National Transportation Safety Board
Office of Aviation Safety
Washington, DC 20594

ERA23FA033

FUEL SYSTEM EXAMINATION SUMMARY

April 4, 2024

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A. ACCIDENT

Location: Keene, New Hampshire
Date: October 21, 2022
Time: 1845 EDT
2245 coordinated universal time (UTC)
Airplane: N8020R, Beech A24R

B. FUEL SYSTEM EXAMINATION SUMMARY

IIC — Timothy W. Monville
NTSB-Office of Aviation Safety/ERA
Washington, DC

Party Coordinator — Ken Stachurski
AVStar Fuel Systems, Inc.
Jupiter, Florida

C. SUMMARY

On October 21, 2022, about 1845 eastern daylight time, a Beech A24R, N8020R, was destroyed when it was involved in an accident near Dillant/Hopkins Airport (KEEN), Keene, New Hampshire. The flight instructor and commercial-rated pilot were fatally injured. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 personal flight.

Prior to departure from KEEN, airport security video depicted the airplane taxi to the fuel farm where 24.380 gallons of 100 low-lead fuel were purchased. Following fuel purchase, a witness noted the airplane taxi to the approach end of runway 02.

According to recorded audio from the common traffic advisory frequency (CTAF), about 1843 EDT, an occupant of the airplane called on the frequency that the flight was departing from runway 02 and would remain in the airport traffic pattern.

According to several witnesses who were located on-airport, one of whom was a pilot and the other was a pilot and airframe and powerplant mechanic, the engine sounded abnormal with the pilot exclaiming that it never sounded smooth during the entire time the airplane was on the runway or while airborne. The pilot-rated mechanic stated that when the flight was airborne along the runway he heard a momentary power reduction, followed by a power advance. The flight continued and was noted to be in a very shallow climb, by witness accounts climbing to between 50 and no higher than about 200 ft when the flight was near the intersection of runways 02/20 and 14/32, which was about 5,200 ft down the runway, with about only 1,000 ft

of runway remaining. The flight continued in a wing and nose level attitude while several witnesses who were located northwest of the departure end of the runway reported the poor engine sound continued. A witness located about .5 nautical mile north-northeast from the departure end of runway 02 reported the airplane was flying not much higher than 50 ft above ground level when it flew by him. When he heard the airplane, he reported hearing pop pop sounds then the airplane began descending and the engine sound became louder but the popping sound stopped when the flight was descending. He heard the impact and ran to the accident site.

The airplane impacted into a storage building attached to a 2-story wood frame apartment building that had 5 separate apartments. There was no distress call made by an occupant of the airplane on the CTAF.

During postaccident examination of the engine, the fuel injector nozzles were removed from each cylinder and none had an insert or restrictor installed.

Figure 1: Close-up Examination of the Fuel Injector Nozzles After Removal from Engine. Note the lack of an insert of restrictor on the lower portion of each nozzle.

Following examination of the engine and its systems, the engine fuel system components consisting of the servo fuel injector, manifold valve, injector lines and fuel injector nozzles without inserts were shipped on December 15, 2022 to AVStar Fuel Systems, Inc., via UPS Ground 1ZA3978T0391011563. The package was delivered on December 20, 2022, and remained secured pending Virtual Examination by NTSB.

D. DETAILS OF THE FUEL SYSTEM INVESTIGATION

1.0 Engine and Fuel System Information

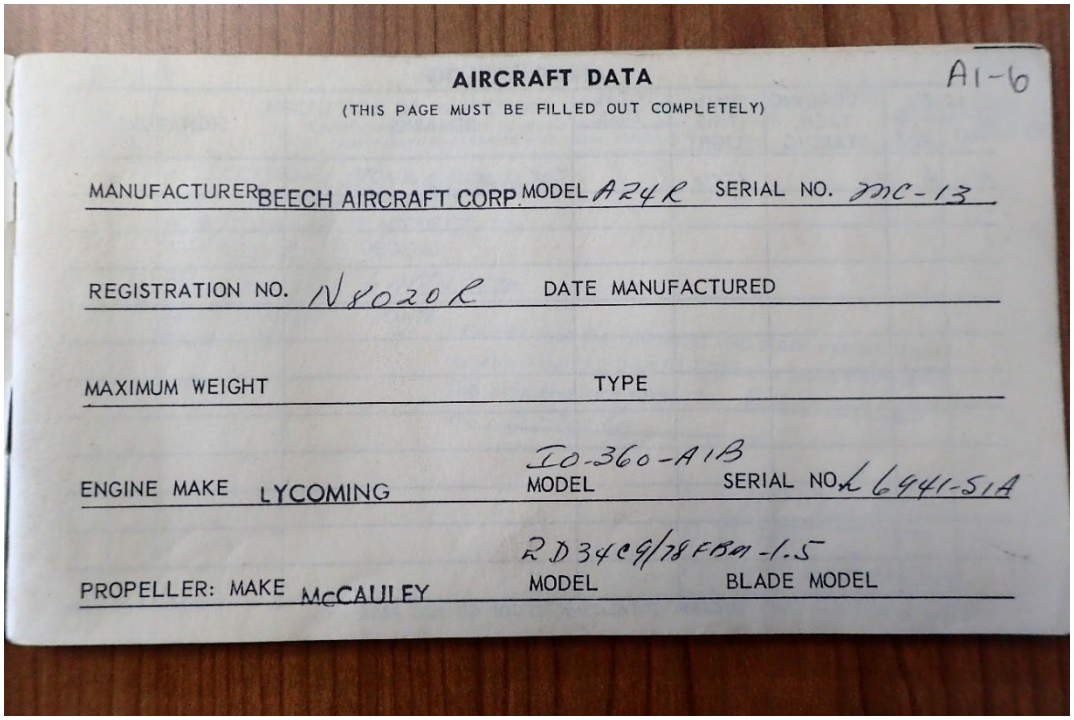
1.1 Basic Engine and Fuel Injection System Information

The Beech A24R was equipped with one Lycoming IO-360-A1B engine. It is a fuel injected, direct drive, air cooled, horizontally opposed 4 cylinder engine rated at 200 horsepower. The takeoff and maximum continuous operation at sea level was 2,700 rpm at full throttle.

The fuel injection system consists of a servo fuel injector with attached throttle and mixture control levers that connect via cables to the throttle and mixture controls in the cockpit. Metered fuel from the servo fuel injector flows via a flexible hose to a fuel manifold assembly, or distributor valve, then via hard stainless steel fuel injector lines connected to the end of a fuel injector nozzle installed in each cylinder.

1.2 Engine and Fuel Injection Nozzle History

The engine, a Lycoming IO-360-A1B, SN L-6941-51A was built in accordance with ENPL 3244 on November 19, 1969, and sold to Beechcraft.


