



Australian Government
Australian Transport Safety Bureau

Loss of separation involving Airbus A330, VH-EBK, and Boeing 787, G-ZBKF

near Sydney Airport, New South Wales on 28 September 2022

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Addendum

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Executive summary

What happened

On the afternoon of 28 September 2022, a Boeing Company 787-9 (787), registered G-ZBKF, was being operated by British Airways as flight number BA16, on an air transport flight from Sydney, New South Wales, to Singapore. At the same time, an Airbus A330-202 (A330), registered VH-EBK, was being operated by Qantas Airways as flight number QF926, on an air transport flight from Sydney to Cairns, Queensland.

At approximately 1508 local time, BA16 was cleared for take-off from runway 16R to conduct the DEENA SEVEN (DEENA 7) standard instrument departure (SID). Shortly after, QF926 was also cleared for take-off conducting the same SID. The Departure controller cleared both aircraft, in sequence, to climb to flight level 280 via the SID.

During the departure, the following aircraft climbed faster than the controller anticipated and turned towards the next waypoint inside the preceding aircraft, resulting in a loss of separation.

What the ATSB found

The ATSB found that the actual climb performance of the A330 was greater than the climb performance of the 787 which was not expected, or identified, by the controller due to their focus on other aircraft. This resulted in the A330, while complying with the SID, turning inside the leading 787, resulting in the loss of separation.

The ATSB also found that the design of the DEENA SEVEN SID did not provide a positive method of providing separation assurance to aircraft with different performance characteristics. As the aircraft had to satisfy 2 separate conditions prior to turning, there was no way of ensuring aircraft would turn at the same distance from the airport. That is, separation could not be assured.

What has been done as a result

Airservices Australia advised that the DEENA SEVEN SID has been redesigned to remove the conditional requirements of the procedure. The change has been approved and planned to be released as part of the Western Sydney International (Nancy-Bird Walton) Airport project. At the time of writing Airservices Australia was developing a timeline for the implementation of the redesigned SID. As such, the ATSB will continue to monitor the safety issue and provide website updates.

Safety message

Maintaining separation in high traffic terminal areas, such as Sydney, requires that both controllers and flight crews remain vigilant, maintain open communications, and use the available systems and tools to minimise the risk of errors. When sequencing departures, controllers should consider a number of factors, including how the flight duration (and the associated fuel load), will likely affect aircraft climb performance.

Standard instrument departures are designed to expedite the safe and efficient flow of air traffic operating from airports through the use of specific routings, levels, speed restrictions and waypoints. Where a SID, with limited designed separation assurance is used, it is important that air traffic controllers regularly monitor individual aircraft performance rather than rely on expected flight characteristics.

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The occurrence

On the afternoon of 28 September 2022, a Boeing Company 787-9 (787), registered G-ZBKF, was being operated by British Airways as flight number BA16, on air transport flight from Sydney, New South Wales, to Singapore. At the same time, an Airbus A330-202 (A330), registered VH-EBK, was being operated by Qantas Airways as flight number QF926, on air transport flight from Sydney to Cairns, Queensland.

The Sydney Airport automatic terminal information service (ATIS)¹ indicated that parallel runways were in use, including simultaneous independent departures² from runways 16R and 16L.³

At approximately 1508 local time, BA16 was cleared for take-off from runway 16R by the Sydney tower controller. They were cleared to conduct a DEENA SEVEN (DEENA 7) standard instrument departure (SID)⁴ (Figure 1) from runway 16R and to climb to 5,000 ft.

The DEENA 7 SID required an aircraft to turn right as soon as practicable after take-off, towards the DUNES waypoint⁵ and then turn left to track 152° towards the DEENA waypoint. The aircraft was required to have passed DEENA and climbed above 6,000 ft prior to turning right towards the ANKUB waypoint. If the aircraft had not reached 6,000 ft at DEENA, there was a requirement to continue on a heading of 152° until passing an altitude of 6,000 ft, before turning towards ANKUB.

Passing 1,500 ft, the flight crew contacted the departure controller (Departures) and advised them that they were a heavy aircraft⁶ on climb to 5,000 ft, departing via the DEENA 7 SID. Departures advised the flight crew the aircraft was identified on radar and instructed them to climb via the SID to flight level (FL) 280.⁷

¹ Automatic terminal information service (ATIS): continuous broadcast of recorded aeronautical information. ATIS broadcasts contain essential information, such as current weather information, active runways, available approaches, and any other information required by flight crew.

