



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

AIRFRAME EXAMINATION

WPR18FA232

This document contains 35 embedded photos.

A. ACCIDENT

Location: Granger, Texas
Date: August 21, 2018
Aircraft: Hughes 369FF, Registration: N530FU
NTSB IIC: Elliott Simpson

B. EXAMINATION PARTICIPANTS:

Elliott Simpson
Senior Aviation Accident Investigator
National Transportation Safety Board

Skip Tackett
Brunner Aerospace

Joan Gregoire (not present at accident site)
Chief Air Safety Investigator
MD Helicopters, Inc

John Hobby (not present at accident site)
Air Safety Investigator
Boeing

Nicholas Shepler (not present at accident site)
Air Safety Investigations
Rolls Royce

C. SUMMARY

Examination of the helicopter was conducted at the accident site and at the facilities of Air Salvage of Dallas, on October 2, 2018. Most of the main cabin was consumed by fire. All main and tail rotor blades and their respective tips were located. Evidence of wire contact was visible to the landing gear struts and one of the main rotor blades. The upper tube of the right upper engine mount was observed detached from its fitting at the 124.0 canted frame, and there was no evidence of its attachment nut, bolt, or fretting damage to the mating surfaces. The helicopter was painted black with silver lettering, however evidence suggests that it was previously painted red, as layers of red paint were observed under the paint of various skin and fairing components. Red transfer marks were observed on a 75-ft-long section of the severed power line wire.

D. DETAILS OF THE INVESTIGATION

1.0 Airframe Examination

1.1 Main Cabin

Most of the fuselage forward of the station 124 bulkhead was destroyed by fire and impact damage. Unburnt cabin components included those ejected during the impact sequence, and located in the unburnt area debris field, close to the initial point of impact. These included a fire extinguisher, fragments of cabin Plexiglas, and the left foot pedals. The red belly-mounted beacon lens was located about 100 ft east of the severed power line, and 800 ft west of the main wreckage (Photo 31).

1.2 Landing Gear

The landing gear struts and skid tubes were fragmented, detached from the airframe, and located distributed along the debris field.

All four landing gear struts remained attached to their respective braces, all of which had detached from the center beam (Photo 1). The forward ends of both skid tubes were impacted with dirt. The red position light remained loosely attached to the forward end of the left skid by the lights wiring; the green position light was separated and displayed indications of thermal damage and was located detached in the burn area of the debris field.

On the right landing gear assembly, the front and rear struts had broken away from the skid tube at their respective feet. The skid tube had separated into two pieces at the intersection with the foot of the forward skid. A serrated gouge, parallel to the helicopters horizontal plane, was observed in the leading edge of the forward upper strut fairing (Photo 2). Horizontal scratches in the paint and outer surface of the strut fairing continued up the fairing, exposing red paint and the resin surface of the strut fairing. Wire-like striations were present along the outboard side of the rear strut fairing (Photo 3).

On the left side landing gear assembly, the front strut had broken away from the skid tube at its feet. The skid tube had separated into two pieces at the intersection with the foot of the forward skid. The rear section of the skid remained attached to the rear strut. The front strut below the step did not have a fairing installed. According to the representative from Brunner Aerospace, the strut fairing had been removed to aid with ground observations during helicopter use. The forward strut's fairing exhibited a vertical dent on the outboard side, just above the step (Photo 4). The rear strut fairing exhibited an 8-inch-long series of striation marks, leading to a tear on its trailing edge near the upper section of the fairing. The width of the tear and its damage features were similar to that of the power line. (Photo 5, 6)

Figures 1, 2, and 3 indicate areas that displayed gouges, cuts, dents, and striation marks.

1.3 Aft Bulkhead

The aft fuselage section, aft of the station 124 canted frame, had sustained extensive thermal damage. The main transmission gearbox housing was consumed by fire, liberating its gears.

