Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

AVIATION OCCURRENCE REPORT

CONTROLLED DESCENT - FORCED LANDING

MOONEY M-20C CF-MBV
ROSS RIVER, YUKON TERRITORY 50 nm SW
22 AUGUST 1994

REPORT NUMBER A94W0155

Canada

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- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
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Synopsis

The Mooney M-20C went missing while on a visual flight rules flight from Dawson to Watson Lake, Yukon Territory. On the next day, following a search by the Rescue Coordination Centre, the aircraft was located 50 nautical miles southwest of Ross River, Yukon Territory. The aircraft was substantially damaged during a forced landing; however, the pilot and passenger escaped with minor injuries.

The Board determined that the engine power loss was likely due to carburettor icing. Contributing to the accident was the pilot's decision to continue the visual flight into instrument meteorological conditions.

Ce rapport est également disponible en français.

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1.0 Factual Information

1.1 History of the Flight

The pilot of the Mooney M-20C aircraft, registered CF-MBV, planned a visual flight rules (VFR)[1] trip from Dawson with a direct flight to Faro, and a direct flight to Watson Lake. Prior to departure, the pilot arranged for the aircraft to be refuelled, received a weather briefing from the Dawson Flight Service Station (FSS) specialist, and filed a VFR flight plan. An altitude was not stipulated in the plan.

The aircraft departed Dawson at 1141 Pacific daylight saving time (PDT)[2]. On board were the pilot and one passenger. After take-off, the pilot climbed the aircraft to 7,500 feet above sea level (asl). At 1147, he called Dawson FSS and reported five nautical miles (nm) south of the airport. Initially the pilot followed the Tintina Trench, a mountainous valley running between Dawson and Watson Lake and a prominent VFR navigational route; however, as the en route weather deteriorated, the pilot climbed the aircraft to 11,500 feet asl into instrument meteorological conditions (IMC).

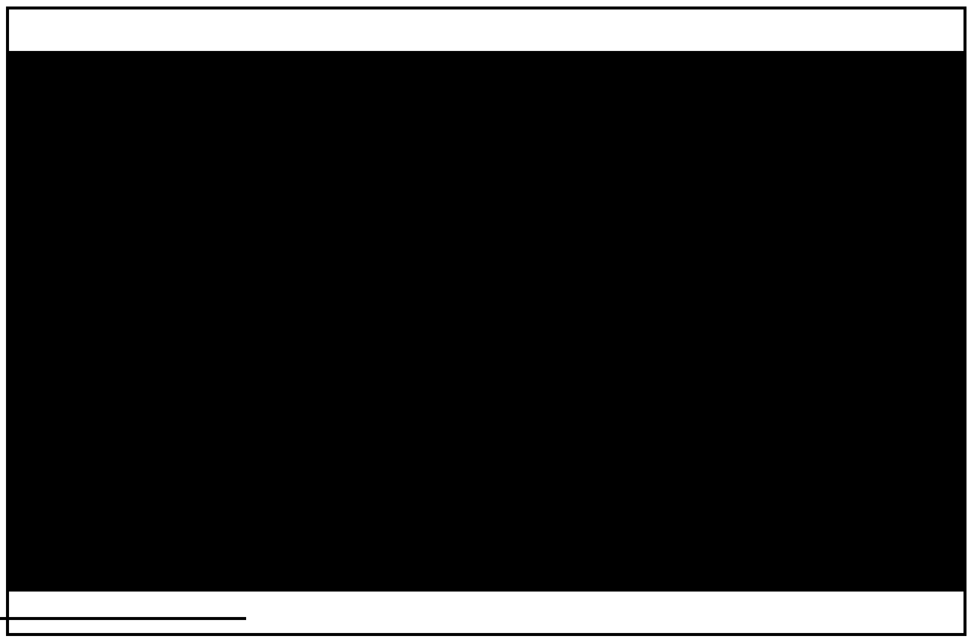

Figure 1

At approximately 1315, during cruise flight, the aircraft's engine began to run roughly, shake, and lose power. When the pilot applied carburettor heat, nearly all of the remaining available engine power was lost. The pilot immediately discontinued the carburettor heat application. Other emergency checks were carried out; nonetheless, the engine continued to run roughly and gradually lost more power.

As the airspeed decreased, the pilot prepared for an imminent forced landing and established the aircraft in a descent through the clouds. The engine had been running roughly

1 See Glossary for all abbreviations and acronyms.

2 All times are PDT (Coordinated Universal Time [UTC] minus seven hours) unless otherwise stated.

and losing power for about five minutes when it lost all remaining power. With the propeller windmilling, the pilot attempted to restart the engine without success.

The pilot selected a mountainous valley creek as a forced-landing site. With the flaps and landing gear UP, the pilot glided the aircraft at about 80 knots toward the site.

On final approach and near the intended touchdown point, the aircraft's starboard wing struck a lone spruce tree located on the creek bank. During the ensuing moments the aircraft swung around, crashed tail first into a shallow creek, skidded rearwards, and came to rest right-side-up, facing the opposite direction of travel.

The pilot and passenger escaped with minor injuries; however, the aircraft was substantially damaged. On the following day, the pilot and passenger were located by a Search and Rescue aircraft, and subsequently rescued.

The aircraft accident occurred at latitude 61°23'N and longitude 133°17'W, at an elevation of 3,550 feet asl[3], at approximately 1325, during the hours of daylight.

1.2 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	-	-	-	-
Serious	-	-	-	-
Minor/None	1	1	-	2
Total	1	1	-	2

1.3 Damage to Aircraft

The aircraft was substantially damaged.

1.4 Other Damage

There was no other damage.

1.5 Personnel Information

1.5.1 General

	Pilot
Age	44
Pilot Licence	PPL
Medical Expiry Date	01 February 95
Total Flying Hours	824
Hours on Type	691
Hours Last 90 Days	17
Hours on Type Last 90 Days	17
Hours on Duty Prior to Occurrence	1
Hours off Duty Prior to Work Period	8

1.5.2 Pilot's History

The pilot commenced his flying training in 1970, and in November 1970 obtained a Private Pilot Licence (PPL). A category 3 medical with restrictions to wear glasses was issued to him, and was valid at the time of the accident. The pilot also held a single-engine seaplane endorsement and a night rating. In 1986, the pilot started, but did not complete, an instrument rating program at which time he logged about 30 hours of instrument training.

He purchased the Mooney aircraft in June 1983.

3 Units are consistent with official manuals, documents, reports, and instructions used by or issued to the crew.

1.6 *Aircraft Information*

Manufacturer	Mooney Aircraft Corporation
Type and Model	M-20C
Year of Manufacture	1962
Serial Number	1953
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	3,461 hr
Engine Type (number of)	Lycoming O-360-A1D (1)
Propeller/Rotor Type (number of)	Hartzell HC-C2YK-1B (1)
Maximum Allowable Take-off Weight	2,575 lb
Recommended Fuel Type(s)	91/98 or 100/130
Fuel Type Used	100 LL

1.6.1 *General*

The aircraft weight and centre of gravity were within the prescribed limits throughout the flight.

Examination of the maintenance log-books revealed no evidence of uncorrected deficiencies relevant to the circumstances of the occurrence. At the time of the occurrence, the aircraft was certified airworthy. The last recorded maintenance (annual inspection) was carried out on 23 December 1993.

Review of the aircraft logs and maintenance records revealed that the aircraft had been imported to Canada on 04 August 1971, and assigned the registration CF-MBV. The aircraft log-books indicated that, at importation, the engine had about 488 hours total time in service. At the time of the accident, this same engine had accrued a total time of about 1,707 hours.

Detailed examination of the aircraft log records further revealed that the engine had not undergone a major overhaul since being imported to Canada; thus, the engine had not been overhauled for at least 23 years.

Lycoming Service Instruction No. 1009AJ states that the recommended time between overhaul (TBO) period is 2,000 hours for this series of engine (Lycoming O-360). The service instruction also states that engines that do not accumulate the recommended TBO operating hours in a twelve (12) consecutive year period must be overhauled during the twelfth year. *Airworthiness Manual Advisory 571.103/1* provides guidance for an "On-Condition" engine maintenance program as an alternative to the manufacturer's recommended "Hard-Time" programs. Transport Canada Regional Airworthiness authorities report that Lycoming engines are to be maintained "On-Condition" in private aircraft if they are operated beyond 12 years since overhaul. There were no log-book entries indicating that the aircraft's engine had been maintained according to the "On-Condition" program.

A journey log entry dated 12 January 1990 states that the aircraft was being maintained in accordance with Chapter 571, Appendix A, of the *Airworthiness Manual*.

1.6.2 *Equipment*

The aircraft was equipped with the basic flight instruments as required by the *Instrument Flight Rules (IFR) Flight Instruments and Equipment Order*, Air Navigation Order (ANO) Series V, No. 22. However, it was not equipped with the required radio navigation equipment for instrument flight, nor was the aircraft equipped for flight into icing conditions.

1.7 *Meteorological Information*

1.7.1 *Synoptic Situation*

The Environment Canada Atmospheric Environment Service (AES) forecast synopsis revealed that a cold unstable air mass resided over the southern and central Yukon on 22 August 1994. This feature supported an expansive area of cloud that covered the central and southern Yukon.

1.7.2 *Forecasts*

The Whitehorse area forecast (FACN1), which covers the area of the intended flight, was issued by AES on 22 August 1994 at 1030 (1730 UTC) and was valid from 1100 to 2300. It forecast a base layer of broken cloud at 5,000 to 6,000 feet asl, with cloud layers from 12,000 to 14,000 feet asl, and scattered cloud above 16,000 feet. The visibilities associated with the weather system would range from one to six miles in light rain showers and smoke. A few embedded altocumulus, topped at 18,000 feet, were also forecast. Light to moderate icing was forecast in cloud above the 8,000 foot freezing level.

The latest en route terminal forecasts (FT) issued by AES, at 0930 for 22 August 1994, were as follows:

> The FT for Dawson, valid from 1000 to 2200, predicted an overcast ceiling of 3,000 feet broken and 5,000 feet overcast. The visibility was forecast to be six miles in light rain showers.
>
> The FT for Mayo, valid from 1000 to 2200, predicted a ceiling of 4,000 feet broken, 10,000 feet overcast, and visibility of four miles in light rain showers and smoke.
>
> The FT for Faro, valid from 1000 to 1600, predicted a ceiling of 3,500 feet overcast, with an occasional ceiling of 1,000 feet broken, and visibility of six miles in light rain.
>
> The FT for Watson Lake, valid from 1000 to 2200, predicted a ceiling of 5,000 feet broken, with an occasional ceiling of 2,500 feet broken, 5,000 feet overcast, and visibility of six miles in light rain showers.

The winds aloft for 12,000 feet asl were forecast by AES to be light and variable, with a temperature of about minus nine degrees Celsius.

1.7.3 *Weather Observations*

The Ross River AES special weather observation at about the time of the accident was reported as an estimated ceiling of 4,800 feet overcast, with 15 miles visibility in very light rain showers.

1.7.4 *Pilot Reports*

Two pilot reports (PIREPs) were issued, one from Carmacks (55 nm northwest of Whitehorse), Yukon Territory, at 1020, and the second from Frank Lake (60 nm north of Whitehorse), Yukon Territory, at 1105. Both indicated the presence of low stratus cloud and fog obscuring the terrain in precipitation. A further PIREP, received from Carmacks at 1547, suggested a similar scenario.

1.7.5 *Satellite Photographs*

The National Oceanic and Atmospheric Administration (NOAA) satellite photograph depicts an expansive area of cloud, covering the central and southern Yukon, along the intended flight route.

1.7.6 *Forest Fires*

Several forest fires were burning in the Yukon, and along the route of intended flight. The pilot was briefed in Dawson, prior to departure, of the obscuring effects and reduced en route visibilities owing to this phenomenon.

1.8 *Aids to Navigation*

At the time of the accident, the air route between Dawson and Watson Lake was served by the following navigational aids: one non-directional beacon (NDB) at Dawson, one NDB at Mayo, one NDB at Faro, and two NDBs at Watson Lake. Watson Lake was also served by a very high frequency omni-directional range (VOR), and distance measuring equipment (DME). The NDBs and the VOR/DME were serviceable, and were used for navigation. The pilot also utilized the Whitehorse VOR/DME for en route navigation by flying a 75 nm arc north of Whitehorse.

1.9 Communications

Very high frequency (VHF) radio communications between the pilot, the FSS specialist, and other aircraft on the mandatory frequency (MF), 122.2 megahertz (MHz), had been established and were functioning normally at the time of the departure from Dawson. In addition, the en route airports at Mayo, Faro, and Ross River are served by Community Aerodrome Radio Stations (CARS) on the MF of 122.1 MHz and the emergency frequency of 121.5 MHz.

There were no further communications with the pilot after he reported 5 nm south of Dawson. A distress message was not transmitted at the time of the forced landing.

1.10 Wreckage and Impact Information

1.10.1 Accident Site

The accident site is located in a sparsely settled area of the Yukon's Pelly Mountain Range. More specifically, the site is 50 nm southwest of Ross River, in the shallow waters of Caribou Creek.

Prior to the initial impact with the tree, the aircraft was on a heading of about 132 degrees magnetic, with a descent angle of approximately seven degrees, and in a slightly right-wing-low attitude.

After initial impact, the aircraft swung in a flat, horizontal, clockwise direction, struck the water tail first, and skidded backwards to a stop. The aircraft came to rest upright, in about 10 inches of water, on a heading of 342 degrees magnetic.

During the secondary impact with the creek bottom, the engine separated from the fuselage at the engine firewall mounts. The empennage, wings, and fuselage of the aircraft remained relatively intact.

Examination of the wreckage revealed that the flaps and landing gear were up during the forced landing.

1.10.2 Wreckage Trail

The first substantial piece of wreckage, the aircraft's right aileron, was located adjacent to the broken spruce tree and was lying on the east bank of the creek. The fuselage was resting about 142 feet beyond the point of initial impact. The aircraft's engine, cowling, and propeller were collectively located about 31 feet south of the aircraft fuselage. The total length of the wreckage trail from the point of initial impact to the engine assembly measured 173 feet.

The tree and creek bottom rock scuff marks were consistent with the deceleration and direction of travel the aircraft took before coming to rest. There was no evidence found of propeller rotational signatures.

1.10.3 Airframe Systems

The post-accident examination of the airframe found no evidence of pre-impact structural failure or loss of control continuity.

The impact airspeed could not be determined from the examination of the aircraft instruments.

A visual field inspection of the aircraft's fuel tanks revealed that they were approximately ⅔ full. Fuel samples were taken from both fuel tanks. The fuel that remained in the aircraft's tanks was uncontaminated and of the recommended grade.

The fuel system was examined to the degree possible, and there was no evidence found of a system defect or malfunction prior to or during the flight.

1.10.4 Propeller

One of the two blades on the constant speed propeller was bent backwards in an unsymmetrical position. Neither of the blades revealed evidence of rotational, torsional, or leading edge damage.

1.10.5 Engine

The engine was transported to the TSB Regional Wreckage Examination Facility and subsequently test run at a local aircraft engine overhaul facility.

The test results indicated that the engine was capable of producing power at the time of impact. The No. 3 cylinder was removed because of low compression, and was visually examined. The top piston ring (compression ring) was broken at approximately mid-point. The second ring (compression ring) and the third ring (oil control ring) were partially seized in the piston grooves. Wear adjacent to the fracture location, on the edge of the piston ring which contacts the cylinder wall, indicated that the piston ring had been broken for some time. There was no evidence of scoring on the cylinder wall.

Several of the spark plugs exhibited evidence of lead fouling. The overall condition indicated that the engine was high time, and that it was nearing the end of its service life; however, no mechanical discrepancies which would have caused a sudden, complete loss of power were identified.

The pilot was unable to recollect, after the accident, the engine instrument indications during the descent.

1.10.6 Carburettor Heat System

The carburettor heat system was examined, and there was no evidence found of a system defect or malfunction prior to or during the flight. The cabin heat and the carburettor heat systems share the same exhaust manifold heat source.

1.11 Survival Aspects

After escaping out the main door of the aircraft, the pilot and passenger pitched a tent near the accident site and built a fire in an effort to stay warm and out of the rain. The pilot reported that the surface temperature was about four degrees Celsius. For sustenance, they rationed their only source of food--a half-empty large bag of chocolate-coated candies.

The accident was considered to be survivable due to the attenuation of the deceleration forces along the final flight path. These forces were attenuated, and progressively absorbed, by the cushioning effect of the shallow water and a growth of thick willows on both banks of the creek. The cabin area maintained its integrity throughout the accident.

The aircraft was not equipped with shoulder harnesses, nor were they required by regulation. As the aircraft slid backwards, both the pilot and passenger were forced against the cushioned seat-backs.

The aircraft was not equipped with survival emergency equipment, as required by the *Sparsely Settled Areas Order*, ANO Series V, No. 12.

The emergency locator transmitter (ELT) (manufactured by Emergency Beacon Corporation) survived the crash, and was manually activated after the impact.

1.12 Additional Information

1.12.1 Carburettor Icing

Icing in the carburettors of piston engines will occur in clear air with high relative humidity. The pilot stated that the temperature at cruising altitude was about minus five degrees Celsius. Carburettor ice is likely to develop during flight through cloud or precipitation.

4
Sandy A.F. MacDonald, *From the Ground Up*, 25th ed. (Ottawa: Aviation Publishers Co. Ltd., 1987) 54.

The Transport Canada *Aeronautical Information Publication* (AIP) describes the effects of carburettor icing as follows:

> Carburettor icing is a common cause of general aviation accidents... Most carburettor icing related engine failure happens during normal cruise. Possibly, this is a result of decreased pilot awareness that carburettor icing will occur at high power settings as well as during descents with reduced power.

During the application of carburettor heat, the pilot must learn to accept a rough-running engine for a minute or so, as the heat melts and loosens the ice which is then ingested into the engine.[4]

1.12.2 Oxygen Requirements

The aircraft was flown at an altitude of 11,500 feet, for a time period that exceeded 30 minutes, without oxygen equipment.

Section 4 of the *Oxygen Equipment Order*, ANO Series II, No. 9, states as follows regarding flight crew member's oxygen requirements:

> No person shall fly an aircraft for more than 30 minutes at an altitude between 10,000 and 13,000 feet above mean sea level, unless there is readily available to each flight crew member an oxygen mask and a supply of oxygen sufficient for 2 hours, or the duration of the flight at cabin pressure altitudes above 10,000 feet, whichever is the greatest period.

Section 8 of ANO Series II, No. 9, states as follows regarding the oxygen requirements for passengers:

> No person shall fly an aircraft for more than 30 minutes at an altitude between 10,000 and 13,000 feet above mean sea level, unless there is readily available to 10 per cent of the passengers and in no case less than one passenger, oxygen masks and a supply of oxygen sufficient for the duration of the flight at such an altitude; in the case of an unpressurized aircraft, an oxygen mask for each passenger and a supply of oxygen sufficient for 1 hour or the duration of the flight at such an altitude, whichever is the greater period.

1.12.3 Emergency Locator Transmitter

The aircraft was equipped with an EBC-102A ELT (Serial No. 12254). This ELT type utilizes a pendulum inertia switch for automatic activation during impact; however, this inertia switch will only function in the forward direction of travel with sufficient gravity (g) forces. The ELT did not activate automatically upon impact because, during the crash sequence, the aircraft was travelling backwards before it came to rest. After exiting the aircraft, the pilot manually activated the ELT; however, the following day, when the pilot suspected it was malfunctioning, he braced a twig against the toggle switch to hold it in the TEST position. A weak signal was subsequently transmitted.

The ELT was sent to the manufacturer for examination and testing. Electronic trial tests revealed that when the ELT was switched to the ON position, it would function intermittently; thus, the reason for the malfunction was diagnosed as a possible intermittent oscillator.

1.12.4 Search and Rescue

When the aircraft did not arrive in Watson Lake as scheduled, the Rescue Coordination Centre (RCC) was notified and search aircraft were dispatched. Initial search efforts were hampered by low cloud, rain, and poor visibility. A high-altitude search aircraft was unable to detect an ELT signal from the downed aircraft. However, the following day, a weak ELT signal was detected, and an RCC search aircraft located the missing aircraft about 50 nm south of the intended flight path. Shortly thereafter, the occupants were rescued and air-lifted via civilian helicopter to Whitehorse, Yukon. They were then transported by taxi to the hospital, and subsequently released after being diagnosed with minor injuries.

1.12.5 Aircraft Fuelling

Fuelling records received from Dawson City Aviation indicate that the aircraft was last fuelled at the Dawson Airport on the morning of 22 August 1994. Examination of the fuel slip revealed that the pilot requested both tanks to be topped. The refueller reported that the addition of the 78 litres of 100 LL octane fuel brought the fuel level in the aircraft's tanks to maximum capacity.

Dawson City Aviation fuelling documents were examined to determine the identity of the fuel source used to fuel the aircraft. Fuel samples obtained from the underground fuel tank established that the fuel was of the proper grade and quality, and contained no contamination. No reports of poor quality fuel were received from other aircraft that fuelled from the same source.

2.0 Analysis

2.1 Introduction

During the investigation, it was determined that the aircraft was flown into IMC above the freezing level. It was further determined that the aircraft was flown in areas of high relative humidity, and that the engine lost power during cruise flight. Since the total loss of engine power could not be explained by any observed engine defect, it is therefore necessary to concentrate on the combined effects of the flight preparations, meteorological conditions, and pilot procedures.

2.2 Flight Preparations

The hourly weather sequences, forecasts, PIREPs, and satellite photographs indicate that the weather was marginal for a VFR flight via the Tintina Trench route. The en route PIREPs reported the presence of low stratus cloud with precipitation, smoke, and fog obscuring the mountainous terrain. The pilot reported there was no pressure to fly to Watson Lake on the day of the accident.

2.3 Pilot Procedures

The pilot flight planned from Dawson direct to Faro, direct to Watson Lake, according to VFR; however, he deviated from this plan by climbing to 11,500 feet asl and flying with reference to flight instruments. He also deviated from his flight plan route by flying an arc off the Whitehorse VOR/DME.

Although he was not certified for instrument flight, the pilot had taken about 30 hours of instrument training about eight years prior to the accident; thus he had acquired the basic knowledge to control the aircraft in instrument conditions. Manoeuvring the aircraft in IMC without recent instrument training or certification, during a loss of engine power, would increase the workload for the pilot.

The investigation established that the high humidity conditions at the time of take-off, climb to altitude, en route cruise, and descent were conducive to serious carburettor icing.

The procedure which was carried out by the pilot when he suspected carburettor ice is contrary to recommended practices. When the pilot selected carburettor heat, it is probable that the hot incoming air melted the carburettor ice that may have accumulated, causing it to enter the cylinders and effect a further loss of engine power.

During the descent, the engine continued to lose power until all power was lost. The propeller continued to windmill up until the point of impact.

The temperatures aloft for 12,000 feet asl were forecast by AES to be about minus nine degrees Celsius. With a surface temperature of about plus four degrees Celsius, it is likely that the carburettor ice would not have melted during the descent, as the same principles of carburettor ice apply with a windmilling propeller; therefore residual heat from the engine would have been lost during the descent, and surface temperatures would have been cool enough to prolong the melting of the ice.

The aircraft is equipped with a carburettor heat and a cabin heat system that share the same exhaust manifold heat source. Rather than being drawn directly into the carburettor, with the application of carburettor heat, the incoming air is circulated around the exhaust stack manifold and heated. However, with the temperatures that were present at cruising altitude, cabin heat would also have been demanded; thus, the output of the carburettor heat supply would have been diminished.

The power loss which occurred during cruise flight may, therefore, have been caused by a combination of factors. However, the total loss of power could not be explained by any observed engine defect.

The effect of stuck and broken piston rings, fouled spark plugs, and a time-worn engine would be a loss of engine power. In addition, because the aircraft was flown in cloud above the freezing level, it is possible that freezing of fuel vents, impact icing, propeller ice, and carburettor ice may also have contributed to the loss of engine power. The combined effects of these factors would be a loss of power to the extent that continued flight would likely be impossible.

3.0 Conclusions

3.1 Findings

1. The flight was conducted in conditions of atmospheric humidity conducive to serious carburettor icing.

2. The pilot continued visual flight into IMC without being certified for instrument flight.

3. The pilot conducted the flight into a sparsely settled area without the required emergency survival equipment.

4. The pilot conducted the flight at 11,500 feet asl, for more than 30 minutes, without the required oxygen and equipment.

5. The pilot conducted the flight into forecast icing conditions. The aircraft was not certified for flight in icing conditions.

6. There were no entries in the aircraft log-books to indicate that the engine was being maintained "On Condition."

7. The pilot deviated from the flight plan route without advising Air Traffic Services of his intentions.

8. Search and Rescue efforts were hampered initially by poor weather conditions, and the lack of an ELT signal.

9. The pilot was not familiar with the operation of the ELT. The ELT was diagnosed as possibly having an intermittent oscillator.

10. The pilot did not declare an emergency following the loss of engine power.

11. Examination of the engine revealed that it was in a time-worn state, and exhibited evidence of stuck and broken piston rings on the No. 3 cylinder which would have contributed to minor loss of engine power.

3.2 Causes

The engine power loss was likely due to carburettor icing. Contributing to the accident was the pilot's decision to continue the visual flight into instrument meteorological conditions.

4.0 Safety Action

The Board has no aviation safety recommendations to issue at this time.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson John W. Stants, and members Zita Brunet and Hugh MacNeil, authorized the release of this report on 01 June 1995.

Appendix A - List of Supporting Reports

The following TSB Engineering Branch Report was completed:

LP 150/94 - Analysis of Engine Components.

This report is available upon request from the Transportation Safety Board of Canada.

Appendix B - Glossary

AES	Atmospheric Environment Service
AIP	Aeronautical Information Publication
ANO	Air Navigation Order
asl	above sea level
CARS	Community Aerodrome Radio Station
DME	distance measuring equipment
ELT	emergency locator transmitter
FACN1	area forecast weather
FSS	Flight Service Station
FT	terminal forecast
g	G load factor
hr	hour(s)
IFR	instrument flight rules
IMC	instrument meteorological conditions
kg	kilogram(s)
lb	pound(s)
LL	low lead
MF	mandatory frequency
MHz	megahertz
N	north
NDB	non-directional beacon
nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration
PDT	Pacific daylight time
PIREP	pilot report of weather conditions in flight
PPL	Private Pilot Licence
RCC	Rescue Coordination Centre
TBO	time between overhaul
TSB	Transportation Safety Board of Canada
UTC	Coordinated Universal Time
VFR	visual flight rules
VHF	very high frequency
VOR	very high frequency omni-directional range
W	west
'	minute(s)
°	degree(s)

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