Australian Government
Australian Transport Safety Bureau

Birdstrike and inflight vibration involving Boeing 747-438 ER VH-OEH

near San Francisco International Airport, United States | 6 October 2016

Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation
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Addendum

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Safety summary

What happened

On 6 October 2016, a Boeing 747-438 ER, registered VH-OEH and operated by Qantas International, departed San Francisco International Airport, United States, for a flight to Sydney, Australia. Soon after departure and during the climb, the crew became aware of an abnormal vibration in the area of the left over-wing door. There were no cockpit indications or associated procedures to manage the observed vibration. Consequently, the flight crew were required to use their professional judgement to assess its impact on the flight. The crew utilised available crew resources and maintenance expertise to troubleshoot and assess that the flight could safely continue to Sydney.

What the ATSB found

The ATSB found that during departure from San Francisco International airport, and unbeknown to the flight crew, the aircraft sustained impact damage from a birdstrike. The birdstrike sheared a landing gear door strut resulting in the door not closing. That in turn led to turbulent airflow and in-cabin vibration.

What's been done as a result

While the birdstrike resulted in a landing gear door not closing, the overall impact on the flight was minimal. Larger doors that have the potential to cause damage have warning systems to indicate if they have not operated as selected.

There was no additional wear or damage to any of the landing gear components. The landing gear door strut was replaced and the aircraft returned to service.

Safety message

This occurrence highlights that, even with the assistance of sophisticated technology and systems, flight crew may experience situations that can only be managed using their professional judgement.

In this case, the flight crew utilised the support of both on-ground maintenance personnel and cabin crew to methodically troubleshoot the source of the vibration and assess that the flight could be safely continued to the destination airport.

The occurrence

At about 2335 local time on 6 October 2016, a Boeing 747-438 ER, registered VH-OEH and operated by Qantas International, departed San Francisco International Airport, United States, for a flight to Sydney, Australia. The flight crew reported that the night departure was uneventful.

Soon after take-off, the cabin services manager (CSM) was contacted via the aircraft interphone system by a cabin crew supervisor seated near door L3 (Figure 1). The supervisor advised the CSM that there was vibration and louder than normal cabin noise in their area. The CSM recalled that following receipt of that advice from the supervisor, they also became aware of the increased noise.

A training captain seated in the flight deck, also reported being aware of a louder than normal noise during the climb. The captain under training was new to the aircraft type and therefore did not notice the additional noise.

As the aircraft approached top of climb, and after the flight crew had turned off the fasten seatbelts sign, the CSM contacted the flight crew to report the additional noise/vibration. As indications on the flight deck were normal, the second officer was sent to investigate the source of the vibration.

The second officer inspected several sections of the cabin in consultation with the CSM and other flight attendants. They concluded the magnitude of the vibration was largest near door L3 (rows 47-49, seats ABC) and that it was considerably noisier than normal. The CSM recalled that the second officer suspected the vibration may have been due to a landing gear door seal. Unlike other large passenger aircraft, VH-OEH did not have installed video cameras that permitted the crew to view external parts of the aircraft. In any event, the night conditions may have hampered visual examination of the landing gear area on this occasion. The second officer returned to the flight deck and briefed the other flight crew.

About 2 hours into the flight, the flight crew contacted the company's maintenance operational control (MOC) centre via satellite phone seeking technical assistance to identify the source of vibration. The flight crew relayed the relevant information to the duty manager, a senior aircraft engineer, who then asked additional questions to assist with the diagnosis. The MOC duty manager advised the crew that it could be a gear door seal or wing-to-body seal as they were located in that area.

The MOC duty manager subsequently checked the:

- aircraft history for any similar faults/reports, of which there were none
- relevant aircraft system diagrams to ascertain what systems were located near door L3 and capable of generating the reported vibration/noise
- relevant maintenance manual section covering possible sources of airframe vibrations.

The flight crew, in consultation with the MOC duty manager and cabin crew, then systematically went through a process of trying to isolate the source of the vibration/noise.