² Simultaneous independent departures are simultaneous departures for aircraft departing in the same direction from parallel runways.

³ Runway number: the number represents the magnetic heading of the runway. The runway identification may include L, R or C as required for left, right or centre.

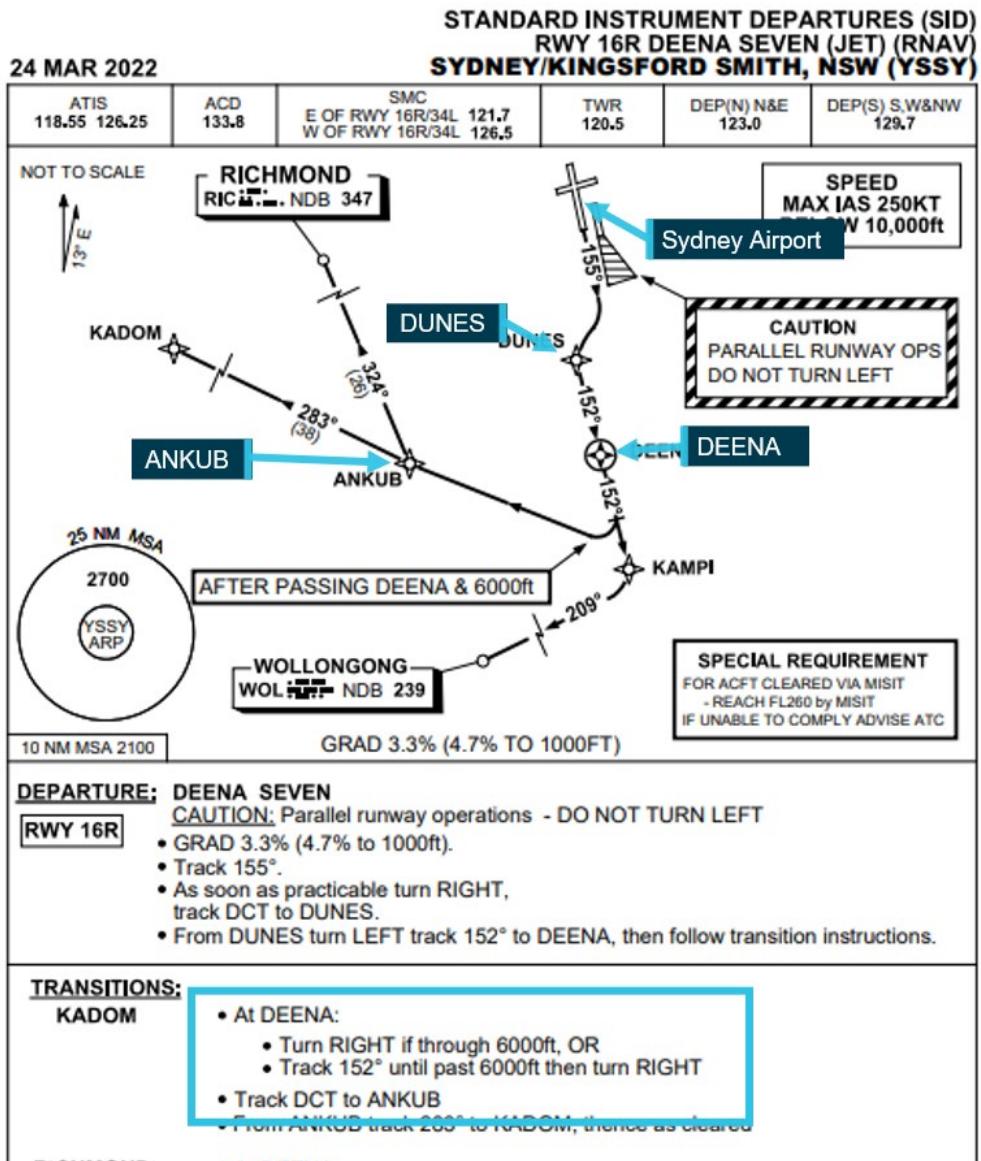
⁴ Standard instrument departure (SID): an air traffic control (ATC) defined procedure, that simplifies departure tracking while also balancing terrain/obstacle avoidance, noise abatement and airspace management considerations.

