Australian Government
Australian Transport Safety Bureau

Incorrect configuration involving Airbus A320, VH-VFX

near Sydney Airport, New South Wales, on 29 September 2018

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Addendum

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Safety summary

What happened

On 29 September 2018, a Jetstar Airways Airbus A320 aircraft, registered VH-VFK, was operating a scheduled passenger flight from Sydney, New South Wales to Melbourne, Victoria. While preparing for the flight and having difficulties with the electronic system used for calculating take-off performance figures, the flight crew reverted to the back-up procedure of manual calculations.

Shortly after take-off, the maximum flap extended speed was exceeded. As the aircraft climbed through 2,800 ft, the flight crew retracted the landing gear after realising it was still extended, resulting in a landing gear retraction overspeed.

What the ATSB found

In completing the manual calculations for take-off performance, the flight crew inadvertently calculated speeds that were higher than required for the actual aircraft weight and environmental conditions. The incorrect take-off speeds were not identified by independent verification and cross-checking.

During the first segment of the take-off climb period, at maximum engine power settings, the aircraft pitch rate was below the recommended 3° per second, resulting in a higher acceleration rate than anticipated. Due to the incorrect calculated speeds, the aircraft rotated with a margin of only 16 kt to the flap extended limit speed. Five seconds after rotation, the flap extended overspeed event occurred.

The aircraft did not rotate to the correct pitch attitude and the pilot monitoring did not alert the pilot flying of this. However, he called ‘speed, speed’ in an attempt to assist the pilot flying manage the airspeed, to which the pilot flying reduced the engine power in response, rather than increasing the aircraft pitch. The action of reducing the engine power was taken when the aircraft was below the safe altitude above ground.

The landing gear would normally be retracted by the flight crew as soon as the aircraft had a positive rate of climb. In this case, the crew did not retract the landing gear when required. Climbing through 2,800 ft, they identified that the landing gear was still extended while troubleshooting the source of a buffeting noise. They then immediately selected the gear to ‘UP’ without first checking the aircraft speed, resulting in a landing gear retraction overspeed event.

What's been done as a result

Jetstar Airways advised that they undertook several actions to prevent a similar occurrence in the future. A safety summary of the incident was distributed to the wider pilot community, focusing on the importance of having the latest Flysmart software database version on their Electronic Flight Bag. It also highlighted the importance of considering reasonability and accuracy checks, consulting company procedure manuals in the event of Electronic Flight Bag issues, and conducting a normal rotation followed by reference to the Speed Reference System.

Safety message

This incident highlights the importance of independent validation and cross-check by the flight crew, in particular for performance speeds and aircraft weight.

The Airbus magazine *Safety First #18* reports on potential problems with using incorrect reference speeds. This highlights the design and operational considerations underlying recommendations that Airbus has issued to flight crews.

The occurrence

On 29 September 2018, the flight crew of an Airbus A320 aircraft, registered VH-VFX and operated by Jetstar Airways, prepared to conduct a scheduled passenger flight from Sydney, New South Wales to Melbourne, Victoria. The flight crew had recently completed their third sector for that day in a different aircraft and were required to change aircraft for this flight, which had a scheduled departure time of 2200 Eastern Standard Time (EST).[1]

Take-off performance calculations – Electronic Flight Bag

The first officer, who was the designated pilot monitoring (PM) [2] for this flight, boarded VH-VFX in advance of the captain who was the pilot flying (PF) to begin flight preparations so as to minimise any delay. Jetstar had issued each pilot with their own electronic flight bag (EFB), an electronic information management device that helps the flight crew perform flight management tasks more easily and efficiently. The EFB enables the flight crew to access up-to-date information and contains applications to automate other functions, such as performance take-off calculations. Neither flight crew updated their EFBs before the first flight of the day, as required by Jetstar Airways.

The PM updated his EFB's Flysmart[3] database shortly before the occurrence flight. When the PF arrived on the flight deck, he and the PM continued their preparations for departure. Both the PF and the PM used their respective EFBs to calculate the take-off performance data. The PF entered the data from his EFB into the flight management system (FMS)[4] performance take-off page. When the PM cross-checked the performance data displayed on his EFB with the information that the PF had entered into the FMS, he identified that the data was inconsistent. The PM and the PF then conducted a series of checks to troubleshoot the problem. During the flight crew's attempt to identify the discrepancy, they found that the PF had an older software version of the EFB database on his device. The flight crew assessed that the out-of-date database was possibly related to the performance data discrepancy.

