Australian Government
Australian Transport Safety Bureau

Flap and landing gear overspeed during go-around involving Airbus A320, VH-VQL

9 km south of Sydney Airport, NSW, on 9 May 2018

ATSB Transport Safety Report
Aviation Occurrence Investigation
AO-2018-034
Final – 7 May 2019

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

Publishing information

Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 2463 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

Addendum

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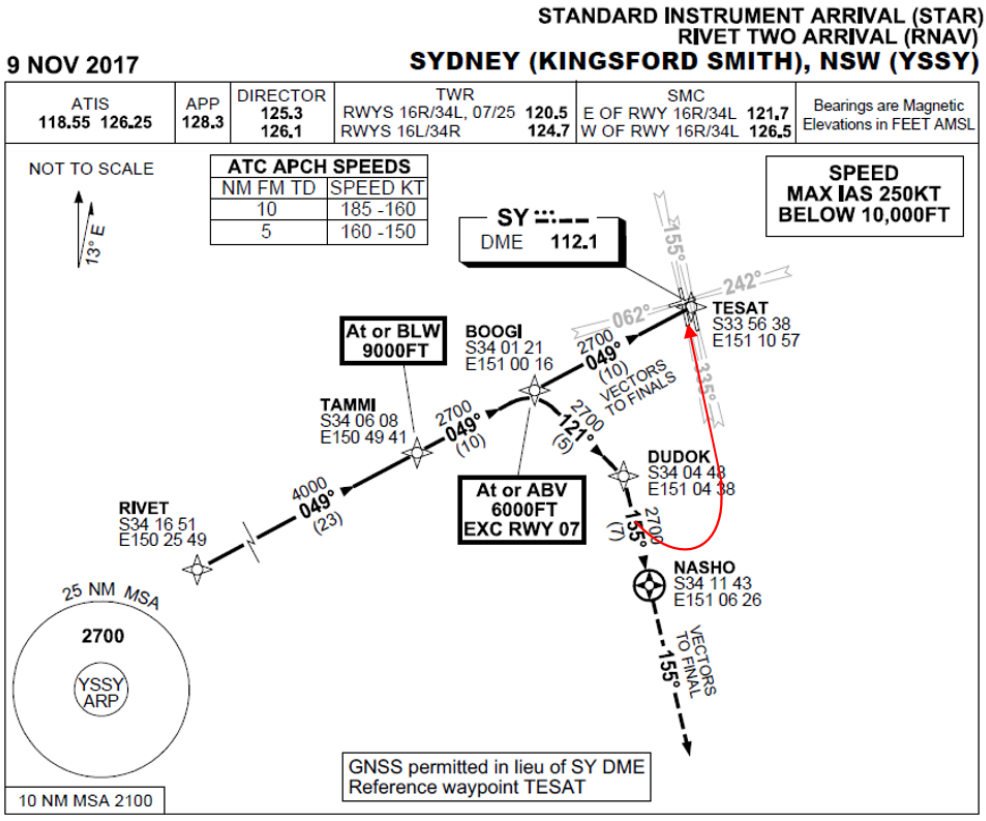
Flap and landing gear overspeed during a go-around involving Airbus A320, VH-VQL

What happened

On the evening of 9 May 2018, an Airbus A320, registration VH-VQL, was being operated on a regular public transport flight by Jetstar Airways Pty. Ltd. The flight departed Avalon Airport, Victoria, at about 1800 Eastern Standard Time,[1] for Sydney, New South Wales.

Approaching Sydney Airport, air traffic control (ATC) cleared the aircraft for a high-speed descent from flight level FL 250[2] for the RIVET TWO Standard Instrument Arrival (STAR). [3] At about 1846, the first officer (FO), who was the pilot flying, commenced the descent via the published waypoints for the STAR (Figure 1).

Figure 1: Departure and approach chart – Sydney Airport



Source: Airservices Australia, modified by ATSB. After passing DUDOK, ATC provided clearance to conduct the runway 34L[4] Independent Visual Approach (IVA) and provided radar vectors for a final approach intercept (Figure 2 and red line on Figure 1). Crossing the coast, the aircraft was about 2,000 ft high on profile compared with other similar approaches (see the section titled *Approach profiles*) Figure 1.

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1 Eastern Standard Time (EST): Coordinated Universal Time (UTC) + 10 hours.

2 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 250 equates to 25,000 ft.

