NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

May 28, 2020

Group Chairman's Factual Report

AIRWORTHINESS

DCA20MA059

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AIRWORTHINESS GROUP CHAIRMAN'S FACTUAL REPORT

NTSB No: DCA20MA059

A. ACCIDENT

Operator:	Island Express Helicopters, Inc
Aircraft:	Sikorsky S-76B / N72EX
Location:	Calabasas, CA
Date:	January 26, 2020
Time:	0945 PST

B. GROUP

Group Chairman:	Van S. McKenny IV National Transportation Safety Board Washington, DC
Member:	Adam Huray National Transportation Safety Board Washington, DC
Member:	Mike Hemann Federal Aviation Administration Fort Worth, TX
Member:	Stephen L. Ratcliff Federal Aviation Administration Van Nuys, CA
Member:	Chris O. Lowenstein Sikorsky, a Lockheed Martin Company Stratford, CT
Member:	Sean Eason Rotorcraft Support Inc Van Nuys, CA
Member:	Jay Eller Honeywell Aerospace Phoenix, AZ

LIST OF ACRONYMS

FAA	Federal Aviation Administration
FMS	Flight Management System
Ft	Feet
inHg	Inches of mercury
IGB	Intermediate Gear Box
KCMA	Camarillo Airport, CA
KSNA	Santa Ana Airport, CA
MGB	Main Gear Box
PN	Part Number
SAS	Stability Augmentation System
SN	Serial Number
TCDS	Type Certificate Data Sheet
TGB	Tail rotor Gear Box

C. SUMMARY

On January 26, 2020, about 0945 PST, a Sikorsky S76-B helicopter, N72EX, was destroyed when it was involved in an accident near Calabasas, California. The pilot and eight passengers were fatally injured. The helicopter was operated as a Title 14 Code of Federal Regulations Part 135 charter flight.

D. DETAILS OF THE INVESTIGATION

Not all group members participated in all group activities.

On Monday, 27 January, 2020: Organizational meeting was conducted. Van McKenny (NTSB) as Airworthiness Group Chairman formed the Airworthiness Group. Group members were representatives from the NTSB, FAA, Sikorsky, and Island Express Helicopters. The Airworthiness Group proceeded to the accident scene and conducted on-site documentation of the wreckage.

On Tuesday, 28 January, 2020: Airworthiness Group members returned to the accident site. On site efforts focused around gathering electronic equipment for further examination, collection of identifiable flight control elements, transmission drive elements, and cockpit instruments.

On Wednesday, 29 January, 2020: Airworthiness group a departed Calabasas, CA, and traveled to Phoenix, AZ.

On Thursday, 30 January, 2020: Airworthiness Group reconvened at Air Transport, Phoenix, AZ, to conduct the wreckage layout. Island Express replaced the airworthiness group member with a representative from Rotorcraft Support Inc. Honeywell provided on site expertise regarding avionics equipment documentation.

On Friday, 31 January, 2020: Airworthiness Group completed the field phase of the investigation.

E. FACTUAL INFORMATION

1.0 HELICOPTER INFORMATION

1.1 HELICOPTER DESCRIPTION

The Model S-76B, manufactured by Sikorsky Aircraft Corporation, is a twin engine, single main rotor helicopter designed to carry up to 13 passengers and a pilot. Flight controls and instrumentation for a second pilot are also available as optional equipment. Various cabin configurations are available and range from the standard interior arrangement to a four- to eight-place executive version. Four large doors provide entrance and exit from the cabin. The four-bladed main rotor is mounted on the main gear box, which is directly above the cabin. The two Pratt and Whitney PT6B-36A gas turbine engines are mounted side-by-side aft of the main gear box. Both engines have separate drive inputs to the main transmission, which reduce engine rpm and distribute torque upward to drive the main rotor, and aft through intermediate and tail gear boxes to drive the four-bladed tail rotor. Flight control forces from the main and tail rotor blades are reacted by a two-stage hydraulic servo system. The main rotor flight controls have a stick positioning and force gradient system. The tricycle-type landing gear is hydraulically retractable[1]. The S-76B helicopter is type certificated under Federal Aviation Administration (FAA) Type Certificate Data Sheet (TCDS) No. H1NE.

