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January 10, 1997

Mr. Frank Gattolin
National Transportation Safety Board
North Central Regional Office
31 W. 775 North Avenue
West Chicago, IL 60185

Subject: Panther F9F Fuel Pumps Test Report

Dear Mr. Gattolin:

Attached is our report on the fuel pumps from the Kalamazoo F9F accident aircraft. These units were sealed in containers in Kalamazoo by you and brought to South Bend by John Loring for testing in our Engineering Laboratory. The testing was witnessed by Mr. Ted Willis of the South Bend FAA FSDO. While there were some limitation on the testing we could perform, we believe that we performed sufficient testing to determine that both pumps worked to specification.

After the testing , Mr. Willis witnessed the repackaging and sealing of the units which were then transported back to Western Michigan University, Kalamazoo, for testing on the engine. Several AlliedSignal employees, including myself and Mr. Loring, participated in the testing of the engine. We observed that the engine ran properly with the controls and pumps in both the normal and emergency modes and reacted as predicted by the performance schedules in the Technical Order used to bench test the units.

In conclusion, it is the unanimous opinion of the AlliedSignal technical experts that these units perform to specification and that the engine and its controls were capable of sustained operation in the aircraft throughout the entire operational envelop. If we can be of any further assistance, please do not hesitate to call.

Sincerely,

[redacted]

David W. Dodson
AlliedSignal Aerospace Equipment Systems
Product Safety & Integrity

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A. Title

Investigation of JP-A5 fuel pumps and pressure switches which had been involved in a Grumman F9F-2 aircraft accident September 19, 1996, at Kalamazoo Battlecreek International Airport.

B. Purpose

To investigate two fuel pumps and two pressure switches to determine their condition as received at AlliedSignal Engine Systems and Accessories (ESA) South Bend, Indiana, on October 25, 1996.

C. Description of Units

AlliedSignal (Formerly Bendix) P/N	Model	S/N
368012-2	JP-A5	4437
368012-2	JP-A5	2889
Grumman P/N	**Model**	**S/N**
555-2052	Pressure Switch-Hydrol	2302L
555-2052	Pressure Switch-Hydrol	2612L

D. Background

The Aircraft (Grumman F9F-2) had been stored at the Kalamazoo Aviation History Museum and was flown only occasionally for air shows. After take off, the pilot reported he was going to return immediately for a precautionary landing. Touching down with a high rate of speed, the aircraft skidded off the end of the runway and caught fire. Refer to Report No. ECD 422-AR82 for Main Fuel Control investigation.

The pumps and switches were last overhauled in 1983 by Aero Turbine of Stockton, CA. and flowbench tested/readjusted in April, 1996.

We were advised that the pilot claimed the engine speed during his landing, could not be reduced less than 85% using the throttle. We were also advised later, that this percentage of engine speed was lowered.

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E. Summary of Results

Witnessing/Taking part in the investigation which took place October 25, 28, 29, 1996 at ESA Engineering Laboratory were:

Mr. T. Willis	FAA FSDO
Mr. D. Dodson	ESA Product Integrity
Mr. J. Loring	ESA Design Engineering
Mr. W. Hayden	ESA Engineering Lab
Mr. R. Terry	ESA Customer Support

The subject pumps and switches were x-rayed then, functionally tested. The only defect noted was the switch S/N 2302L that would not close the circuit at any fuel pressure.

F. Sequence of Inspection/Tests

The fuel pumps and two switches were hand carried in one sealed container and opened in the ESA Engineering Lab. Mr. T. Willis, FAA Representative witnessed the opening and unpacking (Reference Exhibit #AR86-F1). The pumps and switches were taken to the Engineering Machine Shop for x-ray prior to any functional testing (Reference Exhibit #AR86-F2, F3, F4). This was in an effort to determine if there were any signs of internal damage. With no internal damage identified, it was decided to return to the Engineering Lab for functional testing.

Pump S/N 4437 was used to adapt pumps to Test Cell C-20. Pumps and switches were stored in a locked cabinet over the weekend.