The engine was coated in soot deposits but remained largely intact. The left upper engine mount assembly remained attached to the engine and airframe. The lower engine mount assembly was attached to the engine but had fractured at the threaded section near the station 137.5 airframe attach point. The right upper engine mount remained attached to the engine and the lower tube was attached to the airframe at the landing gear damper fitting. The upper tube of the right upper engine mount was observed detached from its mount fitting at the station 124 canted frame. There was no evidence of its attachment nut, bolt, or washers, and there was no indication of damage to the bores of either the tie rod or corresponding bulkhead attachment bracket, or fretting damage to the mating surfaces indicative of long term movement (Photo 7, 8, Figure 4).

1.4 Transmission

The overrunning clutch and engine Kamatics' KA flex® driveshaft remained attached to the engine gearbox output drive (Photo 9). The overrunning clutch could be rotated by hand in one direction and would lock when rotated in the other direction. The flexible coupling at the engine side of the driveshaft was intact. The flexible coupling on the main transmission side had detached, with segments of the flexible coupling frames still remaining on the shaft (Photo 10, 12), and segments of coupling frames detaching from the complete assembly (Photo 11). Neither the overlapping sleeve nor the driveshaft insert exhibited any indications of rotational scoring. (Photo 10, 12).

1.5 Main Rotor Hub Assembly

The static mast remained partially attached by three of its legs to the mast rails bridging stations 78.5 and 124. The fourth leg was consumed by fire. The main rotor driveshaft was intact and remained connected to the main drive ring gear. The static mast did not exhibit any striation marks, and no power wire fragments were observed anywhere in the main rotor assembly.

The collective mixer control rod, longitudinal mixer control rod, lateral mixer control rod, and anti-torque control rod remained attached to their respective idlers and bellcranks. All rods except for the collective appeared to have burnt away about 10 inches below their respective rod end at the approximate entry location to the control tunnel entrance (Photo 13). The collective rod had separated directly below the threaded portion of its rod end.

The stationary swashplate remained connected to the longitudinal link and lateral mixer link. The longitudinal mixer link had separated just below its spherical bearing.

Due to thermal damage, the blade colors for all but the red blade could not be definitively determined, therefore the colors used do not necessarily match the actual blade colors.

The pitch control link rod ends for the yellow and green blades remained attached between the rotating swashplate and their respective pitch control horns. The remaining pitch links had separated, but their rod ends remained connected to their respective pitch links and pitch control horns.

The entire red blade pitch housing had pulled away from the upper hub, revealing remnants of the strap pack assembly (Photo 14). The blade remained attached to the pitch housing, and the lead lag bolt was intact along with the damper (Photo 15). The entire blade was bent 90 ° opposite the direction of travel in a progressive curve (Photo 16). The tip was still attached, and the trailing edges had opened exposing the core. The inboard 30-inch trailing edge section of the blade was coated in soot.

The green blade pitch housing remained attached to the upper hub. The damper was still attached to the pitch housing, and the elastomer had pulled free (Photo 17). The blade remained attached to the pitch housing and had bent back on itself such that the tip was resting next to the root (Photo 18). The tip was still attached, and most of the skins and honeycomb material were consumed by fire, exposing the main spar and leading-edge balance weight.

The yellow blade pitch housing remained attached to the upper hub (Photo 19). The damper was still attached to the housing, and the elastomer remained loosely within. The blade was still attached to the pitch housing and was twisted into a progressive “S” shape along its entire length (Photo 20). The tip was still attached, and fire had consumed about 4ft of the skins from the root outboard.

The blue blade pitch housing remained attached to the upper hub. The damper was still attached to the housing, and the elastomer had pulled free (Photo 21). The blade had detached from the pitch housing and separated into two equally sized sections (Photo 22). The outboard section had sustained thermal damage, and the inboard section, which was found separate from the main wreckage in the debris field, exhibited striations on its underside (Photo 23). The tip was still attached.

The white blade pitch housing had fractured at its base but remained partially attached by the straps (Photo 24). The damper was still attached to the housing, and the elastomer remained loosely within. The blade was still attached to the pitch housing, and the inboard 6 ft section of skins had burnt revealing the main spar and leading-edge balance weight. (Photo 25).