3 Standard terminal arrival route.

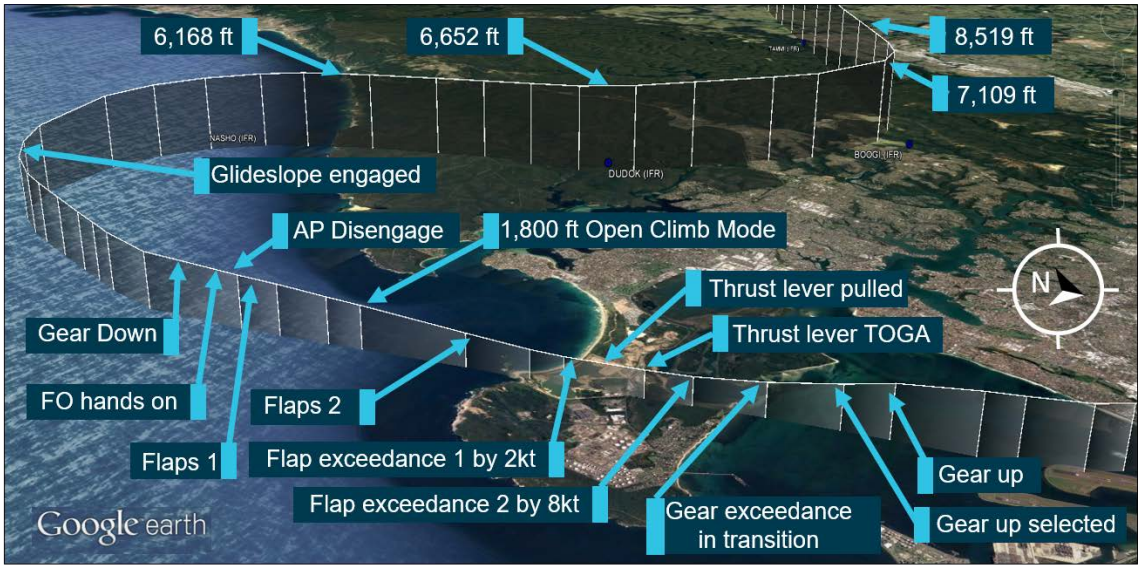
4 Runway number: the number 34 represents the magnetic heading of the runway, 340°. The runway identification may include L, R or C as required for left, right or centre.

After passing BOOGI on descent, the captain commented to the FO on the possibility of track shortening[5] due to the only preceding traffic being on final approach for runway 34L.

Observing the aircraft was high, the flight crew selected 'open descent mode'[6] in order to increase the aircraft's rate of descent. They then deployed speed brakes in an attempt to intercept the runway 34L glideslope.

After intercepting the final approach course, the flight crew selected landing gear down and disengaged the autopilot. The FO reported manually flying the aircraft to intercept the glideslope from above. At about 2,850 ft, which was 300 ft above glideslope, the flight crew selected the first flap setting for landing.

Figure 2: VH-VQL approach path to runway 34L Sydney



Source: Google earth, modified by ATSB

Prior to configuring for 'flaps 2', the flight crew selected the missed approach altitude of 3,000 ft in the altitude window of the flight control unit (FCU). The recorded data indicated that the altitude selector was also pulled, which changed the aircraft's vertical flight mode from open descent to open climb. In response to the mode change, the auto-thrust system, which was active at the time, increased thrust to climb the aircraft to 3,000 ft. Unaware of the thrust increase, the flight crew continued configuring for the approach by selecting 'flaps 2'.

The increase in thrust increased the aircraft's airspeed. This led to the FO reducing the aircraft's descent rate in an attempt to manage the acceleration and prevent flap overspeed. Despite this, the aircraft's airspeed continued to increase, leading to a 2 kt flap overspeed. Reducing the rate of descent also resulted in the aircraft diverging further from the approach glide path.

The recorded data showed that a thrust lever reduction to idle occurred just prior to exceeding the 'flaps 2' extension speed. A few seconds later, the airspeed decreased back below the maximum 'flaps 2' extension speed. Observing that the approach was not stable, the captain commanded the FO to go around.[7]

In response, the FO increased the thrust levers to the take-off/go-around setting (TOGA) however, recorded data showed that the aircraft was not pitched to the required 15° nose-up attitude. Consequently, the aircraft continued to accelerate. The captain reported that he announced 'pitch'

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5 Track shortening occurs when air traffic controllers direct an aircraft to turn earlier than usual, to land in a shorter time frame, which assists with sequencing aircraft for landing and take-off.