The PF attempted to update the database on his EFB, however, the device screen continuously displayed the 'busy' symbol and, at that time, the update was unsuccessful. The flight crew then attempted to use the spare EFB[5] on the aircraft. This had an outdated version of the software database.[6] The PF attempted to update the spare EFB. This update was also unsuccessful. Both the spare EFB and the PF's EFB were effectively inoperative, continuously displaying the 'busy' symbol.

Take-off performance calculations – manual calculations

The flight crew resorted to the back-up procedure in which performance speeds were derived from manual calculations. The manual calculations involved reading the performance speeds off the regulated take-off weight (RTOW)[7] tables.

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

[2] Pilot Flying (PF) and Pilot Monitoring (PM): procedurally assigned roles with specifically assigned duties at specific stages of a flight. The PF does most of the flying, except in defined circumstances, such as planning for descent, approach and landing. The PM carries out support duties and monitors the PF's actions and the aircraft's flight path.

[3] Flysmart is the Airbus software installed on electronic portable devices so they function as an EFB.

[4] The flight management system is an on-board multi-purpose navigation, performance and aircraft operations computer. It automates a wide variety of in-flight tasks. It is comprised of the following interrelated functions: navigation, flight planning, performance computations, data communications and optimised route determination and en route guidance.

[5] Spare EFB is how this operator refers to the EFB kept on the aircraft.

[6] As outlined in the Jetstar A320 Company Procedures Manual: 'The spare iPad may be up to 8 weeks out-of-date and so all required operational apps must be updated IAW normal procedures prior to operational use.'

[7] RTOW is the limiting take-off weight calculated for a particular runway under particular specified conditions.

The PM recalled that he performed the calculations and that the PF agreed with the results, but the PM did not recall the PF independently performing that task. However, the PF's recollection was that he did independently check the performance speed calculations that the PM had achieved. The flight crew agreed on the following performance speeds that were entered into the flight management system:

- V_1[8]: 157 kt
- V_R[9]: 161 kt
- V_2[10]: 164 kt.

Flap overspeed

The flight crew commenced the take-off at 2237 EST (1237 UTC), using the manually-calculated performance data and take-off/go-around (TOGA)[11] thrust. Table 1 shows the quick access recorder (QAR) data at one second intervals, including indicated airspeed (KIAS), aircraft pitch attitude, pitch rate and the pitch and thrust commands by the pilot flying. Aircraft data times below are in UTC. QAR data showed the aircraft rotated at 169 kt with an initial pitch rate of 2.8º/sec. After rotation, the pitch rate remained under the desired 3º/sec (see *Speed Reference System*), reducing across the next 7 seconds before increasing.

Table 1: Aircraft data showing pitch attitude and pitch commands

Time (UTC)[12]	KIAS (knots)	Radio Altitude (feet)	Pitch attitude (degrees)	Pitch command (degrees)	Pitch rate (deg/sec)	Nose Landing Gear	Main Landing Gear	Thrust lever angle (degrees)	Performance speeds (knots)
1237:32	155.5	0	0.4	0	0.2	Ground	Ground	45	
1237:33	160.5	0.2	0.4	0	-0.3	Ground	Ground	45	157 = V_1
1237:34	163.9	0	0.4	0	0.1	Ground	Ground	45	161 = V_R
1237:35	169.6	0	0.7	4.0	2.8	Air	Ground	45	164 = V_2
1237:36	169.9	0	4.2	1.6	2.0	Air	Ground	45	
1237:37	178.0	6.0	5.6	4.3	1.7	Air	Air	45	174 = V_2+10
1237:38	179.6	17.4	7.7	3.3	1.8	Air	Air	45	
1237:39	184.4	37.7	9.5	3.5	1.2	Air	Air	45	
1237:40	186.5	63.4	10.5	3.5	0.6	Air	Air	45	
1237:41	187.9	100.4	10.9	4.7	0.1	Air	Air	45	
1237:42	188.0	143.7	10.9	-1.1	-0.3	Air	Air	36.6	
1237:43	189.1	196.4	11.6	8.9	1.1	Air	Air	33.8	189 = V_{FE}+4

The green highlighted line shows the rotation. The shaded line shows the flap overspeed. The yellow highlighted line shows when the thrust was reduced. The orange highlighted line shows when the master warning has been triggered.
Source: Quick access recorder (QAR) data provided by Jetstar and tabulated by ATSB.

8 V_1: the critical engine failure speed or decision speed required for take-off. Engine failure below V_1 should result in a rejected take off; above this speed the take-off should be continued.