AIRCRAFT DATA A1-6

(THIS PAGE MUST BE FILLED OUT COMPLETELY)

MANUFACTURER BEECH AIRCRAFT CORP. MODEL A24R SERIAL NO. MC-13

REGISTRATION NO. N8020R DATE MANUFACTURED

MAXIMUM WEIGHT TYPE

ENGINE MAKE LYCOMING MODEL IO-360-A1B SERIAL NO. L6941-51A

PROPELLER: MAKE McCAULEY MODEL 2D34C9/78FBM-1.5 BLADE MODEL

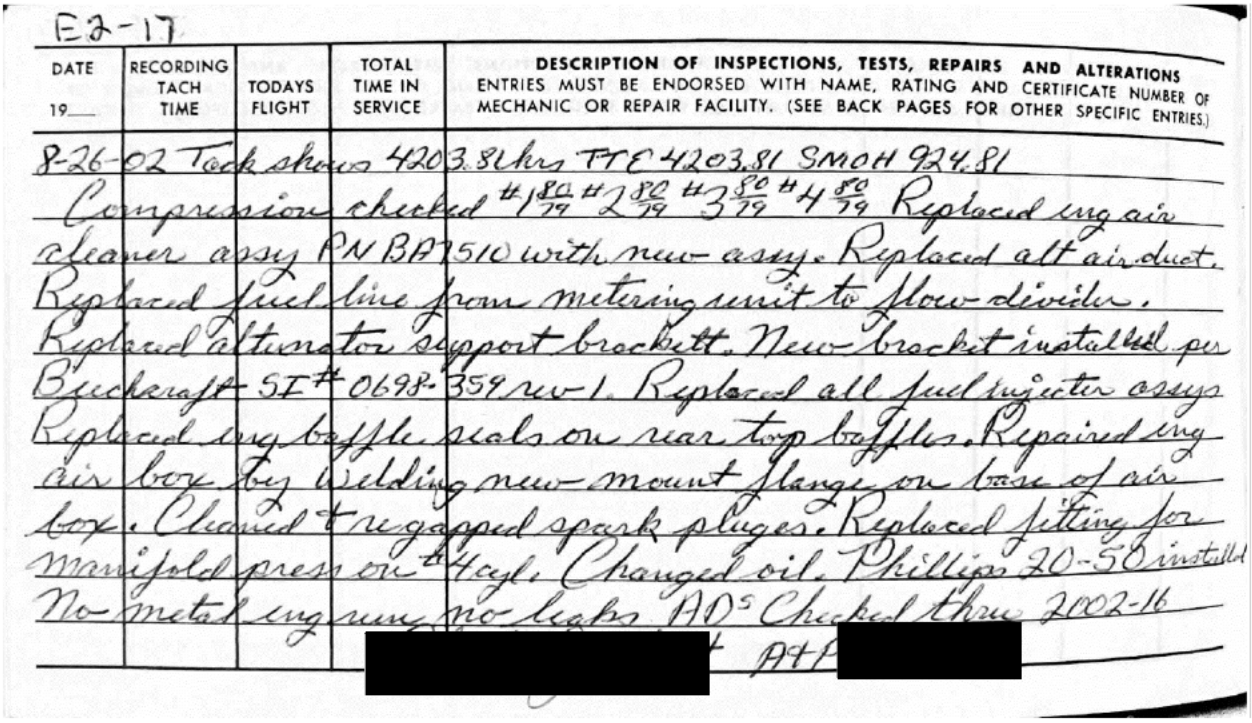
Figure 2: Page from 1st Airframe Logbook Showing Installed Engine Serial Number.

Based on the original ENPL 3244 and the engine production date, the engine would have had one-piece fuel injector nozzles installed, part number (P/N) 74151. Those nozzles were utilized until Engineering Change Order (ECO) 21447 dated May 7, 1981 at which time a cleanable two-piece fuel injector nozzle P/N LW-18265 was utilized[1].

Lycoming Service Instruction (SI) 1414B, which include Allied Bendix Aerospace (Bendix) Service Bulletin (SB) No. RS-77, Issued June 15, 1981, and Rev 2, issued November 15, 1986, introduced a new two-piece nozzle with removable fuel restrictor. The Bendix SB specified the two-piece fuel injector nozzle as Lycoming P/N LW-18265 which correlated to Bendix P/N 2524864, with a nomenclature "Air Bleed Nozzle Assembly."

1.3 Fuel Injection Servo and Fuel Injector Nozzle Maintenance

A review of engine maintenance records revealed an August 26, 2002 entry, at engine time of about 4204 hours indicating all fuel injector nozzles were replaced. The entry did not specify the P/N of the installed nozzles.



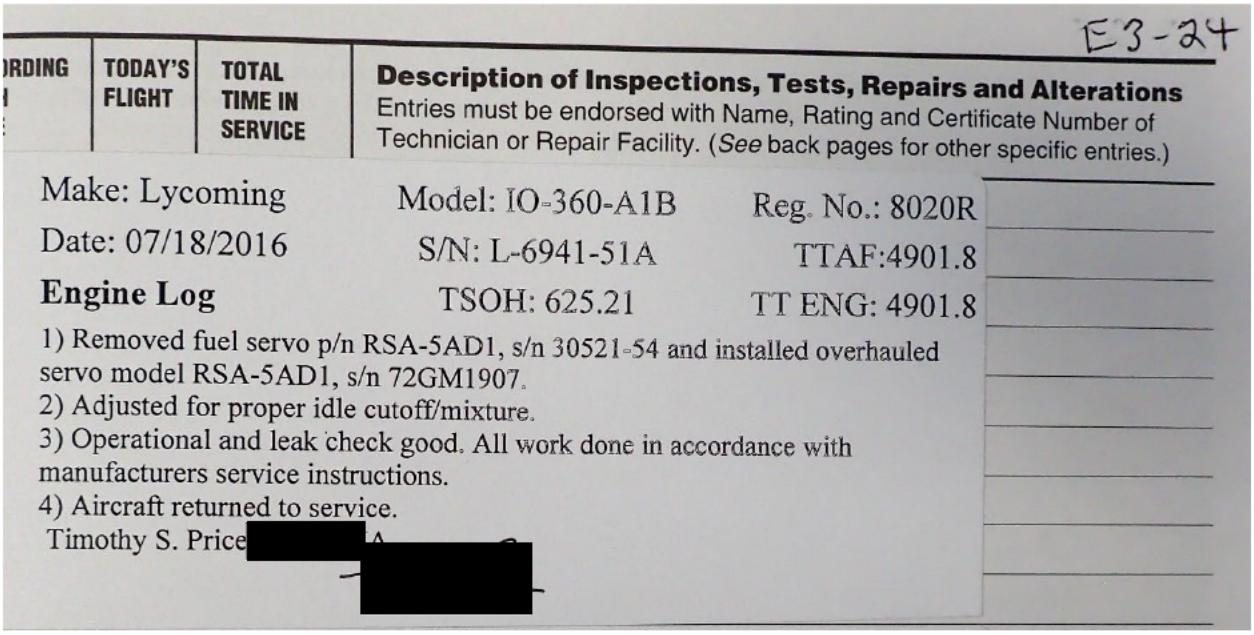
E2-17

DATE 19__	RECORDING TACH TIME	TODAYS FLIGHT	TOTAL TIME IN SERVICE	DESCRIPTION OF INSPECTIONS, TESTS, REPAIRS AND ALTERATIONS ENTRIES MUST BE ENDORSED WITH NAME, RATING AND CERTIFICATE NUMBER OF MECHANIC OR REPAIR FACILITY. (SEE BACK PAGES FOR OTHER SPECIFIC ENTRIES.)
8-26-02			4203.8	Tach shows 4203.8 hrs TTE 4203.81 SMOH 924.81 Compressions checked #1 80/79 #2 80/79 #3 80/79 #4 80/79 Replaced eng air cleaner assy PN BA7510 with new assy. Replaced alt air duct. Replaced fuel line from metering unit to flow divider. Replaced alternator support bracket. New bracket installed per Beechcraft SI # 0698-359 rev-1. Replaced all fuel injector assys Replaced eng baffle seals on rear top baffles. Repaired eng air box by welding new mount flange on bottom of air box. Cleaned & regapped spark pluges. Replaced fitting for manifold press on #4 cyl. Changed oil. Phillips 20-50 installed No metal in eng sump no leaks AD's Checked thru 2002-16 [redacted] A&P [redacted]

Figure 3: Entry for Fuel Injector Nozzle Replacement.

