AVIATION OCCURRENCE REPORT

LOSS OF ENGINE POWER

OTTAWA AVIATION SERVICES INC.
DIAMOND DA20-A1 KATANA C-FTKZ
CORNWALL REGIONAL AIRPORT, ONTARIO
15 APRIL 1997

REPORT NUMBER A97O0055

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Summary

The aircraft, with an instructor pilot and private pilot on board, departed Ottawa, Ontario, on a planned night cross-country training flight to Cornwall,, Mirabel, Quebec, and return to Ottawa. During the climb to cruise flight, the smell of hot oil was detected in the cockpit. The engine oil temperature was observed to be higher than normal, but the oil pressure was normal. The smell was attributed to possible spillage during the addition of oil to the aircraft engine (Bombardier-Rotax GMBH Type 912A3) before departure. The smell faded away and did not reoccur, so the flight was continued. After arriving at Cornwall, a touch-and-go landing was completed on runway 28. At about 300 feet above ground level (agl), the after take-off checks were completed and the engine oil temperature was again noted to be higher than normal, but now the oil pressure was observed to be lower than normal. At about 500 feet agl, a decision was made to return to the airport and land on the reciprocal runway, runway 10. The private pilot completed the turn back to the airport; however, being close to the runway the aircraft was high on the approach. The private pilot placed the aircraft into a forward slip to quickly lose altitude, but the instructor determined that the aircraft could not be landed on the remaining runway without experiencing a runway excursion. The instructor pilot took control of the aircraft and initiated an overshoot at low level. Shortly thereafter the aircraft engine lost all power, and the instructor pilot carried out a forced landing into a field adjacent to the airport. During the landing, the nose gear was torn from the aircraft causing the aircraft to flip over. The crew sustained minor injuries, and the aircraft was substantially damaged.

Ce rapport est également disponible en français.

Other Factual Information

The instructor pilot and private pilot were qualified and certified for the flight in accordance with existing regulations. The private pilot was receiving dual instruction toward his night rating when the accident occurred.

The aircraft was examined and no abnormalities were noted except with the aircraft engine. During the examination of the engine it was observed that a clamp installed on the No. 2 exhaust pipe to secure asbestos tape to the pipe had been chafing the outboard end of the pressure oil filter. This chafing action, sustained by the vibration of the engine during operation, had worn a hole in the filter case that allowed oil to escape from the engine which resulted in diminished oil pressure. The No. 2 exhaust pipe is fastened to the No. 2 cylinder head on studs by M8 self-locking nuts (Rotax part number (P/N) 942-035). It was discovered that these nuts had lost their torque and became loose which allowed the exhaust pipe to become loose, causing contact with the oil filter. Oil had sprayed over the windshield of the aircraft.

The exhaust nuts on Nos. 1 and 4 cylinders were also found loose but the exhaust nuts on the No. 3 cylinder were tight. Review of the aircraft maintenance records revealed that work had been done on cylinder Nos. 1, 2, and 4 that involved the removal and installation of the exhaust nuts.

The locking mechanism of the M8 lock nut is an oval-shaped thread hole manufactured into the nut cylinder which, on installation on the exhaust stud, pinches the stud thread. During removal of the lock nut, the pinch on the stud thread is reduced and the locking capability is diminished. The aircraft maintenance manual states that "self locking nuts must be replaced with new items after removal in the event that the friction torque has diminished". Testing conducted at the Transportation Safety Board of Canada, Engineering Branch, determined that each time a M8 lock nut is installed and removed from an exhaust stud on the ROTAX engine, the friction torque diminishes. Investigation also determined that the exhaust nuts on the occurrence engine had been re-installed and that the maintenance facility had no M8 self-locking exhaust nuts in their spares stock.

A spring contained in the original oil pressure filter (Rotax P/N 825-700) was causing cracks to develop in the end of the filter housing. Diamond Aircraft recommended the replacement of this assembly in Diamond Aircraft Alert Service Bulletin No. DA20-79-04A, Rev. 0, issued 10 January 1997, with oil filter Rotax P/N 825-701. The replacement filter is dimensionally longer than the original filter and, when installed on the engine, reduces the end clearance with the No.2 exhaust pipe. Further, each time the filter is required to be replaced, the No. 2 exhaust pipe must be removed and reinstalled.

