NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

ON SCENE and POST RECOVERY INFORMATION

NTSB Accident: WPR13FA244
Accident Date: May 28, 2013

Examination Dates: May 29-30, 2013

This document contains 57 embedded images
Photographs: Beech, CMI, & NTSB

A. ACCIDENT

Location:	Mountainaire, Arizona
Date:	May 28, 2013
Aircraft:	Beech A36, N999PK, Serial # 3380
NTSB IIC:	Michael Huhn

B. EXAMINATION PARTICIPANTS:

Michael Huhn
Air Safety Investigator
National Transportation Safety Board
Gardena, CA

Leon "Pete" Kelley
Airworthiness Inspector
Federal Aviation Administration
Scottsdale, AZ

Nicole Charnon
Air Safety Investigator
Continental Motors, Inc
Mobile, AL

Kris Wetherell
Air Safety Investigator
Beechcraft
Wichita, KS

C. SUMMARY

On May 28, 2013, about 1143 Mountain standard time, a Beechcraft A36, N999PK, was destroyed when it impacted trees and terrain shortly after takeoff from Flagstaff Pulliam airport (FLG), Flagstaff, Arizona. A significant post-impact fire ensued immediately. The owner/private pilot and the one passenger received fatal injuries. The personal flight was operated under the provisions of Title 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the flight.

No persons on the ground were injured or killed.

The airplane was examined by representatives of the FAA, NTSB, Beech and CMI on-site on May 29, 2013. The wreckage was removed from the site by Air Transport personnel and relocated to their facility in Phoenix on May 29. Representatives of the FAA, NTSB, Beech and CMI examined the wreckage at the Air Transport facility on May 30, 2013.

All major components were accounted for on scene. No evidence consistent with in-flight fire or in-flight structural failure was observed. Propeller and tree damage was consistent with the engine developing power at the time of impact.

D. RESPONSE and SITE LOCATION INFORMATION

1.0 Response

- The accident occurred about 1843 MST
- The accident site was located in the semi-rural neighborhood of Mountainaire that bordered the Coconino National Forest (CNF)
- The impact site was on CNF property
- Several residents of the neighborhood were eyewitnesses to the final portion of the flight, and were the first responders to the accident
- They immediately began fire suppression efforts using portable fire extinguishers, shovels of dirt, and household/garden hoses
    - All these individuals reported that the fire was large and intense, but that their efforts were partially successful in suppressing and containing the fire
- One first responder reported that he briefly observed the two occupants in the cockpit, and believed the pilot to be alive for a very short time
- Coconino County firefighters (known as "Highlands Fire" and "Bear Jaw") responded to the scene with personnel, vehicles, and equipment. A copy of the incident report has been requested by the NTSB
- The victims were removed from the wreckage the day of the accident
- An FAA inspector from the Scottsdale FSDO arrived on scene about 3 hours after the accident
- Representatives of the NTSB and Beechcraft arrived on scene on the morning after the accident, and the CMI representative arrived a few hours later

2.0 Location and Site Condition Information

- The wreckage was tightly contained in an area that was located behind (west of) the houses on the west side of Iroquois Street in Mountainaire
- Most or all of the trees were Ponderosa pines
- The first tree strike occurred at a group of three trunks, which were fractured about 40 feet above ground level (agl)
    - The trunks at the fracture locations were about 12 to 18 inches in diameter
    - The GPS-indicated geographic coordinates of the first tree strikes were
        - Latitude: 35º 04' 59.2" N
        - Longitude: 111º 40' 06.6" W
- The second tree strike occurred at single trunk, which was fractured about 23 feet agl
    - The trunk at the fracture location was about 12 inches in diameter
    - The GPS-indicated geographic coordinates of the second tree strike were
        - Latitude: 35º 04' 58.7" N
        - Longitude: 111º 40' 06.7" W
- The third tree strike occurred at cluster of trees, which were fractured and uprooted
    - The trunks had fractured about 15 feet agl; the lower trunks fell in the direction of the wreckage path, while the upper portions trunks 'folded' back in the opposite direction of the wreckage path

    - The trunks near the bases were about 12 inches in diameter
    - The GPS-indicated geographic coordinates of the tree cluster were
        - Latitude: 35º 04' 58.7" N
        - Longitude: 111º 40' 06.7" W
    - The location was 2.95 nm170 degrees true from the threshold of FLG runway 3 (elevation 7,000 feet)
    - The impact site elevation was 6,815 feet
    - The impact site was about 1 nm to the east of the southern end of a straight section of Interstate 17, a four-lane north-south highway.
        - That section measured 1.15 nm in length
        - That section began about 1.17 nm from the threshold of runway 3
        - That section at an elevation of about 6,700 feet
- The main wreckage consisted of the fuselage, from tail to propeller
- The depression angle (from horizontal) from the fracture locations of the first tree strike to the fuselage was measured to be 14 degrees
- The azimuth angle from the first tree strike to the fuselage was measured to be 190 degrees magnetic
- The GPS-indicated geographic coordinates of the main wreckage (the fuselage) were
    - Latitude: 35º 04' 57.9" N
    - Longitude: 111º 40' 07.1" W
    - Elevation: 6,844 feet
- An approximate 5 foot diameter shallow depression of disturbed earth and rock, consistent with propeller/engine impact, was located about 40 feet beyond the uprooted tree cluster
- The nose of the airplane was situated about 5 feet beyond the depression
- When plotted using Google Earth, the impact location was 2.94 nautical miles from the center of the threshold of FLG runway3, on a true bearing of 170 degrees from that runway location
- When plotted using Google Earth, the distance from the first tree strike to the main wreckage was 135 feet, on a true heading of 180 degrees
- The wreckage was contained in an approximate 100 ft by 75 ft oval of burned vegetation and forest floor matter, and charred/sooted soil and rock

