

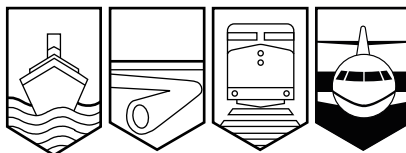
Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT

A00P0009



OPERATING IRREGULARITY

CENTRAL MOUNTAIN AIRWAYS

BEECH 1900D C-FCMP

VANCOUVER, BRITISH COLUMBIA 20 NM NE

13 JANUARY 2000

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Aviation Investigation Report

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Report Number A00P0009

Summary

Central Mountain Airways flight 785, a Beech 1900D, departed Vancouver International Airport at 1723 Pacific standard time on a POCO ONE standard instrument departure. The aircraft was following Canadian Regional flight 1114, a slower-climbing de Havilland DHC-8. Both aircraft were en route to Kamloops, British Columbia. The departure controller on initial contact cleared the Beech 1900D to 7000 feet and to turn to a heading of 010 degrees passing through 3000 feet, for vectors around the slower traffic. The aircraft was later cleared to maintain 16 000 feet and, while climbing through 6100 feet, entered airspace in which the minimum vectoring altitude was 7000 feet. It reached 7000 feet approximately 2.5 nautical miles inside the boundary and was subsequently cleared to maintain 8000 feet and later 11 000 feet. While climbing through 8400 feet, it entered airspace in which the minimum vectoring altitude was 9000 feet. The Beech 1900D reached 9000 feet approximately 20 seconds or about 1.5 nautical miles after penetrating the 9000-foot minimum vectoring altitude area.

Ce rapport est également disponible en français.

Other Factual Information

The first Vancouver departure controller had four years experience as a controller in the Vancouver Terminal specialty of Vancouver area control centre (ACC). He was working the fifth day of his shift cycle and had worked two 11-hour shifts, one 9.5-hour shift, and one 8.5-hour shift in the previous four days. He had been on duty for 5.5 hours on the day of the occurrence and for approximately 1 hour since his last relief break. He had been working the south departure position until about 10 minutes before the occurrence when the north and south departure positions were combined and he took over responsibility for both. Workload was described as moderate with some complexity. The second Vancouver departure controller had seven years experience as a controller and five years experience in the Vancouver Terminal specialty. He was working the third day of his shift cycle and had been on duty for approximately four hours.

The Beech 1900D aircraft accelerates quickly after take-off and climbs at a faster rate than several other equivalent passenger turboprop aircraft. The ACC controllers are aware of the performance advantage exhibited by the Beech 1900D. The POCO ONE Standard Instrument Departure (SID), devised to accommodate propeller driven aircraft departures on runway 08, imposes an initial climb speed of 165 knots to 3000 feet in order to equalize initial departure performance among aircraft.

When runways 08 right and 08 left are active in Vancouver, much of the traffic inbound from the east follows the Booth arrival procedure. This procedure normally directs aircraft to a downwind leg approximately seven miles north of Vancouver and roughly parallel to and about three miles south of the line marking the 7000-foot minimum vectoring altitude (MVA). Inbound aircraft are not permitted to descend below 10 000 feet until directly north of the airport, at which point further descent is authorized. As a result, departures to the north must be vectored below inbound traffic but above the steadily climbing MVA contours. When a faster aircraft follows a slower one, the climb rate of the faster aircraft must be carefully controlled, until it is horizontally clear of the slower aircraft and north of the inbound arrival track. (See Appendix A.)

The POCO ONE SID requires pilots departing from runways 08 left or 08 right, to turn left at 500 feet to a heading of 050 degrees or as assigned by air traffic control. Early turns off runway heading (of slower turboprop aircraft) clear the departure path and permit higher speed jet traffic to take off. This action allows increased traffic handling and minimizes departure delays. Both aircraft pilots complied with POCO ONE SID requirements. The first departure controller was aware that as soon as the Beech 1900D was radar identified and turned on course, the 165-knot speed restriction would be terminated and it would quickly overtake the DHC-8. In order to avoid conflict with the DHC-8, he turned the Beech 1900D further left to a heading of 010 degrees, which was directly toward higher terrain. At the initiation of the turn at 3000 feet, the aircraft was approximately seven miles from the boundary of the 7000-foot MVA. When it was established on a heading of 010 degrees at 5000 feet climbing, approximately four nautical miles (nm) from the 7000-foot MVA boundary, and clear of the DHC-8's track, the first departure controller cleared the Beech 1900D to continue the climb to 16 000 feet. The departure controller was aware of the aircraft's high performance capabilities and anticipated that it would

easily reach the MVA altitude of 7000 feet before reaching the boundary. He then temporarily diverted his attention to the south departure area to resolve a separation requirement between two aircraft en route to Seattle.

