



Aviation Safety Investigation Report - Final

British Aerospace Plc BAe 146-200A, VH-YAD

Occurrence Details

Occurrence Number:	200203030	Location:	37 km S Brisbane, Aero.
Occurrence Date:	29 June 2002	State:	QLD
Occurrence Time:	1425 hours EST	Highest Injury Level:	None
Occurrence Category:	Incident	Investigation Type:	
Occurrence Class:		Investigation Status:	
Occurrence Type:		Release Date:	21 August 2003

Aircraft Details

Aircraft Manufacturer:	British Aerospace Plc	Aircraft Model:	BAe 146-200A	
Aircraft Registration:	VH-YAD	Serial Number:	E2097	
Type of Operation:	Air Transport, Domestic, High Capacity, Passenger, Scheduled			
Damage to Aircraft:	Nil			
Departure Point:	Brisbane, QLD	Departure Time:	1416 hours EST	
Destination:	Canberra, ACT			
Crew Details:	Role	Class of Licence	Hours on Type	Hours Total
	Pilot-In-Command	ATPL	1475.0	7750

Factual Information

The British Aerospace BAe 146-200A (BAe 146) was being operated on a regular public transport service from Brisbane, Qld to Canberra, ACT. Approximately 5 minutes after take-off the flight crew detected that smoke was present on the flight deck. They donned their oxygen masks in accordance with the emergency checklists that dealt with smoke, fumes or fire and made a PAN transmission to air traffic control, requesting a return to the airport. The approach controller issued radar vectors to facilitate the prompt return of the aircraft to Brisbane and placed the airport's emergency services on standby. During the descent, the pilot in command briefed the cabin crew, alerting them to the possibility of a cabin evacuation.

At the time of the incident, the BAe 146 Quick Reference Handbook (QRH) contained an emergency checklist procedure titled Smoke, Fumes or Fire on Flight Deck or in Cabin - Any Source. That checklist inferred that if the source of the smoke was identified, the crew should then conduct an appropriate procedure from a choice of further checklists contained within the QRH. The crew's selection of an appropriate checklist was dependent on whether the source of smoke was either from the electrical system, from the air conditioning system, or from the cabin equipment/furnishings.

Initially believing that the electrical system was the source of the smoke, the crew commenced the emergency checklist for Electrical Smoke, Fumes or Fire of Unknown Origin. That checklist had the potential to take in excess of 8 minutes to complete because it involved the troubleshooting of the aircraft's electrical system to determine the source of the smoke. As the aircraft was close to landing and the crew's priority was to land as soon as possible, that checklist was not completed. Since the incident, the aircraft manufacturer issued a revision to the QRH that simplified and combined the checklists described above. The new checklist was not generated in response to this particular incident.

The aircraft landed 20 minutes after take-off without further incident. Rescue and fire fighting services (RFFS) were in attendance as the crew stopped the aircraft on the taxiway. The RFFS personnel inspected the aircraft's electronics bay in an attempt to trace the source of the smoke, but nothing abnormal was observed. The aircraft was then taxied to the airport terminal and the passengers were disembarked. The co-pilot suffered eye irritation as a result of the smoke, but the passengers and the other members of the crew reported no symptoms.

Maintenance personnel inspected the aircraft and established that the smoke and fumes in the cockpit were due to contaminated bleed air from the number-1 engine. During normal operation, bleed air from that engine, along with bleed air from the number-2 engine, was fed to airconditioning pack one. Pack one supplied conditioned air to the flight deck and augmented the passenger cabin supply. Bleed air from the number-3 and number-4 engines was fed to pack two, which in normal operation supplied air to the cabin only.

The engineers addressed the defect in accordance with the Civil Aviation Safety Authority (CASA) airworthiness directive AD/BAe146/86 and the British Aerospace Systems Information Service Bulletin (ISB) 21-150. That ISB required certain actions to be performed whenever a cabin air quality problem was identified, which was suspected of being associated with oil contamination of the air supply from the airconditioning packs. The bleed air supply from the number-1 engine was isolated and the defect was deferred in accordance with the aircraft's approved Minimum Equipment List. The aircraft resumed service and no further smoke or fumes were evident during subsequent flights.

The defective engine was removed from the aircraft 5 days later and was returned to the engine manufacturer for overhaul. The overhaul procedure revealed that the engine's number-2 forward and aft carbon seals had heavy carbon build-up and were leaking oil. The manufacturer's report stated that the engine's number-4 carbon seal also showed evidence of oil leakage. Previous incidents of air system contamination on this type of aircraft had indicated that the fumes were a consequence of failures of the engine oil seals.

It has been noted in previous incidents, both in Australia and overseas, that there was a reluctance of the crews to use oxygen masks when air contamination was detected on the flight deck. Those incidents indicated that operating crews were not aware of their potential impairment and the consequent effect on their decision-making ability. The safety implications of that impairment was reflected in the decision by CASA to adopt a United Kingdom Air Accidents Investigation Branch (AAIB) recommendation requiring flight crew to use oxygen masks selected to 100 percent when there was a suspicion of flight deck or cabin air contamination.

Analysis

The engine bearing seals normally protected the bleed air supplied to the airconditioning packs from oil contamination. A technical defect in one or more of the seals resulted in oil entering the flight deck airconditioning system, with the first indication of the defect being an awareness of smoke on the flight deck. The flight crew correctly donned their oxygen masks as the first step in addressing the problem and then proceeded to comply with the emergency checklist by landing at the nearest suitable airport.

The difficulty that the crew faced in correctly determining the source of the smoke resulted in the initiation of a non-normal checklist that was not pertinent to the situation. The aircraft manufacturer's subsequent revision of the QRH, simplifying and clarifying the checklists, has diminished the likelihood of a similar occurrence. As the incident took place during daylight hours, in visual meteorological conditions close to the departure airport, the potential to affect the safety of flight was limited. It is considered that if the smoke event had occurred later in the flight, the crew would have had more time to carry out the checklist procedures and successfully isolate the source of the smoke.

The possibility that the air conditioning system was supplying contaminated air to the flight deck while the crew was carrying out the emergency procedure for electrical smoke, highlights the importance of crews donning oxygen masks at the first sign of fumes or smoke contamination of flight deck air.