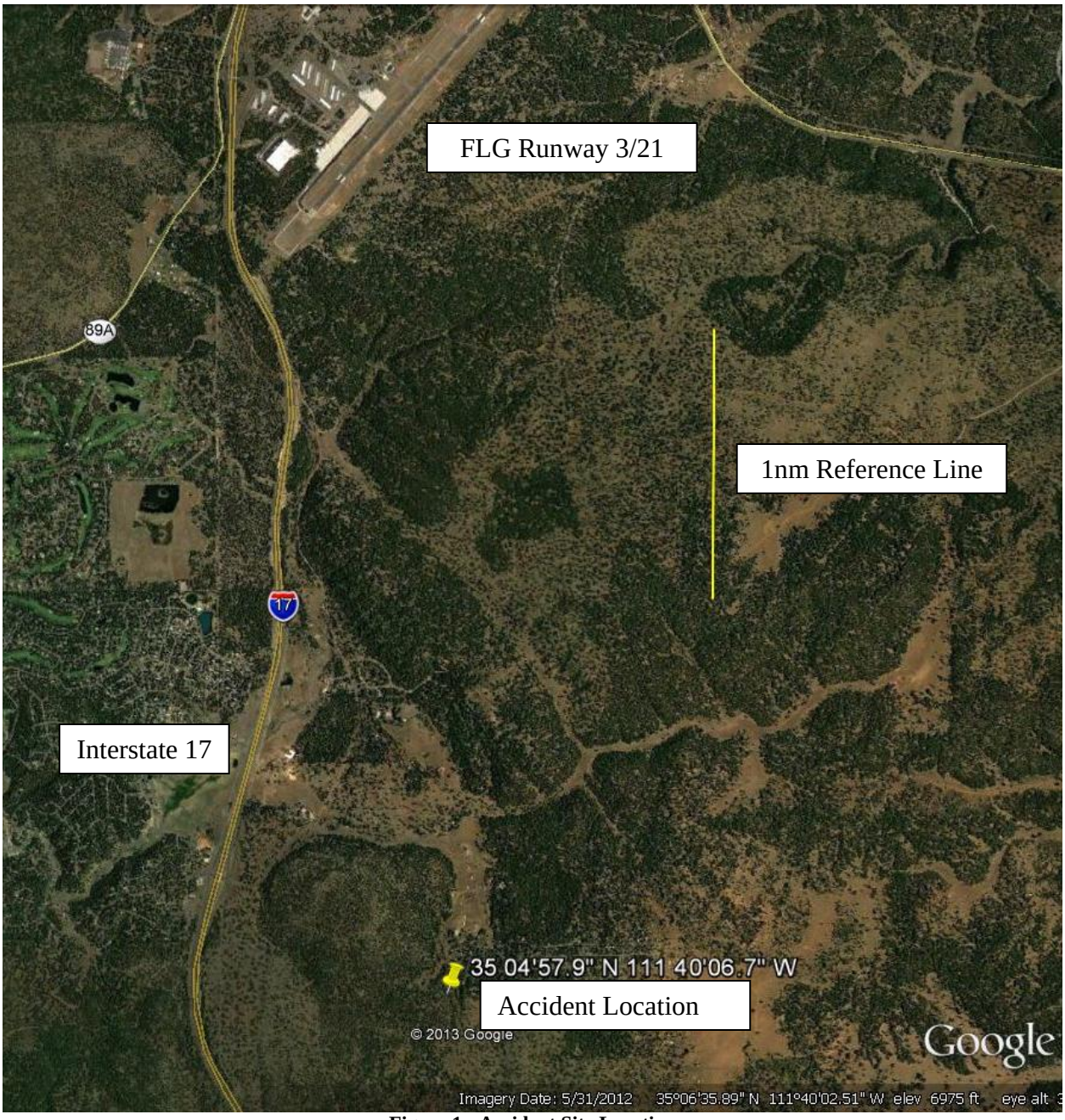

Figure 1 - Accident Site Location

Figure 2 - Tree Strikes (view north; back along flight path)

Figure 3 - Tree Strikes (View north)

E. AIRFRAME INFORMATION

1.0 General

- Portions of the airplane and its contents were consumed by fire, and the bulk of the remaining wreckage was fire damaged.
- The wreckage consisted of three primary segments
    - Outboard left wing
    - Right wing
    - Main wreckage
- Multiple smaller fragments of the airplane and/or its contents were also strewn about the burned oval area
    - It could not be determined whether some of these items' locations were a result of the impact, or of the firefighting or victim recovery efforts
- Outboard left wing
    - This segment consisted of the outboard 91 inches of the wing, including the wing tip tank
    - Segment extended from the inboard end of the aileron to the wing fuel tip tank,
    - The segment was found inverted
    - It was moderately fire-damaged
    - It was located adjacent to (just prior wrt the wreckage path) the uprooted tree cluster
- Right wing
    - This segment consisted of the entire wing, including the wing tip tank
    - The segment was found inverted
    - It was located about 25 feet along the wreckage path from the 'third tree strike' trees that had been uprooted and fractured
    - It partially covered, and was partially covered by, sections of those trees
    - The trees and the wing section were severely fire-damaged
- Main wreckage
    - Consisted of the fuselage from the propeller to the empennage
    - Significantly fire damaged or consumed
    - Oriented upright
    - Longitudinal axis oriented on a magnetic heading of approximately 310 degrees
- An approximate 7-foot segment of the TKS (ice protection system) leading edge assembly from one wing was located in the second tree cluster

Figure 4 - Main Wreckage

Figure 5 - Main Wreckage

Figure 6 - Main Wreckage

2.0 Left Wing

Approximately 91 inches of the outboard end of the left wing, including the left aileron, separated from the wing and was resting inverted. This portion of the wing displayed post-impact fire damage. The leading edge of this portion of the wing displayed compression damage just inboard of the leading edge wedge. The stall warning vane mounted on this portion of the wing remained in place, and was free to move. The pitot tube was separated from this portion of the wing, and was found near the separated mounting location. The leading edge wedge remained intact and attached to the leading edge of the wing. The wing tip was equipped with an Osborne (STC modification) fuel tip tank. The tip tank did not contain any fuel and did not display any signatures of hydraulic deformation.

The inboard portion of the left wing remained in place at the fuselage and revealed significant post-impact fire damage. Post-impact fire consumed portions of the front and rear carry-through

spar/wing spar attachments. A large portion of the wing skin and structure was consumed by post-impact fire. The front and rear spars displayed an aft bend outboard of the left main landing gear attachments. The fuel tank bladder was completely consumed by post-impact fire.

Figure 7 - Left Wingtip and Tank (inverted)

Figure 8 - Stall Vane on Left Wing

Figure 9 - Pitot Tube

3.0 Right Wing

The right wing separated from the airframe just outboard of the front and rear spar / carry-thru spar attachment locations. The right wing was located at N 35 04 58.0 and W 111 40 07.4 along the wreckage path. The wing came to rest inverted, adjacent to the engine and propeller ground scar. The wing was thermally reduced to remnants of the original structure and skin which appeared in the original configuration of the wing. It was lying beneath 4+ pine trees that were struck by the airplane during the impact sequence. The wing was equipped with an Osborne fuel tip tank. The tank was breached and did not contain any fuel. The tank did contain some liquid that appeared clear and did not emit any odor of fuel. Emergency fire personnel indicated that the entire wreckage site had been drenched with water during their initial response to the accident. The metal tank did not reveal any hydraulic deformation. The fuel tank bladder was completely consumed by post-impact fire.

Figure 10 - Right Wing (inverted)

4.0 Ailerons

The left aileron remained attached to the left wing at all mounting hinges and revealed post-impact fire damage. The left aileron bellcrank remained attached to the mounting location in the wing. The aileron bellcrank pushrod was separated between the bellcrank and the aileron surface. One bellcrank arm separated and remained attached to the corresponding aileron crossover cable. The other aileron cable remained attached to the bellcrank. This cable was separated approximately 9 feet inboard from the bellcrank. The separated cable displayed splayed ends and individual filaments consistent with tensile overload. The crossover cable was not separated and remained intact to the right aileron bellcrank location. The aileron trim actuator, located on the left wing, remained intact and attached to the wing mounting location.

