ACCIDENT

Aircraft Type and Registration:	Piper PA-28-140 Cherokee, G-AWPS
No & Type of Engines:	1 Lycoming O-320-E2A piston engine
Year of Manufacture:	1964
Date & Time (UTC):	2 January 2009 at 1154 hrs
Location:	Colwich Junction, near Little Haywood, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - 1 (Fatal) Passengers - 2 (Fatal)
Nature of Damage:	Aircraft destroyed, railway overhead gantry and power cables disrupted
Commander's Licence:	Private Pilot's Licence (lapsed)
Commander's Age:	59 years
Commander's Flying Experience:	Estimated 600 hours (of which 500 were on type) Last 90 days - not known Last 28 days - not known
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was seen carrying out a manoeuvre described by witnesses as similar to a wingover or stall turn. During the manoeuvre it entered a steep nose-down descent from which it did not recover and which resulted in a high-speed impact on a railway line. The accident was not survivable. The pilot's medical and licence validity had expired a number of years previously. The aircraft maintenance records were incomplete and did not show that the required maintenance had been correctly performed. There was, however, no evidence of any mechanical defect causing, or contributing to, the accident.

History of the flight

The flight was planned to take place as air experience for a couple who knew the pilot through his work. On the morning of the accident the pilot went to Sittles Airfield where he kept his aircraft and prepared it for a flight. It had been cold overnight and as the aircraft was parked outside it was covered in frost. The pilot moved the aircraft from the parking area to the edge of the landing strip to allow it to defrost in the sun. Later during the morning he telephoned his wife to say that the frost was melting and that he would be able to fly.

The pilot met his passengers at an arranged location and guided them to Sittles Airfield. There was no-one else at the airfield and no witnesses to the takeoff. There

were, however, some people at an airstrip ½ nm to the north of Sittles Airfield who reported seeing the aircraft shortly after takeoff. They said that it had taken off in an easterly direction, had flown directly overhead their airstrip and performed a couple of manoeuvres that were described as wingovers or stall turns, before flying away to the west.

The aircraft track was recorded on radar showing a generally north-westerly direction of travel as far as the area of Little Haywood, a distance of some 10 nm. The final part of the recording showed a turn to the right.

Various witnesses noticed the aircraft close to the time of the accident; some described it as climbing steeply or performing a wingover or stall turn before descending. A number of people described seeing the aircraft descending steeply or hearing a loud, or 'roaring', noise before the impact. The aircraft hit the ground in a steep nose-down attitude at high speed and there was a post-crash fire. The accident was not survivable.

Radar information

Recorded radar data was provided by the NATS, the UK national air traffic service provider. Data was recovered from the Claxby and Manchester radar recordings along with a screen-capture video of the controller's screen at Birmingham Airport. All three sources identified G-AWPS in various stages of its flight although only primary returns were recorded, meaning that no altitude information was available to the investigation. This, along with the generally poor resolution of the recorded radar positions, meant that a detailed flight path analysis could not be performed.

The Birmingham Airport recording indentified G-AWPS in the vicinity of Sittles Farm at approximately 1145 hrs, tracking north in the direction of Roddige. The aircraft then turned left and tracked in a north-westerly direction towards Little Haywood. This track was confirmed by both the Manchester and Claxby radar recordings, which commenced just after the turn towards Little Haywood.

The final moments of flight from the Manchester and Claxby recordings showed G-AWPS performing a right turn, just to the south of Little Haywood. Again, due to the poor resolution of the position recording from these radar heads, there was significant scatter either side of an apparent straight-line track, which meant a detailed analysis of the final stages of flight could not be performed. The final recorded radar position was at 1153:40, approximately 150 metres from the accident site.

Aircraft information

The PA28-140 was originally produced as a two-seat aircraft. However, an optional jump seat modification is available and when this is installed four people may be carried. The most recent weight and balance schedule for G-AWPS, dated 19 June 1991, showed that there were two seats fitted, but the evidence from the wreckage suggested that there were four seats.

The Piper PA28-140 may be operated in either the Normal Category or the Utility Category, the latter has more restrictive weight and balance limitations. The Normal Category Maximum Weight is 2,150 lb, whereas that for the Utility Category is 1,950 lb with a relatively forward CG position, which generally precludes carrying a rear seat passenger. When operated in accordance with the Utility Category limitations certain types of aerobatic manoeuvres are allowed, these are spins, steep turns, 'lazy eights' and chandelles. The never-exceed speed (V_{NE}) of the aircraft is 168 mph IAS (146 kt), marked on the airspeed indicator as 171 mph CAS (corrected for position error).

