Piper PA-28R-200B, G-AZRV, 30 December 2000 at 1436 hrs

AAIB Bulletin No: 8/2001 Ref: EW/C2000/12/08 Category: 1.3

Aircraft Type and Registration:	Piper PA-28R-200B, G-AZRV
No & Type of Engines:	1 Lycoming 10-360-C-IC piston engine
Year of Manufacture:	1971
Date & Time (UTC):	30 December 2000 at 1436 hrs
Location:	Compton Abbas Airfield, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - 1
Injuries:	Crew - 1 (serious) - Passengers - 1 (serious)
Nature of Damage:	Aircraft damaged beyond repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	465 hours (of which 105 were on type) Last 90 days - 16 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB investigation of the engine

History of the flight

Following an uneventful flight from Blackbushe to Compton Abbas Airfield, a pre-flight inspection of the aircraft was carried out by the pilot before the subsequent departure. This included checking of the engine oil contents, which were found satisfactory. The aircraft then departed normally but some 5 minutes later, when it had climbed to some 2,500 feet amsl, the propeller rpm suddenly increased. The pilot retarded the propeller pitch control lever, but this had no effect. He then noted that the engine oil pressure gauge was indicating zero, although the oil pressure had been normal when he had checked the gauge during the climb.

The pilot immediately turned the aircraft back towards Compton Abbas and reduced the engine power to 20 inches of manifold pressure, since he realised that the engine was likely to seize at any moment. Snow on the ground made obstacle identification and field conditions difficult to assess, and so he decided to attempt to land on the airfield since he considered that he had sufficient height available at that stage. However the engine then suddenly seized, causing the aircraft to land 'short' from where it carried on across a road before being brought to an abrupt halt by a low bank within a

hedge, which formed the western perimeter of the airfield. This impact caused substantial damage to the underside of the aircraft and probably contributed to the severity of the occupants' injuries.

On-site inspection of the engine

On-site inspection of the engine revealed that a catastrophic failure had occurred which had resulted in the top of the crankcase rupturing open. This had exposed some of the internal components and it was apparent that the No 2 connecting rod big end had failed. The No 1 big end bearing appeared to be in a condition of imminent failure, and it was evident that considerable heat had been generated. There was no oil film on these components, and virtually no oil remained in the sump.

Recent maintenance history

A few days before this accident, the engine which had previously been in this aircraft had become time expired and so had been removed. A factory-overhauled replacement engine was then fitted, and its installation completed on 22 December 2000. Two 'running in' flights, each of approximately one hour's duration, were later conducted on the 27 December. The oil filter was then renewed and the filter which had been replaced was then cut open in order to check for any debris, but was found satisfactory. The next flight was the trip to Compton Abbas on the day of the accident.

Following the accident, the aircraft operator and the licensed aircraft engineer who had carried out the engine change became aware of the existence of a Federal Aviation Administration (FAA) Airworthiness Directive (AD) regarding the fitment of engine oil quick drain valves. The engineer then realised that the drain valve that he had fitted prior to installing the engine was of a type which was not approved by the aircraft manufacturer for this particular engine/airframe combination.

Over the last 30 years there have been a number of incidents involving PA-28R series aircraft in which installation of an unapproved drain valve has resulted in the nose landing gear drag link striking the drain valve during gear retraction. This in turn has resulted in the drain valve being pushed open, with consequent loss of oil. Piper Service Letter No 910, dated 29 December 1980, drew operators' attention to the problem, and became the subject of Airworthiness Directive (AD) No 81-11-02 in October 1981. This applied to PA-28R-200, PA-28R-201 and PA-28RT-201 aircraft with certain serial numbers, and specified that the quick drain valve should have Piper Part No 492-172V. The AD additionally required that two warning placards be installed, one on each of the lower engine mounting tubes, which read:

CAUTION

UNAPPROVED OIL DRAIN VALVES CAN CAUSE INADVERTENT DRAINING WHEN THE GEAR IS RETRACTED - USE ONLY PIPER APPROVED PART

The placards were found on G-AZRV and the airframe log book indicated that this AD had been accomplished in November 1989.

The Piper Maintenance Manual, in microfiche form, was available to the engineer, who used it to obtain torque loading data for the engine mounting bolts. The 'Engine Installation' section was not otherwise referred to on this occasion as he had carried out engine changes previously and thus regarded it as a repetitive task.