1.6 Tailboom

The aft boom fairing sustained thermal damage just above the engine and remained partially attached to the aft fuselage section (Photo 26). The remaining section of the tailboom sustained less thermal damage, limited to bubbling paint and soot deposits. The aft end of the tailboom had detached about 10 inches forward of the horizontal stabilizer attachment fittings (Photo 27). Both the tail rotor driveshaft and tailboom control rod were continuous within the tailboom, and the aft section of the driveshaft was impacted with mud. The tail rotor gearbox, along with the upper

and lower sections of the vertical stabilizer remained attached to the aft end of the tailboom. The assembly was located about 20 ft beyond and to the east of the main wreckage and did not exhibit any thermal damage. The stinger was still attached to the lower vertical stabilizer and had bent 180 ° upwards and against the left stabilizer surface. The horizontal stabilizer was attached to the vertical stabilizer.

The tail rotor gearbox remained attached to the aft tailboom through its extension tube. The tail rotor control bellcrank at station 284 had fractured from the tail rotor transmission housing. The swashplate bearing could be moved and rotated smoothly. One blade was attached to the tail rotor hub assembly, and its pitch link, which was intact, was connected to the swashplate. The tail rotor blade exhibited a square-shaped 4-inch-wide indentation to its outer surface about midspan (Photo 28). The indentation contained yellow transfer marks, similar in shade to the yellow paint on the main rotor blade tips (Photo 29). The main rotor blade tip weight section was about 4 inches wide (Photo 29). The other tail rotor blade remained partially attached to the hub and had broken away from its pitch link (Photo 30).

The chip plug was removed from the tail rotor gearbox and appeared to be coated in oil; its magnetic surface had not been bridged with debris.

1.7 Power Line

A section of power line from the accident site was examined. Red transfer marks extended about 75 ft along its entire surface, from the area which would have been south of the separation point. The cable exhibited, “necking” deformation at the separation surfaces.