A weight and balance calculation based on the 19 June 1991 schedule was carried out for the investigation using estimated figures for the fuel and the best available weights for the pilot and passengers. The seat which each person occupied could not be determined. This showed that if the fuel tanks were half full, 20 imperial gallons (91 litre), then the aircraft was probably within the Normal Category limitations, but was not within the Utility Category limitations.

Pilot information and records

The pilot qualified for his Private Pilot's Licence (PPL) in 1988 and initially flew on a regular basis, averaging about 22 hours each year until April 1997 when he purchased G-AWPS. At that time there were 300 hours recorded in his personal logbook, most of which had been conducted from Halfpenny Green Airport. These recorded hours were endorsed by annual Certificates of Experience (C of E).

After the pilot had purchased G-AWPS it was based at Tatenhill Airfield until September 1999, and after that at Sittles Airfield. In October 1997, some six months and 30 hours of flying since he bought the aircraft, the entries in his personal logbook ended, totalling 330 hours.

In September 1999 the pilot started a second personal logbook in which he recorded 800 hours as the starting value. This logbook was kept until January 2001; 47 hours were recorded in it, 42 of which were in G-AWPS. There was a recorded flight with an instructor and a C of E, signed on 6 January 2001, this was the final entry. The pilot's licence had thus been validated until 5 January 2003. No further personal logbooks were found. The airframe logbooks recorded 64 hours of flight time between 19 March 2006 and 24 May 2008 and it is likely that most of these were flown by the pilot. The last recorded medical examination for the pilot, according to the CAA records, was in 1995 and the validity expired in 1997.

One person, who had been on a flight with the pilot some years previously, described having been shown a manoeuvre in which the aircraft was placed in a shallow dive, then pulled up to a nose-high attitude before being turned with the rudder until it was in a nose-down attitude, and then recovering from the ensuing dive.

Pathological information

According to an expert aviation pathologist, all three people on board the aircraft died of multiple injuries and the crash forces were non-survivable. The condition of the pilot's body was consistent with peak deceleration forces '*in excess of 350g'*. It was not possible to determine whether any pre-existing natural disease could have affected the pilot; no such evidence was apparent from the post-mortem examination and there were no recent medical records available.

Accident site examination

The accident site was at Colwich Junction near Little Haywood, Staffordshire. The aircraft wreckage was found between the two branches of railway track that form part of the West Coast mainline. The aircraft's initial impact (Figure 1) was with an overhead power cable gantry. This moved the gantry on its mounting plinth, disrupted the cantilever part of the gantry and failed the overhead electric power cable. The first ground marks were scrape marks on one of the railway tracks and a significant crater to the side of the track, both close to the damaged overhead gantry. Most of the fragmented wreckage was distributed in a splay in a westerly direction from these initial impact marks. Parts of the wreckage were found outside this main splay and some parts were recovered up to 60 m from

the initial impact point. There was a fire but it was localised and only affected parts of the wreckage. A police underwater search team recovered several items from the nearby canal.

Initial wreckage examination

All the major parts of the aircraft were accounted for at the accident site. The empennage remained relatively intact and the control cables to the stabilator, trim and rudder were still connected. There was no liquid fuel remaining on site, but in some areas there was a residual fuel smell.

The propeller was found in the impact crater and was complete except for approximately the last 10 cm of one blade; this missing piece was located a short distance from the main wreckage and damage indicated it had become detached during the impact. Both blades were bent rearwards, with chord-wise scratching and indentations to the blade leading edges, indicating propeller rotation at impact.

The core of the engine was found just outside the crater. It had suffered substantial damage and most of the external auxiliary components were detached. Parts of a cylinder head and its valve gear were found in the crater. No evidence of pre-existing defects was seen and the aircraft wreckage was recovered to the AAIB's facilities for detailed examination.

