ACCIDENT

Aircraft Type and Registration:	Rockwell Commander 114 Commander, G-BDYD
No & Type of Engines:	1 Lycoming IO-540-T4A5D piston engine
Year of Manufacture:	1976
Date & Time (UTC):	31 May 2009 at 1218 hrs
Location:	Ballynakilly Road, Cookstown, Northern Ireland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Serious)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	526 hours (of which 145 were on type) Last 90 days - 6 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB examination of the aircraft

Synopsis

The aircraft suffered an in-flight engine failure as a result of a total oil loss; the subsequent forced landing was made into a cultivated field, but the aircraft failed to stop before encountering a ditch and hedge at its far end. The aircraft was damaged substantially as it came to an abrupt halt.

The oil loss was caused by the failure of a gasket on the oil filter converter plate, mounted on the rear of the engine. The gasket was the subject of an Airworthiness Directive (AD) which required gasket renewal at 50 hour intervals. This requirement was terminated when an improved design of gasket was fitted. The aircraft's maintenance records indicated periodic replacement of the gasket for a time following the issue of the AD. However, the aircraft was subsequently transferred to a different maintenance organisation, which concluded that the new type of gasket had been fitted and that the AD was no longer applicable.

History of the flight

The aircraft was on a flight from Oban to Abbeyshrule, in the Irish Republic. It was in the cruise at 2,000 ft close to Cookstown, when there was a sudden vibration followed by a rapid increase in propeller speed. This was followed by a loud rattling sound from the engine, which then stopped. The pilot reported that the entire sequence lasted approximately 10 to 15 seconds. He

also noted that the engine oil pressure had dropped to zero prior to the engine failing completely. He transmitted a MAYDAY call to Scottish Information before looking for a field in which to carry out a forced landing. However, all the fields he could see were small and uneven. The pilot lowered the landing gear and turned off the fuel and battery master switch, before landing downhill in a cultivated field, at the far end of which was a ditch and a hedge. The combined effect of the nose striking the hedge and the main landing gear entering the ditch caused the aircraft to come to an immediate halt. Despite considerable disruption to the fuselage, the lap and diagonal harnesses held on impact. The occupants, who had sustained minor fractures, vacated the aircraft via the left door, having been unable to open the right door.

The pilot stated that prior to the flight, he had checked the engine oil level, which was showing just below maximum, and noted that the indication had not changed from the previous flight.

Examination of the aircraft

The wreckage of the aircraft was recovered to the UK mainland where it was subsequently examined by the AAIB. It was apparent that oil had been lost from the engine, although there were no holes in the engine casing or accessories and the drain plug was present. Attempts to rotate the engine by hand using the propeller revealed the presence of severe internal damage, with at least one broken connecting rod. After removing the oil drain plug, less than half a pint of oil was drained out; it was noted that the oil contained a quantity of metallic debris.

It was observed that the accessory gearbox at the rear of the engine was covered in oily deposits, whereas the rest of the engine was relatively clean. After removing the oil filter from its threaded boss, it was apparent that a seal on the converter plate within the filter mount, Figure 1, was in a deteriorated condition. The converter plate was removed from the mount after unscrewing the boss, which is shown at Figure 2. It can be seen that there is a breach in the circumference of the seal, which has also been 'extruded' between the converter plate and the accessory housing**.** It was established that the filter was the correct type for use with this particular engine.

Converter plate gasket history

The converter plate gasket was the subject of Lycoming Service Bulletin (SB) 543B, issued on 1 July 2003. This superseded an earlier version that had been mandated by Federal Aviation Administration (FAA) Airworthiness Directive (AD) 2000-18-53. This AD stated that swelling or extrusion of the gasket allowed engine oil to leak from between the converter plate and the engine accessory housing. The AD requires inspection of the oil filter base for evidence of oil leakage and/or gasket extrusion, together with replacement of the gasket at intervals not exceeding 50 hours. These actions were intended

> *'...to prevent the complete loss of engine oil and subsequent seizing of the engine and possible fire...'*

AD 2000-18-53 was amended in July 2002, when it became AD 2002-12-07. This took account of an improved design of gasket which, when fitted, constituted terminating action for the repetitive replacements.

