



NATIONAL TRANSPORTATION SAFETY BOARD

**Office of Aviation Safety
Western Pacific Region**

SITE, ON-SCENE, & EXAMINATION INFORMATION Rev A

**NTSB Accident: WPR17FA041
Accident Date: December 26, 2016
Examination Dates: 12/27 & 12/29 2016**

This document contains 69 embedded images

A. ACCIDENT

Location: Fresno, California
Date: December 26, 2016
Aircraft: Petrus Express S90, N176PA, Serial # 80842
NTSB IIC: Michael Huhn

B. EXAMINATION PARTICIPANTS:

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C. SUMMARY

On December 26, 2016, about 1318 Pacific standard time, an experimental amateur-built Express S-90, N176PA, was destroyed when it departed controlled flight and impacted terrain shortly after takeoff from runway 30 at Sierra Sky Park Airport (E79, Fresno, California). The private pilot/owner and his passenger received fatal injuries. Visual meteorological conditions prevailed at the time of the accident. .

The wreckage was partially examined on scene, and then examined in detail subsequent to its recovery to a secure facility. All major components were identified on scene. No evidence consistent with any pre-impact mechanical anomalies that would have precluded continued flight was observed.

D. RESPONSE and SITE LOCATION INFORMATION

1.0 Response

- The accident occurred about 1318
- First responders arrived on scene very shortly thereafter
- FAA representative arrived about 1530

- NTSB representative arrived on scene at 0700 the morning after the accident
- The wreckage was recovered two days after the accident, and examined the day after that

2.0 Location

- The airplane impacted and came to rest at the southern shore of a lake that adjoined and was supplied by the San Joachin River
- The impact area was marshy ground and shallow (6 to 12 inches deep) fresh water
- The accident location was 900 feet, on a bearing of 28 degrees True, from the threshold of runway 12 at E79
- The accident site elevation was 239 feet above mean sea level, which was about 80 feet below the elevation of E79
- The geographic coordinates were N 36.84447°, W -119.870883°
- The impact area could only be reached on foot or by boat, due to the lack of paved roads, the marshy ground, and surrounding forestation
- The lake and impact site were California state property, and that property was a State ecological reserve



Figure 1 - Overall Site Scene



Figure 2 - Airplane with Cowling Fragments in Foreground



Figure 3 - Main Wreckage

3.0 Impact Site and General Wreckage Information

- The marshy ground, combined with the contamination and disruption of the site by first responders and victim recovery teams, precluded a high-confidence determination of the airplane initial impact location, attitude, or direction of travel
- Some cowling and wing fragments were dispersed in an area approximately east, and within 70 feet, of the main wreckage, and some of the marsh grass was flattened in this area as well. However, no significant gouges or other ground scars were observed in this region
- The main wreckage of the composite airplane came to rest in three major pieces, which remained partially attached to one another;
 - These 3 pieces were the wings, the engine and cockpit, and the aft fuselage.
- The two wings remained attached to one another, and came to rest approximately perpendicular to the ground, leading edge down.
- The engine and attached propeller were fully immersed in the water and underlying mud/silt, with the significantly deformed and fractured cockpit remnants mostly above the waterline.
- The aft fuselage came to rest inverted over the top of the cockpit
- The USAF Rescue Coordination Center reported that shortly after the accident, they began receiving an ELT signal from the accident airplane
 - The first responders and FAA personnel were unable to locate or silence the ELT, and it continued to transmit through the afternoon and night
 - The NTSB IIC was notified of this situation sometime that evening, and it was agreed that locating and silencing the ELT would be the first priority at daybreak
- On the morning after the accident, no ELT antenna was able to be located on the exterior of the airplane, and the wreckage orientation and distribution precluded normal access to the presumed ELT location inside the aft fuselage
 - A hole was cut in the aft fuselage and the ELT was located and deactivated
 - The ELT was an ACK Technologies brand, Model E-04, which broadcast on 121.5 and 406 MHz



Figure 4 - Main Wreckage



Figure 5 - Main Wreckage with Left Wing



Figure 6 - Main Wreckage with Right Wing

E. WRECKAGE INFORMATION

1.0 General, Aero Surfaces, and Flight Controls

NOTE: Also see separate document "Flight Control Diagrams" in public docket for this accident

- The wing assembly (both wings and connecting structure) was standing in about 12 inches of water, and slightly embedded in the underlying silt
- Leading edge crush and fracture damage was continuous along the entire span
 - Wing damage/disruption was generally absent aft of the main/forward spar
- Both removable (via multiple screws) wingtips were fracture-separated from their respective wings, and both wing-ends exhibited LE crush and fracture damage
 - The left wingtip was complete, but with multiple partial fractures
 - The right wingtip was missing its forward 25% (which was not located), and the remainder of the wingtip contained multiple partial fractures
 - The wingtip damage appeared consistent with the wing damage, and both were consistent with a laterally symmetric wing leading edge impact, in the aft (chordwise) direction, across the entire span
- The wings did not display any other significant damage signatures



Figure 7 - Left Wing



Figure 8 - Left Outboard Wing



Figure 9 - Wingtips (Undersides)



Figure 10 - Wingtips (Upper sides)

- The two trailing edge flaps remained fully attached to their respective wings
 - The left flap was locked in position, about 5° TEU
 - The right flap was free to be manually moved throughout what appeared to be its entire range of travel
- The flaps were electrically controlled from the cockpit via a paddle switch, and extended or retracted via an electric linear actuator that bussed to each flap from a single drive rod
 - The left flap drive remained connected to the actuator
 - The right flap drive was fracture-separated at the flap fitting
- The two ailerons remained fully attached to their respective wings
 - The left aileron was able to be moved/rotated about 2 inches at its trailing edge
 - The right aileron was able to be moved/rotated about 1 inch at its trailing edge

- The ailerons were controlled by dual sticks in the cockpit, and then via a series of control rods, bellcranks, and torque tubes
- The cockpit surrounding the control stick assembly was fragmented into multiple sections
 - The control stick assembly was liberated from its cockpit mounts, but remained partially attached to the airplane via some of the control rods
 - The left-side control stick was separated from the control stick assembly
 - The right-side control stick remained intact and attached to the control assembly
- Each aileron was equipped with two balance weights mounted on a common arm
 - The balance weights were mounted, one inboard and one outboard, on an arm that attached to the aileron and extended forward into the wing
 - Each aileron weight assembly was fully enclosed within its respective wing
 - Each weight was a lead plate that measured about 9/16" x 3" x 5"
 - With the aileron faired, the arm was approximately horizontal
 - The weights were also oriented horizontally, with the 3" dimension oriented fore-aft, and the 5" dimension oriented left-right (parallel to the airplane lateral axis)
 - Two rods, about 3/16" in diameter, and threaded at each end, were used to attach each set of two weights to each aileron arm
 - The rods were oriented parallel to the lateral axis, and occupied through-holes near the forward and aft ends of the weights
 - Nuts on each threaded portion of each rod (2 per rod, 4 total per side) secured the weights to the rods
 - During the post recovery examination, the left weights were found partially displaced from their normal orientation
 - The aft threaded rod of the left weight assembly were failed at the junctures of the weights and arm
 - The timing and cause of this failure were not immediately apparent
 - The rod failure allowed the weights to pivot around their forward attach rod, resulting in the aft edges of the weights being re-oriented to become the lower edges
 - With the aileron faired, these 'new' lower edges of the weights contact the interior surface of the lower wing skin, which prevents any left aileron trailing edge up travel
 - The timing and cause of this weight rotation could not be determined
 - The right aileron weights remained securely attached to their arm