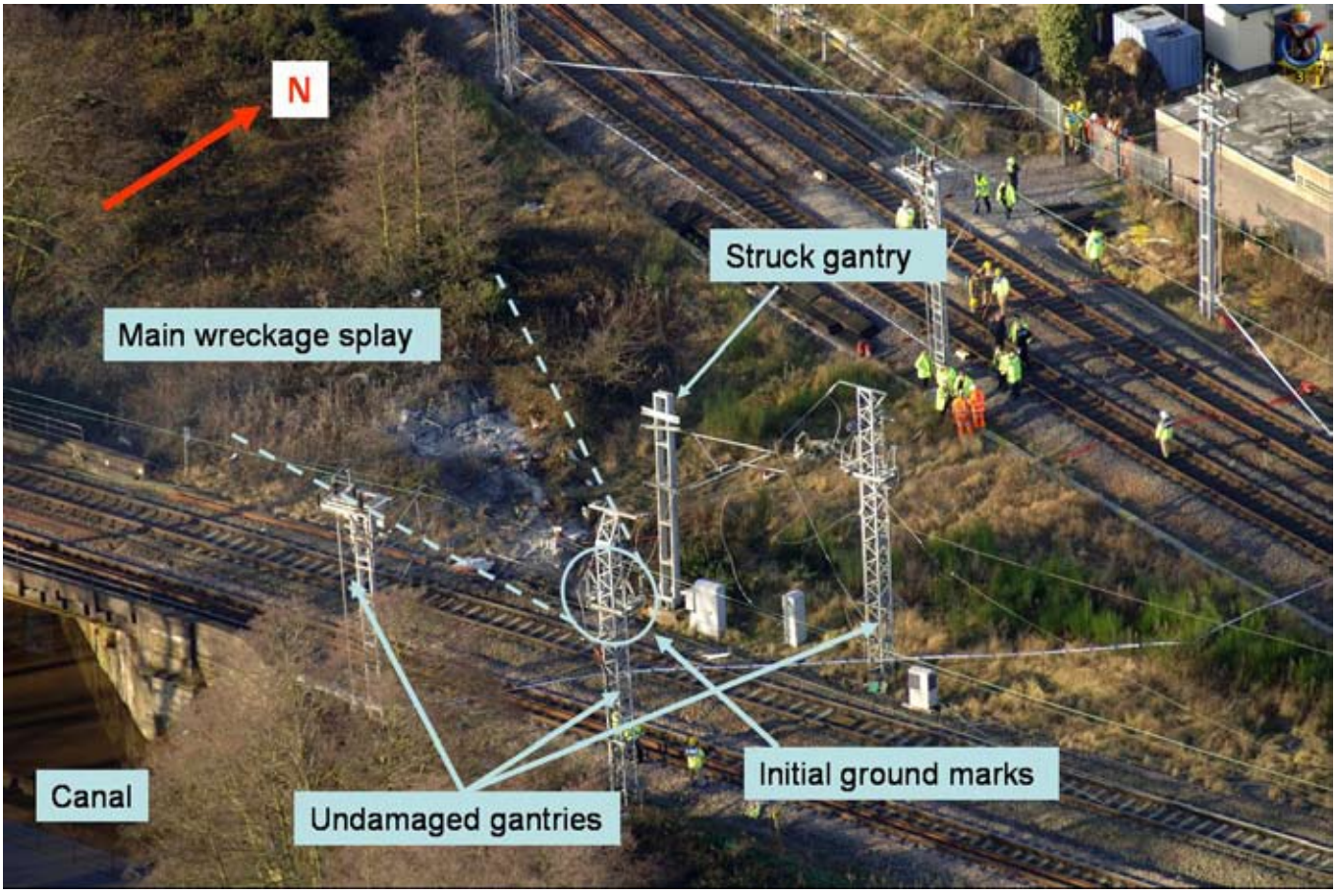

Figure 1

G-AWPS accident site (*courtesy Central Counties Air Operations Unit*)

Detailed wreckage examination

Flight, fuel and engine control systems

Detailed examination of the flight control systems indicated that they were intact up to the impact and that any disruptions were overload failures caused by the accident. In the fuel system, both wing tanks were ruptured and appeared to have been forcibly pulled forward, tearing along a riveted joint line. Both fuel filler caps had been displaced but were found amongst the wreckage and, as far as could be determined, the fuel system was intact and any disruption was as a result of the accident.

No pre-accident defects were identified in the engine. The throttle control is a plunger-type knob connected to the throttle by a push-pull cable. The knob was found in a partly closed position and the exposed shaft was bent from where it entered its mounting on the instrument panel. The engine primer was locked in the closed position and the ignition switch was in the normal BOTH position. It was not possible to check the other engine controls due to the extensive damage.

Instruments and fuel

The flight instruments were destroyed apart from the face of the airspeed indicator (ASI) and the compass. The needle of the ASI was stuck at an indication of 173 mph (Figure 2).

