Australian Government
Australian Transport Safety Bureau

Flight below minimum altitude involving Aero Commander 500-S, VH-LTP

near Adelaide Airport, South Australia, on 12 August 2021

ATSB Transport Safety Report
Aviation Occurrence Investigation (Short)
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Addendum

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Safety summary

What happened

On 12 August 2021, at about 0858 Central Standard Time, an Aero Commander 500-S aircraft, registered VH-LTP, departed Port Lincoln on a private flight to Adelaide, South Australia under instrument flight rules. On board were the pilot and one passenger.

During the descent in instrument meteorological conditions, when passing about 6,000 ft, the aircraft began to encounter turbulence. Following clearance to track direct to the GPS waypoint GULLY, the pilot reported having difficulties entering the area navigation (RNAV) instrument approach data into the aircraft's touchscreen multi-function display due to turbulence. By the time the pilot had correctly entered it, the aircraft had just passed the waypoint. When the pilot then selected the 'Direct-To' option on the display, the autopilot commanded a sharp turn to the right, to commence an orbit to attempt to overfly the waypoint to recapture it.

On observing the aircraft's track, the controller instructed the pilot to maintain 3,800 ft and to turn onto a heading of 360°, intending to vector the aircraft back towards the waypoint. About 90 seconds later, the controller instructed the pilot to turn onto heading 120°, which the pilot read back. When the controller tried to contact the pilot about 1 minute later, the pilot did not respond and communications were lost.

The aircraft continued on the assigned heading but began descending below its assigned altitude, which was also the minimum sector altitude. For 4 minutes, ATC, with the assistance from the pilot of a nearby aircraft, continued to attempt to contact the pilot of VH-LTP. During this time, the approach controller also issued the pilot three terrain safety alerts.

The pilot contacted the Melbourne Centre controller, who instructed the pilot to transfer back to the Adelaide Approach frequency. Upon regaining communication, the approach controller issued the pilot a terrain safety alert and instructed the pilot to climb immediately to 5,000 ft. The lowest altitude the aircraft descended to was 2,480 ft and the highest point within 5 NM of the aircraft's track was 1,913 ft.

The aircraft then tracked to Adelaide Airport and landed without further incident.

What the ATSB found

The ATSB found that during the approach, the pilot was experiencing data entry difficulties due to turbulent conditions and inadvertently selected the incorrect radio frequency. Further, several factors including the environmental conditions, data entry difficulties and the timing of the clearance for the GULLY waypoint, likely led to the pilot experiencing a high workload. This in turn, likely affected the pilot's situational awareness where they did not initially notice the frequency change nor the continued descent and descent below the assigned (minimum sector) altitude.

Safety message

The approach and landing phases are known periods of high workload for pilots. Pilots must continuously monitor aircraft and approach parameters, and the external environment, to ensure they maintain a stable approach profile and make appropriate decisions for a safe landing. The Flight Safety Foundation found that between 1984 and 1994, 50 per cent of controlled flight into terrain accidents were due to inadequate monitoring by the pilot. Distractions and unanticipated events can further increase a pilot's workload leading to undetected errors and a loss of situational awareness. During high workload phases of flight, pilots should remain focused on monitoring the aircraft instruments and avoid fixating on a problem.

The investigation

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 investigation was conducted in order to produce a short investigation report, and allow for greater industry awareness of findings that affect safety and potential learning opportunities.

The occurrence

On 12 August 2021, at about 0858 Central Standard Time,[1] an Aero Commander 500-S aircraft, registered VH-LTP, departed Port Lincoln on a private flight to Adelaide, South Australia under instrument flight rules.[2] On board were the pilot and one passenger.