The actuator push rod remained attached to the aileron trim surface. The aileron trim actuator extension measured 1.4 inches, which equated to 2 degrees tab trailing edge up. Aileron trim control cable continuity was established from the aileron tab to where the cables would normally attach to the trim control drum, which is located at the base of the throttle quadrant; however, the trim control wheel and associated drum were consumed by fire.

The right aileron remained attached to the wing at all mounting hinges, and was partially consumed by post-impact fire. The aileron bellcrank and pushrod were consumed by fire. A fragment of the right aileron bellcrank crossover cable arm remained attached to the aileron crossover cable. A fragment of the other bellcrank arm remained attached to an approximately 70-inch portion of separated aileron cable. The separated cable end revealed splayed ends and individual filaments consistent with separation in tensile overload.

Aileron cable continuity was established from the right and left control column sprockets to the right and left aileron bellcranks. One aileron cable was burned through at the landing gear actuator location. The burned ends of the cable were white in coloration, and had been exposed to the post-impact fire in the vicinity of the magnesium landing gear actuator housing.

5.0 Flaps

The left flap was post-impact fire damaged and remained in place at the flap tracks. The left flap actuator remained attached to the mounting location. It remained attached to the flap surface and to the flap flex drive cable. The left flap actuator extension measured 1.7 inches. This measurement equated to a flaps retracted position.

The right flap was damaged by post-impact fire and remained attached to the wing at the flap tracks. The right flap actuator was burned away from the flap surface and had separated from the flex drive cable. The right flap actuator extension measured 1.7 inches, which equated to a flaps retracted position.

Figure 11 - Flap in Retracted Position

6.0 Horizontal Stabilizers and Elevators

The horizontal stabilizers remained attached to the aft fuselage and displayed post-impact fire exposure. The left and right elevators remained attached to the horizontal stabilizers at the hinges. The left and right elevator trim surfaces remained attached to their respective elevators at their hinges. The left and right elevator pushrods were separated near the elevator control horns. The right elevator control horn displayed impact damage which separated the horn from the bearing. The left and right elevator balance weights remained attached to the elevators. The left elevator balance weight was deformed in an inboard direction, and was in contact with the left horizontal stabilizer.

Elevator control cable continuity was established from the control column to the elevator bellcrank. Portions of the forward elevator bellcrank at the control column were burned away. The two elevator control cable ends at the control column remained attached to the swedge ball ends. The elevator cables in the aft fuselage remained attached to the upper and lower aft bellcrank arms. Actuation of the bellcrank was observed when the cables were pulled by hand from their control column ends.

Figure 12 - Horizontal Stabilizers and Elevators

Figure 13 - Stabilizers, Elevators and Rudder Post

Figure 14 - Elevator Pivot

7.0 Elevator Trim

The left elevator trim actuator extension (from actuator face to centerline of attach bolt) measured 1.4 inches, which equated to approximately 5 degrees tab trailing edge down. The right elevator trim actuator extension measured 1.5 inches, which equated to approximately 7 degrees tab trailing edge down.

Elevator trim cable continuity was confirmed from the control wheel adjacent to the throttle quadrant to the right and left actuators in the empennage. The drive chain for each elevator trim actuator remained attached to its respective cable.

Figure 15 - Right Elevator Tab

8.0 Vertical Stabilizer and Rudder

The vertical stabilizer was fracture-separated from the aft fuselage at the roots of the front and rear spars. The surface displayed some leading edge compression damage and had been exposed to post-impact fire. A portion of the rudder torque tube, the rudder bellcrank, and fragments of the rudder remained attached to the aft fuselage by the rudder cables. The remainder of the rudder, including the rudder balance weight, was found resting near the aft fuselage and vertical stabilizer on the left side of the airplane. The rudder was fracture-separated from the vertical stabilizer at the mounting hinges and displayed compression damage.

The rudder cables remained attached to the forward rudder bellcrank below the left pilot seat. One of the rudder cables was burned through at the landing gear actuator location (center of the fuselage) due to exposure to the burning magnesium housing of the landing gear actuator. This burned through portion appeared white and did not reveal any evidence of tensile overloading. Appropriate actuation of the rudder bellcrank was achieved by pulling the rudder cables by hand on both cables and on both sides of the burned through cable. Continuity of the rudder cables was established from the front bellcrank to the aft bellcrank. The right side front rudder bellcrank was consumed by fire. The left front to right front rudder bellcrank interconnect rod was bent and fire damaged.

Figure 16 - Rudder Post

Figure 17 - Rudder

9.0 Control Cable Continuity

No evidence of any pre-impact anomalies (such as corrosion, wear, or misrouting) were found on the primary or secondary flight control cables. Cable separations were attributed to impact overload and/or thermal exposure.

10.0 Landing Gear

All three landing gear were exposed to post-impact fire. Both main landing gear assemblies were found in a retracted position. The nose landing gear was deformed, and appeared to be in a near-retracted position. The landing gear actuator housing was burned away. The left main landing gear actuator rod and the nose gear actuator rod were positioned in the retracted position relative to the main actuator drive gear, which was exposed due to thermal damage. The right actuator rod separated from both the actuator and the right main landing gear, and was located near the separated right wing. The right tire was partially consumed by post-impact fire.

Figure 18 - Right MLG

11.0 Fuel Selector Valve

The fuel selector valve remained attached to the left front cockpit mounting location. The valve was exposed to post-impact fire. The selector valve placard was burned away. The selector valve handle was found pointing toward the left main tank selected position, and was within its corresponding detent. The valve and attached fuel strainer were photographed and labeled prior to removal from the wreckage at the impact site. All safety wires were found in place prior to

disassembly. The selector valve and fuel strainer were disassembled and photographed during the post-recovery examination.

Examination of the fuel selector valve revealed that the valve was selected to the left main tank. The port from the left main fuel tank was open to the port leading to the engine. Air blown through the valve passed from the left fuel tank port to the engine port freely. Further disassembly revealed no obstruction in the valve and no ability to flow air from the right fuel tank port to the engine feed port. The selector valve design is such that when the selector handle is in a detent (which was the as-found condition), the valve is completely aligned with the ports, enabling unrestricted fuel flow.

The fuel strainer fuel screen revealed some thermal damage. The screen was found clear and free of any visible particles or occlusions.