That process included isolation and/or consideration of:

- the aircraft air-conditioning packs
- the air recirculation fans
- re-selection of the landing gear handle to the UP position
- checking toilets for possible vacuum leaks.

That troubleshooting was unable to isolate the source of vibration and noise. The flight crew requested that the cabin crew continue to monitor the vibration/noise and to advise them of any change. As the aircraft was otherwise performing normally, the flight was continued.

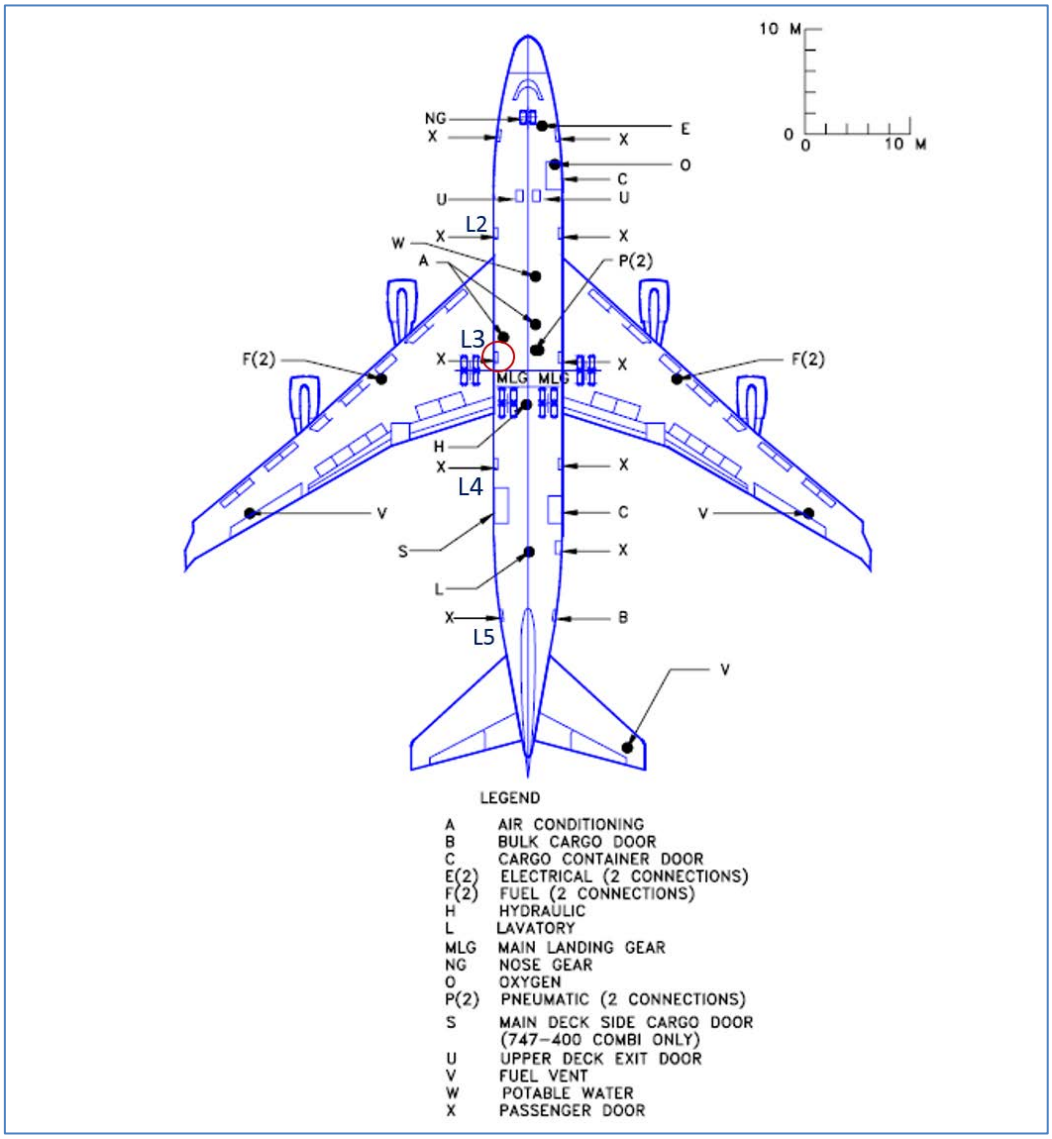
About 4.5 hours into the flight and with no reported change to the vibration/noise levels, the training captain left the flight deck to personally assess the vibration and assessed that it was still