At about 0930, the pilot made first contact with Adelaide Approach air traffic control (ATC) and was cleared to track direct to Adelaide maintaining 7,000 ft. The controller also advised the pilot to expect vectors for the area navigation Z (RNAV-Z)[3] approach for runway 23. The aircraft was in instrument meteorological conditions (IMC).[4]

About 14 minutes later, the controller cleared the aircraft to descend to 5,000 ft and turn left on a heading of 050°. The pilot recalled the aircraft encountering turbulence during the descent, which started when passing about 6,000 ft. At 0947, the controller cleared the pilot to descend to 3,800 ft and to turn right on a heading of 090°. The controller advised the pilot to expect a clearance shortly to navigate to GPS waypoint GULLY, which was the initial approach fix for the RNAV approach. Less than 1 minute later, when the aircraft was 6 NM north-west of GULLY, the controller cleared the pilot for the RNAV approach and instructed the pilot to track direct to GULLY (Figure 1).

The pilot began tracking to GULLY and reported having difficulties entering the RNAV approach details into the aircraft's touchscreen multi-function display (MFD) due to the turbulence. By the time the pilot had correctly entered it, the aircraft had just passed the GULLY waypoint and when the pilot then selected the 'Direct-To' option on the display, the autopilot commanded a sharp turn to the right, to orbit back around to recapture the waypoint (Figure 1).

Observing the aircraft's track away from the waypoint, the controller, at 0951, advised the pilot they had missed the approach and instructed them to maintain 3,800 ft. They then instructed the pilot to turn right on a heading of 360° and to expect vectors back to GULLY. After turning to the assigned heading, the aircraft started a gentle climb. At 0953, the controller instructed the pilot to turn right onto heading 120° and to expect a clearance to navigate to GULLY shortly. The pilot correctly read back the clearance and later recalled having commenced a descent, realising the aircraft was then above the assigned altitude. This was the last radio call the pilot received from the Adelaide Approach controller before the pilot inadvertently switched the radio frequency back to Melbourne Centre.[5]

About 1 minute later, when the aircraft was 2.5 NM north of GULLY, the controller issued the expected clearance – to resume their own navigation, track direct to GULLY, descend to 3,800 ft

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1 Central Standard Time (CST): Coordinated Universal Time (UTC) + 9.5 hours.

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

3 Area navigation (RNAV) approach: An approach flown along a path of GPS waypoints.

4 Instrument meteorological conditions (IMC): weather conditions that require pilots to fly primarily by reference to instruments, and therefore under instrument flight rules (IFR), rather than by outside visual reference. Typically, this means flying in cloud or limited visibility.

5 Melbourne Centre: Responsible for enroute services throughout the Melbourne flight information region, which includes the southern half of Australia and the Southern and Indian oceans.

