



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

AIRFRAME EXAMINATION

WPR16FA029

A. ACCIDENT

Location: Carlsbad, CA
Date: November 18, 2015.
Aircraft: AS350B3e, Registration N711BE, S/N 7934
NTSB IIC: Elliott Simpson

B. EXAMINATION PARTICIPANTS:

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C. SUMMARY

Examination of the helicopter was conducted at the accident site on November 18, 19 2015, with a follow up examination performed at a hangar at KCRQ on November 20. No evidence of preimpact mechanical malfunction was noted during the examination.

D. DETAILS OF THE INVESTIGATION

1.0 Airframe Examination (On-Scene)

The aft end of the tailboom was found about 450 feet away from the main wreckage, and had separated immediately forward of the tail gearbox. The vertical fins remained attached. The lower vertical fin tail guard exhibited evidence of upward deformation and scuffing consistent with a ground strike.

The tail gearbox remained attached to the structure. The tail rotor blades had fractured and separated from the tail rotor hub near the intersection with the teeter bolt, but the tail rotor hub remained attached to the tail gearbox output shaft. The 'red' and 'yellow' tail rotor pitch links remained attached to the tail rotor rotating plate on their inboard end and to their respective tail rotor blade pitch horns, with boss weights still attached. The mount plate for balance weights exhibited surface abrasion consistent with sliding contact with the tarmac.

The aft end of the tail rotor driveshaft remained attached to the tail gearbox input flange via the flexible coupling. The tail rotor driveshaft had fractured forward of the tail gearbox, with the fracture surfaces exhibiting evidence of overstress failure.

The tail rotor control input rod remained connected on its aft end to the tail rotor pitch control bellcrank, but was fractured adjacent to the tail rotor driveshaft aft flange; the fracture exhibited signatures consistent with overstress failure. The remainder of the rod was found as a single piece, exhibited bending deformation, and was found about 60 feet away from the aft end of the tailboom and about 400 feet away from the main wreckage.

Both tail rotor blade tips exhibited deformation in the direction opposite of normal rotation, with "broomstrawing" of the spar, and separation of afterbody core material.

The aluminum tail rotor driveshaft was fractured in two locations and observed in three pieces. The aft-most piece remained attached to the tail gearbox, as discussed in the previously. The middle piece, containing the last hanger bearing (of 5 total hanger bearings on the tail rotor driveshaft), was found loose on the tarmac near the aft end of the tailboom (containing the vertical fins). The forward portion of the tail rotor driveshaft contained 4 of the 5 hanger bearings. The hanger bearing exhibited smooth rotation when manually spun. All fracture features exhibited signatures consistent with overload.

Two main rotor blade frequency adapters (from the 'blue' and 'red' blades) were found away from the main wreckage. The third frequency adapter remained attached to the 'yellow' main rotor sleeve assembly.

The 'yellow' main rotor blade assembly was found separated from the Starflex. The blade was found attached to both of its sleeves, which contained its frequency adapter and elastomeric thrust bearing. Portions of the sleeves exhibited a broomstrawed appearance. The pitch horn remained attached to the lower sleeve. The blade was generally intact except for the damage to its outboard section. The outboard section of the spar exhibited evidence of broomstrawing consistent with impact damage and the blade afterbody was largely missing. Remnant foam pieces consistent with main rotor blade afterbody core material was found throughout the tarmac between the dolly and the location where the helicopter came to rest.

The 'blue' main rotor blade assembly was found separated from the Starflex. The blade was found attached to the remnant sleeves, which exhibited a severe broomstrawed appearance. The blade exhibited a chordwise upward bend adjacent to the blade profile transition near the root end. A

significant portion of blade afterbody (skin and core) was missing across the blade span. The outboard section of the spar exhibited evidence of broomstrawing consistent with impact damage.

The 'red' main rotor blade assembly was found separated from the Starflex. The upper sleeve remained installed but exhibited a broomstrawed appearance. The lower sleeve was found separate from the 'red' blade assembly and exhibited a severe broomstrawed appearance, though remnant pieces remained attached near the blade attachment pins. The pitch horn remained attached to the separated lower sleeve. The leading edge of the blade contained several impact marks. The outboard section of the spar exhibited evidence of broomstrawing consistent with impact damage and the blade afterbody was largely missing.