2.0 Examination Photos and Figures



Photo 1 – Strut and Skid Assembly

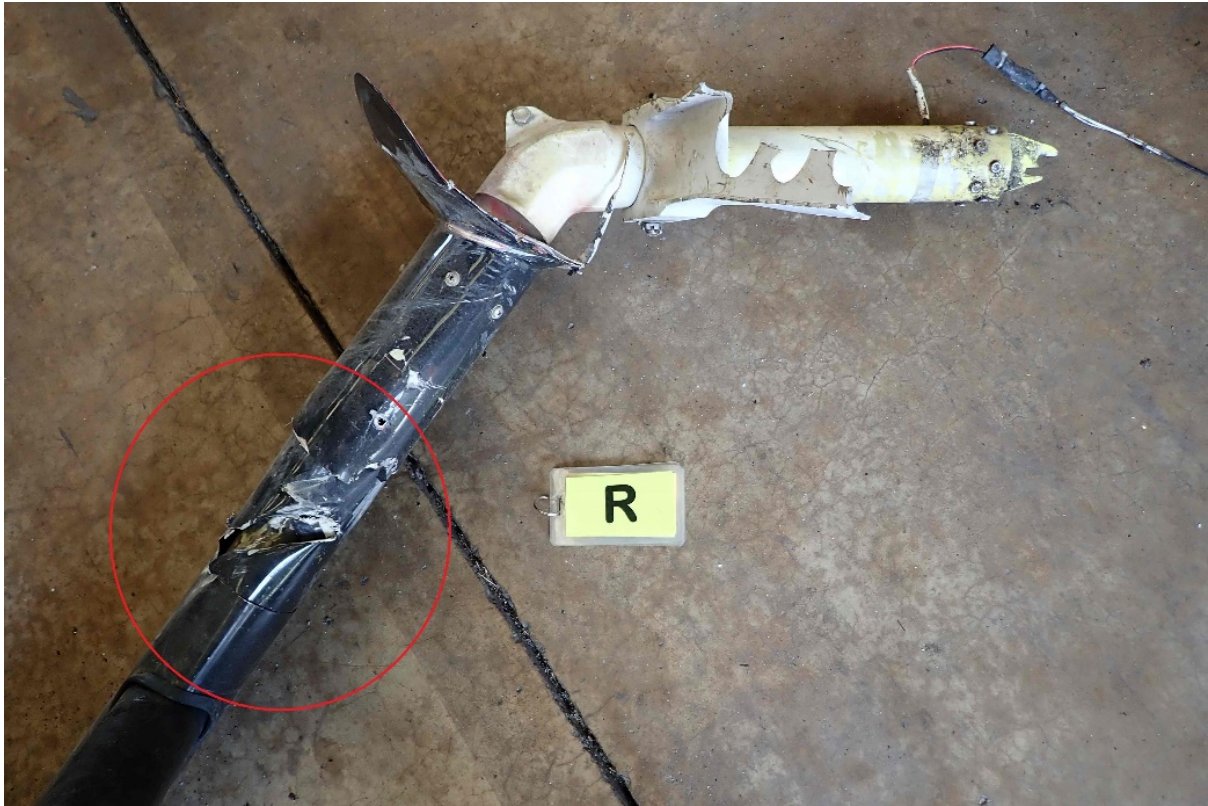


Photo 2 – Forward Right Strut and Fairing



Photo 3 – Outboard Right Rear Strut and Fairing



Photo 4 – Left Forward Strut, Upper Fairing



Photo 5 – Left Rear Strut Fairing



Photo 6 - Left Rear Strut Fairing and Cable



Photo 7 – Upper Tube of Right Upper Engine Mount



Photo 8 - Upper Tube of Right Upper Engine Mount



Photo 9 - Overrunning Clutch and Engine Driveshaft



Photo 10 – Flexible Coupling Engine Side



Photo 11 – Flexible Coupling Fractures



Photo 12 - Flexible Coupling Transmission Side



Photo 13 – Static Mast and Upper Main Rotor Flight Controls



