



**Australian Government**

**Australian Transport Safety Bureau**

# Flight envelope protection event involving an Airbus A320, VH-VQY

near Mildura Airport, Victoria, 12 March 2014

**ATSB Transport Safety Report**  
Aviation Occurrence Investigation  
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#### **Addendum**

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# Flight envelope protection event involving an Airbus A320, VH-VQY

## What happened

On 12 March 2014, at about 0920 Eastern Daylight-savings Time (EDT), an Airbus A320 aircraft, registered VH-VQY, departed Melbourne, Victoria on a ferry flight to Darwin, Northern Territory, with a captain and first officer on board.

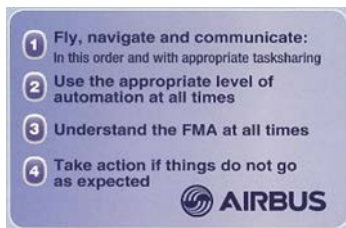
When established in the cruise, at FL 360,<sup>1</sup> the crew completed checks and all indications were normal. After about 5 minutes in the cruise at FL 360, the captain briefed the first officer on the nearest suitable airport in case of emergency and then the captain temporarily left the cockpit. At that time, the aircraft was operating in managed<sup>2</sup> cruise mode, with speed in selected<sup>3</sup> mode at Mach 0.78. The aircraft had encountered minor turbulence during the cruise.

When abeam Mildura, Victoria, the first officer received a clearance from air traffic control (ATC) to climb to FL 380. As the captain exited the cockpit, the first officer read back the clearance and the captain confirmed the read-back.

The first officer selected a managed climb mode to FL 380, and the speed remained in selected mode at Mach 0.78. Approaching FL 380, at about FL 373, the first officer observed the airspeed increase to about Mach 0.81 and the airspeed trend indicator approaching the maximum Mach number at which the aircraft has been certified to operate ( $M_{MO}$ ), which was Mach 0.82. He also observed a rate of climb of about 3,000 feet per minute (fpm). The first officer reported that the normal rate of climb when within 1,000 ft of the selected altitude, is about 1,000 fpm and he had not previously observed such a high rate of climb when approaching the top of climb.

The first officer attempted to reduce the airspeed by selecting the speed back to M 0.76 however he observed that the airspeed and the trend continued to increase. One of the Airbus ‘Golden Rules’ was: ‘Take action if things do not go as expected’ (Figure 1). Following this ‘Golden Rule’, the first officer reduced the thrust to idle, which disconnected the autothrust, and took manual control of the thrust in an attempt to reduce the airspeed. He extended the speed brake and disconnected the autopilot to adjust the pitch attitude of the aircraft in an attempt to maintain the selected altitude. With the autopilot disconnected, the speed brake extended fully (with the autopilot engaged only half extension of the speed brake is available).

**Figure 1: Golden Rules Card**



Source: Airbus

The aircraft climbed above the assigned altitude of FL 380 and the altitude warning sounded. When at about FL 383, ATC called the first officer to confirm altitude, to which he responded that

<sup>1</sup> 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 360 equates to 36,000 ft.

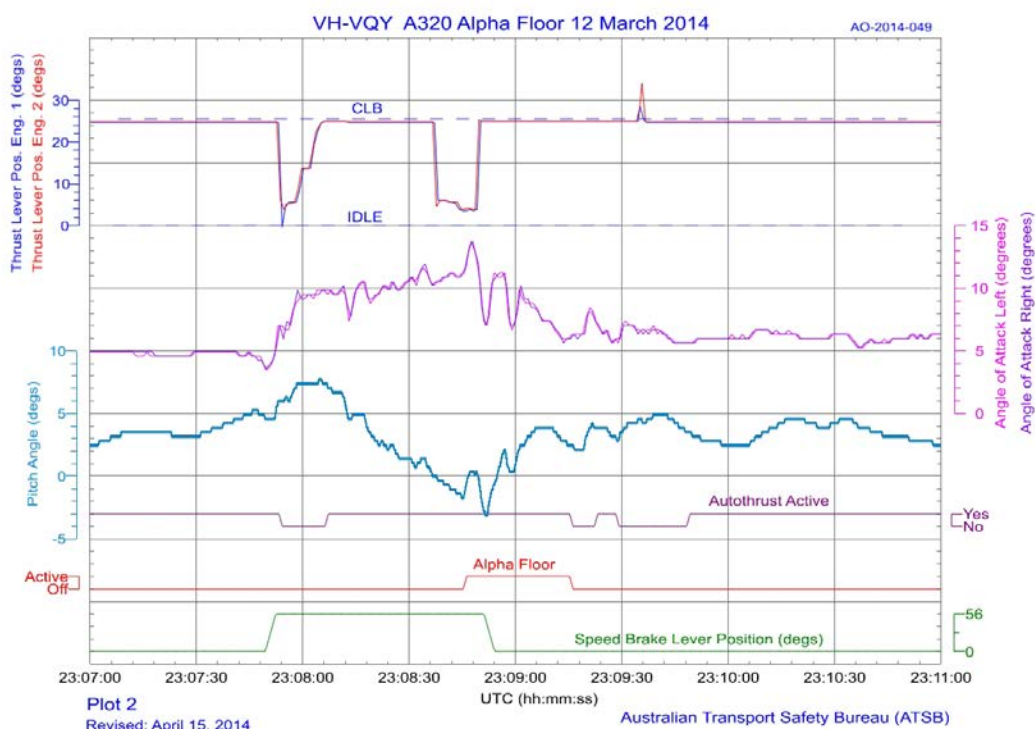
<sup>2</sup> The aircraft is guided along the pilot-defined flight management system (FMS) lateral and vertical flight plan, speed profile and altitude targets, as managed by the FMS (accounting for altitude and speed constraints, as applicable).

<sup>3</sup> The aircraft is guided to acquire and maintain the targets set by the crew, using the modes engaged or armed by the crew (i.e., using the flight control unit (FCU) target setting knobs and mode arming / engagement pushbuttons).

the aircraft was returning to FL 380. The first officer then re-engaged the autothrust, and returned the thrust levers to the climb detent. He also momentarily engaged the autopilot, however again disconnected it and applied forward pressure on the sidestick to lower the nose attitude of the aircraft in an attempt to recapture FL 380.

The aircraft then descended and the airspeed slowed below the  $V_{LS}$  speed: the lowest selectable speed that autothrust permits. The first officer then applied rearward pressure on the sidestick in an attempt to regain FL 380 and reduced the thrust levers towards idle, but short of the idle stop position. This limited the maximum amount of thrust available. The application of back pressure increased the aircraft's angle of attack. At the Alpha Protection speed,<sup>4</sup> which corresponds with the angle of attack at which Alpha Protection becomes active, the Alpha Floor function activated. In that mode, the speed brakes retracted<sup>5</sup> (Figure 2) and the take-off/go-around (TOGA) thrust lock was activated.

**Figure 2: Thrust settings, angle of attack, pitch, speed brake and Alpha Floor**



Source: ATSB

The first officer reported that the aircraft changed very rapidly from an overspeed to an Alpha Protection state, and this rate of change may have been due to a combination of the high altitude and the light weight of the aircraft. He observed the TOGA LOCK display on the electronic centralized aircraft monitoring (ECAM), but did not recall an ALPHA FLOOR annunciation on the Flight Mode Annunciator (FMA).

At this time, the captain returned to the cockpit and immediately scanned the primary flight display (PFD) to establish the current state of the aircraft. He observed the pitch attitude at about 0, on the horizon. The speed was in the 'yellow band' about half way between the Alpha Protection speed and  $V_{LS}$  and the trend accelerating. The aircraft was then at about FL 365 and descended to about

<sup>4</sup> When the angle of attack is greater than Alpha Protection (black and amber band on the airspeed scale) Alpha Protection is activated. When airspeed is in the Alpha Protection range to Alpha Max, the side stick commands angle of attack directly.

<sup>5</sup> The lever remained in the extended position.

FL 362 prior to re-commencing the climb. There were no returns visible on the aircraft’s traffic collision avoidance system (TCAS) display, indicating no other aircraft were likely to come into conflict. The captain also observed TOGA LOCK displayed on the engine display.

