Aviation Safety Investigation Report 199601750

Aero Commander Div
Shrike Commander
Boeing Co
B737

01 June 1996

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Aviation Safety Investigation Report

199601750

Occurrence Number:	199601750	**Occurrence Type:**	Incident
Location:	24km NW Hobart, Aerodrome		
State:	TAS	**Inv Category:**	3
Date:	Saturday 01 June 1996		
Time:	0930 hours	**Time Zone**	EST
Highest Injury Level:	None		

Aircraft Manufacturer:	Boeing Co		
Aircraft Model:	737-377		
Aircraft Registration:	VH-CZH	**Serial Number:**	23660
Type of Operation:	Air Transport Domestic High Capacity Passenger Scheduled		
Damage to Aircraft:			
Departure Point:	Melbourne VIC		
Departure Time:	0825 EST		
Destination:	Hobart TAS		

Aircraft Manufacturer:	Aero Commander Div		
Aircraft Model:	500-S		
Aircraft Registration:	VH-EXF	**Serial Number:**	1797
Type of Operation:	Air Transport Domestic High Capacity Passenger Scheduled Domestic High Capacity Passenger Scheduled		
Damage to Aircraft:			
Departure Point:	Cambridge Tas.		
Departure Time:	0920 EST		
Destination:	Devonport Tas.		

Approved for Release: Friday, July 25, 1997

FACTUAL INFORMATION

History of the flight

A Boeing 737 (B737) aircraft was tracking via the 320 degree radial of the Hobart VHF omnidirectional radio range (VOR) beacon, on a flight from Melbourne to Hobart. In accordance with standard procedures, Air Traffic Control had transferred the aircraft from Melbourne Sector control to Hobart Tower control.

The Hobart Aerodrome Controller (ADC) cleared the B737 crew to descend to 6,000 ft. This altitude assignment was a restriction due to opposite direction IFR traffic, an Aero Commander (AC500) aircraft which was to track outbound on the Hobart VOR 320 radial.

The AC500 departed Cambridge for Devonport and was on climb to an initial altitude of 4,000 ft for a planned cruise altitude of 8,000 ft. The pilot was advised that there were two B737 aircraft inbound to Hobart on the 320 radial (the second B737 was approximately 20 NM behind the first). He was subsequently instructed by the ADC to climb to 5,000 ft.

At 0916, the ADC carried out a distance measuring equipment (DME) check between the B737 and the AC500 which established that the AC500 was 6 DME and the B737 40 DME from Hobart. The ADC then provided traffic information to both pilots which included a request that each report sighting the other aircraft. While providing the traffic information to the B737 crew the ADC advised that they "should pass [him/in] round about 15 to 16 miles".

At 0918 the B737 crew reported at 24 DME and were advised by the ADC that the AC500 should be in their 1 o'clock to 2 o'clock position and low. Immediately following this transmission, the AC500 pilot reported at 10 DME and maintaining 5,000 ft.

Thirty seconds later, the ADC authorised the B737 crew to track towards a right base for runway 30. He did not specify the time at which they should commence the left turn.

At 0919 the ADC informed the B737 crew that he had the two aircraft in sight, and that as the B737 had turned and was diverging, instructed them to descend to 3,000 ft. He then immediately instructed the AC500 pilot to climb to 6,000ft. The pilots of both aircraft acknowledged their instructions.

The AC500 pilot then reported sighting the B737. This was acknowledged by the ADC but no new instruction was issued other than a request to report sighting the second B737.

The crew of the B737 had not sighted the AC500, but accepted the ADC's judgement that they were clear of that aircraft and commenced a descent from 6,000 ft. At 0919.54 they declared an emergency with a 'PAN' broadcast indicating that the AC500 had passed directly overhead and within 400 ft.

Information later provided by the pilots of both aircraft and a passenger seated on the left side of the AC500 indicated that the AC500 had passed approximately 400 ft above and marginally to the left of the B737 such that their wing tips probably overlapped.

At the time of the confliction, the aircraft were approximately 14 NM from Hobart on the VOR 320 radial, with the AC500 maintaining 6,000 ft. The B737 had just left 6,000 ft in a shallow descent of approximately 600 to 800 ft/min and had commenced the left turn.

Aerodrome controller

The ADC was controlling five aircraft and could not constantly monitor the B737 and the AC500. In accordance with the required standards he initially applied vertical separation of 1,000 ft by maintaining the AC500 at 5,000 ft and the B737 at 6,000 ft. Using binoculars he observed both aircraft and considered that the AC500 was tracking left of the radial. He therefore expected to see the B737 to the right of that aircraft and subsequently assessed that they were just to the right of each other and issued traffic information to that effect.

