No: 9/88 **Ref: EW/C1063** **Category: 1c**

Aircraft Type and Registration:	Jodel D 120A, G-AZXE
No & Type of Engines:	1 Rolls-Royce Continental C90 12F piston engine
Year of Manufacture:	1965 (Wassmer built)
Date and Time (UTC):	28 March 1988 at 1805 hrs
Location:	near Cotgrave, Nottinghamshire
Type of Flight:	Private (pleasure)
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew: - 1(Fatal) Passengers - N/A
Nature of Damage:	Aircraft totally destroyed
Commander's Licence	Private Pilot's Licence
Commander's Age:	29 years
Commander's Total Flying Experience:	189 hours (of which 86 were on type)
Information Source:	AAIB Field Investigation

The pilot, who was a member of a group which owned and operated G-AZXE from the airfield at Hucknall, had flown four times the previous day, twice with another member of the group. These flights were unremarkable.

On the day of the accident, the aircraft was refuelled with 12 gallons of AVGAS and later took off (between 1830 and 1840 hrs) to fly to Peterborough. It carried out several low passes over the airfield and adjacent roads, each culminating in a wing-over or stall turn manoeuvre, before departing the area in a south easterly direction. At approximately 1850 hrs, a light aircraft was seen overflying the Sherwood district of Nottingham, in a south-easterly direction. Three witnesses, who lived near the top of the hill at Mapperly, saw a light aircraft perform a single "looping" manoeuvre before continuing on in the same direction.

The aircraft was next seen 5 km south-east of Nottingham Airport, and south-west of Owthorpe village, flying in a westerly direction at an estimated 200 feet agl and in a slight climb. One witness, who was indoors at the time, described the aircraft as doing a series of "up to three" rolls. Another witness stated that the aircraft had been "rocking its wings" whilst flying over Cotgrave forest at 100 ft agl and in a slight climb, before it dived into the ground. Of ten witnesses, three heard a "crack" (or "bang") before the aircraft pitched nose-down. It then momentarily recovered, before diving into the ground at a steep angle. One of these witnesses was about 100 metres from the impact site and saw a roughly semi-circular hole in the trailing edge of one wing, and was aware of a sound like a "flapping tarpaulin on a moving lorry". Most witnesses to the final dive recalled some sort of rotational movement of the aircraft.

There was no recorded telephone or RTF contact with Peterborough (Sibson) or Conington airfield, or RTF contact with East Midland or Nottingham Airports, although the aircraft's radio was selected to the latter's frequency. The weather was generally fine with good visibility. The wind was 250°/08 kts.

The pilot was killed instantly by impact forces and there was no fire. Police and emergency vehicles attended at the site within 5-10 minutes.

The subsequent post-mortem examination of the pilot revealed no physical impairment or disease which might have contributed to the accident. Toxicological and drug screening were negative.

The aircraft had crashed just to the south of the village of Cotgrave, into a flat cultivated field on the top of some local high ground. Analysis of the wreckage and accident site indicated that the aircraft had struck the ground in a "left wing-low" and nose-down attitude of some 45 degrees, whilst rotating to the left. Its forward speed had been very low, whilst its rate of descent had been relatively high. At the time of impact, the propeller was either stationary or had been producing very little power. There was no fire, but evidence was apparent at the site that fuel had been present in the aircraft's single fuel tank.

Wreckage examination, both on site and at the AAIB facility at Farnborough, failed to reveal any pre-existing defects in the aircraft's flying control systems, but it was established that a failure had occurred in the left wing structure whilst the aircraft was airborne. This was later confirmed by the discovery of a trail of light wood and fabric debris across the ground, for approximately 1 km, slightly downwind of the aircraft's final flight path.

A reconstruction of the left and right wings showed the right wing to have been intact prior to impact, whilst the left wing showed evidence of failures having occurred in the centre wing rib structures, aft of the spar, and their associated trailing edge section (see figure 1). The spar itself had been intact at impact. The upper surface fabric covering this left wing had become detached in flight from the structure around all of the trailing edge. In addition, an area of lower surface fabric had also become detached at the trailing edge around the centre of this inner wing. Only some of the fabric and trailing edge section from this region of the wing was recovered from the wreckage trail.

Detailed macro and microscopic examination of some of the ribs and trailing edge from the left wing was carried out by the Wood Section of the Building Research Advisory Service. From their examination the following conclusions were drawn.

- Failure of the joints occurred, with few exceptions, through the timber, with no evidence to suggest any fault in the application or performance of the glue.

- There was no evidence of fungal attack or water ingress.

- Considerable similarity was noted in the fractures present in the two centre ribs of the left wing, *ie* L3 and L4.

- Two fractures in rib L4 were associated with"sloping grain". This would have reduced the bending strength by 20%, although it was considered unlikely that this would have been sufficient to initiate the major failure. However, it was considered that it may well have been a contributory factor in the failure.

