



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

AIRFRAME AND ENGINE EXAMINATION

WPR22FA169

A. ACCIDENT

Location: Kalispell, Montana
Date: April 30, 2022
Aircraft: Bearhawk LSA, N1908A
NTSB IIC: Elliott Simpson

B. EXAMINATION PARTICIPANTS:

Elliott Simpson
Senior Aviation Accident Investigator
National Transportation Safety Board

Clint Crookshanks (June 15 exam only)
Aerospace Engineer (Structures)
National Transportation Safety Board

C. SUMMARY

Examination of the airplane was conducted at the accident site on May 1, 2022, and then at a remote hangar on May 2, 2022, and June 15, 2022.

The right wing had separated and was located about 950 ft southeast of the main wreckage. Evidence suggests that it initially failed downward, buckling the strut downwards. The wing then made contact with the right main landing gear and entry step. Damage to the spar endcaps and their respective steel fuselage attach fittings indicated that the wing ultimately departed the airframe in an upward direction.

The tube diameters of the steel airframe members met the diameters specified in the plans; however, most tubes were about 30% thicker. The steel tube members appeared to have been welded using the metal inert gas (MIG) arc welding technique contrary to both the kit manufacturer's recommendations and FAA requirements for certified aircraft. According to friends of the pilot, he had elected to use thicker gauge tube because he was using a MIG welder and was aware of the increased weight penalty using the thicker tube would incur.

The weld quality was generally poor with multiple areas of incomplete fusion, porosity, and burn-through. The left fore-aft lower wing box longeron exhibited an incomplete weld to the left aft vertical support with no penetration. However, the remaining airframe welds in all other locations appeared intact, with the separation failures appearing to have occurred in overload, just beyond the welds.

The construction plans call for diagonal bracing of the forward wing spar carry through area. Review of the build logs and airframe remnants revealed that this bracing had been omitted. There was nothing in the build logs that indicated this omission was intentional.

D. DETAILS OF THE INVESTIGATION

1.0 Airframe Examination

Cabin

The airframe sustained extensive crush damage and fragmentation through to the leading edge of the vertical stabilizer (figure 1). The engine remained partially attached to its mount and had been compressed aft such that fragmented remnants of the firewall had formed around the rear of the engine.

The steel members of the cabin were deformed and fragmented. Crushed remnants of the forward seat remained attached to the right attach fittings. The airplane appeared to be equipped with lap belts only; the front belt was still latched and remained attached to its anchor fittings at the seat base (figure 2). (The belt was cut by first responders). The rear seat had detached from the airframe, with its six mounting bolts still intact (figure 3). The rear seatbelt was found unlatched (Figure 4), with each end still attached to the airframe structure. The pull up tab of the buckle exhibited downward deformation (figure 5); the latch mechanism still worked when tested.

The left and right main landing gear legs remained connected to their respective gas struts, which remained attached to each wheel and the airframe center section. The upper landing gear attach points remained partially attached to the deformed remnants of the airframe.

The instrument panel sustained crush damage, fragmenting the flight instruments, engine monitor, and avionics systems. No Hobbs or similar time recording meter was located intact.

Review of the plans for the forward spar carry through assembly indicated that there should have been four diagonal braces between the main carry through tube and the forward carry through tube. Examination of the build logs and airframe revealed that they had not been installed (figure 6).

The forward spar wing carry through tube, was 1 inch in diameter, with a material thickness of 0.060 inches, which met the plan specifications. The tube had separated at both ends from the main spar attach fitting cluster just inboard of both welds. The carry through tube exhibited a slight rearward buckle along its length (figure 7).

The forward carry through tube was 0.75 inch in diameter, which met the plan specifications, but was 0.05 inches thick rather than the 0.028 inch thickness called for in the plans. The tube exhibited a pronounced aft buckle with similar separations inboard of both weld clusters (figure 7).

The right wing root box assembly was mostly intact (figure 8). The forward spar attach point aft tang was straight, the forward tang had bent forward, but the bolt remained installed. The rear spar attach point assembly was intact, and the spar bolt was in place (figure 8).

