Aviation Safety Investigation Report 199500522

Israel Aircraft Industries Ltd Westwind

23 February 1995

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Aviation Safety Investigation Report

199500522

The Bureau did not conduct an on scene investigation of this occurrence. The information presented below was obtained from information supplied to the Bureau.

Occurrence Number: 199500522 **Occurrence Type:** Incident
Location: Canberra
State: ACT **Inv Category:** 4
Date: Thursday 23 February 1995
Time: 1300 hours **Time Zone** ESuT
Highest Injury Level: None

Aircraft Manufacturer: Israel Aircraft Industries Ltd
Aircraft Model: 1124
Aircraft Registration: VH-ASR **Serial Number:** 316
Type of Operation: Charter Passenger
Damage to Aircraft: Nil
Departure Point: Canberra ACT
Departure Time: 1250 ESuT
Destination: Essendon VIC

Approved for Release: Thursday, August 24, 1995

FACTUAL DATA

1. The flight.

Passing through 15,000 ft. during climb out of Canberra the left engine N1 and N2 rpm indicators began to fluctuate to 10% of engine rpm. This was accompanied by fluctuating ITT and fuel flow. At this time the engine was being controlled by the onboard computer in the Auto mode, therefore, in accordance with flight manual procedures, the pilot selected Manual mode. The engine parameters then steadied, apart from N2 which continued to fluctuate by 10% rpm. It was then noted that the oil temperature had increased to the top of the green arc on the gauge. A reduction in power had little or no effect on the temperature, however the oil pressure remained normal. Approximately five minutes later the engine flamed out with N1 observed to be windmilling and N2 stationary. The engine was secured and the aircraft continued for an asymmetric landing at Essendon where it is based.

2. The investigation

The starter motor was removed and the engine hand turned to check for freedom of rotation. Although a slight rumble could be heard from the vicinity of the transfer gearbox the N1 appeared to turn freely. However, on removal of the cover plate from the transfer gearbox it became apparent that the horizontal bevel gear was damaged. The freedom of rotation of the N2 assembly was then checked with no apparent problems noted.

The engine was removed from the airframe and, when re-fitting the cover plate to the transfer gearbox in preparation for dispatch to the overhaul facility, a screw and washer were found loose in the bottom of the transfer gearbox. A borescope inspection of the gearbox found that the top screw, P/No. NASllOIE3-8, was missing from the cylindrical roller bearing housing in the transfer gearbox assembly p/n 3070093-4.

The missing screw was one of three that holds the cylindrical roller bearing in place. During assembly these should be torqued to 40 in lbs. A torque check prior to disassembly of the other two screws showed that they were below that torque and both needed a further quarter turn before attaining the required 40 in lbs torque.

The horizontal bevel gear P/No. 3070212-3 had impact damage on the back of the gear and also damage to the gear teeth. The vertical bevel gear P/No. 3070219-2 had sustained severe damage to the gear teeth. The transfer gearbox housing assembly P/No. 3070429-6 was foreign object damaged (FOD) over its internal surfaces and the transducer P/No. 3070722-3 was severely damaged. Metal contamination was found throughout the gearbox components including the bearings. The engine oil pump was found FOD contaminated and completely seized.

The gearbox had operated 4,253 hours and had not been disassembled since new.

ANALYSIS

The top cylindrical roller bearing screw P/No. NASllOlE3-8 became dislodged in service resulting in substantial secondary damage to the transfer gearbox components. Considerable metal contamination of both the transfer and accessory gearboxes occurred. The failure of the transfer gearbox resulted in the break-down of the drive to the accessory gearbox which in turn resulted in the fuel pump failing to deliver adequate fuel to the engine resulting in flame out. The considerable metal contamination as a result of the failure also resulted in the oil pump seizing.

The fluctuations in N1 and N2 rpm coupled with the fluctuating ITT and fuel flow as reported by the pilot were genuine fluctuations as a result of the transfer gearbox failing, with consequent intermittent drive to the accessory gearbox and fuel pump. The fact that the engine settled down again when manual mode was selected is considered to be a coincidence. The continuing apparent fluctuations in N2 rpm would have been due to the transducer beginning to sustain the damage which eventually rendered it unserviceable. The reason for the N2 gauge failing to read for the remainder of the flight after engine flameout, although the LP shaft was windmilling, is because of the damage to the transducer rendering it incapable of sending a signal to the indicator.

It is considered that during initial installation the bolts may have been oil lubricated. This procedure is known to result in a lower torque than that achieved in a dry installation.

The gear box installation on all jet engines is subject to heat and vibration. If the securing screws were not properly installed, and were not properly tightened to the designated torque, the operating environment would be conducive to those screws loosening and becoming displaced.

Significant factors.

The following factors was considered relevant to the development of the incident.

1. During initial assembly of the gearbox the three cylindrical bearing retaining screws were not tightened to the specified torque.

2. One cylindrical bearing retaining screw loosened and became displaced.

3. The displaced screw caused distress to the gearbox components sufficient to fail the gearbox drive to the engine fuel pump.

4. The engine flamed out due lack of fuel.

GLOSSARY OF TERMS.

rpm engine speed in revolutions per minute

ITT engine operating temperature (Interstage Turbine Temperature)

N1 engine HP core speed

N2 engine LP fan speed

FOD foreign object damage

in lbs inch pounds -the measure of torque applied to a screw

LP engine low pressure (N2) stage