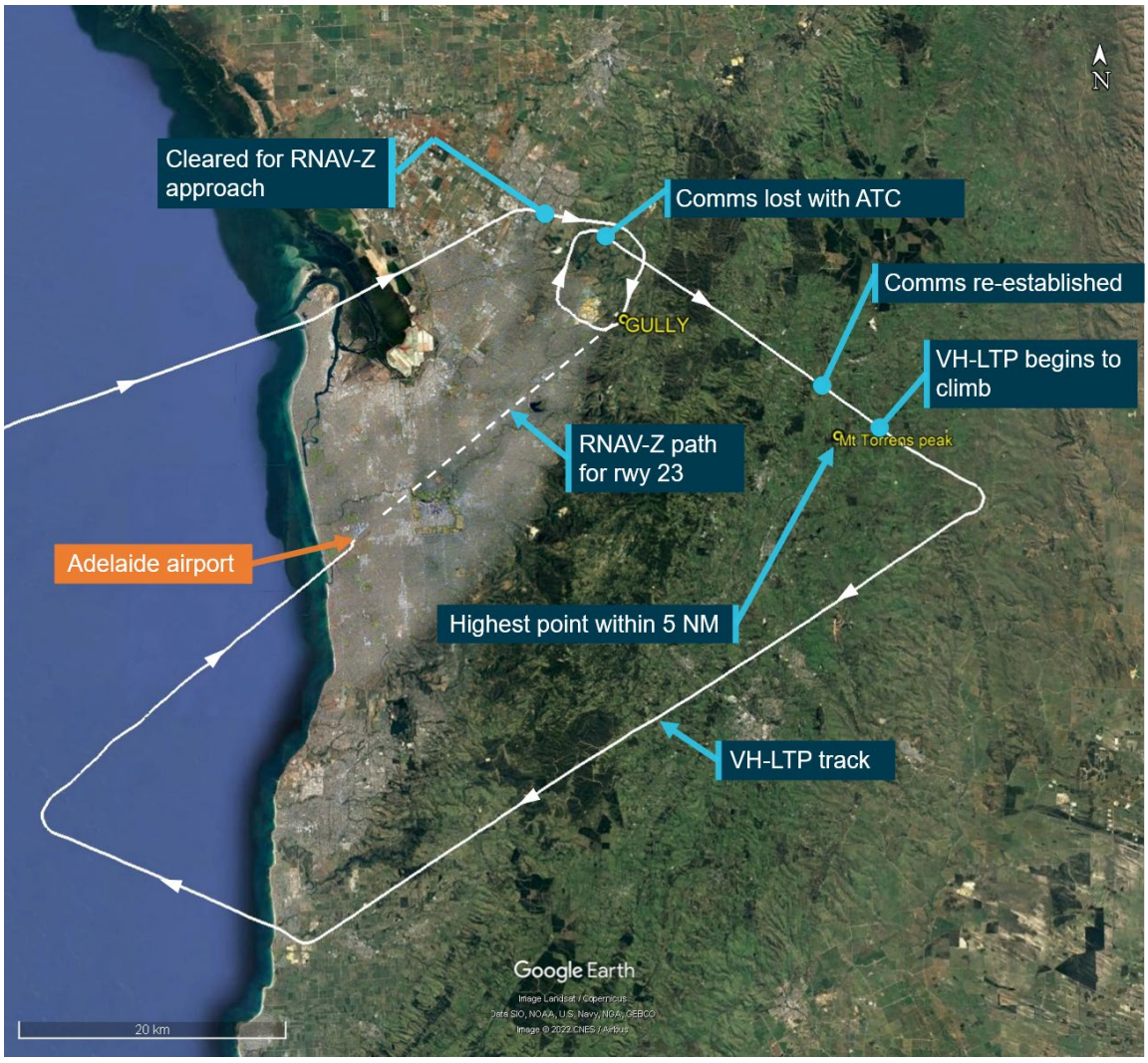
and conduct the RNAV approach for runway 23. The controller did not receive a response from the pilot.

The pilot continued on their last assigned heading of 120° and the aircraft began descending below its assigned altitude of 3,800 ft, which was also the minimum sector altitude. For 4 minutes, ATC, with the assistance from the pilot of a nearby aircraft, continued to attempt to contact the pilot of VH-LTP. During this time, the controller also issued the pilot three terrain safety alerts.

At 0957, the pilot of VH-LTP made a radio call to ATC, which was received by the Melbourne Centre, to ask the approach controller whether they should track back to GULLY. When the pilot received no reply, they made another call. The Melbourne Centre controller responded, told the pilot to standby and then instructed them to contact Adelaide Approach on frequency 118.2. The controller then contacted the Adelaide Approach controller to inform them that they had the pilot on the Melbourne Centre frequency, and the pilot was transferring back to the correct frequency. Upon regaining communication with the pilot, the approach controller immediately issued a terrain safety alert and instructed the pilot to climb immediately to 5,000 ft. The aircraft's altitude at that time was 2,780 ft.

After observing no increase in the aircraft's altitude for almost 1 minute, the controller contacted the pilot and asked them to confirm climbing to 5,000 ft. The pilot confirmed and the aircraft began to climb. The lowest altitude the aircraft descended to was 2,480 ft, the highest point within 5 NM of the aircraft's track was 1,913 ft (Figure 2).

Figure 1: **VH-LTP flight path (dotted line shows RNAV instrument approach path)**



Source: Google Earth overlaid with Airservices data, annotated by the ATSB

Figure 2: VH-LTP's altitude relative to the terrain (in feet)

Source: Geoscience terrain data overlaid with Airservices data, annotated by the ATSB

The controller vectored the aircraft back to Adelaide Airport for a RNAV-Z approach for runway 05. The aircraft landed at Adelaide Airport at 1028.

