

AVIATION INVESTIGATION REPORT

A03W0210

LOSS OF CONTROL/STALL

SCENIC AIR SERVICES LTD.

PIPER PA-18-150 C-FIWV

LINDA LAKE, BRITISH COLUMBIA

04 OCTOBER 2003

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.

Aviation Investigation Report

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Scenic Air Services Ltd.
Piper PA-18-150 C-FIWV
Linda Lake, British Columbia
04 October 2003

Report Number A03W0210

Summary

The Scenic Air Services Ltd. float-equipped Piper PA-18-150 (registration C-FIWV, serial number 18-6299) departed Tootsie Lake, British Columbia, at 1119 Pacific daylight time on a day visual flight rules flight to Linda Lake, British Columbia. The purpose of the flight was to transport moose meat, antlers, and camp materials located at the outfitter's camp at Linda Lake, British Columbia to the outfitter's base camp at Tootsie Lake.

The aircraft was not heard from after it departed Tootsie Lake. At 1228, the Search and Rescue Satellite System received an emergency locator transmitter signal, and the aircraft was subsequently reported overdue. A helicopter was chartered out of Watson Lake, Yukon, to conduct a search; the wreckage was found on the shoreline of Linda Lake at 1602. The aircraft was substantially damaged, and the pilot, the lone occupant, sustained fatal injuries. There was no post-impact fire.

Ce rapport est également disponible en français.

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1.0 *Other Factual Information*

1.1 *History of the Flight*

The Scenic Air Services Ltd. float-equipped Piper PA-18-150 aircraft had been based at the Kawdy Outfitters base camp at Tootsie Lake, British Columbia, for the duration of the summer/fall hunting season. The aircraft was being operated under Canadian Aviation Regulation (CAR) 703, "Air Taxi Operations." The flight to Linda Lake was approximately 15 miles, and this was the pilot's third return trip to Linda Lake that day and his fourth trip of the day overall.

The flight was being conducted under day visual flight rules. The pilot intended to pick up moose meat, antlers, and camp supplies located at the outfitter's camp at Linda Lake and return to the outfitter's base camp at Tootsie Lake. The aircraft was not heard from after it departed Tootsie Lake. At 1228 Pacific daylight time,¹ the Search and Rescue Satellite System received an emergency locator transmitter signal. At 1346, the outfitter contacted an air operator in Watson Lake, Yukon, by satellite telephone and reported the aircraft overdue. A helicopter was chartered out of Watson Lake to conduct a search; the wreckage was found at 1602 on the shoreline of Linda Lake. The aircraft was substantially damaged and the pilot, the lone occupant, had sustained fatal injuries. There was no post-impact fire.

The outfitter's camp at Linda Lake was unoccupied at the time of the accident and there were no witnesses to the accident.

1.2 *Injuries to Persons*

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

1.3 *Damage to Aircraft*

The damage patterns indicated that the aircraft struck the ground in a steep, right-wing-low attitude at low forward speed. The float struts collapsed at impact and the right wing sustained heavy impact damage. The cabin structure partially collapsed and the supporting structure on

¹ All times are Pacific daylight time (Coordinated Universal Time minus seven hours).

the pilot's seat buckled at impact, indicating high vertical deceleration forces. The flap handle was set in the second of three possible flaps-extended notches, indicating the flaps were at an intermediate position at impact.

1.4 Personnel Information

	Captain
Pilot Licence	CPL
Medical Expiry Date	01 Nov. 03
Total Flying Hours	2500
Hours on Type	1600
Hours Last 90 Days	171
Hours on Type Last 90 Days	171
Hours on Duty Prior to Occurrence	5
Hours off Duty Prior to Work Period	12

The pilot was characterized as a skilled and cautious flyer, and a meticulous aircraft maintenance engineer. He held a commercial pilot licence valid for single-engine landplanes and seaplanes with a restriction for daylight flying only, and he held an aircraft maintenance engineer licence with an M1 category rating. He had obtained a private pilot licence in 1971, and a commercial pilot licence and a float endorsement in 1974. There were no entries in his pilot logbook for the period between September 1977 and March 1997, and there was nothing found to indicate he had acquired any commercial aviation experience between 1977 and 1997. Prior to commencing employment with Scenic Air Services Ltd. in the spring of 1997, the pilot received 3.8 hours of recurrent flight training on a wheel-equipped Cessna 172, to return him to commercial pilot standards. There was no record of the pilot having received formal flight training subsequent to 1997.