The captain placed his left hand on the sidestick and his right hand on the thrust levers and stated that he had control of the aircraft. He noted that the thrust levers were just above the idle position, and ‘double clicked’ the autothrust disconnect pushbuttons to take control of the thrust levers and remove the TOGA LOCK. The captain detected that the speed brake lever was in the extended position and moved the lever to the retracted position. The captain then set a pitch attitude of about 5° to 7°, a rate of climb of about 700 – 1,000 fpm, selected the thrust levers to the climb detent, and heard the altitude warning horn.

ATC observed the aircraft below the assigned altitude of FL 380 and called the crew to confirm the altitude and to check whether operations were normal. The first officer replied that they were climbing to FL 380 and ‘ops normal’.

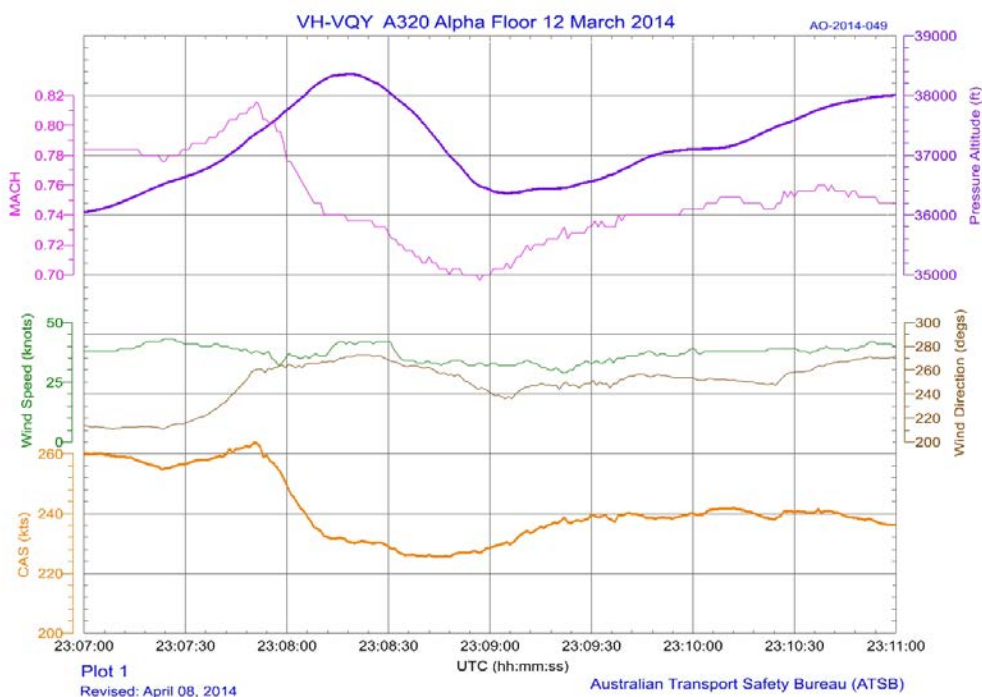
The captain continued to observe the Flight Mode Annunciator (FMA) during the climb and once re-established in the cruise at FL 380. He reported that he was cognisant of conducting a gentle recovery given the high altitude and potential for a secondary flight envelope event.

**Flight data**

The flight data indicated the following (Figure 3):

- During the climb, passing about FL 365, the wind shifted from a tailwind of about 20 knots to a headwind of about 15 kt, resulting in an effective 35 kt windshear on the aircraft. This resulted in a rate of climb of 3,005 fpm and a transient Mach increase.
- The computed airspeed (CAS) increased about 6 kt from 256 to 262 kt.
- The Alpha Floor activated when the aircraft was on descent passing about FL 370, at a CAS of 226 kt, thrust levers just above the idle stop with autothrust disconnected, and the aircraft descending at about 4,500 fpm.

**Figure 3: Altitude, Mach, Wind speed and CAS**



Source: ATSB

## ***Pilot comments***

### ***Captain comments:***

The captain provided the following comments:

- The autothrust lags and the engines also take time to spool up after being selected to idle.
- He had used 'selected speed' mode during the cruise as the aircraft had encountered some minor turbulence and he would have been able to quickly select the turbulence penetration speed (of Mach 0.76) in the event of moderate turbulence.
- When the A320 encounters wind condition changes in the cruise similar to shear, the airspeed can increase quite quickly and this is not a rare event on the A320. During flights between Melbourne and Gold Coast/Brisbane airports, this windshear/wind speed change and potential overspeed situation is not uncommon as the aircraft transits the southern jetstream.
- FL 380 was selected to optimise fuel economy. The recommended maximum altitude was about FL 392, hence a significant buffer existed between the operating level and the maximum.