9 V_R: the speed at which the rotation of the aircraft is initiated to take-off attitude. This speed cannot be less than V_1 or less than 1.05 times V_{MCG}. With an engine failure, it must also allow for the acceleration to V_2 at a height of 35 ft at the end of the runway.

10 V_2: the minimum speed at which a transport category aircraft complies with those handling criteria associated with climb following an engine failure. V_2 is the take-off safety speed and is normally obtained by factoring the stalling speed or minimum control (airborne) speed, whichever is the greater, to provide a safe margin.

11 TOGA: Take-off/go-around is a throttle position (detent) that gives the maximum available engine thrust for the environmental conditions. This throttle position is required when the performance speeds are manually calculated.

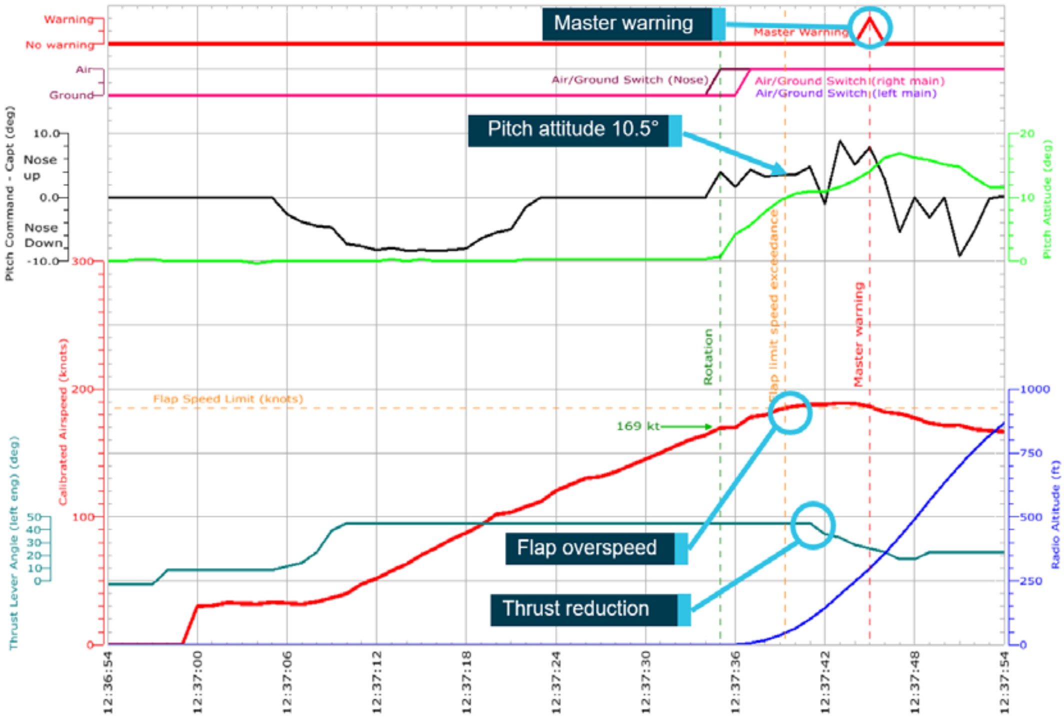
12 Coordinated Universal Time (UTC): the time zone used for aviation. Local time zones around the world can be expressed as positive or negative offsets from UTC. Australian Eastern Standard Time = UTC + 10:00.

In the normal procedure, following take-off, the PM would call ‘positive climb’ and the PF would call ‘gear up.’ In this case, neither of the calls were heard by the other flight crew member, although they were both reported as having been made.

The PM reported then calling ‘speed, speed’, indicating that the aircraft was nearly at maximum speed for the flap extension configuration. The aircraft exceeded the flap extended limit speed 5 seconds after rotation (Table 1 and Figure 1).[13] By this time, at 1237:40 UTC, the aircraft was about 63 ft above ground level (AGL) and had a pitch attitude of 10.5° (green graph in Figure 1).

The overspeed warning was triggered when the airspeed exceeded the maximum flap extended speed (V_{FE}[14]) by more than 4 kt. This occurred at a time between 1237:42 and 1237:43 UTC (the yellow and orange lines in Table 1). Airbus advised that the aircraft was at 180 ft radio altitude (AGL) at that time. The overspeed warning was displayed on the electronic centralised aircraft monitor, in addition to an aural warning and the master warning light.

