ACCIDENT

Aircraft Type and Registration:	Europa (Tri-gear variant), G-PUDS
No & Type of Engines:	1 Rotax 914T turbocharged piston engine
Category:	1.3
Year of Manufacture:	1997
Date & Time (UTC):	7 June 2005 at 1540 hrs
Location:	Curry Rivel, Somerset
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller, nose landing gear and fuselage underside
Commander's Licence:	Private Pilot's Licence
Commander's Age:	69 years
Commander's Flying Experience:	13,700 hours (of which 2 were on type) Last 90 days - 5 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB examination of the nose landing gear components

Circumstances

The aircraft had recently been purchased from the previous owner, who had also built it. A few days prior to the accident the new owner, together with another, more experienced pilot had attempted to fly it from Cumbria to its new base at Curry Rivel in Somerset. A condition of the purchase was that the aircraft came with a renewed Permit to Fly. Whilst the work for this had been completed, the flight test had not been conducted due to the lack of a suitably qualified person: it was therefore decided to accomplish this during the ferry flight. However, the flight test had to be abandoned when it was realised that the engine was developing insufficient power to meet the performance requirements, although the two occupants decided that this would not prevent the continuation of the flight to Somerset. Sometime later, the flight had progressed as far as Herefordshire when the engine temperature was seen to rise suddenly, which necessitated an immediate precautionary landing. Fortunately a farm strip came into view, and apart from the fact that the electrically operated flaps would not deploy, an otherwise uneventful landing was made. Afterwards it was noted that coolant was leaking from a small crack in a radiator joint. The crew were forced to leave the aircraft where it was, and to make alternative arrangements to get home.

Two days later, the new owner, together with the same pilot who had accompanied him on the earlier flight, drove to the Herefordshire airstrip and made temporary repairs to the engine. It was arranged that the owner would drive back to Somerset and meet the aircraft there. After they had satisfied themselves that there were no leaks, the pilot boarded the aircraft and took off, observed by the owner, who noticed nothing untoward.

The flight progressed without incident until arrival at the Curry Rivel circuit, where the pilot found that once again the flaps would not operate. As a result he made three approaches in order to assess the handling prior to committing to a landing. Just before touch down, a gust of wind disturbed the aircraft resulting in a "firm" landing. The pilot was nevertheless surprised when, during the roll-out, the nose dropped and the aircraft subsequently came to rest at the side of the runway, having sustained damage to the propeller and nose underside. The pilot was uninjured and exited the aircraft without assistance.

It was immediately evident that the nose wheel, together with its fork assembly, had become detached; however they were nowhere to be found. The pilot examined the marks made by the aircraft on the grass surface of the runway, which seemed to suggest that the wheel may have been missing before touchdown. This view was also formed by the aircraft owner when he subsequently arrived at the airfield by road. The nose wheel assembly was never found, despite searches of the Curry Rivel and Herefordshire airstrips.

Description of the nose landing gear

The nose landing gear leg on this type of aircraft comprises a length of steel bar attached to the aircraft structure at the rear of the engine compartment. The geometry is such that the leg makes an angle of approximately 30º to the horizontal. The nose wheel fork assembly is attached by means of a shaft to a cylindrical housing welded to the lower end of the leg; - see Figure 1. The shaft is a light interference fit in the top of the fork assembly, with positive location achieved by means of a rolled steel pin inserted into fore-aft drillings in the fork and the lower portion of the shaft. The threaded upper end of the shaft is inserted through a bushed hole within the cylindrical housing and is secured by means of a nut,

