

NO.HQCAA/1901/231/SIB



CIVIL AVIATION AUTHORITY

INVESTIGATION IN RESPECT OF A SERIOUS INCIDENT

TO M/S PIAC F-27 AIRCRAFT REG. NO.AP-ATU

OCCURRED ON 8TH AUGUST, 1998

AT

MULTAN AIRPORT

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KARACHI, PAKISTAN

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ON 8TH AUGUST, 1998 AT MULTAN AIRPORT

Authority:- Director General Civil Aviation Authority Memorandum No.
HQ CAA/1901/231/SIB dated 13th August, 1998 (Appendix 'A')

Composition of Investigation Team

- | | | |
|-----|--|-----------------------|
| (a) | Air Commodore (Retd)
Jamal Hussain
President SIB CAA | Investigator Incharge |
| (b) | Wg. Cdr (Retd) Zia-ul-Haque
Ops. Engineer | Investigator |

1. AIRCRAFT INFORMATION

- | | | | |
|------|---|---|--|
| 1.1. | Aircraft type | : | Fokker-27 |
| 1.2. | Reg. NO. | : | AP-ATU |
| 1.3. | Engine types, airframe positions & S.Nos. | : | Dart 532-7 Eng No. 8214, Part side
Eng. NO. 13288 STBD side. |
| 1.4 | Certificate of Registration | : | 370 (REV-1) validity up to date |
| 1.5 | Certificate of Airworthiness No. & date of expiry, and flight manual No. | : | 322 valid up to 9.7. 1999. |
| 1.6 | Date of construction of airframe. | : | July, 1965 |
| 1.7 | Name address of Owner. | : | PIAC |
| 1.8 | Airframe history. (Give flying times since manufacture, last overhaul and last periodic check. List also essential modifications completed. | : | Flight Hours up to 8/8/98 65146003
TSO 3450.27
Last Periodic Check. B3 = 150 hr. |
| 1.9 | Engine history. (Give flying time since manufacture, last overhaul and last periodic check. List also essential modifications completed). | : | TSN 49319
TSO 2597.43
Last Periodic Check B3 - 150 hr. |
| 1.10 | Gross Weights. Maximum permitted by C of A for this flight, at the time of accident. | : | 37982
41 000 kg. |

- 1.11. Accessory history, (Give details of : TSN 39550
operating life and operating time since
manufacture and overhaul). TSO 2054.41

2. **CREW INFORMATION**

2.1 **Pilot-in-Command**

2.1.1. Name : Captain Irfan Mahmood Faiz.

2.1.2. Position in the Cockpit : P-I

2.1.3. Date of Birth : 11.10.1958

2.1.4. Type of Lic and No : ATPL 1008.

2.1.5. Medical date with status : 21.7.1998-CLASS I

2.1.6. **Rating**

2.1.6.1. Type(s) held : F-27 P1-1,P2, T/OTTER.-P1, P-2
B-737 P-2

2.1.6.2. Type current : F-27 - P-1

2.1.7. **Flying Experience**

2.1.7.1. Grand total : 3237 : 24 hrs

2.1.7.2. Total -in -Command : 941 : 35 hrs

2.1.7.3. Total On the type : 2295:49 hrs

2.1.7.4 Where trained : Karachi

2.1.7.5 Date of joining the Org. : 26th December 1988.

2.2 **Co-Pilot**

2.2.1. Name : Sheikh Rehan Fazal Haqqi

2.2.2. Position in the Cockpit : Co-Pilot

2.2.3. Date of Birth : 01-11-1964

2.2.4. Type of Lic and No : CPL No. 1677

2.2.5. Medical date with status : 14.7.1998 Class I

2.2.6. **Rating**

2.2.6.1. Type(s) held : F-27 P-2
S.E. PIST P-1, P-2.

2.2.6.2. Type current : F-27 P-2

2.2.7. Flying Experience

2.2.7.1. Grand total	:	843 : 13 hrs
2.2.7.2. Total -in- Command	:	204 : 10 hrs
2.2.7.3. Total -in -Command on the type accident/ incident occurred	:	639 : 03. hrs
2.2.7.4 where trained	:	Karachi
2.2.7.5. Joining the Org.	:	03.03.1996