Figure 11 - Displaced Left Aileron Weights (looking inbd)



Figure 12 - Non-Displaced Right Aileron Weights (wing inverted)

- The aft fuselage was almost completely fracture-separated from the cabin, at approximately the station of the aft end of the rear windows
 - The aft fuselage was nearly intact, except as follows:
 - A circumferential crack, of unknown depth, and located about 18 inches aft of where the vertical stabilizer faired into the aft fuselage, fully ringed the aft fuselage
 - Portions of this crack possibly fully penetrated the structure



Figure 13 - Circumferential Crack on Aft Fuselage

- The horizontal stabilizers remained integrally attached to the aft fuselage, and appeared undamaged
- The two elevators remained securely attached to the horizontal stabilizer, and appeared undamaged
 - The two elevators remained securely bussed to one another
 - The bussed elevators could be manually moved freely throughout their apparent full travel range
 - It was not determined whether the elevator aerodynamic balance horns also contained balance weights, but the horns were undamaged
- The elevators were controlled by dual sticks in the cockpit, and then via a series of control rods and bellcranks
 - The control rod from the aft fuselage bellcrank to the elevators remained connected to the elevators, but was fracture separated at the rod end at the aft bellcrank
 - The control rod from the aft fuselage bellcrank to the mid fuselage bellcrank was fracture-separated at the rod end at the aft bellcrank, but remained attached to the mid fuselage bellcrank
 - The control rod from the mid-fuselage bellcrank forward remained attached to the that bellcrank, but terminated in a fracture/tear at the same approximate station as the aft fuselage fracture
 - All fracture faces were consistent with one-time overload fractures, with no evidence of pre-existing failures

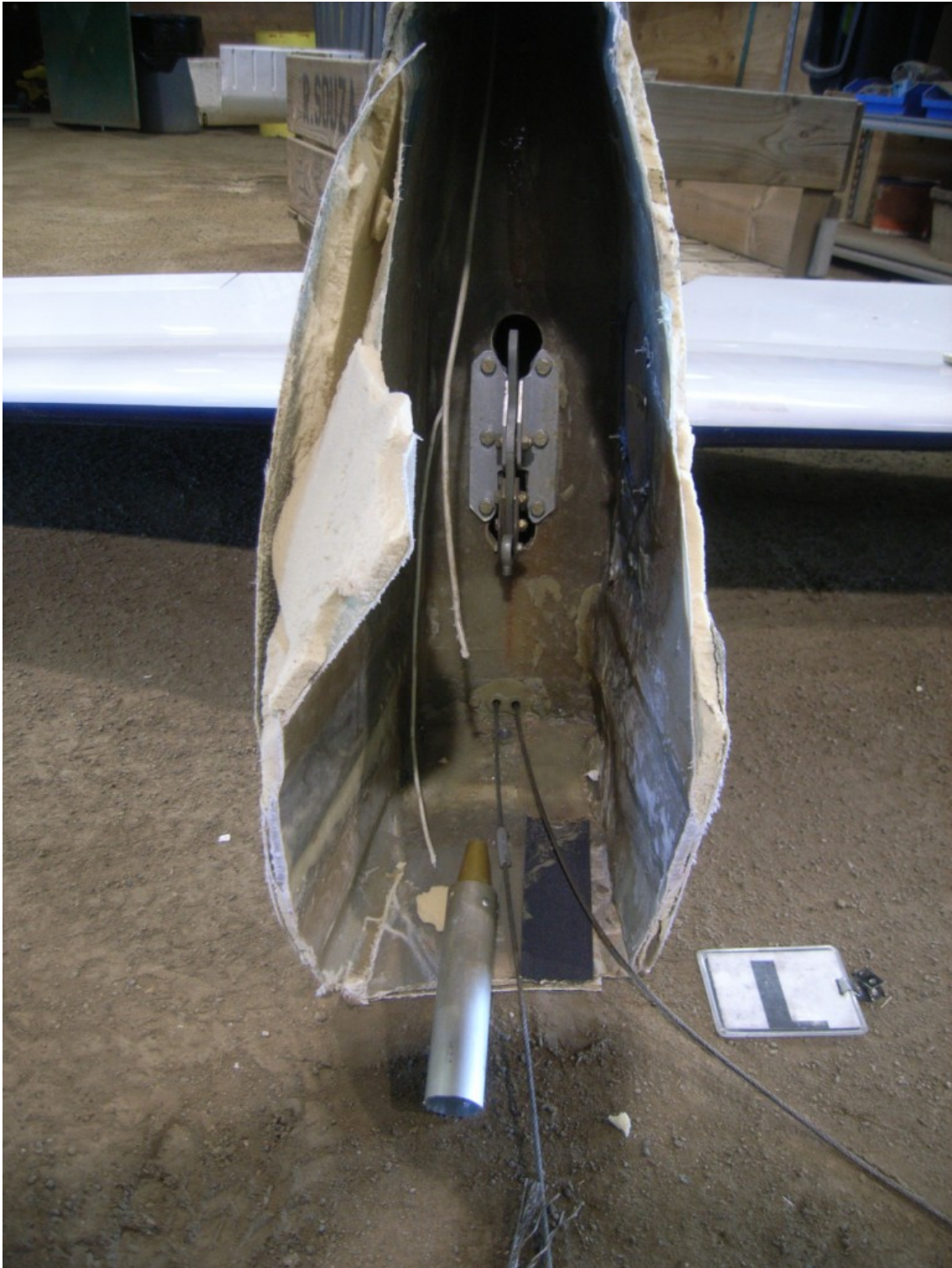


Figure 14 - Recovery-Separated Aft Fuselage



Figure 15 - Elevator Bellcrank Assembly



Figure 16 - Aft Fuselage with Elevator Control Rod



Figure 17 - Fractured Elevator Control Rod

- Autopilot Pitch Servo
 - The electrically controlled and actuated autopilot pitch servo attached via links to the elevator control rod just aft of the cabin
 - The servo, links, and attach hardware remained intact
 - The pitch servo control- and power wires remained intact at the servo