Figure 19 - Fuel Selector As Found

Figure 20 - Fuel Selector After Removal

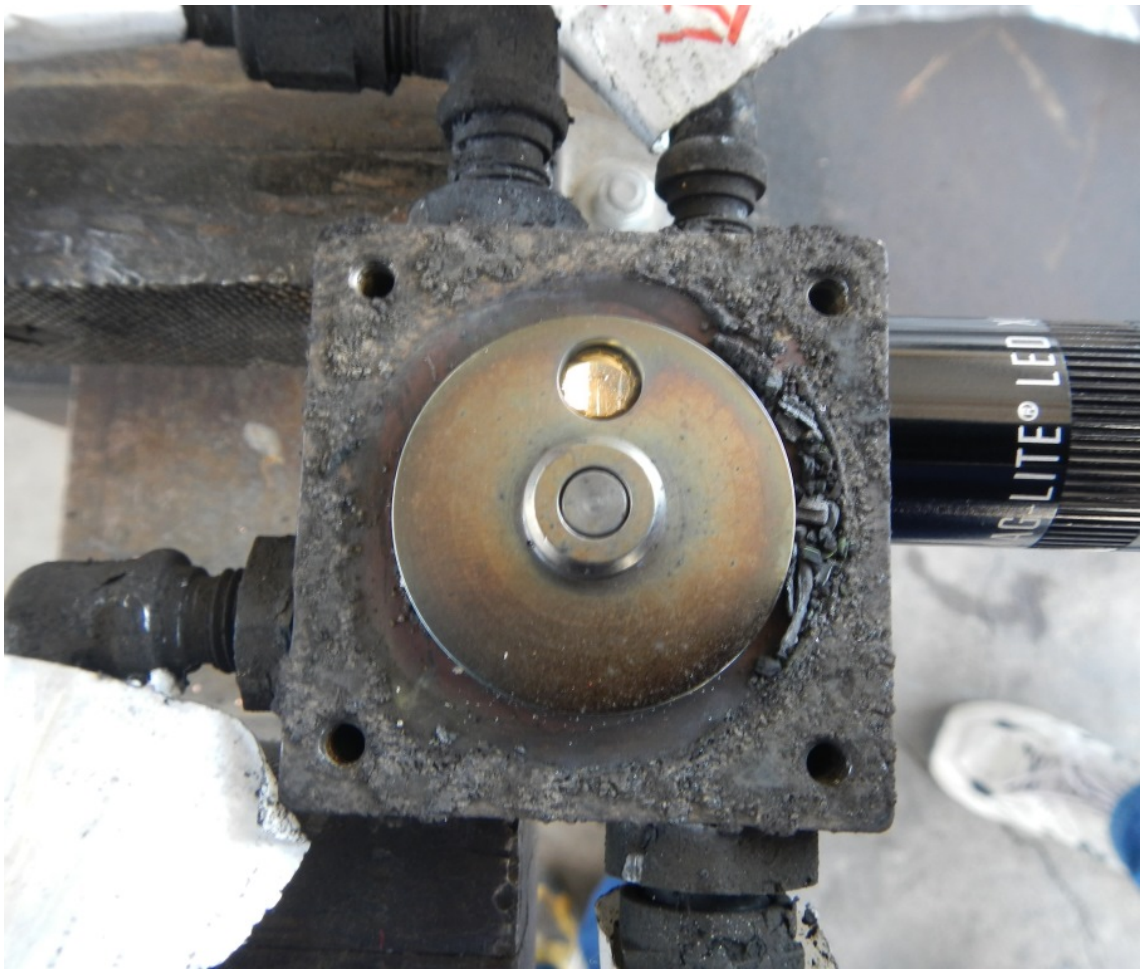

Figure 21 - Fuel Selector (Note lighted port and flashlight)

12.0 Fuel Boost Pumps

The instrument panel switch for the airplane's primary fuel boost pump was not located in the wreckage. The fuel boost pump was not located during the on-scene or post recovery examinations, due to the fact that the TKS pump was incorrectly identified as the fuel boost pump. A separate effort to locate and examine the fuel boost pump was initiated on June 4. Those results will be documented separately from this report.

One fuel boost pump (of two installed) from the Osborne tip tank installation was recovered intact from the left wing. The right wing pump for the tip tank installation was not recovered.

Figure 22 - Left Tip Tank Fuel Pump

13.0 TKS System Pump

The TKS system pump was found in the left wing. Initially it was incorrectly identified as the fuel boost pump during the on-scene and post recovery examinations. The TKS pump was exposed to post-impact fire, was impact damaged and was found near the separated right wing. The electric motor was impact damaged and bent. The drive rod from the motor to the pump remained engaged to the pump rotor, and the blades that sit within the rotor were not visible. The pump housing was partially melted and solidified around the rotor. The rotor could not be rotated by hand. The rotor did not reveal any rotational scoring.

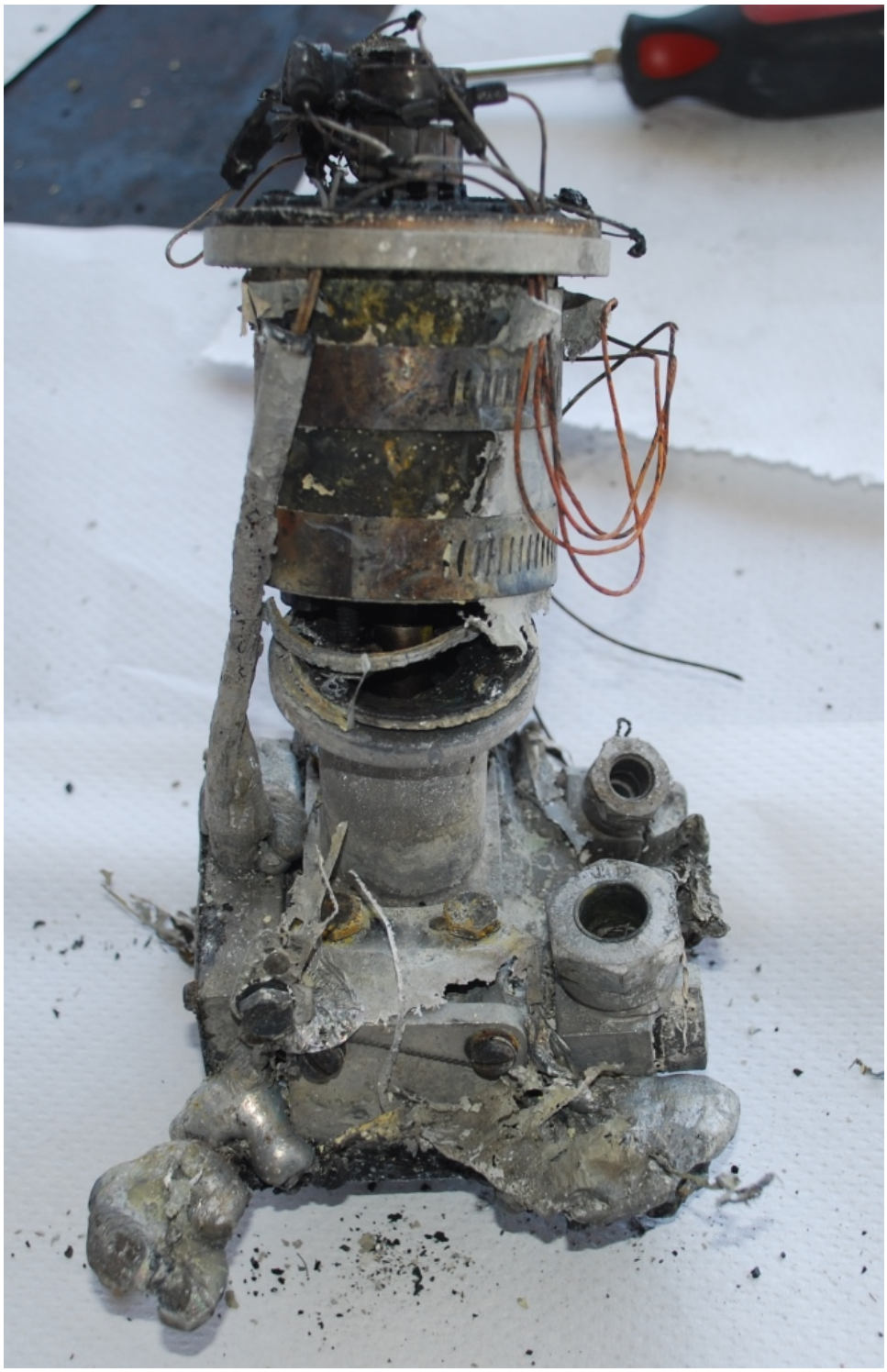

Figure 23 - TKS Pump

14.0 Cockpit and Instruments

The cockpit/cabin was significantly damaged or consumed by the post-impact fire. No useful information was able to be obtained from the instruments, switches, circuit breakers, or engine controls.

