



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

May, 2016

AIRFRAME AND ENGINE EXAMINATION

WPR16FA087

This document contains 71 embedded photos.

A. ACCIDENT

Location: Astoria, Oregon
Date: March 23, 2016
Aircraft: North American AT-6A, N7055D
NTSB IIC: Elliott Simpson

B. EXAMINATION PARTICIPANTS:

Elliott Simpson
Aviation Accident Investigator
National Transportation Safety Board
Los Angeles, California

Dan Merritt
Airframe and Powerplant Mechanic/AI/ATP
Seattle, Washington

Jack Vanover
Aviation Accident Investigator
National Transportation Safety Board
Federal Way, Washington

C. SUMMARY

Examination of the recovered airframe and engine was conducted on May 10 and 11, 2016, and December 8, 2017, at the facilities of Avtech in Auburn, Washington. Elliott Simpson was present for the May 10 & 11, 2016 examination, Dan Merritt was present for the May 10, 2016 examination, and Jack Vanover was present for the aircraft river recovery on March 29, 2016, and a follow up examination on December 8, 2017.

D. DETAILS OF THE INVESTIGATION

1.0 Airframe Examination

Fuselage

The forward fuselage sustained crush damage, compressing and fracturing most of the longerons and webs, and shedding and separating the side skins (Photo 1). Aft of the cabin, the tailcone remained intact sustaining crush damage buckling the forward skins. Aft of the damage, the horizontal stabilizer remained attached (the left horizontal stabilizer was cut off during recovery).

The vertical stabilizer remained partially attached at the root (Photo 2). A can of lubricant was found loose with the tail cone void, sitting against the aft cabin bulkhead (Photo 3, 4).

The sliding canopy sustained extensive damage, such that both the right side of the canopy frames and the right sliding rails had detached along with all the plexiglass and glass windshield. Examination of the remaining left-side components revealed that the rear canopy remnants were in the full-forward position (Photo 5), with the front left side of the rear canopy wrapped around the front side of the overturn pylon (Photo 6). The forward sliding canopy remained attached to the left rail, and was about 2-inches aft of the full-forward position (Photo 5).

An unbuckled-parachute was located in the rear seat area; it had not been deployed (Photo 7, 8). All avionics, along with the "Hobbs" hour meter were fragmented; as such their settings could not be determined.

The rear seat was in the forward position and its back had moved about 30 degrees forward (Photo 9). Its swiveling mount remained attached to the fuselage, and three of its four "spider" mounting legs had fractured (Photo 10). The lock pedal was in the locked position (Photo 10), with its pin in forward detent.

The rear control stick was located separately, and its fitting in the control system did not reveal any indications of damage (Photo 11, 12). The stick was undamaged, and its storage dock on the left side of the fuselage was broken (Photo 13).

The rear lap belt clasp was in the latched and closed position; the belt remained attached to the seat on both sides, but had been cut by Sheriff's divers during recovery of the passenger. The shoulder straps remained attached to the chair frame, and were intact. Both shoulder clasps were free, and the center belt clasp was locked (Photo 14).

The forward seat pan had separated from the airframe. The lap and shoulder belts remained clasped together, consistent with the belt being used at the time of the accident (Photo 15). The right lap belt remained attached to the seat, the left belt had separated, with its bolt still intact, and separated from its respective lug on the seat frame. The shoulder belts remained attached to the center mounting bar, which had separated from the rear of the seat. The rear seat members remained attached to the airframe, and had separated from the seat pan.

The forward control stick remained attached to its swivel joint fitting on the airframe (Photo 16).

Right Wing

The right wing had separated from the wing center section at the wing attach point (Photo 17). The wing sustained concertina-like crush damage from the leading edge through to the aft spar (Photo 18). The flap remained attached at all three hinges and had buckled upwards about 20 degrees midspan (Photo 19). The flap actuation rod remained in place, and attached to all three extension rods, which remained attached to the flap fittings. The universal joint fitting had separated at the wing root, examination of the failure surfaces revealed grey granular features.

The wing attach points were examined for indications of failure of the angle attach brackets described in FAA Airworthiness Directive 2005-12-51. The lower angle bracket had peeled away from the center section, and remained attached to the lower wing skin. All separations were observed traversing through the bolt holes, and the entire area was free of indications of corrosion (Photo 20, 21). At the wing center section, the upper and lower skins appeared to have splayed open, consistent with forward impact. (Photo 22)

Left Wing

The left wing had separated from the wing center section at the wing attach point. The wing sustained extensive fragmentation, with about 50% of all components recovered (Photo 23). The flap fragmented into three sections, with the inboard section folded upwards and attached at the wing root. The flap actuation rod had separated about midspan, and all three extension rods remained attached to their respective flap fittings.

The wing attach points were examined for indications of failure of the angle attach brackets described in FAA Airworthiness Directive 2005-12-51. The lower angle bracket remained intact and attached to the center section and the wing had separated outboard of the bracket (Photo 24). All separations were observed traversing either through the bolt holes, or wing skin, and the entire area was free of indications of corrosion. At the center section, the upper and lower skins appeared to have splayed open, consistent with forward impact (Photo 25).

Center Wing Section

The center section had separated from the airframe. The section exhibited leading edge crush damage, and was folded about 15 degrees upwards midspan (Photo 26). The right main landing gear remained attached to the box frame, and was in the extended position (Photo 27). The left main landing gear remained partially attached and separated during recovery, and was observed in the extended position (Photo 28). The right main landing gear wheel-well exhibited rubber transfer marks at the retracted tire location (Photo 29), consistent with the landing gear being retracted at impact. The landing gear actuation rod exhibited about 4 inches of extension and was bent; the lockout latch was open, consistent with the retracted landing gear position. Examination of recovery photos indicated that the center section was recovered by pulling the airplane out by the landing gear.

The left fuel tank cap was in place at the filler neck, the entire leading edge and underside of the tank was breached (Photo 30). The right tank cap was missing, and the tank exhibited crush marks but was largely intact. The smell of aviation gasoline was present throughout the area of the wing center section.

The center flap appeared to be in the retracted position when recovered (Photo 66) and remained attached at both of its outboard hinges, which were secured with castellated nuts, although no cotter pins were present (Photo 31). Two outboard flap extension pushrods were undamaged, and remained attached to the actuator rod and flap (Photo 67, 68). Both the right inboard and center section hinge bolts and nuts were not located (Photo 32, 33). The left inboard hinge tang on the outboard side had bent about 45 degrees out, and the flap casting had partially detached with dull

granular surface features (Photo 34). The piston rods on both sides of the hydraulic flap actuator were in the extended position (Photo 69), and the flap actuator control arm was angled about 30 degrees relative to the longitudinal axis (Photo 70). When compared to an exemplar AT-6 flap actuating system, these setting appeared consistent with retracted flaps (Photo 71).