[1] Sikorsky S-76B Flight Manual, Part 2, 1-9

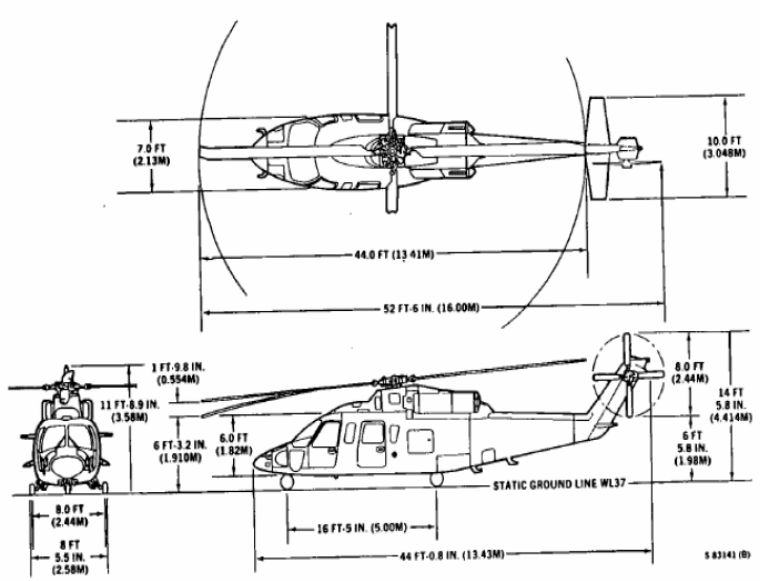

Figure 1-3-view diagram of the S-76B helicopter.

1.2 HELICOPTER HISTORY

The accident helicopter, serial number (S/N) 760379, was manufactured in 1991. According to helicopter records, the airframe had accumulated 4,717.4 flight hours (aircraft total time) at the time of the accident. Two Pratt & Whitney PT6B-36A engines were installed on the accident helicopter (refer to the Powerplants Group Chairman's Factual Report for additional information).

2.0 WRECKAGE DOCUMENTATION

2.1 ON-SCENE DOCUMENTATION

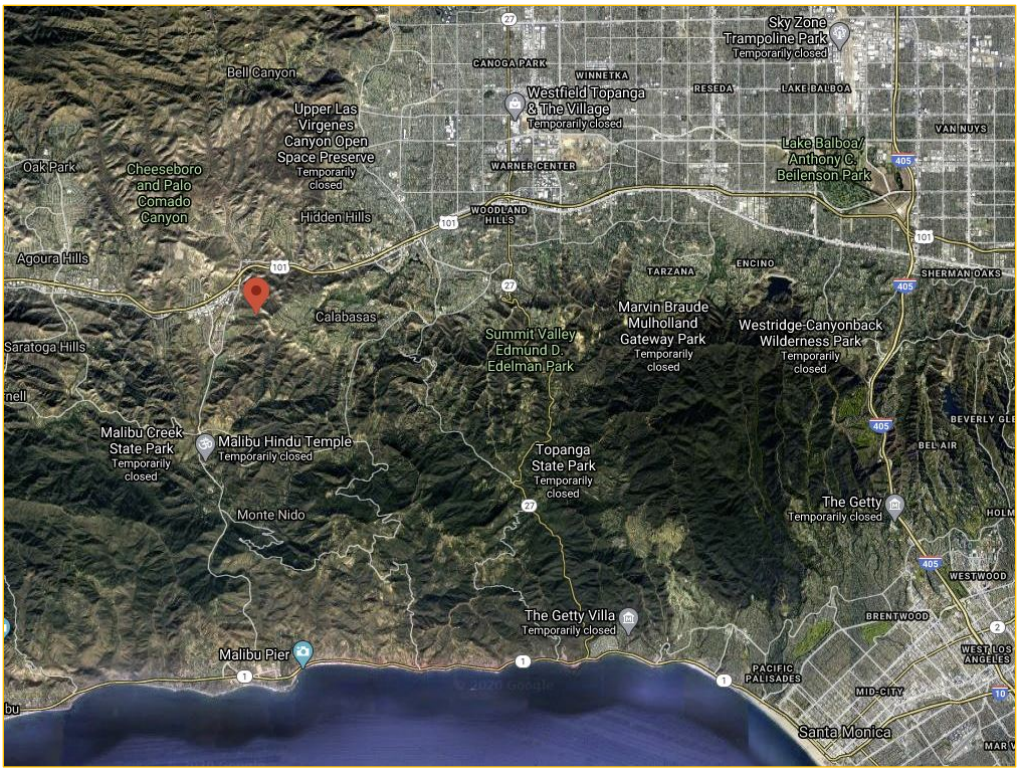

Figure 2-Wreckage location map.

