No: 1/92 **Ref: EW/G91/10/14** **Category: 1c**

Aircraft Type and Registration:	Falco F8L Series 2, G-OCDS
No & Type of Engines:	1 Lycoming O-320-A3A piston engine
Year of Manufacture:	1958
Date & Time (UTC):	23 October 1991 at 1100 hrs
Location:	Gransden Airfield, Sandy, Bedfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller bent, slight damage to engine cowling
Commander's Licence:	Private Pilot's Licence with IMC and Night ratings
Commander's Age:	39 years
Commander's Flying Experience:	357 hours (of which 99 were on type)
Information Source:	Aircraft Accident Report Form submitted by the pilot and visit to the maintenance company repairing the aircraft

On returning to Gransden after an aborted trip to Leavesden, the pilot reported that when the landing gear was selected down, the main gear extended but the nose gear gave no down indication. The motor circuit-breaker also tripped and it was found that the emergency handle could not be moved.

The pilot made a number of fly-pasts to enable ground personnel to view the landing gear. They reported that the nose-leg was extended but not in the locked position. A conventional approach was then made at minimum speed, the engine being turned off 100 metres before the threshold. Touchdown took-place 150 metres after the threshold, the nose of the aircraft then being allowed to lower gently onto the ground.

On subsequent examination, the aircraft was found to have suffered failure of a universal-joint in the drive between the landing gear motor and the nose-leg operating screw-jack. Four such universal-joints are utilised in the total landing-gear operating system of this aircraft type, one on each main-leg drive and two on the nose-leg drive. Motion is transmitted through the universal-joints during retraction and extension, both when the the gear is operated in the normal electrical mode and when the emergency manual system is used.

Examination of a similar joint revealed that the design utilises a pair of pins passing at right-angles through drillings in a cube-shaped block. These two drillings are orientated in a single plane. The two exposed ends of each pin then form the pivot points of each of the two halves of the joint. Since the two pins are both orientated in the one plane, it is necessary for one pin to pass through the other at mid length position. This is permitted by manufacturing one pin of larger diameter and drilling through it at right-angles, thereby permitting the smaller diameter pin to pass at right-angles through it at the mid-length position.

It was found that in the failed joint, the larger diameter pin had fractured at this mid-length drilling. This had permitted its two ends to separate and come out of the block. The diameter of the drilling was such that it left a minimal material cross-section linking the two ends of the pin. The fracture faces were thus too small to readily establish the precise mode of failure.

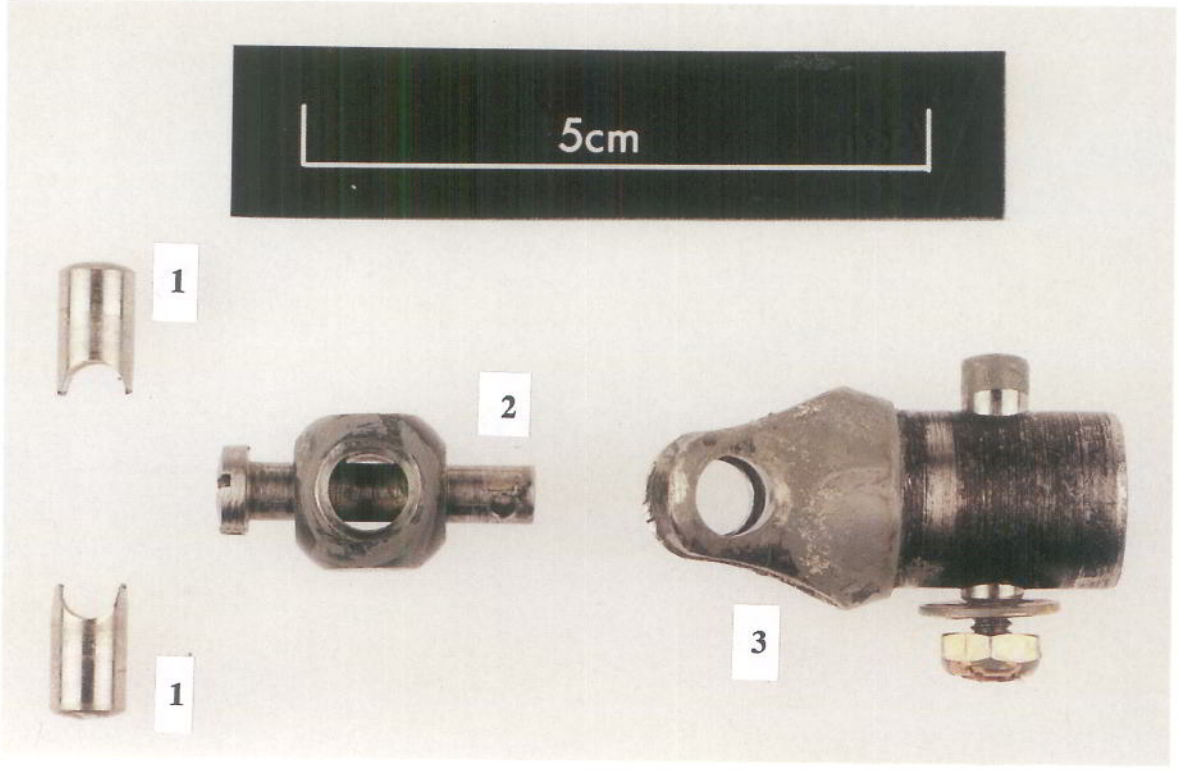
The maintenance company which handles this aircraft (and the only other of the type on the UK register) reports that the remaining three joints in the system were all replaced during a previous repair after the aircraft had carried out an emergency landing with the gear only partly lowered. CAA approval was obtained at that time for a minor modification which was designed to prevent the two ends of a failed pin from moving axially should such a failure occur. This modification was incorporated in the three joints replaced at that time, but not in the the joint which failed on this last occasion. This latter joint was inspected at the time of the repair and found to be undamaged.

