ACCIDENT

Aircraft Type and Registration:	Europa XL, N8027U
No & Type of Engines:	1 Rotax 912 piston engine
Year of Manufacture:	2004
Date & Time (UTC):	25 March 2005 at 1430 hrs
Location:	Kemble Airfield, Gloucestershire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	636 hours (of which 28 were on type) Last 90 days - 4 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

The kit built aircraft was taking off in good weather conditions with the owner and his daughter, both pilots, on board. During the climb-out it entered a spin, from which it did not recover. Both pilots were fatally injured in the accident. A post crash fire destroyed much of the aircraft rendering identification of features of the aircraft and hence the process of investigation more difficult. It was concluded, however, that the aircraft probably lacked any form of effective stall warning and may well have retained undesirable stall/spin characteristics. Development flying to improve such characteristics, normally carried out on British registered examples of the type, appears not to have taken place on this aircraft. No positive evidence of mechanical or structural failure or of pilot incapacitation was found.

History of the flight

The pilot and his daughter had travelled to Nympsfield on the morning of 25 March 2005 in order for the daughter to have a trial glider lesson. The gliding instructor subsequently commented that the daughter demonstrated a high level of competence during the 40 minute flight and quickly became comfortable with glider operation, landing the glider under the instructor's supervision. The instructor stated that father and daughter appeared happy and that the daughter was very keen to carry out a further launch after lunch. However, as they were leaving, they told the instructor that the launch queue was too long and that they had decided instead to go to Kemble to fly in their own powered aircraft. The instructor recalled that they left at or shortly after 1230 hrs.

They were next seen at a hangar on the south side of Kemble Airfield, preparing their aircraft for flight. The owner of another aircraft that was kept in the same hangar helped them to pull their aircraft out of the hangar and did not recall anything unusual about the occupants, the aircraft or its preparation. He recalls seeing the father occupying the left seat as the aircraft taxied for departure, and presumed that he was therefore the pilot.

At 1430 hrs N8027U contacted AFIS, which was manned by a Flight Information Service Officer (FISO) and his assistant, to book out for a VFR flight to Shobdon. The FISO saw the aircraft taxi to Hold C1, at the intersection of the perimeter track and Runway 26, and hold here for a few minutes, suggesting to him that power checks were accomplished. At 1436 hrs the aircraft reported ready for departure and was told to line up on Runway 26 and takeoff at the pilot's discretion. The aircraft began its take-off roll at approximately 1437 hrs and was seen to climb normally to a height of 80 to 100 ft as it passed the air traffic control tower. At this point, judging that the departure was successful, the FISO turned his attention to a microlight aircraft which was holding opposite Hold C1 prior to departure from Runway 26. This aircraft was also advised to line up and depart at the pilot's discretion.

There was then a transmission, heard by the FISO, the pilot of the microlight and other pilots on the Kemble frequency, which sounded like a scream. This caused the FISO to look up, and he saw what he thought initially was a model aircraft descending almost vertically at the south-western edge of the airfield. The pilot of the microlight also saw this, and also thought initially that it was a model aircraft. The aircraft was observed to continue its descent, with a slow, probably right hand, rotation, which the FISO called a "spiral dive". He pressed the crash button to alert the AFRS and called his assistant, who saw the aircraft moments before impact at 1438 hrs. The AFRS was on site within one minute and extinguished numerous fires which had ignited around the wreckage. The occupants had been fatally injured in the impact.