When controllers are providing radar vectors to aircraft, in accordance with MANOPS, article 546.2, they are to provide terrain clearance by ensuring that aircraft operate at an altitude which is at or above the minimum instrument flight rules (IFR) altitude specified for the area in which the aircraft is being vectored. The MVA was the minimum IFR altitude for the area in which the Beech 1900D was flying.

The pilot of the Beech 1900D reported that he accelerated quickly and that he had visual contact with both the DHC-8 and the terrain at all times. When the first departure controller issued climb clearance to 16 000 feet, the aircraft had been maintaining a climb rate of approximately 1600 feet per minute for the previous minute. From that point until the Beech 1900D entered the 7000-foot MVA sector at 6100 feet, that aircraft maintained a climb rate of approximately 1000 feet per minute.

When the first departure controller detected the Beech 1900D entering the 7000-foot MVA sector at 6100 feet, he issued a 080 heading to turn the aircraft away from the higher terrain and parallel to—but still within—the sector boundary. He then requested that the aircraft increase the rate of climb. MANOPS requires controllers to “issue a safety alert to an aircraft if you are aware the aircraft is at an altitude which, in your judgment, places it in unsafe proximity to the terrain, an obstruction or another aircraft.” One optional example of phraseology to be used is: “The minimum IFR altitude in your area is [altitude]. Altimeter setting is [setting].” The pilot of the Beech 1900D was not made aware that he was below the required MVA during the incursion of the 7000-foot MVA sector at 6100 feet or during the later incursion of the 9000-foot sector at 8400 feet. The TSB has previously made findings and issued a Safety Advisory Letter (see TSB Report A96P0293) on the lack of use of safety alert phraseology by controllers.

The turn to 080 degrees and the previously issued climb clearance to 16 000 feet put the Beech 1900D in a potential conflict with the DHC-8 which was cleared to 9000 feet and about four miles further east. To rectify this potential conflict, the first departure controller altered the altitude clearance for the Beech 1900D to 8000 feet with a request for a good rate through 7000 feet for terrain. He then cleared the DHC-8 to climb to 16 000 feet.

In the event of an operating irregularity, NAV CANADA requires that air traffic services (ATS) personnel be relieved of operational duties as soon as alternative arrangements can be made. When the first departure controller noticed that the Beech 1900D had penetrated the 7000-foot MVA below the required altitude, he advised the terminal data controller of the occurrence and advised that he would have to be relieved. He continued providing control instructions until the data controller (second departure controller) was prepared to relieve him.

The second departure controller took over the position quickly in order to relieve the first departure controller as soon as possible. He reported that the transfer of position responsibility briefing was hurried and there was, in his experience, no standard list of briefing items in general use for the departure position as required by the NAV CANADA ATS Administration and Management Manual (ATSAMM). On takeover, he was under the impression that the

Beech 1900D had been cleared and was climbing to 9000 feet. He did not believe that the flight progress strip had that information because he did not remember the flight progress strip being filled in with the altitudes at the time of his take over. After having been cleared to maintain 8000 feet by the first departure controller, the Beech 1900D continued in the climb to 8400 feet before returning to 8000 feet. The second departure controller speculated that he may have seen the Mode C altitude readout indicating 8400 feet and assumed that aircraft was still climbing. He advised the pilot to keep climbing, to turn back to a northerly heading, and further climb would be authorized in a couple of miles. The pilot of the Beech 1900D misheard that transmission, and when the information was repeated the message only included the heading change and the advisory of a further climb in a couple of miles.

After the Beech 1900D regained the cleared level at 8000 feet, and when it was approximately two miles from the 9000-foot MVA boundary, the second departure controller issued a further climb clearance to 11 000 feet. He then immediately transferred his attention to traffic that had just departed from Vancouver en route to the south. The incursion by the Beech 1900D into the 9000-foot MVA at 8400 feet was detected the next day during review of the radar tapes.

Flight data strips contain written information on the current status, intentions, and altitudes of aircraft passing through a sector. Strips are updated as changes occur. Directions for the marking and manipulation of flight data strips is contained in MANOPS. Throughout the climb of the Beech 1900D while under the control of the departure controllers, the pilot received clearances to 7000, 16 000, 8000, 11 000, and finally 16 000 feet. The flight data strip for the Beech 1900D shows cleared altitudes for the aircraft of 7000, 9000, 16 000, 8000 and 16 000 feet (7, 9, 16, 8, and 16 on the strip). MANOPS directs that altitudes be depicted in hundreds of feet, for example, 70 is the depiction for 7000 feet.