A fractured section of tailboom containing the horizontal stabilizer was found about 120 feet away from the main wreckage. The left horizontal stabilizer was generally undamaged. Only about 1/3 of the inboard section of the right horizontal stabilizer remained with the tailboom. A fractured section of the right horizontal stabilizer containing the stabilizer tip was found about 100 feet from the main wreckage. The aft end of the tailboom exhibited surface abrasion consistent with sliding contact with the tarmac. Both forward and aft fracture surfaces on the tailboom exhibited signatures consistent with overstress failure. The tail rotor driveshaft cowling remained installed along the length of the tailboom section, but did not contain any driveshaft pieces.

The right landing skid tube with portions of the forward and aft struts were found about 200 feet away, from the main wreckage. The outboard surface of the landing skid tube and struts exhibited surface abrasion consistent with sliding contact with the tarmac. The right landing skid step was found about 275 feet away from the main wreckage and exhibited localized deformation but was found as a single piece.

The main wreckage contained the cockpit and cabin, main fuselage, main transmission, engine, fuel system, the forward portion of the tailboom, and portions of the landing skids. The helicopter was resting on its right side and its nose was oriented about 215 degrees (magnetic).

The main transmission remained installed to the airframe. The transmission suspension bars did not exhibit evidence of fractures. The engine-to-transmission driveshaft remained attached to the transmission input flange. The swashplate guide had fractured near the location the guide attaches to the upper transmission housing. The upper portion of the main rotor shaft, immediately below the Starflex, exhibited evidence of rotational scoring. The rotating scissors attachment point to the main rotor shaft was displaced forward in the direction of normal rotation relative to the rotating scissors attachment point to the rotating swashplate. The 'blue' and 'red' main rotor pitch links remained attached to the rotating swashplate, but were fractured adjacent to where the upper rod end would normally exist. The 'yellow' main rotor pitch link lower spherical bearing remained attached to the rotating swashplate but was fractured at the threaded rod end. All three main rotor servo controls remained attached to the stationary swashplate. The stationary scissors was observed to be intact.

The Starflex exhibited 45-degree fractures on all three Starflex arms. On all three Starflex arm 45-degree fractures, the fractures began at the inboard side of the leading side of the Starflex arm and grew outboard near the lagging side of the Starflex arm. Two of the three fractured Starflex arms were found underneath the main wreckage; the third Starflex arm was found about 100 feet away

from the main wreckage. The cutouts for the elastomeric thrust bearings for the 'red' and 'blue' blades exhibited significant wear into the lagging side of the cutout, consistent with a rotational shift of the elastomeric thrust bearing in the direction opposite of normal rotation. The elastomeric thrust bearing for the 'blue' blade remained installed on the Starflex but was rotationally shifted in the direction opposite of normal rotation. The vibration damper springs remained installed above the Starflex with all three springs. The elastomeric thrust bearings for the 'red' and 'yellow' blades remained installed on their respective sleeves.

Continuity of the flight controls between the main rotor servo controls to the cockpit controls was confirmed via manipulation of the collective stick and observed movement of the stationary swashplate. The helicopter had controls installed for both left and right seats. Manipulation of the cyclic and collective sticks on one side resulted in a corresponding movement on the cyclic and collective sticks on the other side.

Residual fluid with the color and consistency of hydraulic fluid was observed on the tarmac near the transmission and Starflex.

The hydraulic isolation toggle switch on the right seat collective stick was in the "off" (aft) position. The rotor brake lever was forward, consistent with the rotor brake being disengaged. The emergency fuel shutoff lever was partially aft, though cable to the fuel shutoff lever and rotor brake were severed when the upper cabin was cut open by first responders.

The battery master toggle switch was observed to be in the 'off' position. When toggled to the 'on' position, the instrument panel illuminated, but the toggle switch was quickly turned back to the 'off' position.

The engine throttle twist grip on both left and right collective sticks were observed to be at the "flight" setting.