Figure 18 - Elevator Control Rod and Autopilot Pitch Servo

- The pitch trim tab remained securely attached to the right elevator, and appeared undamaged
 - It was locked/immobilized in the faired position
- The pitch trim tab was operated by an electrically controlled electric actuator mounted in the right elevator
 - Removal of the aerodynamic fairing revealed that the link rod from the actuator to the tab was bent about 5 degrees
 - The actuator plastic case halves were found to be partially separated
 - No impact or other scarring or damage was observed, and the cause(s) and timing of the actuator and link rod damage could not be determined
 - The control/power wires remained connected to the actuator



Figure 19 - Right Horizontal Stabilizer with Trim Tab



Figure 20 – Pitch Trim Tab with Actuator Fairing



Figure 21 - Pitch Trim Tab and Actuator



Figure 22 - Pitch Trim Actuator and Rod

- The vertical stabilizer remained integrally attached to the aft fuselage, and appeared undamaged
- The rudder remained securely attached to the vertical stabilizer
 - The top of the rudder exhibited minor crush/impact damage
 - The rudder could be manually moved freely throughout its apparent full travel range
- The rudder was controlled by two cables that were routed along the lower fuselage interior, and linked to the rudder pedals via a series of pulleys
 - The two rudder cables remained attached to the rudder, and both exhibited tensile overload failures at the same approximate fuselage station at the primary fuselage break
 - Remnants of rudder cables were identified in the forward fuselage area
- It was not determined whether the rudder aerodynamic balance horn also contained balance weights, but the horn was only slightly damaged, and there were no indications that a balance weight, if installed, had been separated from the rudder
- The dual control stick assembly was partially fracture-separated from its cockpit mounts and the airplane control rods
 - All fractures were consistent with one-time overload failure
 - Some control rods or rod segments were not identified in the wreckage



Figure 23 - Wings and Center Section



Figure 24 - Center Section with Flight Control Segments

2.0 Fuselage and Cabin

- Photographs of the wreckage prior to recovery of the occupants indicate that that portion of the airplane came to rest inverted, with significant crush and fracture damage.
- Portions of the upper cabin structure were separated from the wreckage by first responders in order to recover the occupants
- The forward and lower regions of the cabin were severely disrupted by the impact
- Both front seats were fracture-separated from the structure
 - The available evidence indicated that both occupants were using their seat belts and shoulder harnesses, and that those components remained intact and fastened during the impact
- The rear bench seat remained partially attached to the structure

3.0 Miscellaneous

- The airplane was equipped with a total of four integral (composite material only, no liner) fuel tanks
 - All four tanks were forward of the main/forward spar
 - One outboard (cap placarded 15 gallons capacity) and one just inboard of that (cap placarded 30 gallons capacity) tank per wing
 - All four tanks retained their caps, which were properly secured in their respective filler necks
 - All four tanks were observed to be breached at their leading edges
 - No fuel was observed the day after the accident
- The two main gear (fixed/non-retractable) remained securely attached to the wing
 - Both gear legs retained their wheel, tire, and brake assemblies
 - The left wheel pant was partially crushed, and its forward portion was fracture-separated
 - The right wheel pant was fully fracture-separated from the gear, but relatively intact
- The nose gear leg remained attached to the airframe structure
 - The leg was deformed/displaced aft and up
 - The nose gear wheel and tire assembly remained attached to the gear leg
 - The NLG wheel pant was not identified in the wreckage



Figure 25 - Left Main Landing Gear



Figure 26 - Right Main Landing Gear



Figure 27 - RMLG Wheel Pant



Figure 28 - RMLG Wheel Pant

- The nose gear spring leg assembly, including the axle, wheel, and tire, remained partially attached to the firewall/engine mount structure
 - Some of the steel attach tubing was fractured
 - The nose gear assembly was deformed aft and up
 - The nose gear pant was fracture-separated from the gear leg, but fragments of it were identified in the wreckage
- Additional engine cowling fragments remained partially attached, or in close proximity, to the forward fuselage and engine area
 - No evidence of any fire, smoke or heavy oil streaking was observed on any cowl fragments
- No evidence of abnormal or heavy external smoke or oil streaking was observed on any of the airplane skins

4.0 Cockpit Controls and Instrument Panel

4.1 Installed Equipment and Configuration Information

- Pre-accident photographs indicated that the airplane was equipped with two large electronic displays for flight and engine information presentation
 - These were Grand Rapids Technologies (GRT) brand S200-01 "Aircraft Primary Flight Instrument" devices
 - These were serial numbers 927 (installed on cockpit left) and 921 (installed on cockpit right)
- The instrumentation also included the following
 - Panel-mounted (via "Air-Gizmo") Garmin GPSMap 496 SN 19787454
 - Garmin GNS 480 Nav/Comm control and display
 - Grand Rapids Technologies EIS-6000 engine information system (Serial number 22134, "SW Ver 66583F")
 - Electro-mechanical or pneumatic attitude indicator, airspeed indicator, altimeter, rate of climb indicator, and fuel quantity gauge
- Almost all switches and circuit breakers were mounted on/in the forward instrument panel



Figure 29 – Pre-Accident Instrument Panel

- A center pedestal/console contained the engine controls and fuel selector valve
- The fuel selector valve was mounted horizontally between the two front seats
 - The selector valve design and installation allowed it to be rotated an unlimited number of degrees/rotations in either direction
 - The only inhibitions to handle/valve rotation were the detented setting; there were no hard stops (either fixed or able to be overridden/defeated)
 - The valve had four detented settings
 - LEFT (forward/12 o'clock)
 - RIGHT (right/3 o'clock)
 - OFF (aft/6 o'clock) AND OFF (left/9 o'clock)



Figure 30 - Cockpit Fuel Selector Panel with Fractured Handle



Figure 31 - Cockpit Center Console (Forward to image top-right)

- The fuel selector valve was found fully fracture-separated from the airplane, but captive by the console facing which bore the selector setting positions
 - This precluded ready determination of the as-found setting of the selector valve
 - Most of the selector valve handle was fracture-separated from the valve

- Comparison with pre-accident photos of the airplane, combined with damage and fracture information, indicated that the fuel selector valve was found in a position that likely corresponded to the left tank setting
- The valve passage from the (presumed) left tank line to the engine line allowed unobstructed passage of low pressure air
- The valve was unable to be rotated/actuated
- Upon disassembly, the rotatable internal valving/routing mechanism was found to be plastic/nylon, while the valve body appeared to be brass
 - No internal debris was observed in the valve body or passages