3. SUMMARY OF THE SERIOUS INCIDENT

3.1. Captain Irfan Faiz and First Officer Sheikh Rehan Fazal Haqqi were detailed to operate PK-685 (F-27) for Multan - D.I. Khan - Peshawar - Islamabad Sector. The aircraft gross weight was 38,000 Lbs. and surface temperature was 41 degrees Centigrade. V1/VR was calculated at 106 Kts and V2 110 Kts. Start up and taxi was normal. The aircraft executed a rolling no flap take off from RW 36 with Captain Irfan on the controls with First Officer Haqqi performing the duties of pilot not flying. Take off acceleration was normal. 50 Kts, 80 Kts and V1/VR were called and till then both the engines were developing full wet power. Aircraft lifted off and immediately after lift off the first officer heard a noise from the right. Engine instruments confirmed No.2 engine had auto feathered. He immediately informed the Captain. The Captain felt the aircraft lose height and settle back on the runway. He decided to reject take off and while taking this decision, neither the Captain nor the first officer recalls the airspeed. Normal reject take off actions were performed and the aircraft was stopped 18 feet short of threshold RW-18. There was no fire or apparent damage to the aircraft and the passengers were disembarked safely, The aircraft could not be removed from the runway because both the brakes had jammed. After replacement of brakes. the aircraft was eventually towed out. The runway remained blocked for just over an hour.

4. INJURY TO PERSONS

4.1. No apparent physical injury to any of the crew or passenger.

5. DAMAGE TO AIRCRAFT

5.1. Nil.

6. OTHER DAMAGES

6.1. Nil.

7. METEOROLOGICAL CONDITION

7.1. Visibility 7 Kms, no weather warning.

8. AIDS TO NAVIGATION

8.1. Not relevant.

9. **COMMUNICATION**

9.1. Not relevant

10. **AERODROME AND GROUND FACILITIES**

10.1. Not relevant.

11. **WRECKAGE AND IMPACT INFORMATION**

11.1. Nil.

12. **FIRE**

12.1. No fire was caused in this incident.

13. **Witnesses**

13.1. Statement of witnesses are given at appendices B to D

14. **INVESTIGATION:**

14.1. **Witnesses:** Statements of key witnesses (Captain, First Officer and Duty Controller) were recorded. All the three statements complemented one another and there were no divergent views. From the statements it was established that No. 2 engine auto feathered after lift off and the Captain decided to reject take off and succeeded in stopping the aircraft on the runway. The brakes were jammed in the process and they had to be replaced before the runway could be cleared. In this process, Multan Runway remained blocked for about one hour. One ground run after the incident at Multan, the fault could not be duplicated.

14.2. **Site Inspection. :** Runway at Multan was examined to trace the ground path of the aircraft. From the available tire marks, it was possible to establish the aircraft track after the decision to abort was taken (Schematic diagram at Appendix E). Study of the track revealed the following:-

(a) Initial touch down mark after lift off at 3300 feet of R/W remaining.

(b) The aircraft followed a mild zigzag 'S' pattern before coming to a stop at 18 feet short of RW 36 end /18 beginning.

14.3. **DFDR/CVR:**

DFDR read out was studied (details of DFDR reading given at Appendix F). F-27 DFDR parameters cover airspeed, attitude, heading and vertical velocity vector. No engine parameters or control input parameters are available. Direct pin pointing of the speed at which No.2 engine failed was not possible. However through inference and correlation with other known data it was possible to determine with fair degree of accuracy the speeds corresponding to the two key events i.e. engine failure, and initiation of reject take off actions. In this case, engine failure occurred around 120 Kts., about 6 seconds after V1/VR. In the next six seconds the aircraft settled back on the runway with the speed increasing to 125 Kts. Once on ground at 125 Kts., throttles were

retarded and reject actions were initiated. CVR reading unfortunately was not available.

14.4. **Technical Investigation**

After the occurrence following checks were carried out.

14.4.1. **Visual Inspection:**

ENGINE: The engine intake/exhaust areas were checked for any abnormality and were found to be satisfactory. No signs of over heating were observed.

Oil System: The oil level was checked and was found satisfactory. The oil filters were removed and checked for any metal particles or any other contamination. The filters were found to be clean.

14.4.2. **Engine Operational Check.**

After the visual inspection the engine was motored. The engine was started and all checks including ground idle, flight idle, dry + wet power checks were carried out and all parameters were found to be satisfactory. See Appendix G.

14.4.3. **Power Control Unit**

The PCU was removed at Islamabad and sent for Investigation. The PCU was found fully serviceable and no abnormality was observed on the test rig. See Appendix H.

14.4.4. **Engine Inspection**

The engine was removed on 11th Aug. and sent for investigation. The engine was due for a mid overhaul for high time i.e. 2600 hrs TSO. The engine only showed signs of over heating at No.1 & No.7 position burner. The uneven/bad fuel spray pattern was the cause of turbine vibrations. The carbon deposits at burner tips were causing erratic fuel spray. However, it had no bearing on the occurrence. See Appendix J.