Personnel information

Pilot

The pilot spent a considerable amount of time in the United States, where previously he had a financial interest in a flying club, although there is no record of him having held an instructor rating. He possessed a Private Pilot's Licence (PPL) which had been issued by the United Kingdom CAA on 3 January 1997. He also held an FAA pilot certificate, which had been issued on the basis of his UK PPL, on 22 March 1997. The pilot required an FAA pilot certificate in order to fly as the commander of N8027U, a US registered civil aircraft, but could only exercise the privileges of that licence whilst his UK PPL remained effective. Although the pilot had carried out the required FAA biennial flight review on 15 April 2003, the available records showed that he had not conducted a CAA single engine piston class rating renewal since 16 November 2001. As this renewal was required at intervals of not more than 24 months, this indicates that his UK PPL, and hence his FAA pilot certificate, were invalid at the time of the accident flight. He had, however, carried out a flight of one hour duration with an instructor on 25 May 2004, which included a practice forced landing and simulated engine failure after takeoff. This flight would have satisfied the requirement to revalidate his licence for a further 24 months had his licence been so endorsed. It should be noted that training for neither the UK PPL nor the FAA pilot certificate requires entry into and recovery from a spin to be either demonstrated or practiced.

At the time of the accident, the pilot's flying log book indicated that he had completed a total of 636 hours flying. This represents an average of almost 80 hours flying each year, which is a considerable amount for an individual whose primary occupation was not flying. His first recorded flight in N8027U was on 5 February 2004, departing its base in Winter Haven, Florida and returning after one hour. During the course of the next four months he recorded a total of 16.5 hours flying in N8027U, before its was shipped to the UK. Thereafter, he recorded 11.5 hours in this aircraft between 10 September 2004 and 13 March 2005; this flying encompassed only four flights, three of which lasted for three hours or more.

Passenger

The passenger, who was the pilot's daughter, held a UK PPL issued on 11 July 2001 and an FAA PPL issued on the basis of her UK PPL on 17 July 2001. At the time of the accident her flying log book indicated that she had completed a total of 131 hours flying in a variety of US and UK registered single engine light aircraft, including two hours in N8027U.

Witness information

Unfortunately, no witnesses were identified who saw the transition between the apparently normal climb and the subsequent vertical descent. Statements were, however, taken from several eye witnesses who saw the aircraft both on takeoff and just prior to impact. Some of these witnesses referred to its final manoeuvre as a "spiral dive".

Meteorological information

The surface wind recorded at Kemble at the time of the accident was from 190º at 5 kt and the visibility was approximately 25 km; the runway surface was dry. An aftercast produced by the Met Office for the time of the accident indicated that visibility in the area would have been greater than 20 km, with a few cumulous clouds at 3,000 ft and scattered strato-cumulus clouds at 4,500 ft. Conditions of temperature and humidity were not recorded at Kemble; the figures of 12ºC and 8ºC respectively were recorded at Lyneham whilst 13ºC and 6ºC respectively were recorded at Brize Norton. Kemble lies approximately 10 nm north of Lynham and 20 nm west of Brize Norton and is approximately mid-way between the two elevations.

Witnesses on the airfield and other pilots described the general conditions as excellent for flying.

Medical and pathological information

The pilot held a valid UK CAA Class 2 medical certificate, which satisfied the medical requirements of his FAA PPL. He had a visual impairment in his left eye, following an accident as a child, but limitations recorded in his UK PPL in relation to this fact did not preclude him from conducting the planned flight. The medical certificate was endorsed with the limitation that he should wear corrective lenses and carry a spare set of spectacles.

The post mortem examination of both occupants carried out by a consultant aviation pathologist revealed no evidence of natural disease or the presence of any substance which may have caused or contributed to the accident. Toxicology on the pilot revealed a very low level of salicylic acid, which is the active constituent of aspirin and other pain killers, but this was present at a sub-therapeutic level and played no part in the accident.

The injuries to the occupants, although fatal, indicated a relatively low velocity at impact. Nevertheless, the impact severity, combined with the small size of the aircraft and the consequent proximity of the occupants to the surrounding structure was such that the provision of additional or alternative safety equipment would not have altered the fatal outcome. Injuries to the father's hands suggested that he was handling the controls at the time of the accident.

Aircraft information

The aircraft type was developed in the UK for production as a kit, capable of being de-rigged for ease of transport, whilst having performance characteristics enabling it to use short, semi-prepared strips, yet possessing a high cruise speed and a low fuel burn. To achieve the desired performance, an advanced wing design profile was adopted. The aircraft type used a glass-reinforced plastic (GRP) structure in which the fuselage consisted of a number of pre-molded modules to be joined, using adhesive bonding, following detailed fitting out. The wings, tail-plane and control surfaces required a wet lay-up of glass fibre and resin to be carried out over a pre-profiled foam core. In the case of the wings, both the spars and the blocks of profiled foam were factory prepared.