⁵ Waypoint: A defined position of latitude and longitude coordinates, primarily used for navigation.

⁶ Wake turbulence separation is determined by aircraft maximum take-off weight. Aircraft with a maximum take-off weight of 136,000 kg or greater are categorised as heavy aircraft.

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 280 equates to 28,000 ft.

Figure 1: DEENA SEVEN standard instrument departure (SID) from runway 16R

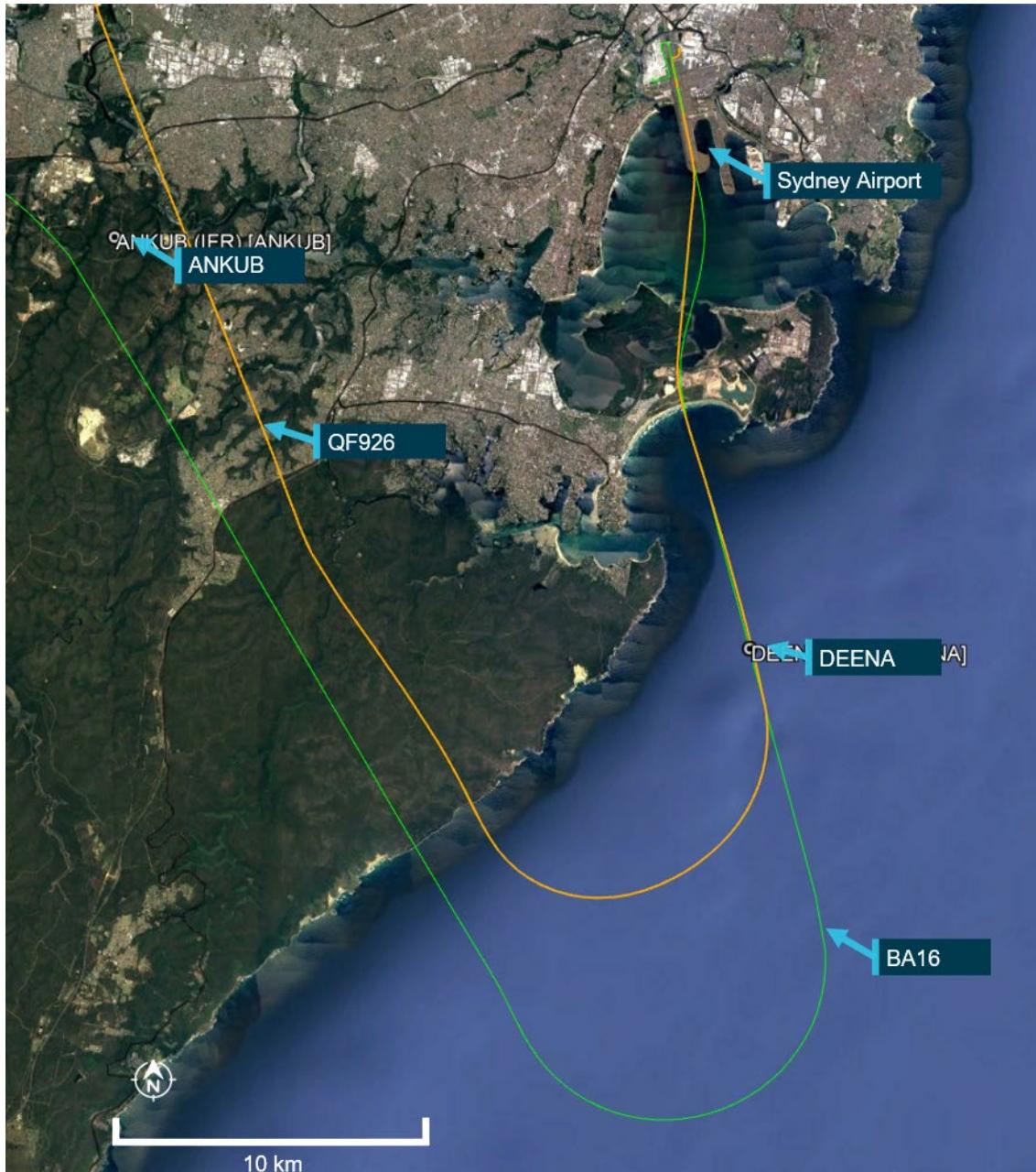


Source: Airservices Australia, annotated by ATSB

At approximately 1511, and with 6.3 NM spacing behind BA16, QF926 departed from runway 16R, also cleared on a DEENA 7 SID. During the initial climb, the flight crew contacted Departures advising that they were a heavy aircraft, passing 1,500 ft on climb to 5,000 ft, cleared on a DEENA 7 SID. Departures subsequently cleared them to climb to FL 280 via the SID.

