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

SAFETY AVIATION REFLEXIONS

Issue 24

- THE URGE TO PRESS ON
- OUT OF ALTITUDE, OUT OF VISIBILITY

Canada

AVIATION SAFETY REFLEXIONS

Issue 24

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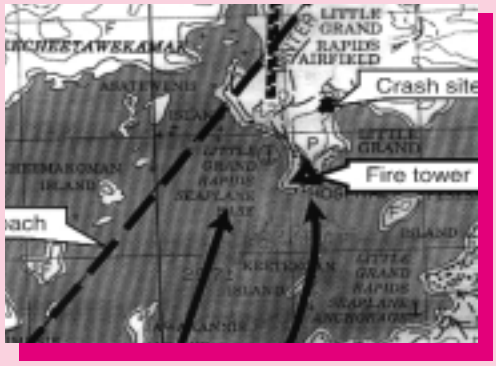
THE URGE TO PRESS ON



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OUT OF ALTITUDE, OUT OF VISIBILITY

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❑ COVER PHOTO: Cessna 210

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The Urge to *Press on*

TSB files contain many reports of accidents in which a contributing factor was the pilot's desire to embark on or continue a flight, despite known risks, because of what is commonly referred to as "get-home-itis". In this instance, investigators suspect the pilot and his family's desire to start their summer vacation on schedule led to the accident. Their airplane, a Cessna 210F, broke up in flight in an area of thunderstorms near Milan, Que., on 28 July 1997. The pilot, his wife, and their three children were fatally injured.

Report No. A97Q0158

The pilot, who was employed by an airline, held an instrument rating and had over 5,000 hours, including 1,300 hours under instrument flight rules (IFR), in a variety of single- and multi-engine aircraft. His employer considered him to be a safe pilot who did not hesitate to postpone or cancel a trip when he thought the weather unfavourable for a flight. The pilot had completed the Transport Canada company air safety officer course.

The pilot and his family had rented a house on Prince Edward Island (P.E.I.) for a one-week vacation starting on 28 July 1997 and planned to take off in his Cessna 210 from Tillsonburg, Ont., that morning in order to reach P.E.I. before sunset.

Prior to take-off, the pilot obtained a full weather report as part of his flight planning. The weather prognosis, area forecasts, significant meteorological message (SIGMET) C2, and specific reports of the locations of heavy precipitation were fairly representative of the conditions prevailing en route. Based on this

The pilot of this Cessna 210 tried to squeeze between thunderstorms, but the aircraft broke up in midair.

The pilot would have to cross a cold front and storm line to get to Charlottetown

information, supplied by flight service station (FSS) specialists and air traffic services (ATS) controllers, the pilot would have been able to conclude that he would have to cross a cold front and storm line to get to Charlottetown, P.E.I.

SIGMET WARNED OF CONDITIONS

About 35 minutes before landing at Cornwall, Ont., to refuel, the pilot called the FSS specialist at Gatineau, Que., to advise that he planned to take off IFR from Cornwall around 1600 EDT and request en route weather. Visual meteorological conditions (VMC) were forecast for Charlottetown for 1600. Next, the specialist specifically mentioned that an area of active thunderstorms was over Montréal, Que., and vicinity and that a SIGMET was issued at 1321 for the storm area. A SIGMET is issued only for the most dangerous phenomena of vital importance to all aircraft types, and this one, SIGMET C2, said:

> Thunderstorms were observed by weather radar and satellite photo on a line from 30 miles east of Quebec to Trois-Rivières to 30 miles north of Montreal to 20 miles northeast of Ottawa. The maximum summit of the storm line is estimated at 40,000 feet causing visibility of two to five miles, thunderstorms and heavy rain showers, and a risk of hail and local gusting to 50 knots. The storm line is moving east at 35 knots and gaining in intensity until 2015 UTC.

As holder of an airline pilot licence and instrument rating, the pilot had the ability, knowledge, and experience to recognize the dangers associated with flying near thunderstorms. The pilot correctly calculated before leaving Tillsonburg that he would catch up with the cold front near Cornwall and be clear of it around Sherbrooke, Que. He also estimated that he would fly through the storm area south of Montréal.

Since the pilot could neither fly over the storm line (because he was limited to an altitude of 19,900 feet) nor fly around it (because it extended too far north-south), and since the aircraft did not have weather radar or a Stormscope storm detector, it would have been appropriate to wait on the ground until conditions improved.

It would have been appropriate to wait on the ground until conditions improved

At about 1545, shortly after taking off from Cornwall on an IFR flight plan for the final leg of the flight, the pilot contacted Montréal Air Traffic Control (ATC). The controller first instructed the pilot to proceed on a heading of 075° magnetic at 9,000 feet above sea level (asl) to keep the aircraft north of significant weather returns displayed on his screen. The controller then told the pilot that he would be radar vectored to his destination because the planned flight route ran right through an area of adverse weather.