The original aircraft was developed as a retractable mono-wheel type in which a large diameter main wheel and a pair of light outriggers were arranged to retract manually in unison with the flaps. A fixed tail wheel was also fitted. At a later date the fuselage profile of newly supplied kits was altered, the built-up wings using wet lay-up were replaced by factory pre-molded items and the cowlings supplied from the factory were substantially modified. Numerous other modifications became available as factory furnished options. These included a fixed tricycle undercarriage with electrically operated flaps in place of the linked mechanical system used in the mono-wheel aircraft.

UK home-built aircraft are generally constructed under regulations which enable the CAA to delegate supervision to the PFA who fulfill the design, construction and quality functions. Such aircraft normally operate after issue of a Permit to Fly.

Large numbers of Europa Kits have been exported, notably to the USA, where the regulation of home-built aircraft is carried out somewhat differently. Such aircraft are normally issued with a Certificate of Airworthiness in the Experimental category, by the FAA, before flight.

During development, the kit manufacturers and the PFA established that the stall characteristics of individual aircraft having those earlier wings incorporating wet lay-up were a consequence of both the design profile and the consistency of build. Accordingly, test flying of each finished example was required by the PFA to include extensive evaluation of stall behaviour, and modification action when necessary, to prevent excessive wing-drop during a power-off 1g stall. This modification was achieved by fitting short triangular section strips (stall strips) to the inboard sections of the wing leading-edges, as required after initial test flights, thus promoting stall initiation symmetrically at the roots and rendering the stall behaviour benign in addition to providing some warning of the impending stall. The PFA have reported that most Europas they have tested, having the earlier wet lay-up wing structures, have required installation of stall strips to obtain acceptable stall characteristics.

Europas may be powered by a variety of engine types; however, the Rotax 912 is one of the types specifically recommended by the kit manufacturer. Similarly, a number of propeller types are also recommended. Although instructions for assembly of the airframe fuel system were provided by the kit manufacturers, these left considerable scope for individual variation in components and layout of the system. A study of six different completed Europas showed detailed differences between each example.

The accident aircraft

N8027U was constructed using a kit supplied to the USA in the late 1990s where it was partly built by the original owner before being sold to the pilot involved in the accident. It was apparently completed for him in 2004 by a company specializing in providing assistance to home builders and having considerable experience of Europa aircraft. It was fitted with a Rotax 912 engine obtained locally by the pilot and as the original kit did not incorporate the items forward of the firewall, certain differences in this area from the layout recommended by the Kit manufacturer may have occurred. The aircraft appeared to have a number of features known to be standard on later machines built from kit parts supplied in significant numbers only well after the date on which the original kit, or part kit was supplied. In particular the aircraft was fitted with a fixed tricycle undercarriage.

The propeller fitted was a three-bladed unit of a type not specifically recommended by the kit manufacturer and was of a design capable of being installed as an in-flight controllable pitch unit, also having the capability to be used in a constant-speed mode. These functions were electrically/electronically controlled. Documentation indicates that this in-flight pitch change capability had been disconnected.

The Rotax 912 series of engines incorporate a reduction gear between the crankshaft and the propeller. This enables the engine and propeller to be optimized to each rotate at speeds close to those most suitable to their efficient function. The gearing has the effect, however, that should an in-flight loss of engine power occur at other than high airspeeds, the propeller will not be capable of driving the engine, so rotation will not continue under the effects of airflow in the manner familiar to users of slower revolving, un-geared engines.

The aircraft was issued with a Special Airworthiness Certificate in the Experimental category on 2 March 2004, by the FAA. This certificate was issued before the first flight, which occurred in Florida. Operating limitations dated the same day formed part of this certificate. These included the limitation that the aircraft was permitted to undertake 40 hours of flight test within 45 miles of Winter Haven, Florida, USA. The aircraft appears to have been shipped to the UK following a period of flying from its base at Winter Haven.