About 25 seconds after advising the B737 crew that they could turn left off the 320 radial, the ADC assessed that the aircraft had begun the turn and was therefore diverging and providing azimuth separation. He believed that he saw a change in the aircraft profile with only one landing light visible, caused by the nose of the aircraft shielding the other light as the aircraft commenced its anticipated turn. However, the aircraft did not begin the turn until almost a minute later.

Having assumed that the aircraft were diverging, the ADC elected to cancel the vertical separation and issued descent instructions to the crew of the B737. He then instructed the AC500 pilot to climb and was advised by the pilot that he had sighted the B737. The ADC later said that he then automatically transferred the responsibility for separation of the two aircraft to the AC500 pilot and did not continue to monitor their separation. In fact, the ADC did not assign separation responsibility to the AC500 pilot.

Shortly after the occurrence the ADC asserted that the automatic transfer of separation responsibility to the AC500 pilot was valid once the pilot had reported sighting the B737. This was not in accordance with the Australian Manual of Air Traffic Services (MATS) and the ADC subsequently accepted that his position had been incorrect.

MATS provides instructions on the controller's responsibilities when applying visual separation. These instructions include:

- when providing visual separation, controllers shall rely primarily on azimuth;

- corroborative evidence from the pilot of one aircraft on the relative position of another aircraft shall be obtained whenever possible before providing visual separation; and

- visual separation may be achieved when a pilot reports sighting another aircraft and is instructed to maintain separation from that aircraft.

During the period surrounding the occurrence, some phraseologies used by the ADC were not in accordance with the MATS. There were non-standard and/or inappropriate phrases transmitted which led to confusion and added to the air time taken by the ADC.

These included:

- The ADC's advice to the B737 crew, of the opposite direction traffic, was not clear in that he had intended to indicate that the aircraft would pass at about 15 to 16 DME from Hobart, but the crew understood it to mean in 15 to 16 NM from their present position (therefore at about 24 DME). The use, by the ADC, of the non-standard word "him", which the B737 crew heard as "in", in the statement referring to the distance at which the AC500 should pass, contributed to the confusion.

- The ADC, when issuing the instruction for the B737 to divert from the Hobart VOR 320 radial was not specific, in that he said only "CZH you can track towards right base", and did not include a time requirement.

- The ADC's later remark concerning the B737 making a turn and thereby diverging, was not recognised by the crew.

The controller stated that visual separation is a subjective judgement and, in this case, he was satisfied with the separation provided. He did not enter the details of the PAN radio transmission into the tower log because he did not consider that an incident had occurred. MATS states that such an entry must be recorded, even though subsequent transmissions indicated that the B737 had resumed normal operations within a few seconds of the PAN broadcast.

B737 Crew

As the B737 approached 6,000 ft, it was maintaining approximately 250 kts, and the crew had not yet sighted the AC500. The aircraft was being levelled at 6,000 ft when the ADC informed the crew that he had both aircraft in sight and issued instructions for a further descent to 3,000 ft. They believed that they could descend and turn at their discretion. Consequently, the crew elected to maintain 6,000 ft for a short time while continuing to look for the AC500 in their 1 to 2 o'clock low position as advised by the ADC.

The crew could not recall hearing the ADC's reference to their aircraft having turned left, nor the clearance for the AC500 to climb to 6,000 ft. They considered that transmissions by the ADC had been generally vague and had contained unnecessary chatter.

At approximately 15 DME, and within one minute of the instruction to descend, they decided to continue descent. Earlier in the flight they had expected that the point of passing would be at about 24 DME. However, this was reassessed when at 24 DME the AC500 reported at 10 DME. Confident that the ADC was maintaining separation and that the AC500 must by then have passed, they commenced the descent and the left turn towards the runway 30 base leg. The AC500 then passed close over their aircraft.

AC500 pilot

Although the flight was a single pilot operation, a second pilot (travelling as a passenger) was seated in the right front seat. During the period of the occurrence, the passenger assisted the pilot to monitor the proximity of the other aircraft and to assess possible responses to the situation.

The pilot advised that the aircraft was established on the 320 radial and climbed to 6,000 ft in accordance with the ADC's instructions. At about one minute prior to passing he sighted the B737 and was expecting the ADC to transfer the responsibility for separation to him. This did not occur and the pilot assumed that the ADC continued to provide separation. As the two aircraft came closer (about 20 seconds prior to passing), both he and the passenger observed that the B737 was at about their height. They considered that avoiding action was not necessary as the aircraft was descending and would pass beneath. They assessed that the B737 passed about 400 ft below and slightly to the left.