14.4.5. **Low Torque Switch**

This switch is positioned in the circuit in such a way that when HP fuel cock switch is on cruise lock out/fuel on position and throttle switch is on cruise then if a low torque is sensed by this switch connection is made to energize Auto Feathering Relay. This switch was removed and checked in the shop and was found to be having no defect. See Appendix K.

14.4.6. **Over loading of aircraft.**

The possibility of over-loading of the aircraft was also investigated. The outside temperature was 41 degrees Centigrade and the aircraft Take off Gross weight limit was 41,000 kg while the total weight of

the aircraft was 38000 kg. I.e. the aircraft was under loaded by 3000 Kg. So the weight of aircraft was not a contributing factor. See Appendix L.

14.4.7. **Test flight.**

A test flight of 0:43 minutes was conducted by Deputy Chief Pilot North (F-27) and all functions including single engine performance were checked and the engine performance was found to be satisfactory.

14.4.8. **Ferry flight**

The aircraft was ferried to Islamabad and the flight time was 1:40 hrs. The flight was uneventful.

14.4.9. **History**

The only history of defect on the engine was RPM fluctuation plus minus 100 along with torque fluctuation which was reported on 5th August 1998 and again on 8th Aug, 98. The only rectification carried out was re-torquing of PCU Base Nuts and other parameters were reported to be within limits. See Appendix M.

15. **Technical Analysis**

- 15.1. The engine LTP Switch and prop control unit were thoroughly checked in the shop for abnormality and were found to be serviceable and could not have contributed to the occurrence. The engine was given a ground run immediately after the occurrence and performed satisfactorily. The aircraft was test flown for 43 minutes and later ferried to Islamabad and the flight time was 1:40 hrs. During all these operations there was no indication of the defect or the duplication of auto feathering. The cause of auto feathering could not be established during investigation.

15.2. **Operational Analysis**

From the study of crew statements, DFDR read out and tire marks on the runway, it was determined that acceleration up to V1/VR and V2 was normal. The aircraft lifted off at about 110 Kts. and at about 120 Kts., No. 2 engine failed. The aircraft further accelerated to 125 Kts. and during the process when the Captain was controlling the adverse yaw to the right the aircraft lost height and gently settled back on the runway. Although the Captain does not recall the speed at which abort action was initiated, from DFDR reading this speed was calculated at 125 Kts., about 19 Kts. above V1. The Captain's decision to abort was based on the following two considerations: -

- (a) Since the aircraft had settled back on the runway, he presumed that the aircraft might not be able to get airborne on one engine in the remaining length of the runway.
- (b) In his judgment, he thought that the remaining length of runway available was sufficient to stop the aircraft within the runway length.

The Captain's presumption that the aircraft would not be able to get airborne and sustain flight was not correct. Unfortunately he did not look at the speed which had increased to 125 Kts. and was holding. Considering that V2 was 110 Kts., this speed of 125 Kts. was more than adequate for the aircraft to lift off again and maintain climb on one engine. A loss of 10/20 feet of height when an engine fails is not something very unusual, specially when with the loss of 50% thrust, drag also increases momentarily when the pilot attempts to correct the ensuing yaw. Had the Captain elected to continue take off, the aircraft would have gotten airborne safely on one engine, as it is expected to.

While calculating the value of V1, gross weight, runway temperature, runway elevation, QNH and runway lengths are the key ingredients. As the runway length available increases, value of V1 also increases up to a limit beyond which V1 is kept constant even if the runway length available continues to increase. In PIA SOPs, for F-27, VR value is kept equal to V1. For the conditions that were prevalent at Multan, V1 and Vr was calculated at 106 Kts which corresponded to a balanced field length of 4500 feet. (See Appendix N). Although Multan had a 9000 feet Runway, the value of V1 remained at 106 Kts. Longer than the balanced field length does not confer any V1 increment advantage but it does give leeway to the operator to operate at a higher gross weight for the prevalent conditions, as compared to operating from a balanced field length. F-27 Training Manual also cautions against rejecting take off above V1 'even though it might look like the stopping distance available is sufficient'. See Appendix O.

The jamming of the brakes indicated that the entire brake energy had been consumed in bringing the aircraft to a stop from 125 Kts. There was no further braking action of wheel brakes available with the pilot and if at that point of time the aircraft had any residual speed, it would have continued to roll and would have gone off the prepared surface.

