



Aviation Safety Investigation Report - Final

British Aerospace Plc BAe 146-300 , VH-NJF

Occurrence Details

Occurrence Number:	199702276	Location:	Epping, Locator
Occurrence Date:	10 July 1997	State:	VIC
Occurrence Time:	0030 hours EST	Highest Injury Level:	Minor
Occurrence Category:	Incident	Investigation Type:	
Occurrence Class:		Investigation Status:	
Occurrence Type:		Release Date:	06 September 1999

Aircraft Details

Aircraft Manufacturer:	British Aerospace Plc	Aircraft Model:	BAe 146-300	
Aircraft Registration:	VH-NJF	Serial Number:	E3198	
Type of Operation:	Air Transport, Cargo, Domestic, High Capacity, Scheduled			
Damage to Aircraft:	Nil			
Departure Point:	Sydney NSW	Departure Time:	2310 hours EST	
Destination:	Melbourne, VIC			
Crew Details:	Role	Class of Licence	Hours on Type	Hours Total
	Pilot-In-Command	ATPL	3400.0	14350

Factual Information

While on descent into Melbourne, the crew of a British Aerospace 146 (BAe 146) freighter reported that they began to smell oil fumes. The descent was being conducted at an engine power setting of between 60% and 70% N2, with all four engines supplying bleed air. Both environment control system (air conditioning) packs were selected ON. The crew, who were the only occupants of the aircraft, consisted of the pilot in command, the co-pilot, and a supernumerary pilot. The pilot in command was the handling pilot for the sector.

The pilot in command advised that, following the onset of the fumes, he had experienced difficulty in concentrating on the operation of the aircraft, and had suffered from a loss of situational awareness. By the time the aircraft had reached an altitude of approximately 2,000 ft, his control inputs had become jerky and he began suffering vertigo. He relinquished control of the aircraft to the co-pilot, who continued with the approach and landing. The supernumerary pilot advised that he had felt nauseous. The pilot in command advised that because no smoke or mist was present within the cockpit, he did not consider it necessary to follow the smoke-removal checklist. He also advised that the crew did not consider the use of crew oxygen masks was necessary in the situation.

After boarding the flight in Sydney, the supernumerary pilot had examined the aircraft maintenance release and noted a deferred defect concerning oil residue at the number two air conditioning pack inlet, resulting from an oil leak from the number four engine. This maintenance release entry was dated 17 June 1997. Maintenance trouble-shooting had isolated the problem to a failing oil seal within the number four engine. The aircraft had been cleared for further flight without any operational restrictions being noted, and the defect was listed for rectification at company convenience.

On experiencing the fumes during the descent into Melbourne, the supernumerary pilot recalled that he had noted a defect concerning the number two air conditioning system, and rechecked the maintenance log to determine which bleed air system may have been contributing to the source of contamination.

After shutdown at Melbourne, the crew vacated the aircraft. Following exposure to fresh air for about 30 minutes, the effects of the oil fumes dissipated. As a result, the crew did not consider it necessary to seek medical advice before continuing the scheduled flights. This decision was reinforced by the fact that the co-pilot had not reported being affected by the fumes. The crew further advised that because the technical log already contained an entry regarding the number four engine, and because Maintenance were aware of the problem, another entry regarding the same problem was unnecessary. They elected to continue the remaining scheduled flight sectors with the number four-engine bleed air system turned off, in accordance with the provisions of the master minimum equipment list (MMEL). The remainder of their tour of duty was completed without incident.

Some 6 hours after the incident, and for the next 10 days, the pilot in command suffered from severe headaches characterised by the feeling of a strong pressure on the top of the head. This diminished over time; however, he did report having balance problems while attempting to rise in a darkened room at night, and also reported that he had experienced increased headaches and vertigo while travelling. The supernumerary pilot reported reduced but similar symptoms. The co-pilot did not report having been affected by the fumes.

Following this occurrence, the pilot in command submitted an air safety incident report, and also advised the operator of the circumstances of the occurrence. The operator applied minimum equipment list (MEL) 20-50-1 on 14 July 1997, prohibiting the use of the number two air conditioning pack, thus preventing oil contamination of the air conditioning system by the number four engine. The engine was subsequently replaced on 16 July 1997.

The BAe146 aircraft is a high-wing, four-engine jet transport, which first entered service in 1983. An auxiliary power unit (APU) is mounted in the tail, along with two environment control system packs. High temperature bleed air is supplied by the compressor section of each engine and the APU. The bleed air is then passed through the environment control system packs, where it is conditioned before distribution into the aircraft cabin.