The pilot was appointed Chief Pilot and Operations Manager of Scenic Air Services Ltd. in July 1997. The appointment was approved subject to a Transport Canada review after six months; however, there was nothing found to indicate that a six-month review had been performed. At the time of the accident, the pilot held the positions of Operations Manager, Chief Pilot, Director of Maintenance, Maintenance Manager, Quality Manager, Production Manager, and Stores Manager for the company. As such, he was responsible for all aspects of the company's aviation operations, including flight operations, maintenance, quality assurance, and training.

1.5 Aircraft Information

Manufacturer	Piper Aircraft Corporation
Type and Model	PA-18-150
Year of Manufacture	1958
Serial Number	18-6299
Certificate of Airworthiness	Issued 17 April 2003
Total Airframe Time	3624 hours
Engine Type (number of)	Lycoming O-320-A2B (1)
Propeller/Rotor Type (number of)	McCauley 1A175-GM8241 (1)
Maximum Allowable Take-off Weight	794 kg
Recommended Fuel Type(s)	Minimum grade aviation gasoline 80/87
Fuel Type Used	100 LL

Log entries indicate that the aircraft was certified and being maintained in accordance with existing regulations. The most recent 100-hour inspection had been completed 48.4 hours before the accident, on 13 September 2003. There was no record of outstanding defects in the aircraft journey log.

The aircraft airframe and systems were examined in the field. All flight and engine controls were continuous, and all damage to the aircraft was attributable to the severe impact forces. The aircraft had sufficient fuel for the intended flight. Propeller blade twist and leading edge damage indicated that the engine was likely operating at a mid-range power setting at impact. The engine (Lycoming O-320-A2B) was removed and transported to an engine overhaul facility for a test run. During the engine testing, it was determined that the right magneto was intermittently inoperative because of the grounding of the core wire to the shielding on the right magneto p-lead. The TSB Engineering Laboratory examined the p-lead and determined that several of the copper strands in the core wire were discontinuous at the aft end of the ferrule, where the lead attached to the magneto. As well, the insulation between the core and the shielding was broken and separated in that area, exposing the copper wire to the shield. The grungy appearance of the p-lead indicated it had been in service for a long time. No other significant pre-impact engine discrepancies were identified during the engine examination and test run. Communication with the engine manufacturer determined that the loss of one magneto on this model of engine would result in an estimated 9 to 10 per cent reduction in available power at full throttle.

The rear cockpit control stick had been removed, and a hand-fabricated aluminum protective cover had been installed over the rear stick socket to prevent cargo being carried in the rear seat area from jamming the flight controls. Visual examination of the inside of the protective cover showed that the top end of the stick socket had been contacting the rear wall of the cover when the control stick was pulled to the full-aft position. There was no indication that the protective cover had collapsed or was interfering with the rear stick socket during flight in a manner that would prevent normal operation of the flight controls.

The aircraft was fitted with a six-foot-long cargo box mounted aft of the cabin in the rear fuselage. The installation resembled a ski cargo box that had been approved as a one-time installation in another PA-18 in 1972, under approval number W72-199. There was no record of the installation in the aircraft records. The ski cargo box was estimated to weigh nine pounds. It could not be determined if the aircraft was fitted with the cargo box when the aircraft was last weighed. The aircraft was also fitted with a VHF FM radio that was unaccounted for in the weight and balance reports.

The aircraft was equipped with a McCauley 1A175-GM8241 ("Borer") propeller, in accordance with Supplemental Type Certificate (STC) SA279AL. However, the STC did not provide for operation of this propeller in combination with the Canadian Aircraft Products (CAP) 67-2000 floats that were installed on the aircraft.

The aircraft was not equipped with a stall warning system that would have warned the pilot of an impending stall, and a stall warning system was not required by regulation. This deficiency has been identified in the past in numerous accidents involving older light aircraft designs.

1.6 Weight and Balance

The original production weight and balance report for the aircraft identified the datum as a point 60 inches forward of the wing leading edge. The current Type Certificate Data Sheet for the PA-18-150, Aircraft Specification No. 1A2, Revision 37, identifies the datum as the wing leading edge. Some of the references in the original production weight and balance material use the point 60 inches forward of the wing leading edge as the datum, while other references such as the original equipment list and the centre of gravity envelope chart use the wing leading edge as the datum.