Photo 14 – Main Rotor Hub



Photo 15 – Red Blade Pitch Housing



Photo 16 – Red Blade



Photo 17 – Green Blade Pitch Housing



Photo 18 – Green Blade

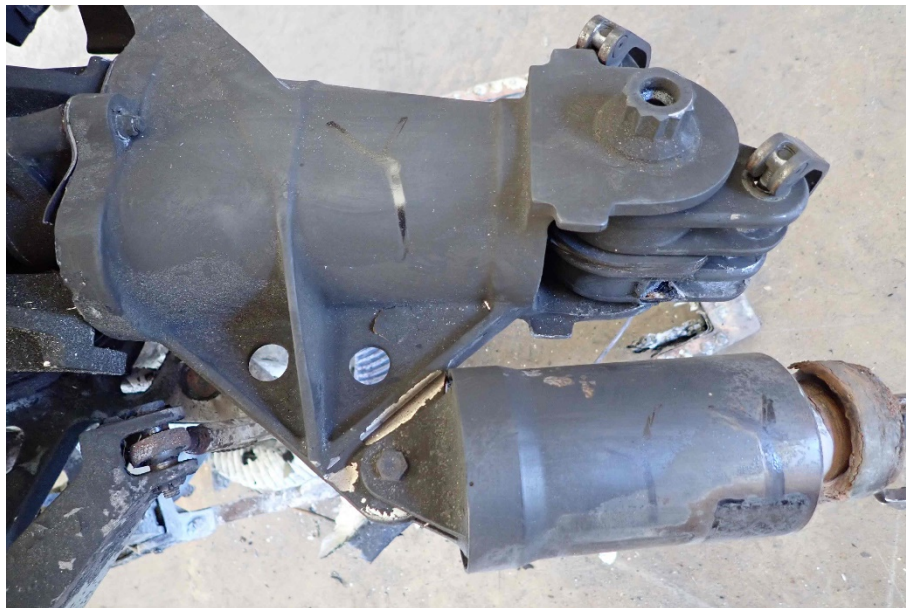


Photo 19 – Yellow Blade Pitch Housing



Photo 20 – Yellow Blade



Photo 21 – Blue Blade Pitch Housing



Photo 22 – Blue Blade



Photo 23 – Blue Blade Damage



Photo 24 – White Blade Pitch Housing



Photo 25 – White Blade



Photo 26 – Tailboom and Main Wreckage



Photo 27 – Tail Section



Photo 28 – Tail Rotor Blade



Photo 29 – Main Rotor Blade Tip



Photo 30 – Tail Rotor Blade



Photo 31 - Red Belly-mounted Beacon Lens

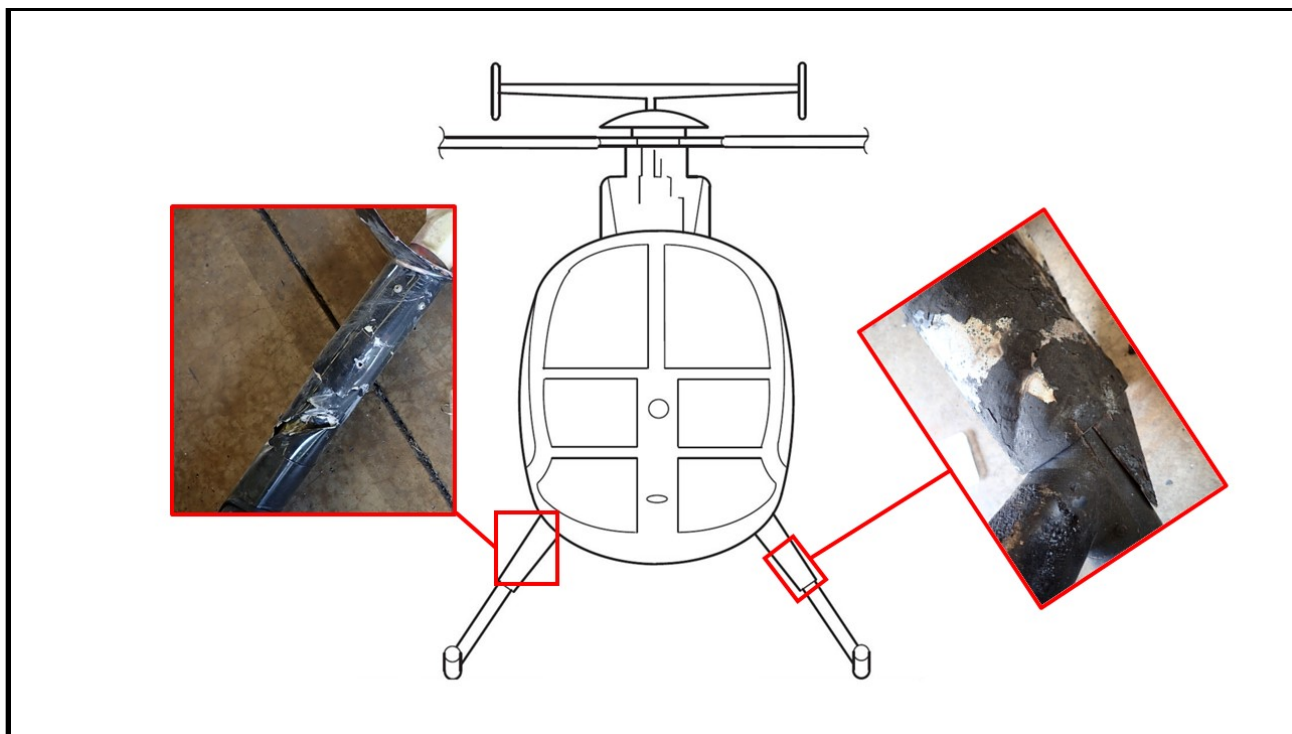


Figure 1 – Damage, Forward (see photos 2, 4)