Flight Controls

Elevators

The horizontal stabilizer remained attached to the airframe at its forward and aft spar attach fittings (Photo 35). The right elevator remained attached to the horizontal stabilizer at its hinge points. The left elevator remained attached at the inboard hinge, and had folded aft about midspan, separating from its hinge, which exhibited dull granular surfaces features at the separation point. The inboard section of the left elevator sustained a three-inch-deep indentation to its leading edge (Photo 36).

The control horn remained attached to the elevator torque tube, which was still attached to the elevators (Photo 37). Evidence of elevator over-travel was observed to the deck skin in the tailcone, where the elevator horn appeared to have peeled the skins back (Photo 38). The upper elevator control cable was continuous through the aft fitting on the forward control stick. The lower control cable was continuous through to the forward cabin, and had separated about 4 ft from the forward fitting on the forward control stick. The remainder of the cable was intact and attached to the control stick fitting. The cable had separated with "broomstraw" features (Photo 39).

The elevator trim wheel was in the neutral trim position. The trim cables were continuous from the wheel assembly, through the airframe and pulley wheels, to the capstain wheels in the elevators.

The right elevator trim surface remained attached to the airframe and the control rod. The left trim surface had separated and was not located; its control rod had been cut during recovery, and the left outboard hinge remained attached to the elevator.

Ailerons

The rear control stick assembly including the fore-aft torque tube and elevator for-aft pushrod had separated from the airframe at the rear roll bearing (Photo 40). The forward section of the control stick assembly remained attached to the airframe at the forward roll bearing. The roll and elevator tubes remained attached to the rear control stick, but had both separated at the forward stick, bending aft at the separation point. The left aileron control arm had separated aft at the torque tube fitting, and remained attached to both aileron control cable fittings (Photo 41). The right aileron control arm remained attached, but was bent about 5 degrees aft (Photo 41). The aft cable attach tang had separated (Photo 42) from the left side of the control arm, and neither control cable eyebolt fitting was attached, and the bolt was not located. The separation surface exhibited dull granular features.

The aileron pulley assembly, located in the wing center section, remained attached to the center spar, and had been pulled away from the rivets at the center rib (Photo 43). The right control arm eyebolt cable fittings had been partially pulled through the pulley wheels (Photo 43). The separated

left control arm cable was continuous through to the left aileron bellcrank, the other cable had separated about 5 inches from its eyebolt fitting on the arm (Photo 44).

The left wing aileron cables were continuous from the center pulley, through to the outboard bellcrank. The bellcrank remained attached to its stringer and rib fittings, which had separated from the wing. The control rod remained attached to the bellcrank, and had separated from the aileron, which was not located.

The right wing aileron cables had both separated from their eyebolts at the center pulley assembly. Beyond the breaks, the cables were continuous through to the aileron bellcrank. The bellcrank remained attached to its stringer and rib fittings within the wing and the entire assembly remained partially attached to the inside of the crushed wing (Photo 45). The control rod remained attached to the bellcrank, and had separated from the aileron. The only recovered piece of the aileron was the outboard aileron rib, which remained attached to its hinge and the wing training edge spar (Photo 46).

Vertical Stabilizer/Rudder

The vertical stabilizer remained attached at the forward spar to the pylon, however the castellated nut on the forward-aft mounting bolt was finger tight, and about 3 threads short of correct installation, and no cotter pin was present (Photo 47). The aft spar had spilt across its full length, just below the lower rib, with the rudder bending to the left.

The rudder remained attached to the aft spar of the vertical stabilizer at all three hinges. The control cables remained attached to the rudder horns and were continuous through the tail bellcranks and then through to the forward rudder pedal for-aft tube fittings. The forward rudder pedal assembly had broken away from the airframe at its mounting lugs, and the right pedal had separated from the torque tube (Photo 48, 49). The for-aft rudder interconnect tubes had fragmented, and separated from the front pedal attach fitting. The rear rudder pedals had separated from the airframe, and the right pedal had separated from the torque tube (Photo 50). Both brake cables remained attached to the pedals (and were cut by recovery).

The tailwheel appeared to have been converted to the free-castering type, as the steering cables were not present.

A 10-inch crescent wrench (with an opening set to about 9/16 inches), along with a 9/16 wrench were found loose within the tailwheel well area above the tailwheel assembly, and below the horizontal stabilizer main spar attach points (Photo 51). The rudder cables passed through this "box" area, along with the lower elevator horn. Just forward of the box, a 3-inch-long 9/16th bolt was located. (Photo 52, 53).

The rudder trim wheel was in the 5 degrees left of neutral position. The control cable was continuous through to the capstain wheel in the rudder. The trim pushrod had separated at the eyebolt on the capstain wheel with bending damage. The remaining rod was still attached to the tab surface.

2.0 Engine Examination

Engine

The engine separated from the blower/accessory case, which remained attached to the engine mount (Photo 54). The engine mount was twisted and buckled, and had separated from the airframe. The accessory gears were exposed, and although exhibiting deformation damage, all teeth were intact, the area was wet with oil, and there were no indications of catastrophic failure (Photo 54). The carburetor and both magnetos had separated from the engine, and neither was located.

The forward engine gearbox cover had fragmented, exposing the cams and followers. All gear teeth were intact, the area was wet with oil, and there were no indications of catastrophic failure (Photo 55). Cylinders one and nine had separated aft, with each piston resting undamaged within their respective bores in the "pineapple" crank case (Photo 56). The cylinder bolt heads had all separated from the bolts, which exhibited aft bending damage and were still in place in the crankcase. The majority of the forward cooling fins on the aluminum portions of cylinder's one, two, three, four, five, six, and nine had separated (Photo 57). All engine pushrods were separated with the exception of cylinder seven exhaust and induction, along with cylinder four and six exhaust, and eight induction, which all exhibited aft crush damage. All spark plug leads were severed and separated, and all spark plugs sustained varying degrees of bending damage. The rear spark plugs for cylinders three, four, and five along with the front spark plugs for the remaining cylinders were removed. All electrodes were dark in color, and exhibited wear signatures normal operation and short service life when compared to the Champion AV-27 Check-A-Plug chart (Photo 58, 59).

All cylinders were examined with a borescope through the spark plug bores. There were no indications of catastrophic internal failure. The interior surfaces of the exhaust pipe contained tan deposits, and was free of oily residue (Photo 60).