BA16 climbed through 6,000 ft at around 25 km from Sydney Airport and initiated a turn to ANKUB in accordance with the SID. QF926 passed DEENA approximately coincident with climbing through 6,000 ft and initiated a turn to ANKUB at approximately 20 km from the airport, also in accordance with the SID (Figure 2).

Figure 2: Flight tracks of both aircraft during their departure from Sydney



Qantas Q926 is depicted in orange and BA16 is depicted in green.
 Source: Google Earth with Flight Radar 24 tracks and annotated by ATSB

As QF926 was turning, the controller detected that the aircraft had climbed faster than they had anticipated and instructed QF926 to stop their climb at 9,000 ft, to which the flight crew advised they would do their best. The controller then instructed BA16 to expedite their climb through 10,000 ft.

The controller subsequently advised the flight crew of QF926 that there was a 787 above their aircraft, and they would step climb their aircraft underneath the 787. The Qantas flight crew advised they had sighted the higher aircraft.

There was a loss of separation standards (see the section titled *Required separation*) between the two aircraft with the minimum vertical separation reducing to 600 ft and lateral separation reducing to 2.4 NM.

The flight crew in BA16 later advised that they had received a traffic alert and collision avoidance system (TCAS)⁸ traffic advisory⁹ during the event and the first officer subsequently visually identified the A330. They also advised they were informed by air traffic control of the traffic, however this was not recorded on the departures frequency.

⁸ Traffic alert and collision avoidance system (TCAS): a type of airborne collision avoidance system (ACAS).
⁹ Traffic advisory (TA): an alert issued by an airborne collision avoidance system (ACAS) when the detected traffic may result in a conflict. Pilots are expected to initiate a visual search for the traffic causing the TA.

Context

Air traffic controller information

The controller had worked as a controller from 2008 and had moved to Sydney in 2015 where they had qualified in both the Sydney Approach Director and Departures positions. While they mainly worked in the Approach Director position, they were rostered in the Departures position regularly to remain current in that role.

They had conducted compromised separation training in their last departures refresher training session in June 2022.

The controller advised that they expected the A330 would have a comparative climb performance to the 787. Hence, they instructed them to follow the 787. Qantas typically utilised the A330 on international routes, however, more recently had been utilising the A330 on domestic routes, including Sydney to Cairns, with correspondingly lower fuel loads and higher climb performance.

The controller then proceeded to assess other traffic in the area. Specifically, they were assessing a track for an aircraft, on descent from FL 280 to Shellharbour to ensure separation between this aircraft and an Airbus A380, which was in the list to depart runway 16R. They were also assessing the departure tracks for other aircraft due to depart from runway 16L and coordinating a media helicopter, overflying the airspace at 500 ft, with the Bankstown Airport tower controller. The controller advised they considered their workload to be manageable at the time.

Air traffic control procedures

Departure procedures

At the time, auto-release departures were in progress at Sydney Airport. This procedure allowed the tower controller (Tower) to depart aircraft without prior coordination with the departures controller (Departures). Departures had a list of aircraft on their console which were due to depart. These aircraft were listed in order of departure from the runway they were using, but the Tower controller could depart the aircraft from either runway in the order which allowed best use of the runways.

Tower was required to ensure there was a minimum separation between the aircraft of 5 NM when aircraft were departing from runway 16R. When using the DEENA 7 SID, Tower cleared the aircraft to climb to 5,000 ft via the SID, this ensured that departing aircraft continued on a heading of 152° and would not initiate a turn unless they received a further clearance from Departures.

Required separation

The required separation standards at Sydney are specified in the manual of air traffic services (MATS). The manual specified that the separation standard in the Sydney terminal control unit (TCU) was 3 NM lateral or 1,000 ft vertical separation. However, the wake turbulence standards between 2 heavy aircraft, required a minimum of 4 NM separation where aircraft were departing using the same runway, which was the case for this departure.