THREE COURSE CHANGES

The controller also advised the pilot to expect heavy weather, rain, and storms all the way to near Millinocket, Maine, and that the adverse weather over the St. Lawrence River had moved south of Montréal. The pilot then decided to divert to the north of the weather system instead of to the south as he had intended previously.

At 1607 the controller for the Granby, Que., sector took charge of the flight. Between 1607 and 1613 the pilot modified his route three times due to adverse weather:

- At 1607 the pilot decided to head directly for Sherbrooke VOR (VHF omnidirectional radio range).
- At 1611 he requested to divert north to Beauce VOR to avoid the weather.
- At 1613 he opted to head directly for Charlottetown: the controller had just advised him that, based on the radar sweep, the weather was more favourable to the east and toward Charlottetown than around the Beauce VOR. The controller also told the pilot he should be clear of the weather after Sherbrooke.

THE RADAR PICTURE

The radars at Québec and Montréal, which provide data to the controller, showed a line of significant weather returns extending from Québec to south of Montréal. The line appeared to be unbroken except for a gap over the Sherbrooke area. The ATS radar indicated that the aircraft was headed toward the gap on a track that seemed largely free of

Upper surface of the 210's fuselage. The vertical fin separated in flight.

weather returns. In fact, the pilot was about to fly through heavy rain that was not shown on the controller's screen.

ATS radar, due to its inherent limitations, cannot always detect weather disturbances. A storm cell can be concealed if it is behind other radar contacts. Also, neither ATS radars nor weather radars can see turbulence.

Still, the pilot must have been at least somewhat aware of the limitations of the radar system because the controller had occasionally asked him to describe the weather he observed in front of him. In any case, the pilot was entirely responsible for the aircraft, and he tried to squeeze between the storms despite the risks that he had recognized.

The pilot tried to squeeze between the storms despite the risks that he had recognized

At 1626 the pilot reported that he was "plowing through" some rain showers, even though it did not seem very safe to him. He also confirmed that he would continue the flight to Charlottetown. That was the last message received from the pilot. At that time the aircraft was in level flight at 9,000 feet asl and a ground speed of 190 knots and was 10 nautical miles south of the weather line observed by ATS radar. Abeam the Sherbrooke VOR, the pilot made three heading corrections and headed toward an area of weather returns, where the aircraft disappeared from the radar screen at 1636.

Failure analysis suggests that the right wing fractured first, just inboard of the strut joint. The wing then struck the fin and the right horizontal stabilizer, which then failed.

Following this accident, Transport Canada said that, in order to increase pilot awareness of ATC limitations in providing current en route weather, additional questions in this area would be included on the instrument rating and Air Transport Pilot Licence written examinations.

OUT OF ALTITUDE, OUT OF VISIBILITY

An Embraer EMB-110 Bandeirante crashed while attempting a visual approach to land at Little Grand Rapids, Man., in marginal weather during daylight on 09 December 1997. The captain and three passengers were fatally injured; the first officer and the remaining 12 passengers suffered serious injuries.

Report No. A97C0236

The Board determined that at the time of the occurrence, the base of the cloud at Little Grand Rapids was between 100 and 300 feet above ground level (agl), with fog to the east of the airport, and the visibility was one to two miles. The aircraft was flown below the minimum en route altitude for commuter operations and below the minimum descent altitude (MDA) for the non-directional beacon (NDB) A approach, which was 1,560 feet above sea level, 555 feet above the airport elevation.

THE FLIGHT

The Sowind Air Ltd. Bandeirante departed St. Andrews under visual flight rules (VFR) on a 40-minute scheduled flight to Little Grand Rapids. When the aircraft approached its destination, the crew received the unofficial airport weather report by radio from the airport manager (APM), who reported a ceiling of 200 feet agl and visibility of one statute mile. The crew flew an instrument approach and, when the aircraft was overhead the airfield (the NDB is located on the airport), asked the APM if the aircraft could be seen. The APM responded negatively, and the crew initiated a missed approach, advising that they had not acquired the airport visually.

After the aircraft had climbed back above the cloud layer, a second Sowind Air Ltd. aircraft, a Piper PA-31-350 Navajo, arrived in the vicinity of Little Grand Rapids, operating under VFR. The Navajo pilot reported that he flew over the runway from the south-west at a height of about 300 feet agl, turned, and made a successful landing on runway 18. He then advised the Bandeirante crew by radio that the visibility on final for runway 18 was two miles and that he was on the ground.