Minimum safe altitude warning (MSAW) is a system designed for en route and terminal radar control positions to alert controllers to potentially hazardous situations where aircraft breach minimum safe altitudes. Development of MSAW for Canadian controllers began in 1986. In its Corporate Safety Plan 1998/99, NAV CANADA stated that it is committed to "the national installation of minimum safe altitude warning systems / conflict alert (MSAW/CA) on existing surveillance systems." Not mentioned were either an implementation date or additional resources to be dedicated to the realization of this commitment. This system is not yet in operational use.

Analysis

The first departure controller's experience led him to believe that a Beech 1900D on departure from runway 08 right, given a vector of 010 degrees when through 3000 feet, would easily achieve the altitude levels necessary to meet the MVA to the north of Vancouver. In this occurrence, aircraft climb performance varied from what was expected by the controller. The need to attend to a separation problem to the south of Vancouver, an area designed to be controlled by another controller, diverted the first departure controller's attention for a short time. The distraction was long enough to allow the aircraft's climb rate and high forward speed to place it inside the boundary of the 7000-foot MVA before the first departure controller noticed it.

The perceived need to quickly relieve the first departure controller led to a hastily performed transfer of position responsibility briefing which may not have been sufficiently accurate to ensure that the relieving controller was fully aware of the dynamic control situation. The speedy replacement may have encouraged the controllers to ignore the use of the transfer of position responsibility checklist.

The lack of (or inaccurate) altitude information on the flight progress strip, together with the Mode C altitude readout showing the aircraft above 8000 feet and the lack of an adequate change of position responsibility briefing, may have contributed to the belief of the second departure controller that the Beech 1900D was established in a climb. The time at which the flight progress strip was annotated with altitude information, or the reason(s) some of that information was inaccurate, could not be determined.

When the second departure controller cleared the Beech 1900D to climb to 11 000 feet only two miles from the 9000-foot MVA boundary, he expected the aircraft to be able to meet the altitude requirements. Again, traffic to the south distracted the controller, and he was not aware that the Beech 1900D had penetrated the 9000-foot MVA below the required altitude.

The practice of vectoring departures off runway 08 directly toward the high terrain to the north of Vancouver in order to expedite traffic movements requires that controllers pay careful attention to the climb performance of those aircraft. The need to control the climb rate of those northbound departures to keep them above the steadily climbing MVA contours, yet below the arrivals on the downwind leg at 10 000 feet, places an additional onus on controllers to be particularly vigilant. The additional duties of the south departure controller position inevitably divert attention away from the climbing northbound traffic, impose additional distractions during this particularly critical phase of flight, and increase the risk of an ATS incident.

Findings as to Causes and Contributing Factors

1. Traffic within the south departure sector distracted both departure controllers from their duty of ensuring terrain clearance for an aircraft on radar vectors in the north departure sector.
2. A standard change of position responsibility briefing was not conducted adequately when the second departure controller quickly took over from the first.
3. Erroneous altitude information was entered on the flight progress strip.
4. The flight data strip was not marked and updated in accordance with directives.
5. The climb performance of the Beech 1900D differed from the departure controllers' expectations.

Findings as to Risk

1. The pilot of the Beech 1900D was not made aware that, while on radar vectors, the aircraft had twice been permitted to enter airspace below the minimum IFR altitude.
2. The controllers did not use the recommended MANOPS phraseology to warn the pilot that the aircraft was below the minimum IFR altitude.
3. The POCO ONE SID requires northbound propeller-driven aircraft to turn toward high terrain soon after take-off in order to expedite other departures.

Other Findings

1. The second incursion of the Beech 1900D into a 9000-foot MVA sector below the minimum IFR altitude was not detected until radar tapes were reviewed the day after the occurrence.

Safety Action

Immediately following this occurrence, Vancouver ACC and tower management issued direction to controllers cancelling the POCO ONE SID until a review of the SID and all associated procedures could be completed. Tower controllers will ensure that propeller aircraft departing runway 08 right northbound will be assigned runway heading and will not be turned immediately toward the higher terrain to the north of Vancouver.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 20 December 2000.