During the course of the investigation, a number of flight and cabin crew members, employed by various Australian operators on BAe146 type aircraft, reported to the Bureau that they and others were experiencing a number of health problems. The crew members reported that they were either off work permanently, on prolonged sick leave, or in receipt of medical certificates that precluded them from undertaking normal crew duties on the aircraft. The crew members reported a variety of differing physical reactions arising from their perceived exposure to fume contamination, the most common being sore eyes, nose and throat; nausea; tiredness; and headache. The more disabling reactions reported include any of the above symptoms plus any of the following: dizziness, balance problems, extreme tiredness, extreme reaction to all oil-based products (including plastics and cosmetics), feelings of intoxication, slurred speech, inability to walk straight, skin rash, itchiness and blotching.

The investigation found that smoke and fume contamination of cabin air is neither a new phenomenon nor a particularly rare event and that over time, it has been experienced in many aircraft types. The Australian experience has found that many complaints have been recorded against the BAe146 type. As a result, Australian domestic operators of the BAe146 have established internal reporting systems whereby reports of odours are submitted by crews on specifically designed forms that are collated and analysed, as a means of establishing the extent of the problem.

In August 1997, the operator published a Notice to Pilots (NOTOP) 37/97 concerning alleged air conditioning contamination on BAe146 and Avro RJ aircraft types. The NOTOP stated that it was not a new phenomenon, and that all aircraft air conditioning systems would induce foreign odours from oil or fuel on occasions during routine operations. Attached to the NOTOP was a schedule to be used by flight crew to determine the source of air conditioning contamination. The schedule required flight crews to operate BAe146 aircraft on a series of sectors with various air supply and air conditioning pack selections to identify the source of contamination.

One operator supplied air-sampling kits on board the aircraft, and medical checks were offered when crew complained of exposure to cabin air contamination. The Bureau of Air Safety Investigation was unable to determine if details of all reported odour occurrences were entered into aircraft maintenance logs. Other reports were made directly to medical personnel, some to employee representatives, and some were made verbally to the Bureau. Some reporters advised that they would not report to their employers because they feared reprisals.

Visual descriptors of the contamination included "smoke", "fumes", "oil mist", and "fog". Smell descriptors included "acid", "vomit", and "smelly socks". The investigation labelled all described forms of contamination as odours. It was found that the odour reports defined two distinct modes: one that could be associated with oil fumes, and another that could be associated with a stale air environment. Identified causes of foul air supply included engine and APU oil seal leakage, hydraulic oil leaks, electrical component overheating, and problems associated with food heating facilities in galleys.

BAe146 operators approached the manufacturers of the aircraft, engines and APU. As a result, a series of tests and trials were designed to ascertain whether the aircraft met all the relevant certification requirements, and whether modifications were required to alleviate the cabin air quality problems being experienced from time to time.

As a result of testing and research, operators undertook a number of corrective maintenance actions and modifications to BAe 146 aircraft in the Australian fleet in an attempt to mitigate odour occurrences within the cabin. These actions included more frequent air filter cleaning, replacement of APUs with an alternative unit, modifications to APUs to improve ventilation in and around the unit and associated air intakes, assessment of filter life, air duct cleaning, and the replacement of ducts likely to trap oily deposits. The air conditioning packs were also "burnt out" on a daily basis. This procedure was intended to increase pack operating temperatures in an attempt to burn off any remaining oil residues within the air conditioning system, but was discontinued by Australian operators because it apparently caused deterioration of the packs. There was also an increase in the frequency of engine oil seal inspections and replacement.

The Bureau of Air Safety Investigation is particularly concerned about the potential for further BAe146 flight and cabin crew to become incapacitated during flight due to exposure to odours being introduced into the aircraft cabin environment. In this occurrence, two of the three flight crew members on board the aircraft suffered from symptoms that prevented them from properly carrying out their assigned duties. The introduction of fumes and odours into the cabin environment following an engine defect constitutes a possible safety deficiency that should be addressed by the regulatory authority, in accordance with its statutory responsibility to monitor the continued airworthiness of aircraft.

The implications of long-term exposure to cabin air contamination for the health of passengers and crew requires further examination, together with the development and implementation of suitable counter-measures. The competent authority to co-ordinate such activities is the regulatory authority.

Safety Action

The Bureau of Air Safety Investigation recommends that:

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The Civil Aviation Safety Authority, in conjunction with the aircraft manufacturer, British Aerospace Plc, address deficiencies that permit the entry of fumes into the cockpit and cabin areas of BAe146 aircraft. These deficiencies should be examined by the regulatory authority as part of its responsibilities for initial certification and continued airworthiness of the BAe 146 aircraft.

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British Aerospace Plc liaise with the engine manufacturer AlliedSignal to investigate failures within the engine that result in fumes entering the cockpit and cabin areas of BAe146 aircraft.