Propeller

Both propeller blades remained attached to the hub. Both balance weights were intact. Blade number one was at about 35 degrees forward pitch (Photo 61). The blade was bent about 40 degrees aft midspan, and exhibited trailing edge wrinkles and tip twist (Photo 62, 63). The second blade was at flat pitch (Photo 64), and bent about 70 degrees aft midspan (photo 65).

3.0 Examination Photos



Photo 1 – Aft Fuselage



Photo 2 - Tail

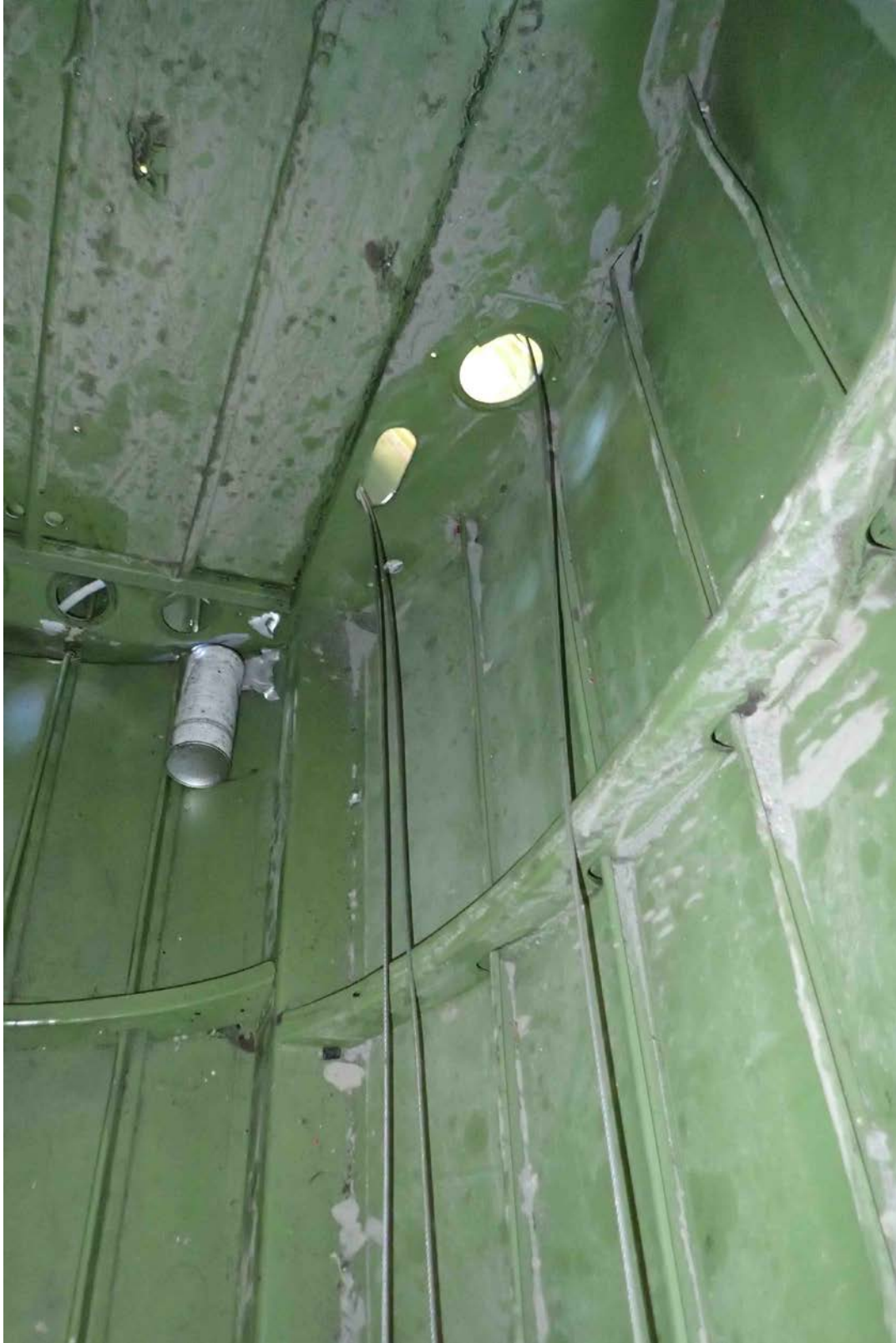


Photo 3 – Oil Can



Photo 4 – Oil Can



Photo 5 – Canopy Remnants on Left Side of Airframe



