TRANSPORT ACCIDENT INVESTIGATION COMMISSION
TE KOMIHANA TIROTIRO AITUA WAKA

AIRCRAFT ACCIDENT REPORT

No. 91-023

De Havilland 112 Venom

ZK-VNM

Ardmore Aerodrome

17 November 1991

Transport Accident Investigation Commission
Wellington · New Zealand

Price $10.80 (including G.S.T.)

ISSN 0112-6482

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Aircraft Type, Serial Number and Registration:	de Havilland 112 Venom, 884 ZK-VNM
Number and Type of Engines:	1 de Havilland Ghost turbojet
Year of Manufacture:	1955
Date and Time:	17 November 1991, 1527 hours NZDT
Location:	Ardmore Aerodrome Latitude: 37°02'S Longitude: 174°58'E
Type of Flight:	Private
Persons on Board:	Crew: 1
Injuries:	Crew: 1 nil
Nature of Damage:	Substantial
Pilot in Command's Licence:	Airline Transport Pilot Licence (Aeroplane)
Pilot in Command's Age:	49
Pilot in Command's Total Flying Experience:	12713 15 on type
Information Sources:	Transport Accident Investigation Commission field investigation
Investigator in Charge:	Mr Alister Buckingham

All times in this report are NZDT (UTC + 13 hours)

1. NARRATIVE

1.1 ZK-VNM was operated by New Zealand Warbirds Incorporated and was to take part in a formation display in the Auckland area, in company with a P-51D Mustang. Both aircraft lined up on Ardmore's runway 25 for a stream take-off, with the Mustang to lead.

1.2 The meteorological conditions at the time were: wind 210° M at 10 knots, temperature 15° C. Although the wind direction favoured runway 21, runway 25 was allocated in order to achieve an "on-time" departure. Runway 21 was moderately busy with circuit traffic.

1.3 After the Mustang had begun its take-off roll, the pilot of ZK-VNM applied power and followed suit. The Venom pilot was concentrating on the Mustang during the roll, and when he estimated that he had reached the point where he would normally raise the nosewheel, he attempted to do so with no result.

1.4 After winding on some nose-up trim, he tried again to raise the nosewheel, this time successfully. However, he realised by this time that he had an accelerate-stop problem, in that he could neither continue the take-off successfully nor stop the aircraft within the confines of the runway. In the event, he elected to attempt to take off. The aircraft was lifted off at 102 knots, but realising that he had no climb performance and with the right wing beginning to drop, the pilot decided to land straight ahead.

1.5 Touching down just beyond the departure end of the runway, the aircraft broke through several fences and a line of trees, coming to rest against a poplar shelter belt about 150 m from the runway end. During this phase, the aircraft also crossed a road adjacent to the aerodrome, narrowly missing a passing car. The car was damaged by flying debris from the aerodrome boundary fence.

1.7 The pilot was uninjured, and after shutting down the engine, was able to vacate the aircraft immediately.

1.8 Although the Venom suffered numerous dents and tears to most areas, and the wings were bent rearwards slightly, no disintegration occurred. The damage was later assessed as being beyond economic repair.

1.9 Several witnesses expressed the opinion that the Venom sounded "quieter than usual" during take-off and that it appeared to be lacking in thrust. The pilot stated that he did not check the rpm on take-off, because of preoccupation with the lead aircraft. Normal RPM at full power during take-off is 10250.

1.10 The entire sequence was recorded by video camera, from a point roughly 80 m south of the departure end of the runway. Spectrum analaysis of the audio portion of the recording was attempted but owing to an equipment malfunction, the results were not conclusive. They did, however, indicate that the aircraft's engine was operating as much as 10% below its maximum rpm.

1.11 Examination of the engine after the mishap revealed no damage other than that caused by ingestion of debris after touchdown.