Figure 1: Quick access recorder data graph showing take-off period



This graph shows when the master warning was recorded in the QAR data.
Source: Jetstar Airways quick access recorder data – graphed by ATSB

The PF retarded the thrust levers from the TOGA position 2 seconds after the flap overspeed, while the aircraft was at 144 ft AGL, which was below the thrust reduction altitude of 800 ft. After a further 7 seconds, the PF increased the thrust by advancing the thrust levers to the climb detent. The PF then retracted the flaps from position 3 to position 1.[15] The autopilot was engaged in climb mode and the aircraft continued climb with subsequent retraction of the flaps from position 1 to 0.[16]

13 The quick access recorder data was recorded once every second.

14 V_{FE}: maximum speed with flaps extended. V_{FE} = 185 kt for flaps at configuration 3.

15 The flap lever is marked 0, 1, 2, 3 and FULL. They mark flap stages: 1 = 10 degrees of flaps; 2 = 15 degrees of flaps; 3 = 20 degrees of flaps and FULL = 35 degrees of flaps.

16 The take-off procedure in the Jetstar A320/A321 Flight Crew Operating Manual had several segments with instructions at each. The instructions to progressively retract the flaps were part of the segment for after the acceleration altitude has been reached. This is the altitude at which the pilot accelerates the aircraft by reducing the aircraft’s pitch, to allow acceleration to a speed safe enough to raise flaps and slats. The acceleration altitude in this case was 800 ft.

Landing gear retraction overspeed

The take-off standard operating procedure was to retract the landing gear as soon as a positive climb rate was established. Shortly after completely retracting the flaps, the flight crew reported that they heard a ‘buffeting noise’. They commenced trouble-shooting the source of this sound and they identified that the aircraft’s auxiliary power unit (APU) was still on and delivering bleed air to the air-conditioning packs (as required when take-off performance speeds are calculated using the RTOW tables). Thinking that this may have been causing the buffeting noise, they turned the bleed air off, as per the standard operating procedures. This did not resolve the buffeting noise. The flight crew then realised the landing gear was still extended. The PF immediately called ‘gear up’ and the PM responded by retracting the landing gear immediately. The airspeed was then 250 kt,[17] which was above the maximum landing gear retraction speed of 220 kt.

The flight crew discussed the occurrence and, having no known adverse indications, decided to continue the flight to Melbourne.

17 This was below the maximum operating speed with the landing gear extended of 280 kt.

Context

Electronic flight bag

The operator's procedures required the flight crew to verify the Flysmart software database version on their electronic flight bag (EFB), and update it if required prior to their first flight of the day. On this occasion, neither flight crew member updated their Flysmart software prior to their first flight of the day despite an updated version being available. Included in the updated version was the removal of an obstacle relevant to the departure runway. However, Jetstar Airways later reported that the two software versions should have produced identical take-off performance results for this flight. Different performance data could result from a discrepancy in manually entered parameters. For example, if the incorrect aircraft registration was entered into Flysmart, different performance data would likely result.

The standard operating procedures, which the flight crew were required to complete as part of the preparation of the aircraft, included steps for starting the EFB and using it to calculate the take-off performance data. Subsequently, the flight crew were required to complete the flight management and guidance system preparation, which included entering the take-off data from the EFB into the flight management system's performance take-off page and completing a cross-check of that data.

For dispatch, the EFB's *AIB Take-off* application[18] had to be present and functioning on two EFBs (which could include the spare EFB) unless backup provisions were satisfied. The backup provisions, as detailed in the Jetstar *A320 Company Procedures Manual*, were 'manual take-off charts available and/or independent calculations on one device.' Since the flight crew did not have the AIB Take-off application functioning on two EFBs, they chose to use the manual take-off tables. However, in accordance with the backup provisions, they could also have completed independent calculations on the one functioning device.

Manual calculation for performance values

The manual take-off charts (regulated take-off weight (RTOW) tables) served as a backup method for calculation of the performance speeds when Flysmart was not available. The tables and the instructions for using them were contained in the Jetstar *A320/A321 Performance Manual*. The instructions spanned three pages and the tables were contained in a separate appendix. The manual was stored electronically on the EFBs and the flight crew accessed it on the PM's EFB.

To use the manual tables (extract shown in Figure 2), the flight crew had to select the row corresponding to the outside air temperature, in this case 15º (shown by the green arrow). They then had to select the column corresponding to the wind, in this case 'nil wind' (shown by the green circle). The point where they intersect is the maximum RTOW for these conditions, which was 85.7 t (shown by the red box). The take-off reference speeds used by the crew corresponded to this row.

The next step in the procedure was to move down the wind column to the row with the weight that was nearest to, but greater than the actual take-off weight (TOW) of 64.5t. The instruction to move down the 'wind column' appears at the top of the second page of the instructions. In this case, that weight was 68 t. According to this method, 68 t corresponded to the performance speeds of V_1 = 120 kt, V_R = 128 kt, V_2 = 133 kt (shown by the green box).

