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ATSB TRANSPORT SAFETY INVESTIGATION REPORT
Aviation Occurrence Investigation No. AO-2007-051
Final

Hydraulic system event – Los Angeles International Airport, USA Boeing Company 747-438, VH-OJB

20 October 2007

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Abstract

At 0715 Coordinated Universal Time on 20 October 2007, a Boeing Company 747-438 aircraft, registered VH-OJB, departed Los Angeles International Airport, USA, on a scheduled passenger flight to Brisbane, Australia. There were four flight crew, 14 cabin crew, and 406 passengers on board the aircraft. The first officer was the handling pilot for the flight. As the aircraft became airborne, a tyre on the left body landing gear disintegrated and a section of tyre debris impacted a line of the number-1 hydraulics system in the left body landing gear well. That caused fluid and pressure loss from that system. A short time later, the electronic indicating and crew alerting system (EICAS) screen in the cockpit advised that the number-1 hydraulics system had failed and a report was received from the cabin crew that a 'bang' was heard in the vicinity of the left main landing gear shortly before the aircraft became airborne. The flight crew completed checklist items and the flight continued uneventfully to Brisbane.

The operator found some inconsistencies in the aircraft manufacturer's documentation relating to hydraulics failures. The aircraft manufacturer has noted those and has advised that it will examine them as part of its ongoing standardisation program.

FACTUAL INFORMATION

At 0715 Coordinated Universal Time on 20 October 2007, a Boeing Company 747-438 aircraft, registered VH-OJB, departed Los Angeles International Airport, USA, on a scheduled passenger flight to Brisbane, Australia. There were four flight crew, 14 cabin crew, and 406 passengers on board the aircraft. The first officer was the handling pilot for the flight.

As the aircraft became airborne, a tyre on the left body landing gear disintegrated. A section of tyre debris impacted a line of the number-1 hydraulics system in the left body landing gear well, causing fluid and pressure loss from that system. A short time later, advice that the number-1 hydraulics system had failed was displayed on the electronic indicating and crew alerting system (EICAS) screen in the cockpit and a report was received from the cabin crew that a 'bang' was heard in the vicinity of the left main landing gear shortly before the aircraft became airborne.

The crew reported that they completed the appropriate checks and were advised by air traffic control that tyre debris, but no other material, had been recovered from the runway. The crew also checked other aircraft systems that had the potential to be affected by the tyre failure, including flight controls, pressurisation, engines, and fuel. The crew confirmed that all other aircraft systems were functioning normally and, after considering the status of the aircraft and the option of dumping fuel and returning for a night landing at Los Angeles, decided to proceed towards the planned destination, while closely monitoring the aircraft's systems and fuel usage. A check with the operator's maintenance control home base advised concurrence with the crew's intention. The flight continued normally and the aircraft subsequently landed at Brisbane. The aircraft was required to be towed from the runway

because the loss of the number-1 hydraulics system meant that nosewheel steering was not available for taxiing to the parking bay.

A Post-flight inspection revealed that a number-1 hydraulics system line in the landing gear bay had ruptured when struck by a tyre segment, resulting in the loss of system fluid contents. In addition, there was minor damage where a tyre segment had impacted the landing gear bay door.

An examination of recorded flight data indicated that the number-1 hydraulic system quantity started to decrease late during the take-off roll. There was a spike in vertical acceleration at that time, which was likely to have been caused by the tyre failure event. The aircraft's computed speed at the time was approximately 160 kts.

The crew reported that, in accordance with normal procedures, they responded to the EICAS messages and evaluated the situation in accordance with the company's Boeing 747-400 Flight Crew Operations Manual (FCOM). That manual provided checklists for non-normal situations, including hydraulic systems malfunctions. It followed directly the aircraft manufacturer's non-normal checklist for hydraulics system malfunctions. The Non-Normal Checklist stated that, if system pressure loss occurred in more than one of the four hydraulics systems, the crew should plan to land at the nearest available airport. For single hydraulic systems failures, the checklist listed the aircraft services that the relevant system operated. It did not suggest a course of action.

The introduction section of the Non-Normal Checklist included the following statements:

> While every attempt is made to establish necessary non-normal checklists, it is not possible to develop checklists for all conceivable situations, especially those involving multiple failures.
>
> The captain must assess the situation and use sound judgement to determine the safest course of action.

The suite of aircraft manuals carried on the aircraft also included the Boeing 747-400 Flight Crew Training Manual (FCTM). The introduction to that manual included the following statement:

> The Flight Crew Training Manual is intended to provide information in support of procedures listed in the Flight Crew Operations Manual (FCOM) and is intended to help the pilot accomplish these procedures safely and efficiently.

At page 8.19, the FCTM included a section titled Landing Gear, Tyre Failure on Takeoff, which contained the following statement:

> The Flight Crew should consider continuing to the destination unless there is an indication that other damage has occurred (non-normal engine indications, engine vibrations, hydraulic systems failures or leaks, etc).

The aircraft operator advised that the company FCTM directly followed the aircraft manufacturer's FCTM, including the statement relating to tyre failure on takeoff.

Both the aircraft's pilot in command and the copilot advised that they considered the information in the FCTM to be for general guidance only, and to have lower authority than the information in the FCOM.

The aircraft operator confirmed that information in the FCTM was for 'guidance' rather than 'operational' purposes, and had lower authority than the FCOM.

Shortly after the occurrence, the aircraft operator formally asked the aircraft manufacturer whether, as stated in the FCTM, it was the manufacturer's policy that a flight should land at the nearest suitable airport following a tyre failure that resulted in a hydraulic system failure.

The manufacturer replied that, for a single hydraulic system failure, it was not policy to land at the nearest suitable airport, but that for a loss of multiple hydraulic systems, the current checklists directed a landing at the nearest suitable airport.

ANALYSIS

The crew's response to the number-1 hydraulics system loss was measured and in accordance with company procedures, and those of the aircraft manufacturer.

The conflicting information between the FCOM and the FCTM regarding hydraulic system pressure loss created the potential for confusion and a less than optimal response by the crew.

FINDINGS

From the evidence available, the following findings are made with respect to the tyre failure and hydraulics system event involving VH-OJB on 20 October 2007 and should not be read as apportioning blame or liability to any particular organisation or individual.

Other safety factors

The conflicting information between the FCOM and the FCTM regarding hydraulic system pressure loss created the potential for confusion by flight crew.

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Safety Issue

The conflicting information between the FCOM and the FCTM regarding hydraulic system pressure loss created the potential for confusion by flight crew.

Action taken by the operator and aircraft manufacturer

The operator suggested to the manufacturer that, if it was not policy to land at the nearest suitable airport in the case of a single hydraulic system failure, the FCTM text be either clarified or deleted. The operator noted that there were other 'operational policy statements' in the FCTM and suggested that their applicability to the FCTM should also be checked. The manufacturer accepted that suggestion and indicated that an examination would be undertaken as part of its ongoing standardisation program.

Similar clarification concerning FCTM information was sought by the operator regarding other aircraft types from the same manufacturer that were in the operator's fleet. The manufacturer confirmed that such an examination would be undertaken.

SOURCES AND SUBMISSIONS

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to the pilots involved, the aircraft operator, the aircraft manufacturer and the Civil Aviation Safety Authority.

Submissions were received from one of the pilots involved and the Civil Aviation Safety Authority. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly