Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Report – 200606215

Final

Smoke event – 65 km NNE Melbourne
19 October 2006
VH-TQX
de Havilland Canada DHC-8-202

Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Report

200606215

Final

Smoke event – 65 km NNE Melbourne
19 October 2006
VH-TQX
de Havilland Canada DHC-8-202

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Published by: Australian Transport Safety Bureau

Postal address: PO Box 967, Civic Square ACT 2608

Office location: 15 Mort Street, Canberra City, Australian Capital Territory

Telephone: 1800 621 372; from overseas + 61 2 6274 6590

Accident and serious incident notification: 1800 011 034 (24 hours)

Facsimile: 02 6274 6474; from overseas + 61 2 6274 6474

E-mail: atsbinfo@atsb.gov.au

Internet: www.atsb.gov.au

© Commonwealth of Australia 2007.

This work is copyright. In the interests of enhancing the value of the information contained in this publication you may copy, download, display, print, reproduce and distribute this material in unaltered form (retaining this notice). However, copyright in the material obtained from non-Commonwealth agencies, private individuals or organisations, belongs to those agencies, individuals or organisations. Where you want to use their material you will need to contact them directly.

Subject to the provisions of the *Copyright Act 1968*, you must not make any other use of the material in this publication unless you have the permission of the Australian Transport Safety Bureau.

Please direct requests for further information or authorisation to:

Commonwealth Copyright Administration, Copyright Law Branch
Attorney-General's Department, Robert Garran Offices, National Circuit, Barton ACT 2600

www.ag.gov.au/cca

ISBN and formal report title: see 'Document retrieval information' on page iii.

DOCUMENT RETRIEVAL INFORMATION

Report No.	Publication date	No. of pages	ISBN
200606215	2 April 2007	8	978 1 921164 61 3

Publication title

Smoke event – 65 km NNE Melbourne - 19 October 2006 – VH-TQX – de Havilland Canada DHC-8-202

Prepared by

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608 Australia
www.atsb.gov.au

Reference No.

Apr2007/DOTARS 50187

Acknowledgements

Figure 1 used with the permission of Pratt & Whitney Canada and adapted for use by the ATSB with the inclusion of approximate bearing positions.

Abstract

On 19 October 2006, at about 0635 Eastern Standard Time the crew of a de Havilland Canada DHC 8-200 aircraft, registered VH-TQX, departed from Melbourne Airport, Vic on a scheduled flight to Wollongong NSW. At about 0645, as the aircraft was climbing through flight level 140, the pilot in command (PIC) detected smoke in the aircraft. Soon afterwards a smoke detector warning sounded in the aircraft toilet and the flight and cabin crew observed smoke haze. The flight crew reported the situation to air traffic control (ATC) then diverted the aircraft to Melbourne and carried out the appropriate recall and checklist actions. The aircraft landed in Melbourne on runway 16 at 0658. There were no reported passenger or crew injuries.

The manufacturer's examination of the engine showed that oil had leaked from several compressor bearings into the low pressure compressor of the engine. The high temperature of the compressed air and the engine components caused the oil to vaporize, contaminating the air extracted from that engine section to the aircraft cabin. The manufacturer had previously issued three service bulletins recommending engine modifications pertinent to this occurrence. Compliance with the bulletins was optional. However, the operator had already modified about 90% of the affected engines in its fleet at the time of the incident. The operator has planned to modify the remaining engines at the next period of scheduled or unscheduled maintenance.

The crew's timely assessment and response to the in-flight emergency reduced the likelihood of an extended exposure to the fumes by the passengers and crew. Also, the initiation of an emergency phase by air traffic control ensured that appropriate services were available to assist the crew after the aircraft had landed.

The engine manufacturer has undertaken to update the Workscope Planning Guide for the PW 123D engine to improve its resistance to internal oil leakage.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations. Accordingly, the ATSB also conducts investigations and studies of the transport system to identify underlying factors and trends that have the potential to adversely affect safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and, where applicable, relevant international agreements. The object of a safety investigation is to determine the circumstances in order to prevent other similar events. The results of these determinations form the basis for safety action, including recommendations where necessary. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations.