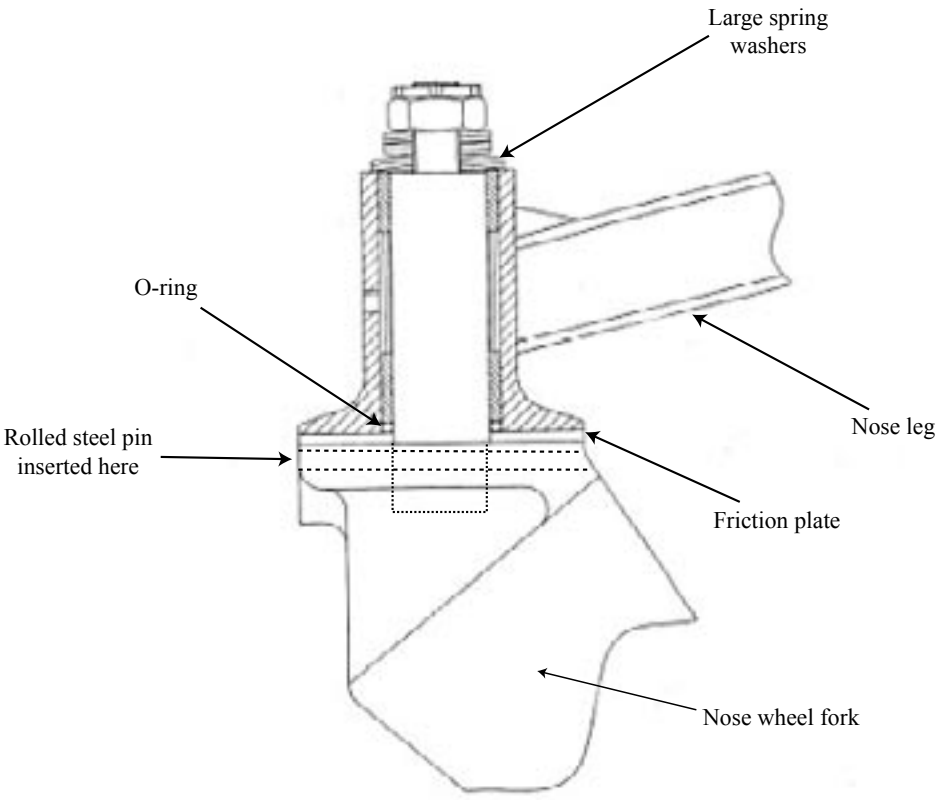

Figure 1

Details of attachment of nose wheel fork to leg

which tightens down onto a stack of spring washers. These, in conjunction with a friction plate between the fork and the housing, allow the nose wheel to castor.

Examination of the aircraft

The loss of the nose wheel fork had left the stub of its associated shaft protruding from the bottom of the housing on the nose leg. This had clearly dug into the ground during the landing roll, causing the leg to be bent aft around its approximate mid point. Figure 2a shows the lower end of the leg, complete with the housing and nose wheel pivot shaft. It can be seen that the nut on top of the housing had been secured by a split pin and the lower end of the shaft had sustained considerable distortion in the accident, having been bent in an aft direction. It was also apparent that the lower of the two bronze bushes had partially migrated out of the housing during the failure process. The remains of the rolled steel pin had been retained within the bore of the shaft, both ends having suffered shear failures. Figure 2b shows a close-up view of the end of the shaft, where it can be seen that two holes have been drilled, in the same plane but at 90º to each other. Since the shaft had been supplied by the kit manufacturer in an un-drilled state, it was concluded that the two holes had been made during the construction of the aircraft, the first perhaps being slightly out of position, thus necessitating the drilling of the second hole. Also visible in Figure 2b is one of four cracks emanating from each of the holes and running longitudinally to the lower end of the shaft. It was considered that these occurred as a result of the rearwards distortion, with the sum total of all the damage being entirely consistent with a significant overload, such as could be caused by a hard landing or striking an obstruction.

Flap system

The flaps on this aircraft are powered by a DC electric motor that is supplied from the battery via a circuit breaker. It was subsequently found that an unlabelled toggle switch on the centre console functioned as an isolation switch, which, when moved to the opposite position at which it was found following the accident, allowed the flaps to operate normally. This switch did not appear in the electrical diagram in the Europa Build Manual.