No records of fuel uplift were found. Aircraft operators at Sittles Airfield stated that the pilot/owner refuelled the aircraft using jerry cans; equipment in his car and a picture on the airfield club member's website confirmed this and there was no record of aviation fuel supplied to the pilot/owner in the previous four months. A jerry can found next to the pilot's lockup store at Sittles Airfield contained a small amount of fuel; the grass under the jerry can had died, indicating it had been there for some time. Chemical analysis of this fuel identified that it was most likely a type of unleaded motor fuel available from a petrol station.

A number of containers of fuel were found in a lock-up store the pilot used at the airfield, and one in the boot of his car, although it could not be confirmed whether this fuel was intended for the aircraft. There was no evidence to suggest that the aircraft was refuelled on the morning of the accident as no recently used empty containers were found either in the pilot's car or at the airfield.

Maintenance History

The aircraft held a non-expiring Certificate of Airworthiness (C of A) issued on the 19 March 2008 and an Airworthiness Review Certificate (ARC) which was valid until 17 March 2009.

Figure 2

Face of airspeed indicator (ASI)

The airframe log book contained entries from March 2006 to May 2008 and the engine log book entries from April 2005 to Mach 2008. Both log books recorded the last annual inspection, a three-yearly 'STAR' annual, on 13 March 2008 but there was no reference to the required worksheets detailing the inspections and their certification. No defects were recorded in either log book.

A separate certificate with the log books recorded the completion of the annual radio inspection on 7 March 2008 and the engineer who undertook the certification stated that the inspection was completed at Spanhoe. This certificate noted that both the transponder and the ADF were inoperative and were placarded as such. A propeller overhaul certificate was also with the log books and although the propeller was released to service from the overhaul on 6 November 2008, there was no record of it being fitted to the aircraft. Older log books, with entries up to the mid 1980s, were found at the pilot/owner's home with the current C of A, ARC and an EASA Form 1[1] for the propeller overhaul.

The last recorded maintenance organisations to be involved with this aircraft were those which undertook the 'STAR' annual inspection in March 2008 which included the transfer to a non- expiring C of A and an ARC. One was a maintenance company, which consisted of a single Licensed Aircraft Maintenance Engineer (LAME), based at Spanhoe Airfield, Northamptonshire and the other was an M3 Maintenance Organisation[2], based at Seething Airfield, Norfolk. The two signatories were interviewed about the maintenance activity and records.

Footnote

[1] An EASA form 1, Authorised Release Certificate, is issued by an EASA approved organisation to signify the component to which it refers is in an airworthy condition and ready for release to service.

[2] A maintenance organisation that is approved in accordance with British Civil Airworthiness Requirements (BCAR) Chapter A8-15 is identified as an M3 organisation.

The LAME stated that the aircraft had been at Spanhoe for approximately one month at the beginning of 2008, whilst maintenance activity prior to the C of A renewal was completed. He reported that he then took the aircraft to Seething to allow the M3 organisation to complete the necessary inspections and audit for the C of A renewal. He returned the aircraft to Spanhoe from where it was collected by the owner. The LAME could not provide the exact dates when these events occurred and did not have records of the work completed. He recalled having worked on the aircraft on one other occasion, a previous Annual Inspection.

The M3 organisation recorded the aircraft arriving at Seething on the 6 March 2008 and the survey was completed on the 13 March 2008. The signatory advised that the preparatory work had been completed at Spanhoe but the audit and 'STAR' annual inspection activity under the Light Aircraft Maintenance Schedule had been completed at Seething between 6 and 13 March 2008. The aircraft remained there until the new C of A had been issued. He was able to provide a copy of his Check Master Sheet which contained basic aircraft information.

For this period of maintenance activity, the aircraft log books contain a record of a flight of 35 minutes on 16 February 2008. The next recorded flight was on 13 March 2008 of 1 hour and 20 minutes duration; a further flight of 35 minutes was recorded on 22 March 2008.

The Civil Aviation Authority (CAA) was contacted to obtain copies of the previous C of A renewal recommendation forms for this aircraft. In January 2008 an application to renew the C of A had been received from a different M3 organisation at Seething. Further enquires found that it was, in fact, the same person who had made the recommendation for the transfer to

a non-expiring C of A in March 2008, but at the time he was trading under a different company name and approval number. The previous recommendation for a C of A renewal was made in March 2007 by the same person, also in their earlier trading name. The preceding C of A renewal recommendation in March 2004 was made by the maintenance company at Spanhoe, who at that time was a CAA-approved organisation. Information about who completed the intermediate annual inspections would have been recorded in the missing aircraft and airframe logbooks.