It is not the object of an investigation to determine blame or liability. However, it should be recognised that an investigation report must include factual material of sufficient weight to support the analysis and findings. That material will at times contain information reflecting on the performance of individuals and organisations, and how their actions may have contributed to the outcomes of the matter under investigation. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. While the Bureau issues recommendations to regulatory authorities, industry, or other agencies in order to address safety issues, its preference is for organisations to make safety enhancements during the course of an investigation. The Bureau prefers to report positive safety action in its final reports rather than making formal recommendations. Recommendations may be issued in conjunction with ATSB reports or independently. A safety issue may lead to a number of similar recommendations, each issued to a different agency.

The ATSB does not have the resources to carry out a full cost-benefit analysis of each safety recommendation. The cost of a recommendation must be balanced against its benefits to safety, and transport safety involves the whole community. Such analysis is a matter for the body to which the recommendation is addressed (for example, the relevant regulatory authority in aviation, marine or rail in consultation with the industry).

FACTUAL INFORMATION

On 19 October 2006, at about 0635 Eastern Standard Time[1] the crew of a de Havilland Canada DHC 8-200 aircraft (Dash 8), registered VH-TQX, departed from Melbourne Airport, Vic on a scheduled flight to Wollongong NSW. At about 0645, as the aircraft was climbing through flight level 140[2], the pilot in command (PIC) asked the other crew members whether they could smell smoke in the aircraft. Soon afterwards a smoke detector warning sounded in the aircraft toilet and the flight crew and cabin crew observed smoke haze in the aircraft. The flight crew reported the situation to air traffic control (ATC) and initiated a diversion to return to Melbourne. The flight crew had intended to declare an urgency condition to ATC using standard phraseology[3] but did not, due to the perceived requirement to deal with flight management issues of a higher priority. Air traffic control declared an emergency distress phase and alerted the Melbourne aerodrome rescue and fire-fighting service (ARFFS) on the basis of the information provided by the flight crew.

The flight crew reported that they recalled and actioned the *Fuselage-Fire or Smoke* checklist from memory and then read and partially actioned the *Known-Source of Fire or Smoke.* There was insufficient time to complete that checklist or the *Unknown-Source of Fire or Smoke or Air-conditioning Smoke* checklist from the quick reference handbook before landing. The flight crew reported that after they reduced engine power to descend the aircraft, the cabin smoke density reduced so that by the time they commenced their final approach to land it had substantially dispersed. The aircraft landed in Melbourne on, runway 16, at 0658. After landing, the PIC cleared the runway and stopped the aircraft on taxiway Echo. He then contacted the Melbourne Fire Commander by radio to confirm that there was no engine / fuselage fire or other abnormality. Once this confirmation was received the aircraft was taxied to the parking apron, escorted by the ARFFS, where the passengers were disembarked. There were no reported passenger or crew injuries.

The operator tested the aircraft on the ground and attributed the cabin smoke to a fault in the number-1 engine (left engine). This engine, model PW 123D, was removed from the aircraft and shipped to the engine manufacturer for examination.

A proportion of air from the compressor section (see figure 1) of the engine is extracted (prior to combustion), for the purposes of aircraft pressurisation, cabin ventilation and air conditioning. The manufacturer's examination of the engine showed that oil had leaked from the number-3 bearing, into the low pressure compressor section of the engine (see figure 1). The high temperature of the compressed air and engine components caused that oil to vaporize, thereby contaminating the air extracted from that section of the engine to the aircraft cabin.