Figure 32 - Excised Fuel Selector Valve



Figure 33 - Fuel Selector Valve Internals

4.2 Instrumentation

- The instrument panel and center pedestal/console were severely disrupted by the impact
 - Most of the instruments were dislodged from the instrument panel
 - The instrument panel was fractured into multiple sections
- All the electronic devices were recovered
 - Most were found immersed in the water at the site
 - Exclusive of the GPSMap 496, most were significantly impact-damaged
 - The GPSMap 496 was only slightly impact-damaged
- The electro-mechanical and pneumatic instruments were heavily impact-damaged, and elements of most, but not all, were identified in the wreckage
- The airspeed indicator (ASI) face was recovered damaged and fracture-separated from the rest of the unit.
 - The lower quarter of the face was bent about 90° away from its display side
 - No needle or 'needle slap marks' were observed
- The ASI face was labeled and graduated in "knots"
- The ASI was manufactured with a white face. A marginally-visible (non-prominent) yellowish arc, presumed to be the normal white (flap operating range) arc, appeared to extend from 55 knots to 120 knots
- The remaining ASI colored arc markings were as follows:
 - Green: 57 to 195
 - Yellow: 195 to 230
 - Redline: 230
- The POH recovered in the wreckage listed the following limiting airspeed ranges (in KCAS)
 - White (cited as "Full flap operating range"): 50 to 87
 - Green: 104 to 151
 - Yellow: 123 to 151
 - Redline: 204
- The POH also cited the following limiting or operating airspeeds (in KCAS)
 - Stall speed landing configuration: 50
 - Clean stall speed: 55
 - Maneuvering speed: 123
- Subsequent to the exam, the previous owner provided a copy of the checklist that he used for the airplane, and which he reported he had provided to the accident pilot.
 - The previous owner reported that he got the speeds from the kit manufacturer and/or from direct experience with the airplane
 - The checklist was not recovered in the wreckage, so it could not be established whether the accident pilot utilized this checklist or some other checklist
- Comparison of those checklist speeds with what was found in the POH and on the ASI revealed several discrepancies or conflicting values.

Speed Reference	ASI	POH	Previous Owner's Checklist
V _S (Minimum steady-state stall speed)	Not marked		85*
V _{ROT} (Rotation speed)	Not marked		80
V _{SO} (Landing configuration stall speed (power off, full flaps; bottom of white arc))	55	50	70*
V _{S1} (Clean configuration stall speed)	57	55	
V _{REF} (Approach reference speed)	Not marked		85
V _G (Best glide speed)	Not marked		90
V _X (Best angle climb speed)	Not marked		110
V _Y (Best rate climb speed)	Not marked		120
Normal operating range (Min speed; bottom of green arc)	57	104	
V _A (Maneuvering speed)	Not marked	123	130
V _{FE} (Max flap speed; top of white arc)	120	87	123
V _{NO} (Max normal operating speed; top of green arc)	195	151	
Caution range min speed (bottom of yellow arc)	195	123	
Caution range max speed (top of yellow arc)	230	151	
V _{NE} (Max operating speed; redline)	230	204	220

* Owner's checklist did not specify configurations

All speeds in knots



Figure 34 - Upper Face of Airspeed Indicator



Figure 35 - Lower Face of Airspeed Indicator

- Most engine controls were fracture-separated from the panel, and all were damaged and disrupted by impact

- o Their post impact settings were deemed to be unreliable
 - o No pre-impact failures were identified in those components
- The ignition switch was found set to the BOTH position, but the key was either absent or broken off inside the switch
- Switch and circuit breaker positions were deemed to be unreliable due to impact and recovery disruption

4.3 Potential Accident Flight Data Sources

- Discussions with NTSB Recorders Laboratory and GRT personnel, and the previous owner of the airplane, indicated that of all the electronic devices installed, only the GPSMap 496 were equipped with any non-volatile memory (NVM) that might contain data from the accident flight
 - Each GRT S200 device had the capability of storing flight data on a "thumb drive" type memory stick, which was to be inserted into the instrument aft face (forward side in airplane axis system)
 - Data recording also required explicit additional programming of the S200 by the pilot/owner
 - One GRT S200 was located without any memory stick, and the other contained remnants of a memory stick terminal
 - No memory sticks were identified in the wreckage
- The GPSMap 496 device was rinsed, packed in distilled water, and sent to the NTSB Recorders Laboratory in Washington DC for potential data download
 - All results will be documented separately from this report

5.0 Engine and Propeller

5.1 General

- The engine remained partially attached to the engine mount, which remained partially attached to the fuselage structure
- The propeller remained attached to the engine
- The engine and propeller assembly was nearly fully submerged in the water and underlying silt/mud
- The engine came to rest about 30 degrees nose down, and about 45 degrees right side low
- All aft-face mounted engine accessories except the vacuum pump were fracture-separated from the engine
- The engine and propeller assembly was cut from the fuselage for recovery purposes
- The engine was a Lycoming IO-540 series
 - Each bank of cylinders was routed to its own-side straight exhaust tube which exited the cowling underside
 - Each exhaust pipe was situated about 8 inches inboard of the cowling outer side mold line



Figure 36 - Nose Gear Attached to Inverted Engine



Figure 37 - Left Side of Inverted Engine



Figure 38 - Front Left of Inverted Engine



Figure 39 - Front Right of Inverted Engine



Figure 40 - Top Left of Upright Engine

5.2 Engine

- The engine was determined to have originally been equipped with dual turbochargers, which had been removed in 2014 by the previous airplane owner
 - The turbochargers system are not part of the Lycoming TCDS for this engine model
- The engine data plate indicated that the engine was a Lycoming IO-540-K1E5, serial number L-11658-48
- The engine was moderately intact, but had sustained crush damage in the aft and up directions on the bottom and sides, and metallic object strike damage on top
- The crankcase remained intact
- The oil pan was fractured from impact
- The exhaust and intake tubing mostly remained attached to its respective cylinder ports
 - The left side tubing was relatively undamaged, whereas the right side tubing displayed moderate crush damage
 - The interior surfaces of the two exhaust pipe exits appeared dark gray to tan in color, but were partially contaminated by silt from the lake, and displayed some light corrosion. There was no oil residue observed in the exhaust pipes.
- The fuel servo was fracture-separated from the engine
 - The throttle and mixture push-pull cables remained securely attached to the their respective control arms of the servo
 - Those cables remained connected to the fuel servo body but were cut for recovery

- All cylinder bases remained firmly attached to crankcase
- All cylinders except No. 1 (front right) retained their heads, valve rocker assemblies, and rocker covers
- The head, valves, rocker assembly, and rocker cover were fracture-separated from the No.1 cylinder, but partially retained by the baffling and other components
 - Some fragments of those components were identified on scene, consistent with their separation at the accident site
 - The No. 1 cylinder bore shear/smear damage consistent with being cut/sheared by a metal object
 - A linear indentation across the tops of the middle and aft right cylinders (Nos 3 & 5, respectively) extended diagonally aft from near the engine centerline outboard
 - This indentation was angled approximately 70 degrees from the lateral axis
 - One of the propeller blades bore leading edge gouges and indentations, and the blade face bore scoring
 - These gouges and indentations aligned precisely with similar features on the engine
 - That blade was bent aft, near its root, approximately 45 degrees