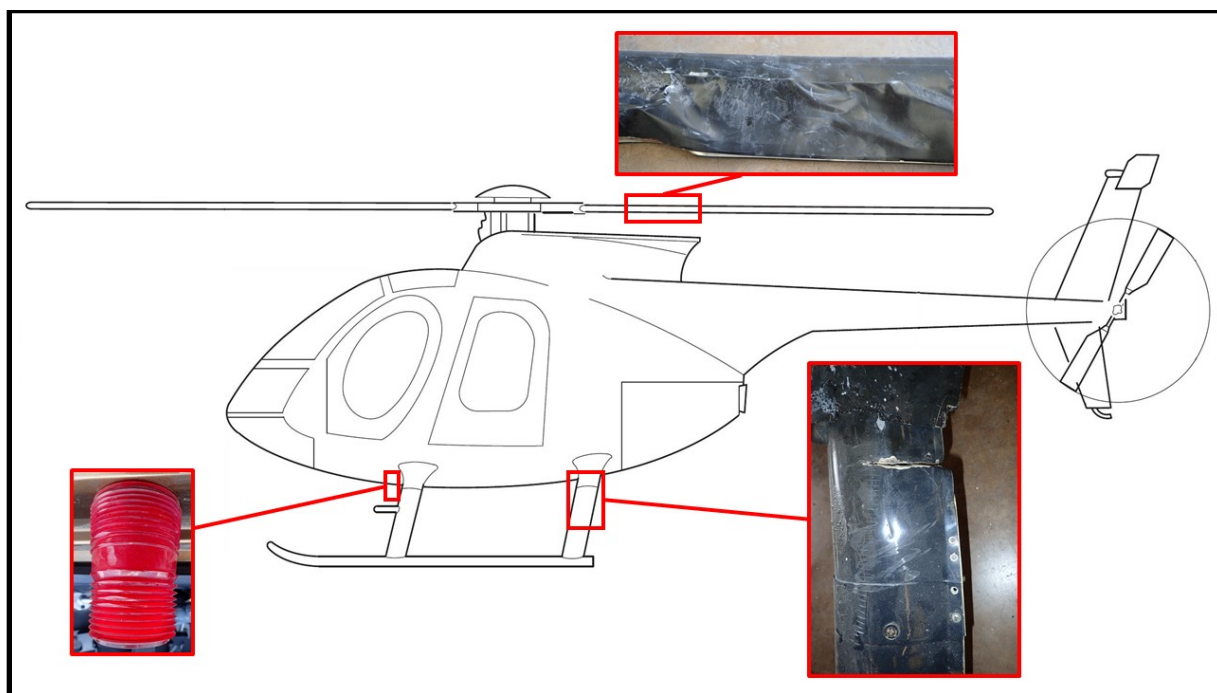


Figure 2 – Damage, Left Side (see photos 5, 23, 31)