[1] According to Lycoming Service Instructions (SI) No. 1532N, Approved Fuel Injectors, Fuel Manifold Assemblies, and Fuel Nozzle Assemblies for Lycoming Engines, the approved fuel nozzle for the accident engine by make and model was Lycoming P/N LW-18265.

Review of the maintenance records revealed that the fuel injection servo was overhauled and then installed on July 18, 2016, at engine total time of about 4,902.



E3-24

ORDING	TODAY'S FLIGHT	TOTAL TIME IN SERVICE	**Description of Inspections, Tests, Repairs and Alterations** Entries must be endorsed with Name, Rating and Certificate Number of Technician or Repair Facility. (*See* back pages for other specific entries.)

Make: Lycoming Model: IO-360-A1B Reg. No.: 8020R

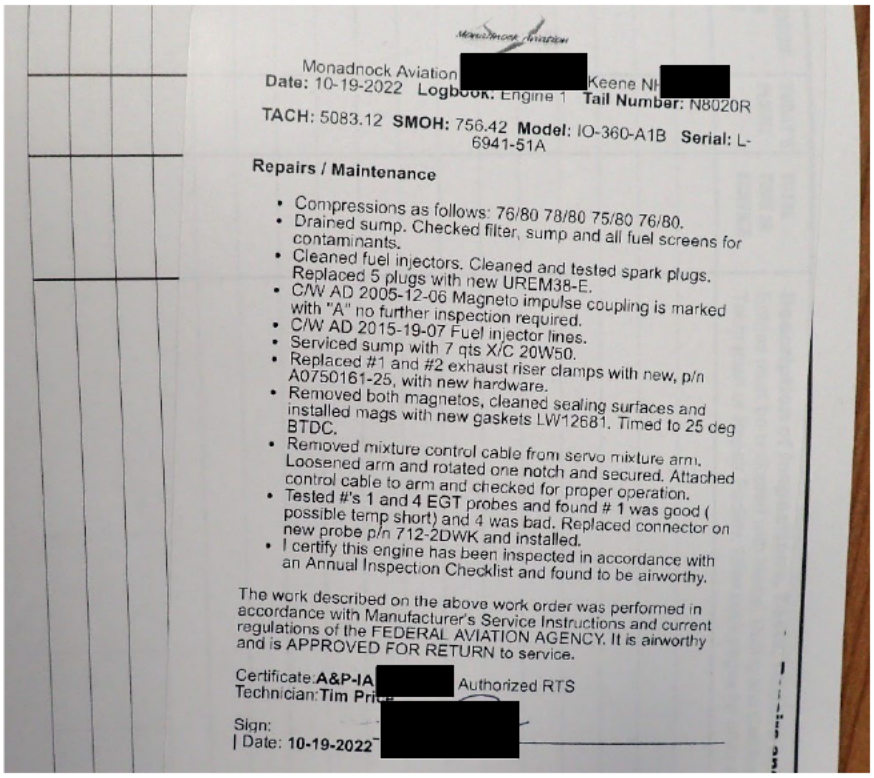
Date: 07/18/2016 S/N: L-6941-51A TTAF:4901.8

Engine Log TSOH: 625.21 TT ENG: 4901.8

1) Removed fuel servo p/n RSA-5AD1, s/n 30521-54 and installed overhauled servo model RSA-5AD1, s/n 72GM1907.
2) Adjusted for proper idle cutoff/mixture.
3) Operational and leak check good. All work done in accordance with manufacturers service instructions.
4) Aircraft returned to service.
Timothy S. Price [redacted]

Figure 4: Entry for Fuel Injection Servo Installation After Overhaul.

Between July 18, 2016 and June 10, 2022, there was no entry indicating the fuel injection servo was removed, replaced, or repaired. The last entry in the Engine logbook dated October 19, 2022, indicated that the fuel injectors were cleaned. The same entry also indicated that the mixture control cable was removed from the mixture lever at the fuel injection servo, the lever was loosened and rotated one notch, and then the lever was secured, the mixture control cable reattached, and was checked for proper operation.



Monadnock Aviation [redacted] Keene NH [redacted]
Date: 10-19-2022 **Logbook:** Engine 1 **Tail Number:** N8020R

TACH: 5083.12 **SMOH:** 756.42 **Model:** IO-360-A1B **Serial:** L-6941-51A

Repairs / Maintenance

- Compressions as follows: 76/80 78/80 75/80 76/80.
- Drained sump. Checked filter, sump and all fuel screens for contaminants.
- Cleaned fuel injectors. Cleaned and tested spark plugs. Replaced 5 plugs with new UREM38-E.
- C/W AD 2005-12-06 Magneto impulse coupling is marked with "A" no further inspection required.
- C/W AD 2015-19-07 Fuel injector lines.
- Serviced sump with 7 qts X/C 20W50.
- Replaced #1 and #2 exhaust riser clamps with new, p/n A0750161-25, with new hardware.
- Removed both magnetos, cleaned sealing surfaces and installed mags with new gaskets LW12681. Timed to 25 deg BTDC.
- Removed mixture control cable from servo mixture arm. Loosened arm and rotated one notch and secured. Attached control cable to arm and checked for proper operation.
- Tested #'s 1 and 4 EGT probes and found # 1 was good (possible temp short) and 4 was bad. Replaced connector on new probe p/n 712-2DWK and installed.
- I certify this engine has been inspected in accordance with an Annual Inspection Checklist and found to be airworthy.

The work described on the above work order was performed in accordance with Manufacturer's Service Instructions and current regulations of the FEDERAL AVIATION AGENCY. It is airworthy and is APPROVED FOR RETURN to service.

Certificate:**A&P-IA** [redacted] Authorized RTS
Technician:**Tim Pri**[redacted]

Sign: [redacted]
Date: **10-19-2022**

Figure 5: Entry for Fuel Injector Nozzles Cleaning and Fuel Injection Servo work.

2.0 Fuel Injection System Examination

2.1 Manifold Valve

Examination of the manifold valve (P/N) 2524232-2, Lycoming P/N 2524232-2-70, serial number (S/N) AC**A**[2]8012, revealed it sustained heat damage that precluded operational testing. The cover screws were in-place and safety wired but there was no lead seal present. During removal of the screws no torque was present. Following removal of the cover the diaphragm was nearly completely destroyed.

[2] Or R.

Figure 6: View of the Manifold Valve Following Removal of the Cover. Note the Heat Destroyed Diaphragm.

The diaphragm P/N (2526388) was displayed in reverse on the interior of the cover. A 2 psi spring was installed (correct). The spool P/N A1598 was in the fully closed position, and no gouges were noted to it.