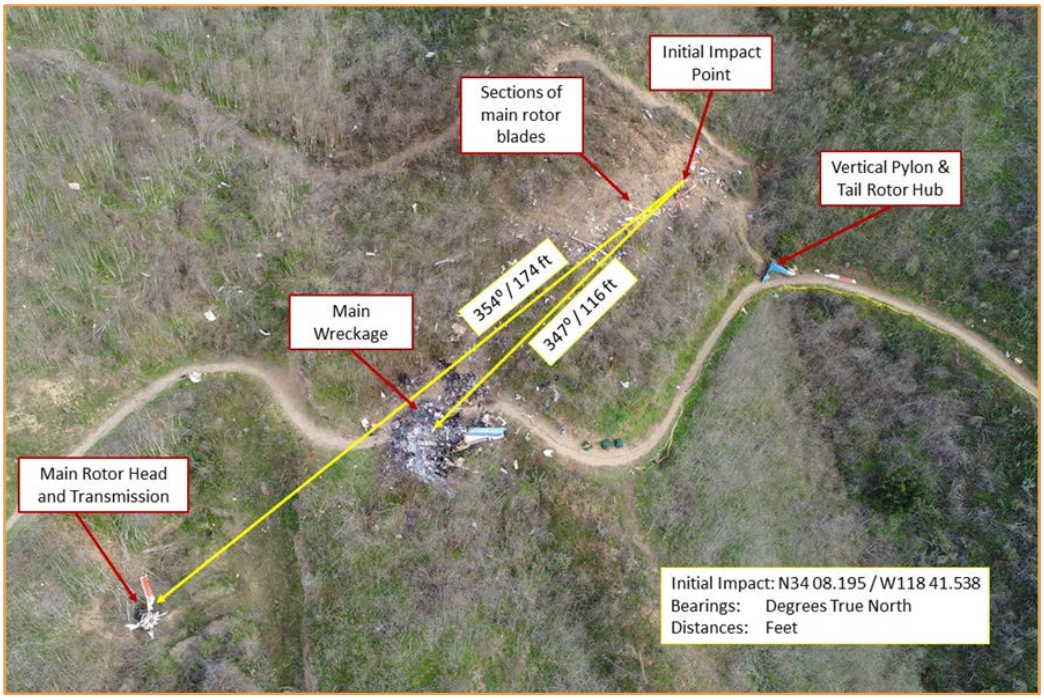

Figure 3 - Wreckage diagram. Overall view of initial impact area and wreckage path with select measurements and significant items.

The initial point of impact was on a 36-degree sloped terrain and consisted of highly fragmented cabin and cockpit debris. The vertical pylon and horizontal stabilizer were located about 40 feet below (downhill) from the impact crater. The impact crater measured 24 feet long, 15 feet wide, and about 2 feet in depth. A witness mark consistent with the length and width of a rotor blade was positioned perpendicular to the direction of the debris line and directly above the impact crater. The witness mark contained fragments of rotor blade skin and honeycomb blade core. One piece of 2-inch diameter tree branch was cut cleanly in 3 locations (similar to saw cuts) at ground level about 30 feet behind the initial impact crater.

Specific items identified in the impact crater were both pitot tubes, collective control fragment, headsets, and a 10-foot section of the yellow main rotor blade. The nose landing gear was located at the north end of the impact crater. Helicopter belly skin with the transponder antenna and landing gear hydraulic lines were plastically deformed into the side of the hill on the uphill side of the impact crater. There was a strong odor of jet fuel present in the crater area, but no evidence of fire at the impact crater.

The vertical pylon contained the intermediate gearbox and tail rotor drive segment. The tail rotor gearbox had separated from the mounting fixture and was located next to the vertical pylon. The tail rotor servo remained attached to the gear box. The rotor head was attached to the gear box, all 4 pitch link rod ends remained attached to the pitch beam, and two of the four pitch links (yellow and black)remained attached to the pitch beam All four tail rotor blades had separated from the rotor head via spar fractures near the root end.

Items located between the impact crater and the main wreckage include 3 main rotor blade sections each approximately 7 feet long stacked next to each other, a 10 foot section of the Red main rotor blade, the right main landing gear, cabin debris, and the Flight Management System (FMS) unit.