Due to the gap in the aircraft log books, the airframe hours recorded at each Certificate of Airworthiness (CoA) renewal (three year intervals) by the CAA were used to determine the hours flown. This information showed that 30 hours were recorded as flown on the aircraft from when the owner/pilot purchased the aircraft in April 1997 up to 31 December 1999. From then until 31 December 2007 a further 170 hours were recorded.

Analysis

General

The pilot was on a local cross-country flight with two acquaintances. The weather conditions were good and he was familiar with both the aircraft and the route of the flight. There were a number of witnesses to the final part of the flight, they were consistent in their reports of a steep descent into the ground at high speed.

Aircraft capability

The aircraft, when operated in the utility category, is allowed to perform certain limited aerobatic manoeuvres. These include a 'lazy eight', which, when performed as an aerobatic manoeuvre, may be described as two wingovers in succession, leading to the nose of the aircraft following a horizontal figure of eight. Thus, a wingover is allowed to be performed in the aircraft provided the weight and balance criteria are met. Stall turns, where the rudder is used to turn the aircraft instead of the ailerons, are not allowed. At the time of the accident the aircraft was not operating within the utility category limits and therefore no aerobatic manoeuvres were allowed.

Final descent

The final steep descent at high speed, evident from the witnesses and the on-site examination, indicate that a loss of control of the aircraft occurred. However, several witnesses said that the aircraft had appeared to be under control until the final steep dive; this would be consistent with a deliberate entry to the final manoeuvre rather than with an inadvertent one. The pilot was known to have previously performed 'wingover or stall turn' types of manoeuvres on similar flights and it is possible that this is what he was attempting, but that he lost control of the aircraft. There are a number of reasons why such a loss of control could have occurred. These include an error of judgement by the pilot, unexpected handling characteristics of the aircraft because of an out-of-CG condition, interference with the controls by a passenger, a restriction of the control systems by a loose object, or an incapacitation of the pilot.

The height at which the pilot was flying before the accident could not be determined, but from the witness descriptions it was not at a great height and appears to have been insufficient to recover from a loss of control. There was no evidence that the pilot had received training in performing aerobatic manoeuvres.

Evidence from the on-site and wreckage examination

The damage and fragmentation of the aircraft was consistent with it striking the overhead gantry, and then the ground, at high speed in a 'right wing low' attitude.

The localised damage to the overhead gantries and electrical cables, and the proximity of the initial ground marks to the struck gantry, indicate the aircraft was descending at a steep angle.

The aircraft was intact prior to impact as all major parts were found with the wreckage. No significant pre-existing defects were found with the aircraft or its control systems. The throttle control was set to a low power setting and damage to the propeller indicates it was rotating but was at low power on impact. This is consistent with a high-speed dive with the engine running at a reduced throttle setting. The 'roaring' noise described by several witnesses and the indication on the ASI of 173 mph, which appears to be valid, are consistent with this scenario.

The fuel tanks appear to have been abruptly and forcibly pulled forward and away from their mountings. The nature of the damage suggests that fuel was present in the tanks and it was the mass of the fuel that led to the damage. It was not possible to determine the type of fuel used or how much was onboard. Witness accounts of the impact and evidence of fire also suggest that a quantity of fuel was in the tanks.

Records and record-keeping

The pilot, when he first started flying and for ten years thereafter, kept his personal logbook records, C of E and Medicals up to date. Once he acquired his own aircraft, and thus left the supervised environment of a flying/training club, his medical lapsed, he no longer kept his personal logbook record and his C of E expired. Other than in a flying club environment, there is no system for checking that pilots are suitably qualified for flying an aircraft. Thus, when a member of the public accepts a flight with a private pilot there is no assurance that the pilot is qualified and fit to fly other than the pilot's own integrity. This situation of mutual trust, however, is little different from accepting a lift in a person's car or other private vehicle and is not a basis for a safety recommendation.

The hours recorded in the aircraft logbooks, as declared to the Civil Aviation Authority at the time of each C of A renewal, were not consistent with those recorded in the pilot's personal flying log book on this aircraft and appear to have been understated. The airframe and engine hours recorded in the aircraft log books ceased in May 2008 and March 2008 respectively.