The pitot tube was observed in the wreckage. It did not bear any evidence consistent with it being covered during the impact or fire.

Figure 24 - Circuit Breaker and Switch Panel

Figure 25 - Instrument Panel

Figure 26 - Instruments

Figure 27 - Instruments

Figure 28 - Engine Control Quadrant Remnants

F. ENGINE INFORMATION

1.0 General

The Continental Motors (CMI) IO-550-B39 engine (Serial Number: 684677) came to rest in an upright position, but with the left side (even-numbered cylinders) lying low. The engine was separated from all four engine mounts, but came to rest adjacent to the firewall. The engine throttle, propeller, and mixture control cables remained attached to the throttle quadrant and their respective components. Electrical wires and cables also remained attached to the firewall and engine accessories.

Figure 29 - Top of Engine

Figure 30 - Top of Engine (View aft)

Figure 31 -Engine Aft/Accessory Face

2.0 Engine-Driven Fuel Pump

The engine driven fuel pump (EDP, CMI Part Number: 646212-18, Serial Number: B00HA286) remained attached and secured to the backside of the engine with its fuel lines/fittings in place. The pump cooling shroud and scat tubing remained in place. The fuel lines to and from the pump were removed. The fuel pump was removed from the engine, and its drive coupling was found in place and intact. Manual rotation of the drive coupling while installed in the fuel pump drive shaft resulted in rotation of the shaft; however, there was some binding noted (likely due to internal coking from intense thermal exposure). The fuel pump safety wire was in place and was secured with the original lead seal. The fuel lines were thermally damaged, but their fire sleeves remained in place. Removal of the fuel lines resulted in charred hose matter pouring from some of the lines. Removal of the fuel line fittings from the fuel pump revealed a significant amount of material accumulated in the vapor return outlet area (no other ports contained similar material). The material was partially removed and bagged for further examination by the NTSB Materials Laboratory. No other anomalies were noted with the fuel pump besides thermal damage. The pump will be shipped to CMI where it will remain in bonded storage until an examination with federal oversight can be scheduled.

Figure 32 - Engine Driven Pump (In place)

Figure 33 - Engine Driven Pump

Figure 34 - EDP Drive Link (Intact)

Figure 35 - Debris in EDP

3.0 Throttle Body/Fuel Metering Unit

The throttle body/fuel metering unit (CMI Part Number: 649468-2, Serial Number: A00HA381) was normally positioned on the bottom side of the engine, which is where it was located during the on-scene examination. The fuel inlet and return fittings remained attached to the metering unit; however, the fuel outlet fitting was fractured within the fuel metering unit body. The idle mixture adjustment linkage was fractured with bending deformation damage being observed at the threaded portion of the linkage. The throttle and mixture control levers remained attached and secured to their respective control shafts and no slipping was noted between the shafts and levers. The fuel inlet screen was removed and found clear and unobstructed. The mixture control shaft could not be rotated with a manual manipulation of the mixture control lever. Examination of the mixture control shaft through the fuel inlet port revealed charred debris adhering to the shaft and walls of the metering unit. None of the throttle body remained intact. The throttle plate remained attached to the throttle shaft and lever.

Figure 36 - Throttle Body (in place)

Figure 37 - Throttle Body and Metering Unit

Figure 38 - Metering Unit and Screen

4.0 Fuel Manifold Valve

The fuel manifold valve (CMI Part Number: 64650847A5, Serial Number: C00HA348) remained intact and attached to the topside of the engine. The fuel injector lines remained attached to the manifold valve. The fuel injector lines remained intact. The lines were removed and the manifold valve was detached from its mounting bracket. The fuel manifold valve's safety wire remained in place, intact, and secured with its lead seal. The manifold valve was disassembled and the diaphragm was stuck to the cap and the housing of the manifold valve. To remove the diaphragm cap a hammer had to be used to dislodge the cap from the diaphragm. The diaphragm was brittle (likely due to the excessive thermal exposure from the post-crash fire as opposed to dry rot) and tore when the cap was removed. The spring was in place between the cap and the diaphragm. The plunger was secured to the diaphragm and the screen was clear. No obstructions were noted.