Photo 6 – Canopy Remnants Wrapped around A-Pillar



Photo 7 – Parachute in Rear Seat



Photo 8 – Rear Seat Parachute



Photo 9 – Rear Seat



Photo 10 – Rear Seat Pedal Lock



Photo 11 – Rear Control Stick Fitting



Photo 12 – Rear Control Stick



Photo 13 – Rear Control Stick Storage Dock

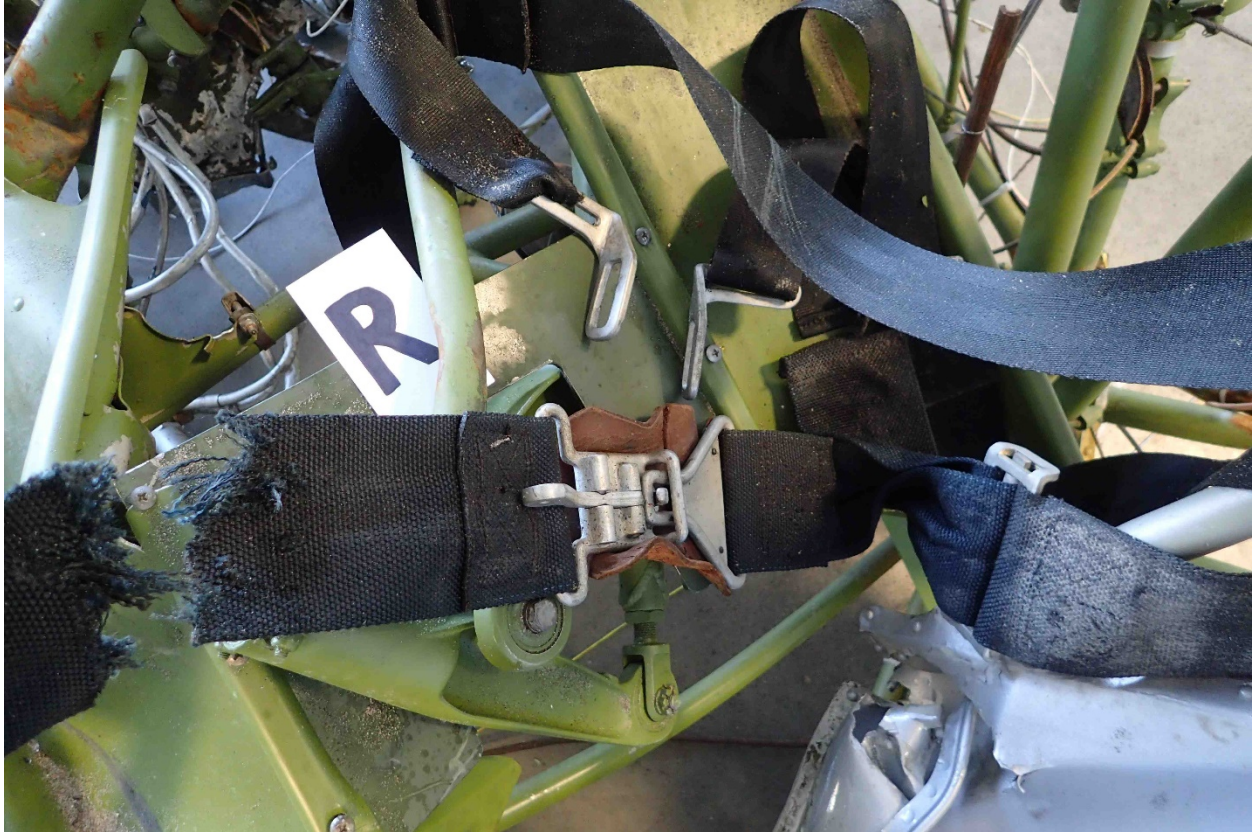


Photo 14 – Rear Seat Belt Clasp



Photo 15 – Front Seat Pan and Belt



Photo 16 – Forward Control Stick Assembly



Photo 17 – Right Wing

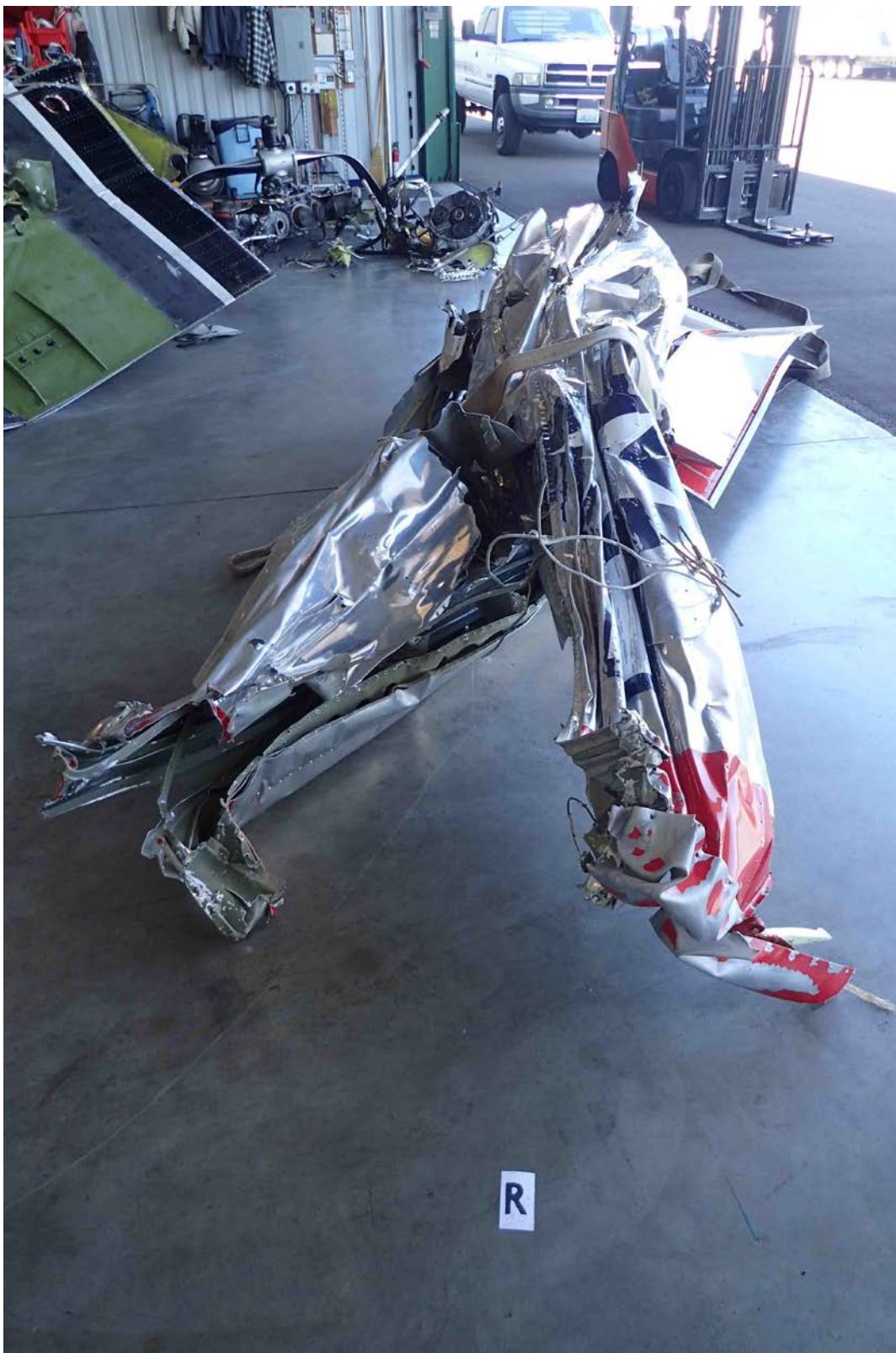


Photo 18 – Right Wing



Photo 19 -Right Wing and Flap