Other information

Information obtained during test flying of the first example of the aircraft type to be built, which was supplied to AAIB following the accident, indicated that once appropriate development flying had been carried out and any necessary modifications applied, the stall behaviour of the prototype involved considerable aerodynamic warning followed by a benign stall. When a spin was deliberately induced, the attitude was approximately 40º nose-down and rotation was rapid.

A log book detailing flights carried out by the aircraft survived the post-crash fire and remained legible. It apparently detailed all the flying undertaken, including in-flight engine cooling tests, but did not refer to any evaluation of the low-speed or stall characteristics of the machine.

A digital photograph taken some months before the accident of the aircraft in a hangar at Kemble was obtained. The leading edge of the starboard wing was visible but no stall strips could be discerned. The accident aircraft appeared not to be fitted with any artificial stall-warning device.

The original layout of the fuel system normally included attachment of the fuel cock to the fuselage lower skin between the two occupant seats. The pilot could reach the fuel selector handle, attached directly to the fuel cock spindle, by way of an aperture in the console between the occupants. This aperture was normally closed by a hinged or velcro-ed door panel. During examination of other completed examples of the type it was noted that some aircraft had an extension tube pinned to the upper end of the fuel cock spindle. This enabled the operating handle to be attached to the upper end of the tube, thus positioned more accessibly in a recess on top of the console, rather than lower down within the console, close to the fuselage bottom skin.

Two full containers of motor fuel were recovered from the owner's car after the accident together with a receipt for the appropriate quantity of fuel dated on the day of the accident and clearly purchased from an outlet between the owner's home and Nympsfield.

Site examination

The accident site was 1.2 nm approximately WSW of the holding point C1, which was abeam the point at which the takeoff was reported to commence. The aircraft was destroyed by a combination of impact and fire. The initial impact had occurred at a steep nose-down angle but at a relatively low speed and descent rate. An assessment of the aircraft component damage and ground markings confirmed that they were not consistent with the effects of a spiral dive but were as would be expected to result from ground impact occurring during a spin.

The complete forward section, from the propeller to a station aft of the instrument panel, was separated from the remainder of the structure. The latter was lying in a nose down attitude and had been extensively burnt such that most of the aft fuselage and tail unit had ceased to exist as a structure and the wings had rotated in their heat-softened mountings in the fuselage attachments. Much of the burnt structure remained as glassfibre laminates without the uniting resin matrix materials. Hence all structural shape and stiffness was lost from these areas.

No evidence of wing-tip ground strikes could be detected at the site. Two small staggered impact depressions, sited between the initial impact point and the final position of the wing/aft fuselage structure were subsequently identified as those produced by the main-wheels which were later determined to have not been equipped with their wheel spats during the final flight.

The glass-fibre laminates of both tailplanes, the fin and rudder and one of the two trim/anti balance tabs were identified in the extensively burnt wreckage. Both complete wings were present.

Examination of the propeller revealed no evidence of rotational damage on two of the blades. The third blade was found orientated at the vertically downward position, extensively damaged by fire and with the central steel tube bent backwards. Fragments of the composite blade sheath, including the tip section, were recovered from the site. They revealed no conclusive evidence of rotational damage nor of their direction of loading and separation from the remainder of the blade. No rotational 'slash' marks were observed in the ground impact area. Examination of the surviving two blades indicated that they were in a fine but positive pitch position.

Examination of the inboard sections of the wing leading edges showed that neither had contacted the ground during the impact sequence, both were fire damaged to the extent that the gel coat had decomposed and some of the resin was beginning to be lost. There was no evidence of the presence of the stall strips and no shadowing effects to suggest that they had been present during the early part of the fire.

