Australian Government
Australian Transport Safety Bureau

Engine malfunction involving Airbus A330-202, VH-EBQ

1,370 km west-south-west of Los Angeles International Airport, United States of America, on 4 December 2024

ATSB Transport Safety Report
Aviation Occurrence Investigation
AO-2024-063
Preliminary – 8 May 2025

Cover photo: Pascal Simon

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

Publishing information

Published by: Australian Transport Safety Bureau
Postal address: GPO Box 321, Canberra, ACT 2601
Office: 12 Moore Street, Canberra, ACT 2601
Telephone: 1800 020 616, from overseas +61 2 6257 2463
Accident and incident notification: 1800 011 034 (24 hours)
Email: atsbinfo@atsb.gov.au
Website: www.atsb.gov.au

Addendum

Page	Change	Date

Preliminary report

This preliminary report details factual information established in the investigation's early evidence collection phase, and has been prepared to provide timely information to the industry and public. Preliminary reports contain no analysis or findings, which will be detailed in the investigation's final report. The information contained in this preliminary report is released in accordance with section 25 of the *Transport Safety Investigation Act 2003*.

The occurrence

Overview

On 4 December 2024, the ATSB was notified of an air-return involving a Qantas Airbus A330 aircraft, registered VH-EBQ, operating a scheduled passenger flight from Los Angeles, United States of America, to Brisbane, Australia. During the cruise, sparks were observed coming from the right engine and the flight crew initiated a turnback to Los Angeles Airport. During the descent to the airport, 'bangs' were heard accompanied by indication of a right engine compressor stall.[1] The flight crew operated the engine at idle for the rest of the descent and landing in Los Angeles.

The previous flight and turnaround maintenance

Prior to the incident flight, the aircraft was operated on a scheduled passenger flight between Brisbane and Los Angeles. On 4 December 2024, at around 0120 UTC[2] and shortly after top of descent, the flight crew observed a high N2[3] vibration advisory for the right engine on the electronic centralized aircraft monitor.[4] In response, the flight crew operated the right engine at idle for the remainder of the flight. The aircraft landed in Los Angeles at 0153.

In preparation for the return flight to Brisbane, a licenced aircraft maintenance engineer (LAME) and an aircraft maintenance engineer (AME) assisted with the turnaround of the aircraft. When visually inspecting the right engine exhaust, both the AME and the LAME observed particles. The LAME carried out troubleshooting steps related to the right engine N2 vibration issue, which included consultation with the Qantas maintenance operation centre.[5] The troubleshooting

---

1 A stall in a turbine engine refers to a compressor stall. It is abnormal airflow resulting from the aerodynamic stall of aerofoils (compressor blades) within the compressor. Steady flow through the stages of a compressor occurs within a relatively narrow band of conditions. If the conditions inside a compressor go outside of this band due to an operating condition or a disturbance, the flow around the blades can break down in a manner known as a stall. In this instance, the blades would no longer effectively compress the air. If the breakdown of flow in a compressor stall is significant enough, the pressure change within the engine could be sufficient to reverse the flow through the compressor in a phenomenon known as a 'surge'. A surge is often associated with a loud bang, or series of bangs, that can be heard in the aircraft.

2 Coordinated Universal Time (UTC): the time zone used for aviation. Local time zones around the world can be expressed as positive or negative offsets from UTC. Los Angeles was UTC -8 hours meaning that 0120 UTC on 4 December 2024 was 1720 on 3 December 2024 Los Angeles time. Sydney was UTC +10 hours and Brisbane was UTC +11 hours.

3 N2: N2 refers to the rotational speed of the engine's high-speed spool, which consisted of the high-pressure compressor and the high-pressure turbine.

4 ECAM: Electronic centralized aircraft monitor (ECAM) is a system on Airbus aircraft for monitoring and displaying engine and aircraft system information to the pilots. In the event of a malfunction, it will display the fault and may also display the appropriate steps of the remedial action.

5 The Qantas maintenance operation centre was a section of the Qantas integrated operations centre, which responded to services requests from all areas within the company and provided engineering information and support as required.

activities culminated in the application of a minimum equipment list (MEL)[6] item for the right engine N2 vibration sensor. This meant that the N2 vibration readings for the right engine would not be available for flight crew on subsequent flights, until the component was replaced. The LAME subsequently released the aircraft for service at 0358.

The incident flight

The flight crew for the next scheduled flight of VH-EBQ from Los Angeles for Brisbane, consisting of a captain, a first officer, and 2 second officers, familiarised themselves with the aircraft status and became aware of the reported N2 vibration issue. Preparations for the flight continued and the aircraft departed Los Angeles at 0458. The flight crew later reported to the ATSB that they were not aware of the particles observed in the exhaust.