Figure 41 - Aft Lower View of Inverted Engine



Figure 42 - Aft Face of Upright Engine



Figure 43 - Right Side of Upright Engine



Figure 44 - Left Exhaust Outlet



Figure 45 - Right Exhaust Outlet



Figure 46 - Front Upper Right of Upright Engine

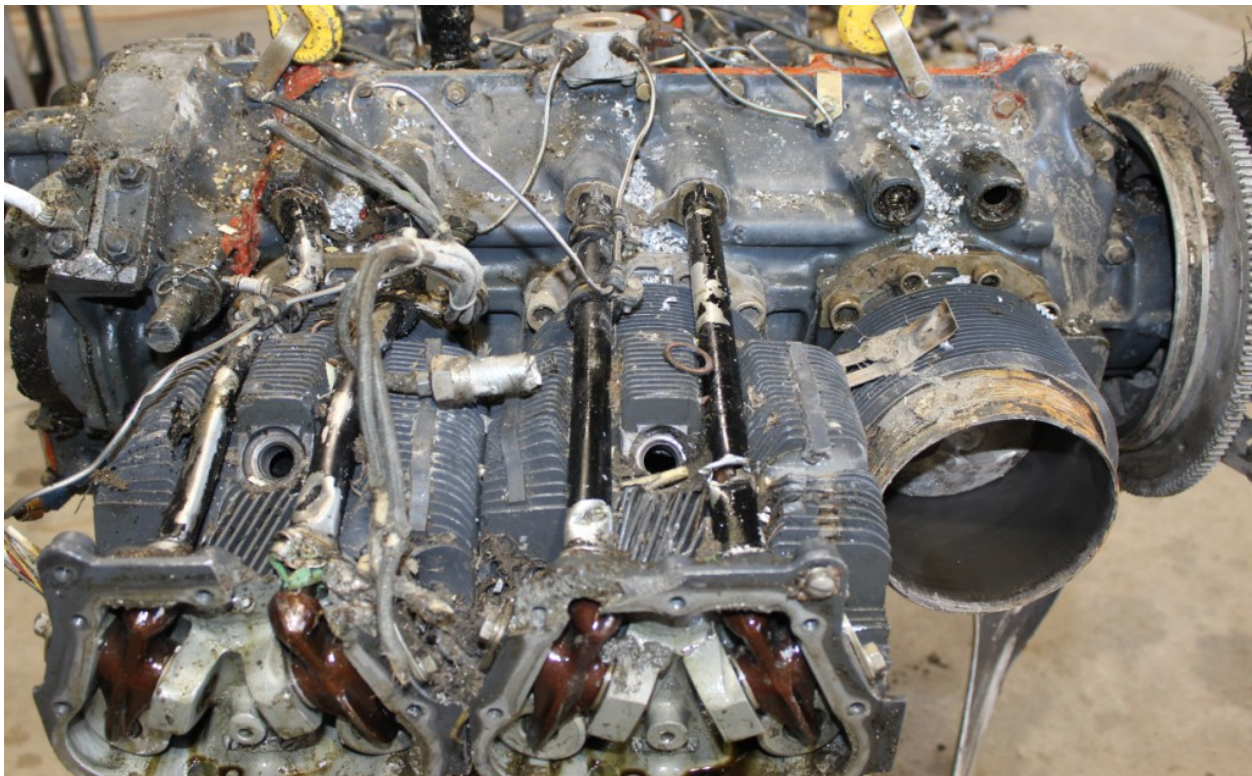


Figure 47 - Top Right of Upright Engine



Figure 48 - Top Right of Upright Engine

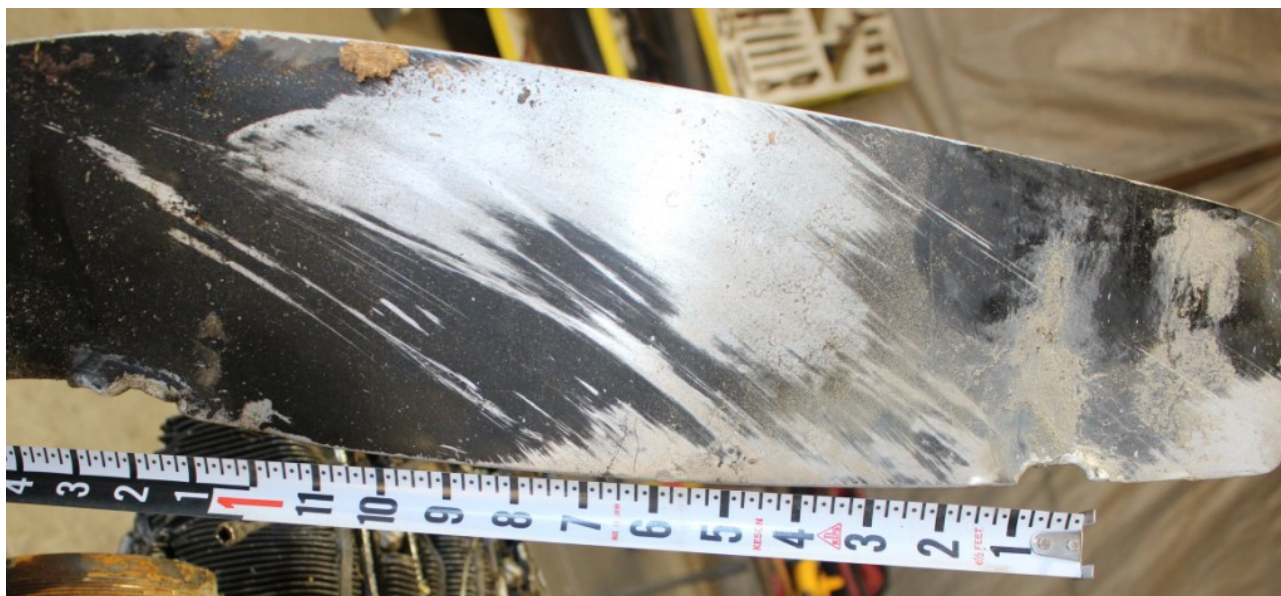


Figure 49 - Propeller Blade with Engine-Congruent Gouges



Figure 50 - Propeller-Separated Portion of No 1 Cylinder

- Several pushrods and pushrod tubes were significantly damaged, and all damage was consistent with external impact
 - None displayed damage consistent with internal failure
- Exclusive of the valve assemblies struck by the propeller, none displayed any damage
 - No damage was consistent with any internal mechanical malfunctions or failures