After the event, the pilot monitoring (PM) stated that, in hindsight, he did not complete the process and move down the wind column until the actual TOW was less than the RTOW, as required by the procedure.

[18] *AIB Take-off* is the application installed on the operator's EFB used to calculate take-off performance figures for a given aircraft and environmental conditions.

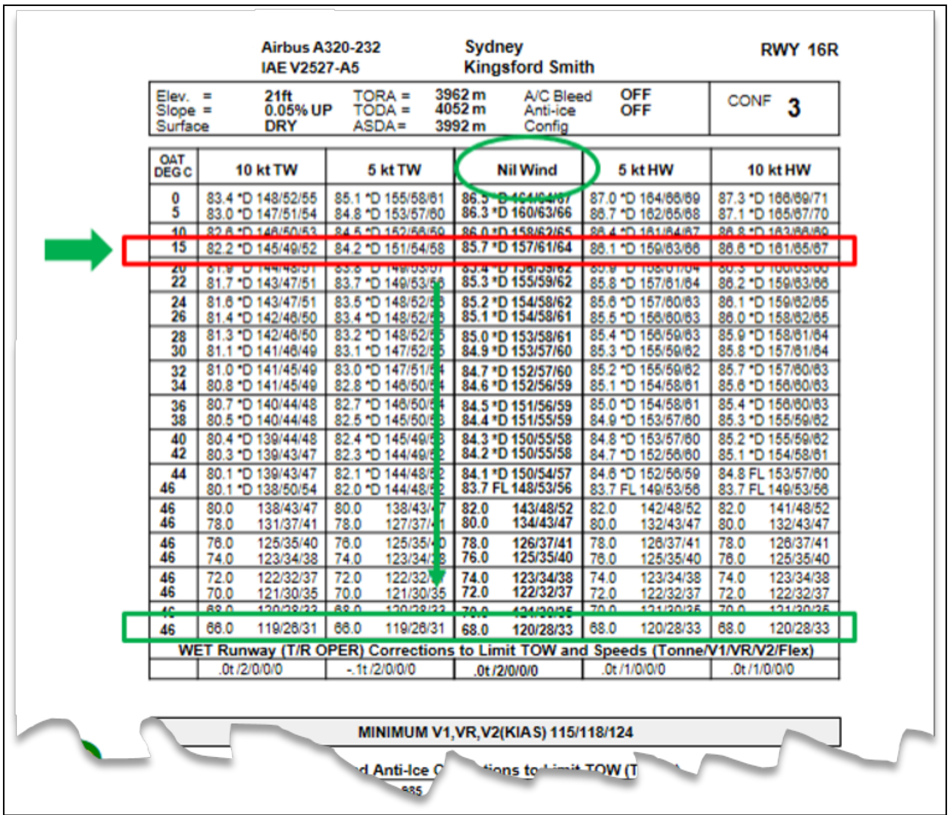
Training to use the tables was included as part of the operator's initial ground school and line training. Both flight crewmembers had received this training. However, as the EFBs had been very reliable, it was rarely necessary to use the tables. Additionally, there was no recurrent training or practice with the tables.

Prior to the introduction of Flysmart in 2014, the procedures and charts were the normal method of calculation for the take-off performance speeds. The pilot flying (PF) commenced with Jetstar in 2006, so had prior, although not recent, experience with the charts. The PM stated that before commencing with Jetstar 18 months ago, he had used similar charts for calculating performance speeds for a different aircraft type. Those charts, however, did not require the user to use the aircraft weight to go down the wind column.

The operator's procedures explaining how to use the tables also stated that normally the PM will calculate and record the performance data. The PF will only enter the performance data into the multifunction control display unit (MCDU) once they have checked and confirmed the calculated data is correct. If the PF identifies an error in the PM's calculations, they may recalculate the recorded data. In any case, both the PF and the PM must agree on any data before entry into the MCDU, which they did in this instance. However, as described above, there was different recollection among the two crewmembers about whether the PF independently checked the speed calculations.

Both the PF and the PM explained that their resulting take-off reference speeds were 'on the faster side' but that this was consistent with what they were expecting, because using the charts required using TOGA thrust.