On the left side of the wing root box assembly, the forward portion had partially detached, and had broken away from the wing root box assembly (figure 9- note bolt removed for clarity) at upper main spar cluster. The aft spar attach fitting remained attached to the assembly.

The left fore-aft lower wing box longeron exhibited a detached weld, at the interface with the left aft vertical support (figure 10). Examination of the weld indicated that there was almost no penetration into the vertical and horizontal members. Weld defects included porous weld fillets, and multiple remnants of welding wire.

Tail Section

The tail section remained largely intact (figure 11). The vertical stabilizer remained attached at its base, and the rudder was still attached to its hinges, and moved freely. The rudder control cables were continuous from the control surface horn through to the foot pedals.

The elevators remained attached to the horizontal stabilizer at their hinges and could be moved freely. The elevator push-pull tube remained attached to the right elevator bellcrank and was broken away from the left elevator bellcrank (figure 12). The push-pull tube was continuous to the intermediate bellcrank, which had detached from the lower airframe (figure 13). Forward of the bellcrank, the remaining section of the push-pull tube had separated and was located in the primary debris field. The other end of the tube had broken away from the aft control stick within the control column assembly (figure 14). All separated sections of the push-pull tube exhibited bending damage with granular surface features at the partings consistent with overload failure.

For the left horizontal stabilizer, the upper brace and the lower forward braces remained attached. The lower rear brace separated at the outboard fitting, with granular surface features at the break.

For the right horizontal stabilizer, the upper brace separated at outboard fitting, with similar granular surface feature at the separation point. Both lower braces remained attached, but the lower forward brace exhibited a 10 ° bend/buckle midspan. Outboard of the lower brace point, the right horizontal stabilizer and elevator had bent down about 20° (figure 11). This damage appeared to be consistent with ground impact (15).

Pitch trim cable continuity was traced through to the control arm in the cabin. The control arm could be moved, and slight friction was felt, which appeared to be consistent with a friction lock system (figure 16). The trim tab actuator torque tube remained connected to each side, but the right trim tab push-pull tube had broken away at the fitting on the tab, with granular surface features noted at the separation surface.

Left Wing

The left wing remained partially attached to the airframe remnants by its forward spar end cap (figure 17). The rear end cap had pulled away from the airframe fitting (figure 18) but the fitting bolt remained in place (figure 19). The entire wing sustained rearward crush damage to the aft spar, with the aileron remaining attached (figure 20). The aileron control cable was continuous from the outboard bellcrank (figure 21) assembly through the strut and remained attached to the lower forward control stick

assembly. The return cable was continuous from the outboard bellcrank through to the inboard section of the right wing, where it had disconnected with broom straw damage (figure 22).

The strut remained attached to both the wing and the left main landing gear mount point.

The left wing contained a uAvionix skyBeacon ADS-B out system.

Right Wing

The right wing had detached at both the forward and aft end caps (figure 23). The attach holes for the caps exhibited inboard and up “pull through”. Both caps were bent aft with their tips damaged consistent with ground/tarmac damage. The root rib sustained spanwise crush damage consistent with ground contact.

The strut had fractured near midspan. The upper section remained connected to the wing attach point (figure 24), and the lower section had detached from the lower fitting on the landing gear assembly. Concave buckling damage was noted on the upper (wing side) of the strut (figure 25), and on the outer side (lower section), material appeared to have torn out, and bent back against the strut structure (figure 26).

The strut bolt remained in place on the lower fuselage fitting along with the tip of one of the lower strut brackets (figure 27, 28). The clevises at the lower section of the strut exhibited downward deformation and failure. There was a one-inch-wide square shaped impact impression and bend centered about 9.5 inches above the lower attached point in the lower section of the strut (figure 24). The bend matched the dimensions and locations of the right landing gear step strut, when the strut was oriented down (figure 29, 30).

