



Australian Government

Australian Transport Safety Bureau

Abnormal engine indications involving a Boeing 747-438, VH-OJS

Near Suvarnabhumi Airport, Bangkok, Thailand, 16 October 2010

ATSB Transport Safety Report
Aviation Occurrence Investigation
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Addendum

Page	Change	Date
1, 2	Inserted Rolls-Royce investigation outcomes and safety actions. Adjusted original engine examination text accordingly.	30 August 2013

Abnormal engine indications involving a Boeing 747-438, VH-OJS

This investigation report was originally released in August 2012. This revision contains an update based on additional information from the outcomes of the engine manufacturer's internal investigation into the occurrence.

What happened

On 16 October 2011, at about 1033 Coordinated Universal Time (UTC)¹, a Boeing 747-438 aircraft, registered VH-OJS, operated by Qantas Airways, departed Suvarnabhumi Airport, Bangkok, Thailand on a scheduled passenger flight to Sydney, Australia.

About 8 minutes into the flight, as the aircraft was climbing through 13,000 ft, the crew reported hearing a loud bang and experiencing vibrations and abnormal indications from the No. 3 engine. Fumes were also reported in the cabin for several minutes after the event.

The flight crew shutdown the engine and broadcast a 'PAN'² before jettisoning approximately 55 tonnes of fuel and returning to Bangkok where the aircraft landed safely at 1147 UTC. The engine failure was fully contained and there were no reported injuries to passengers or crew.

Initial engine examination

Initial borescope inspection of the Rolls-Royce RB211-524G2-T engine, serial number 13748, was conducted by the aircraft operator before the engine was removed for disassembly and examination at an overhaul facility in Hong Kong.

The initial inspection showed that a single, stage 7 intermediate pressure compressor (IPC) blade had separated from its slot in the compressor disc (Figure 1). Disassembly of the engine confirmed the blade release and revealed significant damage to the remaining IPC blades as well as to the surrounding components.

There was evidence of a small, localised titanium fire that appeared to be the result of the released blade being jammed between the stage 7 IPC rotors and stators.

The released blade was destroyed as a result of its passage through the engine.

Engine history

The engine had undergone a full overhaul prior to being fitted to VH-OJS in August 2007 and had accrued 19,615 hours and 1,988 cycles since that time. There were no known issues with the engine.

Previous occurrences

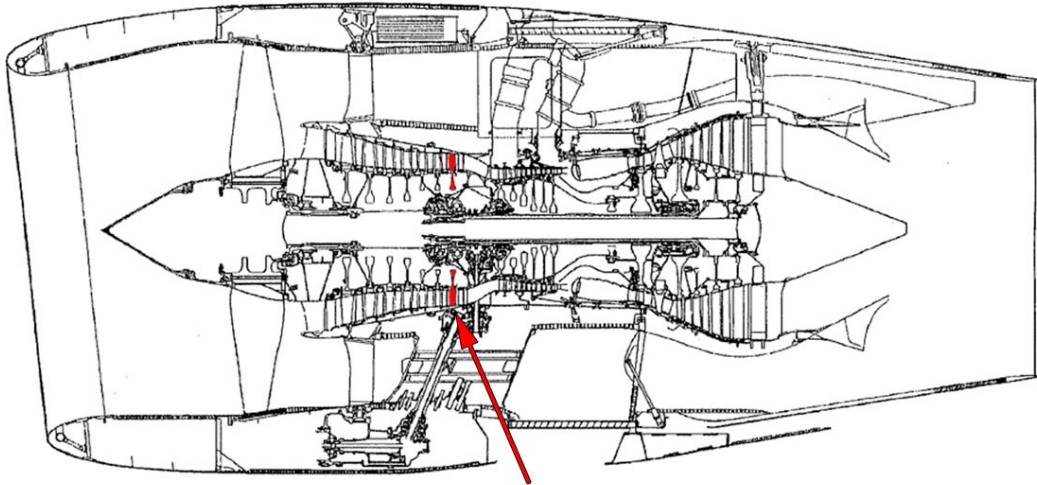
The engine manufacturer advised that this was the first recorded stage 7 IPC blade release event in over 40 million hours of engine-type service and that there had only been two previous findings relating to stage 7 IPC blades.

In 2005, a stage 7, IPC blade was found to contain cracking in the blade root during a routine inspection after a planned engine removal, however the cause of the crack was not conclusively identified. In 2007, an engine was rejected due to a stage 7, IPC blade that was found displaced rearwards within the disc slot during a routine engine inspection.

¹ Coordinated Universal Time (UTC) is the time zone used for civil aviation. Local time zones around the world can be expressed as positive or negative offsets from UTC. Bangkok was UTC + 7 hours.

² An internationally recognised radio call announcing an urgency condition which concerns the safety of an aircraft or its occupants but where the flight crew does not require immediate assistance.

Figure 1: RB211-524 engine with stage 7 IPC rotor highlighted



Source: Rolls-Royce

Rolls-Royce investigation

In May 2013, the Rolls-Royce completed a comprehensive and detailed investigation into the cause of the stage 7 IPC blade release. The investigation involved an examination of the remaining physical evidence, assembly trials, detailed modelling and stress analyses and a comparison with the 2005 occurrence of blade cracking.

The investigation concluded that the released stage 7, IPC blade had most probably been locked in place at an offset angle to the engine axis during assembly. The offset installation resulted in localised wear and significantly increased bedding stresses between the blade and disc. The increased stresses resulted in the initiation and propagation of a fatigue crack through the blade root until the blade was released under normal operational loads.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Rolls-Royce

As a result of this occurrence, Rolls-Royce has advised the ATSB that they have introduced additional quality inspection checks to mitigate the risk of future events relating to misassembly during IPC blade installation.

General details

Occurrence details

Date and time:	16 October 2011 – 1041 UTC	
Occurrence category:	Incident	
Primary occurrence type:	Abnormal engine indications	
Location:	Near Suvarnabhumi Airport, Bangkok, Thailand	
	Latitude: 13° 10.73' N	Longitude: 100° 45.18' E

Aircraft details

Manufacturer and model:	The Boeing Company 747-438	
Registration:	VH-OJS	
Operator:	Qantas Airways Limited	
Serial number:	25564	
Type of operation:	Air transport – high capacity	
Persons on board:	Crew – 18	Passengers – 358
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Minor	

About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and fostering safety awareness, knowledge and action.

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.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. 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.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in

order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.