- There was some evidence of previous crack growth in rib L3, next to the trailing edge. There was also evidence of "rubbing together" of the fracture surfaces of one failure, in both ribs. There was considerable and consistent evidence that the rib members had been subjected to high compressive stresses and that these, because of their distribution, had not occurred at the time of the major break-up of the wing. It would appear, therefore, that the wing had been subjected to high compressive stressing before the final break-up. Two possible sources of such stressing were considered:-

a) An over-taut fabric covering

While it was not possible to eliminate this source completely as the major cause, it seemed unlikely in the absence of compression damage at some distance from the actual fracture surfaces, assuming an even distribution of stress. However, if the effects of fabric shrinkage were concentrated around critical areas near the joints, the fracture pattern would be similar to that observed.

b) Overstressing in use

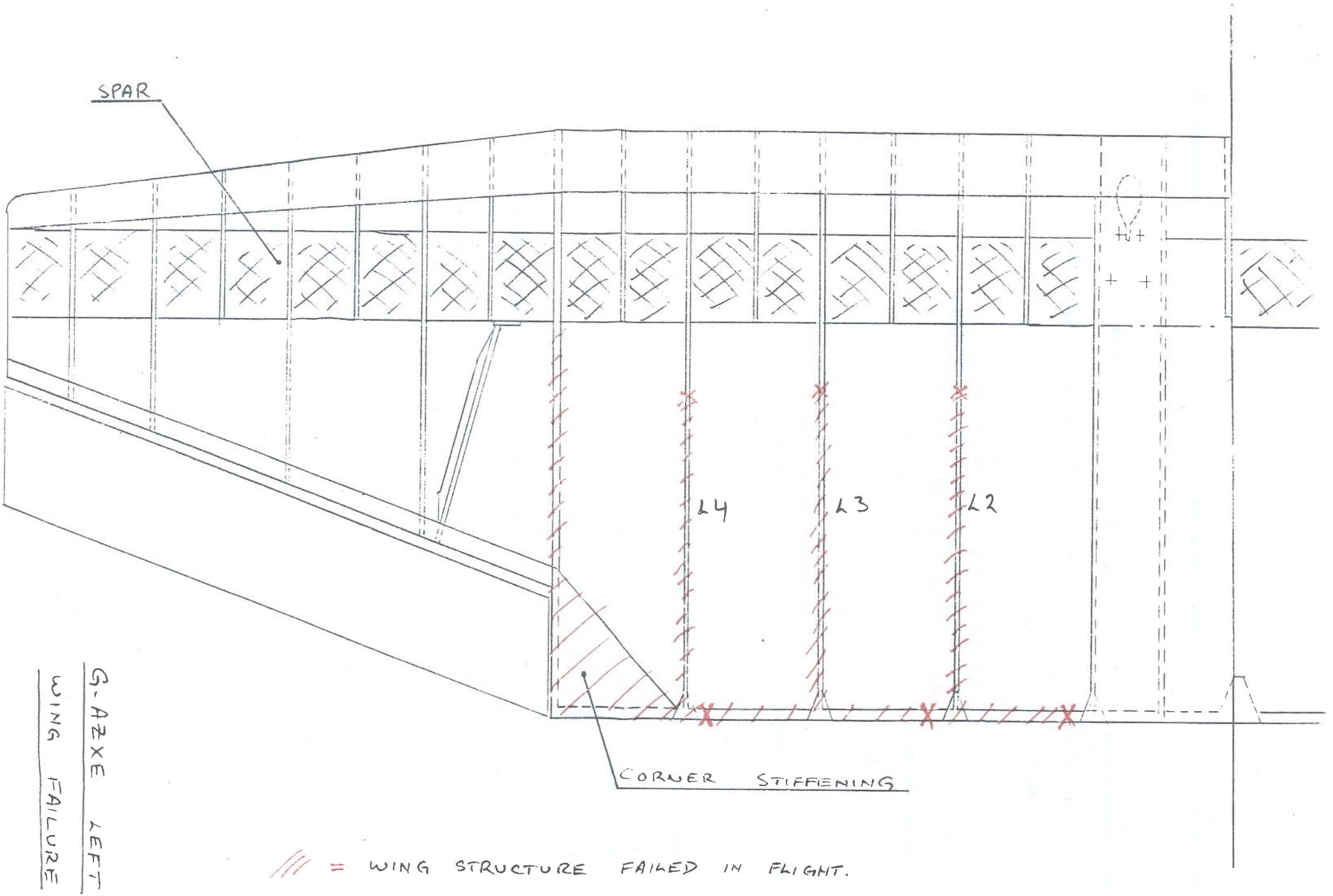
While it was not possible to eliminate the possibility that separation and abrasion of the surfaces of one fracture in each rib occurred during the major break-up of the wing, it was likely from the extent of the abrasion that separation occurred at some time before the major break-up. In particular, the discolouration associated with one of the fractures would indicate that a considerable time elapsed (several months) between the generation of the crack along induced compression creases (in the wood fibres) and the final break-up of the wing. These findings would be consistent with overstressing of the wing at some earlier date.

The wing design dates from the late 1950's and this particular example was factory-built in 1965, in France. Four years ago, the wing was re-covered with a modern man-made polyester fabric. The main advantage of this material compared to linen type fabrics, is that it is virtually "rot-proof". One characteristic difference between such fabrics is that tautness is achieved through shrinkage with the modern material. This is induced by the application of heat, typically using a thermostatically controlled iron set at about 120°C. All French and British airworthiness documentation examined relating to this type of covering contain warnings to the effect that care is necessary to prevent the application of excessive heat, as this may cause excessive shrinkage of the covering and distort the underlying structure. The wing of G-AZXE had been modified, in common with other re-covered Jodel wings examined, by the addition of a three dimensional "gusset", stiffening the structure at the outboard aft corner of the centre wing. This modification is designed to resist local deflections of the wooden structure, when the wing is covered with polyester fabric. It is thus evident that this material can induce higher static loads into this design of wing than were contemplated when it was originally designed.

The original French and British airworthiness documentation for the D120A aircraft quotes the following:-

Load factors in manoeuvres	n = +3.8g	n = -1.5g
Never exceed speed	250 km/h	(134 kts)
Max operating speed	215 km/h	(115 kts)

Aerobatics, including spins, are not permitted.



G-AZXE LEFT WING FAILURE

/// = WING STRUCTURE FAILED IN FLIGHT.