The main wreckage was approximately 95 feet from the impact crater along the 345º true bearing and consisted of the empennage/tailboom, both engines, avionics boxes, and portions of the cockpit instrument panel. The entire fuselage/cabin and both engines were subjected to a post-crash fire. Items identified within the main wreckage included collective segments, antitorque pedals, a circuit breaker panel, altimeter (the drum dial read 1,400 ft (needle detached) , 30.16 inHg), 1 engine to transmission drive shaft segment, and the left main landing gear..

The main rotor head, main rotor shaft, swashplates, and main gear box with bull gear were located approximately 155 feet from the impact crater along the 350º bearing line in a drainage ravine. A disturbed earth indentation approximately the same size as the rotor bull gear was about 25 feet above the rotor head in the ravine slope.

2.2 WRECKAGE LAYOUT AND EXAMINATION

The helicopter wreckage was recovered and transported to a facility for further layout and examination.

2.2.1 Cockpit & Fuselage

The cockpit had experienced extreme fragmentation. The instrument panel was destroyed and most instruments were displaced out of their panel mounts. Flight controls were fragmented and fire damaged. The nose landing gear and blowdown bottle were present. Both pitot tubes were recovered. Portions of both collective sticks, cyclic sticks, and antitorque pedals were present. The lower flight control walking beam assembly had rod ends attached but the control tubes were separated in overload. One broom closet control tube was identified as buckled in 5 places and separated in overload. Portions of both pilot and copilot seats were identified.

The right-side baggage door had separated from the fuselage at the hinges and the latch pin was extended. The two integrated fuel tanks were highly fragmented. Portions of the fuel lines and two fuel level probes were identified. There was no evidence of fire in this section of the airframe. The tail was crushed/collapsed along the longitudinal axis. The tail had separated from the cabin at the cabin-tail transition as a result of the post-crash fire. Both left and right main landing gear as well as the nose gear had separated from the airframe.