The Hobbs hour-meter indicated 35.2 hours.

The engine free turbine blades were visible through the engine exhaust. The free turbine blades did not exhibit evidence of shedding.

The engine exhaust and aft portion of the tailboom attached to the main fuselage exhibited signatures consistent with a rotating main rotor blade impact in a flapwise, downward direction.

The resin polyamide fuel tank remained installed in the main fuselage and did not exhibit evidence of fracture or leakage.

The forward portion of the left landing skid tube remained attached to the forward strut. The remainder of the left landing skid tube was found near the main wreckage. Both forward and aft crosstubes were rotated forward and upward.

An Appareo Vision 1000 was found installed on the roof of the cabin. The Vision 1000 was serial number VIS-FFR7, part number 153070-000016, amendment B. The Vision 1000 was removed and retained by the NTSB.

Damage to the tarmac about 30 ft east of the dolly was observed, and appeared to indicate 5 tail rotor blade strikes and indents consistent with contact with the attaching hardware adjacent to the tail rotor balance weight mounting plate.

About 5 ground scars consistent with main rotor blade strikes on the tarmac was observed about 50 feet from the tail rotor blade strikes to the tarmac.

Circular scars and smear marks on the tarmac were observed about 40 feet away from the main rotor blade strikes to the tarmac. The circular scars travel for about 375 feet and ended near the resting location of the main wreckage.

The wreckage was subsequently recovered and stored in a hangar on airport grounds for further examination on November 20, 2015.

1.1 Airframe Examination (Post-Recovery)

Measurements from the fractured outboard ends of the main rotor blades to the center of the leading edge stainless steel cuff “V” of the blue, red, and yellow blades were 59, 79, and 64 inches respectively.

The tail rotor driveshaft cover containing the stainless-steel cover (near the engine exhaust) exhibited outward denting and fracture near its forward end. The damage was consistent with impact between its interior surface and aft flange of the stainless-steel tail rotor drive shaft.

The tail rotor driveshaft remained attached to the tail rotor drive output flange (adjacent to the module 5 gearbox). The driveshaft could be manually rotated, and exhibited evidence of slight resistance, but a corresponding rotation of the main rotor shaft and Starflex was observed. The aft portion of the driveshaft tube, adjacent to the link connecting the tail rotor servo to the yaw load compensator, exhibited rotational wear through the paint. The forward portion of the driveshaft tube near the tail rotor drive output flange exhibited rotational wear through the paint.

Movement of the two pedals resulted in corresponding movement of the tail rotor servo. The link attached to the tail rotor servo (at the link forward end) and yaw load compensator lever (at the link aft end) remained attached to the tail rotor servo, but was separated from the yaw load compensator lever. The link’s aft spherical bearing remained installed on the yaw load compensator lever. Structure adjacent to the link and yaw load compensator lever exhibited multiple impact damage signatures, consistent with impact by the aft end of the steel tail rotor driveshaft.

Removal of the engine intake cover and air intake plenum revealed no evidence of foreign object debris.

Removal of the module 5 gearbox from the engine revealed the input pinion index marks were aligned.

All four main transmission suspension bars were intact. An auxiliary fuel tank was installed on the left baggage compartment. Removal of the panels from the right baggage compartment revealed the "X" frame structure adjacent to the fuel tank, which did not exhibit evidence of damage or deformation.

The front left seat did not exhibit evidence of vertical seat stroking.

The front right seat's left side did not exhibit evidence of vertical seat stroking. The right side of the seat exhibited a vertical seat stroke (displacement) of about 1 inch downward.

Rotation of the left and right twist grip throttle controls revealed that they both moved in concert with each other smoothly between the control detents.

Manipulation of the cyclic resulted in corresponding movement of the stationary swashplate Indicating control continuity. The control mixing unit was found in good condition with no evidence of damage or wear.

The main transmission magnetic chip detector was removed and did not reveal evidence of ferrous particles.

The engine electronic chip detector (for the rear bearing) was removed and did not reveal evidence of ferrous particles. The module 1 and module 5 magnetic chip detectors were removed and did not reveal evidence of ferrous particles.

Submitted by: Elliott Simpson