Figure 2a

View of nose leg, showing distortion of lower end of attachment shaft

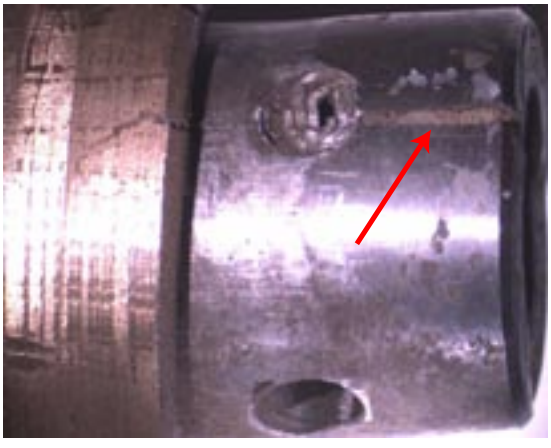

Figure 2b

Close-up view of shaft, showing additional drilling, remains of rolled steel pin and crack (arrowed)

The airworthiness aspects of this class of aircraft are administered by the Popular Flying Association (PFA); changes or modifications can be embodied to the constructor's requirements, subject to some caveats and the authorisation of the local PFA Inspector. The new owner had had no communication with the Inspector concerned with the subject aircraft as had been unable to obtain the necessary contact details from the previous owner. However, it should be noted that all Inspectors' details are available via the PFA. It was later established that the Inspector concerned with this aircraft was unaware of the modification to the flap operating system.

Other information

During the investigation, the aircraft owner indicated a number of features about the aircraft that had led him to become dissatisfied with his purchase. For example, he noted that a narrow bladed propeller was fitted, instead of the recommended broad blade version from the same manufacturer. This may have accounted for the apparent lack of power observed on the test flight (although it is also possible that the turbocharger waste gate was incorrectly adjusted). In addition it was apparent that the nose leg fairing had been the subject of an earlier repair using duct tape. The owner had been unable to establish from the previous owner how and when this damage had occurred. Examination of the fairing, which was non-standard and appeared to be to the previous owner's own design and construction, revealed that it consisted of a foam lined glass fibre moulding that fitted over the cylindrical section of the nose leg: it made no contribution to the strength of the landing gear. The fairing had broken during the accident but it was clear that tape had been applied to two separate areas, although only one area showed evidence of a pre-existing crack: no pre-existing damage was apparent on the leg itself. It was concluded that the damaged fairing bore no relevance to the subject accident. However, this damage, plus the crack in the radiator, the additional hole on the nose wheel fork shaft and the different propeller had led the owner to suspect that the aircraft may have suffered a previous incident, which weakened the fork attachment.

Discussion

Damaged nose landing gears feature prominently among the minor accidents and incidents to general aviation aircraft that are reported to the AAIB. This one was unusual in that the detached nose wheel could not be found after the accident, suggesting that the failure occurred elsewhere. Furthermore the inoperative flap system may have presented difficulties, albeit minor, in landing the aircraft, to a pilot who was inexperienced on type. Ultimately however, the nose wheel fork detached as a result of a simple overload failure of the shaft that attached the fork to the leg. The shaft should have been a light interference fit in the fork; this would normally result in fore-aft loads in the fork placing the shaft in shear. Any looseness in the fitting would give rise to a degree of bending and also produce shear loads in the retaining pin. The extent of the distortion in the bottom of the shaft, plus the absence of the fork, meant that the quality of the fit could not be checked. It could be argued that the additional hole drilled in the shaft caused a slight weakness; this would probably only be significant in the event of a loose fit between the shaft and fork. However it appeared unlikely that it would be weakened to the extent that a failure could result from normal landing loads.

The absence of the nose wheel assembly from the accident site suggests that the damage may have occured at the Herefordshire strip, with some evidence pointing to the possibility of an earlier incident. However, whenever it occurred, the degree of distortion in the shaft to which the fork was attached ought to have made this damage clearly visible, although it seems probable that the nose wheel became detached during or perhaps shortly after the takeoff from Herefordshire.

The apparent problem with the flaps stemmed from an unlabelled switch in the cockpit, which in turn pointed to an inadequate handover briefing when the current owner purchased the aircraft. The reason for the additional switch was not established, but such additions to the electrical systems of kit-built aircraft are not uncommon, and can legitimately be incorporated provided the necessary advice is sought from the PFA Inspector.

Following this incident the PFA expressed concern that the aircraft, which had no Permit to Fly, had been force-landed during a long ferry flight, with the subsequent rectification work and resumption of the flight being undertaken without any reference to them.