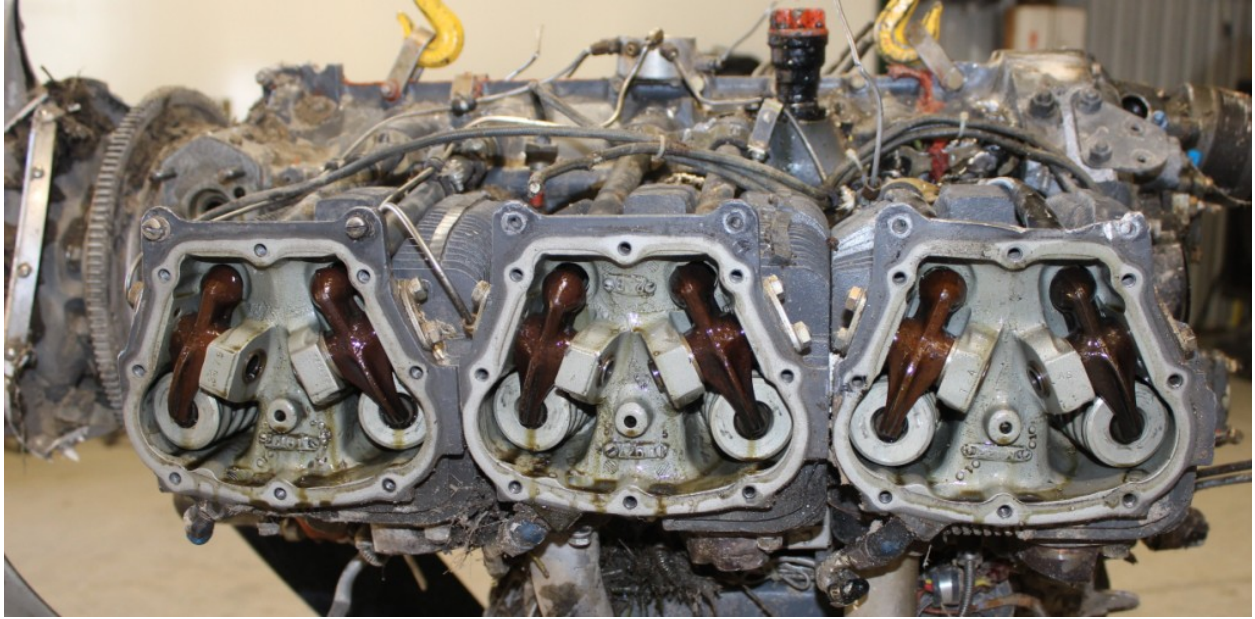


Figure 51 - Left Cylinder Bank Rocker Assemblies



Figure 52 - Right Cylinder Bank Rocker Assemblies



Figure 53 – No. 1 Cylinder Rocker Assembly

- The oil filler cap remained securely installed in its crankcase mount
- The engine internal oil screen was found to be clean/unobstructed
- The filter element of the externally mounted, spin-on oil filter was free of debris or contamination

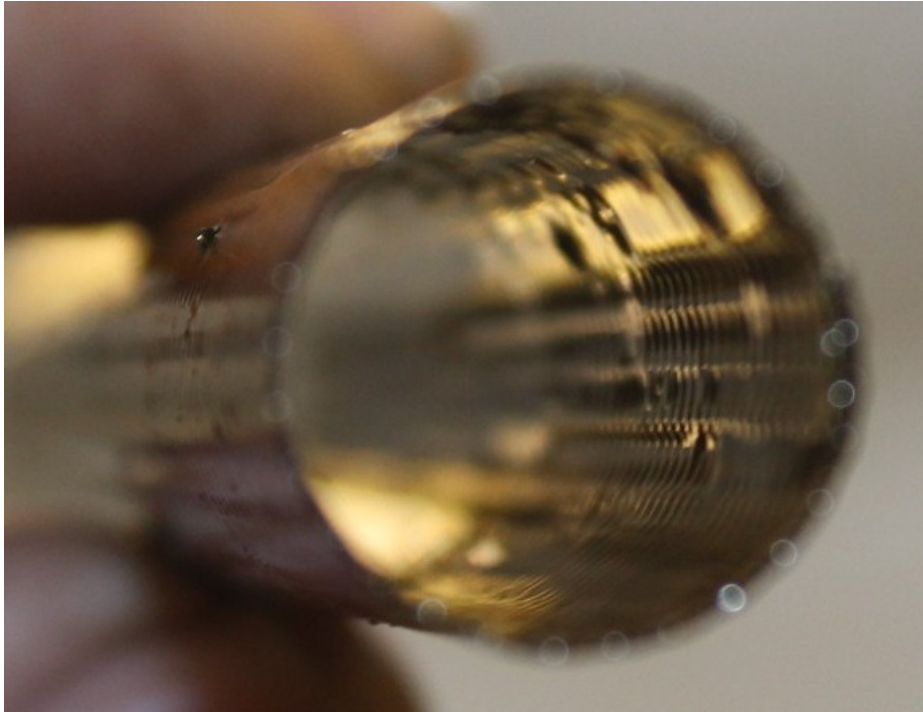


Figure 54 - Internal Engine Oil Screen



Figure 55 - External Oil Filter Internal Filter Element

- The rotary-type engine-driven fuel pump (EDP) was fracture-separated from the engine but was recovered
 - The drive gear was manually rotated and turned freely
 - ROMEC PN RG9080J4A SN D-7796