### ***First officer comments:***

The first officer provided the following comments:

- The rate of things happening seemed much quicker than usual. The aircraft was light due to being a ferry flight (53,300 kg) and they were approaching FL 380. Although this was higher than the usual operating altitude, it was more than 1,000 ft below the maximum operating altitude for the aircraft.
- Prior to the captain leaving the cockpit, he had mentally rehearsed the depressurisation and engine failure checklists, however the situation that then unfolded was not one he had been prepared for.
- At the time of the incident, due to the rapidity of the changing conditions and the high workload, he believed that he may not have had time to action the overspeed checklist.
- In future when operating at high altitudes, he would leave the autopilot on.

## ***Weather***

In a report provided to the ATSB by the Bureau of Meteorology, a significant change in wind direction and speed was forecast for the incident area. The wind was forecast to veer from 253° at 31 kt at FL 340, to 268° at 60 kt at FL 380.

## ***Flight crew operating manual (FCOM) and standard procedures***

- Until mid 2013, there was only a descending aircraft overspeed prevention checklist. That checklist included disconnecting the autopilot and raising the aircraft nose. Use of that checklist in the cruise was inappropriate because it could result in a significant altitude exceedance at high speed and manually flying the aircraft at high speed and high altitude was not practiced often.
- Airbus published new flight crew operating manual (FCOM) procedures for overspeed prevention and recovery. Both checklists commence with AP (autopilot):KEEP ON. A newsletter distributed to company flight crew contained the new overspeed recovery FCOM but not the overspeed prevention FCOM.
- If the autopilot remained engaged during an aircraft overspeed, flight envelope speed protection is provided in the relevant AFS modes, resulting in a nose up order within the limit of the autopilot authority to reduce or stop the airspeed increase.
- In previous flight crew cyclic checks in the simulator, the aircraft was put into an upset to simulate a potential aircraft overspeed – a high speed spiral dive, and the crew had to recover the aircraft to normal flight.

## 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 ATSB has been advised of the following proactive safety action in response to this occurrence.

### **Operator of VH-VQY**

As a result of this occurrence, the aircraft operator has advised the ATSB that they are taking the following safety actions:

- The operator did not require two pilots to be on the flight deck for an enroute level change, however the FCOM has subsequently been amended as follows: ‘During normal operations, altitude changes should normally be conducted with both pilots at the controls unless complying with an ATC requirement or for traffic separation’.
- In subsequent cyclic checks, a training scenario to emulate the conditions encountered in this incident, including a climb at high altitude may be included.

## Safety message

This incident provides a reminder to pilots of all aircraft types regarding the potential for an aerodynamic stall. The stall occurs at a critical angle of attack. The airspeed associated with the stall angle of attack varies depending on the aircraft weight and load factor (such as angle of bank), and the configuration of flaps, slats and spoilers.

The Golden Rules for Pilots article in *Safety First - The Airbus Safety Magazine*, Issue 15, January 2013, states that on highly automated and integrated aircraft, several levels of automation are available to perform a given task; and the ‘appropriate’ level of automation depends on the situation and task. It advises flight crew to understand the implication of the intended level of automation. Being able to anticipate the reaction of the automated response is important in deciding whether to proceed to rule 4 and change the level of automation.

In this incident, understanding the automated response to a potential overspeed situation may have given the first officer more time to analyse and resolve the situation. Disconnecting the autopilot and autothrust led to a rapid increase in workload and the aircraft changing from a potential overspeed to a slow speed state.

## General details

### **Occurrence details**

Date and time:	12 March 2014 – 1017 EDT	
Occurrence category:	Serious incident	
Primary occurrence type:	Flight envelope protection event	
Location:	abeam Mildura, Victoria	
	Latitude: 34° 13.75' S	Longitude: 142° 05.13' E

## Aircraft details

Manufacturer and model:	Airbus Industrie A320	
Registration:	VH-VQY	
Operator:	Jetstar Airways	
Serial number:	2299	
Type of operation:	Air transport – ferry	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

## About the ATSB

The Australian Transport Safety Bureau (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 fare-paying passenger operations.

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.