Subsequent detailed examination

Detailed examination revealed no evidence of any pre-impact defects in the surviving parts of the flying control system. Extensive fire damage did, however, inhibit effective examination of certain components. The plastic material of the rack assembly of the flap drive motor had melted preventing assessment of the flap position at impact. The electric trim motor was identified and was found to be in the fully nose down position. The remains of the engine cowlings and the locations of the radiator and oil cooler therein were noted as being of the general design found on the later types of kits.

The engine was removed and subjected to a strip examination at the premises of the UK importers of the units. It was found that the propeller shaft had been displaced aft in the casing of the reduction gear by the impact and the carburetors had similarly been extensively damaged. No internal damage or defect was found and no evidence of tooth damage was found in the displaced reduction gearing. The carburetors were free from contamination. The ignition harnesses were extensively fire damaged although the ignition stator remained intact. The sparking plugs remained in good condition.

It was noted that the installed fuel piping included a vapour return line and restrictor required to eliminate vapour locking of the fuel system; this had been introduced as a modification to overcome a significant problem encountered on early aircraft.

The flattened exhaust system muffler unit was cut open and subjected to an internal examination. It was noted that this was a late model, of a type normally free from the problem of a separated baffle blocking the exhaust outlet, a difficulty encountered on some early examples of the type. Internal examination of the unit confirmed that the baffles remained correctly positioned.

Examination of the surviving fuel piping and fuel cock assembly indicated that the latter was mounted on the lower skin of the fuselage in broadly the way described in the builder's manual for the early examples of the type. Examination of fragments of the wreckage further confirmed that the aircraft was equipped with a narrow console between the occupants, as used in many later build aircraft, an arrangement which leaves insufficient room to enable the handle to be reached if the cock is mounted directly on the bottom skin and the handle fixed to the top of the spindle. Examination of the fuel cock in the wreckage indicated that it had a tube pinned to the upper end of the spindle but this was fractured approximately flush with the end face of the latter and neither the remainder of the tube nor the operating handle was recovered. It was presumed, however, that the valve was operated by a lever mounted remotely on a tubular extension and positioned in a circular recess in the top surface of the console. Boroscope examination of the interior of the cock revealed that the rotating inner cylinder had its internal passages positioned so as to allow flow from the tank supply to the engine supply pipe, but not fully aligned and hence capable of providing more restriction of the flow rate to the engine than would occur with full alignment.

Tests and research

The UK agents for the Rotax engine were requested to establish the length of time a Rotax 912 would operate at takeoff/climb power, with the fuel supply isolated, before the unit lost power. Utilising a similarly powered EV 97 Eurostar microlight aircraft, they were able to operate it statically at maximum power, select the fuel OFF and time the period until the engine began to loose power. The interval was found to be approximately 22 seconds.

Shortly after the completion of the component examination from this aircraft, an accident occurred to a different type of aircraft having a similar engine. This second accident involved a similar type of ground impact to that which occurred to N8027U. Examination of the two bladed propeller of the second aircraft showed that one blade had failed as a result of backward bending whilst the other blade was undamaged. No slash marks were evident in the ground. This was originally judged to be consistent with the accident occurring with the engine not operating. (It should be noted that any complete loss of engine power on this type of geared unit at other than very high airspeeds results in the engine and propeller ceasing to rotate.)

The circumstances of the second accident, however, were such that a complete loss of engine power was judged to be unlikely. The engine was therefore subjected to an unusual sequence of examination. Before any attempt to rotate it was embarked upon, the reduction gear was dismantled. Positive evidence was then found, via microscopic examination, of marks on the aft (forward facing) internal surface of the reduction gear casing which matched the faint circular machine marks present on the adjacent propeller shaft gear. In addition fine slivers of casing material in a form analogous with swarf could be seen by microscopic examination of the spaces between teeth of the gear wheel.

Analysis

Although both occupants possessed licenses appropriate to the operation of the accident aircraft, the father was probably acting as pilot during the accident. His hand injuries further suggest that he was handling the controls at impact. The available documentary evidence suggests that he was in current flying experience on the aircraft and, although his license was not valid at the time of the accident, his log book indicated that he had conducted sufficient flying, including a flight with an instructor, for it to have been valid had it been so endorsed.