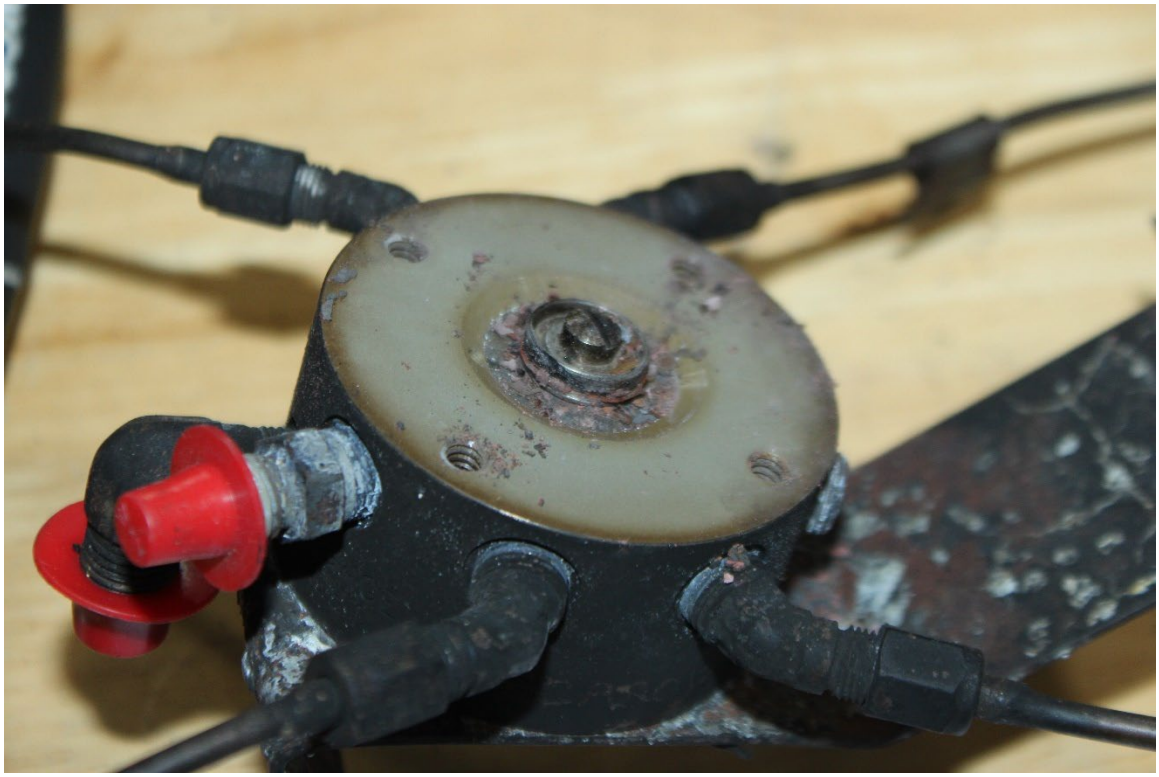


Figure 7: View of the Spool in the Fully Closed Position.

During removal of the cover debris from the heat damaged diaphragm dropped into the bushing area. To facilitate removal of the spool the bracket cover was removed to access the bushing. During removal of the screws, they were noted to be loose (likely due to damage to the gasket).

Figure 8: View of the Heat Damaged Gasket Following Removal Of the Bottom Cover of the Manifold Valve.

Following removal of the bushing it was etched with "A1598." Inspection of the bushing revealed no evidence of wear.

2.2 Fuel Injector Lines

The fuel injector lines were removed and air was blown into each with the following results:

No. 1 – Clear no water.
No. 3 – Clear no water.
No. 2 – Clear no water.
No. 4 – Liquid was ejected from the line onto a bench before sample taken. An additional sample was blown into the palm of a hand and tested to be water using Water Finding Paste. The sample was retained for testing by the NTSB Materials Laboratory for fluoride, though testing was never performed[3].

[3] This was based on the totality of the evidence of the investigation.

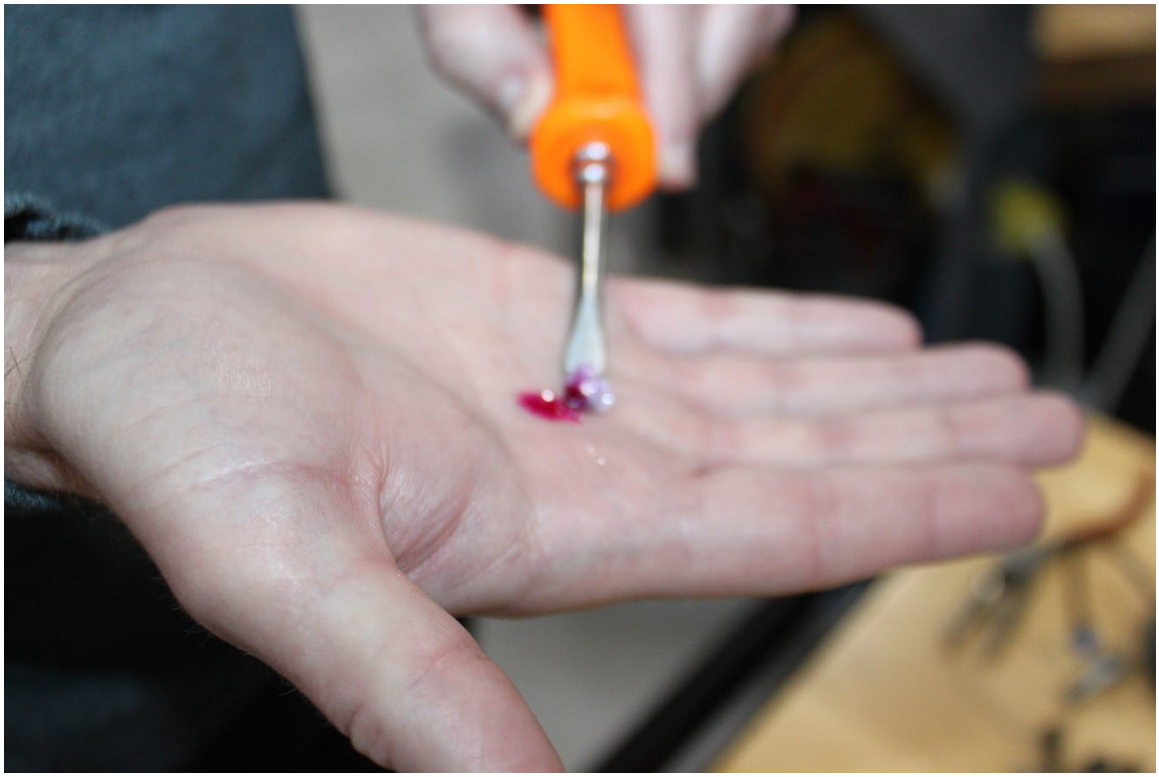


Figure 9: View of the Liquid Drained From the No. 4 Fuel Injector Line and the Positive Results when Tested with Water Finding Paste.

2.3 Fuel Injection Servo

Examination of the servo fuel injector (fuel injector) model RSA-5AD1, parts list 2524054-11, S/N 72GM1907 revealed it sustained heat damage which precluded operational testing.

Figure 10: View of the Heat Damaged Fuel Injector.

