



Aviation Safety Investigation Report - Final

British Aerospace Plc BAe 146-300, VH-NJL

Occurrence Details

Occurrence Number:	200204912	Location:	6 km E Karratha, Aero.
Occurrence Date:	20 October 2002	State:	WA
Occurrence Time:	1810 hours WST	Highest Injury Level:	None
Occurrence Category:	Incident	Investigation Type:	
Occurrence Class:		Investigation Status:	
Occurrence Type:		Release Date:	20 August 2003

Aircraft Details

Aircraft Manufacturer:	British Aerospace Plc	Aircraft Model:	BAe 146-300
Aircraft Registration:	VH-NJL	Serial Number:	E3213
Type of Operation:	Air Transport, Domestic, High Capacity, Passenger, Scheduled		
Damage to Aircraft:	Nil		
Departure Point:	Perth, WA	Departure Time:	1610 hours WST
Destination:	Karratha, WA		

Factual Information

The co-pilot of the BAe146-300 reported that he noticed both cockpit side windows were open as he entered the flight deck to commence his pre-flight preparations and almost immediately detected the presence of fumes. He stated that these fumes had a distinctive odour that he recognised as being consistent with the contamination of the cabin air supply by lubricating oil from the aircraft's engines. This typically occurs when a faulty bearing seal allows lubricating oil to escape and contaminates one of the sources of cabin air for the aircraft.

The auxiliary power unit (APU) was operating and air conditioning Pack 1 and 2 were supplying air to the flight deck and passenger cabin. As Pack 1 supplies most of the air to the flight deck and because fumes were not apparent in the passenger cabin, the co-pilot immediately suspected that the contamination was associated with Pack 1. He de-selected Pack 1 and noticed an immediate improvement to the quality of the air.

The co-pilot briefed the pilot in command of these observations when he arrived on the flight deck. The crew used engine bleed air to provide cabin air conditioning as the aircraft taxied for takeoff and Pack 1 remained de-selected. This was on the basis of the tailwind conditions encountered while taxiing, to reduce the possibility of ingesting fumes from the APU's exhaust into the aircraft cabin and the co-pilot's observations of air quality from Pack 1. The takeoff was performed with all air conditioning packs selected off and number-4 engine supplying bleed air for pressurisation control of the aircraft cabin.

The co-pilot was the handling pilot for the sector from Perth to Karratha. After takeoff, the crew selected engine bleed air sources from all engines and Pack 1 and 2 were used to provide air conditioning to the passenger cabin and flight deck. No fumes were evident in either the passenger cabin or the flight deck and the flight proceeded normally.

About 10 minutes prior to the top of descent, the co-pilot recalled starting to experience symptoms of a headache. He was able to continue his duties as handling pilot and completed the descent to the Karratha circuit area. The

aircraft was on final approach to land, when strong oil-type fumes were again detected on the flight deck. As the aircraft cabin had already stabilised at sea-level atmospheric pressure and the source of fumes appeared to be either the air conditioning packs or one of the engine bleed air supplies, all air conditioning packs and all sources of engine bleed air were selected off. The intensity of the fumes quickly dissipated and the co-pilot completed the landing. Fumes were not detected in the passenger cabin by any of the flight attendants. The co-pilot reported that supplemental oxygen was not used on this occasion due to the critical phase of flight (short final approach to land) and the prompt action taken to isolate the source of fumes.

During the taxi to the passenger terminal, the co-pilot became aware that he was experiencing symptoms of an unusually strong headache, nausea and irritated eyes, nose and throat. His symptoms quickly improved as he conducted the external turnaround duties and he felt capable of performing his duties on the return sector as pilot not flying.

The pilot in command was satisfied that the source of fumes experienced on short final was associated with contamination of the cabin air supply by engine lubricating oil. The return flight was conducted without using APU air and with Pack 1 de-selected to minimise the possible recurrence of fume contamination. The flight was completed without incident.

Subsequent to the incident, the co-pilot recalled that during the outbound sector his bottled drinking water, which had been poured and left standing in his cup, had acquired a rank swampy, slightly metallic taste. The pilot in command was also reported to have made a similar comment about the taste of his drinking water. The cups were resting in the flight deck cup holders adjacent to the air outlet vents. This was noticed prior to the co-pilot reporting symptoms of a headache and fresh cups of water from the bottle tasted normal with no apparent sign of contamination. The ATSB were not able to test the water for contaminants as it had been discarded following the flight.

Following entry of the fume report in the aircraft's defect log, company engineering personnel applied the requirements of Airworthiness Directive AD BAe 146/86, issued 30 March 2001 that required inspection of various components associated with the aircraft's cabin air supply. This inspection revealed no apparent defects or source of contamination to the cabin air.

The operator received subsequent Operating Crew Reports associated with poor cabin air quality on 23 and 26 October 2002. The aircraft commenced a period of heavy maintenance on 28 October 2002. During this maintenance the APU was removed from the aircraft, cleaned, inspected (with nil defects found) and refitted. Air conditioning Pack 1 was also cleaned. The operator received subsequent reports of flight deck odours with respect to this aircraft on 5 and 8 December 2002 and the requirements of the Airworthiness Directive were again applied. On this occasion the inspections revealed slight leakage of engine lubricating oil from a bearing seal on the number-4 engine.

Analysis

The investigation considered that the intermittent deterioration in cabin air quality was consistent with other similar occurrences during which the cabin air was contaminated by engine or APU lubricating oil. Due to the intermittent nature of contamination the source of the fumes was difficult to positively identify.

It was not possible to identify the substance(s) that had apparently contaminated the crew's drinking water while it had been left standing in the cups. However, the investigation could not discount the possibility that the drinking water had been contaminated by water-soluble compounds from cabin air contaminated by engine lubricating oil.

Safety Action

Issues associated with improving cabin air quality are the subject of ongoing efforts by the aircraft manufacturer, engine manufacturer, aircraft operators and some aviation regulatory authorities including the Australian Civil Aviation Safety Authority.

The Civil Aviation Safety Authority issued an airworthiness directive on 28 November 2002 (AD/BAe 146/102) requiring operators of BAe 146 type aircraft to action requirements of a manufacturer's Inspection Service Bulletin (ISB) 21-156. This related to the recurrent inspection of air conditioning ducts for traces of possible contamination and inspection of the ducts following a cabin air quality event.

The aircraft operator has also commenced replacing the noise-attenuating material that lines the air conditioning ducts across their entire BAe 146 fleet. This action exceeded the manufacturer's requirements outlined in its ISB 21-156.

The engine manufacturer is developing a redesigned bearing seal to improve the component's reliability and consequently reduce the frequency of incidents where cabin air is contaminated by engine lubricating oil.