Although the AC500 pilot said that he was used to seeing other aircraft pass within about 500 ft, he had not seen a jet at that distance before. He commented on the unexpectedly high closing speed of the aircraft.

The aircraft were closing at approximately 7 NM/min.

"See-and-avoid"

Previous BASI reports have described in detail the limitations of the "see-and-avoid" principle in circumstances such as those applying to this occurrence. The time required to detect the traffic, decide upon and execute evasive action, combined with the delay of the aircraft in taking up the commands, can require approximately 8-12 seconds. However, "see-and-avoid" without accurate traffic position alerting is likely to be ineffective.

ANALYSIS

Separation

The controller initially applied vertical separation procedures, but reverted to visual procedures when he assumed that the B737 had begun to turn from the 320 radial. Having earlier assessed that the aircraft were to the right of each other, he was satisfied that the left turn he believed had been commenced would provide azimuth separation. However, the required separation did not exist, as the aircraft were being flown on track and the B737 had not commenced the turn until immediately prior to the time of passing.

The pilots were given misleading advice regarding the relative positions of the aircraft. However, having sighted the B737 about one minute before passing, the AC500 pilot did not advise either the ADC or the other crew of the positions of the aircraft. Consequently the potential benefit of alerted "see-and-avoid" was reduced, with the B737 crew continuing to search for traffic in the 1 to 2 o'clock low position, when the AC500 was directly ahead and at about the same level.

The ADC's judgement that visual separation had been achieved was based on a very short monitoring period. Human visual acuity is degraded when anticipated tracking time and target exposure time are both short. He was providing visual monitoring at distances greater than 15 NM. Without the aid of binoculars, details such as aircraft profile and the number of lights would not be adequately distinguishable. However, using binoculars to see such detail severely restricts the field of view, to the extent that the opportunity of using distinct visual reference cues, such as the attitude of the B737 in relation to the ground or to the AC500, would have been reduced.

Expectation is a powerful influence when information detail is incomplete. In this case, it is possible that the ADC allowed his expectancy to fill in the gaps when, due to other work related tasks, he was unable to constantly monitor the progress of both aircraft.

Radio phraseology

It is likely that the use of standard, precise phraseology by the ADC would have resulted in less confusion and a greater awareness of the situation by all involved. The ADC had, on previous occasions, been made formally aware of the need for the disciplined use of standard phraseology.

B737 crew

The B737 crew commenced their descent from 6,000 ft within the required time frame. However, the timing of their descent was slightly delayed, reflecting their uncertainty resulting from the ADC's poor application of phraseology and separation procedures. The crew's mis-understanding of the ADC's earlier estimated point of passing together with their inability to visually acquire the traffic, and the vague instruction to turn left, were all potentially distracting. The words "..you can...", used in the instruction, were the subject of some discussion by the crew and were considered by them to mean "when ready". At a time of heightened cockpit workload, these sources of ambiguity may have degraded the crew's ability to assimilate other information transmitted by either the ADC or other aircrew.

It is likely that this environment contributed to the apparent lack of recognition by the crew concerning the ADC's comment that the aircraft had turned, and was now diverging. Had the crew recognised the error and corrected the ADC, he may have applied more appropriate separation procedures. However, the crew accepted the ADC's assertion that he was able to visually separate both aircraft.

The instruction to the AC500 pilot to climb to 6,000 ft probably did not appear to be significant to the B737 crew at that time as they assumed that the aircraft had already passed.

The AC500 pilot

Although the pilot was aware that the ADC's traffic advice was incorrect, he did not recognise the value of an accurate position alert to the B737 crew to help ensure their safe passing. It is likely that this was because he believed that the ADC was providing the separation. However, he did not consider questioning that the separation was adequate.

SIGNIFICANT FACTORS

1. The ADC's perception of the relative positions of the two aircraft was incorrect.

2. The ADC used poor and confusing phraseology.

3. The ADC's uncertainty of the rules relating to visual separation by pilots resulted in no positive separation being applied at the time of the occurrence.

4. The pilots of both aircraft missed opportunities to resolve confusion and errors in the ADC's management of the separation of the aircraft.

SAFETY ACTION

As a result of the investigation of this and other occurrences, the Bureau of Air Safety Investigation reviewed aspects of visual separation guidance in MATS.

Airservices Australia have advised that references in MATS to visual separation are to be consolidated into a new section titled 'Visual Separation'. A controller's guide to the application of visual separation procedures is also to be produced.