Context

Pilot information

The pilot previously held a Commercial Pilot Licence (Aeroplane), but at the time of the incident was exercising the privileges of a Private Pilot Licence, with an instrument rating and a valid Class 2 Aviation Medical Certificate. The pilot had a total flying experience of about 16,800 hours, they had accrued about 9,800 hours on the Aero Commander 500-S and about 4,700 hours total instrument time. The pilot completed their instrument proficiency check on 29 June 2021 and last flew an RNAV approach in instrument meteorological conditions (IMC) on 6 August 2021.

Weather observations

The pilot reported being aware of forecast IMC prior to departing Port Lincoln and planned their flight accordingly. They reported operating in cloud until the aircraft had descended to 1,000 ft on approach for runway 05, and turbulence from 6,000 to 3,000 ft, with the intensity increasing between 4,000 ft and 3,000 ft.

The pilot's observations were consistent with the forecast weather conditions.

Garmin GTN 650 touchscreen

The Garmin GTN 650 is a navigation aid that combines GPS, communication and navigation functions in an MFD, capable of showing high resolution terrain mapping, graphical flight planning, multiple weather options and traffic display. The touchscreen uses capacitive technology to sense the proximity of skin to the display, responding to light touches, without the need of pressure for detection.

Functions related to this incident include a 'Direct-To' key, which when pressed provided a direct course to a selected waypoint. The navigation and communication frequencies could be changed by touching the standby window and the keypad to enter the desired frequency. To flip between active and standby frequencies, the operator needed to touch the active navigation/communication frequency field (Figure 3). Upon touching the frequency field, a text box 'Hold for Flip-Flop' is displayed near the knob. If the active navigation/communication frequency field is touched and held it will switch between the navigation and communication frequencies.

Figure 3: Garmin GTN 650 display screen

Source: Garmin, annotated by the ATSB

The pilot reported that when operating in turbulent conditions, they usually put two fingers on the side of the display to stabilise their hand and use their thumb to enter the data. After missing the initial approach fix, and during the second attempt to enter the waypoint into the MFD, the pilot reported that their finger slipped and inadvertently selected the Melbourne Centre frequency, which was the previous frequency selected.

Workload

Speed and timeframe

During the descent, the aircraft's airspeed was about 170 kt. The pilot reported receiving a late descent to commence the RNAV-Z approach, which resulted in the aircraft being too high and fast to commence the approach. The pilot reported feeling rushed due to the combination of speed and the timing of the descent and approach clearances. The pilot reported their ideal approach speed would be 120-140 kt. However, data from previous flights inbound to Adelaide, that were probably flown by the pilot, show the aircraft conducting approaches at similar speeds.

Handling speeds for instrument approaches are specified in Airservices Australia's Aeronautical Information Publication, En Route 1.16.1 These included a range of 120–180 kt indicated airspeed for Category B aircraft during the initial and intermediate approach. VH-LTP was within this range when the pilot was cleared to conduct the RNAV approach.

Monitoring

When assigned heading 120°, the pilot realised the aircraft had climbed since the turning onto the 360° heading, and therefore commenced a descent to the assigned altitude. However, the pilot was unaware the aircraft had subsequently continued to descend while they were out of communication with Adelaide Approach.

The pilot recalled becoming aware that something was wrong when they had not received any further instructions from ATC and recognised the voice of the Melbourne Centre controller. This prompted the pilot to contact the controller, who transferred them back to Adelaide Approach.

Self-assessment

The pilot rated their workload during the incident as 7 out of 10. The pilot reported that typically during an approach, their workload is 'not too bad', however, in this incident, the turbulence,

difficulties entering in the waypoint, the late clearance for descent and then the aircraft turning away from the approach added to their workload. The pilot thought they were coping well with the situation, but advised that they were busy, with the situation moving quickly and little things were adding up.