6 The open descent mode is a selected mode where the aircraft uses target values set by the flight crew using the flight control unit (FCU) selections, while disregarding any constraints contained within the prepared vertical flight path loaded in the flight management guidance computer.

7 To abandon the landing and make a fresh approach.

and ‘speed’ to draw the FO’s attention to the under rotation. However, the aircraft’s airspeed exceeded the maximum ‘flaps 2’ extension speed by 8 kt. The FO reported identifying that as the aircraft was going to exceed the ‘flaps 2’ speed, he selected ‘flaps 1’, which was not in accordance with the standard operating procedures. However, the aircraft also accelerated through the maximum ‘flaps 1’ extension speed of 230 kt by about 8 kt and by the time the flap had fully retracted, the exceedance had increased to 24 kt.

Due to the aircraft’s acceleration the FO also ordered the retraction of the landing gear. By the time the landing gear had retracted fully, the aircraft had exceeded the maximum landing gear transition speed by 13 kt.

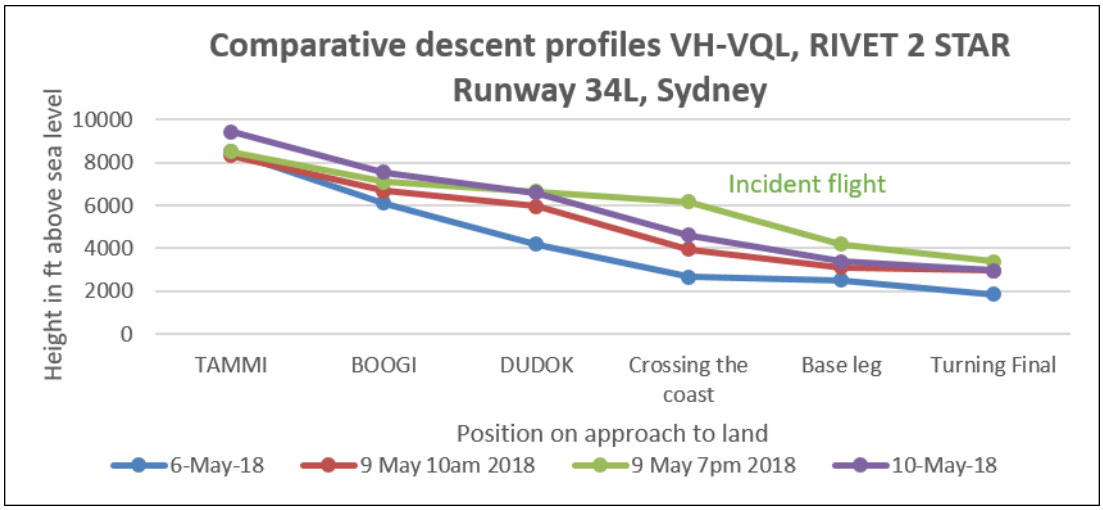
As the ‘flaps 1’ extension speed was exceeded, the captain advised the FO that he was taking control of the aircraft. Recorded data showed that the captain reduced the thrust, pitched the aircraft to 15° nose-up, and climbed to the missed approach altitude. The captain assumed the pilot flying role for the remainder of the flight, and an approach and landing was made on runway 34L.

Approach profile

A number of ATSB investigations have identified the importance of the management of the aircraft energy state and profile during the approach and landing phases of flight. They are known to be high workload periods for flight crew, especially during high-speed descents. This requires a high level of attention to ensure the aircraft meets the stabilised approach criteria prior to the required altitude.

The approach profile for VH-VQL, between DUDOK and final approach to runway 34L, was comparably higher and faster than previous flights (Table 1 and Figure 3).

Table 1: Comparative descent profiles for VH-VQL on the RIVET 2 STAR, Sydney



Source: ATSB

Despite being cleared for a high speed descent during the initial phase of the arrival, the aircraft was recorded to have arrived at BOOGI slightly high on profile, with an airspeed reduced to 250 kt, which was required by the standard operating procedures (SOP). However, between DUDOK and NASHO the aircraft’s descent shallowed until crossing the coast prior to NASHO. This positioned the aircraft about 2,000 ft high on profile in comparison to other flights that were flown in the same aircraft type by different flight crews.