The aircraft had last been weighed on 18 March 1974. Between March 1974 and August 2001, the weight and balance report was amended three times. Each of the amended reports used the datum 60 inches forward of the wing leading edge to report the empty weight centre of gravity; however, on two of the three amendments, the arms for the items listed were mixed between inches from the wing leading edge and inches aft of the datum, and the empty weight centre of gravity was erroneous. Aircraft maintenance personnel familiar with PA-18 aircraft have reported finding similar errors in PA-18 weight and balance amendments. There are currently 405 Piper PA-18 aircraft in the Canadian registry, 42 of which are registered for commercial purposes.

The aircraft had been fitted with CAP 67-2000 floats on 16 August 2001. Two weight and balance report amendments applicable to the float installation were found, both dated 16 August 2001. Both reports contained weight and centre of gravity discrepancies. The weight and balance report in the aircraft journey log indicated that the float installation weighed 236.0 pounds, and that the empty weight of the aircraft was 1224.5 pounds. The weight and balance report found in the aircraft technical log identified the weight of the float installation as 286.0 pounds and identified the empty weight of the aircraft on floats as 1274.5 pounds. Weight and balance data for the CAP 67-2000 float installation identified that the floats weighed 290.0 pounds and that the service step and paddle installation weighed an additional 2.5 pounds.

It was not determined if the pilot was aware of the errors in the amended weight and balance reports. The pilot frequently transported hunters and cargo between the main base camp and temporary outlying camps, and the nature of the work required that the weight of the cargo on each flight had to be estimated, as there was no convenient way to weigh each load before take-off.

The cargo was removed from the aircraft and weighed at the accident site. One set of moose antlers, weighing 41 pounds, was found secured to the right float struts. An additional 301 pounds of cargo, including moose meat, a moose cape, camp materials, and survival gear, was recovered from the rear seat area of the wreckage. The left float contained 37 pounds of water. The pilot was in the habit of pumping the right float several times a day; however, the right float sustained substantial impact damage, and the amount of water in the float at impact could not be determined. The cabin load had not been restrained during flight.

Weight and balance calculations completed by investigators, based on a review and correction of the aircraft's weight and balance historical documents, indicated the empty weight of the aircraft was, at a minimum, 1281 pounds. It was calculated that the gross weight of the aircraft at the time of the accident was at least 1922 pounds, and the centre of gravity was 17.0 inches aft of the wing leading edge. The maximum certified seaplane take-off weight was 1760 pounds, and the centre of gravity limits at that weight were 16.2 to 20.0 inches aft of the wing leading edge. Operating an aircraft at a weight that exceeds the maximum take-off weight will reduce the aircraft's climb performance, adversely affect stability and slow flight characteristics, and increase the stall speed.

1.7 Meteorological Information

The ceiling and visibility at the time of the accident were suitable for flight in accordance with visual flight rules. Hunting guides working in the area described the midday visibility as unrestricted and the sky conditions as almost clear, with patches of high cloud. The surface winds were generally from the south or west for most of the day, at speeds estimated to be between 10 to 30 mph, and gusting. The variations in wind speeds and directions may have

been intensified by the local mountainous topography. It had been reported that on two flights earlier in the day, the aircraft had encountered strong wind gusts and turbulence in the vicinity of Linda Lake. The temperature was approximately 8°C.

It is a standard practice to maintain a higher-than-normal indicated airspeed throughout the approach and landing when operating an aircraft in strong and variable winds, so as to maintain effective control response during fluctuations in airspeed and to prevent an inadvertent stall.

1.8 External Load

One set of moose antlers was found secured to the right float diagonal strut and entrance step. The antlers spanned 53 inches from tip to tip. They had been tied parallel to the longitudinal axis of the aircraft, above the float deck, with the palms and tips up.

Piper PA-18 aircraft are commonly used by hunting outfitters to transport animal antlers. The cabin space in the PA-18 precludes the carriage of large moose and caribou antlers inside the aircraft; therefore, the antlers are often carried externally, either on float struts, or, in the case of wheel-equipped aircraft, on the wing struts. The carriage of external loads is not approved in the PA-18 type certificate or in any PA-18 STC. The pilot had flown moose antlers externally on this type of aircraft many times in the past.