The flight crew reported that the take-off and initial climb appeared normal. They received a clearance from air traffic control (ATC) to climb to flight level (FL)[7] 320, and upon reaching FL 200, the first officer and one of the second officers, second officer A, left the flight deck for their allocated crew rest.[8] The captain and the other second officer, second officer B, remained on the flight deck. The captain made regular written observations of engine parameters, including fuel flow and exhaust gas temperature, with the intent that the readings might aid in troubleshooting possible engine issues.

At about 0637, the remaining flight crew received further clearance from ATC to climb to FL 340. After top of climb, a passenger report of sparks emanating from the right engine was relayed to the flight crew by the cabin crew. Second officer B went to the passenger's seat, observed the engine from the window, noted a couple of intermittent sparks, and returned to the flight deck to talk to the captain. The captain and second officer B also reviewed video footage of the sparks recorded by the passenger during the climb (Figure 1).

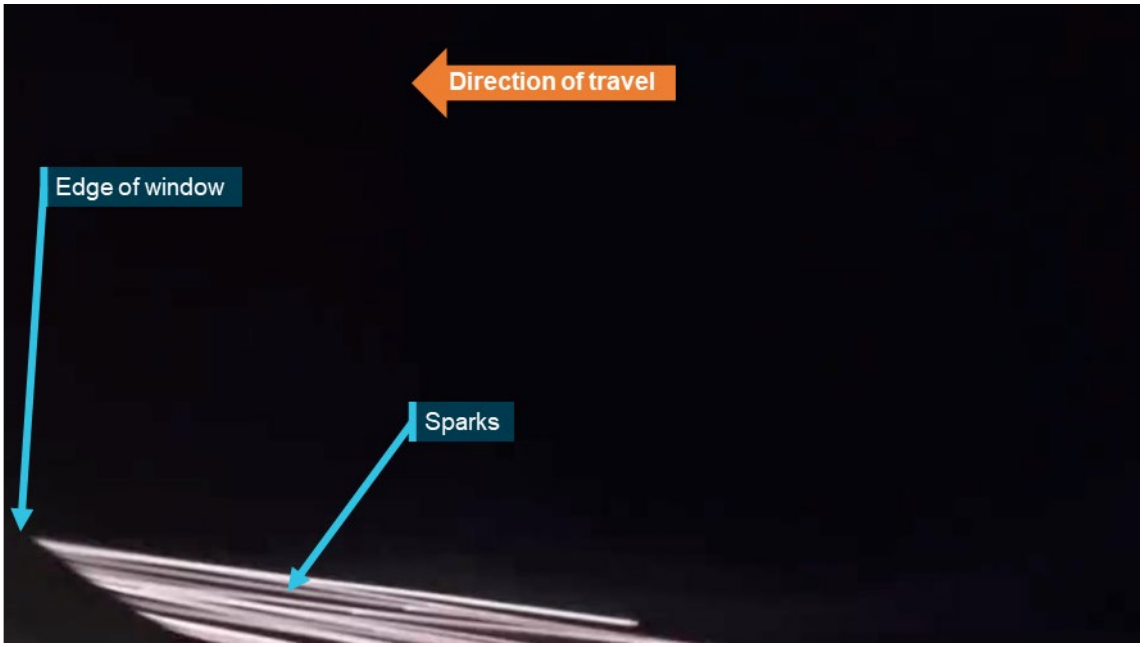
---

[6] The minimum equipment list (MEL) details the system, function, or equipment, which may be inoperative for flight and establishes limitations on the duration of, and conditions for, operation with an inoperative item. The application of an MEL to an item is the phraseology used when an aircraft is certified to fly with that item inoperative.

[7] Flight level: at altitudes above 10,000 ft in Australia, an aircraft's height above mean sea level is referred to as a flight level (FL). FL 320 equates to 32,000 ft.

[8] Crew rest: All commercial flight crew have limits on how much they can work before taking time off. For long flights, the flight crew consists of more than 2 pilots allowing some pilots to rest mid-flight and the flight deck to remain fully staffed.

Figure 1: Still image from passenger video showing sparks from right engine



Source: Qantas passenger, provided by Qantas, annotated by the ATSB

In response to the engine situation, the captain and second officer B decided that continuing to their destination, Brisbane, was no longer acceptable and it would be necessary to divert. The resting flight crew were recalled to the flight deck and the first officer assessed that, at that time, the aircraft was about 30 minutes from the equal time point[9] between Los Angeles and Honolulu. The flight crew initiated a rotation of cabin crew members to be positioned in the passenger's seat to monitor the engine for sparks for the remainder of the flight.