Figure 39 - Fuel Manifold Valve

Figure 40 - Manifold Valve Diaphragm

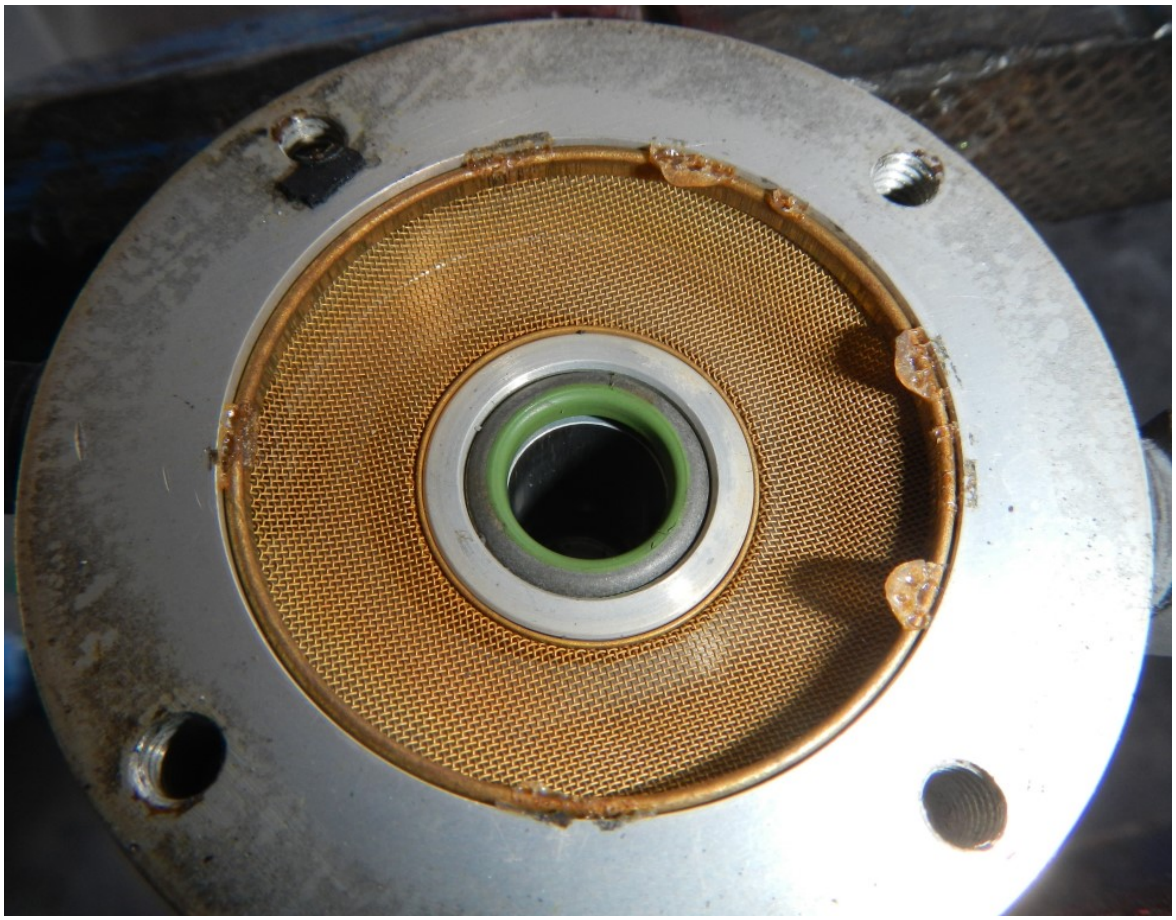

Figure 41 - Manifold Valve Screen

5.0 Fuel Injection Nozzles

The fuel nozzles were removed from their respective cylinders. None of the nozzles were blocked; however, the #5 nozzle displayed some debris within its discharge orifice.

Figure 42 - Fuel Injector Nozzles

Figure 43 - Exemplar Nozzle (note clear orifice)

Figure 44 - Injector Nozzle from No. 5 Cylinder (note partial obstruction)

6.0 Ignition System

Examination of the ignition system revealed that the magnetos were in place and secured to their mounting pads on the topside of the engine (LH Magneto: Slick, Part Number: 6310, Serial Number: 00091583; RH Magneto: Slick, Part Number: 6310, Serial Number: 00091606). There was no evidence of magneto slippage (with respect to the engine) and manual manipulation of the magnetos did not result in any rotation of the magnetos relative to the engine.

The ignition harnesses remained attached to the magnetos but they sustained significant thermal damage. The ignition leads remained attached to their respective spark plugs (Champion RHB32S). The ignition leads were removed from the spark plugs and both the top and bottom

spark plugs from each cylinder were removed. Comparing the spark plugs to the Champion Aviation Service Manual (AV6-R) revealed that the fine-wire spark plugs displayed a normal worn condition with light carbon soot on the #5 cylinders top and bottom spark plugs. The #5 top spark plug also displayed a globule of solidified lead down in the barrel at the base of the insulator; however there was no evidence of lead fouling on any of the spark plugs. The #2 bottom, #4 bottom, and #6 top and bottom spark plugs displayed oil coating (the engine was resting with the even side cylinders low).

Figure 45 - Magnetos and Harnesses

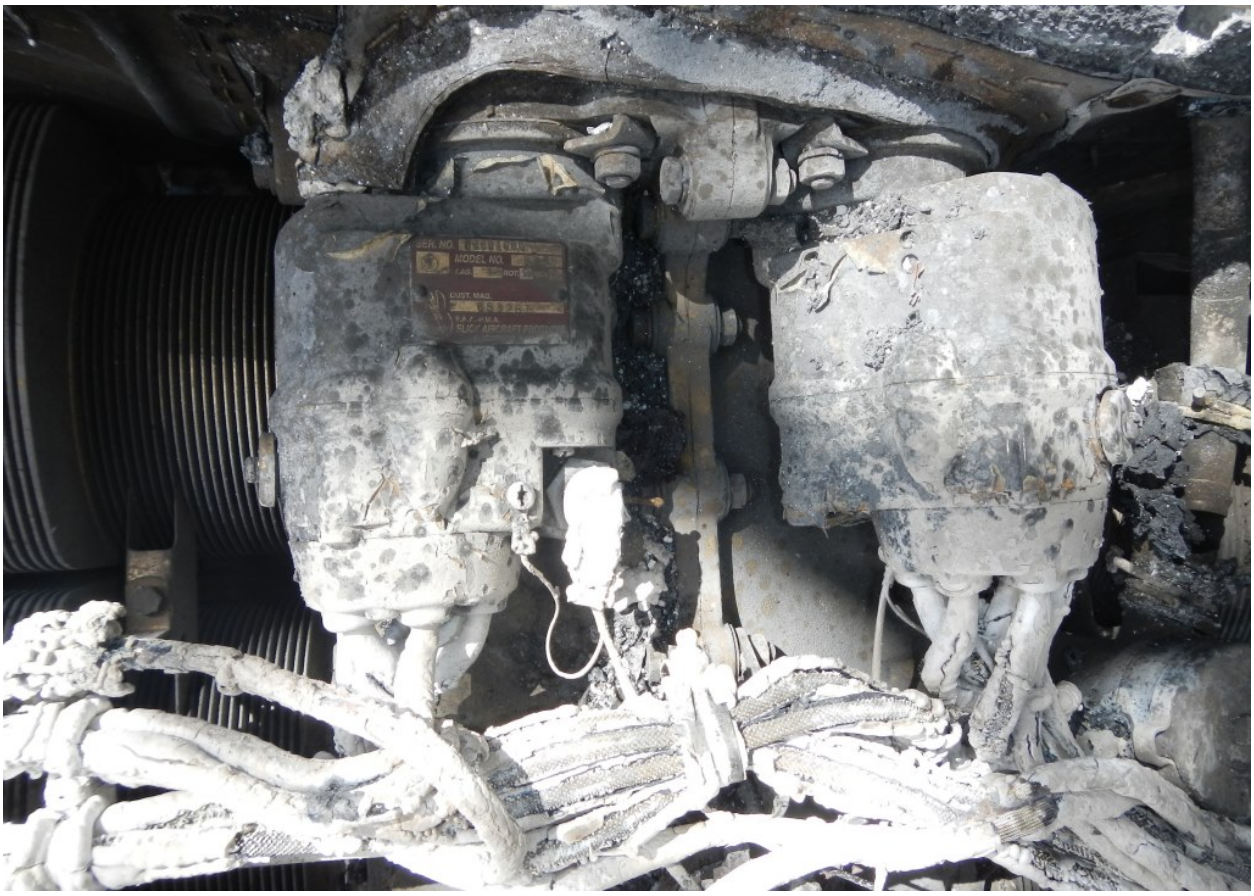

Figure 46 - Magneto Close-up

Figure 47 - Spark Plugs

7.0 Internal Drive Train and Cylinders

With the spark plugs removed, the engine's crankshaft was rotated by manually rotating the propeller. During rotation, audible snaps of the impulse couplings could be heard. A magneto-to-engine timing test was conducted with both magnetos being timed to within 1° of the specified 22° before-top-dead-center (BTDC) ignition point and within 1° of each other. Due to the thermal damage sustained by the ignition harnesses, a decision was made to ship the magnetos to CMI for a federally supervised bench test with a new ignition harness.

