No: 10/85 **Ref: EW/C930/01**

Aircraft type and registration:	North American Harvard Mk 2A G-BGOU (restored World War 2 single-engined training aircraft)
Year of Manufacture:	1942
Date and time (GMT):	7 September 1985 at approximately 1500 hrs
Location:	Bourn airfield, near Cambridge
Type of flight:	Private
Persons on board:	Crew — 1 Passengers — Nil
Injuries:	Crew — 1 (fatal) Passengers — None
Nature of damage:	Aircraft destroyed by impact and fire
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	38 years
Commander's Total Flying Experience:	5258 hours (of which 80 were on type)
Information Source:	AIB Field Investigation.

HISTORY OF THE FLIGHT

On the morning of the day of the accident the pilot flew his aircraft from Debden, where it was normally based, to Finningley, where he flew a short, individual, aerobatic practice before landing. In the afternoon he took off with 3 other Harvards to perform a display, during which he flew in the number 4 position for that part of the display when all 4 aircraft formed a single formation. He spent 25 minutes on the ground at Finningley before taking off in the number 2 position to another Harvard based at Bourn, intending to route via Bourn to Debden. The pilot of the lead aircraft stated that as they approached Bourn the following RTF conversation took place between the 2 aircraft on the Bourn Radio frequency:

No 2: "ARE WE GOING TO GIVE THEM A DISPLAY?"
Leader: "DO YOU WANT TO?"
No 2: "YES"

There was no reason for the Bourn Radio station to be manned at that time and there were no replies from Bourn Radio to the information calls subsequently made by the Leader.

The Leader described the display given at Bourn as orientated along the 01/19 runway and consisting of a series of manoeuvres in the looping plane followed by a wingover manoeuvre intended to bring the aircraft back along runway 19 with increased separation. After the wingover he dived towards the centre of the airfield and then executed a climbing roll before turning right at about 1000 feet agl for a right-hand circuit to land on runway 25. These manoeuvres were part of the standard Harvard display sequence, and had been rehearsed and displayed several times before. The loops were normally flown in line astern with approximately two aircraft lengths separation, increasing during the wingover to give safe separation for the individual climbing roll, which was an optional end to the display and was not always carried out. The Leader neither saw, nor would have expected to see, the No 2 aircraft

during the display at Bourn.

Only one observer on the ground saw the whole of the display. He stated that it was conducted mainly between 500 and 1500 feet agl except for the shallow dive before the climbing roll, when both aircraft descended to between 300 and 400 feet before pulling up. He estimated the separation between the aircraft to have been some 3 to 4 aircraft lengths during the loops.

Three experienced observers saw the climbing rolls and their observations agreed in most details. The lead aircraft was seen to descend to about 300 feet then climb at an angle of about 25° before executing a roll to the left about his axis of flight, the engine cutting momentarily as it passed through the inverted position. The second aircraft followed a similar descent path at a separation estimated by 2 witnesses to be between 300 and 400 feet, although the third witness thought the separation was only 5 to 6 aircraft lengths (145 to 174 feet). It then commenced a roll to the left at about the same height at which the lead aircraft had rolled. However, by the time it reached the inverted position, it had changed heading to the left by about 30° to 45°, the nose was level or slightly below the horizon, and the rate of roll had slowed markedly. The nose continued to drop rapidly as the aircraft continued to roll very slowly left and the aircraft was then seen to pull through, as if executing the second half of a loop. The aircraft pulled through the vertical position and, as it reached about 250 feet agl, still steeply nose down, its pitch attitude increased sharply and half a second later is flicked to the right through at least 180° before crashing in a steep dive and catching fire. Its engine was not heard to cut during the roll, and the engine note was audible at moderate to high power throughout the pull through manoeuvre.

The aircraft had refuelled to full tanks before leaving Finningley and still had approximately 80 gallons of fuel on board at the time of the accident. The estimated centre of gravity (C of G) of the aircraft was 29.73 inches aft of the datum, well within the limits of 27.5 to 32.5 inches aft of the datum.

The C of G of the aircraft at the time of the accident was established because it is known that the Harvard can be difficult to handle in aerobatic manoeuvres if the C of G is close to the aft limit.

PILOT INFORMATION

The aircraft was owned and flown by an experienced airline pilot, who was currently employed on scheduled operations. During the 5 days preceeding the accident he had flown 25 hours of airline service, including two long night flights. He had landed in the UK at 0700 hrs on the day before the accident. In the preceding 30 days, he had flown 75 hours in airline service and approximately 4 hours of Harvard flying, including two displays.

His log book records 80 hours of Harvard flying, mostly flown during the last 2 years and including periods of concentrated aerobatic and formation flying practice in June 1984 and April 1985. He was associated with other Harvard owners in a Harvard formation and aerobatic display team, which had performed regularly at air shows in recent years. There was no evidence that he suffered from any medical condition that could have contributed to the accident.

IMPACT PARAMETERS

The aircraft crashed into a flat stubble-field immediately adjacent to the southern boundary of Bourn airfield; its initial point of impact was some 250 metres south-east of the threshold of runway 01 and it was travelling in a direction of 030°M. The aircraft's attitude at impact was assessed as 80° bank to the right with the fuselage axis approximately 45° nose down, and its speed as between 150 and 200 kt. There was evidence to show that the engine was running and producing a significant level of power, and that both the undercarriage and flaps were fully retracted. The extent and severity of the post-impact fire suggested that a large quantity of fuel was on board at the time.

WRECKAGE EXAMINATION

The wreckage was removed to the AIB facility at Farnborough where a detailed examination took place. This revealed the aircraft to have been complete, and there was no evidence of pre-impact failures in its structure or flying control systems. All damage observed was consistent

with the impact and subsequent fire.

The aircraft's documents showed that it had been constructed in 1942 by North American Aviation Inc. since when it had seen service with the air forces of the United States, Britain, South Africa and Portugal, and had flown for a total of some 5500 hours. It possessed a Permit to Fly, issued by the CAA on 19 April 1985 and valid for 1 year, a condition of which was that a Fitness to Fly Certificate issued within the preceding 25 flying hours be in force at all times. At the time of the accident, the aircraft had flown for approximately 27 hours since the most recent Certificate was issued.