The fact that the two containers of motor fuel in the pilot's car were full after the accident, and the engine performs best in the long term using such motor fuel, indicates that the pilot intended filling the tank at some time during the day but did not do so before takeoff. It thus suggests that the aircraft was not re-fuelled before the flight and that a substantial quantity of fuel, sufficient for the planned trip to Shobdon and back was already in the single fuel tank.

The aircraft was seen descending in a manner described by observers as a spiral dive. The relatively limited impact damage to the aircraft, the lightness of ground impact marks and the compact distribution of the wreckage, together with the limited impact effects on the occupants, were not consistent with the descent speeds encountered in spiral dives nor of the previously observed degree of destruction to aircraft known to have been lost as a result of such events. The relatively tall undercarriage legs (compared with the wing-span and dihedral angle) enabled the aircraft to strike the ground with a significant bank angle (as well as a steeply nose-down attitude) without experiencing an initial wing-tip strike. Hence small to moderate bank angles at impact would not have been evident from this source. The staggered positions of the depressions produced by the main-wheels, however, enabled it to be confirmed that the aircraft was banked at initial impact. From these indications it was clear that the impact parameters were consistent with the aircraft having been descending in a spin.

Analysis of the test data relating to spinning of the early retractable mono-wheel equipped prototype version of the aircraft confirmed that the type spins in an attitude of approximately 40° nose-down; it is reasonable to deduce that a fixed tricycle version would behave in a fairly similar manner to the prototype. The nature of the impact damage to the accident aircraft was consistent with a 40° nose down attitude.

Thus, taking material evidence, known aircraft behaviour and eye witness recollections into account, there is little doubt that the aircraft was in a spin just before and at the time of the impact.

The absence of any evidence of stall strips on the inboard wing leading edges, the absence of any sign of such strips in the photograph taken some months before the accident and the absence of any reference to stall evaluation in the otherwise comprehensive log book record of flights, lead to the conclusion that no such evaluation was done, and that the aircraft, with no stall strips, may well have retained undesirable wing-drop characteristics at the stall, together with a lack of aerodynamic warning of the impending stall.

The trim position of fully nose down is surprising (although no information has been found regarding whether any adjustments to the trim range were found necessary and if so whether they were carried out between the first flight and the accident). The trial carried out on a mono-wheel version with the 90 HP engine showed that the trim needed to be moved well forward during the established climb once the landing gear was retracted. It is not possible to reliably establish the likely trim position required on N8027U since no test data relating to the pitch trim characteristics of that particular aircraft were available.

The damage to the three-bladed propeller was restricted to that inflicted to the blade found to have been in the approximately vertically down position at the time of the impact. Neither of the other two blades had sustained any damage. The composite sheath of the damaged blade was largely broken away in a manner which did not make it clear in which direction the failure forces were orientated; however, its tubular steel central shaft was defected aft, with no deflection in the plane of rotation. It was thus initially concluded that the propeller was not turning at the time of the impact.

Strip examination of the engine and internal examination of the exhaust muffler revealed no evidence of any defect which could have resulted in loss of power. There was no reason to believe that any deficiency in the intake system could have resulted in a power loss. Although the ignition wiring was not in a condition to be tested, the system's 'dual' nature, coupled with the largely undamaged state of the only common parts, make it most unlikely that both ignition systems ceased to work.

The test carried out to determine the operating time of the engine at maximum power, following an OFF selection of the fuel cock confirmed that under such circumstances the engine would stop in a time interval which is far shorter than the time the aircraft required to travel from the point where the take-off roll began to the region of the accident site. Accidental selection of the fuel-cock control to the OFF position just before takeoff can thus be ruled out.

Study of the fuel cock design confirmed that significant restriction of flow rate would not occur even with the unit positioned well away from the fully ON position, either as a result of a simple mis-selection, inaccurate relative angular assembly of the lever, shaft and cock during build, or a combination of both. Hence the setting of the fuel cock as found (ie in a partially restricted flow position) would not have affected the engine at climb power, even if the cock had been set during the flight to the position in which it was found after impact.

