

No: 10/91

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Category: 1b

Aircraft Type and Registration: Piper PA-31 Navajo, G-LYDD

No & Type of Engines: 2 Lycoming TIO-540-A2B piston engines

Year of Manufacture: 1970

Date & Time (UTC): 17 July 1991 at 0930 hrs

Location: Lydd Airport, Kent

Type of Flight: Commercial

Persons on Board: Crew - 2 Passengers - None

Injuries: Crew - None Passengers - N/A

Nature of Damage: Outboard section of right wing and aileron explosively detached

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: 28 years

Commander's Flying Experience: 3,035 hours (of which one was on type)

Information Source: Aircraft Accident Report Form submitted by the pilot and examination of aircraft by AAIB

The aircraft, which had not flown for over 2 years, had been worked-on during the days preceding the accident, with the aim of preparing it for a ferry flight to Blackpool. This work was completed on the 16th July and the fuel tanks were filled to capacity. Following engine runs, a short test flight was conducted. On the following morning the crew decided to top-up the tanks in order to provide adequate reserves for the intended flight, which was to be conducted with the landing gear locked down. Approximately one hour after the refuelling was completed the aircraft taxied for runway 22. During the subsequent take-off run, at a speed of about 60 KIAS, a loud report was heard and the outboard section of the right wing disintegrated. Both engines were immediately shut down and the aircraft brought to a halt on the runway, the commander having transmitted a Mayday call. The crew evacuated the aircraft via the main exits. Two smaller explosions then occurred and a small fire developed, but was quickly extinguished by the airport fire service.

Examination of the aircraft revealed that the outboard 5 ft of the right wing, including the aileron, had explosively detached. The extent of the damage can be seen in the accompanying photograph. The fuel tanks, which were in that section of the wing which had not detached, had not been damaged in

the explosion, and there was no fire damage to the structure, apart from some 'sooting'. The focus of the explosion was determined by examination of the distortion that had occurred to the various ribs and panels; this was an area bounded by the rib at the outboard end of the outboard tank bay, the next rib towards the tip, the main spar and the rear spar. There was no 'pitting' or similar impact damage that would have suggested an exploding object within the wing, indicating that a fuel vapour detonation had occurred. The wing outboard of the tanks contains very little equipment, electrical or otherwise. The wires feeding the navigation lights pass through the area but the crew had pulled the associated circuit breaker before the attempted flight since the navigation lights were known to be unserviceable. The aircraft was not equipped with strobe lights. The one item of electrical apparatus located in the affected zone was the aileron trim position indicator transmitter. Some sooting was present on the surface of this unit and its two associated electrical wires were badly burned. One wire had pulled off its connector and although it was initially considered that it may have fallen off prior to the accident and struck an arc on the wing panel below, metallurgical examination showed that it was a tensile overload failure and therefore probably occurred during the explosion. No evidence of arcing was visible on the wing structure, but the possibility of this having occurred as a result of 'chaffing' at some point along the length of the wiring could not be discounted. The transmitter itself was discounted as a potential ignition source since the internal mechanism of this unit, a rheostat, was found to be in good condition with no evidence of arcing between the resistive element and the wiper-arm.

The fuel tanks are of the 'bladder'-type and no leaks were observed following the accident. In flight, each tank is pressurised by means of air drawn from a NACA vent on the wing underside and connected via a non-return valve to a pipe attached to the top of the tank. The valve operation is such that air is allowed into the tank but fuel cannot get out. The valve and associated pipework for the right wing outboard tank passed close to the area of the explosion and it was found that the union on the "air" side of the valve was loose. It was also found that the rubber seal on the valve flap had perished, with the result that fuel could pass through the valve. This would normally have caused the fuel to drain overboard, although the loose union introduced the possibility of fuel vapour having escaped into the surrounding wing cavity. However the pipework had suffered considerable distortion as a result of the explosion and this may well have caused the nut on the valve union to have become loose. Moreover, the engineer who had been working on the aircraft specifically recalled checking the tank valves.

Another possibility was that the non-wetted areas of the tanks had become slightly porous during the time that the aircraft had not been in use and consequently may have allowed small leakages of fuel through the porous areas when the tanks had been filled to capacity. The resultant vapour could then have migrated outboard around the edges of the rib at the end of the tank bay.

The aircraft manufacturer was not aware of any similar event having occurred to other PA-31 aircraft.

As a result of this potentially very serious accident and the above findings, the following Safety Recommendations have been made to the Civil Aviation Authority:

1. The CAA issue a directive, applicable to Piper PA-31 aircraft, requiring inspection of the fuel tank check valve unions for security.
2. The CAA conduct a review of the sealing characteristics of fuel bladder type tanks in Piper PA-31 aircraft, and other applicable types, with a view towards assessing the extent of any age-induced porosity/leakage problems and the need for remedial airworthiness action.



PA-31 G-LYDD
View showing damage to right wing