When considering which airport to divert to, the flight crew consulted with the Qantas maintenance operations centre, reviewed the weather and NOTAMS[10] for alternate airports, and continued to monitor right engine performance. Although the right engine exhibited greater fuel consumption and exhaust gas temperature than the left engine, all indications, excluding the N2 vibration, which was disconnected, were within the normal range. The flight crew considered reducing the thrust setting on the right engine, but as the parameters indicated it was stable, the setting was left unchanged. The flight crew decided the most suitable airport to divert to was Los Angeles and the first officer made a PAN PAN call[11] and requested a diversion to Los Angeles from ATC through the controller pilot data link communication system.[12]

The flight crew initiated the diversion at about 0732 and shortly after, they requested a descent to FL 310 to reduce the load on the engine. By the time the aircraft reached FL 310, the intermittent sparks were observed to have stopped.

Following a period of observation where the engine parameters were stable and no additional sparks were observed, the captain elected to take a crew rest, with the intent of managing fatigue

---

9 The equal time point is when an aircraft is the same flying time from 2 potential en route diversion locations.

10 NOTAMS: Notice to Airmen (NOTAM) is a notice filed with an aviation authority to alert pilots of potential hazards along a flight route or at a location that could affect the flight.

11 PAN PAN: 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.

12 Controller pilot data link communication is a 2-way data-link system by which air traffic controllers can transmit non urgent strategic messages to an aircraft as an alternative to voice communications. The message is displayed on a flight deck visual display. The pilots are provided with the capability to respond to messages, to request/receive clearances and information, and to report information.

for the descent and landing into Los Angeles. During this time, the flight continued uneventfully and the remaining flight crew prepared for the landing. Activities included an assessment of the runway options and availability, re-assessment of the alternate airports, reviewing updated weather observations, review of the overweight and single-engine landing procedures, and performance checks.

Based on the cockpit voice recording, the captain returned to the flight deck at about 0942, prior to commencing the descent at 1003. The other 3 pilots had noted weather reports of fog developing in Los Angeles and, as a result, consulted the low visibility landing checklist. The flight crew completed the approach checklist at about 1023 and the overweight landing checklist at about 1024. At around 1027, while the aircraft was passing about 7,000 ft, the flight crew heard 3 loud bangs, which they attributed to the right engine based on observation of engine parameters. In response, the captain brought the right engine thrust lever to idle. Second officer B called 'stall' (meaning an engine compressor stall), which was confirmed by the captain. At the direction of the captain, the first officer radioed ATC to report that they had an issue with the engine and to request aircraft rescue and firefighting services attendance on landing.

At about 1029, to aid with management of the situation, the first officer radioed ATC to cancel the approach and request vectors, which the controller provided. The flight crew commenced the engine stall checklist from the Quick Reference Handbook. The last action item in the checklist was to slowly move the thrust lever forward. The flight crew elected to leave the engine at idle to minimise the likelihood of more disruptions. At about 1039, the first officer informed ATC that they were ready for the approach. After an uneventful landing, the aircraft exited the runway and came to a stop on the taxiway to allow rescue and firefighting services to visually inspect the engine. The flight crew completed the after-landing procedures while the engine was inspected. After assurance that no leaks, smoke, or damage was observed, the flight crew taxied the aircraft to the gate, where a normal disembarkation took place.

Following post-flight inspections, the right engine was removed from the aircraft and sent to a GE (General Electric) Aerospace technical facility for further examination.

Post-flight inspection

After the aircraft was repositioned to a maintenance hangar, borescope[13] inspections of the engine were carried out that identified:

- metal debris in the exhaust
- one missing high-pressure compressor blade, liberated at its root
- one fractured high-pressure compressor blade, fractured about half-way up
- damage to several high-pressure compressor blade tips
- a stage 4 variable-stator-vane positioned 90° out of alignment
- a fractured stage 4 variable-stator-vane lever arm (corresponding to the misaligned vane).

The aircraft was subsequently grounded, and the engine replaced before return to service on 16 December 2024.

[13] A borescope is a slender optical periscope, usually incorporating illumination, capable of being inserted into narrow apertures to inspect interior of machinery.

Context

Flight crew information

The captain, first officer and second officers all held valid air transport pilot licences (aeroplane) and aviation medical certificates, and were appropriately qualified for the flight. All flight crew reported feeling well rested and alert when commencing duty.