Interpolating between the temperature and humidity recordings made at locations adjacent to Kemble would put the local conditions just within the region of 'serious carburetor icing at cruise conditions'. This definition applies to 'traditional' aero-engine float type carburetors operating without carburetor heat selected. Those used in the Rotax engine have not been subjected to the same degree of testing for onset of such ice, the layout of the intake system on N8027U and hence the temperature of the air entering the carburetor is not known and the engine type has not been shown to be particularly prone to carburetor icing. In addition, with full throttle presumably set for take-off and climb, the propensity for ice formation to lead to engine stoppage is minimized. It is therefore considered very unlikely that engine problems brought about by carburetor icing occurred.

In the light of all of these findings, no mode of failure or cause of power loss for the engine could be determined.

Evidence drawn from a later accident of a similar type of engine involved in a similar impact (albeit in a different aircraft type) confirmed that the initial impressions of power condition on this engine type could be misleading; at low power settings the engine can cease to revolve during the impact as a result of the propeller shaft being displaced aft and a gear on the shaft coming into firm contact with the rear of the reduction gear casing. This leaves subtle evidence which can only be detected if a specific part of the aft section of the gearbox is microscopically examined before the propeller is rotated.

Normal piston engine examination involves initially rotating the propeller. This sequence was followed in the case of N8027U. As a result of this process the microscopic evidence of rotating contact of the reduction gear pinion and the casing was presumed to have been overlaid on more subtle evidence of rotation at impact. It was therefore not possible to confirm whether or not the engine was developing power and the condition of the propeller was not considered to be a reliable guide.

Loss of power in the climb, whist the aircraft is correctly trimmed, normally results in a lowering of the nose on most aircraft in this category, if not resisted, and does not usually result in sudden loss of airspeed. It is thus not obvious how this aircraft can easily have progressed from a normal climb to the region of the stall and then a spin, following a loss of engine power, without an inappropriate pilot input.

In contrast, the behaviour of an aircraft when climbed too steeply is not entirely predictable. The asymmetry of airflow, as a consequence of the propeller wash, can encourage a sudden wing-drop as the stall condition is reached on some single engined piston types. The absence of stall strips (or the possible possession of a pronounced wing drop characteristic during a level 1 g stall) on this aircraft is likely to have accentuated the suddenness of any wing drop at the power-on stall, and the absence of strips will have lead to minimal stall warning. It appears, however, that the known evidence is more consistent with the aircraft suffering a power-on stall/spin condition rather than entering a spin following a power loss.

A pilot having trained in accordance with either the CAA or the FAA syllabus is not required to undertake spinning. There is no evidence that the pilot of this aircraft underwent any spin recovery training after the issue of his license. It is therefore probable that this was the first occasion either he or his daughter had experienced this flight condition. The disorientating effect of such an event would undoubtedly have reduced the pilot's chances of carrying out the correct spin recovery actions even if he had been familiar with them.

Conclusions

The aircraft was complete at the time of impact and there was no evidence of any mechanical or structural failure.

The aircraft probably entered a spin during the initial climb out. The precise reason for entry into the spin is not known. There was no conclusive evidence of loss of engine power. The possibility that the aircraft was climbed at too steep an angle and therefore lost flying speed whilst under power cannot be ruled out as a cause for initiation of the spin. During the spin the attitude was approximately 40º nose-down and rotation would have been rapid. The aircraft had insufficient height at the entry to the spin to offer a good chance of recovery.

The absence of any evidence of development work to identify and if necessary improve the stall characteristics of this particular aircraft probably rendered it more prone to an accidental spin than would be the case with other Europa aircraft. The aircraft does not appear to have possessed natural or artificial stall warning.

The pilot, who had minor administrative irregularities with his license, but was nonetheless in good flying practice, is unlikely to have possessed the skill or experience to initiate recover action from such a condition in the time available. The ease of spin recovery of the aircraft as built, and without refinement of the stall behaviour, remains unknown.