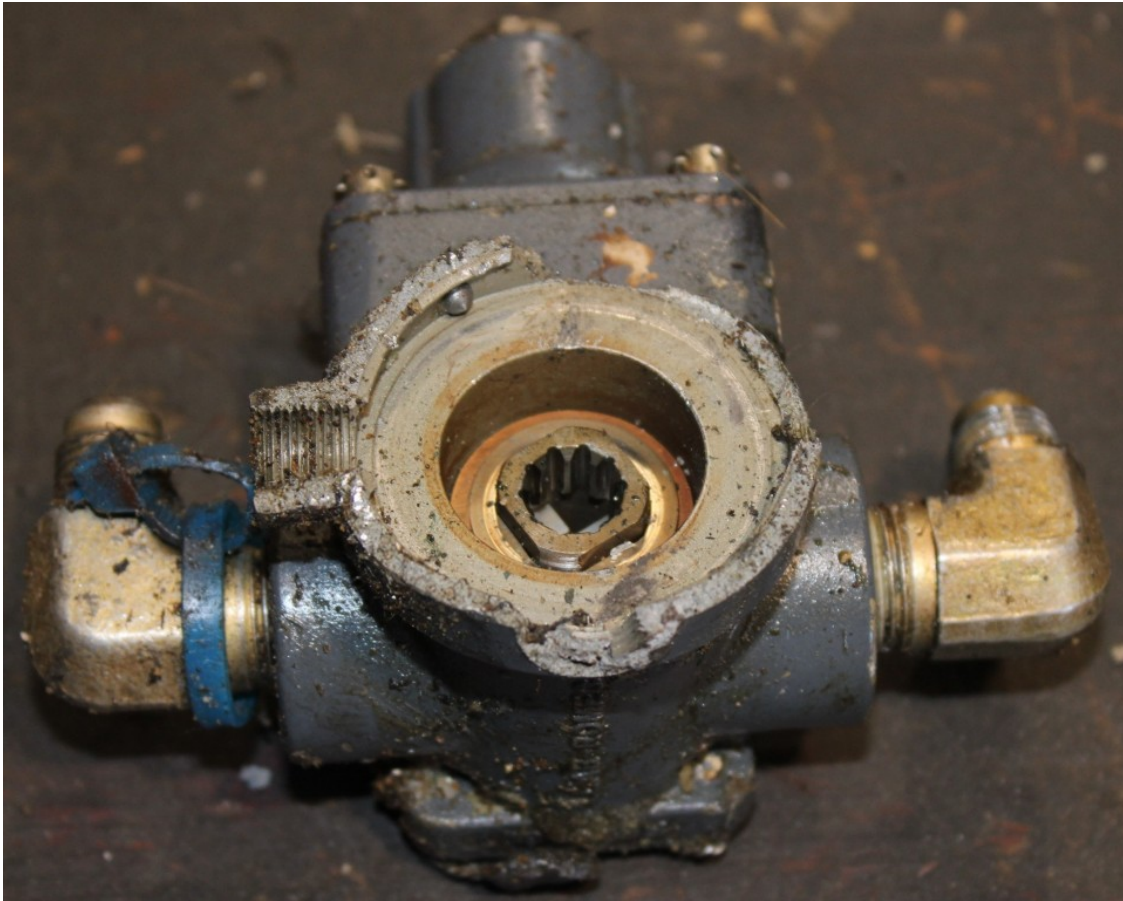


Figure 56 - Engine-Driven Fuel Pump

- The flow divider (fuel manifold distribution valve) remained intact and securely attached to the engine in its normal location
 - With one exception, all fuel line fittings and at least portions of their fuel lines were securely attached to the valve body
 - One was fracture-separated at the body/fitting interface; the fracture was consistent with one time overload
 - All lines were deformed down (towards the engine crankcase) by impact
 - When opened, the internal components of the valve were all clean and intact (including the diaphragm), and no foreign material or corrosion was observed



Figure 57 - Flow Divider

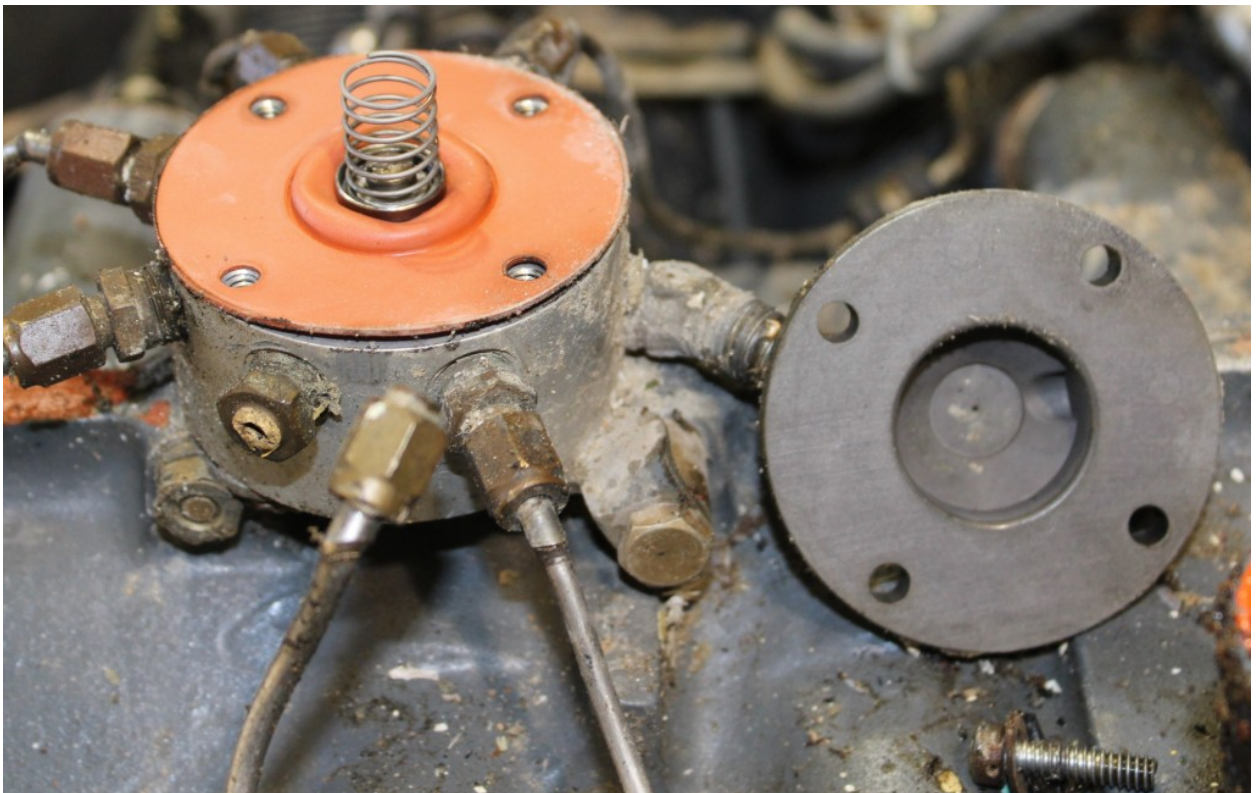


Figure 58 - Partially Disassembled Flow Divider

- Fuel Injection Nozzles
 - o All 6 were found securely installed
 - o All 6 had clear passageways
 - o The #4 injector was slightly damaged during the removal process