Since the accident, Sittles Flying Club Limited, the organisation that runs Sittles Airfield, has put in place measures to ensure that documentation is checked for validity on a regular basis, for all pilot members and their aircraft.

Fuel

Residual fuel found at the departure airfield was probably unleaded motor fuel available from a petrol station and was probably the fuel used in the aircraft. CAA publication '*CAP 747 - Mandatory Requirements for Airworthiness'*, General Concession No. 5 allows the use of unleaded motor gasoline in certain light aircraft. This aircraft is included in the concession subject to the embodiment of the modifications, described in a supplemental type certificate (STC) issued by the Federal Aviation Administration. The modifications consist of extra placards as well as operational and maintenance restrictions. There is no record in the aircraft logbooks of these modifications having been embodied.

Maintenance

Due to the missing logbooks, limited maintenance history was obtained. The last recorded maintenance

was a 'STAR' annual inspection conducted prior to an application for a non-expiring C of A in March 2008. The maintenance organisation did not keep their own records to show the nature and extent of the maintenance activity conducted, or defects identified during the work. A summary of the activity was recorded in the aircraft and engine logbooks. '*CAP 411, Light Aircraft Maintenance Schedule – Aeroplanes'*, specifies in Section 3, Scheduled Maintenance Worksheets:

> *'Worksheets shown in Section 8 must be issued and the tasks certified for all scheduled maintenance checks. These worksheets become part of the maintenance records required to be kept by the operator.'*

The schedule specifies that the worksheets should be certified, suitably referenced and cross-referenced in the appropriate logbooks. No evidence was found for the existence of worksheets and there was no cross-reference information to them in the aircraft logbooks.

A 50 hour / six monthly check was due in September 2008. A pilot is permitted to conduct certain maintenance tasks and it is possible that the pilot/owner undertook this routine task but in the aircraft log books there was no record of it having been completed.

The propeller was removed from the aircraft to undergo overhaul and, following the work, was released to service on 6 November 2008. There was no record or certification for the refitting of the propeller and the task is outside the scope of permitted pilot maintenance.

STAR Annual Inspection activity

The LAME at Spanhoe stated he had conducted the maintenance activity for the annual inspection before the aircraft was taken to the M3 organisation at Seething for completion of the paperwork to recommend renewal of the C of A. The M3 organisation stated that the preparatory work was conducted at Spanhoe and the audit and inspection activity for the 'STAR' annual was carried out at Seething under the their control when the aircraft arrived on 6 March 2008.

The aircraft log book entries show that the aircraft completed a 35 minute flight on 16 February 2008 There is no record of a flight on 6 March 2008 when the M3 organisation recorded the aircraft arriving at Seething. A flight of 1 hour 20 minutes is recorded on 13 March 2008 and a further flight of 35 minutes is recorded on 22 March 2008.

The duration of the flight on the 16 February is consistent with the time it would take to fly between Sittles Farm and Spanhoe and the flight on 22 March is consistent with a return flight from Spanhoe to Sittles Farm. In the absence of a recorded flight on 6 March, and given the radio inspection at Spanhoe on 7 March, it appears from the log books that the only other time the aircraft would have been flown to Seething was on 13 March. The flight time recorded on the 13 March is of sufficient duration for a return flight to Seething from Spanhoe to be completed, although there was no record at Seething of the aircraft arriving or departing during this period. The airfield is unlicensed during the week and pilots are required to book themselves in or out as appropriate.

The British Civil Airworthiness Requirements (BCAR) state in Section A:

> *'A Star Inspection and the coincident annual inspection shall be carried out at the premises of an organisation approved in accordance with BCAR Chapter A8-15…'*

Given the time the aircraft spent at Spanhoe compared to that at Seething, and the description of the activities carried out, including the radio inspection at Spanhoe on 7 March 2008, it appears that most of the maintenance activity was conducted at Spanhoe, before the aircraft may have been moved to the M3 organisation at Seething for the audit and survey inspections to be carried out on 13 March 2008. This practice, however, is contrary to BCAR A8-15 which requires all the activities related to the 'STAR' and coincident annual inspection to be carried out at the premises of the M3 organisation.

Summary

The pilot was in current flying practice but neither his licence nor medical were valid. The aircraft maintenance records were incomplete and there is therefore a lack of evidence to show that the required maintenance was correctly performed on the aircraft. Despite this, the accident appears to have been as a result of a loss of control while the pilot was attempting an aerobatic manoeuvre, and not as a result of a mechanical failure in the aircraft.