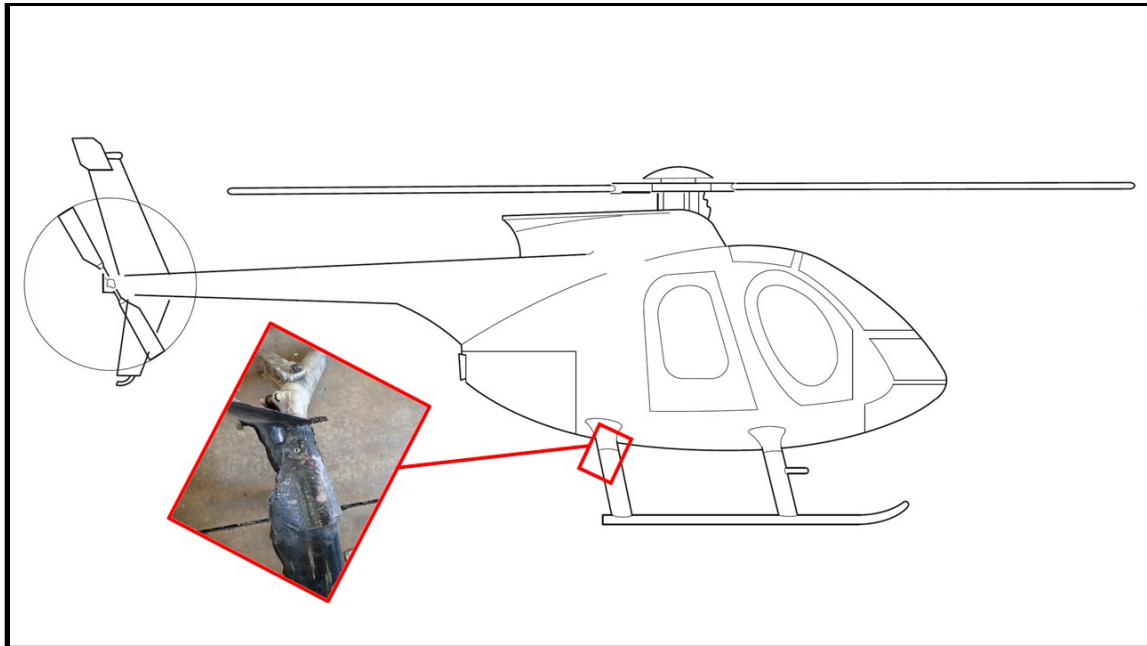


Figure 3 - Damage, Right Side (see photo 3)

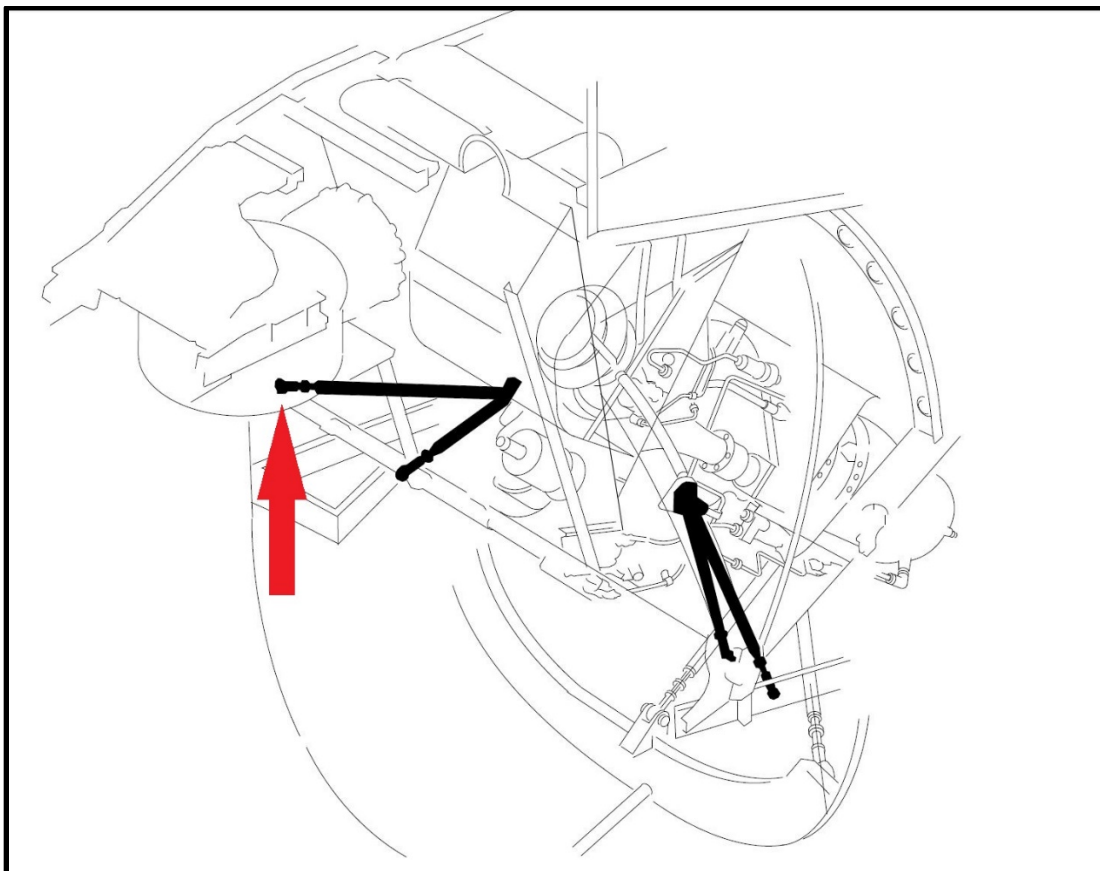


Figure 4 – Engine Mounts (separated mount highlighted, see photos 7,8)