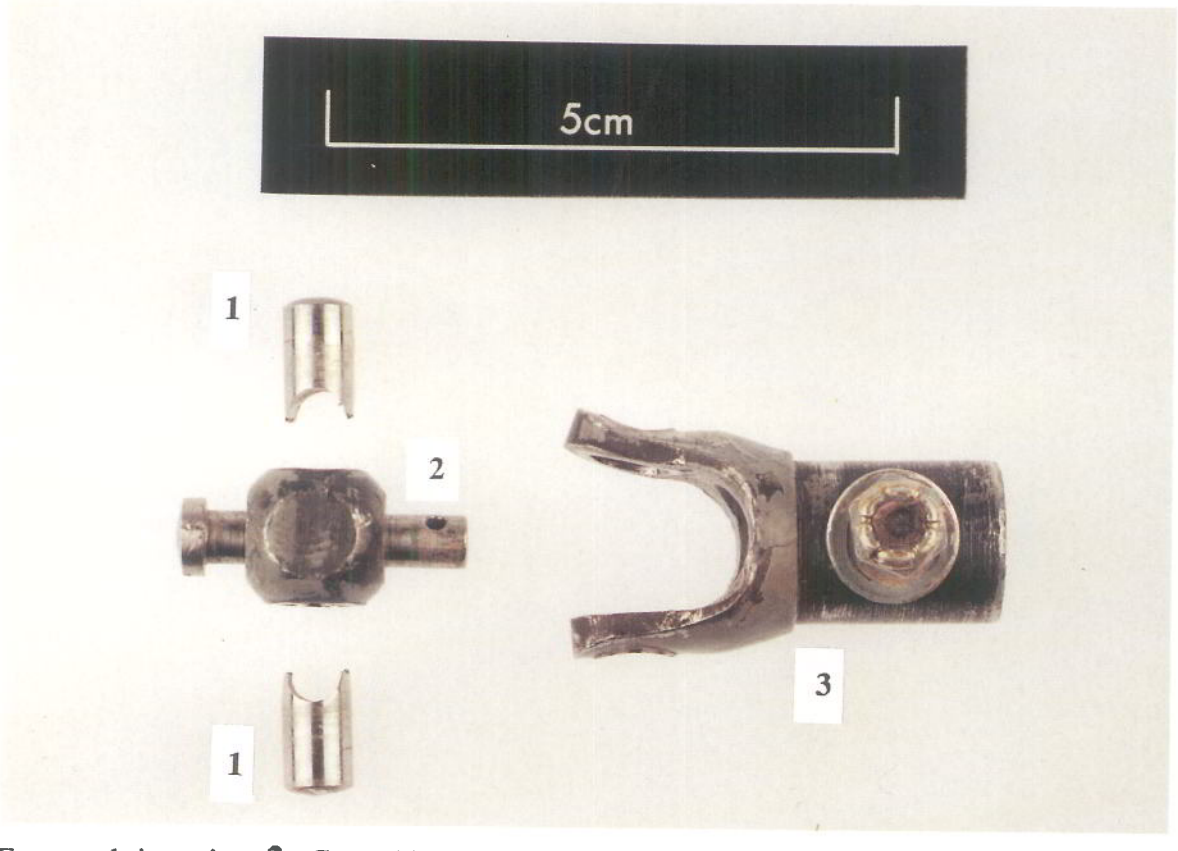
The company considers that the drive comes under load during take-off and landing runs on rough fields. This appears to occur because the degree of over-centring of the nose-leg mechanism is minimal when the gear is fully extended. The geometric lock appears as a consequence to break occasionally during such rough field operation. This has the effect of applying the ground-loading forces to the operating mechanism as well as releasing the limit micro-switch on the nose-leg. The landing gear motor then operates to restore the leg to its correct position. Repeated motor operation is not unusual on rough surfaces. This sequence of events thus places non-design loads on the operating mechanism, including the universal joint in question.

A failure of the larger diameter pivot-pin will not necessarily manifest itself at once; it will only become evident when one of the ends of the failed pin disengages from the central block. Although the point of the failure is theoretically unloaded even when transmitting high torques, in practice, wear, manufacturing inaccuracy and distortion under applied torque may all contribute to causing significant loading to be placed on that point, as will any applied end loading.

The maintenance company is proposing to seek CAA approval to carry out a modification to replace the universal joint with a standard aeronautical joint of similar dimensions but greater mechanical strength.

COMPONENTS FROM FAILED UNIVERSAL JOINT





1 Fractured rivet pin. **2** Central block (approximately cube shaped) with small diameter pivot pin.
3 Distorted fork connection to drive shaft. (Second similar fork connection not shown).