Figure 2: Regulated take-off weight table



Airbus A320-232 IAE V2527-A5 | Sydney Kingsford Smith | RWY 16R

Elev. =	21ft	TORA =	3962 m	A/C Bleed	OFF	CONF 3
Slope =	0.05% UP	TODA =	4052 m	Anti-ice	OFF	
Surface	DRY	ASDA=	3992 m	Config		

OAT DEG C	10 kt TW	5 kt TW	Nil Wind	5 kt HW	10 kt HW
0	83.4 *D 148/52/55	85.1 *D 155/58/61	86.5 [illegible]	87.0 *D 164/66/69	87.3 *D 166/69/71
5	83.0 *D 147/51/54	84.8 *D 153/57/60	86.3 *D 160/63/66	86.7 *D 162/65/68	87.1 *D 165/67/70
10	82.6 *D 146/50/53	84.5 *D 152/56/59	86.0 *D 158/62/65	86.4 *D 161/64/67	86.8 *D 163/66/69
15	82.2 *D 145/49/52	84.2 *D 151/54/58	85.7 *D 157/61/64	86.1 *D 159/63/66	86.6 *D 161/65/67
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	81.7 *D 143/47/51	83.7 *D 149/53/[illegible]	85.3 *D 155/59/62	85.8 *D 157/61/64	86.2 *D 159/63/66
24	81.6 *D 143/47/51	83.5 *D 148/52/[illegible]	85.2 *D 154/58/62	85.6 *D 157/60/63	86.1 *D 159/62/65
26	81.4 *D 142/46/50	83.4 *D 148/52/[illegible]	85.1 *D 154/58/61	85.5 *D 156/60/63	86.0 *D 158/62/65
28	81.3 *D 142/46/50	83.2 *D 148/52/[illegible]	85.0 *D 153/58/61	85.4 *D 156/59/63	85.9 *D 158/61/64
30	81.1 *D 141/46/49	83.1 *D 147/52/[illegible]	84.9 *D 153/57/60	85.3 *D 155/59/62	85.8 *D 157/61/64
32	81.0 *D 141/45/49	83.0 *D 147/51/[illegible]	84.7 *D 152/57/60	85.2 *D 155/59/62	85.7 *D 157/60/63
34	80.8 *D 141/45/49	82.8 *D 146/50/[illegible]	84.6 *D 152/56/59	85.1 *D 154/58/61	85.6 *D 156/60/63
36	80.7 *D 140/44/48	82.7 *D 146/50/[illegible]	84.5 *D 151/56/59	85.0 *D 154/58/61	85.4 *D 156/60/63
38	80.5 *D 140/44/48	82.5 *D 145/50/[illegible]	84.4 *D 151/55/59	84.9 *D 153/57/60	85.3 *D 155/59/62
40	80.4 *D 139/44/48	82.4 *D 145/49/[illegible]	84.3 *D 150/55/58	84.8 *D 153/57/60	85.2 *D 155/59/62
42	80.3 *D 139/43/47	82.3 *D 144/49/[illegible]	84.2 *D 150/55/58	84.7 *D 152/56/60	85.1 *D 154/58/61
44	80.1 *D 139/43/47	82.1 *D 144/48/[illegible]	84.1 *D 150/54/57	84.6 *D 152/56/59	84.8 FL 153/57/60
46	80.1 *D 138/50/54	82.0 *D 144/48/[illegible]	83.7 FL 148/53/56	83.7 FL 149/53/56	83.7 FL 149/53/56
46	80.0 138/43/47	80.0 138/43/[illegible]	82.0 143/48/52	82.0 142/48/52	82.0 141/48/52
46	78.0 131/37/41	78.0 127/37/[illegible]	80.0 134/43/47	80.0 132/43/47	80.0 132/43/47
46	76.0 125/35/40	76.0 125/35/[illegible]	78.0 126/37/41	78.0 126/37/41	78.0 126/37/41
46	74.0 123/34/38	74.0 123/34/[illegible]	76.0 125/35/40	76.0 125/35/40	76.0 125/35/40
46	72.0 122/32/37	72.0 122/32/[illegible]	74.0 123/34/38	74.0 123/34/38	74.0 123/34/38
46	70.0 121/30/35	70.0 121/30/35	72.0 122/32/37	72.0 122/32/37	72.0 122/32/37
46	68.0 120/28/33	68.0 120/28/33	70.0 [illegible]	70.0 121/30/35	70.0 121/30/35
46	66.0 119/26/31	66.0 119/26/31	68.0 120/28/33	68.0 120/28/33	68.0 120/28/33
WET Runway (T/R OPER) Corrections to Limit TOW and Speeds (Tonne/V1/VR/V2/Flex)					
	.0t /2/0/0/0	-.1t /2/0/0/0	.0t /2/0/0/0	.0t /1/0/0/0	.0t /1/0/0/0