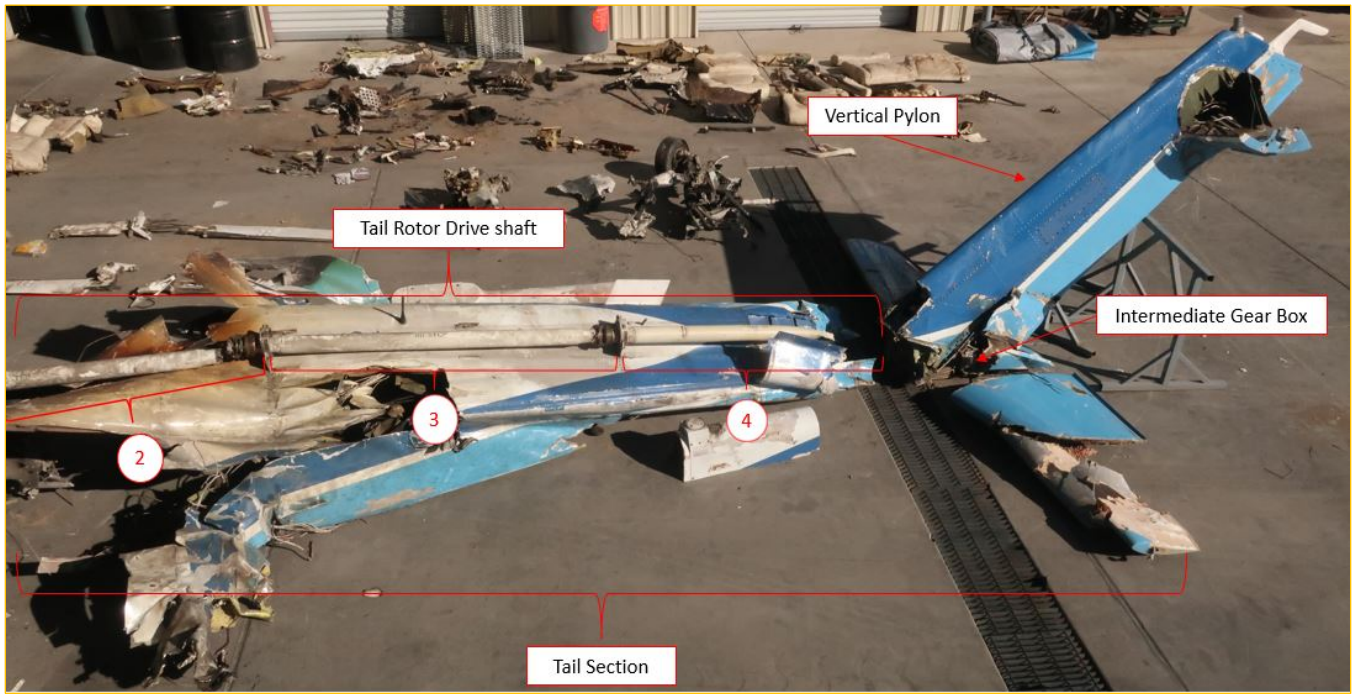

Photo 1- Tail Section with tail rotor drive shaft segments annotated.

2.2.2 Upper Flight Controls

Flight Control System Description[2]

[2] Sikorsky S-76B Flight Manual, Part 2, 1-48

Control movements from the collective pitch lever for vertical control and from the cyclic for longitudinal and lateral control are transmitted by mechanical linkage to a mixing unit which combines the inputs. The combined input is then transmitted to the stationary ring of the swashplate by mechanical linkage, and through the two-stage hydraulic servo system. Movement is transmitted from the stationary ring to the rotating ring of the swashplate to vary the pitch of the main rotor blades. A collective to yaw coupling automatically changes tail rotor blade angle and thrust to compensate for changes in main rotor torque when collective pitch is increased or decreased. The collective control and the cyclic longitudinal and lateral controls have viscous dampers attached at the bottom of the controls closet.

Flight Control Examination

The upper deck mixing unit assembly was fire damaged. Flight control rod ends remained attached to their respective bell cranks. The control rods were damaged by heat, multiple segments (7) of the upper control rods had been flattened, and sections showed overload separations. The pedal damper trim actuator was fire damaged and separated from structure. The collective, pitch, and roll trim actuators were soot covered and the respective control linkages remained connected. Three of the four stability augmentation system (SAS) actuators were attached or partially attached to the control linkages. The upper control walking beam assembly was fragmented. Control tube rod ends remained attached to each walking beam element. All 3 main rotor servos remained attached to the fractured transmission housing. The lateral control servo follow-up arm was fractured at the lower attachment. All main rotor control servos remained attached to the stationary swash plate.

2.2.3 Rotor Drive System

Rotor Drive System Description[3]

The transmission system consists of three gear boxes and associated shafting which transmit engine torque to the gear boxes. Each engine is connected to the main gear box by freewheel units. The main rotor drive shaft, to which the main rotor system is attached, extends upward from the main gear box. A drive shaft extends aft from the main gear box to the intermediate gear box at the base of the tail rotor pylon. Shafting extends up the pylon to the tail rotor gear box which drives the tail rotor. The intermediate and tail gear boxes are splash-lubricated and have no pressure or temperature gages. An accessory drive section at the rear of the main gear box drives the first and second stage hydraulic pumps, two main gear box oil pumps and two oil cooler blowers.

Rotor Drive System Examination

The main gear box (MGB) had been liberated from its airframe mounts. Half the magnesium transmission case had fractured leaving large gaps in the case and revealed the bull gear. The chip detector located on the lower half of the case was missing along with major portions of the lower case. The left spiral bevel gear and spur pinion assembly had separated from the transmission. The right spiral

[3] Sikorsky S-76B Flight Manual, Part 2, 1-28

bevel gear and spur pinion assembly was not recovered. Both engine power input shafts and the two hydraulic pumps were present. The tail rotor drive gear with attached rotor brake disk and drive shaft segment was also present. Examination of the rotor brake disk and calipers showed no evidence of high temperature or overheating.

