J. L. Shoenhair	40-01	102	1	15 Jan 1971
Q. H. Burden	40-03	511	5	32635

TRIP REPORT

A four man team from Lockheed (Burden, Taylor, Keller, Burrell) departed SFO 0800 on the 5th of January to address safety of flight problems encountered by the Army pilots flying the YO-3A at Long Thank, Vietnam. The following are the problems addressed and solutions.

1. Engine stoppage in flight.
2. Engine stoppage after take-off.
3. Inconsistent RPM during engine run-up prior to take-off.
4. Excessive fuel consumption.
5. Uneven fuel consumption between tanks.
6. Fuel tank selection deficiencies.
7. Flight procedures.

Item 1 - Engine stoppage in flight.

It was found after flight test and system analysis that engine stoppage could occur from fuel starvation induced by previous fuel system usage. If the vapor return lines to and within the fuel cells are clogged or crimped engine stoppage could occur due to excessively rich mixture. Also, with the fuel selector on BOTH fuel can be vented overboard as all fuel will be returned to one tank. This situation can no longer occur due to the elimination of the BOTH selection.

From flight test data it was also found that with one empty tank and the selector valve on BOTH the engine fuel pump would suck air into the lines from the empty tank and cause rough running or engine stoppage. A fuel system modification has been completed on 5 aircraft to date to eliminate these problems, and completion on the remaining 3 is expected shortly. Fuel system modifications are as follows:

1. Installation of a rigid tank vapor return line to assure no possibility of line closure and resultant engine malfunction.

2. The addition of a fuel selector valve fixed step plate to delete the BOTH position and function and, to provide positive steps for LEFT and RIGHT selector positions.

3. The addition of a revised shaft between the fuel selector valve and the selector gear box to assure fail-safe operation in conjunction with the new fuel selector valve step system.

4. The addition of a fixed link in the alternate air valve to immobilize the 'automatic' alternate air function. Deletion of this function does not affect the manual control for alternate air but eliminated the introduction of hot engine compartment air during normal operations with resultant power losses.

5. The boost pump switch in the pilots compartment was relocated to a new position adjacent to the starter button on the main instrument panel for ease of access during normal and emergency operations.

6. A new access door in the wing-to-fuselage fairing was added to provide better access to the main fuel strainer for daily maintenance.

Item 2 - Engine stoppage after take-off.

Engine failure after take-off is caused by two conditions, 1) introduction of engine compartment air through the alternate air valve, and 2) cylinder head temperatures above 200° Centigrade. The aircraft in the non-modified configuration with the automatic alternate air feature operated at times with the alternate air in the equivalent of hot air position, depending on atmospheric conditions. The alternate air modification is covered above under the fuel system modifications enumerated in Item 1.

Item 3 - Inconsistent RPM during engine run-up prior to take-off.

Inconsistent RPM readings at run-up were determined to be caused by the alternate air automatic system. From visual observation it was determined that, in fact, the alternate air valve was moving during engine run-up, and therefore, during flight. This condition was eliminated by the deletion of the automatic function.

Item 4 - Excessive fuel consumption.

Several aspects of an important nature must be considered. First, the YO-3A operated for maximum endurance, cruising at 75 knots with 5 pounds fuel pressure, will use 5.2 gallons per hour, and therefore will give a total flight time of 5 hours before fuel is totally exhausted. Second, with the unmodified fuel system it was possible to have the fuel selector on BOTH position and to vent fuel overboard due to vapor return line malfunction. Third, the fuel volume increases by 1% with each 10° rise in temperature. This along with the practice of fueling the aircraft during the day and flying the aircraft at night without topping off the tanks prior to night take-off does not utilize the maximum endurance capability of the aircraft.

To assure that no unknown anomalies exist peculiar to the area of excessive fuel consumption, a test flight was conducted on aircraft serial 18006 with all of the latest field modifications installed. This test was conducted during the day with full tanks. With the cruise made at a fuel pressure of 5.0 psi at approximately 75 knots Indicated Air Speed and 1500 to 2000 feet altitude, a total flight time of 5 hours was demonstrated. It should be noted that approximately 3.7 pounds of fuel remained in the tanks and that fuel leaning was done at day time temperatures.

Item 5 - Uneven fuel consumption between tanks.

From test flights it was found that with the aircraft fuel selector on the BOTH position the vapor return line could return fuel to only one tank and if that tank was full it would vent fuel overboard giving a visual indication from the fuel gauges of uneven fuel usage.

Vapor return lines were replaced and the fuel selector now has the BOTH position removed eliminating this problem.

Item 6 - Fuel tank selection deficiencies.

Fuel selector detents become weak after a period of usage and there were times when the pilot was in doubt as to the position of the fuel valve selector. This condition was cleared and is covered in fuel system modifications enumerated under Item 1.

Item 7 - Flight procedures.

Fifteen test flights were conducted at Long Thanh demonstrating fuel consumption, alternate air effects, and engine failures, to fourteen Army pilots. The engine was allowed to fail from fuel starvation approximately 8 to 10 times on each flight and started again in dives, yaws, and in every unusual configuration.

From data obtained during these flights and from data and analyses conducted in CONUS we have prepared a separate document covering our recommended flight operational procedures. We have also prepared recommended maintenance procedure changes.

Recommended YO-3A Flight Procedures

NOTE: If a fuel tank was run dry on a previous flight, momentary fuel starvation will occur after approximately 30 seconds to one minute of operation due to trapped air in the fuel line. Momentary use of boost pump when changing tank will preclude engine stoppage.

1. Start on Left Hand tank.

2. After start change the fuel selector to Right Hand tank and hit low boost, then change the fuel selector back to Left Hand tank.

3. Take off and climb on Left Hand tank.

4. Cruise: Change to Right Hand tank and hit boost pump until engine runs rough, then release. If tank had been run dry previously, stand by for 30 seconds to clear all air out of the fuel line system.

5. If it is necessary to deplete fuel completely, always deplete from the Right Hand tank. After re-start on the Left Hand tank, hit boost pump again to remove all air from the fuel lines and ensure engine runs smoothly.

6. Re-start procedure from cruise configuration and depleted Right Hand tank is as follows:

   a. Switch to Left Hand tank.
   b. Hit boost pump until fuel pressure reads 4 psi and/or engine runs smoothly.

7. Climb configuration is 70 to 80 knots IAS, full rich, full or part throttle as required for mission or engine temperature control.

8. Long range cruise power settings are as follows:

   a. 2150 to 2250 RPM
   b. 70 to 75 knots IAS
   c. 5 psi fuel pressure
   d. 1500 to 2000 feet altitude

9. Note: Always hit boost pump when changing the fuel selector; always inspect fuel selector valve steps for foreign objects befor any flight.

Conclusion

I would consider the trip a success due to the fact, as a team, all safety of flight items were solved and corrected, however, it is my opinion that the mission profile used by the military pilots greatly reduce the effectability of the total covent weapons system. From private interrogation it was found that most missions were flown at an altitude of 2000 feet and mission time of about 2-1/2 hours. The recommendation to Col. Brown, Project Manager, is under consideration and I believe a lower mission profile is in the making.

Q. H. Burden
Engineer Test Pilot

QHB:bc

cc: C. Tucker
F. D. Schnebly
G. R. Taylor
C. W. Burrell
N. A. Keller
J. H. Chiles