MINIMUM V1,VR,V2(KIAS) 115/118/124

*The header of the table shows the aircraft type and variant, the airport location and runway to which the table applies. The sub-header gives more details about the airport and the configuration required. The main body of the table contains data provided for various temperature and wind combinations. The data corresponding to the ambient temperature (to the left) and the wind component (above) are RTOW in tonnes/ Performance Limit Code/Take-off speeds (V_1, V_R and V_2). (Note: 100 must be added to V_R and V_2.). The performance limit code of *D is an obstacle limit weight. The lower sections of the table show corrections required for such things as wet runway, QNH corrections. They were not required in this case.*

Source: Jetstar Airways – annotated by ATSB

Speed Reference System

The take-off procedure prescribed in the Jetstar *A320/A321 Flight Crew Operating Manual* (FCOM) stated:

> At V_R, initiate the rotation to achieve a continuous rotation with a rate of about 3°/s, towards a pitch attitude of 15°.

The FCOM further stated 'After lift-off, follow the [speed reference system] SRS[19] pitch command bar.' The speed reference system (SRS) shows a pitch line on the primary flight display (PFD). After rotation, the PF is required to bring the aircraft symbol on the PFD up to this line by rotating the aircraft at about 3°/s. While the pitch line is above the aircraft symbol, the PF is required to continue with a smooth rotation rate until the aircraft symbol intercepts the pitch line. From then on, the PF should aim to adjust the pitch only as necessary to keep the aircraft symbol on the pitch bar.

This guidance provided by the SRS helps the PF to maintain speed and pitch within defined parameters. With normal engine configuration, the SRS commands a target speed of V_2 + 10 kt and contains speed protection limiting the target speed to V_2 + 15 kt. In this case, the calculated V_2 was 164 kt, giving a target speed of 174 kt. This speed was achieved less than 2 seconds after rotation. Using the correct weight for the manual calculations would have given a V_2 of 133 kt, hence a target speed of 143 kt.

In addition to providing the correct pitch to maintain the target speed, the SRS pitch command bar also provides attitude protection to reduce the aircraft nose-up effect during take-off (limited to 18°) and flight path angle protection that ensures a minimum vertical speed of 120 ft/minute.

Airbus conducted a simulation using the data obtained from the Quick Assess Recorder (QAR), but modifying the pitch input to target a 3°/s pitch rate. From this they were able to conclude in this case the airspeed would have remained below 180 kt and that a 3°/s pitch rate would have prevented the flap overspeed. Airbus further advised that the SRS would likely have been indicating a pitch guidance lower than the maximum 18º. This was evidenced by the speed decrease of 3 kt/s when the pitch attitude reached 17º in response to the PF's pitch-up input.

Thrust management

The Jetstar *A320/A321 Performance Manual* required the crew to use TOGA thrust when performance speeds calculated from the RTOW tables were used for take-off. TOGA thrust is the take-off/go-around throttle position that provides maximum power. For most take-offs, maximum power is not necessary and the aircraft can take off using less thrust than the engines are capable of producing, which reduces engine wear. This is implemented by assuming that the temperature for performance speed calculations is higher than actual outside air temperature. The 'assumed temperature' gives the required thrust for the available runway length.

The PF reported that TOGA take-offs were only used about two to three times a year and the PM said that he had never experienced TOGA thrust setting with the flaps in configuration three. The limit speed for flaps extended has a specific value for each flap setting—the higher the configuration of the flaps, the lower the limit speed.

The take-off procedure prescribed in the Flight Crew Operating Manual (FCOM) dictated that the thrust levers were to remain in the take-off configuration until the thrust reduction altitude was reached. A minimum thrust reduction altitude ensures that the aircraft has reached a safe height above the ground before reducing thrust.

The PM called 'speed, speed' to alert the PF to the impending flap overspeed event.

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[19] SRS: speed reference system. The SRS pitch command bar provides the correct pitch to maintain the target speed during take-off.

Safety analysis

Electronic flight bag

The flight crew did not have the same database versions on their electronic flight bags (EFB). The standard operating procedures required the version to be checked at sign-on each day. Had this been completed the databases on the flight crew's EFBs would have been the same and the current database. Although the operator reported that the discrepancy should not have made a difference to the performance results obtained for this flight, had both databases been up to date, it is more likely the crew would have considered the source of the discrepancy between the two EFBs was related to something else, such as a data entry, and resolved the discrepancy.

