Aviation Safety Investigation Report 200200007

Government Aircraft Factories N22C

04 January 2002

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Occurrence Number: 200200007 **Occurrence Type:** Serious Incident
Location: 4km N Porpoise Point, VTC Approach Point
Date: 04 January 2002 **Time:** 1715 EST
Highest Injury Level: Nil
Injuries:

	Fatal	Serious	Minor	None
Crew	0	0	0	1
Ground	0	0	0	-
Passenger	0	0	0	10
Total	**0**	**0**	**0**	**11**

Aircraft Details: Government Aircraft Factories N22C
Registration: VH-MSF
Serial Number: N22B-69
Operation Type: Charter Passenger
Damage Level: Nil
Departure Point: Wanggoolba Qld
Departure Time: 1610
Destination: Coolangatta Qld

Approved for Release: 20 August 2002

FACTUAL INFORMATION

History of the flight

The pilot was conducting a charter flight in the Nomad N22C aircraft with 11 persons on board from Wanggoolba Aircraft Landing Area (ALA), Fraser Island to Coolangatta. During cruise flight at 1,000 ft, approximately 2 NM north of Porpoise Point, South Stradbroke Island, the pilot noticed a slight yaw to the left and felt the aircraft decelerate. He then saw that the left engine low oil pressure and generator warning lights had illuminated. While responding to the left engine failure, the pilot noted that both low fuel pressure warning lights had illuminated and that the right engine had failed. The pilot then conducted a successful forced landing straight ahead on the northern end of Main Beach, immediately south of the Gold Coast Seaway.

After arriving at the beach landing site, the owner/chief pilot and engineering personnel inspected the aircraft, during which it was noted that the left fuel gauges indicated 120 lbs and the right fuel gauges indicated 160 lbs fuel remaining. A small amount of fuel was visible in the left fuel tank from the left filler point and no fuel was visible in the right tank. The gradient of the beach resulted in the aircraft being slightly left-wing low. Operator personnel used jerry cans to add a total of 178 L of avtur to the aircraft and bled air from both the left and right fuel lines. The owner/chief pilot then flew the aircraft from the beach to Coolangatta.

After the aircraft arrived back at Coolangatta, engineers disconnected the fuel lines from the engine-driven fuel pumps and ran the electric fuel pumps until the low fuel pressure lights illuminated, indicating that fuel was no longer being pumped. The fuel debi-meter indicated that 192 lbs, or approximately 107 L of fuel had been recovered. The estimated fuel consumption for the flight from the beach to Coolangatta was approximately 40 L, leaving approximately 30 L of the 178 L added on the beach unaccounted for. The aircraft flight manual stated that

total unusable fuel was 19 L. No evidence of a fuel leak was identified. Although Operator personnel conducted a comprehensive engineering inspection of the aircraft's fuel system, the missing fuel could not be accounted for.

The incident flight was the aircraft's first commercial flight following a period of maintenance work during which engineers had ground run the aircraft several times and the owner/chief pilot had conducted two test flights.

Fuel

Before departing Coolangatta on the first leg of the days flying, the pilot had noted the fuel gauge indications and calculated that he required 200 L to attain full tanks. He then asked the refueller to add 120 L to the left tank and 80 L to the right tank. The pilot did not mention to the refueller that he intended to depart with full fuel tanks. After the refuelling was completed, the pilot noted that the fuel gauges indicated full, however he did not visually check the contents of the fuel tanks. The refueller later stated that neither fuel tank was full after he had added the requested amount of fuel to each tank.

The aircraft fuel system included four usable fuel tanks, two in each wing. The two tanks in each wing were filled from a single filler point. There were four fuel gauges, one for each of the four usable fuel tanks. During refuelling, it took a little time for fuel to flow from the outboard tank to the inboard tank. When asked to fill the tanks, the refueller normally had to fill one side, then fill the other side before returning to each side in turn to top them up. The refueller later commented that on the morning of the occurrence flight, he was able to add the requested amount of fuel without having to return to each tank to top it up, confirming that the aircraft fuel tanks were not full after the requested amount of fuel had been added.

During the day, the pilot landed the aircraft on three occasions at aerodromes where additional fuel was available. Based on the assumption that the aircraft was full on departure from Coolangatta, the pilot believed that the aircraft carried sufficient fuel, including reserve fuel, to complete the flight from Wanggoolba ALA to Coolangatta.

Operator pilots usually recorded fuel added, fuel on board, flight times and fuel consumed (from debi-meter indications) on a daily flight sheet. About six months prior to the incident, the Operator began using flight sheets with a carbon copy page so that the previous day's flight details were available to the pilot. Normally, the fuel details on the previous day's flight sheet could have been compared with the fuel gauge indications to provide additional information to the subsequent pilot regarding the fuel on board the aircraft. However, the details of fuel consumption during the maintenance-related ground runs and test flights had not been recorded on a flight sheet. Therefore, that information was not available to the incident pilot during his pre-flight preparations.

The operator's operations manual, section 3.5, titled "Fuel Documentation" stated that "[b]efore commencing each flight or flight segment, the pilot in command shall be personally responsible for...verifying, by means of fuel gauges and visually, the total fuel on board is sufficient for the flight...". The pilot stated that he had never visually checked fuel tank contents in the Nomad, or in the Cessna Caravan, the other aircraft type he flew for the operator. The chief pilot and other operator pilots said they did not always visually check the contents of aircraft fuel tanks during pre-flight inspections.

Pilot experience and training

The pilot had accumulated a total of about 2,750 hours flying experience, of which 70 hours was in the Nomad. The majority of his recent flying was in Cessna Caravan aircraft, in which he had accumulated about 1,500 hours. The

operator considered that the Caravan was equipped with a fuel quantity indicating system that was more accurate than that installed in the Nomad.

The pilot had completed his Nomad endorsement training and ICUS (in command under supervision) training with the operator. In a general sense, endorsement training was designed to provide training in the systems and characteristics of the new aircraft type, while ICUS training was designed to train the pilot in the normal operations of the aircraft type, including pre-flight inspection procedures. The pilot did not recall any discussion during his Nomad endorsement training regarding the accuracy of the Nomad fuel quantity indicating system in comparison with the Caravan. The pilot indicated that he had always calculated the amount of fuel required to be added based on fuel gauge indications. He had used this procedure when flying both the Caravan and the Nomad, and while undergoing ICUS training on the Nomad.

Microbiological contamination

Inspections of the fuel tanks identified contamination with microbiological material. There was one fuel quantity transmitter unit in each of the four useable fuel tanks. All four transmitter units were contaminated by microbiological material. The transmitter units consisted of a float inside an aluminium tube. Fuel entered the tube through small holes in the bottom of the tube, and the level of the float was electrically sensed and transmitted to the fuel gauges in the cockpit. The amount of microbiological material in the fuel quantity transmitter units was sufficient to interfere with the flow of fuel into the tube and to affect the electrical circuits at the bottom of the tube.

Various species of bacteria and fungi can grow in aircraft fuel systems given suitable temperature conditions and the availability of water and essential nutrients. In particular, cladosporium resinae fungus can grow into a "mat" at water collection points, and corrode tank lining and structural components.

The aircraft manufacturer recommended that fuel tanks and fuel quantity transmitter units be cleaned every 1,800 hours time in service. The transmitter units in VH-MSF had been cleaned less than 1,000 hours prior to the occurrence. The operator's fuel supplier at Coolangatta added fuel system icing inhibitor (FSII) to the bulk fuel supply. FSII is an effective biocide in avtur if used continuously. The operator also added a biocide to the aircraft fuel tanks each month.

ANALYSIS

The evidence indicates that the aircraft's engines failed due to fuel exhaustion. The pilot's method of establishing fuel on board was not robust, as it relied exclusively on the accuracy of the fuel quantity indicating system. It is clear that the fuel gauges were not accurately indicating the quantity of fuel on board the aircraft, probably because of microbiological contamination. A fuel log, if available, and a visual inspection of tank contents, if conducted, would have provided additional assurance regarding the quantity of fuel on board the aircraft. The use of two separate methods to establish fuel quantity on board is substantially more reliable than, and therefore preferable to the method used by the incident pilot. If the fuel tanks had been full on departure from Coolangatta, there should have been sufficient fuel to complete the flight with required reserves intact.

The evidence indicates that the pilot's endorsement training on the Nomad did not place sufficient emphasis on the differences between the fuel quantity indicating systems in the Nomad and Cessna Caravan aircraft. The incident pilot had substantial experience operating the Caravan, and flew that aircraft more frequently than the Nomad. The extent of his reliance on the Nomad fuel gauge indications was possibly influenced by his familiarity with, and operation of, the Caravan fuel quantity indicating system.

The pilot did not conduct a visual determination of fuel quantity, even though this was required by the operator's operations manual. However, the fuel system configuration of most aircraft in the operator's fleet, including the Nomad, meant that it was not possible to conduct a visual inspection of fuel quantity unless the fuel tanks were either full or nearly full. In this context, the operations manual procedure was deficient in that it did not adequately address the individual fuel system characteristics of the different aircraft types in the operator fleet.

LOCAL SAFETY ACTION

On 11 January 2002, the operator issued a memo to all pilots emphasising the operations manual requirement for fuel quantity to be checked using both the fuel gauges and visually. The memo also required increased fuel reserves for operations in the Nomad and increased fuel consumption rates for use during flight planning.

The operator advised that it intended to amend its operations manual to ensure acceptable fuel quantity assessment methods are clearly identified and are appropriate for the various fuel system configurations in the operator's fleet.

The operator's Nomad pilots now have access to a manometer for a more accurate determination of fuel quantity. (A manometer fuel quantity assessment involves attaching a clear, flexible tube to the underwing fuel drain and comparing the level of fuel in the tube against a calibrated scale marked on the side of the aircraft.)

The operator advised that it had reviewed and rewritten Operator training documentation to ensure that pilots learn necessary aircraft specific information during endorsement and ICUS training. The operator also advised that they would maintain more detailed records of pilot training.

The operator's personnel were in the process of developing a check and training manual to comply with the requirements of Civil Aviation Regulation 217 for training and checking organisations, and the requirements for Approved Single Engine Turbine Powered Aircraft operations. It is intended that the manual will include specific instructions regarding fuel quantity assessment methods appropriate to the various aircraft in the operators fleet.

The operator also indicated that it had written to the aircraft manufacturer regarding the time interval between fuel tank inspections. The operator has reduced the interval between fuel tank inspections to every 900 hours.