External loads create parasite drag, which degrades aircraft performance. Animal antlers are not streamlined and, considering their size, may, therefore, create unusually high drag. Several experienced PA-18 pilots were contacted to determine the performance degradation associated with carrying antlers as external loads. The comments varied widely, with some pilots reporting little degradation in overall performance and others reporting significant degradation. One highly experienced pilot advised that moose antlers must be secured with the palms down and the tips resting on the float deck, so as to reduce the airflow disturbance over the tail. No flight test data were found that documented PA-18 float plane performance with externally mounted antlers.

In April 1997, the Canadian Aviation Regulation Advisory Council (CARAC) started to review the issue of the carriage of external loads on aircraft. CAR 703.25 states that except where carriage of an external load has been authorized in a Type Certificate or Supplemental Type Certificate (TC/STC), no operator shall operate an aircraft to carry an external load with passengers on board. The CARAC External Loads Working Group recognized that CAR 703.25, while prohibiting passengers, does not prohibit unauthorized external loads when there are no passengers, and that the regulation could be misinterpreted as allowing external loads without passengers. The working group's final report recommended the deletion of CAR 703.25 and the revision of CAR to accommodate external load operations with/without passengers, private and

commercial operations, for aeroplanes and helicopters whose flight authority is not validated by a TC/STC. The CAR has not been revised to accommodate the recommendations contained in the External Loads Working Group's final report.

Transport Canada Commercial and Business Aviation Advisory Circular No. 0209 informs float plane operators of an exemption to CAR 703.25. The purpose of the exemption is to permit float plane operators to carry passengers and an external load without authorization in a TC/STC, provided certain conditions are met. The exemption frees the operator from having to comply with the passenger restriction imposed by CAR 703.25; however, there is no specific reference to operations where external loads are carried without passengers on board.

The exemption is subject to several conditions. The *Company Operations Manual* must contain direction to flight crews concerning operations with external loads, and a one-time proving flight is required for each particular type of load. As well, pilots must be briefed and trained in accordance with Section 723.88 of the *Canadian Air Services Standard*. The operating limitations include a requirement to reduce the maximum gross take-off weight of the aircraft by twice the weight of any external load. Airworthiness Manual Advisory 500/10 provides similar appropriate guidelines for the operation of aircraft carrying external loads.

Scenic Air Services Ltd.'s *Company Operations Manual* contained contradictory information regarding the carriage of external loads. Section 3.16 of the manual stated that pilots shall not fly company aeroplanes with an external load and passengers on board, unless authorized by a TC/STC. Section 5.11.1 required that pilots be instructed on the carriage of external loads on floats during initial technical ground training. Section 5.6 stated there would be no carriage of external loads. There was nothing found to indicate that a moose antler, external-load, proving flight had ever been accomplished.

The TSB Aviation Safety Information System database (1976 to 2004) contains records of, at minimum, 17 occurrences that have involved float planes carrying external loads. The occurrences involved nine private operators, six commercial operators, and two government operators. A review of the circumstances surrounding 16 of these 17 occurrences indicated that the presence of an external load was a contributing factor, due to the adverse effect of the external load on the aircraft's aerodynamics and performance. Fourteen of the occurrences were accidents due to a loss of control that resulted in a stall or spin. The accidents resulted in 19 fatalities and 6 serious injuries. (See Appendix A – Accidents Involving External Loads.)

1.9 *Communications*

The aircraft was on a company flight itinerary, and there was no NAV CANADA involvement.

1.10 Aerodrome Information

Linda Lake is a small, teardrop-shaped lake, located at 59°51' north and 130°14' west. The surface altitude is 4100 feet above sea level. The lake is 0.7 nautical miles (nm) long and oriented north/south in a mountain valley. The wreckage was found on the northeast shoreline, approximately 0.2 nm south of the north end of the lake.

1.11 Medical Information

Post-mortem examination of the pilot did not reveal any indication that incapacitation or any physiological factor had affected his performance. Ibuprofen, in an amount that was too small to quantify, was detected during toxicology testing. The amount present would not have affected the pilot's performance. Tests for the presence of other common drugs and alcohol were negative.

