AVIATION OCCURRENCE REPORT

POWER LOSS - FORCED LANDING

AVIATION CAREER ACADEMY LIMITED
ZENAIR CH2000 C-GSOA
BELL ISLAND, NEWFOUNDLAND
05 SEPTEMBER 1997

REPORT NUMBER A97A0170

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

The aircraft departed the St. John's, Newfoundland airport at 1955 Newfoundland daylight time en route to the Bell Island flight training area, about 10 miles to the west. The right fuel tank was selected for the departure and after reaching the training area the left tank was selected. The electric fuel boost pump was selected on for the duration of the training exercise. The chief flight instructor (CFI), who sat in the left seat, was giving a type check out to the right-seat instructor. The first sideslip manoeuvre was initiated at 3 000 feet above sea level (asl) by applying a co-ordinated partial-travel left aileron and right rudder input. The abrupt nose-down pitch that resulted startled the right-seat instructor and he reacted by recovering the aircraft from the manoeuvre. A faint fuel smell was detected in the cockpit during the manoeuvre, a smell that had always been noticeable when in the sideslip. After the right-seat instructor was briefed that the pitch-down was normal, the CFI instructed him to initiate a second sideslip, this time applying full left aileron and full right rudder input. The aircraft pitched down and the negative gravitational forces that resulted caused the crew to be restrained hard against their shoulder harnesses; the fuel smell in the cockpit was much stronger this time. When the pilot recovered from the descent, he advanced the throttle, but the engine did not respond. A check of the fuel gauges confirmed there was an adequate fuel quantity indication in the selected tank and the engine fuel pressure indication was normal. He briefly advanced the throttle but returned it to idle after the engine did not restart. The propeller was windmilling as the aircraft descended and the pilot set up for a forced landing to the Bell Island airport, joining the circuit downwind after crossing overhead the field. The CFI then took control of the aircraft since her left-seat position provided a better view of the runway. However, because of darkness, she lost sight of the unlit runway after turning onto final approach and the aircraft struck a grassy knoll about 700 feet short of the threshold of runway 26. Both pilots received minor injuries, the aircraft was destroyed.

Ce rapport est également disponible en français.

Other Factual Information

The emergency locator transmitter (ELT) was not armed, and consequently did not activate during the ground impact. The ELT was not a checklist item and its switch position went unnoticed by the flight crew during their preflight checks.

The structural integrity of the cockpit was compromised as a result of the impact forces. The fuselage side structure that secures each latch portion of the seat belts had separated causing the outboard lap belts to become unsecured. The main landing gear, a one-piece spring steel gear that is externally bolted to the fuselage, rotated aft at impact causing the lower fuselage structure above it to be forced upward . This action forced the seat back adjustment rods (attached to brackets on the fuselage lower skin) to move forward forcing the seat backs forward.

Several other safety related issues were identified during the course of the investigation. The latch bar (P.N. 20-F-32-3) of the door latching mechanism exhibited excessive wear considering the aircraft's low time in service (41.1 hours). The exhaust stack on the number-2 (front left) cylinder is slip jointed. Exhaust stains on the air heater indicate there was an exhaust leak. Examination of the aircraft cabin heat box supply hose indicated that exhaust gases had entered the air box. The aircraft owner's manual, as it pertains to the operation of the alternate static, could result in confusion and incorrect interpretation by the reader. Firstly, Section 3, (emergency procedures, icing), states: "When the pitot is not frozen and the alternate static is used, the airspeed reading must be increased by 20 KT". Pilots report that the airspeed indication actually increases by 20 kt. Secondly, Section 4 (normal procedures, before take-off) states: "Check alternate static (if installed) switch (normal: switch down)". In the occurrence aircraft, the switch is not placarded "Normal", rather it is placarded "Alternate Static" and the placard location and wording would indicate that when the switch is in the down position the alternate static is selected "on", which is contrary to the owner's manual. Additionally, Section 4 (Normal Operations, Pre-Landing Check, Note:) states: "Large or full rudder deflection side-slip may cause some pitch oscillation at or below normal approach speeds. This does not affect control of the aeroplane. Remove pro side slip input as required". Pilot's report that the CH2000 side slips can result in a steep nose down pitch attitude, even when entered at speeds greater than normal approach speeds.

Aircraft records indicate there was about nine gallons of fuel in the left tank and seven gallons in the right tank at impact. The aircraft fuel selector was on left tank at impact. The fuel supply hose had separated at the engine firewall fitting during the ground impact and the fuel gascolator received impact damage, emptying the contents of the left fuel tank onto the ground. The investigation identified that, other than the impact damage, all the fuel lines were correctly secured, all fuel filters and screens were clean, and the fuel supply lines were unrestricted.

The aircraft was leased by the operator from the aircraft manufacturer; it had a total of 41.1 hours air-time since manufacture in May, 1997, and records indicate that it was maintained in accordance with existing regulations.

The engine, which exhibited only minor impact damage to the exhaust system, induction air box, and alternator mount bracket, was transported to an engine overhaul facility for running in a test cell. Prior to running the engine, it was identified that the carburettor (MA-3PA) needle valve was jammed in the closed position. An attempt was made to test the engine using the carburettor in that condition. An inlet air box was installed on the carburettor using two diagonally placed bolts (for time saving purposes). When the fuel supply was introduced to the carburettor a massive fuel leak was observed. Fuel poured from an air box attach bolt hole in the rear of the carburettor that was left void for the test. The two rear bolts thread into the bottom of the carburettor and appear as a raised boss on the bottom of each float chamber. The carburettor was dismantled and one of the bosses was found broken off of the carburettor bowl and was against the float chamber wall. The carburettor was re-assembled and the engine successfully test run to maximum power. When the carburettor was disassembled after the test run it was observed that the broken boss had moved. Surface finish discolouration on

the broken boss and float bowl indicated that the carburettor had been damaged for some time.