An examination of the cylinders with a lighted borescope was conducted. There were no anomalies noted with the cylinder barrels, pistons, valves, or valve seats. Only light deposits (consistent with the combustion process) were noted in each of the cylinders. A thumb compression test was conducted, and compression was obtained on all six cylinders, verifying crankshaft and connecting rod continuity. Manual rotation of the propeller also resulted in movement of all of the rocker arms, verifying camshaft continuity.

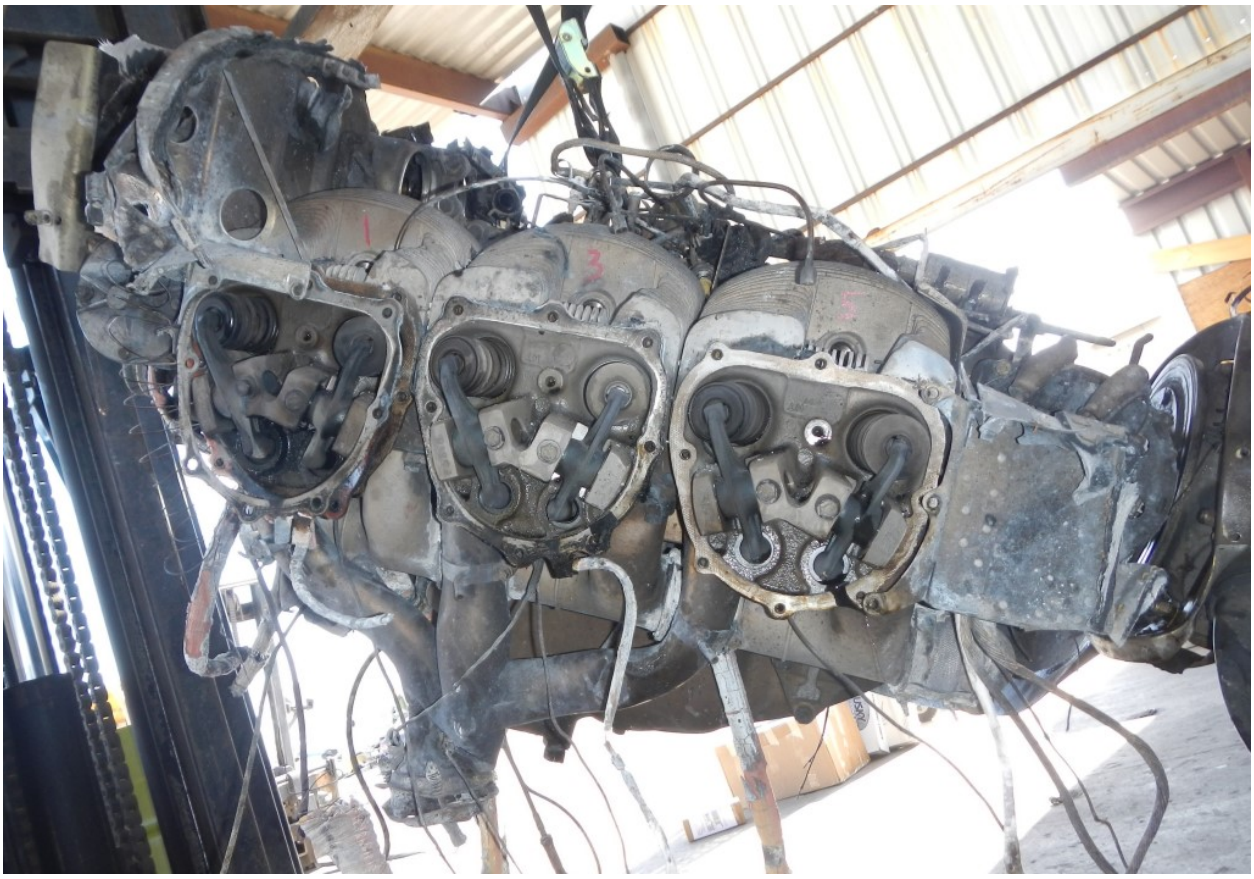

Figure 48 - Right Cylinder Bank

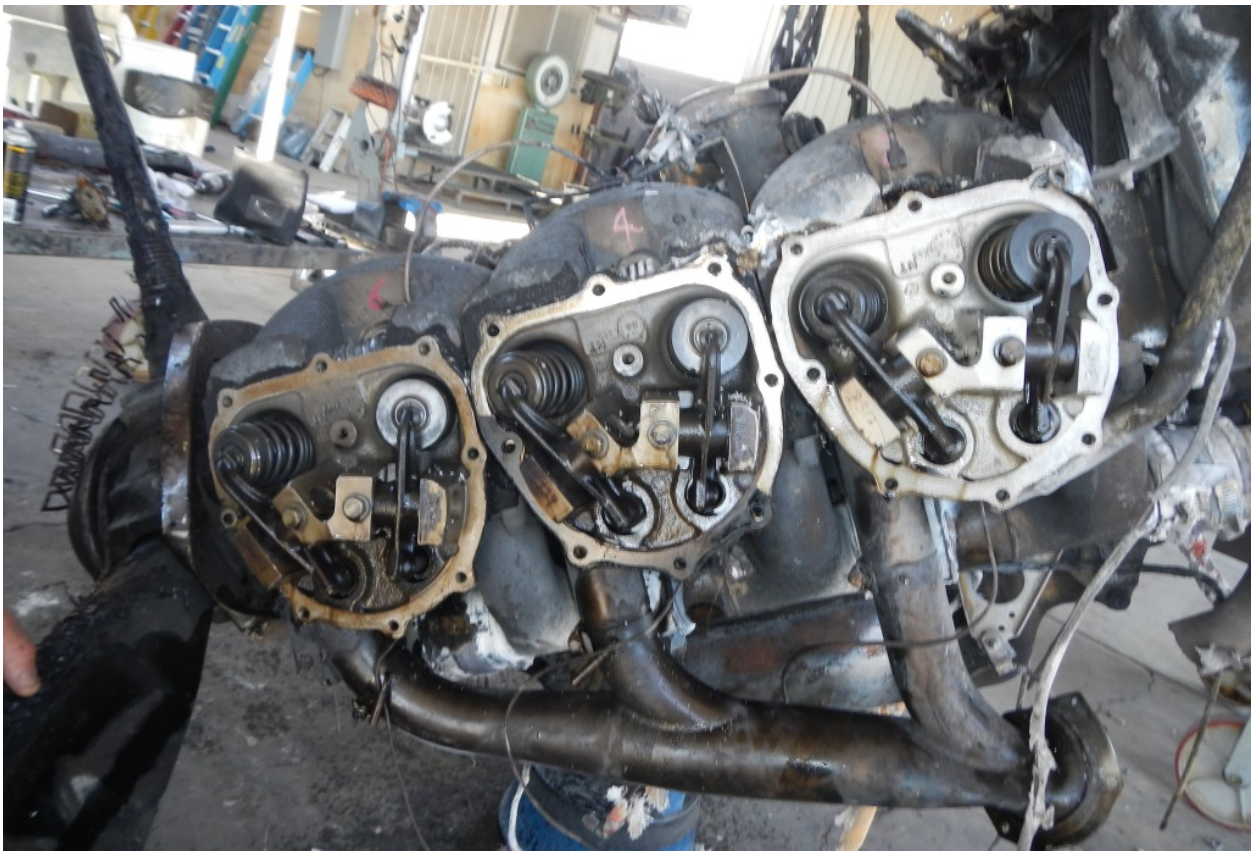

Figure 49 - Left Cylinder Bank

8.0 Lubrication System

The oil filler cap/dipstick was removed from the oil filler neck while the engine was in a near level attitude, and 10 quarts of oil registered on the dipstick. The oil cooler remained intact and secured to the aft left end of the engine. The oil filter was removed from the oil filter adapter and was cut open using an oil filter cutting tool. The filter element sustained thermal damage and was brittle; however, no metallic debris was noted within the folds of the filter element. The oil pump housing cap was removed and the oil pump gears were found intact and undamaged. Some thermal coking/discoloration was noted on the gears due to thermal exposure from the post-accident fire. Removal of the drive and idler gears did not reveal any anomalies to the gears or housing walls. Rotation of the propeller with the oil pump housing cap removed revealed normal rotation of the oil pump gears.

Figure 50 - Oil Pump

Figure 51 - Oil Filter

9.0 Vacuum System

The vacuum pump, alternator, and starter motor/starter adapter remained secured to their respective mounting pads on the engine. The vacuum pump drive shaft was melted away, and resolidified remnants could be seen adhering to the bottom side of the vacuum pump mounting base. An electrically-powered standby vacuum pump and motor assembly was found fracture-separated from the airplane

G. PROPELLER INFORMATION

The three-bladed Hartzell propeller (Serial Number: EE37473) remained attached to the crankshaft's propeller flange. The blades were arbitrarily labeled A, B, and C for the purposes of the examination. All three propeller blades remained attached to the propeller hub, but two of the blades (blades A and B) were separated from their pitch change links, as evidenced by the fact that they could be rotated within the hub without affecting the other blades.