Photo 20 – Lower Wing Angle Bracket



Photo 21 – Lower Wing Angle Bracket



Photo 22 – Wing Root



Photo 23 – Left Wing



Photo 24 – Left Wing Root



Photo 25 – Wing Root



Photo 26 – Wing Center Section



Photo 27 -Right Main Landing Gear



Photo 28 – Left Main Landing Gear



Photo 29 –Transfer Marks in Right Wheel Well



Photo 30 – Left Fuel Tank

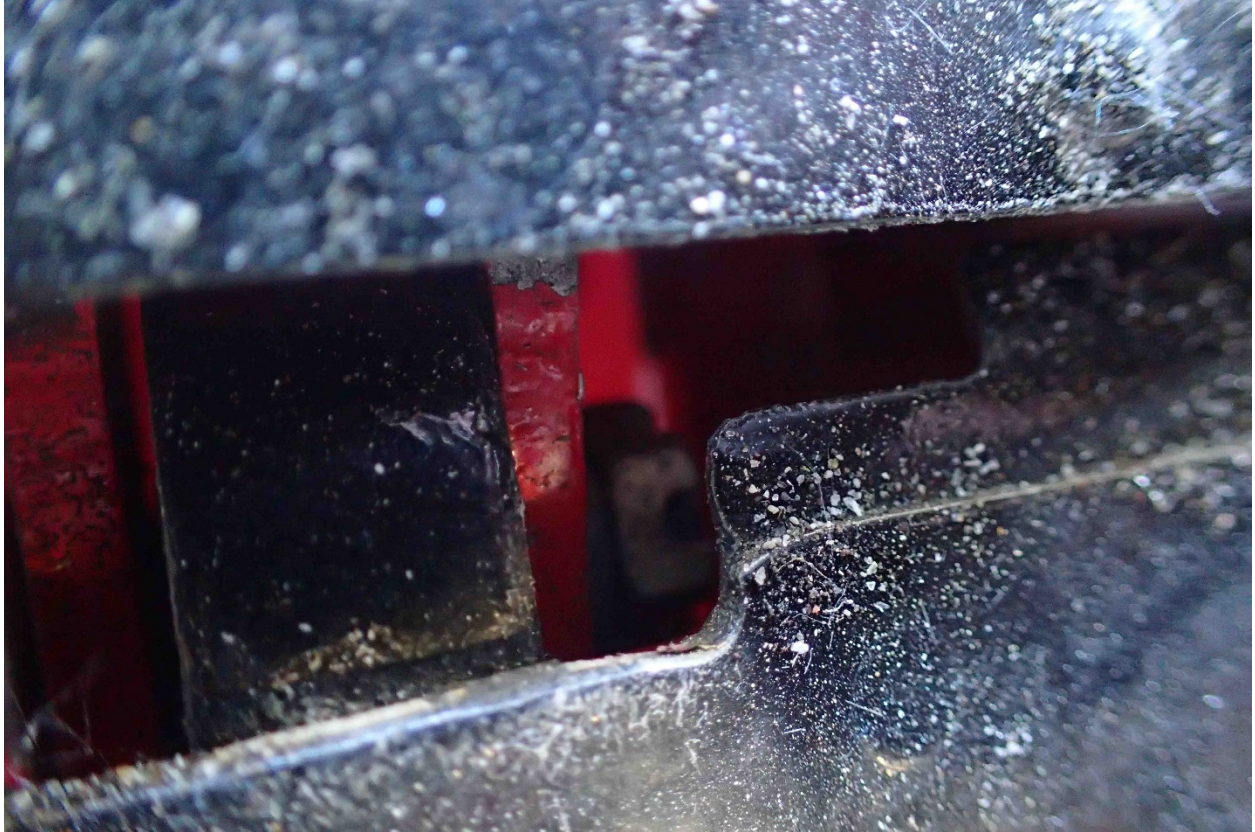


Photo 31 – Flap Hinge Bolt Without Cotter Pin



Photo 32 – Center Flap Hinge



Photo 33 – Right Inboard Flap Hinge



Photo 34 – Left Inboard Flap Hinge



Photo 35 – Horizontal Stabilizer Root Fittings