Similarly, a puncture to the underside wing skin surface, inboard of the strut mount, appeared to match the dimensions of the step, and exhibited scrape signatures to its surface that matched the anti-slip coating on the step (figure 24). A 20-inch-wide impact impression in the lower leading of the wing was present adjacent to the strut attach point, the dent matched the approximate diameter of the main landing gear tire (figure 24). There were also black transfer marks consistent with tire contact, and yellow paint transfer matching the tire hub cap (figure 31, 32).

The wing was mostly straight along the lifting plane, but exhibited a forward bend at the tire indentation, with crumpling of the wing skin surfaces in the area (figure 33, 34). Examination of the main spar aft of the impact impression revealed that the spar caps had deformed into compete S-bends with some fracturing in the spanwise direction, reducing the wingspan by about 7 inches. The wing fuel tank was almost full at the time of the accident, and this spanwise crushing appeared to be consistent with ground impact.

The bolts for both the right forward and aft spar end cap were still in place at their respective fuselage fittings (figure 8). Close examination revealed two notches (figure 35) in the upper surface of the aft fitting, that matched the dimensions of a notch in the layup of the aft end cap tang (figure 36). Similarly, the forward fitting exhibited two scrape marks to its upper surface (figure 37), that matched the layup of the forward end cap tang.

The right aileron remained attached, and the control cable was continuous to the cable separations at the strut and wing root, with broom straw signatures observed at the separation points.

The right wing contained a standalone uAvionix skyBeacon ADS-B in system. The assembly had broken away from the wingtip.

2.0 Engine Examination

The engine sustained significant impact damage, partially detaching the starter motor and alternator assembly, along with the ignition wires and all ancillary cables, and fuel lines (figure 38). The induction system was crushed, and the carburetor had detached but appeared largely undamaged. There was no evidence of catastrophic engine failure such as a crankcase breach, and all six cylinders remained attached to the crankcase. The gascolator had broken open, exposing the screen which was free of debris.

The engine was fitted with a composite two-blade propeller. Both blades had separated at their root and were found in the impact crater next to the forward section of the engine and the propeller hub.

Spark plugs from cylinders 2, 4, and 6 were removed. The electrodes were intact, undamaged, and exhibited dark brown coloration and deposits. The rocker cover from cylinder number 4 was removed; the rocker assemblies were intact and lightly covered in clear/brown colored oil. There was no evidence of catastrophic engine failure.