quite noisy. Consequently, the flight crew again made contact with the MOC to seek further technical input. They asked the duty manager what other aircraft systems were in the L3 door area. The duty manager advised that there were hydraulics and centre fuel tank transfer pumps. While the crew could not isolate the hydraulics, the transfer pumps were OFF.

The duty manager advised the crew that maintenance services were available at the now nearby Honolulu Airport, Hawaii and enquired if the crew wished to divert. The crew advised the MOC that they did not intend to divert at that stage. The training captain reported to the ATSB that, as the aircraft was otherwise performing normally, it was not considered necessary to divert from the original destination.

The flight crew, with the assistance of the cabin crew, continued to monitor the vibration (which remained constant) and the flight continued to Sydney. They also remained in contact with the MOC.

Figure 1: Aircraft schematic showing location of door L3 (circled red) and other services



Source: Boeing Commercial Airplanes

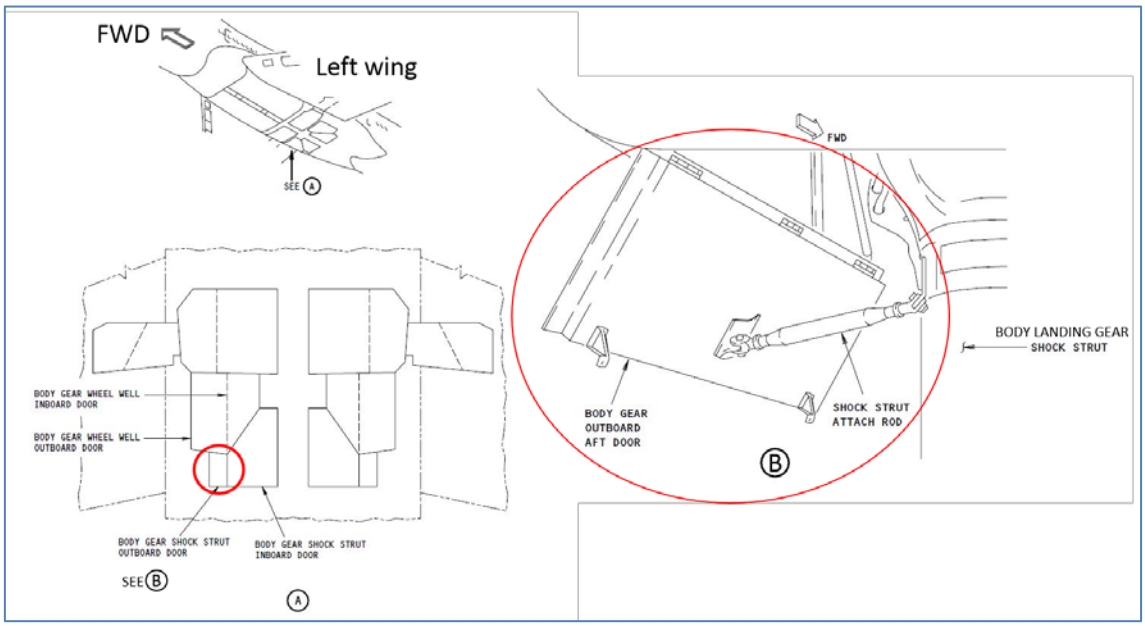
The CMS reported that the vibration and noise persisted up until the landing gear was extended during the approach into Sydney. The cabin crew did not receive any comments about the vibration or noise from the passengers.

After landing, ground engineers inspected the aircraft and immediately identified a protruding landing gear seal and initially thought this was the source of the vibration. On closer examination

they observed that a rod, which normally attaches a small outboard landing gear door to the body landing gear shock strut (Figure 2), was sheared at the door attachment point as a result of a birdstrike.