Appendix A - Flight Paths of Beech 1900D and DHC-8

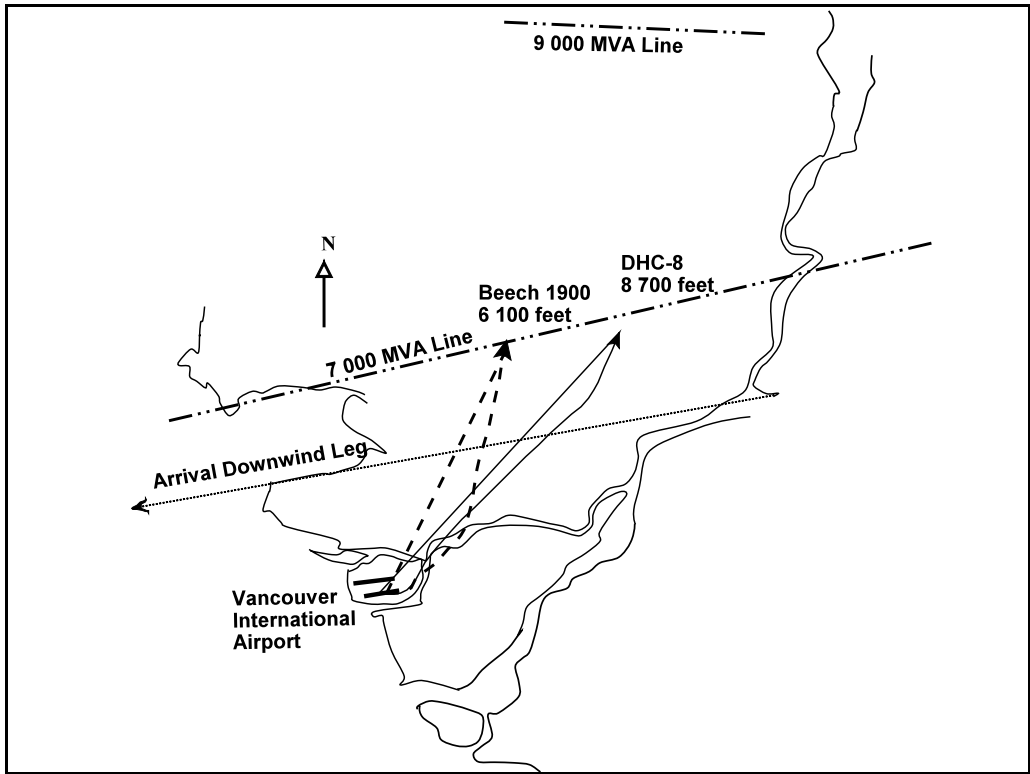


Figure 1. Beech 1900D penetrates 7000 feet MVA at 6100 feet (not to scale).

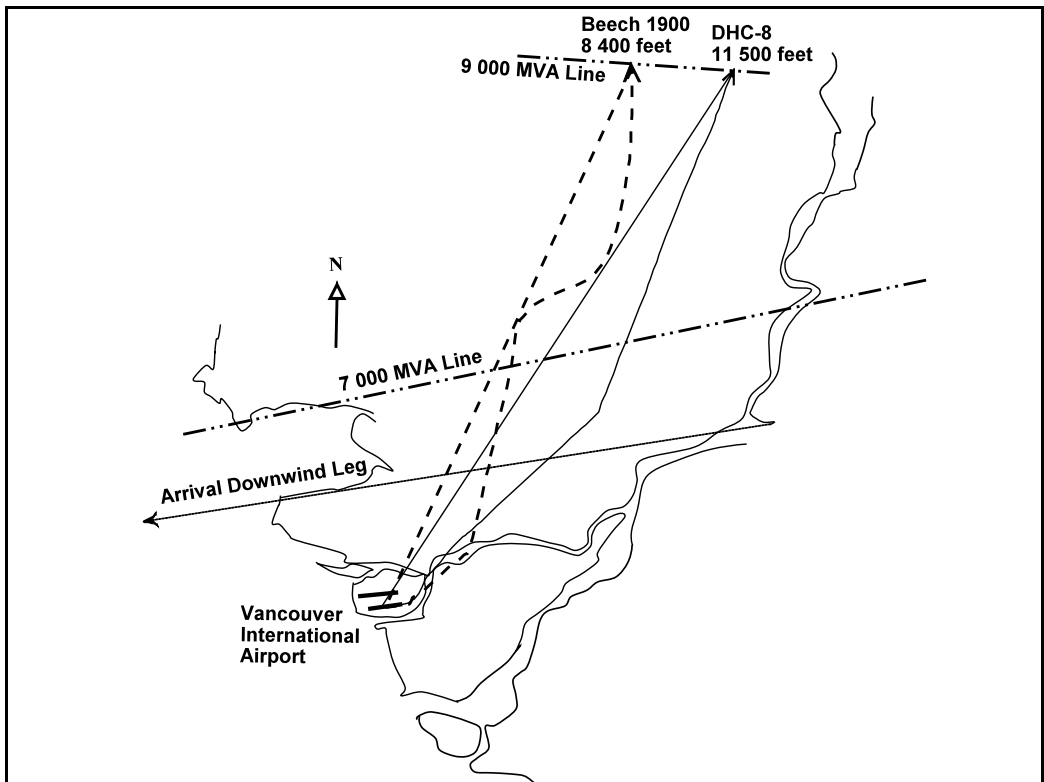


Figure 2. Beech 1900D penetrates 9000 feet MVA at 8400 feet (not to scale).