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Australian Transport Safety Bureau

Incorrect configuration involving Boeing 717, VH-YQV

Canberra Airport, Australian Capital Territory, 20 June 2016

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Addendum

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Incorrect configuration involving Boeing 717, VH-YQV

What happened

On 20 June 2016, a captain and first officer, employed by Cobham Aviation Services, conducted a QantasLink flight from Sydney Airport, New South Wales, to Canberra Airport, Australian Capital Territory, in a Boeing 717-200 aircraft, registered VH-YQV.

The aircraft arrived in Canberra at about 0720 Eastern Standard Time (EST), and the first officer then conducted an external inspection of the aircraft, while the captain prepared the cockpit including the take-off data for the next sector to Sydney. The captain wrote the reduced-thrust take-off data onto the take-off and landing data (TOLD) card, including a flex temperature[1] of 40 °C, which was obtained from a table in the regulated take-off (RTO) book, an engine pressure ratio (EPR)[2] of 1.39, aircraft take-off weight, flap setting 5, and the take-off reference speeds (V speeds).[3] As the runway was wet, the V speeds were obtained manually from a table in the RTO book.[4]

After completing the external inspection, the first officer returned to the cockpit and the flight crew checked the take-off data in accordance with standard procedures. The first officer assessed that based on the environmental conditions, the flex temperature should be 39°. The first officer amended the TOLD card by striking through the 40 and writing 39 next to it, and similarly amended the V speeds based on the manual V speeds provided in the table for that flex temperature.

The captain was the pilot flying[5] for the sector to Sydney, so commenced briefing for the flight. The captain read out the data from the TOLD card, including the flex temperature and EPR, and the first officer entered the flex temperature and V speeds into the take-off page of the flight management system (FMS), which then calculated an EPR.

The flight crew then completed the cockpit checklist down to the last four items, in accordance with standard procedures. At that time, a member of the cabin crew entered the cockpit to advise the flight crew that an additional 22 passengers would be boarding the flight. As the aircraft take-off weight would increase by about 2 tonnes, the first officer recalculated the take-off data. The newly derived flex temperature was 34°, and as there was not much room left on the TOLD card, the first officer overwrote the previous figure of 39 with 34. The first officer then obtained the new V speeds, which the captain crosschecked and the first officer wrote them on the TOLD card.

The aircraft communications, addressing and reporting system (ACARS) then chimed with the loadsheet coming through on the printer, and at about the same time, a cabin crewmember entered the cockpit to confirm passenger numbers and ground personnel communicated over the intercom with the flight crew about removing the wheel chocks. After entering the zero fuel weight

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1 Flex temperature is a calculated outside temperature used for a reduced thrust take-off. The flex temperature (which is hotter than actual outside temperature) is used for generating take-off parameters rather than the actual outside temperature. It takes into account the runway length and aircraft weight to ensure the aircraft can take off within the runway distance available and maintain the required obstacle clearance during the subsequent climb. The aim is to prolong engine life.

2 The engine pressure ratio, or EPR, is a pressure ratio indicative of engine thrust. The pressure is sensed by two probes, one ahead and one aft of the jet engine fan.

3 Take-off reference speeds or V speeds assist pilots in determining when a rejected take-off can be initiated, and when the aircraft can rotate, lift-off and climb.

4 For a dry runway, the V speeds used would have been automatically generated by the flight management system.

5 Pilot flying (PF) and pilot monitoring (PM) are 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 aircraft flight path.

from the loadsheet into the FMS and crosschecking the take-off weight in the FMS against the take-off weight derived on the TOLD card, the captain called for the first officer to enter the revised manually derived V speeds from the TOLD card into the FMS.

The standard procedure then was for the captain to call 're-flex' before entering the amended flex temperature and flap setting from the TOLD card into the FMS. The captain was holding the TOLD card and reported stating '39' as the flex temperature, having misread the '34'. The first officer could not recall checking the flex temperature in the FMS at that time, and thought it may have been omitted due to the interruptions.

The crew reported that the EPR calculated by the FMS based on the flex temperature and environmental conditions was 1.39. (The flight data showed that the commanded EPR at that stage was actually 1.38.) The EPR obtained from the RTO book (for flex temperature of 34°) and written on the TOLD card was 1.41. The flight crew crosschecked the FMS EPR with the TOLD card EPR, and although there was a discrepancy of 0.2, it was within the 0.3 margin allowed at that stage.[6]

After obtaining the required air traffic control clearances, the captain taxied the aircraft to the runway and commenced the take-off at about 0812. In accordance with standard procedures, the captain then moved the thrust levers forward and checked for an even spool-up of the engines to an EPR of 1.2. The captain then called 'auto flight' and the first officer engaged the auto-flight system. This action caused the thrust levers to move to a position where the EPR from the FMS was achieved. The captain then called 'check thrust' and the first officer saw that the EPR was 1.38, instead of the required EPR of 1.41 as written on the TOLD card. In accordance with standard procedures, the first officer then moved the thrust levers forward to achieve 1.41 EPR.