Blade A was rotated in the hub about 180 degrees from its normal orientation, or about 50 degrees from the plane of rotation; the de-icing element was positioned away from the direction of normal rotation. Blade A was bent forward about 40 degrees beginning about its mid-span point. The tip of blade A separated from the blade approximately 30 inches from the hub. The separated section, identified as A', was found in the disturbed earth/rock adjacent to the depression attributed to the propeller/engine impact. Blade A displayed some deep leading edge gouges.

Blade B was bent forward about 20 degrees, beginning about the mid span point. The tip of propeller blade B separated approximately 28 inches from the hub. The inboard portion of the separated tip section, identified as B', was found about 115 feet, on an approximate bearing of 115 degrees magnetic, from the main wreckage. That segment was not sooted or fire-damaged. Exclusive of the separated outboard section, blade B displayed some light to moderate leading edge gouging.

Blade C was bent aft about 30 degrees at its midpoint and twisted toward low pitch. Its tip remained attached, but was curled aft more than 180 degrees. Blade C displayed heavy leading edge gouging, mostly on the outboard span section.

The propeller assembly was shipped to Hartzell for detailed examination. Those results are documented separately from this report.

Figure 52 - Propeller

Figure 53 - Blade 'A' with Tip Fragment

Figure 54 - Blade 'B' with Missing Tip

Figure 55 - Blade 'C'

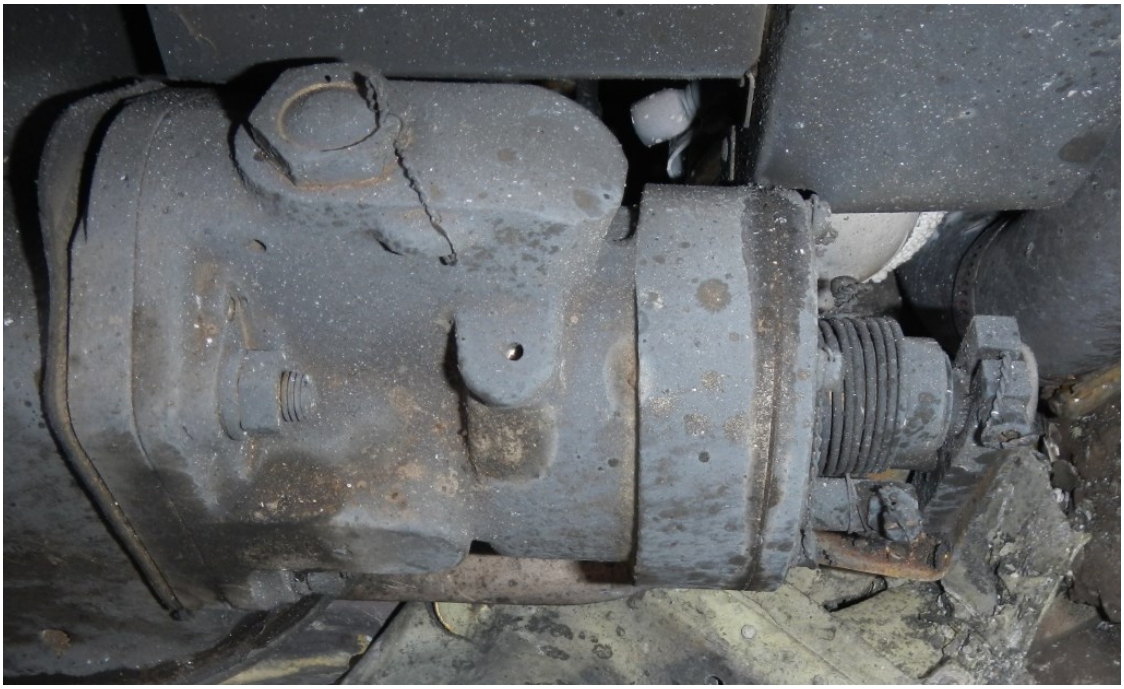

Figure 56 - Propeller Governor

Three 2.5-inch diameter branches and one 4-inch diameter tree displayed fresh cuts consistent with propeller blade strikes. The propeller governor remained attached and secured to its mounting pad and the propeller control cable remained attached to the control lever.

Figure 57 - Cut Tree Sections

H. FOLLOW-UP ACTIVITIES

1.0 Components to CMI

Several components were culled from the wreckage and sent to CMI for detailed examinations Those components included the following:

- Both Magnetos
- Spark plugs
- Engine-Driven Fuel Pump
- Fuel Metering Unit
- Fuel Nozzles
- Electric Fuel Boost Pump
- Cylinder #5

Those results are documented separately from this report.

2.0 Items to NTSB Laboratories

A JPI EDM-700 device was recovered and sent to the NTSB Recorders Laboratory for download. Contaminant samples from the engine-driven fuel pump were sent to the NTSB Materials Laboratory. Those results are documented separately from this report.