1.12 The aircraft's entire fuel system, from the tanks to the burner nozzles, was checked for any abnormality which would have prevented the engine from developing full thrust. The engine fuel pumps and burner nozzles were rig-tested by the Royal New Zealand Air Force, and all components performed to specifications. Fuel filters showed no sign of contamination, and laboratory analysis of the fuel itself found only uncontaminated product which met the specifications for Jet A-1.

1.13 Performance calculations from the graphs used by the Venom's former operator (the Swiss Air Force) showed that the aeroplane should have become airborne without flap, even in zero wind conditions, after a ground roll of about 500 metres (or well under half the available length of runway 25). The calculated take-off distance to 50 feet was about 800 m, still well within the effective operational length of 1290 m. Flap was not used on this take-off, as the aircraft was at a relatively light weight (5180 kg; maximum weight is 7080 kg).

1.14 Comments from former RNZAF pilots who had operated Venoms during their service careers indicated that, regardless of aircraft weight, the use of 30° of flap on take-off was standard procedure. Additionally, premature rotation or over-rotation were known to lengthen the take-off roll, as a result of induced drag. The take-off technique described in the Royal Air Force Pilots Notes for the Venom reads, in part (emphasis added):

> "NOTE — The shortest take-off run is obtained by using 30° flap and opening the throttle fully before releasing the brakes; this procedure is recommended if full tip tanks are carried. At aft C of G positions (e.g. wingtip tanks full), trim $^1/_2$ div [division — refers to the markings on the trim position scale] nose down. **Care must be taken not to raise the nose too high on the take-off run to avoid the possibility of a failure to accelerate."** and:
>
> ...."Ease the nosewheel off the ground at about 80 knots, taking care not to touch the tail on the ground. The aircraft should be flown off at about 110 knots at normal load and at about 120 knots at maximum load. **Because of the possibility of a wing drop, the aircraft should not be pulled off the ground below the recommended speeds."**

1.15 Applying full power before brake release had been avoided by pilots of ZK-VNM, because of concern that the jet exhaust would damage the bitumen runway surfaces of the aerodromes normally used.

1.16 The Swiss Air Force Pilots Manual revealed some significant differences from the RAF Pilots Notes. The take-off technique prescribed by the Swiss manual is to raise the nosewheel only when a minimum pre-computed IAS is reached. The nosewheel is only to be raised **slightly,** (their emphasis) and the aircraft allowed to fly itself off. The minimum IAS is obtained from the performance graphs in the manual, and is a function of aircraft weight and reserve speed for manoeuvring immediately after liftoff. The minimum speed for the lightest weight and no manoeuvring reserve is 103 knots IAS and was signified by a red and white radial line ("barber's pole") on the original airspeed indicator (ASI). (Note: in Swiss usage, the ASI and performance graphs were calibrated in km/hr, from which the conversion has been made to knots for this report.) The take-off range was from 103 KIAS to 130 KIAS, the latter being marked by a yellow radial line on the ASI. For ZK-VNM, at 5180 kg, a minimum IAS of 106 knots was extracted from the graph.

1.17 Comparison of the take-off data extracted from the RAF notes and the Swiss graph also showed marked differences. The RAF notes present the take-off data in a table which considers only two different weights, two wind strength values and five temperature values. For a sample weight of 5550 kg (chosen from the table so as to require no interpolation), the take-off run required in nil wind and 15°C air temperature is 823 m, and the total distance to 50 feet is 1481 m. The figures extracted from the Swiss graph, using the same parameters, were 580 m and 900 m respectively. The possibility that the latter two figures were cumulative (their sum is almost the same as the RAF's total distance to 50 feet) was checked with the Swiss Air Force, who replied that the distance to 50 feet was indeed the total distance, i.e. from the beginning of the take-off roll.

1.18 The differences may possibly result from the differing take-off techniques, where the Swiss method has the nosewheel being raised later (23-50 knots, depending on weight and manoeuvring reserve) than the other. The RAF notes were the primary reference for pilots operating ZK-VNM.