The flight crew thought that the aircraft was then correctly configured for the take-off, with the correct EPR, thrust and flap settings and V speeds, and the captain continued the flight. However, after about 4 seconds at 1.41, the EPR returned to 1.38 for the take-off as the thrust lever position returned to that set by the auto-flight system based on the EPR value in the FMS.

During the initial climb, the first officer identified that the flex temperature set in the FMS was 39 instead of 34. As the short sector to Sydney was busy, the crew waited until the aircraft had arrived in Sydney before discussing the incident. Both members of the flight crew assessed that tiredness due to the early start may have contributed to the flex temperature error, but that they were fit to continue to operate for the remainder of the day's duty.

Flight data

The aircraft operator provided the ATSB with a copy of the quick access recorder (QAR) data for the incident flight. As depicted in Figure 1, the data showed the thrust lever angle set at about 25° and the EPR at 1.38 early in the take-off run. After about 4 seconds at that setting, the thrust lever angle increased to about 26° as the commanded EPR, followed closely by the actual EPR, increased to 1.41. However, after about 4 seconds at 1.41 and a further 6 seconds at 1.39, the EPR reduced to 1.38 and thrust lever angle to about 25°, where they remained for the take-off.

This indicates that although the first officer manually moved the thrust levers forward, as the auto-throttle system was engaged, it then overrode the manual thrust lever position and returned the EPR to the value set in the FMS, which was the target thrust setting. At the time, the computed airspeed was 54 kt. When the airspeed reaches 80 kt in the take-off roll, the auto-throttle system mode changes from 'take-off thrust' to 'take-off clamp' mode. In clamp mode, the auto-throttle servo does not have power and the thrust levers do not move automatically. However, in take-off thrust mode (prior to 80 kt), the flight crew would have to disengage the auto-throttle system to set the thrust manually, or maintain pressure on the levers until the airspeed reached 80 kt.

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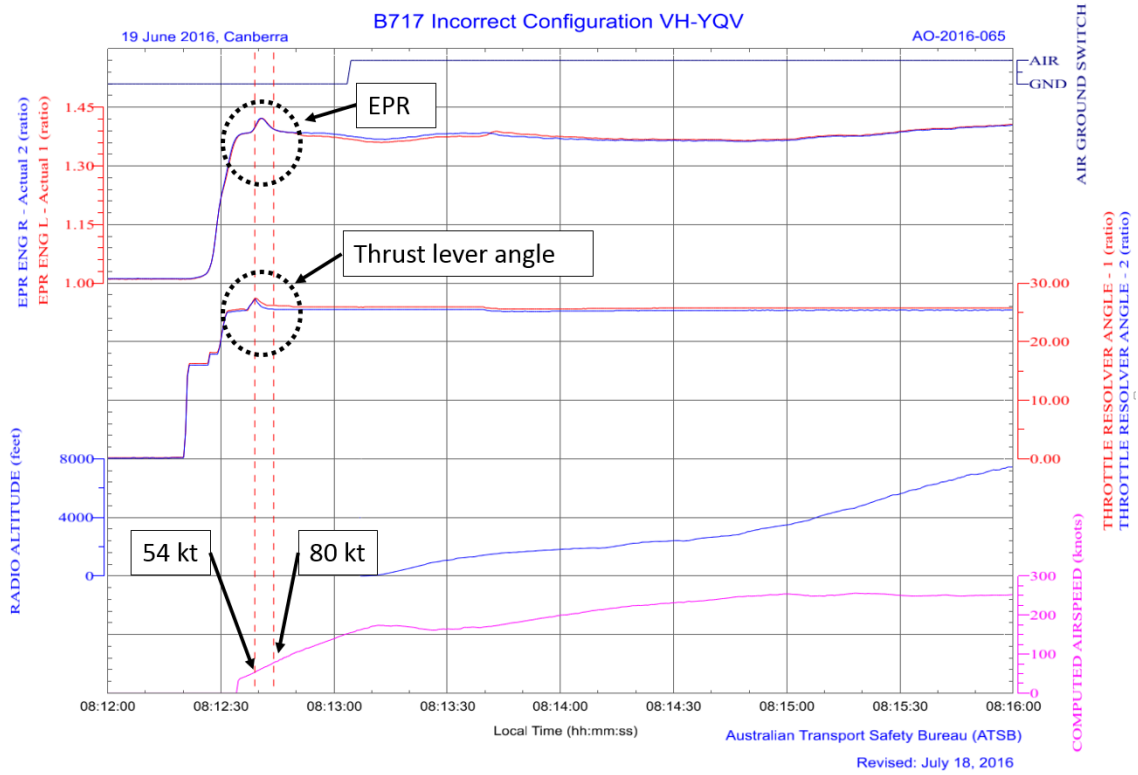
[6] A change in bleed configuration, such as selecting air conditioning packs on or off, can change the EPR value. Therefore there is a small discrepancy allowed while parked and during taxi, but the two figures must match at take-off