Figure 3: VH-VQL comparative approach to Sydney Airport, RIVET TWO STAR 34L

Source: Google earth, modified by ATSB

Recorded data indicated that the descent rate of the aircraft increased after crossing the coast, which corresponded to the ATC clearance for the commencement of the IVA. Further, the data showed the aircraft's selected speed target remained set at 250 kt prior to intercepting the final approach track. The flight crew continued to use various speed targets for the remainder of the approach in an attempt to slow/configure the aircraft and capture the glideslope profile.

The data also indicated that the aircraft turned onto final approach at about 9.8 NM from the runway threshold, at about 3,400 ft. The aircraft's speed turning final was about 223 kt. This resulted in delays with aircraft configuration and achieving a stabilised approach.

Stabilised approach criteria

The company Operations Manual detailed that an approach to land is stabilised when all of the following criteria are met by no later than 1,000 ft height above the aerodrome (HAA):

1. The aircraft is on the correct nominated flight path and only small changes to required bank angle and pitch are needed to maintain the correct flight path
2. The aircraft speed is not more than speed target +10 kt and not less than speed target -5 kt (refer Note immediately below);

   Note: Reference (2) above: In VMC ONLY the approach may be continued below 1000 ft HAA provided the PIC is confident the speed target will be achieved by no later than 500 ft HAA.
3. The aircraft is in the correct landing configuration
4. Sink rate is no greater than 1000 ft per minute below 1000 ft above the aerodrome
5. Thrust setting is appropriate for the aircraft configuration and is not below the minimum power for the approach as defined in the aircraft's operating manual
6. All briefings are completed.

Go-around procedure

In the event of an unstable approach, the company procedure detailed that the pilot flying (PF) should apply three initial actions simultaneously;

- Advance thrust levers to take-off/go-around (TOGA) thrust
- Rotate the aircraft to 15° of pitch, if all engines are operating
- Announce go-around to the pilot monitoring (PM).

Subsequent assistance is then provided by the pilot monitoring (PM) to retract one setting on the flaps and the PF announces the flight mode readout. The PM then checks the modes on the flight mode annunciator and announces positive climb. The PF then commands landing gear up, the PM would then select the landing gear up and the rest of the procedure is actioned.

Flight Crew

The Jetstar operations manual required a minimum of two flight crew for the operation of the A320. Additionally, pilots must also meet the minimum experience and qualification requirements outlined in the company SOPs. To ensure that each member of the flight crew can demonstrate sufficient role competency, newly-appointed captains and FOs operated on a restricted basis, after clearance to line, for a period of six and three months respectively. Jetstar also requires that no more than one pilot may operate under restriction on the flight deck of the A320 at any one time. The captain had just completed his initial command restriction period and all flight crew met the company requirements prior to the flight. Both flight crew were appropriately licenced, qualified and experienced on the aircraft type and held valid Class 1 medicals.

The captain had a total of about 20,000 hours flying experience, of which about 2,600 hours was on A320 aircraft. He had logged over 600 hours and over six months as captain on the A320 prior to the incident. His last flight check was conducted in an A320, on 22 February 2018, and he was familiar with runway 34L as he had been based in Sydney since 2012. He did not have any health issues and advised being well rested prior to the flight.

The FO joined the company in 2011 with significant civil and foreign military flying experience, and had logged over 8,700 flight hours total time, of which over 3,300 hours were on the A320. His last flight check was conducted in an A320 on 9 January 2018 and was familiar with runway 34L as he had been based in Sydney since 2016. The FO reported feeling well rested prior to the flight, and in good health.

Except for the previous sector, both pilots had not flown together in their respective roles on the A320. However, they had flown briefly together about five years prior on the A330 and were aware of each other's experience and aviation background. In reflecting on the occurrence, the captain reported that his knowledge of the FO's background created a performance expectation that reduced the cockpit gradient[8] during the flight and delayed his intervention during the occurrence. The FO reported that his relationship with the captain was good.

Safety analysis

Management of the approach

The arrival to DUDOK was comparatively similar to other flights. However, after DUDOK, insufficient descent rate resulted in the aircraft being high on profile. Additionally, the flight crew maintained a selected speed of 250 kt prior to turning onto final, which positioned the aircraft in a high-energy state and led to delays configuring the aircraft. The high speed and profile required an irregular intercept of the glideslope from above, on final approach. It was likely that, at this time, the flight crew's focus of attention was primarily on configuring the aircraft, reducing its speed and

[8] The term 'cockpit gradient' can variously refer to the difference between involved pilots in terms of age, experience levels and position held in the organisation.

capturing the glideslope. In addition, the flight crew elected to descend manually using the flight directors, increasing their workload as they approached 1,800 ft.