1.19 Although the pilot had flown some 600 hours on Vampires in RNZAF service, he had not flown the heavier, more powerful Venom. A significant difference between the two types is in the wing design, the Venom having a lower thickness-to-chord ratio and incorporating sweep-back. These features are the basis of the Pilot's Notes cautions quoted in paragraph 1.14.

1.20 Before his initial flight on the Venom, the pilot was briefed on its operation by its former owner, who had flown the type during his RNZAF service. The former owner said that he did not go into great detail, as he was well aware of the pilot's Vampire experience and his knowledge of the Venom systems which was acquired during the restoration of the aircraft to flying order. Although the RNZAF take-off technique for the Vampire was virtually identical to that described in the RAF Pilots Notes for the Venom, the Vampire was less susceptible to the effects of over-rotation because of its thicker wing section and unswept planform.

1.21 A frame-by-frame analysis of the accident videotape by an independent consultant showed the aircraft to be in an 8° to 9° nose-up attitude from 500 m into the take-off run, to the point where it actually became airborne, approximately 750 m further on. Shortly after liftoff, the aircraft was in a 14° nose-up attitude, just as the right wing began to drop. This is the point at which the pilot decided to land ahead.

1.22 The pilot stated that he had not checked the engine RPM after he had opened the throttle, nor had he noted the IAS at the point where he attempted to raise the nosewheel. Rather, he at first thought that the forward tip tanks may have been filled and the resulting forward centre of gravity was the cause of the aircraft's reluctance to respond. At this point, there probably would have been sufficient space available to close the throttle and bring the aircraft to a halt, but a definite stop-go decision point had not been established prior to the flight.

1.23 The pilot's perseverance with the take-off attempt may have resulted in the adoption of an excessive nose-up attitude which induced sufficient drag to further reduce the aircraft's already degraded acceleration. Additionally, his attempt to analyse the problem "on the run" deprived him of the opportunity to abort the take-off safely, having utilised the potential stopping distance in his

attempts to become airborne. This resulted in the aircraft's arrival at the departure end of the runway at a speed below safe flying speed.

1.24 The use of 30° flap for take-off may have permitted the aircraft to remain airborne; it was in a stalled condition (as evidenced by the wing drop) at 102 knots, but 30° flap would have reduced the stalling speed by some 15 knots. However, its effect on climb performance may have resulted in the aircraft not being able to clear the trees in the take-off path, with a possibly more serious outcome.

2. FINDINGS

2.1 The pilot was appropriately qualified for the flight.

2.2 The engine did not develop normal power during the take-off run.

2.3 The reason for the power deficiency was not established, despite extensive technical investigation.

2.4 Premature or excessive raising of the nosewheel may have further reduced the aircraft's acceleration to a point where a safe take-off became unlikely.

2.5 Significant performance differences in the British and Swiss Pilots Notes were found for a given set of conditions.

2.6 The performance differences between the British and Swiss Pilots Notes probably arise from the differing take-off techniques given in each manual.

2.7 The pilot's take-off expectation was probably a reversion to his previous experience on Vampire aircraft.

2.8 The absence of a positive stop-go decision point was a causal factor.

3. SAFETY RECOMMENDATIONS

As a result of the investigation of this accident, it was recommended to New Zealand Warbirds Incorporated that they:

Institute a requirement for the pilot to positively check engine power output as early as practicable in the take-off roll;

Devise a suitable stop-go decision-making system in the form of either establishing a minimum speed to be attained by a known distance into the take-off run, or by physically marking the anticipated lift-off point;

Consider adopting the Swiss Air Force take-off technique, and monitor the actual performance achieved against the performance graphs which form part of the Swiss Pilots Manual;

Consider adopting the technique of applying full power before brakes release, where runway surface scorching is not a consideration; and

Consider the use of 30° flap for all take-offs.

15 April 1993

M F DUNPHY
Chief Commissioner