3.0 Examination Figures



Figure 1 – Airplane at the accident site



Figure 2 – Front seat and belt



Figure 3 – Rear seat



Figure 4 – Rear seat belt



Figure 5 – Rear belt buckle

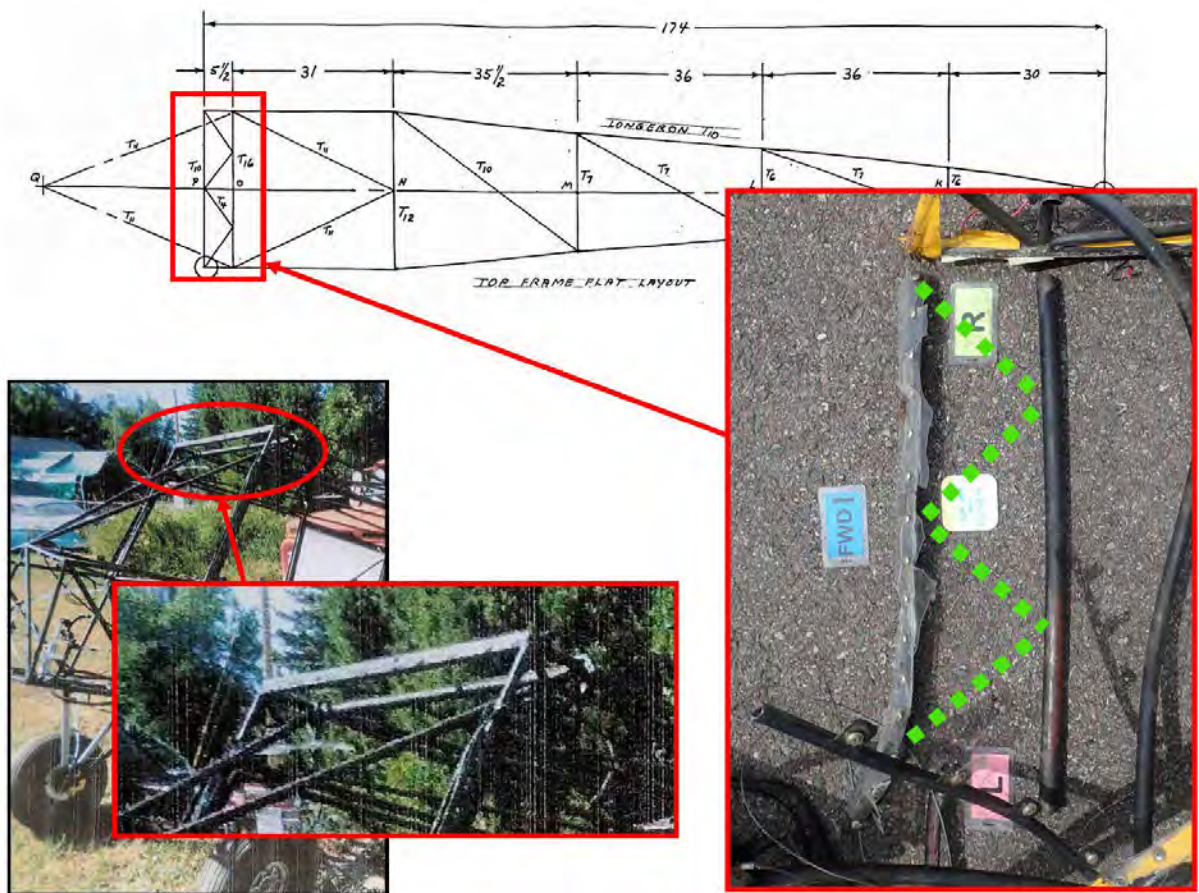


Figure 6 – Forward spar carry through section. Image from build logs (left), post-accident (right).
Location of missing braces highlighted in green.