The A330 departed with the required spacing behind the preceding B787.

Controller traffic alerts

The controller advised they did not receive a short-term conflict alert (STCA) on their console during the event. A replay of the recorded surveillance data indicated the STCA was displayed on a number of occasions. However, Airservices advised that the replay was not a reproduction of the controller's screen at the time. The parameters for a STCA in the TCU environment are that within the following 60 seconds the aircraft will infringe 2.1 NM lateral separation and or 600 ft vertical separation. In this case, as the separation reduced to 600 ft and 2.4 NM in a turn, it is

possible that due to the dynamics of the event, the STCA may not have shown on the controller's console. However, the ATSB was unable to determine whether the controller received a STCA on their console.

Issuing safety alerts

According to MATS, where a controller becomes 'aware that an aircraft is in a situation that places it is unsafe proximity to...other aircraft', the controller should issue a 'safety alert'. They should also use the term 'avoiding action' prior to instructions when in the controller's judgement, the aircraft 'is in a situation that places it at risk of a collision with another aircraft under surveillance'.

Weather

The weather at the airport during the occurrence was fine, with good visibility, scattered¹⁰ cloud at 3,000 ft and a 15 kt easterly wind.

Replanning of Sydney Airspace

Airservices Australia advised that in response to the replanning of the airspace in the Sydney area due to the establishment of the Western Sydney International (Nancy-Bird Walton) Airport, which is due to open in 2026, the DEENA 7 SID has been redesigned.

Related occurrences

In the last 10 years, across Australia, there have been 8 occurrences of a loss of separation reported to the ATSB involving aircraft cleared on a SID where a following aircraft has climbed faster than the preceding aircraft.

Of these, 6 occurrences were at Sydney Airport and 5 of these involved the DEENA 7 SID. Of these, 1 occurred in 2012, 1 in 2019, 1 in 2020, and 2 in 2022.

¹⁰ Cloud cover: in aviation, cloud cover is reported using words that denote the extent of the cover – 'scattered' indicates that cloud is covering between a quarter and a half of the sky

Safety analysis

During the departure of two heavy aircraft conducting the DEENA SEVEN standard instrument departure (SID), the controller assessed that the following Airbus A330 would have a similar climb performance to the leading Boeing 787, without considering that the A330 was conducting a domestic flight and would therefore have a significantly lower fuel load and better climb performance than the preceding heavily-loaded 787. The controller cleared both aircraft, in sequence, to climb to the same level. The controller then became distracted, planning the separation between 2 other aircraft and did not detect the variation in climb performance between the departing A330 and 787.

As the actual climb performance of the A330, on a domestic route, was greater than the climb performance of the 787 on an international route, the separation reduced. When the controller detected the closing aircraft, they instructed both flight crew to take action to increase the separation between their aircraft. During the occurrence, it is likely the controller did not receive a short-term conflict alert (STCA) warning however, they did suspect there had been loss of separation and did not provide a safety alert or advise that the instruction was an avoiding action.

The use of SIDs 'enable the safe and efficient processing of instrument flight rules¹¹ aircraft ... from airports' (Airservices Australia) and will 'deconflict potentially conflicting traffic by the use of specific routings, levels, speed restrictions and check points' (Skybrary). They are particularly useful in high traffic airspace such as departing Sydney Airport. However, according to Airservices Australia, SIDs do not provide longitudinal separation between aircraft which are following in trail with another aircraft, with controller action ensuring the maintenance of separation.

Despite this, the design of the DEENA SEVEN SID (and possibly others) did not provide a positive method of providing lateral separation assurance to departing aircraft with differing climb performance. As the aircraft had to satisfy 2 separate conditions prior to turning, there was no way of ensuring aircraft would turn at the same distance from the airport. As such, lateral separation could not be assured.

Airservices Australia advised that the DEENA SEVEN SID had been redesigned to remove the conditional requirements of the procedure. At the time of writing, the change had been approved and was planned to be released in the first implementation package for the Western Sydney International (Nancy-Bird Walton) Airport project. However, no timeframe for the release of the package was provided.

¹¹ Instrument flight rules (IFR): a set of regulations that permit the pilot to operate an aircraft in instrument meteorological conditions (IMC), which have much lower weather minimums than visual flight rules (VFR).