Safety analysis

Data entry difficulties

The pilot's data entry difficulties were consistent with the research conducted on touchscreen interfaces. During turbulent conditions, aircraft touchscreen interfaces have been known to increase data input errors and create slow interaction times. This is due to the display moving or vibrating independently of the pilot's body, which is itself also vibrating. A study conducted by Dodd and others (2014) found that while operating in moderate turbulence, it took pilots over 2 minutes longer to complete a given task when compared to operating in no turbulence. Although necessary when operating in turbulent conditions, stabilising the hand on the edge of the screen can also increase the risk of accidental presses on the edge of the screen (Coutts and others. 2019).

Ineffective monitoring

The pilot was experiencing a high workload, likely due to operating in instrument meteorological conditions, turbulence, encountering data entry difficulties and feeling rushed. This high workload likely resulted in the pilot not initially noticing the frequency change nor the continued descent and descent below the assigned altitude, which was the minimum sector altitude.

Workload is defined as the sum of task demands placed on an individual's cognitive resources that are used for attention, perception, decision making and action (Skybrary, 2010). Humans are limited in the amount of new information their brain can process at once. Once this limit of cognitive resources has been reached their performance starts to decline with increased error rates and delayed responses, thus resulting in cognitive overload.

During high workload periods, monitoring flight instruments can degrade due to other tasks requiring attention, which can potentially lead to undetected errors (Flight Safety Foundation, 2014). A study on controlled flight into terrain (CFIT) conducted by the International Civil Aviation Organization, Flight Safety Foundation and the United States Federal Aviation Administration (Flight Safety Foundation, n.d.), found that two thirds of all CFIT accidents are a result of altitude error or lack of vertical situational awareness.

Though the pilot reported that they were coping well, pilots are often unaware that their monitoring performance has degraded, subsequently affecting their situational awareness.

Findings

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

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

From the evidence available, the following findings are made with respect to the descent below the minimum sector altitude involving an Aero Commander 500-S, registered VH-LTP that occurred near Adelaide Airport, South Australia, on 12 August 2021.

Contributing factors

- Due to turbulence, the pilot had difficulties entering data into the touchscreen multi-function display and the pilot inadvertently selected the incorrect radio frequency.
- The pilot was likely experiencing high workload in instrument meteorological conditions resulting in a loss of situational awareness and ineffective monitoring of the instruments. This led to the aircraft descending below the minimum sector altitude before the pilot regained communication with air traffic control.

Other findings

- The air traffic controller issued another terrain safety alert to the pilot after communications were restored, which likely prevented a controlled flight into terrain accident.

Sources and submissions

Sources of information

The sources of information during the investigation included:

- the pilot
- Airservices Australia
- Bureau of Meteorology
- Geoscience Australia.

References

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- Dodd, S., Lancaster, J., Miranda, A., Grothe, S., DeMers, B., & Rogers, B. (2014). Touch Screens on the Flight Deck: The Impact of Touch Target Size, Spacing, Touch Technology and Turbulence on Pilot Performance. *Proceedings of the Human Factors and Ergonomics Society 58th Annual Meeting, 58(*1), 6-10. https://doi.org/10.1177/1541931214581002
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Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- the pilot
- the aircraft operator
- Airservices Australia.

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

General details

Occurrence details

Date and time:	12 August 2021 0955 CST	
Occurrence class:	Incident	
Occurrence categories:	Flight below minimum altitude, Air-ground-air, Operational non-compliance	
Location:	32 km north-east of Adelaide Airport, South Australia	
	Latitude: 34º 46.519' S	Longitude: 138º 48.392' E

Aircraft details

Manufacturer and model:	Aero Commander 500-S	
Registration:	VH-LTP	
Serial number:	3323	
Type of operation:	General Aviation-Unknown-Pleasure / Travel - (Private)	
Activity:	General aviation / Recreational-Other general aviation flying-Pleasure and personal transport	
Departure:	Port Lincoln, South Australia	
Destination:	Adelaide, South Australia	
Persons on board:	Crew – 1	Passengers – 1
Injuries:	Crew – Nil	Passengers – Nil
Aircraft damage:	None	