A new or overhauled engine is supplied with a simple oil drain plug. Most operators choose to fit a quick drain type instead, which has a spring-loaded bayonet fitting enabling oil to be drained from the engine via a 'push to open, turn to lock' action. The engine previously fitted to G-AZRV was equipped with such a drain valve and the engineer had attempted to remove it in order to fit it to the replacement engine. However, this Curtiss drain valve had become damaged in the process since it had become seized in the sump, and thus a new component had to be ordered. In fact, the part number of the seized drain valve was not that referred to in AD 81-11-02, despite the stated compliance with this AD, although it was of similar appearance. However, the engineer subsequently stated that he had been 'unaware of the nineteen year old AD and the related Piper Service Letter', and so was unaware that the Curtiss drain valve which had been fitted to the replaced engine was an incorrect part. Whilst the Illustrated Parts Catalogue (IPC) was available, also on microfiche, the engineer had looked up the part in a catalogue issued by a USA-based general aviation parts distributor. He duly ordered a Curtiss CCA-1650 quick drain valve from a local supplier. However, there were none in stock and so the supplier, with the engineer's knowledge, substituted a CCB-37000 instead. The latter differed from the unit ordered in that it was equipped with a hose connector that protruded approximately one inch below the valve body.

The engineer had apparently failed to notice the placards on the lower engine mounting frame, and although he was aware that problems could result from fitting an incorrect drain valve, believed that these were only caused by the type of valves that were equipped with an integral drain hose. The fact that the drain valve fitted to the replaced engine had been of a Curtiss type had influenced the engineer, who subsequently stated: 'I was disposed to obtain a valve of the same make to fit to the new engine before its installation'.

Examination of the engine and drain valve

The engine, still in its mounting frame, together with part of the nose landing gear, was examined by the AAIB. Some oil was noted on the sump underside and on the nose landing gear door linkage. A photograph of the underside of the engine is shown at Figure 1. All the oil hose connections were intact and, after removing the accessory gear case, it was apparent that the gear train and oil pump were in good condition. The quick drain valve was found to be in the closed position. The hose connector was slightly bent, and there were marks on it that could have been made by the nose landing gear drag linkage. When the valve was opened, it was found that a flake of engine debris, possibly bearing shell material, was embedded in the valve and had been moulded to the shape of the valve seat, as shown in Figures 2a and 2b. This indicated that the valve must have been open at some stage, in order to allow the debris to drop in, whilst the engine was running in its damaged condition.

Maintenance Manual

During the investigation it was noted that the 'Engine Installation' section of the PA-28R-200 Maintenance Manual contained a diagram of a dressed engine installed in its frame. There was no direct reference to the dangers of installing an unapproved quick drain valve. However a diagram on a separate page had a note pertaining to the valve, which referred the reader to Service Letter 910. In contrast, the equivalent diagram of the dressed engine in the PA-28R-201 manual included a representation of the warning placard, together with its legend.

It was noted that the text in the 'Handling and Servicing' sections of the PA-28R -200 and the PA-28R-201 Maintenance Manuals each contained cautionary notes about installation of the correct

part numbered quick drain valve. The -201 manual additionally explained the potential consequences of installing an incorrect valve.

Discussion

The engine failed as a result of oil loss caused by the fitting of an unapproved quick drain valve to the sump. Previous incidents have indicated that the nose landing gear drag linkage can contact the valve's hose connector on gear retraction, moving it upwards and so opening the valve. It is perhaps curious that in this case the problem did not manifest itself until the fourth flight following the engine change. However it is possible that factors such as landing gear rigging and any 'overswing' during gear retraction could influence whether the valve is merely pushed open momentarily, or latches in the open position.

Engineers will not refer to manuals for many tasks, especially the minor or more repetitive tasks. However, an engineer is more likely to do so for major tasks, such as engine changes. An explicit warning against fitting an unapproved quick drain valve is contained in the PA-28R-201 Maintenance Manual. No such warning is included in the PA-28R-200 Manual, although sufficient information is included to enable the correct drain valve to be identified. Whilst there are significant airframe differences between the two model types, the landing gear and engine installations are virtually identical, as are the consequences of fitting an incorrect drain valve. It would therefore appear sensible to standardise the manuals across the model types in order to give equal weight to the importance of installing the correct quick drain valve.

Safety recommendation

As a result of the above findings arising from this investigation, the following Safety Recommendation is addressed to New Piper Aircraft Corporation:

Safety Recommendation No 2001-59:

> In order to further reduce the likelihood of fitment of incorrect quick release drain valves to the oil sumps of engines on Piper PA-28R series aircraft, with the attendant risk of contact by retracting noselegs and the sudden release of all engine oil contents, it is recommended that New Piper Aircraft Corporation review the Maintenance Manuals for PA-28R series aircraft with regard to the installation of quick drain valves and make amendments where required to give adequate warnings, for all applicable model types, of the consequences of fitting an incorrect valve.

With regard to the UK CAA, it has indicated that it will include this accident in a forthcoming issue of their General Aviation Safety Information Leaflet (GASIL).