The throttle and mixture controls were tightly attached. The mixture control moved freely but the throttle control was frozen in the idle position. The hex plug was stamped with "G" indicating compliance with Precision Airmotive LLC Service Bulletin PRS-107, dated July 16, 2008, and Federal Aviation Administration (FAA) Emergency Airworthiness Directive (AD) 2008-06-51, issued March 12, 2008. The regulator cover was safety wired with a lead seal present; the lead seal was marked with "PAM" which was consistent with Precision Airmotive. The idle mixture adjustment was towards a slightly lean position. A crack was noted in the bore (likely impact). The venturi was removed and no blue stain was noted. All 3 packings were cracked due to the fire. All impact tubes were clear.

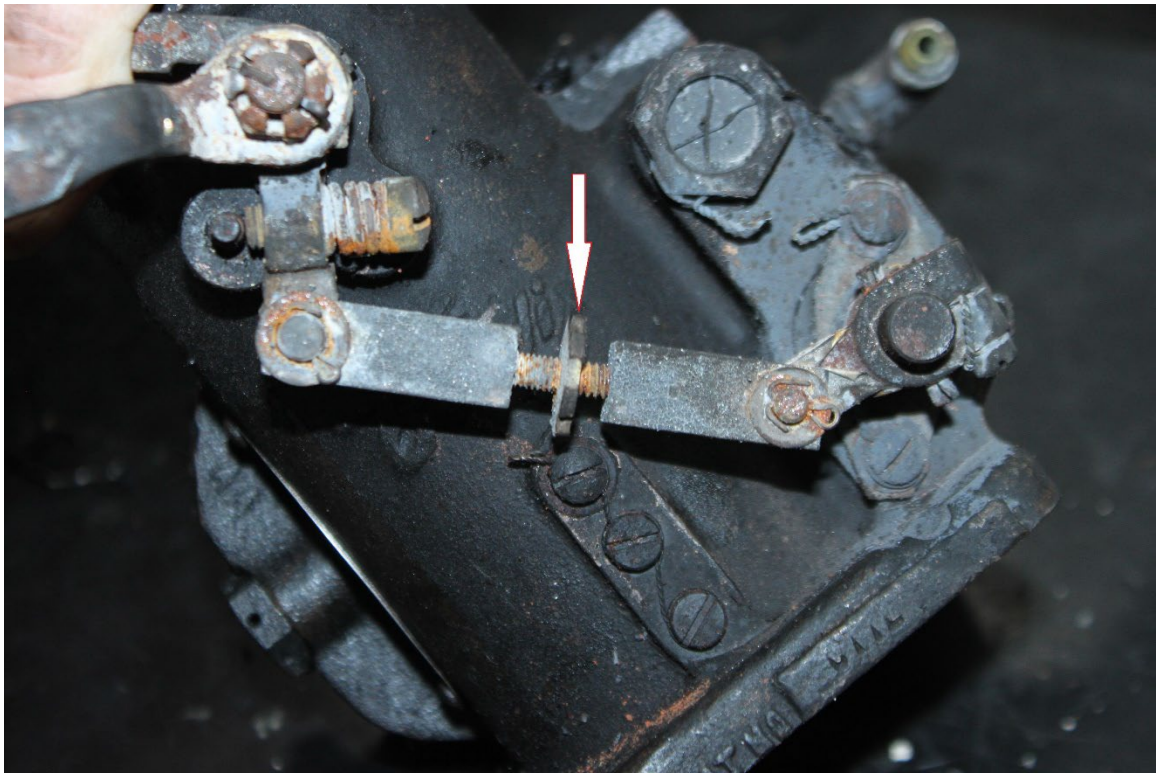


Figure 11: Arrow Points to Idle Mixture Adjustment Towards a Slightly Lean Condition.

The regulator screws were within limits but the cover was loose. The remains of aluminum from the aluminum coated gasket was found beneath the regulator hex plug. Following removal of the regulator hex plug, the self-locking nut was in place on the fuel diaphragm stem and 2 threads were extended beyond the end of the nut. The nut was torque checked with a calibrated wrench[4] and the tightening torque check of the nut was within limits. The regulator appeared to be hanging up.

[4] The torque wrench was calibrated June 2, 2022, and due June 1, 2023.

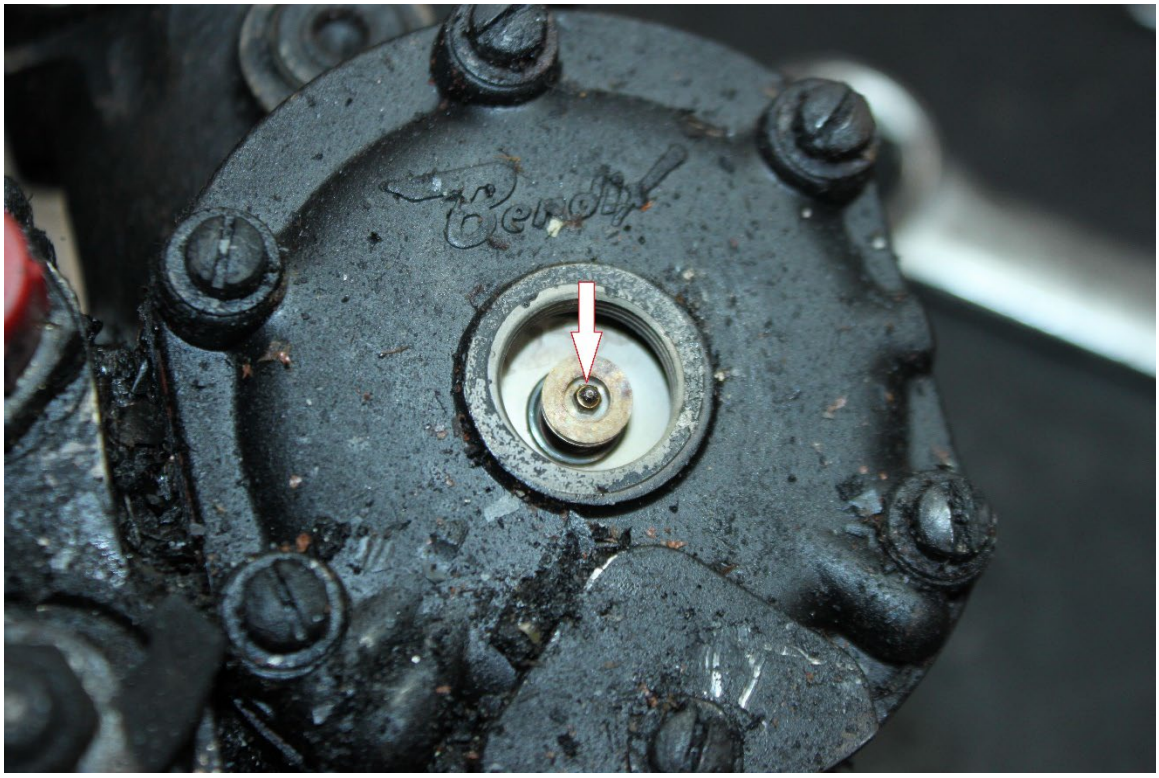


Figure 12: Arrow Points to Self Locking Nut on End of the Fuel Diaphragm Stem. Note 2 threads of the Stem extended Beyond the Nut.

Following disassembly of the air and fuel regulator, moisture was noted on the air diaphragm which was heat damaged in the roll portion. Moisture was also noted on the high-pressure side of the air diaphragm. No blockage was noted on the low-pressure side of the air diaphragm.