The captain had about 16,700 hours of total flight experience, of which about 6,700 hours were on the Airbus A330. In the previous 90 days, the captain had flown about 160 hours on the A330. The first officer had about 7,300 hours of flight experience, of which about 1,000 hours were on the A330, with 153 hours flown in the previous 90 days. Second officer A had about 6,720 hours of flight experience, of which about 4,050 hours were on the A330, with 116 hours flown in the previous 90 days. Second officer B had about 5,200 hours of flight experience, of which about 3,500 hours were on the A330, with 78 hours flown in the previous 90 days.

Aircraft information

General

The Airbus A330-202 is a wide-body, twin-engine, long range, air transport aircraft. VH-EBQ was manufactured in France in 2011 and registered in Australia in the same year. The right engine had accumulated about 15,497 hours since its last overhaul.

Engine information

The aircraft was powered by 2 General Electric CF6-80E1 high-bypass turbofan engines. Engine modules include the fan and low-pressure compressor, the high-pressure compressor, combustion section, the high-pressure turbine, and the low-pressure turbine. N1 refers to the rotational speed of the fan, the low-pressure compressor and associated shaft. N1 is the primary indication of engine thrust. The N2 refers to the rotational speed of the high-pressure compressor, the high-pressure turbine, and associated shaft.

Vibration monitoring was achieved by the engine's engine interface and vibration monitoring system. This system processes signals from 2 accelerometers, the number 1 bearing vibration sensor and the compressor rear frame vibration sensor, to obtain 2 vibration values for each N1 and N2 shafts. N1 vibrations are measured as a displacement in 1/1000 of an inch (mils), while N2 vibrations are measured as a speed in inch per second (ips). The N2 vibrations are displayed to the flight crew as a value between 0 and 10 units, which corresponded to a vibration between 0 and 3 ips on a linear scale. The highest reading observed during the descent into Los Angeles was 9.2 units.

Maintenance actions

Maintenance for the General Electric CF6-80E1 engines was conducted in accordance with the Airbus A330 *Aircraft Maintenance Manual* and *Troubleshooting Manual*. The engineering staff in Los Angeles consulted the Troubleshooting Manual task 77-32-00-810-829-A *N2 Vibration Above Advisory During Descent, Top of Descent Vibration* when addressing the reported vibration associated with the inbound flight.

The certifying LAME wrote in their logbook entry relating to the application of the minimum equipment list item for the N2 vibration, that:

- on consultation with the inbound flight crew, they established that no physical vibration was felt in the airframe
- the right engine main chip detector, inlet, and exhaust were inspected and deemed 'OK'
- the vibration readings were considered to be a faulty indication issue and not generated in response to genuine engine vibration

- minimum equipment list item 77-07-02-07C was applied
- *Aircraft Maintenance Manual* task 77-32-00-040-801-A to deactivate the remote charge converter was completed
- Qantas maintenance operation centre was notified.