Upon completion of the engine manufacturer's certification process, the carburettor is removed, drained and shipped with the engine to Zenair for installation. The inlet air box and the bolt hardware for the installation is supplied by Zenair. During the inlet air box installation, if the rear attach bolt is too long, further bolt tightening can damage the carburettor by breaking off the boss. This can result in fuel leaking out through the threaded bolt bore of the carburettor. It can also result in the broken boss interfering with normal operation of the engine by restricting proper float movement. The carburettor has no fuel in it when installed at Zenair and internal damage resulting from incorrect bolt length would be difficult to recognize.

The float type carburettor is required to ensure an adequate fuel supply and correct fuel/air ratio is available under all normal operating conditions and flight attitudes. Also, the fuel level in the float chamber must always remain at a level below the discharge nozzle outlet to prevent fuel entering the carburettor throat when the engine is not operating. This is accomplished by the float operated needle valve which regulates the flow of fuel into the float chamber. As the fuel level increases, the float repositions the needle valve towards the closed position. The valve is completely closed prior to the fuel level increasing to the height of the nozzle outlet.

The pilot operated throttle lever is manually connected to the throttle valve. As the throttle lever is advanced, the throttle valve opens allowing more air to flow through the throttle body. The airflow increase and pressure drop that results provides a fuel flow increase to the engine.

A disadvantage of the float type carburettor is that abrupt aircraft manoeuvres may interfere with the function of the float mechanism resulting in fuel flow interruptions and sometimes a complete loss of engine power.

Analysis

One of the raised bosses in the carburettor float chamber had been broken off for some time as evidenced by the surface finish wear on the broken boss and on the float chamber floor. Had the carburettor been damaged at the engine manufacturer's facility, it should have been identified during the numerous post-run inspections. Fuel would have drained from the carburettor as soon as the test cell inlet air box was removed.

It is probable that the carburettor was damaged at the Zenair facility when their inlet air box was installed. Since the carburettor was void of fuel during the air box installation, any internal damage resulting from incorrect bolt application would have been difficult to detect.

The aircraft fuel system/components were inspected and found to be serviceable. Aircraft records, flight crew reports, and information gathered at the accident site confirmed that there was sufficient fuel onboard and in each tank to complete the flight. The damaged carburettor was found to be the only part of the aircraft fuel system that could have caused the engine power loss. Had the engine power loss been due to fuel flow interruption during the sideslip, engine power should have returned shortly after recovery from the manoeuvre.

The momentary negative "g " that occurred during the sideslip would cause the broken boss to move about in the float chamber. Although the carburettor needle valve was jammed in the closed position following the ground impact, the strong fuel smell experienced during and following the engine power loss does not support the conclusion that the valve was jammed closed prior to impact.

Had the broken boss caused the needle valve to remain open, fuel under pressure (electric fuel pump on) would continuously discharge into the carburettor throat. Since the fuel delivery would far exceed the engine's fuel demands, the result would be a quickly flooded engine, a complete power loss, and a strong fuel odour in the cockpit.

Findings

1. The internal damage to the carburettor was most likely the result of an incorrect bolt application during the inlet air box installation at the Zenair facility.

2. It is probable that the broken boss jammed the carburettor float and needle valve in the open position, flooding the engine with fuel and resulting in a complete engine power loss.

3. The ELT was not armed and, consequently, did not activate during the ground impact.

4. The outboard portion of each lap belt became unsecured when the fuselage structure, to which it attached, separated at impact.

5. The door latch bar (P.N. 20-F-32-3) exhibited excessive wear given its low time in service (41.1 hours TTSN).

6. Examination of the occurrence aircraft cabin heat box supply hose indicated that exhaust gases had entered the air box.

7. The alternate static switch placarding does not provide clear indication of the static source selected.

8. The CH2000 owner's manual does not provide clear direction as to how the airspeed correction should be applied when the alternate static source is selected.

9. The CH2000 side slips can result in a steep nose down pitch attitude, even when entered at speeds greater than normal approach speeds.

Causes and Contributing Factors

It is probable that the engine power loss was caused by pre-impact carburettor damage that interfered with the normal fuel scheduling to the engine during the sideslip manoeuvre. It is also probable that the carburettor was damaged as a result of an incorrect bolt application during the inlet air box installation.

Safety Action

Zenair has removed all of the air box attach bolts that were in their parts inventory at the time of the occurrence and has replaced them with shorter bolts. Zenair has also issued Service Bulletin (SB) 97-10, requiring aircraft owners and operators to inspect the carburettor for damage and inspect the air box attach bolts to ensure they are the correct length. All of the affected aircraft were inspected. As a direct result of operator compliance with the Service Bulletin instructions, twelve production aircraft have been identified with similar carburettor damage.

Transport Canada has reviewed the owner's manual for the Zenair CH2000 and revisions have been made. The

service manual, the pilot reports on the flight characteristics during side slip manoeuvres, and the operation of the alternate static selection will also be verified. Corrective actions will be initiated as required.

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.