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

Safety issues are highlighted in bold to emphasise their importance. A safety issue is a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the loss of separation involving Airbus A330, VH-EBK, and Boeing 787, G-ZBKF near Sydney Airport, New South Wales on 28 September 2022.

Contributing factors

- When clearing two aircraft on the DEENA 7 standard instrument departure, the controller incorrectly assessed that they would have similar climb performance and became distracted and did not detect the relatively higher climb performance of the departing Airbus A330 aircraft. This resulted in the A330 turning inside the preceding Boeing 787 and a loss of separation standards with that aircraft.
- **The DEENA 7 standard instrument departure has no designed positive separation assurance method, making it susceptible to loss of separation occurrences.** (Safety issue)

Safety issues and actions

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues. The ATSB expects relevant organisations will address all safety issues an investigation identifies.

Depending on the level of risk of a safety issue, the extent of corrective action taken by the relevant organisation(s), or the desirability of directing a broad safety message to the aviation industry, the ATSB may issue a formal safety recommendation or safety advisory notice as part of the final report.

All of the directly involved parties are invited to provide submissions to this draft report. As part of that process, each organisation is asked to communicate what safety actions, if any, they have carried out or are planning to carry out in relation to each safety issue relevant to their organisation.

The initial public version of these safety issues and actions will be provided separately on the ATSB website on release of the final investigation report, to facilitate monitoring by interested parties. Where relevant, the safety issues and actions will be updated on the ATSB website after the release of the final report as further information about safety action comes to hand.

DEENA 7 Standard instrument departure had no positive separation assurance method

Safety issue description

The DEENA 7 standard instrument departure has no designed positive separation method, making it susceptible to loss of separation occurrences.

Issue number:	AO-2022-047-SI-01
Issue owner:	Airservices Australia
Transport function:	Aviation: Air transport
Current issue status:	Open - Safety action pending
Issue status justification:	To be advised

Response by Airservices Australia

Airservices Australia advised that the DEENA 7 SID has been redesigned to remove the 2 conditional requirements of the procedure. The changes are planned to be part of the first implementation package for Western Sydney International (Nancy-Bird Walton) Airport, although at the time of writing the timeframe was unknown.

ATSB comment

As no timeframes for the implementation could be provided, the ATSB will continue to monitor the safety issue and provide website updates.

General details

Occurrence details

Date and time:	28 September 2022 – 1515 Eastern Standard Time	
Occurrence class:	Incident	
Occurrence categories:	Loss of Separation	
Location:	Near Sydney Airport, New South Wales	
	Latitude: 33° 56.7667' S	Longitude: 151° 10.6333' E

Aircraft details

Manufacturer and model:	Airbus A330-202	
Registration:	VH-EBK	
Operator:	Qantas Airways Limited	
Serial number:	945	
Type of operation:	Part 121 Australia air transport operations – Larger aeroplanes	
Activity:	Commercial air transport	
Departure:	Sydney, New South Wales	
Destination:	Cairns, Queensland	
Persons on board:	Crew – Unknown	Passengers – Unknown
Injuries:	Crew – Nil	Passengers – Nil
Aircraft damage:	None	

Aircraft details

Manufacturer and model:	The Boeing Company 787-9	
Registration:	G-ZBKF	
Operator:	British Airways	
Serial number:	38622	
Type of operation:	Part 129 Foreign air transport operators	
Activity:	Commercial air transport	
Departure:	Sydney, New South Wales	
Destination:	Singapore	
Persons on board:	Crew – Unknown	Passengers – Unknown
Injuries:	Crew – Nil	Passengers – Nil
Aircraft damage:	None	

Glossary

ATC	Air traffic control
ATIS	Automatic terminal information service
FL	Flight level
IAS	Indicated airspeed
MATS	Manual of air traffic services
SID	Standard instrument departure
STCA	Short-term conflict alert
TCAS	A type of airborne collision avoidance system (ACAS).
TCU	Terminal control unit

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- involved air traffic controller
- flight crew notifications
- Airservices Australia
- Skybrary

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section 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 following directly involved parties:

- Involved air traffic controller
- Airservices Australia
- Civil Aviation Safety Authority
- Qantas
- Air Accidents Investigation Branch, United Kingdom

A submissions was received from:

- Airservices Australia

The submission was reviewed and, where considered appropriate, the text of the report was amended accordingly.

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.