Manual calculations of performance speeds

Instead of using the one serviceable EFB, the crew reverted to the manual take-off charts to calculate the performance speeds, a procedure rarely practiced by the crew. When using the manual performance tables to derive take-off speeds, it was unlikely the flight crew completed the full procedure for the manual calculation. The instruction to move down the 'wind column' appears at the top of the second page of instructions. It was likely that this step, and subsequent steps, were overlooked, resulting in performance speeds for the maximum regulated take-off weight (RTOW) being used.

The ATSB could not establish whether both of the flight crew independently made the same calculation error or if the results were not independently validated by the pilot flying (PF). Either way, the error by the pilot monitoring (PM) was not detected by the PF.

Rotation and flap overspeed

The actual rotation speed of 169 kt was only 16 kt below the maximum flap extended speed (185 kt), 41 kt closer than the correct rotation speed would have been. The PF rotated the aircraft at a rate significantly below the recommended rate of 3°/s. This resulted in the aircraft attitude reaching 10.5° pitch-up, instead of 15°, 5 seconds after rotation when the maximum flap extended speed was exceeded. The pitch attitude reached 15°; 11 seconds after rotation.

It is likely that the SRS was indicating guidance to the PF to increase the pitch, which, had the PF followed, would have reduced the aircraft acceleration. According to the simulation conducted by Airbus, if a 3°/s pitch rate had been achieved, the flap overspeed would not have occurred.

The PM did not bring to the attention of the PF the incorrect pitch attitude at take-off. Had the PM called 'pitch' it may have prompted the PF to increase the pitch. Jetstar stated this call was not specifically published, like many calls a PM would need to make to identify an incorrect control input.

Thrust management

When the PM called 'speed, speed', the PF reduced the engine power in response, as opposed to increasing the aircraft pitch. The thrust reduction occurred below the thrust reduction altitude and therefore had the potential to affect safety of the flight.

Landing gear retraction overspeed event

The retraction of the landing gear was not performed when positive climb was achieved. While troubleshooting a buffeting sound, the PF found that the landing gear was still extended and called 'gear up'. The PM immediately retracted the landing gear without checking the aircraft's actual airspeed relative to the maximum landing gear retraction speed. This resulted in an overspeed event when the landing gear was retracted beyond the maximum landing retraction speed. The correct procedure was to reduce the aircraft’s speed below the maximum landing gear speed before retracting the landing gear. There is no aircraft warning associated with this event.

Findings

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

- The flight crew did not follow standard operating procedures to verify and update Flysmart database during sign on for the day.
- When using manual calculations to obtain performance speeds, the flight crew made an error which was not detected by independent validation. This resulted in a calculated rotation speed based on an aircraft weight significantly heavier than the actual take-off weight.
- The rotation rate commanded by the pilot flying was too low to prevent a flap overspeed, given the incorrect performance speeds and use of maximum take-off thrust.
- In an attempt to manage the airspeed, the pilot flying reduced the thrust from the take-off setting, rather than increasing the pitch, but the aircraft was below the safe altitude above the ground to do so.
- The landing gear was not retracted at the normal phase of the take-off. When the flight crew identified that the landing gear was still extended, they retracted it immediately, even though the aircraft was above the maximum landing gear retraction speed.

Safety action

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

Jetstar issued an internal safety summary to all flight crew outlining the occurrence and the learning outcomes from the incident. These included reminders to:

- have the correct databases at the start of their duty and perform a verbal cross-check of the databases to ensure compliance
- consider performance figures for reasonability and accuracy
- carefully and methodically follow any available reference instructions, particularly when an 'out of the ordinary' circumstance arises
- consult the Company Procedures manual in the event of electronic flight bag issues
- conduct a normal rotation followed by reference to the speed reference system, in particular if it is noted that the aircraft is carrying a lot of energy.

General details

Occurrence details

Date and time:	29 September 2018– 2237 EST	
Occurrence category:	Incident	
Primary occurrence type:	Aircraft incorrect configuration	
Location:	near Sydney Airport, New South Wales	
	Latitude: 33º 56.77' S	Longitude: 151º 10.63' E

Aircraft details

Manufacturer and model:	Airbus A320-232	
Registration:	VH-VFX	
Operator:	Jetstar Airways	
Serial number:	5871	
Type of operation:	Air transport - high capacity - passenger	
Departure:	Sydney Airport, New South Wales	
Destination:	Melbourne, Victoria	
Persons on board:	Crew – 6	Passengers – 174
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	None	

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (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 flight crew and Jetstar Airways.

Submissions were received from flight crew and Jetstar Airways. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

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; 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.

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.