The fuel diaphragm appeared to move freely. The regulator valve seat was destroyed by fire. The unmetered side of the fuel diaphragm had evidence of internal contamination on the bottom side of the regulator section as installed on the engine. The passage connecting the metered and unmetered fuel diaphragm was clear. The path between the fuel regulator section to the outlet fitting was free of obstructions.

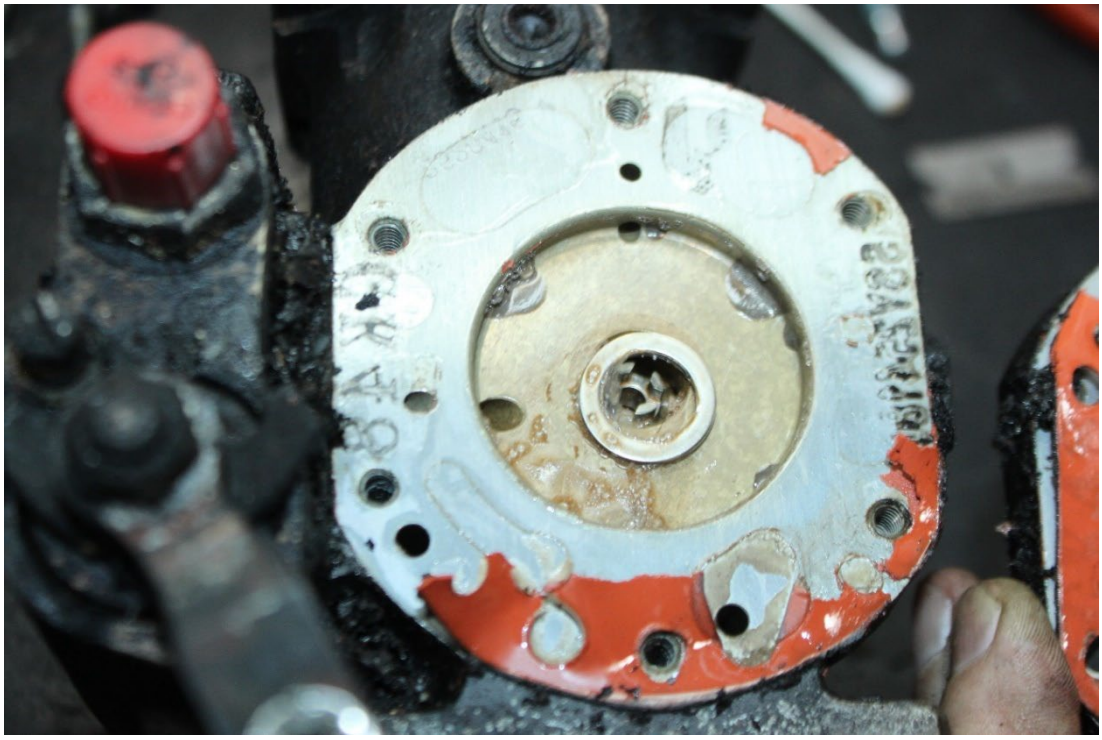


Figure 13: Fuel Regulator Area Depicting the Heat Destroyed Regulator Valve Seat.

Figure 14: View of the Unmetered side of the Fuel Diaphragm showing Contamination.

The inlet screen which had been previously removed exhibited slight contamination on inside. The screen was cut open to access the inside.

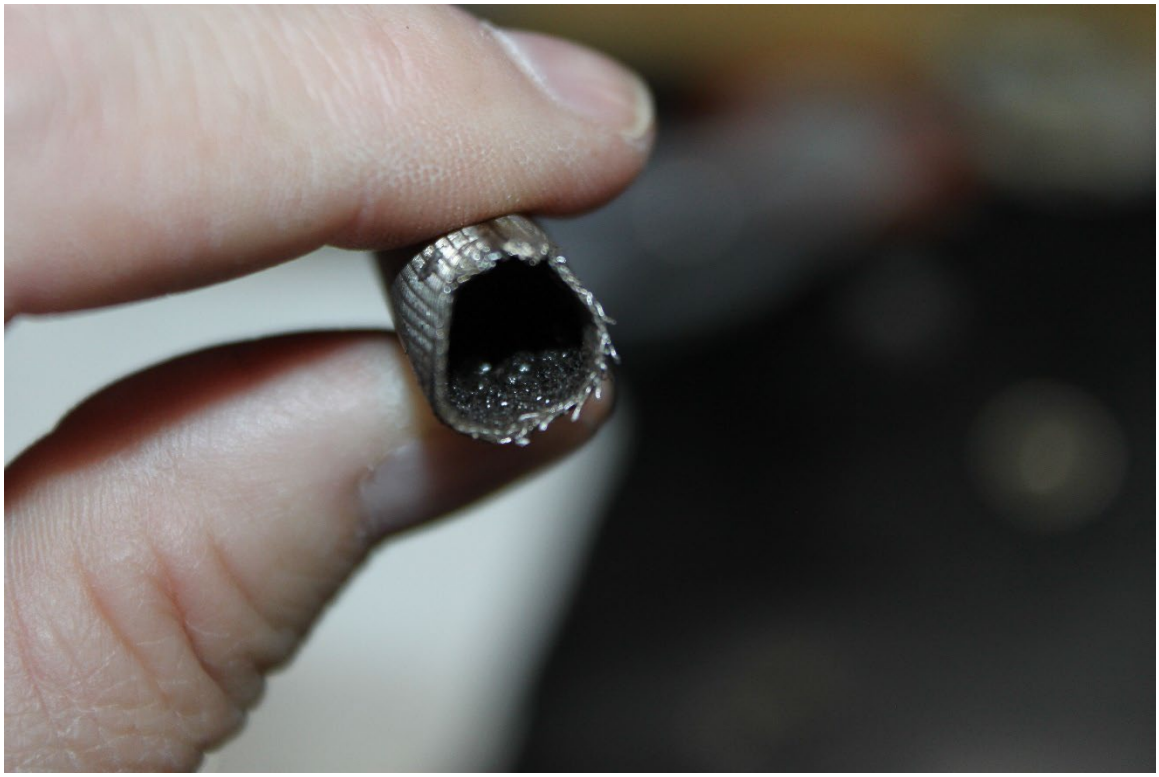


Figure 15: View of the Inlet Screen After Cutting Showing Slight Contamination.

The mixture control nylon stop was missing. Some debris was noted in the mixture control housing consistent with mixture control bushing. Contamination on the mixture control bushing and adjacent area of the mixture control housing was noted. A swab was taken of the contamination of the mixture control housing for examination by the NTSB Materials Laboratory though testing was never performed[5]. A corrosion pit was noted under the contamination after removal of the mixture control valve.

[5] This was based on the totality of the evidence of the investigation.