---

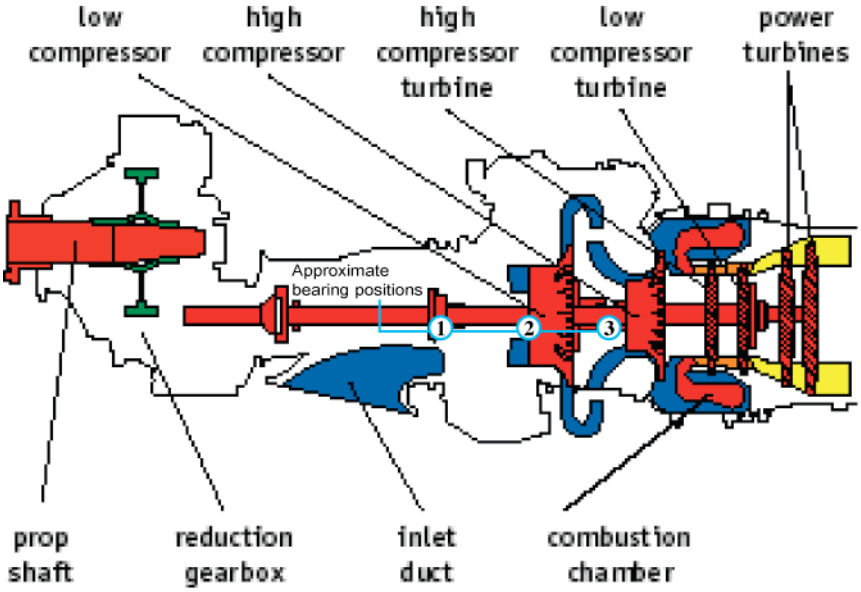
1 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. Eastern Standard Time was Coordinated Universal Time (UTC) + 10 hours.

2 Approximately 14,000 ft above mean sea level.

3 A radio transmission of an urgency condition is preceded by the words PAN PAN, PAN PAN, PAN PAN.

The bearings are lubricated and cooled by oil. Bearing seals are of the non-rubbing labyrinth or abradable type. Labyrinth type seals are constructed so that bearing cavities are surrounded by a blanket of cool air, designed to prevent lubricating oil leaking into the main engine air flow. The leakage of oil from the bearings as described above was due to an increase in accessory gear box (AGB) pressure with a corresponding reduction in sealing air pressure across the oil/air bearing seals. The increase in AGB pressure was attributed to worn and damaged carbon seals on the number-1 bearing and deteriorated packing on the P2.5/3 switching valve transfer tube (not depicted). In addition the deteriorated packing between the low pressure diffuser case and the inter-compressor case and the number-4 bearing housing allowed oil to leak into the P2.5/3 air plenum[4] (not depicted) contaminating it with oil, which also contributed to the smoke in the cabin.

Figure 1: PW 100 series engine



The post engine examination report by the engine manufacturer recommended that the operator comply with the content of service bulletins (SBs) 21680; 21546; 21313. These SBs were intended to address the issues of:

- deteriorated packing- by the use of an improved fluorocarbon packing material and
- the effectiveness of the air/oil bearing seals as identified above- by extending the accessory gear box breather tube into the engine exhaust duct to prevent an increase of pressure within the AGB.

Compliance with these SBs was an option for the operator. At the time of the incident the operator had modified 45 of the 50 engines in their fleet to which the SBs applied. This represented substantial voluntary compliance. As part of the

4 An airtight chamber essential for gas turbines having double-entry or reverse flow compressor with ingestion all round [the compressor] periphery.

operator's current maintenance program the remaining engines will be modified at the next period of scheduled or unscheduled maintenance.

Smoke in cabin events can be extremely serious. The crew's timely assessment and response to the in-flight emergency reduced the likelihood of fire damage or an extended exposure to the fumes by persons on board the aircraft. Also, the initiation of an emergency phase by air traffic control ensured that the appropriate emergency services were available to assist the crew after the aircraft had landed. The operator's voluntary and substantial compliance with the manufacturer's service bulletins has reduced the likelihood of future cabin air contamination events.

The engine manufacturer reported that it is '…currently updating the [PW 123D] Workscope Planning Guide with recommendations for improving the durability and resistance to internal oil leakage'.