1.12 Survival Aspects

Although the pilot's seat was fitted with a four-point lap-belt/shoulder harness restraint system, the shoulder harness was not worn. The shoulder straps were anchored to the seat frame at the lower end of the seat back and extended upward along the seat back, over the top of the seat back, and down the front of the occupant when fastened. The *Small Airplane Crashworthiness Design Guide* states that shoulder straps should pass over the shoulders in a horizontal plane, or at any upward (from shoulders to pull-off point) angle not to exceed 30°, and that any installation that causes the straps to pass over the shoulders at an angle below the horizontal adds additional compressive force to the occupant's spine during an accident. The pilot was reportedly aware of the deficiencies in this shoulder harness design and was reportedly in the habit of not wearing the shoulder harness for that reason.

The autopsy identified that the cause of death was massive cranial and thoracic traumatic injuries. It was the pathologist's opinion that the injuries to the neck and basal skull regions were induced by severe deceleration forces rather than by contact with cabin structure, and that these injuries would not likely have been prevented by the use of the shoulder harness.

1.13 Organizational and Management Information

At the time of the occurrence, Scenic Air Services Ltd. was a small, privately owned company, employing three or fewer people and offering fixed-wing air services to the public in accordance with CAR 702, "Aerial Work," and CAR 703, "Air Taxi Operations". The company operated two Piper PA-18-150 aircraft, seasonally, for outfitters based in northern British Columbia and the Northwest Territories. The original Air Operator Certificate (AOC) was issued in July 1990. The company changed ownership on 31 December 1996. The AOC was suspended 14 March 1997 because the company did not employ a qualified Operations Manager, a Chief Pilot, and a Maintenance Manager, and it had not established an operations manual, as required by the new CARs. The AOC was reinstated 23 July 1997, following the approval of the new *Company Operations Manual* and the appointment of the pilot involved in this occurrence to the required administrative positions. On 11 July 2002, the company received a Certificate of Approval to operate an Approved Maintenance Organization

(AMO).

At the time of the accident, the accident aircraft was registered commercially and the second PA-18 aircraft was registered privately.

1.14 Transport Canada Overview

Inspections and audits are key components in the Transport Canada safety oversight program. Transport Canada Civil Aviation (TCCA) Publication TP 13750E states that Commercial and Business Aviation (CBA) inspection and audit functions confirm for TCCA that a Canadian aviation document holder is operating in compliance with regulatory requirements. A company receives its AOC on the basis that the program submitted for TCCA approval meets regulatory requirements. Emphasis is placed on the operator's control manuals, such as the *Company Operations Manual*, to ensure that the content adequately addresses program control.

Transport Canada CBA inspections and audits are intended to be completed at regular intervals. The Transport Canada *Manual of Regulatory Audits* requires commercial operators to be audited at least once every three years, with an option of extending the interval to five years in 703 operations, where risk factors are deemed low.

The risk factors that may trigger Transport Canada to consider an audit outside of the normal schedule include a poor accident or safety record within a company, a merger or takeover, and safety concerns relating to management history and practices. CBA inspectors had not performed an audit on Scenic Air Services Ltd. since prior to the issue of the original AOC in 1990. An operations audit had been scheduled to take place on 03 July 2001; however, it was postponed.

A Transport Canada Maintenance and Manufacturing regulatory audit had been conducted from 08 to 10 July 2002, prior to Scenic Air Services Ltd. receiving certification as an AMO. The audit findings highlighted several concerns relating to maintaining staff training records and the lack of initial and recurrent staff training. The accident aircraft was not available for examination by the auditors at the time of the audit.

The operator had one reported accident in 1995 that resulted in substantial damage to the aircraft (TSB occurrence No. A95W0145). The company came under new ownership in early 1997. The company had a second accident in 2000 that also resulted in substantial aircraft damage (TSB occurrence No. A00W0187). There were two additional incidents in 2000, one involving an aircraft that nosed down during a short-field take-off, resulting in propeller and cowling damage, and a second involving an unsecured aircraft that rolled in strong winds and collided with a fuel truck.

The following TSB Engineering Laboratory report was completed and is available upon request:

LP 133/03 – Right Magneto P-Lead

2.0 Analysis

2.1 Introduction

There were no witnesses to the occurrence and no survivor; the immediate circumstances leading up to the accident are unknown. The reported wind direction, the aircraft heading, the position of the flaps at impact, and the location of the accident site are consistent with the accident having occurred during an approach for landing. It is, therefore, probable that the pilot had completed a take-off from the lake, and that he was attempting to return to the lake, for undetermined reasons, when the accident occurred.