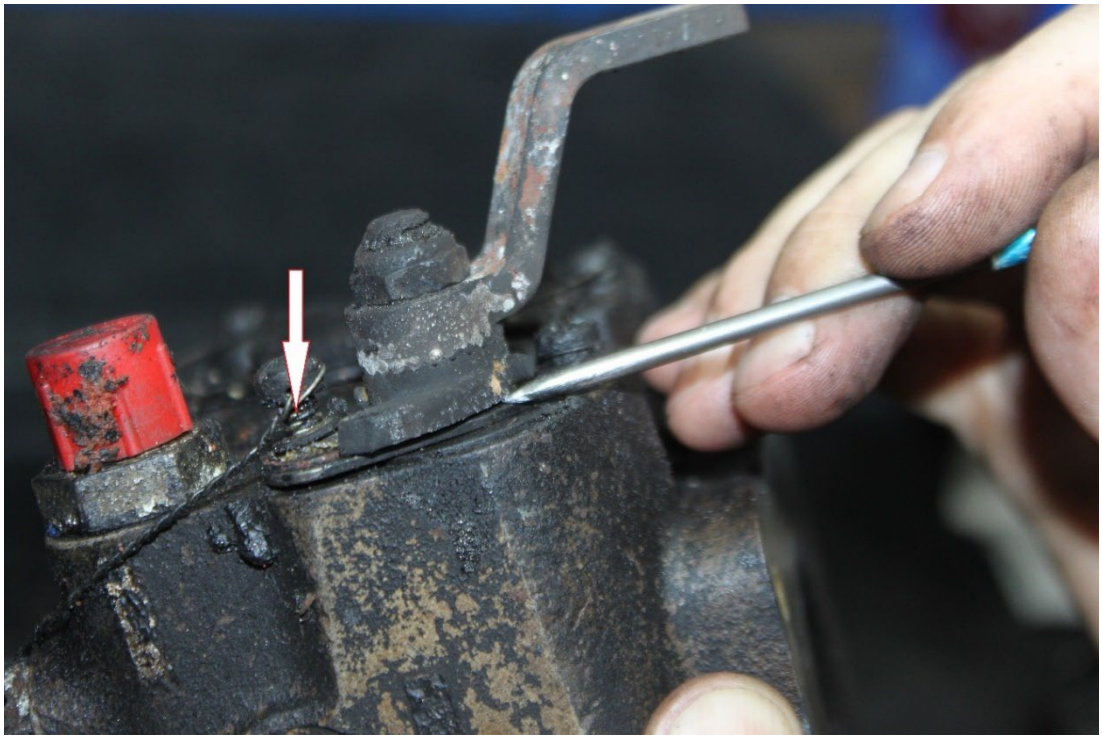


Figure 16: Arrow Points to Where Missing Mixture Control Nylon Stop Would be Installed.

Figure 17: View Showing the Contamination on the Mixture Control Bushing.

The fuel passage from the fuel control to regulator (metered to unmetered) has evidence of contamination in the bore.

The mixture control clevis spring for idle mixture adjustment was in-place but distorted.

Figure 18: View Showing the Distortion of the Mixture Control Clevis Spring.

Examination of the idle valve stem assembly revealed the nylon thrust washer and packing showed evidence of heat damage. The idle valve stem assembly housing area had very slight contamination on the housing wall.

The idle valve was operationally checked on the comparator and flowed 20 cc's greater than the maximum specified value.

2.4 Fuel Injector Nozzles

All fuel injector nozzles were a two-piece design. The screen shield of the fuel injector nozzles were inspected with a go-no-go gauge and the nozzles were vacuum checked without inserts or restrictors (as received) to inches of water and the following results were noted:

No. 1 - (within specification). Had spec of material (flexible) at inlet. The screen shield was nearly fully down and did not pass the go-no-go gauge.

No. 3 - (within specification). Screen shield tested OK.

No. 2 - (within specification). Screen shield gap too big.

No. 4 – Flowed Erratic (within specification). Screen shield too far down (did not pass the go-no-go gauge.

The fuel injectors were inspected and vacuum checked with an exemplar insert to inches of water and the following results were noted:

No. 1 - (3.2 inches of water greater than maximum specified value)
No. 3 - (within specification)
No. 2 - (within specification)
No. 4 – Flowed Erratic (within specification)

The fuel injector nozzles were flowed without inserts (as received) to specification for a two-piece nozzle Bendix P/N 2524864-2, Lycoming P/N LW-18265. The following results were noted:

No. 1 - Could not continue flow due to excessive leakage from bleed hole.
No. 3 - Could not continue flow due to excessive leakage from bleed hole.
No. 2 - Could not continue flow due to excessive leakage from bleed hole.
No. 4 - Could not continue flow due to excessive leakage from bleed hole.

The No. 4 fuel injector nozzle was again flow tested using an exemplar insert and the leakage at the bleed hole stopped.

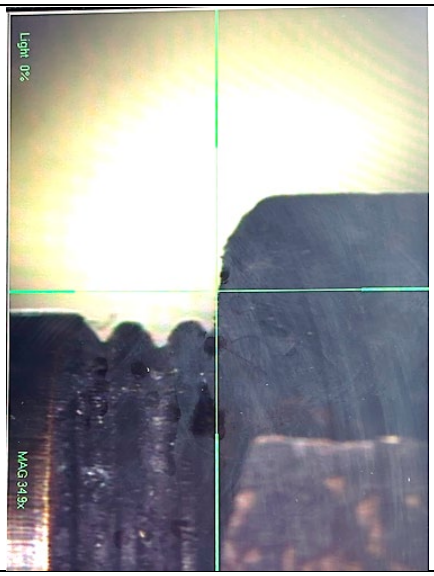
Visual inspection of the upper or top end of all fuel nozzles revealed no evidence of contact signature by the ball end of each fuel injector line.

Each fuel injector nozzle was then subjected to an inspection and then measurements to determine the location of the clean/soot demarcation line on the upper threaded portion of each fuel injector nozzle. In addition, with an exemplar insert installed into each nozzle, the dimension of the clean/soot demarcation line on each fuel injector nozzle below the end of the union nut was recorded with each respective line torqued to about the median specified torque value (37-inch pounds)[6] onto each respective nozzle. The following results were noted:

[6] According to a representative of the engine manufacturer, the specified torque value is 25 to 50 inch pounds, or finger tight and then 30° to 60° more, which equates to (1/2 to 1 flat). The testing was done with a calibrated torque wrench that was due October 14, 2023.

No. 1 Nozzle[7] – Examination of the nozzle revealed the demarcation line was located 0.17509 inch down from the top of the nozzle. A measurement of 0.26664 inch was between the top of the nozzle to the bottom identified thread of the nozzle. The fuel injector line was installed onto the fuel injector nozzle without an insert and torqued to 37-inch pounds. Visually, in that position only sooty threads of the nozzle were noted and a dimension of 0.07076 inch was measured from the bottom of the union nut to the bottom identified thread of the nozzle.

With an exemplar insert installed into the fuel injector nozzle, the No. 1 fuel injector line was installed onto the nozzle and torqued to 37-inch pounds. Visual inspection of the nozzle revealed the pitch of 1 clear thread was noted beneath the bottom of the union nut. Dimensionally, the soot/clean demarcation line was 0.02813 inch below the bottom of the union nut.



View of The No. 1 Fuel Injector Line and Nozzle. The Line was Torqued to 37-inch pounds onto The No. 1 Fuel injector Nozzle Without an Insert. Note the Threads Between the Union Nut and the Lowest Portion of Nozzle Thread.

View of The No. 1 Fuel Injector Line and Nozzle. The Line was Torqued to 37-inch pounds onto The No. 1 Fuel injector Nozzle With an Exemplar Insert. Note the Clean Threads Between the Union Nut and the Lowest Portion of Nozzle Thread.

Figures 19a and 19b.

[7] As previously reported, the screen shield was pushed nearly fully down, thus the bottom thread of the nozzle was clearly identified.