SB 543B additionally stated that some gaskets, with the Part Number LW-13388, had been manufactured from incorrect material, which was given as the reason

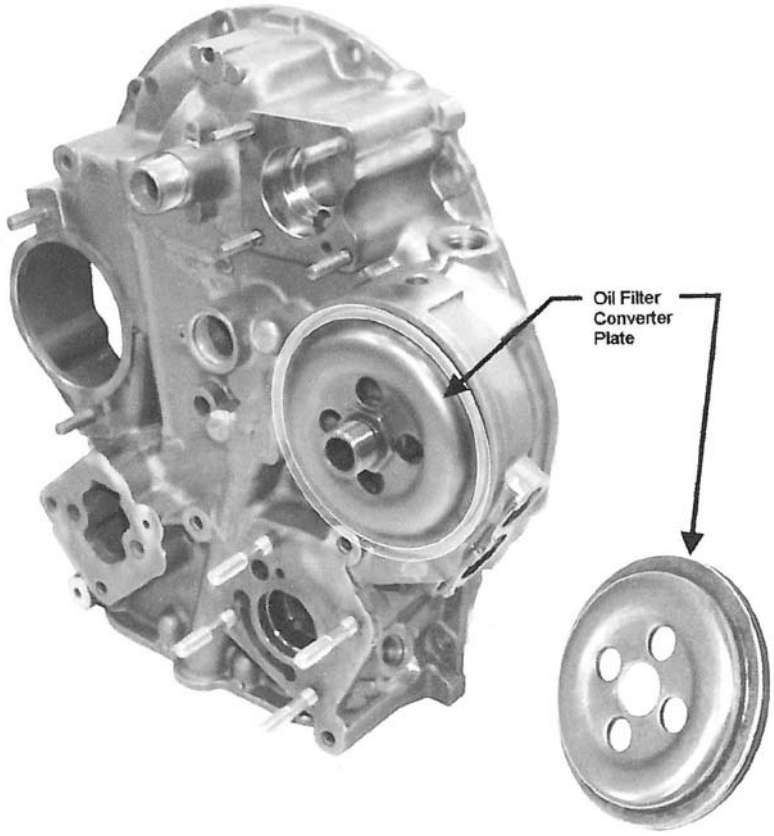

Figure 1

Oil filter converter plate location on the accessory drive housing

Figure 2

View of filter and converter plate, showing damaged gasket

why gaskets become extruded during service. The new gasket has the Part Number 06B23072, and this number is identified on the component. After bonding the new gasket in place, the SB requires the number 543 to be 'vibro-etched' on the outer surface of the converter plate.

Examination of the converter plate gasket

Examination of the converter plate revealed that it had not been marked with the number 543, in accordance with the requirements of the SB, which led to an initial conclusion that the gasket may have been of the old type. A new, correctly identified, gasket was obtained and this, together with the filter canister, converter plate and failed gasket, were subjected to detailed examination. The analysis of the gaskets did not establish the material compositions; however differential scanning calorimetry values were significantly different for the two types, meaning that they had not been manufactured from the same base polymer. This reinforced the view that the failed gasket was an example of the old type. The engine manufacturer stated that the material used for the old gasket was ethylene propylene rubber, which is not recommended for use with petroleum based oils.

The failed gasket had sustained considerable damage, as shown in the photographs at Figure 3a and 3b. It was concluded that this was partly the result of high temperatures generated within the engine following the loss of lubrication.

