

No: 10/92

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Category: 1a

Aircraft Type and Registration: Spitfire FXIV, G-ALGT

No & Type of Engines: 1 Rolls-Royce Griffon RG 30 SM-S piston engine

Year of Manufacture: 1944

Date & Time (UTC): 27 June 1992 at 1508 hrs

Location: Woodford Airport near Manchester

Type of Flight: Private (Air Display)

Persons on Board: Crew - 1 Passengers - None

Injuries: Crew - Fatal Passengers - N/A

Nature of Damage: Aircraft destroyed

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: 47 years

Commander's Flying Experience: 10,509 hours (of which at least 70 were on type)
Last 90 days - 162 hours
Last 28 days - 47 hours

Information Source: AAIB Field Investigation

The display flight

On the day of the accident, the pilot flew the Spitfire to Woodford and refueled it to full tanks. He intended to fly back to East Midlands Airport on completion of his display. The weather at the time of the accident was fine with a surface wind of 230°/06 kt, no significant cloud and a surface temperature of +25°C. The display line was orientated along the runway 25/07. At 1454 hrs G-ALGT took-off and the pilot positioned overhead Macclesfield to await his display slot at 1503 hrs. Some three to four minutes into his display, the pilot slowed the aircraft for a low pass along runway 25 with the landing gear and flaps extended. Having completed an intentional go-around, the pilot then performed a number of low energy manoeuvres culminating in a shallow wing over in the region of the 07 threshold to position the aircraft for a low pass along Runway 07. This was flown at a height of about 50 feet and continued some 150 metres beyond the position previously used by the pilot as his display centre. At this point, at a speed of about 210 kt, the aircraft was seen to pull up into a looping manoeuvre. Throughout the manoeuvre the engine was heard to maintain a steady note and subsequent analysis of video recording soundtracks indicated that the propeller control had been set for

an engine speed of 2400 RPM. Visual evidence from the video recordings also indicated that the RPM had remained stable through the manoeuvre. The display was observed by several practising display pilots who considered that the aircraft was being flown in a spirited but not unreasonable manner. They considered that the entry speed was insufficient for a full loop and assumed that, as he passed the inverted position, the pilot intended to roll out of the manoeuvre into normal flight. This assumption was reinforced when the height achieved by the aircraft at the inverted position was seen to be too low for the loop to be completed. The pilot continued to pull through from the inverted position, however, in an attempt to complete the loop. Initially the rate of pitch was normal but, at about 150 feet agl, the pitch rate was seen to increase rapidly. The aircraft had achieved a level attitude before impact but struck the runway with a high rate of descent. At impact there was an intense fireball which lasted for some three seconds fuelled by the 90 gallons of AVGAS which the aircraft carried. The emergency services were quickly on the scene and were able to extinguish several small fires before they took hold. The pilot had received fatal injuries and a post mortem examination did not reveal any medical condition that could have caused or contributed to the accident.

Wreckage and Impact Information

The aircraft struck the runway close to its display line. Its flightpath was angled at 8° to the right of the runway direction and wreckage was thrown along the runway and on to the flat grassed area along its southern side. On impact the airframe broke into its major components; the airframe sections came to rest at between 800 and 900 feet from the initial impact point and the engine at about 1600 feet. The individual wings, the rear fuselage, the empennage and the fuel tank section of the forward fuselage, though heavily damaged, separated as intact structures but the cockpit suffered complete disintegration and the pilot was thrown out. His harness was later found detached from the structure but with the buckle correctly fastened. The front fuselage fuel tanks, the left wing and the rear fuselage showed marked distortion and damage from the vertical component of the impact, the fuselage having been virtually horizontal when it hit the ground. The fuselage fuel tanks had ruptured and released their contents but the duration of the post impact fire had been very short and little of the airframe had been consumed by fire.

At the point of impact there was a smeared imprint of the left wing and the fuselage underside. From the corresponding scrape marks on the underside of the wing it could be seen that the aircraft had been yawed 14° to the left at impact. This evidence is consistent with the video evidence which shows a left yaw and wing drop immediately before impact. On the left side of the ground marks made by the nose and engine there was a sequence of propeller blade impacts spaced about 29 inches apart. Given that the propeller had five blades and that sound and video analysis showed that the engine had been operating at 2400 RPM (gearbox reduction ratio was 0.51) this represented a horizontal speed of

146 kt for the aircraft at impact. Examination of video images also showed that the aircraft's flightpath was approximately 25° below the horizontal just before impact and its airspeed would therefore be 161 kt.

The wreckage was recovered to AAIB HQ at Farnborough and examined to confirm as far as possible the pre-impact integrity of the structure and the primary flying controls. No evidence was found that there had been any failure in the airframe or any failure or restriction in the controls which could have been a factor in the accident.

Display Authorisation

The aircraft was owned by a British engineering company and was flown for displays by company employed pilots. The display pilot involved in the accident, normally flew executive jet aircraft for the company and he regularly displayed the Spitfire on their behalf throughout the display season. He held a current Display Authorisation issued by the CAA which allowed him to carry out fly pasts at heights down to 50 feet agl and Standard Level aerobatics down to 200 feet agl. These limits are referred to in the Civil Aviation Publication, CAP 403, "Flying Displays: A Guide to Safety and Administrative Arrangements" and, whilst not specifically stated, it is generally accepted that "not below 200 feet agl for Standard Level aerobatics" means that the manoeuvre must be completed by 200 feet agl but by implication it may be commenced at a lower height.

The pilot's most recent flying log book could not be located but it was thought to contain a record of his flying since July 1989. Accordingly his flying experience is based upon estimates with reference to other records where possible. The pilot had been displaying the Spitfire since 1983 and had accumulated about 70 hours on type up to the time of the accident. Displays by G-ALGT were restricted to non-aerobatic manoeuvres until June 1990, when the wing spars were replaced. Thereafter looping manoeuvres were introduced into the display sequence. Since the re-sparing of the wings, the pilot had flown a total of 15 displays and practice displays. His last display before the accident had been on 4 May 1992.

Spitfire display flying technique

Several Spitfire display pilots were consulted regarding the parameters that should be used when looping the aircraft. Although different parameters were quoted for various marks of Spitfire, it was generally agreed that a minimum entry speed of 250 kt was required to guarantee safe completion of a loop from an entry height of 50 feet agl. Regarding engine settings, most pilots set 2600 RPM with appropriate boost but some of the pilots consulted would routinely set 2400 RPM, although these

pilots tended to use higher entry speeds for looping manoeuvres. One pilot who displayed a Merlin powered aircraft at the same airshow, stated that, although he normally used 2400 RPM with +4 inches boost, because of the high ambient temperature on that day, he had decided to use 2600 RPM with +6 inches boost. He subsequently found that he was achieving but not exceeding the performance that he normally obtained using 2400 RPM +4 inches boost. It was not possible to determine what power settings the accident pilot used routinely during his displays.