Photo 36 – Left Horizontal Stabilizer Leading Edge

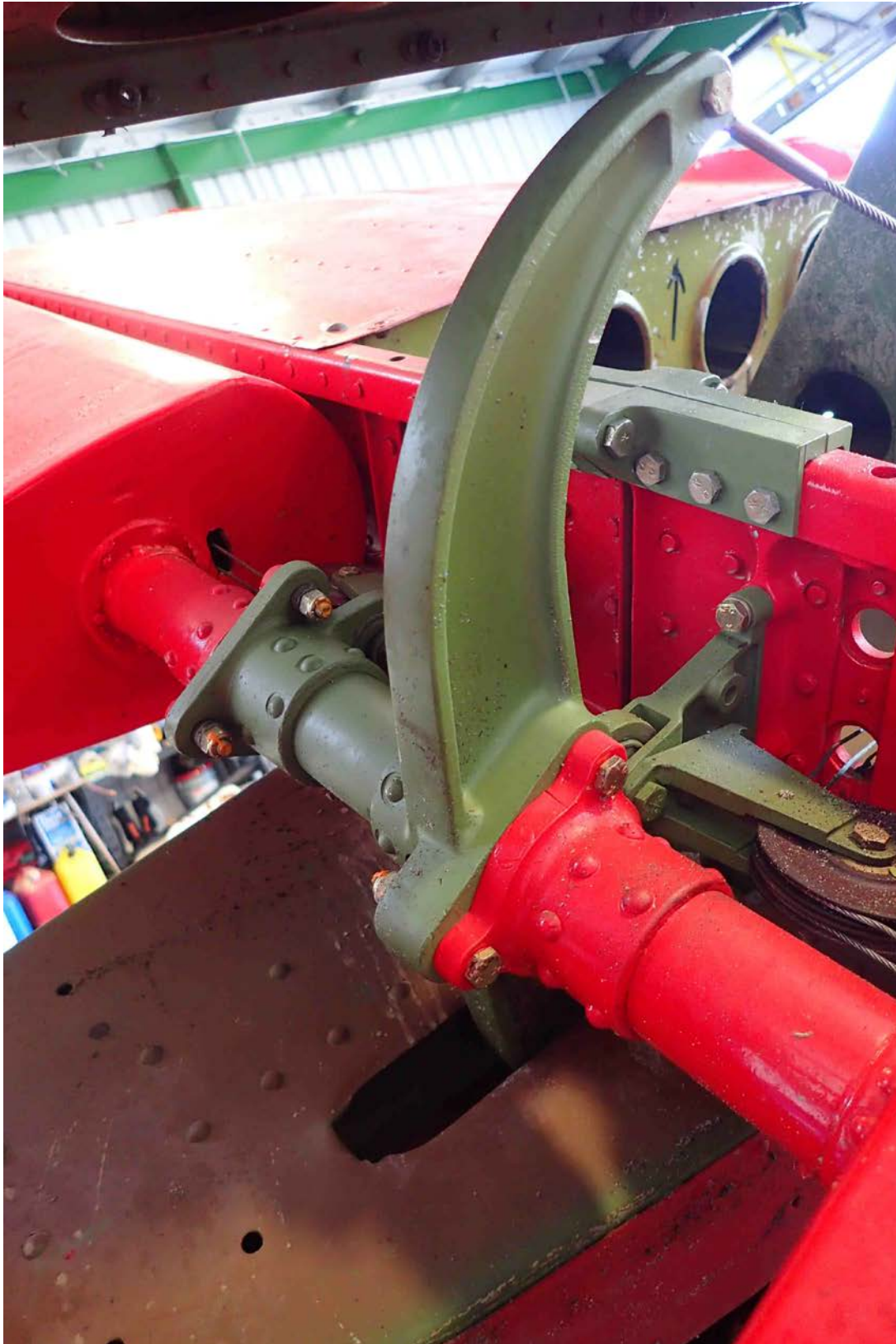


Photo 37 – Elevator Control Horn



Photo 38 – Horizontal Stabilizer Deck



Photo 39 – Lower Elevator Control Cable



Photo 40 – Rear Control Stick Assembly



Photo 41 – Aileron Control Arm



Photo 42 – Aileron Cable Attach Tank



Photo 43 – Aileron Pulley



Photo 44 – Left Aileron Control Arm Cable



Photo 45 – Right Wing Aileron Bellcrank



Photo 46 – Right Aileron Remnants



Photo 47 – Vertical Stabilizer Mounting Bolt



Photo 48 – Forward Rudder Pedal Assembly