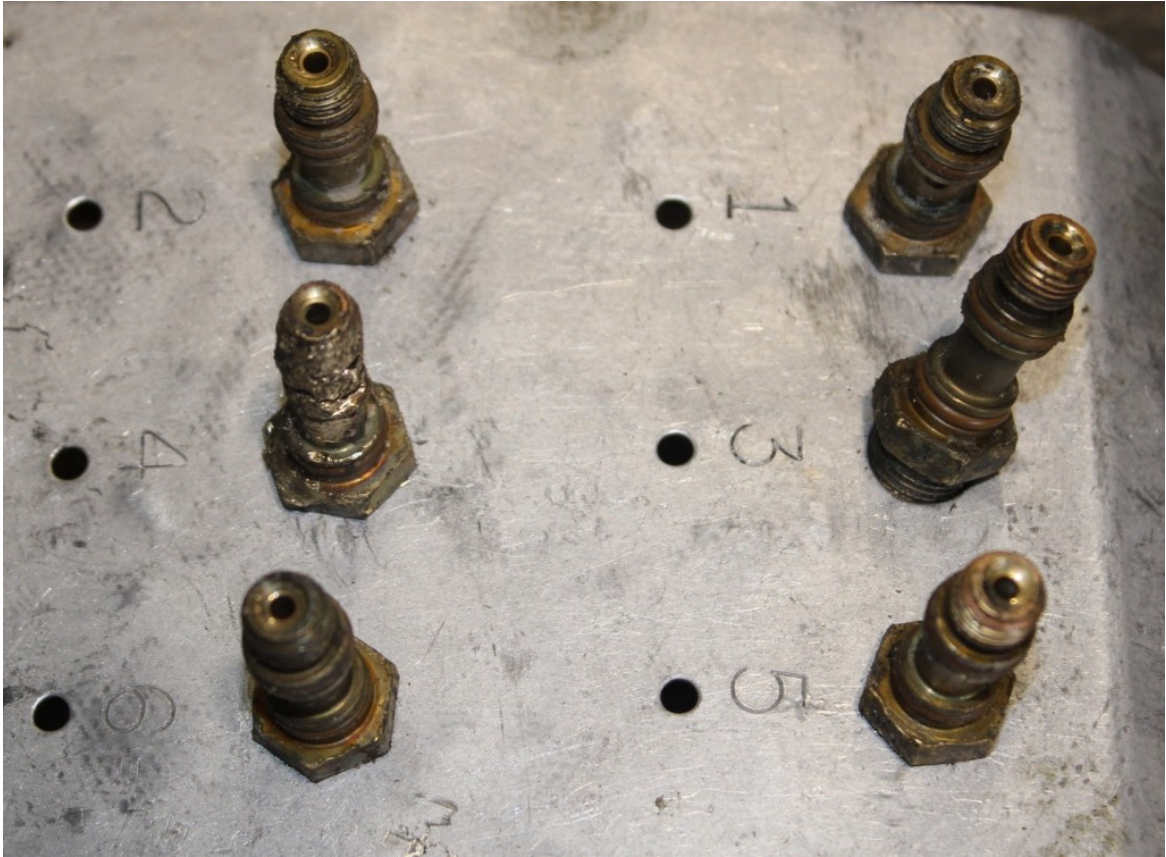


Figure 59 - Fuel Injection Nozzles

- Fuel Servo
 - Precision Airmotive Model RSA-10ED1
 - SN 72GP1101
 - Parts List No 2524298-12
 - "I.C." 38U
 - The throttle and mixture control rods remained securely attached to their respective control arms
 - The internal inlet fuel screen was clean and unobstructed



Figure 60 – Partially Attached Fuel Servo



Figure 61 - Removed Fuel Servo

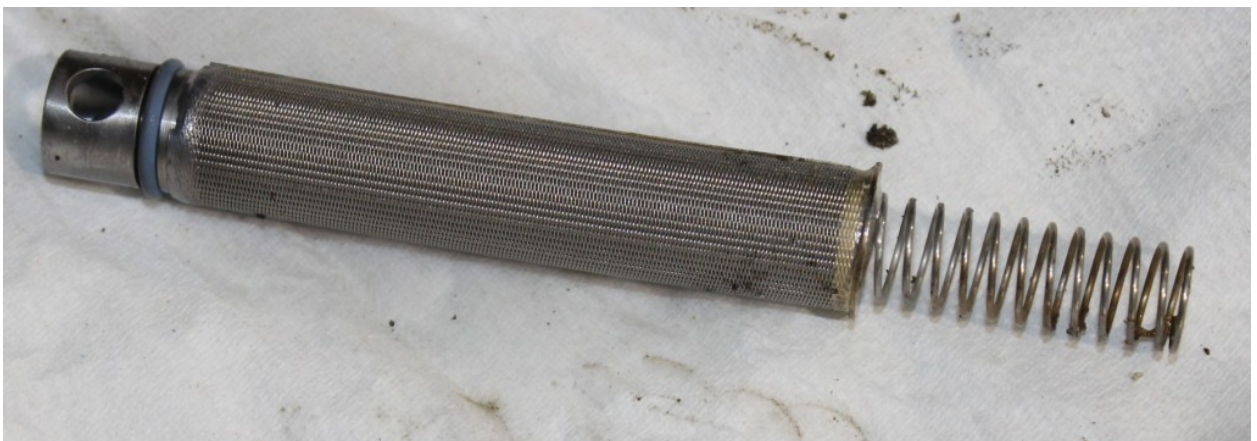


Figure 62 - Fuel Servo Screen

- All spark plugs remained installed
 - No electrodes on any spark plugs exhibited mechanical damage from objects in the cylinders
 - None exhibited any signs of significant fouling
 - Their combustion signatures appeared to be generally normal, although some were contaminated with mud/silt and other lake-water exposure effects



Figure 63 - Top Spark Plugs



Figure 64 - Bottom Spark Plugs

- The two magnetos were fracture-separated from the engine but were recovered
 - o Both were equipped with impulse couplings, which could be heard on manual rotation
 - o Both produced sparks at all towers when manually rotated
 - o Left: Slick Model 6351 SN 04112213 lag 35 Rotation L Rev C
 - o Right: Slick Model 6351 SN 04112214 lag 35 Rotation L Rev C



Figure 65 - Magnetos



Figure 66 - Magnetos

- The forward mounted alternator remained partially attached to the engine
- The starter remained securely attached to the engine in its normal position and orientation
 - The starter gear was found in the retracted position such that it was not in contact with the propeller ring gear

- The propeller governor remained securely attached to the engine in its normal position and orientation
 - o EDO-Aire PN 34-828-014-1 SN 8384
 - o The oil screen was clean & unobstructed
 - o The control rod was fracture-separated at the governor rod-end
 - o The fracture face was consistent with one-time overload



Figure 67 - Removed Propeller Governor



Figure 68 - Propeller Governor Screen

5.3 Propeller

- The propeller was a Hartzell model HG (or HC)-C3YR-1RF, an all-metal, 3 blade, controllable pitch design
 - Hub SN DY4219A
- The propeller hub was intact, and all 3 blades were retained in the hub
 - At least one blade was able to be rotated in the hub
- All 3 propeller blades exhibited significant bending/twisting deformation, and scoring/gouging
- The spinner was not identified in the wreckage
 - The spinner attach screws remained in the spinner mounting flange that remained attached to the engine/propeller
 - The previous owner reported that the spinner was composite



Figure 69 - Propeller

6.0 POH

- A 3-ring binder style POH was recovered in the wreckage; it was only slightly damaged
- The POH cover page stated that it was "Published for" Express Design Incorporated Redmond, OR, and "Produced by" Ed Watson, Cedar West Enterprises, San Diego, CA
- The POH only referenced two engines for the airplane, and did not reference the IO-540
- The POH format required additional inputs (performance, weights etc) specific to the particular airframe; but those entries had not been made for this accident airplane
- Consequently this POH was of very limited utility in the understanding or operation of the accident airplane