Aircraft maintenance records

Copies of the aircraft engine log book pages were obtained, which contained dates of compliance with the various Service Bulletins and Airworthiness Directives that applied to G-BDYD. It was apparent that AD 2000-18-53 was first complied with in September 2000, when the engine had achieved 36.5 hours since overhaul. The next recorded gasket replacement occurred in September 2001, at 122 engine hours, which was clearly in excess of the stipulated 50 hour interval but it was apparent that a 50 hour and an Annual Inspection had been carried out in the intervening period. The last recorded compliance with the AD was in March 2003, at 184 engine hours. There was no record of complying with SB 543B, which introduced the new gasket and which terminated the requirement for its replacement every 50 hours.

The aircraft was subsequently transferred to the organisation responsible for its maintenance at the time of the accident. Their first task was a 50 hour check, carried out in May 2004 at 215 engine hours. It is usual for a maintenance organisation to conduct an audit of modifications, Service Bulletins and Airworthiness Directives to establish which are applicable to a newly 'acquired' aircraft, and whether they have been implemented. In this case, the maintenance organisation stated that AD 2000-18-53 had been raised on their paperwork, but was identified as not applicable due to previous compliance, ie, a new type of gasket had been fitted, thus negating the requirement for subsequent gasket replacements. However, they could not produce any item of the paperwork that led them to this conclusion.

The most recent maintenance conducted on the aircraft by this organisation was an Annual Inspection, which occurred on 16 January 2009, at 280 engine hours. This was five hours prior to the accident.

Conclusion

The available evidence strongly indicated that the engine failed as a result of a complete loss of oil following the failure of the gasket on the oil filter converter plate. Loss of oil was consistent with the reported symptom

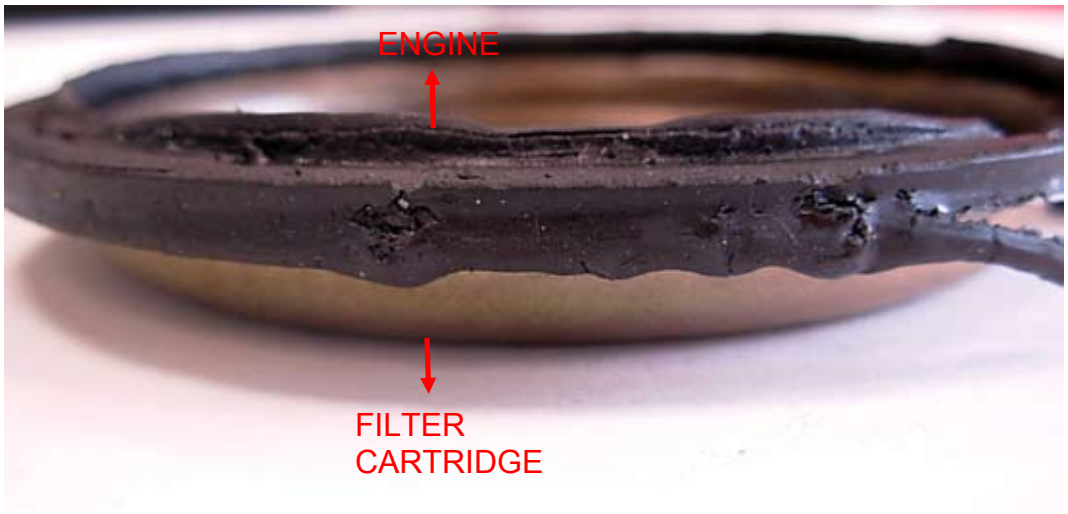

Fig 3a

Fig 3b

Figure 3

Views of damaged gasket

of high engine speed, as oil pressure is used to oppose the aerodynamic forces acting on the propeller blades which, in conjunction with the blade counterweights, act to move the blades towards the fully fine pitch position. Thus, loss of oil pressure would result in the propeller hub piston moving in the fine pitch direction, reducing the load on the engine, with a consequent uncommanded rise in speed.

The forensic examination indicated that the converter plate gasket was likely to have been of the old type, which required replacement at 50 hour intervals. The current maintenance organisation had mistakenly concluded that FAA AD 2000-18-53 was no longer applicable, with the result that the gasket had not been changed for approximately 100 engine operating hours by the time of the accident.