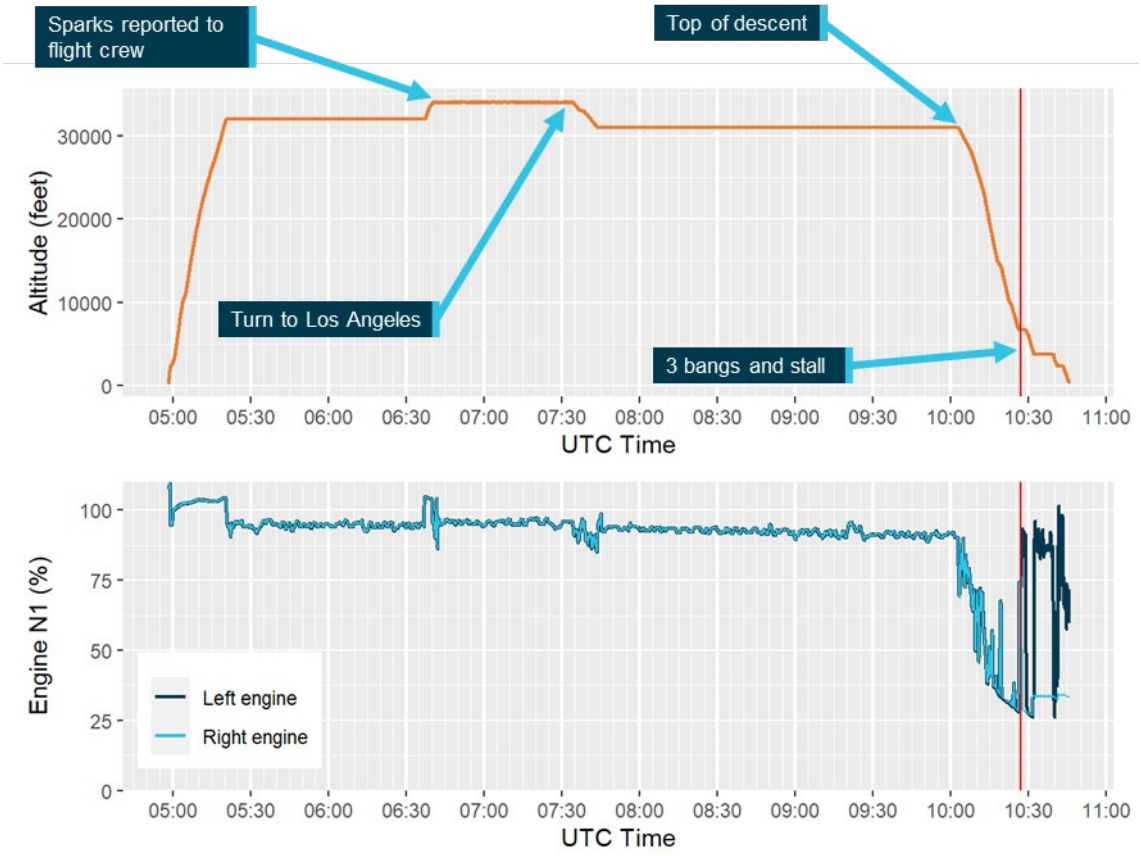
Maintenance history

On 27 November 2024, the right engine of the aircraft had a compressor stall during descent into Los Angeles. A subsequent engineering investigation identified faults associated with the right engine electrical control unit. Following the replacement of faulty parts, engineering personnel conducted engine inspections and ground runs where no further faults were detected. The aircraft subsequently flew 3 uneventful routes before the high N2 vibration was reported on descent into Los Angeles on 4 December 2024.

Recorded data

The aircraft was equipped with a cockpit voice recorder, which recorded audio from the flight deck, and quick access recorder, which recorded aircraft and engine performance data. The altitude of the aircraft and the N1 speed for both engines was extracted from the quick access recorder (Figure 2). The data showed that the engine speed for the left and right engines was consistent up until the time of the 'bangs' and compressor stall, around 1027. After this, the right engine was brought back to idle and the N1 speed remained around 33%.

Figure 2: Altitude and N1 speed for the right and left engines



Source: Qantas, annotated by the ATSB

Further investigation

To date, the ATSB has:

- interviewed involved flight crew, maintenance engineers, and maintenance operation centre staff
- obtained operator and manufacturer engineering procedures
- obtained aircraft operating procedures
- gathered engine maintenance records
- collected recorded data, including from the cockpit voice recorder and quick access recorder
- collected ADS-B[14] data.

The investigation is continuing and will include further review and examination of:

- communications between involved personnel
- recorded data
- maintenance procedures and records
- material failure analysis conducted by GE Aerospace on relevant components of the engine.

A final report will be released at the conclusion of the investigation. Should a critical safety issue be identified during the course of the investigation, the ATSB will immediately notify relevant parties so appropriate and timely safety action can be taken.

[14] ADS-B is a system in which electronic equipment onboard an aircraft automatically broadcasts the precise location of the aircraft via a digital data link. The data can be used by other aircraft and air traffic control to show the aircraft's position and altitude on display screens without the need for radar.

General details

Occurrence details

Date and time:	4 December 2024 – 0640 UTC	
Occurrence class:	Incident	
Occurrence categories:	Engine failure or malfunction, diversion/return	
Location:	1,370 km west-south-west of Los Angeles International Airport, United States of America	
	Latitude: 28.4198° N	Longitude: 131.2818° W

Aircraft details

Manufacturer and model:	Airbus Industrie A330-202	
Registration:	VH-EBQ	
Operator:	Qantas Airways Limited	
Serial number:	1198	
Type of operation:	Part 121 Australian air transport operations-Larger aeroplanes-Standard Part 121	
Activity:	Commercial air transport-Scheduled-International	
Departure:	Los Angeles International Airport, United States of America	
Destination:	Brisbane Airport, Queensland	
Actual destination:	Los Angeles International Airport, United States of America	
Persons on board:	Flight crew – 4, cabin crew – 5	Passengers – 149
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Minor	

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- 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, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

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

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining 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. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.