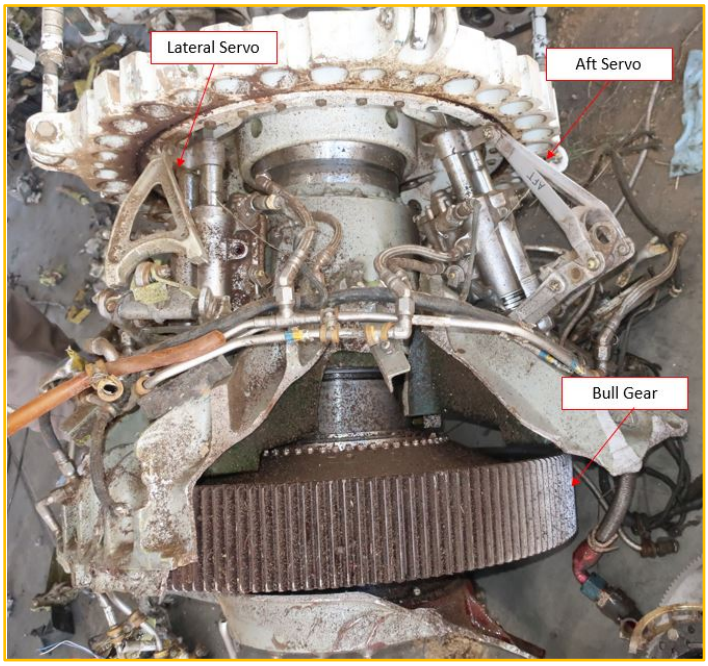

Photo 2 - Main Gear Box

2.2.4 Main Rotor

Main Rotor System Description[4]

The main rotor consists of the main rotor hub bolted to the main rotor drive shaft, four main rotor blades, blade dampers, a swashplate assembly, and a bifilar vibration absorber. The blades are attached to the main rotor hub by elastomeric bearings which permit the blades to flap vertically, hunt horizontally, and rotate about their spanwise axis. At low rotor speeds, anti-flapping restrainers limit the upward movement of the blade and droop stops limit the downward movement. Droop stops release at about 50% to 60% Nr increasing and are back in at about 45% decreasing. Hydraulic dampers minimize hunting movement of the blades and dampen the in-plane response of the blades when the rotor is started or stopped. Flight control inputs are transmitted to the rotating blades through the swashplate. The bifilar vibration absorber, mounted on top of the main rotor hub, absorbs 3-per rev and 5-per rev vibrations that would be transferred to the aircraft.[5]

Main Rotor System Examination

[4] Sikorsky S-76B Flight Manual, Part 2, 1-31
[5] This aircraft did not have the 5-per rev bifilar installed, which is an OEM-approved configuration, frequently used to reduce weight.

The rotor head remained attached to the main rotor shaft and main gear box. All 4 pitch control rods remained attached to the rotating swash plate and to all 4 blade pitch control horns. The Red, Blue, and Yellow blade dampers had fractured from the blade rod end in tension. The Black blade damper remained attached to the Black blade root. All 4 spindles remained attached to the rotor head. The Yellow blade had 86 inches of blade attached. The other three blades had approximately 18 inches of blade attached. The 3-per revolution bifilar vibration absorber remained attached to the top of the rotor head.

Photo 3-Rotor head with blade sections annotated.

Main Rotor Blade Description[6]

The four main rotor blades consist of a titanium spar and a Nomex honeycomb core covered by a fiber glass skin. The leading edge of the blade is protected by titanium and nickel abrasion strips. A swept-back tip improves performance and reduces noise generated at the tip. Grounding of metal fittings and shielding with aluminum mesh provides lightning protection.

Main Rotor Blade Examination

Approximately 95% of the main rotor blades were recovered. All four blades exhibited similar damage consisting of mid span bending, pocket separation, pocket and tip cap compression, blade tip separation, and leading edge indentations & scuffing.

[6] Sikorsky S-76B Flight Manual, Part 2, 1-31

Photo 4-Main rotor blades.

Red	SN: A086-01833
Blue	SN: A086-01831
Yellow	SN: A086-02625
Black	SN: A086-01834

2.2.5 Tail Rotor

Tail Rotor System Description[7]

A cross-beam tail rotor blade system provides anti-torque action and directional control. The blades are of graphite and fiber glass construction. Blade flap and pitch change motion is provided by deflection of the flexible graphite composite spar eliminating all bearings and lubrication. The spar is a continuous member running from the attachment joint of one blade, through the center hub, to the joint of the opposite blade. Like the main rotor blades, the four tail rotor blades have a fiber glass skin that is internally supported by a Nomex honeycomb. Flight control input is transmitted to the blades through control horns that twist the spar. Grounding of metal fillings and shielding with aluminum mesh provides lightning protection.

