

INCIDENT

Aircraft Type and Registration:	Avro 146-RJ100, G-CFAA
No & Type of Engines:	4 Lycoming LF507-1F turbofan engines
Year of Manufacture:	2000
Date & Time (UTC):	20 September 2006 at 2037 hrs
Location:	40 miles south of Edinburgh
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 5 Passengers - 51
Injuries:	Crew - None Passengers - None
Nature of Damage:	Internal damage to No 2 engine
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	7,500 hours (of which 600 were on type) Last 90 days - 154 hours Last 28 days - 66 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, and further AAIB enquiries

Synopsis

During the descent into Edinburgh, smoke began to fill the flight deck. The No 2 engine was identified as defective and was shut down. The aircraft landed safely and was then ferried to a maintenance base where the defective engine was changed but, on the first flight afterwards, smoke again filled the flight deck.

It was concluded that, on the first occasion, a bearing failure lead to seal damage and contamination of the air conditioning system. It appeared that residual oil in the system, resulting from the initial failure, had not been eliminated during the rectification and was responsible for the second event.

This AAIB Bulletin reports on both events. AAIB file EW/G2006/09/22 relates to the event which took place on 20 September 2006, and AAIB file EW/G2006/09/26 refers to the second event which occurred on 26 September 2006.

History of the flights and technical actions

The aircraft was descending through FL120 en route to Edinburgh when the crew became aware of fumes on the flight deck. Oxygen masks were donned. A low oil pressure was then noted on the No 2 engine, and the crew shut the engine down. The Quick-Reference Handbook (QRH) actions for engine failure/shutdown and smoke on flight deck/in the passenger cabin were carried out

and a 'PAN' call was broadcast. An approach was made to Runway 24 and the aircraft was landed and taxied onto the nearest available stand. A precautionary rapid disembarkation was then carried out.

The aircraft was subsequently ferried to the operator's maintenance base at Birmingham where the No 2 engine was changed and other work carried out. It was confirmed that a bearing failure had occurred. The aircraft was in maintenance for approximately a week before being returned to service on 26 September.

At Birmingham International Airport the crew reviewed the Technical Log in preparation for the first flight following the rectification and accepted the aircraft as fit for service. They noted that, according to the Technical Log, the No 2 engine had been replaced, engine test runs had been carried out and the air-conditioning packs and ducting had been checked for traces of contamination.

The aircraft then took off with the first officer acting as the Pilot Flying (PF). Initial climb was normal and flaps were retracted on schedule. Immediately after the air supply was changed over to 'ENGINE' and the APU was shut down, dense smoke rapidly filled the flight deck. At this time the aircraft was in the climb, passing approx 3,500 feet, climbing towards FL60 and following the Daventry 4D departure. Engine air was quickly turned off and APU air selected. The APU was then re-started and, as the APU air entered the aircraft, the smoke started to clear very slowly.

At this point the cabin crew informed the flight crew by intercom that the cabin was full of smoke; the crew responded that they had stopped the source of the smoke and were in the process of clearing it. Whilst this was happening, the aircraft communication was

transferred to the London Control frequency, which was selected but not contacted. The aircraft had by then levelled at FL60 and was following the Standard Instrument Departure. Both pilots then carried out the QRH memory items for smoke, fumes or fire on the flight deck and donned oxygen masks. They then carried out the After Take-Off check-list and part of the QRH to the extent that time permitted. In accordance with guidance in the QRH, they made a decision to land as soon as possible.

London Control then called, as they had yet to hear from the aircraft. The crew requested an immediate return to Birmingham Airport. They then called Birmingham on the Approach/Radar/VDF frequency, transmitted a 'PAN' call and requested vectors to the ILS of Runway 33 to land. In view of the fact that the smoke was clearing, a 'MAYDAY' call was not made and evacuation using slides was not anticipated. The cabin air control was selected to 'FRESH' to help with smoke removal. The cabin crew were informed by intercom that the aircraft was returning to Birmingham as this was an emergency but that the landing was expected to be normal and use of evacuation slides was not expected.

The Purser in charge made calls on the Public Address (PA) system to the passengers and informed them that the crew had the situation under control and they were returning to Birmingham. Passengers were advised to keep their heads low to avoid smoke. The calls were made by the purser, since the flight crew were wearing oxygen masks and it was felt that the passengers might not understand them and might be alarmed by the unusual sound of the pilot's voices created by the wearing of the masks. Use of oxygen or smoke hoods by the cabin crew was briefly discussed but it was left to their discretion and in the end none were used and passenger oxygen masks were not deployed.

Birmingham Tower enquired of the passenger and crew numbers and whether the aircraft was overweight. An approach was made by the first officer, remaining as PF, whilst an uneventful manual landing was carried out by the captain. The runway was vacated and the aircraft taxied to the terminal with fire trucks following, brief radio discussion with the fire service having taken place. Both pilots removed masks and the captain made a PA call to inform the passengers that they would be disembarking normally at the gate using the aircraft front steps.

Technical investigation

The No 2 engine, which had been removed after the first event, was forwarded to its manufacturer's overhaul base for defect investigation and repair. Considerable internal damage was identified but the failure of its No 1 bearing appeared to have been the main event in the failure sequence. Little oil remained in the engine system and damage to the bearing sealing accounted for the loss of oil and its entrainment in the bleed air flow. This then contaminated the air-conditioning system with oil and allowed smoke to enter the cabin.

The operator concluded that the oil contamination of the ducting and internal components of the packs,

which occurred just before the engine was shut down on approach to Edinburgh, remained present thereafter. Its removal had not been carried out successfully during the maintenance activities at Birmingham. Although ground running was carried out following the replacement of the engine, it appears that this did not involve full functioning of the air-conditioning system and consequently oil contamination remained in the packs and ducting and was neither identified nor effectively eliminated.

On removal from service following the second event, the aircraft was subjected to extensive ground running and functioning of the air conditioning. This did not produce smoke in the cabin. It was therefore concluded that all the residual oil in the air-conditioning components had been eliminated during the brief period when the engines were supplying air to the packs. This occurred after the air-conditioning supply was selected from 'APU' to 'ENGINE', early in the climb.

The aircraft was returned to service and no reports of further flight-deck/cabin smoke have been received.