Figure 1: Graph of flight data from the incident flight



Source: QAR data supplied by the aircraft operator analysed by the ATSB

Flight crew comments

During the approach into Canberra from Sydney, the cloud base was at the minima.[7] The captain commented that the workload on an instrument approach down to the minima was high, and would generally result in a reduced state of arousal after landing and shutdown in response.

The flight crew commented that a combination of distraction by cabin crew and ground personnel while re-entering data, a reduced state of arousal following high workload instrument approach, and possibly tiredness from an early start may have contributed to their omitting to enter the correct flex temperature into the FMS.

Although the captain recalled misreading 39 instead of 34, the first officer could not recall the captain calling ‘re-flex’, and commented that it was unlikely to have been called and then not completed. The first officer thought it was more likely that they entered the new V speeds but had omitted to check that the flex temperature written on the TOLD card matched that in the FMS.

Normally by the time they are getting to the third set of amended numbers, the first officer would start a new TOLD card. However, as it was approaching the scheduled departure time, the first officer elected to overwrite the existing figures. The captain further commented that in future, if there were any more than two corrections made to the supplement data on the TOLD card, they would write out a new card.

The captain commented that this incident provided a good example of how adherence to standard operating procedures helps to mitigate errors. While the initial crosscheck prior to taxiing showed a discrepancy between the TOLD card and FMS EPR values, as it was within the permitted tolerance, the flex temperature error was not identified at that time. When the first officer checked the thrust (and EPR) during the take-off run, the too-low EPR setting was identified and the thrust

[7] For a precision approach, the minima is defined as a decision altitude at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

levers set to obtain the correct EPR. Hence following the standard operating procedures provided sufficient risk control to identify and correct the error.

Tiredness

The flight crew signed on at 0505 for a four-sector flight duty from Sydney. The scheduled departure time for their first flight from Sydney was 0620 and the flight crew were required to sign on 1 hour and 15 minutes prior. In addition, the crew had to allow 30 minutes to transfer from the long-term carpark, pass through airport security, and sign on in the crew room in the domestic terminal at Sydney Airport.

The captain reported waking up at 0340 and the first officer at 0305, and both crewmembers reported conducting a self-assessment of their fitness to fly. The first officer reported feeling 'somewhat tired' having had a broken night's sleep, but had the previous four days off work and did not feel fatigued. The captain also reported feeling tired having woken up early, they assessed they were not fatigued, and were fully fit to fly. Both the captain and first officer commented that the early start times generally caused a feeling of tiredness, but did not affect their ability to operate the aircraft.

Cobham operates flight and duty time limitations based on Civil Aviation Order 48 and an exemption, and had not, nor was required to have, implemented a fatigue risk management system. The flight crew reported that the company operations manual included a statement that it is the flight crew's responsibility to determine their fitness to fly.

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 safety action in response to this occurrence.

Aircraft operator

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

Communication to flight crew

The operator will remind pilots to use a new TOLD card in the event that the card data is being changed and comprehension of these changes is not clear. Pilots will be advised of the investigation by its inclusion in the company's staff safety magazine.

Safety message

Inaccurate take-off reference data has potentially serious consequences. ATSB Aviation Research and Analysis Report AR-2009-052 (*Take-off performance calculation and entry errors: A global perspective*) documents a number of accidents and incidents where take-off performance data was inaccurate. The report analyses those accidents and incidents, and concludes:

> … it is imperative that the aviation industry continues to explore solutions to firstly minimise the opportunities for take-off performance parameter errors from occurring and secondly, maximise the chance that any errors that do occur are detected and/or do not lead to negative consequences.

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. One of the safety concerns relates to data input errors.

General details

Occurrence details

Date and time:	20 June 2016 – 0810 EST	
Occurrence category:	Incident	
Primary occurrence type:	Incorrect configuration	
Location:	Canberra Airport, Australian Capital Territory	
	Latitude: 35° 18.42' S	Longitude: 149° 11.70' E

Aircraft details

Manufacturer and model:	The Boeing Company 717	
Registration:	VH-YQV	
Operator:	Cobham Aviation Services	
Serial number:	55193	
Type of operation:	Air transport high capacity - Passenger	
Persons on board:	Crew – 5	Passengers – 91
Injuries:	Crew – 0	Passengers – 0
Aircraft 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 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.