Figure 7 - Forward spar carry through section



Figure 8 – Right wing root box assembly



Figure 9 - Left wing root box assembly

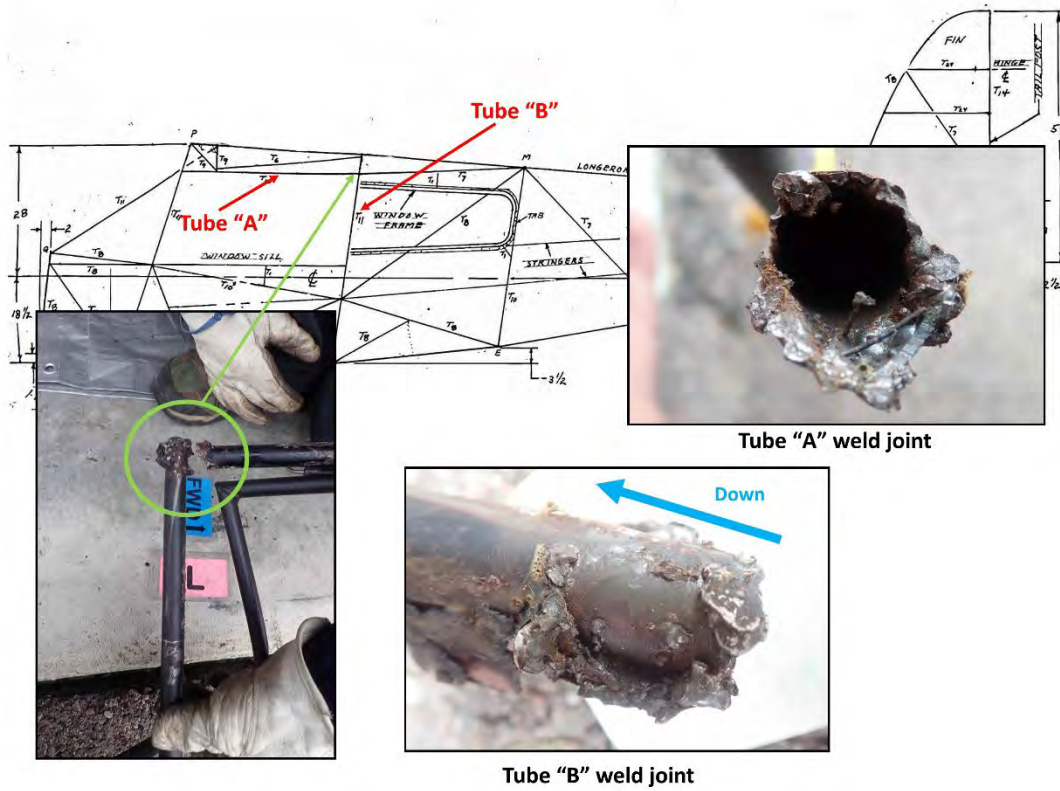


Figure 10 - Left fore-aft lower wing box longeron



Figure 11 – Tail section



Figure 12 - Elevator bellcrank



Figure 13 – Elevator aft push-pull tube



Figure 14 – Elevator push-pull tube assembly at control stick fitting



Figure 15 – Tail section at accident site



Figure 16 – Pitch trim cabin control

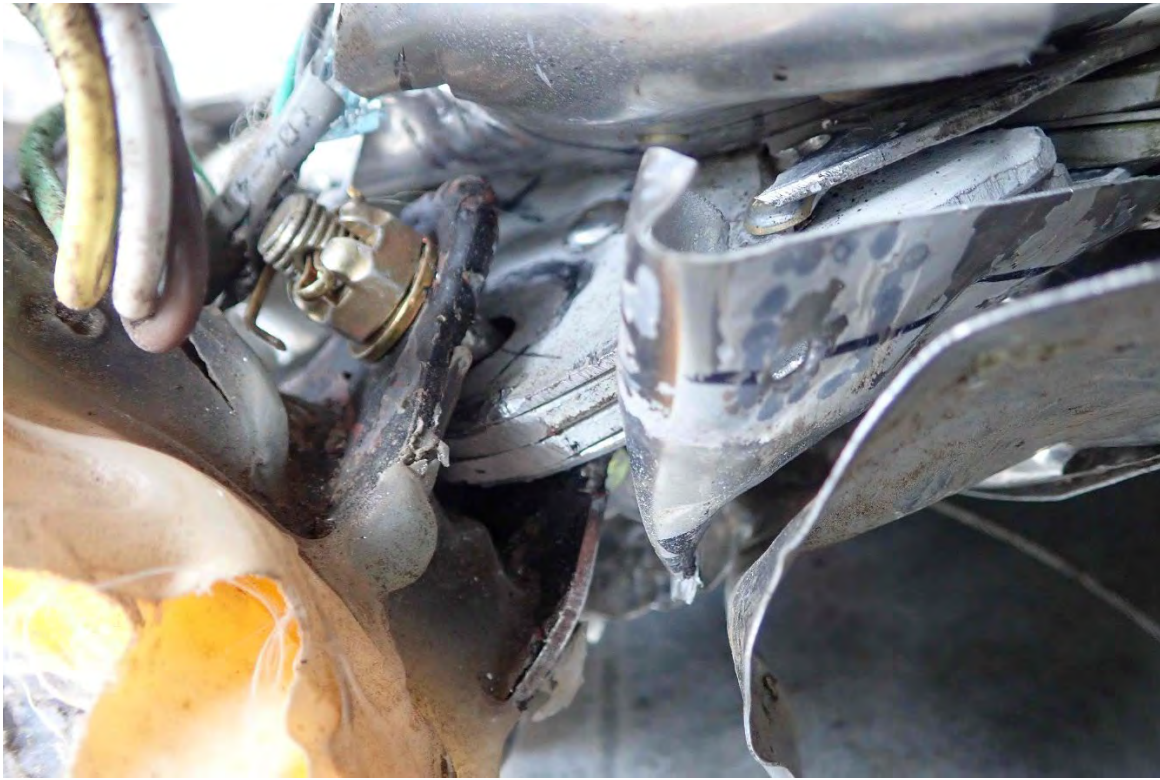


Figure 17 – Left wing forward spar end cap and fuselage fitting