The Captain admitted that the extra runway length available, beyond the balanced field length on which V1 had been calculated, influenced his decision to abort. In his judgment, the remaining runway length of about 3300 feet was enough to stop the aircraft within the runway length. That he barely manage to do so did vindicated his judgment but it was at best a subjective judgment which might have gone wrong, with far more serious consequences. It was also a decision in violation of F-27 and company SOPs, which require the pilot to continue, take off should an engine fail beyond V1. This is the recommended and safer option.

16. **Findings**

- 16.1. PIA F-27, AP-ATU was fully certified and maintained as per laid down standards.
- 16.2. The Captain and First Officer, Captain Irfan Mahmood Faiz ATPL No.1008 and First Officer Sheikh Rehan Fazal Haqqi CPL No.1677 were properly certified and authorized for the flight. Captain Faiz was Pilot in Command and First Officer Haqqi was 'pilot not flying'.
- 16.3. The aircraft executed a full wet power rolling no flap take off, which was consistent with the all up weight, runway temperature, airfield elevation and runway length.

- 16.4. V1/VR was calculated at 106 Kts and V2 110 Kts for balanced field length.
- 16.5. The aircraft accelerated normally till V1/VR, which was called out by the First Officer at which point Captain Faiz rotated the aircraft nose and got airborne.
- 16.6. Immediately after getting airborne at about 120 Kts, No.2 Engine failed and auto feathered. First Officer Haqqi called out the failure.
- 16.7. Captain Faiz corrected for the adverse yaw that had resulted because of asymmetrical thrust. In the process the aircraft settled back on the Runway.
- 16.8. Captain Faiz decided to reject take off. Although he did not register the airspeed at the time he took the decision, the aircraft was at 125 Kts and about 3300 feet of runway was remaining.
- 16.9. The Captain managed to stop the aircraft at the end of the runway. In the process, both brakes had jammed. The jamming of brakes had occurred because the entire brake energy available had been consumed in the process of decelerating the aircraft from 125Kts to zero.
- 16.10. It took about an hour to change the brakes and Multan Runway remained blocked for that period.
- 16.11. There was no other damage to the aircraft.
- 16.12. All passengers disembarked safely.
- 16.13. The Captain had initiated abort at 125 Kts, which was 9Kts above V1.
- 16.14. The aircraft was stopped within the remaining runway because Multan Runway was 4500 feet longer than the balanced field length, on which V1 was calculated.
- 16.15. According to F-27 operating manual and PIA SOPs take off should be continued if one engine fails above V1. Any extra field length available beyond the balanced field length does not alter the V1 decision speed.
- 16.16. Although the pilot's judgement was vindicated as he did stop the aircraft on the runway, his actions were in violation of the Company SOPs. Such a subjective decision could have resulted in the aircraft going off the paved surface. The alternate action of continuing take off above V1 is the safer and recommended action for engine failure above V1.
- 16.17. Engr. Malik Aman Ullah visually inspected the engine, AME-789 of PIA Engineering present at site and no abnormality was observed.
- 16.18. The oil filters were also checked and no metal particles were found in the filter indicating no damage to bearings or other metal parts.
- 16.19. The engine was given ground run and idle, dry/wet power checks were carried out. The engine performed satisfactorily.
- 16.20. All these checks were carried out without the presence of Airworthiness Inspector or a representative of Corporate Flight Safety of PIA.

- 16.21. The aircraft was test flown for 40 minutes by Deputy Chief Pilot North (F-27), Capt. Cheema and was found to be satisfactory.
- 16.22. The aircraft was ferried to Islamabad and no abnormality was observed during the flight.
- 16.23. The engine, propeller control unit and low torque pressure switch were checked at PIA engineering Karachi and did not reveal any abnormality or defect.
- 16.24. The cause of auto feathering could not be established during the investigation as all related components were found to be serviceable.

17. **Cause of the Serious Incident**

The cause of engine auto feathering immediately after take off could not be established. The serious incident was caused because of the Captain's decision to reject take off above V1 which was in violation of Company SOPs. .

18. **Recommendations**

- 18.1 DFO should issue fresh instructions to all PIAC pilots to strictly comply with the company policy of reject take off options above V1. Rejection of take off is only permissible above V1 if the aircraft is incapable of flight. Even when operating from runways longer than the balanced. field length on which V1 was calculated, continuing take off on multi engine aircraft is the recommended and safer option should one engine fail above V1.
- 18.2 DFO to take appropriate corrective action in respect of the Captain of the aircraft.
- 18.3 Whenever an incident occurs the technical staff on their own should not carry out any rectification other than the minimum required to remove or secure the aircraft. All checks / rectification should be carried out in the presence of an Airworthiness Inspector or a representative of Corporate Flight Safety.