Australian Government
Australian Transport Safety Bureau

**ATSB TRANSPORT SAFETY INVESTIGATION REPORT**

Aviation Occurrence Report – 200604807

Final

# In-flight engine fuel leak
# 482 km NW Darwin
# Boeing Co. 747-438, VH-OJP
# 18 August 2006

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Figure 1: QANTAS engineering.



## Abstract

On 18 August 2006, a Boeing 747-438 aircraft, registered VH-OJP, with a crew of 18 and 243 passengers departed Hong Kong, China, on a scheduled passenger service to Melbourne, Australia.

While in cruise, at a position 482 km north-west of Darwin, one of the cabin crew notified the flight crew that there was a smell of fuel in the first class cabin. One of the pilots verified the fuel smell and then proceeded to inspect the engines from the cabin windows.

A fluid trail was evident from the rear of the number-3 engine. During this time, it was noted by the other pilots that the number-3 engine had a higher than normal fuel flow. The flight crew conducted an in-flight shut down of the number-3 engine and diverted the aircraft to Darwin.

A subsequent inspection of the number-3 engine revealed the fuel manifold return line had fractured, causing a fuel leak. The fuel line was replaced and the aircraft was returned to service.

In 2005, the ATSB investigated two other fuel manifold return line fractures, from the same engine type, under similar circumstances.

# 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

## Introduction

On 18 August 2006, at approximately 1530 Central Standard Time[1], a Boeing Company 747-438 aircraft, registered VH-OJP, with a crew of 18 and 243 passengers, departed Hong Kong, China, on a scheduled passenger service to Melbourne, Australia.

While in cruise, at a position 482 km north-west of Darwin, one of the cabin crew notified the flight crew that there was a smell of fuel in the first class cabin. One of the pilots verified the fuel smell and then proceeded to inspect the engines from the cabin windows. A fluid trail was evident from the rear of the number-3 engine. During this time, it was noted by the other pilots that the number-3 engine had a higher than normal fuel flow, with a correspondingly high fuel usage from the number-3 main fuel tank.

Following the non-normal procedures checklist, the pilot in command shut-down the number-3 engine, declared a PAN[2] to Air Traffic Control and diverted the aircraft to Darwin. A subsequent inspection of the number-3 engine revealed that the fuel manifold return line had fractured, resulting in a fuel leak. The fuel line was replaced and the aircraft was returned to service.

In 2005, the ATSB investigated two other fuel manifold return line fractures, from the same engine type, under similar circumstances (Figure 1).

**Figure 1: Previous fuel manifold drain line fracture**

1 Central Standard Time – The 24 hour clock is used in this report to describe the local time of day which was Central Standard Time (CST). CST is Universal Time Co-ordinated + 9.5 hours.

2 PAN – Radio code indicating uncertainty or alert, general broadcast to the widest area but not yet at the level of Mayday.

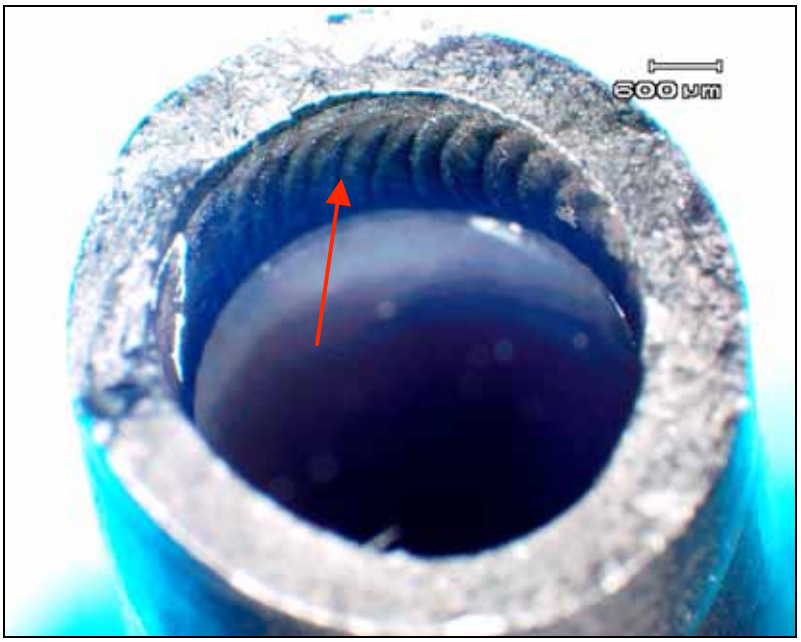
## Fuel Line Examination

The fractured fuel line was sent to the Australian Transport Safety Bureau (ATSB) for examination.

The examination revealed that the line had fractured adjacent to a weld Heat Affected Zone[3], between the fuel line and the connector (on the connector side). Using light microscopy to examine the fracture surface, a dark, crescent shaped region from the inner diameter of the line was observed. This initiation region was consistent with fatigue crack progression. The final fracture was characteristic of rapid failure.

Visual examination of the weld showed no obvious geometrical abnormalities. The weld was a relatively smooth and uniform butt weld, with no visually evident cracking along its internal or external surfaces. Figure 2 shows the welded area as indicated by the red arrow.

**Figure 2: Fuel line fracture surface**




The line fracture surface displayed the same characteristics as the previous two lines that were inspected by the ATSB in 2005. (ATSB Safety Investigation Report BO/200505952[4]).

3 Heat Affected Zone – A region of base material, adjacent to a weld, that may have had its microstructure and properties affected by the heat in the welding process.

4 ATSB report BO/200505952 is available on the ATSB website: www.atsb.gov.au

# SAFETY ACTION

## Engine manufacturer

Due to a number of fuel manifold return line fractures on RB-211 engines (there had been seven world wide events as of 4 August 2006), the engine manufacturer introduced service bulletin SB RB.211-71-F152 on 4 August 2006. The service bulletin required the replacement of the fuel manifold return line with a new type and a change to the line retention clipping arrangement. The engine manufacturer recommended that the service bulletin be carried out at the next scheduled maintenance opportunity.

After two more fuel line fractures in the same week, one on 14 August 2006 and another on 18 August 2006, the engine manufacturer issued a World Wide Communication to all RB-211 engine operators and overhaul facilities. The communication reported the two in flight shut-downs in the previous week due to fractured fuel manifold return lines and recommended incorporation of service bulletin RB.211-71-F152 at the next scheduled maintenance opportunity.

## Aircraft Operator

The aircraft operator, on receipt of the Service Bulletin, issued engineering instruction EI GEN-071-0180R01 on 18 August 2006. The engineering instruction detailed what engines were affected in the aircraft operator's fleet and an implementation schedule to replace the affected fuel lines.

The aircraft operator made a commitment to incorporate the requirements of the engine manufacturer's Service Bulletin on its fleet of aircraft fitted with RB-211 engines by the end of 2006.