It is reasonable to conclude that the information provided by the Navajo pilot influenced the Bandeirante captain's decision to attempt a second approach

It is reasonable to conclude that the information provided by the Navajo pilot influenced the Bandeirante captain's decision to attempt a second approach. The captain had a reputation for "pushing the weather". The knowledge that a company aircraft had just landed was likely a factor in his decision to descend below the MDA and the minimum altitude for commuter operations and attempt a visual approach in marginal conditions.

The aircraft approached from the south over the community of Little Grand Rapids, to the east of the flight path of the Navajo, and crossed the lake at low level. The aircraft was at about half the height flown by the Navajo, or about 150 feet (45.7 m) above the lake surface. When the aircraft approached the shoreline to the south-east of the airport, the engine power was advanced just before the aircraft banked rapidly to the left, followed by a nearly immediate right bank and impact with the terrain. The impact occurred approximately 400 feet (121.9 m) south and 1,600 feet (487.7 m) to the east of the approach to runway 36.

As the aircraft crossed the lake well to the right of the normal approach path, it was flying at about the height of the top of an abandoned, 93-foot (28.3 m) fire tower, about 163 feet (49.7 m) above the lake surface. Because the aircraft was flying to the right of the normal flight path, the fire tower was between the

flight path and the runway. It is possible that the crew observed the fog to the east of the airfield, initiated an overshoot, and turned left to remain clear of the fog. After the left bank was applied, it is possible that the fire tower was observed and the captain immediately banked right to avert a collision. In that case, the aircraft would have turned back towards (or entered) the fog bank, and the crew would have had to transition immediately to instrument flying techniques and start a climb. It is possible that the application of power induced a somatogravic illusion in the crew members, leading them to believe that they were in a climb rather than a descent. In such a situation, the captain would have flown the aircraft into the terrain, believing that he was climbing up through the cloud layer.

WEIGHT AND BALANCE

Although the weight of the aircraft could not be calculated with precision, it was determined to be 495 pounds to 1,095 pounds (224.5 kg to 496.6 kg) greater than its maximum allowable landing weight of 12,015 pounds (5,450 kg) and 10 pounds to 610 pounds (4.5 kg to 276.7 kg) greater than its maximum allowable take-off weight of 12,500 pounds (5,670 kg).

Degrees of bank	Stall (KIAS)
0	88
30	94
45	104
60	124

Stall speeds at 13,000 pounds.

While the airspeed at which the aircraft was being flown is not known, the flight should have been operating at 120 knots indicated airspeed (KIAS) based on the Sowind Air standard operating procedures. The TSB determined that the indicated airspeed at impact was between 138 KIAS and 153 KIAS. Therefore, the airspeed during the approach was probably in the range of 120 knots to 153 knots. Using the accompanying chart showing stall speeds at 13,000 pounds (5,897 kg), it can be seen that the crew would have had to have entered a sustained bank of more than 45 degrees to stall the aircraft at the low end of this speed range. Even at an aggressive bank angle of 45 degrees, the approximate stall speed is 104 KIAS, leaving a 16-knot margin for an increase in stall speed because of residual rime ice. (A pilot who examined the aircraft a few hours after the accident found only a trace of rime ice on the vertical stabilizer.) Thus, a stall caused by a combination of weight, bank angle, and contamination is not considered likely.

In the months of September and December before the occurrence, the maximum take-off weight of the occurrence aircraft had been exceeded on seven flights

TRANSPORT CANADA MONITORING

A post-occurrence audit of Sowind Air Ltd. was conducted in January 1998 by Transport Canada (TC). The audit identified 32 non-conformances, including several training non-conformances. The audit found that the operations manager was not fulfilling the responsibilities of the position. No company pilots, including the two occurrence pilots, had received required training in the use of onboard survival or emergency equipment. Additionally, the captain, who was the company's chief pilot, had not undertaken required training to operate the aircraft from either pilot seat.

The audit also revealed that, in the months of September and December before the occurrence, the maximum take-off weight of the occurrence aircraft had been exceeded on seven flights. There was a belief among pilots that there was little concern for accurate weighing of cargo and passenger baggage. Specific examples of inaccurate weight and balance control were discussed with investigators. The previous chief pilot indicated that sample weight and balance calculations had been made to assist pilots; however, no sample calculations were found.