Despite the door not being closed during the flight, there was no additional wear or damage. The attach rod was replaced and the aircraft returned to normal service, with no further vibration or noise reported.

Figure 2 Main landing gear doors showing location of affected door and attach rod.



Source: Boeing Commercial Airplanes

Safety analysis

Due to the physical size of the aircraft and the night departure, the birdstrike was not detected by the flight crew or ground personnel. Given the vibration was first noticed following retraction of the landing gear, it could be argued that the vibration was therefore directly related to the landing gear. However, all indications were that the landing gear had retracted normally. In addition, as there is significant additional noise and vibration while the landing gear is extended, it is equally plausible that this noise may have been masking something unrelated to the landing gear.

While the training captain was aware of some additional noise during the climb, all flight deck indications were normal including those for the landing gear. Due to sterile cockpit procedures, that limited other than emergency communications during critical phases of flight, the first indication that there was something abnormal was when the cabin services manager contacted the flight deck.

Once the nature and location of the vibration had been established, the flight crew proceeded to make use of all available resources to try and identify the source of the vibration and its implication for the continuation of the flight. In consultation with both maintenance operational control and cabin crew, the crew systematically isolated systems capable of generating the vibration. While they were unable to identify the source of the vibration, the flight crew established that it was constant and that the aircraft was otherwise performing normally. In the absence of any abnormal flight deck indications or relevant checklist, the decision to continue the flight was therefore at the discretion of the flight crew based on their professional judgement.

The landing gear system on the Boeing 747 uses a combination of hydraulics and attach rods to extend/retract both the landing gear and the associated doors. Proximity switch sensors located on both the landing gear and the hydraulically operated doors provide the flight crew with indications of both normal and abnormal operation. Small doors that are attached by rods directly to the landing gear, do not have proximity sensors as they normally open and close with the landing gear.

The discovery of the sheared attach rod, evidence of a birdstrike, and the reported in-flight vibration, is consistent with the aircraft having sustained a birdstrike during the departure and while the landing gear was extended. Due to the sheared attach rod, the associated landing gear door would not have closed resulting in residual turbulence and vibration being generated in the area of door L3. The lack of an associated proximity sensor meant that the flight crew were unaware that the door was not closed.

Findings

From the evidence available, the following findings are made with respect to the birdstrike and inflight vibration involving Boeing 747, registered VH-OEH near San Francisco International Airport, United States on 6 October 2016. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- During departure from San Francisco International airport, and unbeknown to the flight crew, one of the main landing gear door struts sustained impact damage from a birdstrike that resulted in the associated landing gear door not closing.

Other findings

- The noise and vibration experienced in the cabin was due to turbulent airflow associated with the un-closed landing gear door.
- The absence of cockpit indications and/or associated procedures to manage the observed vibration meant that the flight crew were required to use their professional judgement to assess its impact on the flight. The crew utilised available crew resources and maintenance expertise to troubleshoot and assess that the flight could safely continue to the destination airport.

General details

Occurrence details

Date and time:	6 October 2016 – 2330 local time	
Occurrence category:	Incident	
Primary occurrence type:	Birdstrike	
Location:	near San Francisco International Airport, United States	

Aircraft details

Manufacturer and model:	Boeing 747-438 ER	
Year of manufacture:	2003	
Registration:	VH-OEH	
Operator:	Qantas International	
Serial number:	32912	
Type of operation:	High capacity RPT	
Injuries:	Crew – nil	Passengers – nil
Damage:	Minor	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- flight crew
- cabin crew
- maintenance personnel
- aircraft operator and manufacturer.

Submissions

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

A draft of this report was provided to the aircraft operator, flight crew, cabin services manager, maintenance operational control duty manager and the Civil Aviation Safety Authority (CASA).

Submissions were received from CASA, the aircraft operator and maintenance personnel. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The 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; 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 operations involving the travelling public.

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.

Purpose of safety investigations

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

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

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