Photo 49 - Forward Rudder Pedal Assembly



Photo 50 – Rear Rudder Pedal Assembly



Photo 51 – Tools Found Within Tailwheel Well



Photo 52 – Tools and Bolt Found in Tailwheel Well



Photo 53 – Location of Tools Found in Tailwheel Well

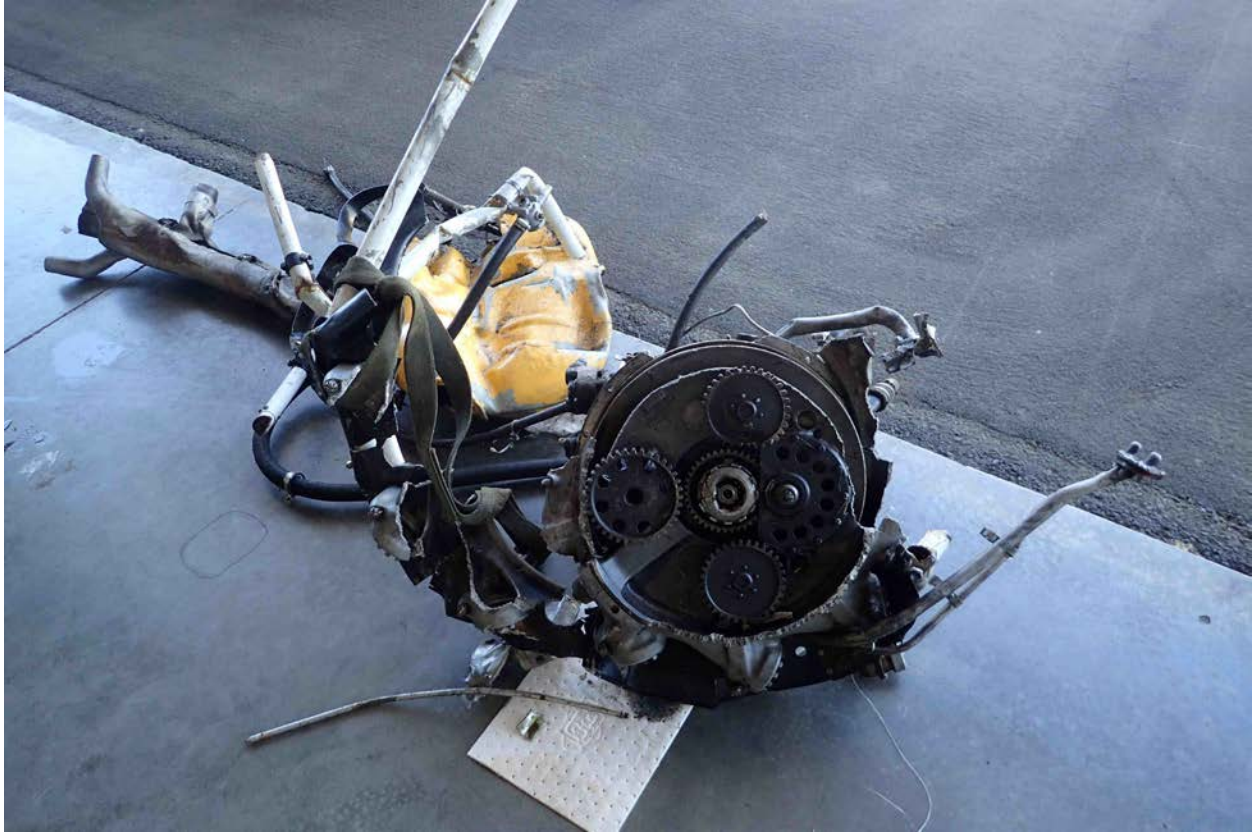


Photo 54 – Engine Accessory Case



Photo 55 – Forward Engine Gearbox

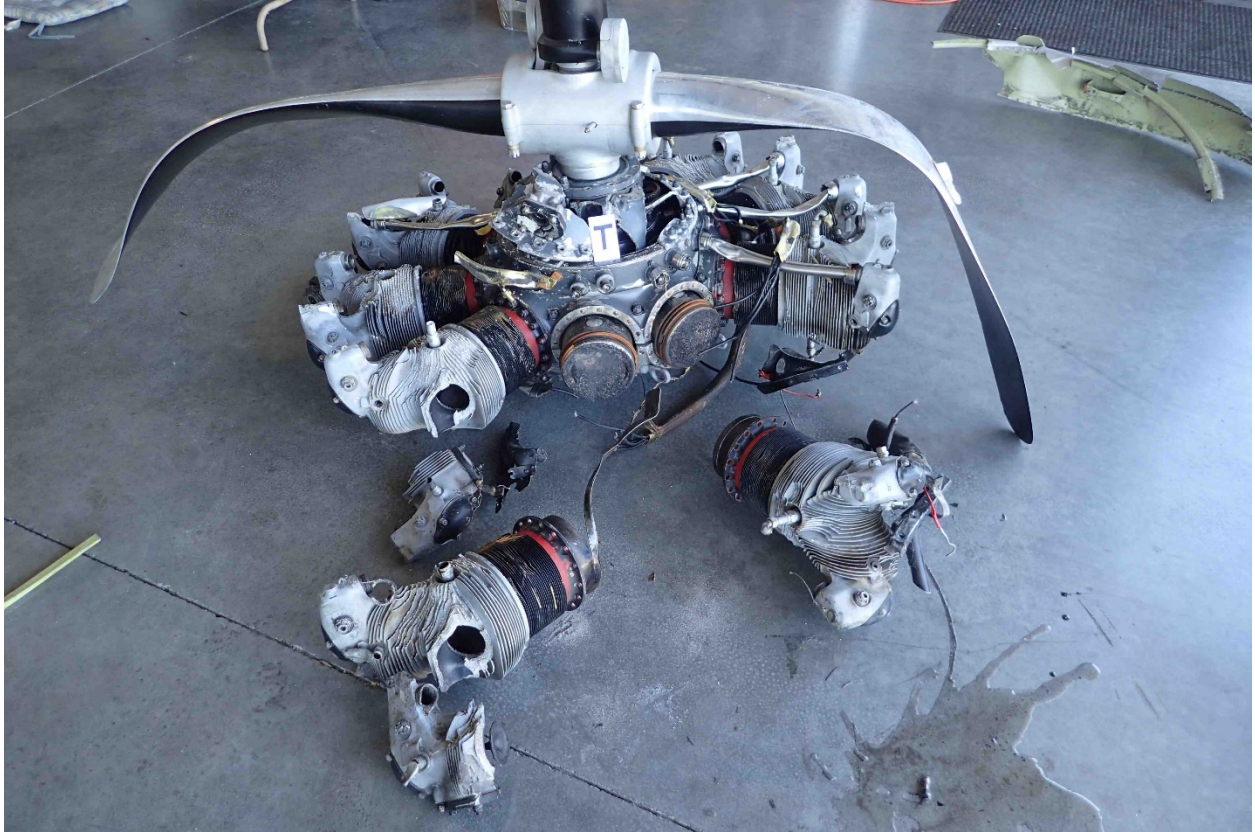


Photo 56 – Engine and Propeller



Photo 57 – Forward Fin Damage to Cylinder Head



Photo 58 – Spark Plugs



Photo 59 – Front Spark Plug for Cylinder # 6



Photo 60 – Exhaust Pipe



Photo 61 – Propeller Blade One Root



Photo 62 - Propeller Blade One



Photo 63 - Propeller Blade One



Photo 64 - Propeller Blade Two Root

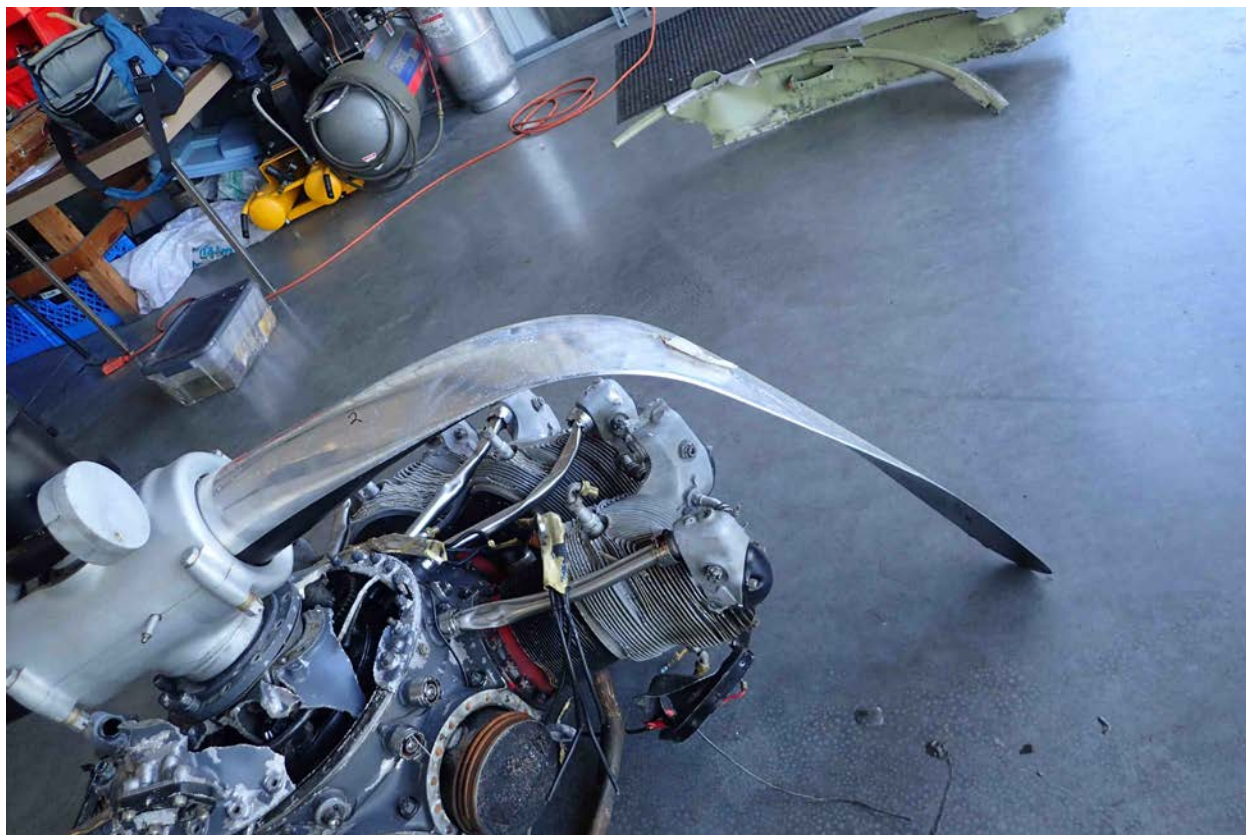


Photo 65 - Propeller Blade Two



Photo 66 – Center Flap Section



Photo 67 – Flap Extension Pushrod



Photo 68 - Flap Extension Pushrod

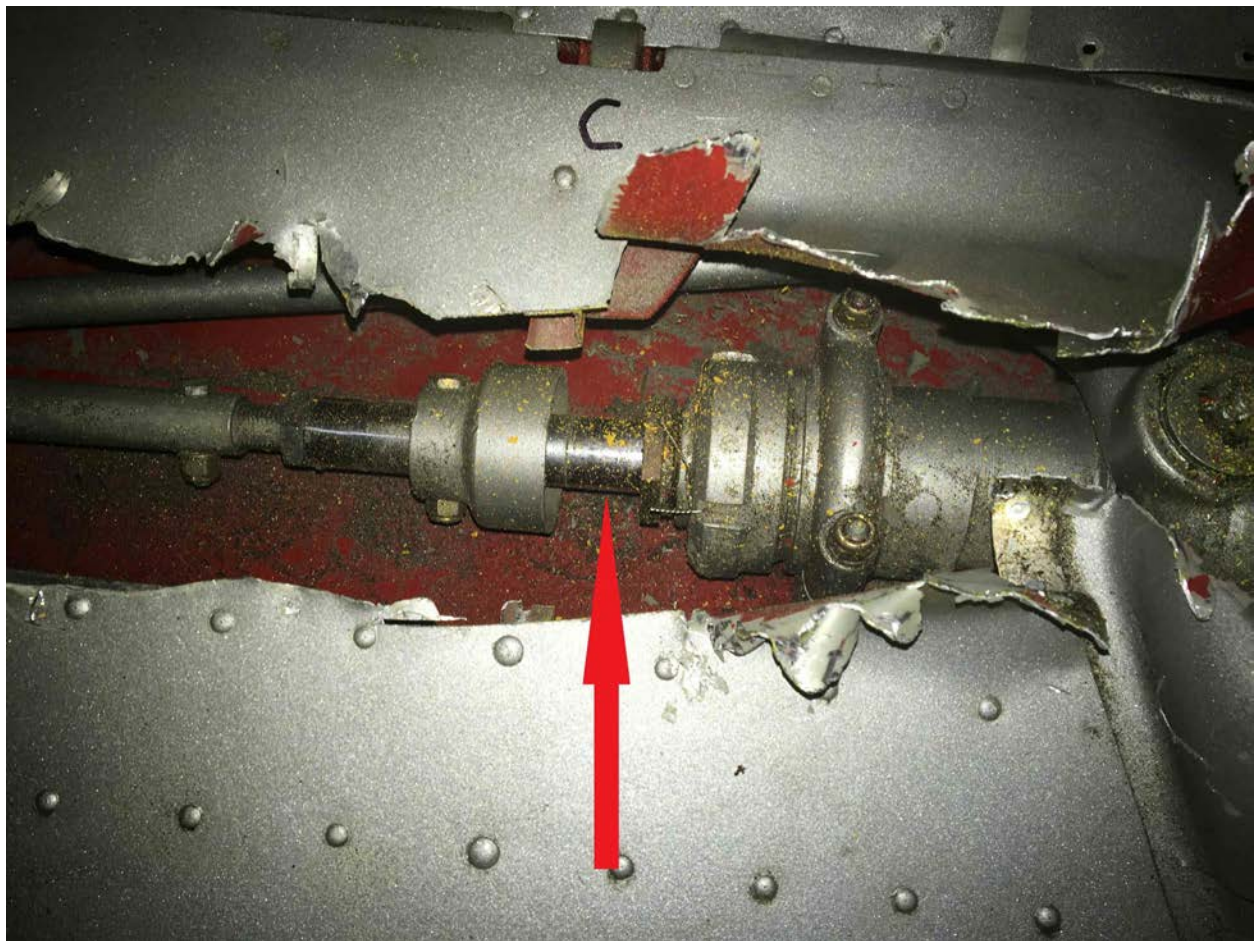


Photo 69 - Flap Actuator Piston Rod



Photo 70 - Flap Actuator Control Arm

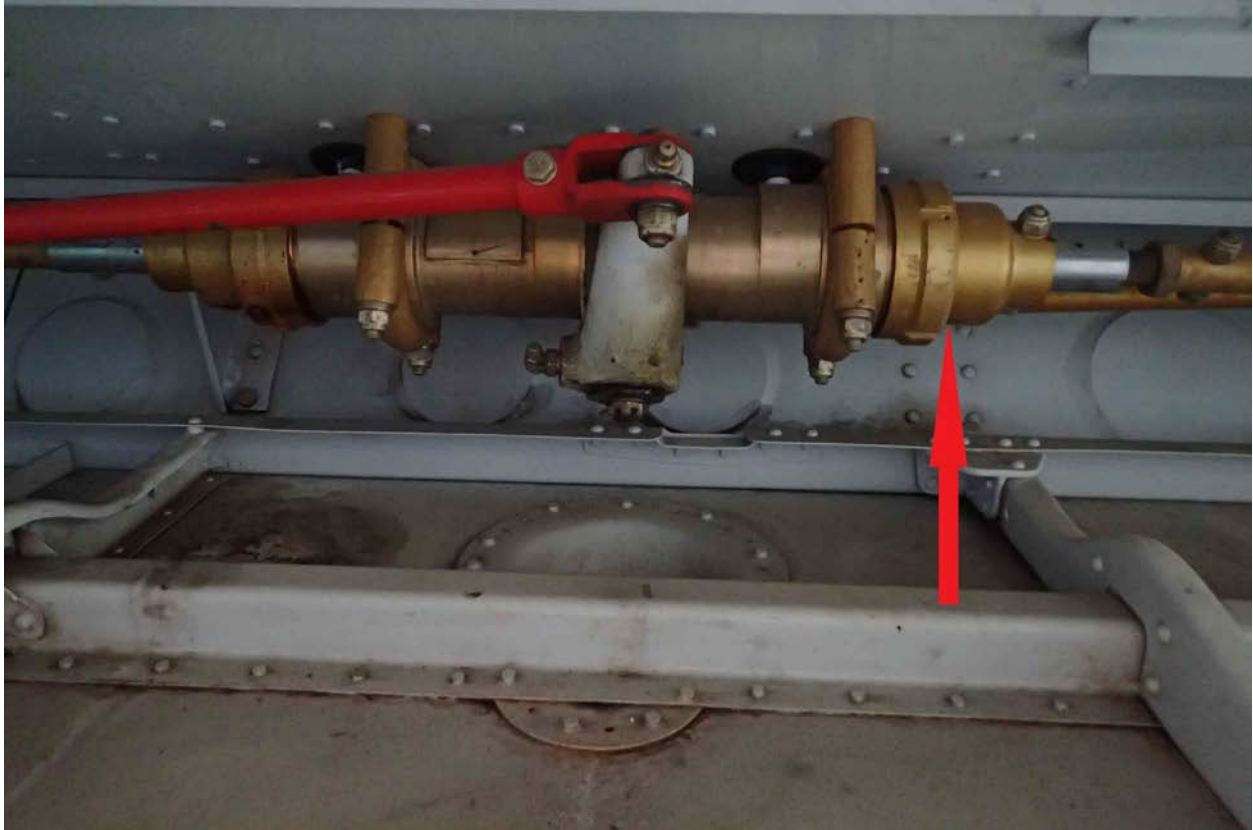


Photo 71 – Exemplar Flap Actuator in Extended Flap Position

Submitted by: Elliott Simpson