Analysis

The decision-making process which surrounded the decision by the flight instructor to conduct an overshoot procedure at night with an indication in the cockpit of low engine oil pressure was examined. In hindsight and with the knowledge of outcome, this decision may appear to be incorrect; however, the decision and the factors influencing the decision must be examined in light of the situation facing the instructor pilot at the time. When the instructor pilot observed that there was a problem with the oil pressure, he immediately instructed the student pilot to turn back to the runway for a landing. The instructor pilot's decision to land the aircraft as soon as possible indicates he considered this situation an emergency and acted accordingly. He did not

immediately take control of the aircraft as the flying pilot was maintaining control of the aircraft and was completing the turn back to the airport in accordance with procedures for landing.

Because the flying pilot did not successfully complete the approach to land on the remaining runway, it could be argued that the instructor pilot should have taken control earlier and guaranteed the landing to be completed on the runway. As it was dark and there was a mist on the canopy, it is not known at what time the instructor pilot could clearly determine his height and position relative to the runway or if the contaminated curved canopy distorted his perception. However, it is apparent that, as soon as the instructor pilot believed the flight was not progressing as it should have been, (i.e., the aircraft was too high), he immediately assumed control.

Once it was apparent that the aircraft was too high to successfully effect a landing on the runway, the instructor pilot was faced with two options: land straight ahead or overshoot and attempt another landing. The instructor knew that if he landed off this approach, he would experience a runway excursion and most likely damage the aircraft. Not knowing what was beyond the surface of the runway and that damage to the aircraft was likely, the instructor pilot decided to overshoot.

Attempting an overshoot at night with low oil pressure was the riskier of the two options. However, the instructor pilot, knowing he had an engine that was still producing power, believed that there was a possibility of completing a safe landing. The decision to overshoot rather than land straight ahead is consistent with framing bias where the decision is framed as a choice between two losses: sure loss and uncertain loss. Landing straight ahead would have most likely guaranteed sure loss, that is damage to the aircraft and possible injuries. In conducting the overshoot, the possibility existed that the aircraft would not have been able to successfully complete the landing; however, that possibility was less known and not as certain as the sure loss that would have been experienced during a runway excursion. Typically, when faced with these types of probabilities, people are prone to accept the uncertain, albeit riskier loss. In the case of the instructor pilot, it appears that his decision was consistent with this type of bias.

In this occurrence investigation the exhaust nuts on three of the four cylinders were found loose. It was determined that after maintenance that involved removing the exhaust system, the self-locking exhaust nuts were not replaced as recommended by the aircraft manufacturer. This style of lock nut is designed to be used only once as the removal reduces the locking qualities to where reinstallation is not recommended.

The replacement oil filter played a minor role in this occurrence. The increased length placed the end of the filter closer to the exhaust pipe; however, had the pipe been installed and secured with new lock nuts torqued to specification, the end clearance would have been maintained and chaffing prevented.

Findings

1. The instructor pilot chose to overshoot and attempt another landing rather than land straight ahead.

2. The replacement oil filter, being physically longer than the original oil filter, reduced the end clearance between the filter and the No. 2 exhaust pipe.

3. The self-locking exhaust nuts that secure the exhaust pipe to the cylinder head were found loose on three of the four cylinders.

4. The loose exhaust lock nuts allowed the No.2 exhaust pipe to move into contact with the oil filter housing and a clamp installed on the pipe chaffed a hole in the housing.

5. There were no M8 lock nuts (ROTAX P/N 942-035) in the spares stock at the maintenance facility.

6. The hole in the pressure oil filter housing allowed the lubricating oil to escape from the engine. When the quantity of oil in the engine became insufficient to supply the oil pump, the oil pressure deteriorated.

7. The aircraft maintenance manual states "self locking nuts must be replaced with new items after removal in the event that the friction torque has diminished."

Causes and Contributing Factors

The self-locking exhaust nuts, re-installed against the aircraft manufacturer's recommendation, came loose and allowed the exhaust pipe to move into contact with the pressure oil filter housing. The vibration of the engine during operation caused a clamp installed on this pipe to chaff a hole into the housing allowing the engine lubricating oil to escape. This resulted in the loss of engine oil pressure. Contributing to this occurrence was the increased length of the replacement oil filter and the lack of replacement nuts.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 22 July 1998.