The wreckage trail and damage patterns were consistent with the aircraft having stalled at a low altitude, which precluded an effective recovery. The conditions that would most likely have contributed to the loss of control are gusty winds, degraded flight performance due to the aircraft's high gross weight, disruption of airflow and drag because of the external load, and a possible reduction in available engine power due to a faulty magneto p-lead.

2.2 Weight and Balance

The aircraft weight at the time of the accident exceeded the maximum allowable take-off weight by at least 162 pounds. Combined with the effects of the moose antlers being carried externally, this would have reduced the aircraft's flight performance, adversely affected the stability and slow flight characteristics, and increased the stall speed. The lack of a stall warning system may have delayed the pilot's recognition of the approaching stall.

There were significant errors in the amended weight and balance reports that were available to the pilot. While there was no indication that the weight and balance report errors contributed directly to the accident, the errors would have precluded an accurate calculation of the actual weight and centre of gravity location.

The Piper PA-18 weight and balance reports and the PA-18 type certificate identify different datums for weight and balance purposes. Because of this conflict, there is a potential for the inadvertent and concurrent application of two different datums in individual weight and balance amendments. While centre of gravity does not appear to be a factor in this accident, the circumstance of having two datums for the weight and balance reference material increases the likelihood that errors will occur during weight and balance amendments. This, in turn, increases the potential for the aircraft to be loaded outside of the centre of gravity limits. Improper loading could contribute to loss of control, serious injury, and fatality in other occurrences.

2.3 *External Loads*

Carriage of external loads, such as moose antlers, is considered an acceptable practice by outfitters and other float plane operators. The risks associated with the carriage of external loads require that consideration be given to the performance degradation. While the exemption to carry external loads with passengers did not apply to this flight, since no passenger was being carried, voluntary compliance with the conditions required for the exemption to CAR 703.25 would have reduced the risks associated with the flight.

CAR 703.25 could be misinterpreted as allowing the carriage of external loads without conditions when passengers are not carried, even though the flight authority for an aircraft becomes invalid if an aircraft has not been certified to carry an external load.

2.4 *Company Organization and Management*

There were several unsafe conditions associated with the operation of the aircraft that increased the risk on this flight. The *Company Operations Manual* contained conflicting information and no specific guidelines concerning operations with external loads, and the Piper PA-18-150 was not approved for the carriage of external loads under the aircraft Type Certificate. However, an external load was being carried. There was no evidence that a proving flight had been accomplished to determine the flight characteristics associated with the external carriage of moose antlers.

The empty weight of the aircraft was under-represented in the available weight and balance reports, and the aircraft's gross weight was considerably above the maximum allowable take-off weight at the time of the accident. The cabin load had not been secured prior to flight, despite the anticipation of turbulent flight conditions. The right magneto p-lead had been in poor condition for some time, and the discrepancy had not been detected during recent maintenance or operation of the aircraft.

The organizational structure of the company placed all of the administrative and risk management responsibilities in the hands of one individual. This negated the advantages of management checks and balances within the company, which normally provide a level of independent oversight, especially in the area of quality assurance. This may have compromised the level of safety within the company.

2.5 *Transport Canada Overview*

The aviation system in Canada relies on built-in checks and balances such as multiple-person management structures within commercial operations and regulatory audits to ensure optimal safety. Despite company risk indicators that included a recent change of ownership, a history of accidents and incidents, and a management structure that placed all operational and maintenance supervisory responsibilities in the hands of one individual, the company had not been audited by CBA inspectors since prior to the issue of the original AOC in 1990. It is possible that a Transport Canada audit would have revealed many or all of the unsafe conditions that were identified during this investigation.

2.6 *Right Magneto P-Lead*

The right magneto p-lead had been in poor condition for some time prior to the accident. The degraded condition of the p-lead had not been detected during recent maintenance, and may have resulted in a partial loss of power immediately prior to the accident.

3.0 *Conclusions*

3.1 *Findings as to Causes and Contributing Factors*

1. The aircraft stalled at low altitude, which precluded an effective recovery; the aircraft was not fitted with a stall warning system, which may have delayed the pilot's recognition of the impending stall.
2. The combination of the aircraft being at least 162 pounds above the maximum seaplane weight of 1760 pounds and the moose antlers being carried externally degraded the performance of the aircraft.