Prior to 1,800 ft, the missed approach altitude of 3,000 ft was selected in the altitude window of the flight control unit (FCU). At this time, the altitude selector was also pulled which initiated a mode change to open climb. This change had the effect of increasing thrust, as the auto-thrust system was still active. This went unnoticed by the crew despite the annunciation and resulted in increasing airspeed.

Without the automated thrust increase the crew may have been able to stabilise the approach in accordance with the operator's required criteria. However, the undetected thrust further destabilised the approach and subsequently led to the initial flap overspeed. Had the flight crew identified the flight mode annunciator (FMA) change, appropriate and timely action may have prevented the flap overspeed and prompted an earlier go-around.

The go-around

Having assessed that the aircraft was unlikely to meet the stable approach criteria, the captain appropriately initiated the go-around.

A go-around requires a methodical sequence of many actions by both the pilot flying and the pilot monitoring. During a go-around, the aircraft transitions quickly from descending at relatively low thrust, to climbing at high thrust with a changing configuration. The tempo of the sequence is relatively rapid compared to other normal in-flight manoeuvres.

At the initiation of the go-around, the flight crew did not conduct the sequence in accordance with the required standard operating procedures. This led to the normal go-around flight crew actions being delayed, omitted, and out of sequence. Further, the nature of the two-engine, high-energy go-around is such that there is a rapid acceleration of the aircraft. When the FO did not increase the pitch to the expected nose up attitude, the aircraft accelerated more quickly than the flight crew expected. This limited the time available to complete the required actions of retracting flap and landing gear before exceeding the operational limitations of the aircraft.

As the pilot monitoring, the captain had good opportunity to observe the rapidly accelerating aircraft, and that the FO had not pitched the aircraft as expected. This, combined with the non-standard flap selection made by the FO, were cues to the captain to formally intervene and reduce the risk of the flap and landing gear overspeed.

Cockpit gradient

The captain reported that he had high regard for the FO's experience and that influenced the performance he expected from him. Consideration of the FO's background also influenced the point at which the captain felt it necessary to intervene during the flight. In hindsight, the captain felt that the cockpit gradient contributed to the occurrence by delaying the required intervention.

Findings

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

- While descending through 1,800 ft, the crew inadvertently activated open climb mode with the selection of the assigned altitude selector to 3,000 ft. This resulted in an undetected increase in thrust, which destabilised the approach, and led to the flap overspeed.
- The use of a non-standard go-around procedure, including a lower than required pitch attitude, resulted in increased acceleration and exceedance of the flap and gear limitations.
- The captain's perception of the first officer's level of experience likely led to a shallow cockpit gradient. This influenced the captain's level of intervention during the approach and go-around.

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 operator conducted an internal investigation which highlighted the importance of situational awareness of flight crews and reiterated the operational guidelines in the 'Airbus 'Golden Rules for Pilots', which included rule 3 'Understand the FMA at all times' and included expectations for the crew to monitor, announce, confirm, and understand FMA changes and annunciations.

Safety message

Handling of approach to land is one of the ATSB's SafetyWatch priorities. Unexpected events during the approach and landing can substantially increase what is often a high workload period. Adherence to standard operating procedures and correctly monitoring the aircraft and approach parameters provides assurance that an independent visual approach can be safely completed. The selection of inappropriate auto-flight modes, unexpected developments, or any confusion about roles or procedures can contribute to decisions and actions that increase the safety risk to the aircraft and its passengers.

A go-around should be immediately carried out if the approach becomes unstable or the landing runway cannot be identified from the minimum descent altitude or missed approach point.

The ATSB SafetyWatch highlights the broad safety concerns that come out of our investigation findings and from the occurrence data reported to us by industry.

General details

Occurrence details

Date and time:	9 May 2018 – 1915 EST	
Occurrence category:	Incident	
Primary occurrence type:	Airframe overspeed	
Location:	9 km South Sydney Airport, New South Wales	
	Latitude: 34° 1.957' S	Longitude: 151° 12.022' E

Aircraft details

Manufacturer and model:	Airbus A320-232	
Registration:	VH-VQL	
Operator:	Jetstar Airways Pty. Ltd.	
Serial number:	2642	
Type of operation:	Air Transport High Capacity	
Persons on board:	Crew – 6	Passengers – 117
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Nil	

About the ATSB

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; 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 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.

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.