| APPROVAL ROUTING (WRITE IN NAME, NOT INITIALS) | DATE |
|---|---|
| H. Piper | 10/27 |
| H.P. Horne | 10/27 |
| B.S. Wygle | 10/25 |
| FOR ADDITIONAL INFORMATION CONTACT | |

October 25, 1978
M-7210-4720-C/G

Mr. Alex Fissher
Director, Flight Standards
Greek C.A.A.
Athens, Greece

Subject: Performance Analysis of the Olympic Airways Takeoff at Athens on August 9, 1978 with an Engine Failure at Rotation

References: (a) Digital Flight Data Recorder (DFDR) printout, Olympic Airways

(b) Olympic Airways letter to Mr. R. Fellows, file no. 5/11-5/12

Dear Mr. Fissher:

The following is a performance analysis of the subject takeoff and is being forwarded for your information.

| INFO. ROUTING | |
|---|---|
| W. Hauser | 10/30 |
| T. Jones | 10/31 |
| RETURN TO: | |
| CORRESPONDENCE RD CASE | |
| FORWARD TO: CORRESPONDENCE FILES | |

The following data, which were forwarded to Boeing, were used in making the performance analysis.

| | |
|---|---|
| Airplane | Boeing 747 (Olympic Airways SX-OAA) |
| Airplane Gross Weight | 350,000 KG (771,600 LB) |
| Flap Position | 20 |
| A/C Packs | Off |
| Engines | JT9D-7A Wet |
| Ambient Temperature | 32°C. |
| Atmospheric Pressure | 29.83 Hg. (Pressure Alt=83 Feet) |
| Wind from/Speed | 310/12 kt. |
| Runway/Slope | 33R/-0.28% |

This performance analysis has been made to determine if the airplane performance was normal during the few minutes immediately following the takeoff. Boeing calculations indicate that the airplane was takeoff climb limited at 353,000 kg (778,200 lb.) using JT9D-7A wet thrust.

CORRESPONDENCE FILE COPY

Figures 1, 2 and 3 (attached) are plots of key airplane parameters taken from Reference (a). Figure 1 shows airspeed and altitude as a function of time. During the takeoff roll and initial climbout, the speed increased and the airplane lifted off and climbed normally. Speed then began to decrease, followed by a loss in altitude. The airplane was recovered and climbed out normally by nosing over and accelerating with throttles advanced to approximately go-around thrust. Significant events highlighted on the time scale of Figure 1 are rotation (from the pitch attitude trace, Figure 3), liftoff (from the altitude trace) and selection and arrival at flap positions 10 and 5 (from the flap position trace, Figure 3). Also shown is the assumed selection of landing gear up and attainment of same. The landing gear events are purely speculative since Reference (a) contains no indication of gear position. Gear up selection event was placed at a time corresponding to reaching 35 feet above the runway. Gear up event was placed 20 seconds later, which is a typical time increment from Boeing flight testing with a failed engine. The gear times are estimated and give credit to the flight crew for timely selection of gear up.

Figure 2 shows Engine Pressure Ratio (EPR) for each engine. These data were used with the speed and altitude traces and temperature data to calculate the installed thrust from each engine as a function of time. Significant events highlighted on the time scale of Figure 2 are number three engine shutdown coincident with rotation, followed approximately nine seconds later by engine water shutoff. Water shutoff has been further substantiated by the information contained in Reference (b).

Figure 3 shows airplane pitch and roll attitude and flap position. These data show pitch attitude to be normal and that a moderate left turn was initiated shortly after takeoff.

An analysis of the takeoff acceleration up to the point of rotation indicates the airplane accelerated as certified with JT9D-7A Wet rated thrust.

Following lift off, the calculated engine thrust (from EPR data) was used in conjunction with the other DFDR output parameters and certified aerodynamic parameters to compute the anticipated airplane altitude based on an approximate fairing of the indicated airspeed recorded on the DFDR.

The altitude data from the DFDR is shown on Figure 1 as an expanded scale and it is evident that the average climb rate matches the climb rate as determined from the computed altitude trace. The small deviations in airspeed from the fairing account for the the variations in the DFDR altitude from the computed altitude.

An exact matching of data during rotation liftoff and initial climb out is precluded by the variation in airspeed and altitude position error due to airplane rotation and climb out of ground effect coupled with the necessity for assuming the point of gear retraction. Comparing the computed to the actual flight path, it is apparent that the airplane performed in a manner consistent with the thrust available.

It is therefore concluded that no malfunction in airframe or engines caused the lack of performance following takeoff. Instead, the problem was caused by the inadvertent shut off of the water injection pumps by the flight crew and the resulting decrease in thrust. Loss of wet thrust in a situation where the airplane was takeoff climb limited severely reduced the ability to continue the flight with any significant amount of positive climb gradient. Once thrust was manually increased at a coordination time of approximately 325 seconds, the airplane climbed out in a normal manner.

Please advise if we can be of further assistance in this matter.

Very truly yours,

Brien S. Wygle
Vice President,
Customer Support

Attachments: 4

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FLIGHT OPERATIONS DEPT
Our file No.: 5/11-5/12

Athens Central Airport, October 4th, 1978

To:
Mr. R. Fellows, -
Boeing Company
Customer Support Representative
Athens - Greece

Subject: "747 A/C, Flight OA 411/August 9, 1978 incident"

Dear Sir,

Further to our conversation we herewith inform you that at the present time, the investigation committee has found the following:

1.- Approximately seven seconds after engine failure the F/E selected the water pump switch to OFF due to his misinterpretation of the extinguished engine 3 "WATER FLOW" warning light as "Water Run-out".

2.- The F/E after selecting OFF the Water pump switch did not apply Go-Around thrust (1.41 EPR for the prevailing conditions) to the 3 good engines. As a result of this delay the engines operated for 30 seconds at an average EPR of 1.343 for engine 1, 1.337 for engine 2, 1.332 for engine 4.

3.- After the above mentioned delay, thrust was increased but still to a lower than GO-AROUND EPR (except engine 4) for an additional time period of approximately 100 seconds for engine 1, the end of 5 minutes of Take off thrust use for engine 2, 27 seconds for engine 4.

4.- After the end of the 5 minutes for Take off thrust use, the engines were subjected to an "overboosting" for 4 minutes approximately.

5.- At around 80 KIAS the EPRs were set to 1.468 for engine 1, 1.460 for engine 2, 1.410 for engine 3, 1.490 for engine 4, instead of 1.492.

6.- During taxi-out, No 3 engine idle EPR reading was between 0.987 and 0.988. The F/E reported that N2 RPM indication was within Green band. No 4 engine indicated also lower idle EPR than normal (1.001 Vs 1.014).

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FLIGHT OPERATIONS DEPT
Our file No.: 5/11-5/12



7.- The F/E drained in flight the remaining water.

We would be happy to receive Boeing analysis of this incident whenever is ready.-

Yours,

A.PAPAGEORGIOU, Dep.Mngr Flt Stads
For Captain G. PANAS
Chairman of the Invest. Committee

c.c.:
F.O.D.
System Chief Pilot
Flt Standards Manager
B-747 Chief Pilot
F/E's Manager

tk