[7] Sikorsky S-76B Flight Manual, Part 2, 1-32

Tail Rotor System Examination

Four segments of the tail rotor drive shaft remained attached to the tail. The intermediate gear box (IGB) remained in its installed location at the base of the vertical pylon. The IGB magnetic drain plug was examined, no chips or debris were observed. Continuity was present through the IGB. 30 inches of the #1 tail rotor drive shaft remained attached to the transmission tail rotor drive gear and exhibited fire damage. The #2 drive shaft had separated from the rear flex coupling. The #3 drive shaft remained attached at both bearings. The #4 drive shaft had separated in torsional shear just forward of the IGB. The drive shaft from the IGB to the tail rotor gear box remained in place and had rotational scoring on the end nearest the tail rotor gear box (TGB). The TGB had separated from the tail mount and continuity was present through the TGB. The vertical pylon had separated from the tail. The right horizontal stabilizer remained attached to the vertical pylon. The left horizontal stabilizer separated from the pylon at the root. The tail rotor control cable was traced from the upper forward quadrant, through the tail pylon to the aft quadrant (tail rotor servo on the TGB). The tail rotor control cable was severed in several locations. The TGB had separated from the tail pylon at the mounting bolt casting. The magnetic drain plug was examined with no chips or debris observed. The tail rotor control servo remained attached to the TGB. The two yaw trim SAS actuators were attached to the upper and lower control arms and the control servo. The tail rotor drive input flex coupling was attached to the TGB drive input. The Blue, Black, and Yellow tail rotor blade cuffs and pitch horns were recovered, but the Red cuff and pitch horn were not recovered. All four blades had separated from the rotor head. The Yellow pitch link was attached to the pitch change beam and the blade attach rod end was on the link. The Black pitch change link was attached to the pitch change beam and the blade rod end had separated. The Red and Blue pitch links were not present on the pitch beam, but both rod ends were attached. All four tail rotor blades fractured near the retention plates, two blades had blade tip separation and two blades remained relatively intact.

Photo 5-Tail rotor hub pitch beam.

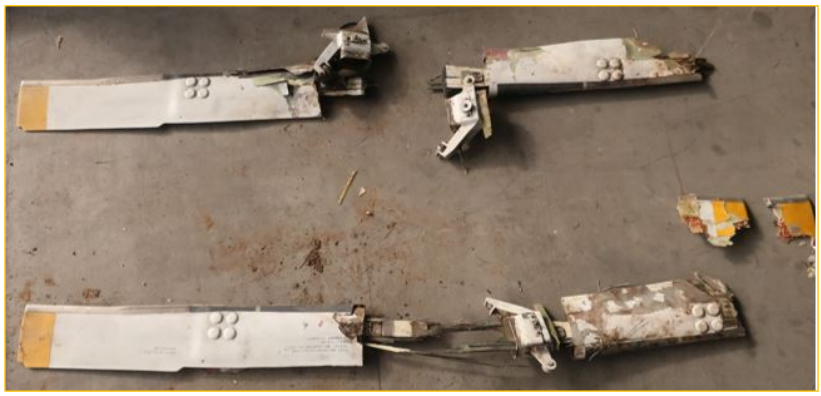

Photo 6-Tail rotor blades.

2.2.6 Component Examinations

The directional gyros were recovered from the wreckage. The spinning masses from the directional gyros were removed and examined during the wreckage exam. The spinning mass for directional gyro #57 (see Attachment 1) was covered with soot and char. The soot and char were removed using a wire

brush and a soft scrubbing pad. A circumferential score mark was identified close to one edge that went approximately 120 degrees around the outer surface of the mass. A second circumferential score mark, adjacent to the first, went approximately 45-degrees around the outer surface of the mass. A small deep gouge was adjacent to and set at approximately a 45-degree angle to the circumferential marks. The gimbal for the spinning mass for directional gyro #65 (see Attachment 1) was broken in several places. The spinning mass for this gyro had circumferential scuff marks 360 degrees around the outer surface of the mass.

The vertical gyros, rate gyros, an attitude indicator, a Flight Director Mode Selector, an Autopilot Controller, a push-button switch, the pilot's side Master Warning Annunciator Panel, and the Caution/Advisory Annunciator Panel were retained for further examination. The FMS Navigation Computer Unit was also retained to attempt a download of relevant data stored in memory. The results of these examinations can be found in other documents in the public docket for this accident.

F. LIST OF ATTACHMENTS

Attachment 1 – Summary list of avionics documentation

Van S. McKenny IV
Aerospace Engineer – Helicopters