October 28, 1996

Mr. Willis was present when pumps and switches were removed from the locked cabinet. The pump drive adapter and snap ring were removed for mating to test cell (Reference Exhibit AR86-F5). Pump S/N 4437 was installed on Test Cell C-20. Refer to Exhibit #AR86-F6 for test cell hookup. Prior to any test runs an air bleeding procedure was verified. With no RPM the boost pressure of 36 psig was applied to the pump inlet and allowed air to bleed from fitting marked B6 (Item 14, Figure 1-1 Page ii in Form 15-46) some air was purged. Then the bleeder plugs were checked and no air was found.

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Additionally, the hex plug, on the drive end next to the pump control bleed, was loosened. A small amount of air was allowed to purge. Test RPM was limited to 1500 due to the drive motor on Test Cell C-20. Test Run #1 was run to determine pump output versus RPM (Reference Exhibit #AR86-F7). Test Run #2 was run in the emergency mode (Reference Exhibit #AR86-F8). Pump S/N 4437 was removed from test cell. Then packaged, sealed and locked in cabinet overnight with the other components.

October 29, 1996

Mr. Willis again witnessed the unpacking of the components from the locked cabinet. The pressure switch S/N 2612L was plumbed to the Test Cell C-20 and checked for opening and closing the circuit. See Exhibit #AR86-F9 attached. Switch S/N 2612L was unplumbed and switch S/N 2302L was checked in the same manner for opening and closing the circuit. S/N 2302L remained open at all pressure settings (Reference Exhibit #AR86-F10). The switches were packed and sealed.

Pump S/N 2889 was installed on Test Cell C-20 for testing. Refer to Exhibit #AR86-F11 for test cell hookup. Before test was begun, the pump outlet check valve was tested and found to open at 50 psig. Inlet boost pressure of 36 psig was applied to purge air. Fitting marked T6 (Item 14, Figure 1-1 Page ii in Form 15-46) was loosened, some air was purged. Then bleeder plugs were checked and no air was found. The hex plug, on the drive end next to the pump control bleed, was loosened. A small amount of air was allowed to purge. Test Run #1 was completed (Reference Exhibit #AR86-F12). Test Run #2 was run in the emergency mode (Reference Exhibit #AR86-F13).

Pump S/N 2889 was removed from test cell. All four components were packaged and sealed in one container (Reference Exhibit #AR86-F14) for transport back to Southwestern Michigan University for possibly engine test.

G. Conclusion

The results of flow bench testing and along with the subsequent engine runs at Southwestern Michigan University on October 31, 1996 suggest that the subject fuel pumps were capable of operating normally at the time of the accident. It is unknown to AlliedSignal what the open switch condition might result in during engine/aircraft operation. It is recommended that this report serve as documentation to describe the

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condition of the subject fuel pumps and switches as received by AlliedSignal Engine Systems and Accessories.

Written by: [redacted]
Robert A. Terry, Senior Service Representative

Approved by: [redacted]
Dave Dodson, Product Integrity

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List of Exhibits

1.	AR86-F1	Unpacking Sealed Components
2.	AR86-F2	X-ray S/N 2889 Fuel Pump
3.	AR86-F3	X-ray S/N 4437 Fuel Pump
4.	AR86-F4	X-ray Switches S/N 2302L and S/N 2612L
5.	AR86-F5	Snap Ring and Drive Adapter Removal
6.	AR86-F6	S/N 4437 Test Cell Hookup
7.	AR86-F7	S/N 4437 Test Run #1
8.	AR86-F8	S/N 4437 Test Run #2
9.	AR86-F9	Switch S/N 2612L Test Run
10.	AR86-F10	Switch S/N 2302L Test Run
11.	AR86-F11	S/N 2889 Test Cell Hookup
12.	AR86-F12	S/N 2889 Test Run #1
13.	AR86-F13	S/N 2889 Test Run #2
14.	AR86-F14	Components Packed for Transport