Figure 18 - Left wing forward spar rear end cap



Figure 19 – Rear spar fuselage fitting and bolt



Figure 20 – Left wing



Figure 21 – Left wing aileron outboard bellcrank



Figure 22 – Left wing aileron cable



Figure 23 – Right wing root rib and end caps



Figure 24 – Right wing outboard lift strut and wheel/step imprints



Figure 25 – Right wing strut upper side



Figure 26 - Right wing strut lower side



Figure 27 – Right wing strut lower fuselage fitting



Figure 28 – Right wing strut lower fitting and clevis



Figure 29 – Right wing strut and contact area with step



Figure 30 - Right wing strut and contact area with step



Figure 31 – Yellow transfer mark on right wing indentation



Figure 32 – Right wheel with remnants of yellow hub cap



Figure 33 – Right wing



Figure 34 – Right wing

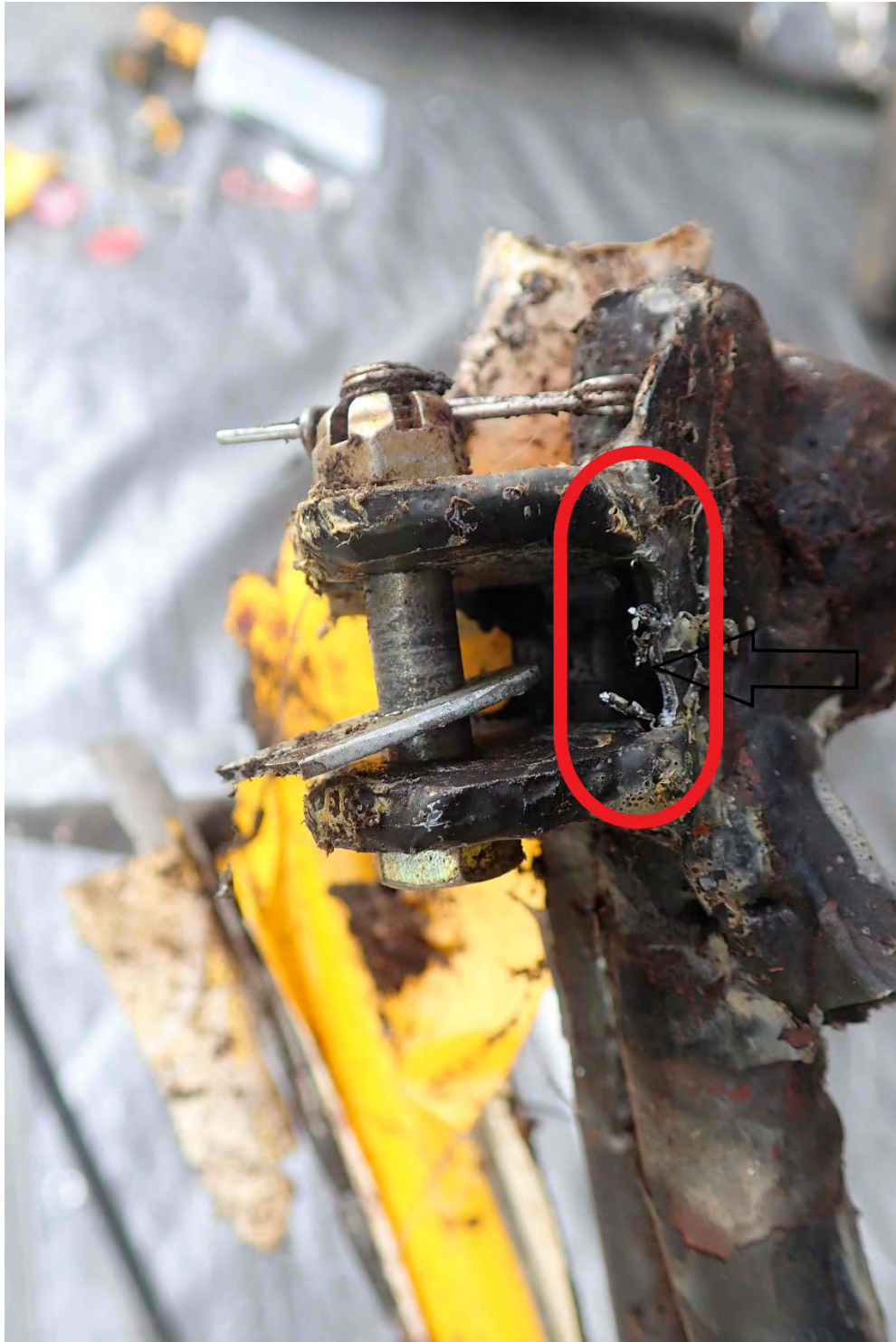


Figure 35 – Aft right fuselage wing cap assembly with notches



Figure 36 - Aft right wing spar cap notch to upper surface



Figure 37 - Forward right fuselage wing cap assembly with notches

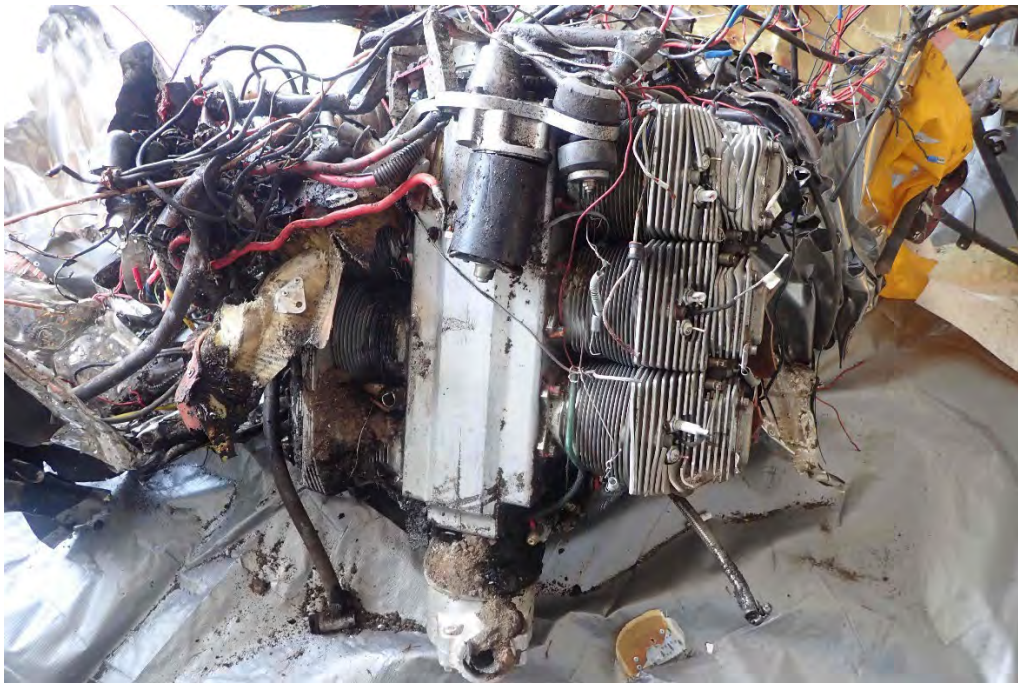


Figure 38 - Engine

Submitted by: Elliott Simpson