124.JPG	L2 preload plate.
P1020125.JPG	L3 preload plate.
P1020126.JPG	L3 preload plate fracture.
P1020127.JPG	Hub.
P1020128.JPG	cylinder.
P1020129.JPG	piston.
P1020130.JPG	left propeller blades.
P1020131.JPG	left propeller blades.

P1020132.JPG	left propeller blades.
P1020133.JPG	left propeller blades.
P1020134.JPG	L1 blade butt.
P1020135.JPG	L2 blade butt.
P1020136.JPG	L3 blade butt.
P1020137.JPG	spinner dome.
P1020138.JPG	bulkhead.
P1020139.JPG	serial number.
P1020140.JPG	serial number.
P1020141.JPG	cylinder assembly.
P1020142.JPG	cylinder.
P1020143.JPG	hub.
P1020144.JPG	preload plates.
P1020145.JPG	R1 preload plate.
P1020146.JPG	R2 preload plate.
P1020147.JPG	R3 preload plate.
P1020148.JPG	fork.
P1020149.JPG	R1 blade butt.
P1020150.JPG	R2 blade butt.
P1020151.JPG	R3 blade butt.
P1020152.JPG	right propeller blades.
P1020153.JPG	right propeller blades.
P1020154.JPG	right propeller blades.
P1020155.JPG	right propeller blades.
P1020156.JPG	right propeller blades.
P1020157.JPG	spinner dome.
P1020158.JPG	spinner dome.
P1020159.JPG	spinner dome.
P1020160.JPG	bulkhead.

The following digital photographs were taken during the second examination on December 10, 2015.

Picture File Name	Description
DSCN2152.JPG	Right blades lead edge view A
DSCN2153.JPG	Right blades trail edge view A
DSCN2154.JPG	Left blades lead edge view A
DSCN2155.JPG	Left blades trail edge view A
DSCN2156.JPG	Left blades camber side view A
DSCN2157.JPG	Left blades face side view A
DSCN2158.JPG	Right blades face side view A
DSCN2159.JPG	Left blades camber side view B
DSCN2160.JPG	Right blades camber side view A
DSCN2161.JPG	Blade L2 face side
DSCN2162.JPG	Blade L2 camber side A
DSCN2163.JPG	Blade L2 camber side B
DSCN2164.JPG	Blade L1 camber side A

DSCN2165.JPG	Blade R2 camber side A
DSCN2166.JPG	Blade R2 camber side B
DSCN2167.JPG	Blade R1 camber side A
DSCN2168.JPG	Blade R1 camber side B
DSCN2170.JPG	Left blades camber side view C
DSCN2171.JPG	Right blades camber side view C
DSCN2172.JPG	Left blades camber side view D
DSCN2173.JPG	Right blades face side view B
DSCN2174.JPG	Left blades face side view B
DSCN2175.JPG	Low pitch stop
DSCN2176.JPG	Left and right cylinders A
DSCN2177.JPG	Left and right cylinders B
DSCN2178.JPG	Left and right ball separators and seals
DSCN2179.JPG	Left fwd hub, inner view A
DSCN2180.JPG	Left fwd hub, inner view B
DSCN2181.JPG	Right fwd hub, inner view A
DSCN2182.JPG	Right aft hub, inner view A
DSCN2183.JPG	L2 bearing race A
DSCN2184.JPG	L2 bearing race B
DSCN2185.JPG	L2 bearing race C
DSCN2186.JPG	L2 bearing race D
DSCN2187.JPG	L2 bearing race E
DSCN2188.JPG	L2 bearing race F
DSCN2189.JPG	L2 bearing race G
DSCN2190.JPG	L2 bearing race H
DSCN2191.JPG	L2 bearing race I
DSCN2192.JPG	L3 bearing race A
DSCN2193.JPG	L3 bearing race B
DSCN2194.JPG	L1 bearing race A
DSCN2195.JPG	R2 bearing race A
DSCN2196.JPG	R2 bearing race B
DSCN2197.JPG	R2 bearing race C
DSCN2198.JPG	R1 bearing race A
DSCN2199.JPG	R1 bearing race B
DSCN2200.JPG	R3 bearing race A
DSCN2201.JPG	R3 bearing race B
DSCN2202.JPG	Right hub P/N and S/N
DSCN2203.JPG	Left hub P/N and S/N
DSCN2204.JPG	L3 hub socket A
DSCN2205.JPG	L3 hub socket B
DSCN2206.JPG	L3 hub socket C
DSCN2207.JPG	L1 hub socket A
DSCN2208.JPG	L1 hub socket B
DSCN2209.JPG	L1 hub socket C
DSCN2210.JPG	L1 hub socket D
DSCN2211.JPG	L2 hub socket A
DSCN2212.JPG	R2 hub socket A
DSCN2213.JPG	R2 hub socket B

DSCN2214.JPG	R2 hub socket C
DSCN2215.JPG	R3 hub socket A
DSCN2216.JPG	R3 hub socket B
DSCN2217.JPG	L3 hub socket D
DSCN2218.JPG	L3 hub socket E
DSCN2219.JPG	R3 hub socket C
DSCN2220.JPG	R3 hub socket D
DSCN2221.JPG	R1 hub socket A
DSCN2222.JPG	R1 hub socket B
DSCN2223.JPG	R2 hub socket D
DSCN2224.JPG	R2 hub socket E
DSCN2225.JPG	R2 hub socket F
DSCN2226.JPG	R2 hub socket G
DSCN2227.JPG	R2 hub socket H
DSCN2228.JPG	Right spinner dome A
DSCN2229.JPG	Left spinner dome A
DSCN2230.JPG	Right spinner dome B
DSCN2231.JPG	Right spinner dome C
DSCN2232.JPG	Left spinner dome B
DSCN2233.JPG	Left preload plates A
DSCN2234.JPG	Left preload plates B
DSCN2235.JPG	Right preload plates A
DSCN2236.JPG	Right preload plates B
DSCN2237.JPG	Throttle quadrant A
DSCN2238.JPG	Throttle quadrant B
DSCN2239.JPG	Throttle quadrant C
DSCN2240.JPG	R2 bearing race D
DSCN2241.JPG	R2 bearing race E
DSCN2242.JPG	R2 bearing race F
DSCN2243.JPG	R2 bearing race G
DSCN2244.JPG	R2 bearing race H
DSCN2245.JPG	L2 bearing race J
DSCN2246.JPG	L2 bearing race K
DSCN2247.JPG	L3 bearing race C
DSCN2248.JPG	R2 bearing race I