A comparison was made of the dimension difference from the bottom of the union nut to the bottom identified thread of the nozzle with the fuel injector line torqued to the fuel injector nozzle with and without an insert installed. With an insert installed, the bottom of the union nut was .03669 inch, or nearly the width of the insert flange higher up the nozzle, and in those conditions, about 1 clean thread of the nozzle was visible.

No. 2 Nozzle[8] - Examination of the nozzle revealed the demarcation line was not as clear as the Nos. 1, 3, and 4 nozzles but a change in color on the threads was noted. The demarcation line was located 0.17598 inch down from the top of the nozzle. A measurement of 0.24990 inch was measured from the top of the nozzle to the top of the screen shield/bottom identified thread of the nozzle. The fuel injector line was installed onto the fuel injector nozzle without an insert and torqued to 37-inch pounds. Visually, in that position, only sooty threads and the pitch of 2 threads were visible and a dimension of 0.04882 inch was measured from the bottom of the union nut to the bottom identified thread of the nozzle.

With an exemplar insert installed into the fuel injector nozzle, the No. 2 fuel injector line was installed onto the nozzle and torqued to 37-inch pounds. Visual inspection of the nozzle revealed the demarcation line was not as clear as the Nos. 1, 3, and 4 nozzles, but it could be determined. Dimensionally, the soot/clean demarcation line was 0.04099 inch below the bottom of the union nut. A dimension of 0.09288 inch was measured from the bottom of the union nut to the bottom identified thread of the nozzle.

[8] As previously reported, the screen shield was too far up the nozzle, thus the bottom thread of the nozzle was not clearly identified.

	
View of The No. 2 Fuel Injector Line and Nozzle. The Line was Torqued to 37-inch pounds onto The No. 2 Fuel injector Nozzle Without an Insert. Note the Threads Between the Union Nut and the Lowest Portion of Nozzle Thread.	**View of The No. 2 Fuel Injector Line and Nozzle. The Line was Torqued to 37-inch pounds onto The No. 2 Fuel injector Nozzle With an Insert. Note the Threads Between the Union Nut and the Lowest Portion of Nozzle Thread.**

Figures 20a and 20B.

A comparison was made of the dimension difference from the bottom of the union nut to the bottom identified thread of the nozzle with the fuel injector line torqued to the fuel injector nozzle with and without an insert installed. With an insert installed, the bottom of the union nut was 0.04406 inch, or nearly the width of the insert flange higher up the nozzle, and in those conditions, about 1 clean thread of the nozzle was visible.

No. 3 Nozzle[9] –Examination of the nozzle revealed the demarcation line was located 0.17161 inch down from the top of the nozzle. A measurement of 0.26622 inch was between the top of the nozzle to the bottom identified thread of the nozzle. The fuel injector line was installed onto the fuel injector nozzle without an insert and torqued to 37-inch pounds. Visually, in that position only sooty threads of the nozzle were noted and a dimension of 0.06351 inch was noted from the bottom of the union nut to the bottom identified thread of the nozzle.

With an exemplar insert installed into the fuel injector nozzle, the No. 3 fuel injector line was installed onto the nozzle and torqued to 37-inch pounds. Visual inspection of the nozzle revealed about 1 clear thread was noted. Dimensionally, the soot/clean demarcation line was 0.0256 inch below the bottom of the union nut. A dimension of 0.09659 inch was noted from the bottom of the union nut to the bottom identified thread of the nozzle.

[9] As previously reported, the screen shield was in the correct location.

	
The No. 3 Fuel Injector Nozzle. Note the Location of the Clean and Dirty Threads in the Right of the Picture.	**View of The No. 3 Fuel Injector Line and Nozzle. The Line was Torqued to 37-inch pounds onto The No. 3 Fuel injector Nozzle With an Insert. Note the Clean Threads Between the Union Nut and the Lowest Portion of Nozzle Thread.**

Figures 21a and 21b.

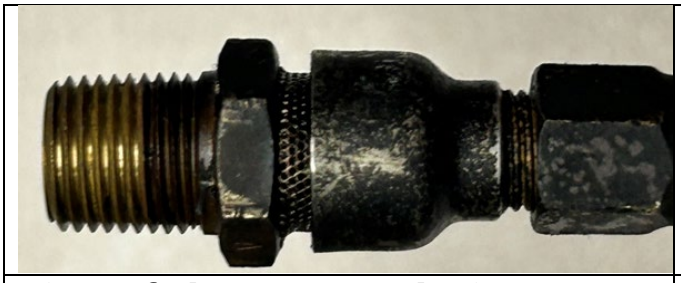
A comparison was made of the dimension difference from the bottom of the union nut to the bottom identified thread of the nozzle with the fuel injector line torqued to the fuel injector nozzle with and without an insert installed. With an insert installed, the bottom of the union nut was 0.03308 inch, or nearly the width of the insert flange higher up the nozzle, and in those conditions, about 1 clean thread of the nozzle was visible.

No. 4 Nozzle[10] - Examination of the nozzle revealed the demarcation line was located 0.20250 inch down from the top of the nozzle. A measurement of 0.27504 inch was between the top of the nozzle to the bottom identified thread of the nozzle. The fuel injector line was installed onto the fuel injector nozzle without an insert and torqued to 37-inch pounds. Visually, in that position only sooty threads of the nozzle were noted and a dimension of 0.08265 inch was noted from the bottom of the union nut to the bottom identified thread of the nozzle.

With an exemplar insert installed into the fuel injector nozzle, the No. 4 fuel injector line was installed onto the nozzle and torqued to 37-inch pounds. Visual inspection of the nozzle revealed the pitch of two clean threads were noted. Dimensionally, the soot/clean demarcation line was 0.4065 inch below the bottom of the union nut. The

[10] As previously reported, the screen shield was too far down, thus the bottom thread of the nozzle could be determined.

distance from the bottom of the union nut to the bottom identified thread of the nozzle was 0.11869.

	
View of The No. 4 Fuel Injector Line and Nozzle. The Line was Torqued to 37-inch pounds onto The No. 4 Fuel injector Nozzle Without an Insert. Note the Threads Between the Union Nut and the Lowest Portion of Nozzle Thread.	**View of The No. 4 Fuel Injector Line and Nozzle. The Line was Torqued to 37-inch pounds onto The No. 4 Fuel injector Nozzle With an Insert. Note the Clean Threads Between the Union Nut and the Lowest Portion of Nozzle Thread.**

Figures 22a and 22b.

A comparison was made of the dimension difference from the bottom of the union nut to the bottom identified thread of the nozzle with the fuel injector line torqued to the fuel injector nozzle with and without an insert installed. With an insert installed, the bottom of the union nut was .03604 inch, or nearly the width of the insert flange higher up the nozzle, and in those conditions, about 1 clean thread of the nozzle was visible.

The fuel injector line was then installed onto the fuel injector nozzle with an exemplar insert installed and torqued to 50-inch pounds[11]. Visually, the pitch of two clean threads were noted. The distance from the bottom of the union nut to the bottom identified thread of the nozzle was 0.11791 inch. Thus, going from 37-inch pounds to 50-inch pounds only resulted in a dimensional change of 0.00078 inch.

[11] This was the upper limit of the specified torque value.

3.0 Parts Distribution

No parts were retained. Following the examination, the retained fuel system components were shipped to the salvage facility. Refer to NTSB Evidence Control Form contained in the public docket for the investigation for the tracking of the fuel system components.

Submitted by:

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