3.2 *Findings as to Risk*

1. The PA-18 Type Certificate does not permit the carriage of external loads; there was no evidence that a proving flight had been accomplished to determine the flight characteristics associated with the external carriage of moose antlers; and the *Company Operations Manual* did not provide direction to flight crews concerning operations with external loads – all of which increased the risk associated with the flight.
2. Several weight and balance report amendments for the aircraft contained aircraft empty weight and centre of gravity errors, which precluded an accurate weight and balance calculation and increased the risk that the aircraft could be flown outside of weight and balance limits.
3. Canadian Aviation Regulation 703.25 could be misinterpreted to allow the carriage of external loads without conditions when passengers are not carried, even though the flight authority for an aircraft becomes invalid if an aircraft has not been certified to carry an external load.
4. The company had not undergone a Transport Canada Commercial and Business Aviation operational audit since prior to the issue of the Air Operator Certificate in 1990, which precluded the early identification of several latent safety deficiencies within the company.

3.3 *Other Findings*

1. The right magneto p-lead was defective, which may have resulted in a partial loss of engine power.
2. For some time prior to the accident, the rear control stick socket was contacting the aft wall of the protective cover when the control stick was in the full-aft position.
3. The "Borer" propeller installation, under Supplemental Type Certificate SA279AL, was not approved for operation in combination with Canadian Aircraft Products 67-2000 floats.
4. There was no record of the ski cargo box having been installed in the aircraft.

4.0 *Safety Action*

4.1 *Action Taken*

On 28 January 2004, the TSB issued an Aviation Safety Information Letter (A040002, PA-18 Weight and Balance Information) to The New Piper Aircraft, Inc., with a copy to Transport Canada. The letter concerned the conflict between datum information on the original Piper PA-18 aircraft weight and balance documents and that on the current type certificate. The information was provided for whatever follow-up action the company deemed appropriate.

On 15 April 2004, the TSB sent to Transport Canada an Aviation Safety Advisory regarding company audits (A040022, Transport Canada Regulatory Overview).

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 07 September 2004.

Visit the Transportation Safety Board's Web site (www.tsb.gc.ca) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.

Appendix A – List of Supporting Reports (Accidents Involving External Loads)

File	Registration	Aircraft Type	Operator Type	External Load	Passengers	Injuries	Phase
1	A76Q0072	PA-18-135	private	canoe, laminates	1	2 serious	approach, base leg
2	A77C0096	DHC-2	government	canoe	2	0	take-off, initial climb
3	A78O0078	PA-18-150	private	plywood, aspenite	0	1 fatal	approach, final
4	A78O0090	DHC-2	commercial	canoe	2	3 fatal	manoeuvring, low flying
5	A79C0125	DHC-2	commercial	rolled linoleum	5	6 fatal	take-off, initial climb
6	A80Q0094	Cessna 185	private	moose head & antlers	0	1 fatal	landing
7	A81O0061	PA-12	private	not identified	2	3 fatal	initial climb
8	A82O0062	PA-12	private	canoe	0	1 minor	approach, base leg
9	A88O0197	PA-18	private	folded boat	1	1 serious	en route
10	A89O0433	PA-18	private	canoe	1	1 fatal, 1 minor	take-off, initial climb
11	A91C0095	DHC-2T	government	boat	2	0	approach, final
12	A92C0155	Cessna 180	private	canoe	1	1 fatal, 1 serious	take-off, initial climb
13	A94Q0131	Champion 7GCB	private	folding canoe	1	2 serious	take-off, initial climb
14	A95W0168	PA-18	commercial	moose head & antlers	1	2 fatal	take-off, initial climb
15	A97W0146	Cessna 185	commercial	canoe	0	0	loss of power, forced landing
16	A02C0143	DHC-2	commercial	2 canoes	3	4 minor	loss of power, forced landing
17	A03W0210	PA-18	commercial	moose antlers	0	1 fatal	approach, final

Appendix B – Glossary

AMO	Approved Maintenance Organization
AOC	Air Operator Certificate
C	Celsius
CARs	<i>Canadian Aviation Regulations</i>
CAP	Canadian Aircraft Products
CARAC	Canadian Aviation Regulation Advisory Council
CBA	Commercial and Business Aviation
CPL	Commercial Pilot Licence
kg	kilogram
mph	miles per hour
nm	nautical miles
STC	Supplemental Type Certificate
TC	Type Certificate
TCCA	Transport Canada Civil Aviation
TSB	Transportation Safety Board of Canada
VHF	very high frequency
°	degree(s)
‘	minute(s)