The audit history of Sowind Air and the positive relationship between the company and TC inspectors did not indicate to TC any need for special attention during the introduction of the Bandeirante in the fall of 1996. With the implementation of the *Canadian Aviation Regulations* (CARs), Sowind Air's smaller aircraft were operated under part 703, Air Taxi Operations, and the Bandeirante was operated under part 704, Commuter

Operations. Further, because TC policy suspended audits during the introduction of the CARs, the initial certification audit was not accomplished. However, the significant number of audit findings, made during the post-occurrence audit, indicates that the company had difficulty with the transition from an air taxi operation to a commuter operation. Given that TC officials were of the opinion that the company had been well managed and could cope with the transition, it is likely that the transition difficulties faced by the company were underestimated by TC. The company president stated that the policy with the Bandeirante was to provide a higher standard of service and that the company's first concern was safety, but safety was compromised in three areas of management responsibility: training and standards, operations, and maintenance.

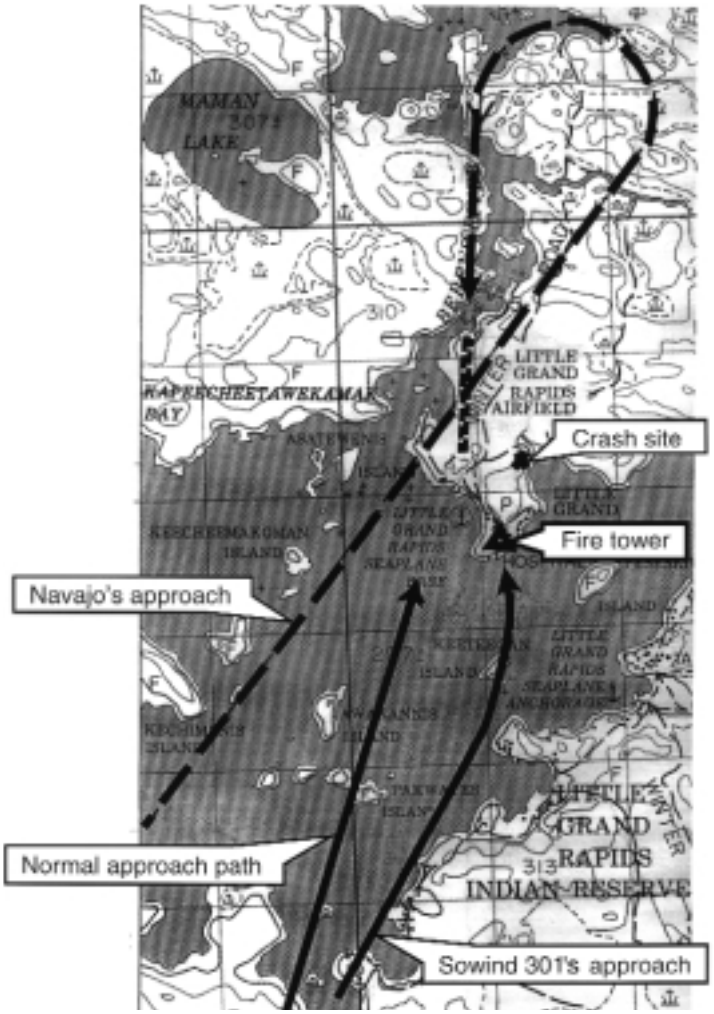
The investigation revealed that the chief pilot's operational control diminished during the introduction of the Bandeirante. Over time, the weighing of cargo and passenger baggage became less effective and the Global Positioning System (GPS) was used routinely on approaches in instrument flight rule conditions, contrary to the provisions of the CARs.

GPS USE

The use of the GPS during the occurrence approaches was not confirmed. However, the GPS was selected to a waypoint that corresponded to the midpoint of the airport, and the GPS would have provided both track guidance and distance. Because the crew descended through the cloud layer to an altitude that was some 400 feet below the MDA, it is likely that they were utilizing the GPS to descend to establish visual contact.

The TSB made a safety recommendation (A95-07) in March 1995 to expedite the implementation of approved GPS standards and procedures for use in Canadian airspace. The TSB also recommended (A95-08) that TC initiate a national safety awareness program addressing the operational limitations and safe use of GPS in remote operations.

The NAV CANADA SAT NAV office is working in co-operation with TC and the U.S. Federal Aviation Administration to implement a phased approach to full realization of GPS for all phases of flight in Canada. The Safety of Air Taxi Operations (SATOPS) Report recommended that TC continue to publish articles in its newsletters about the safe, proper use of GPS and the hazards associated with its misuse. TC has issued many messages in its various publications that address the operating limitations and safe use of GPS.



The captain of the aircraft involved in this occurrence had a reputation for "pushing the weather". The approach was conducted below the MDA for the NDB approach.

MARGINAL WEATHER OPERATIONS

Subsequent to the TSB recommendation (A96-11) in August 1996 to raise commercial operators' awareness of the risks associated with flight operations in marginal VFR conditions, many of TC's national aviation

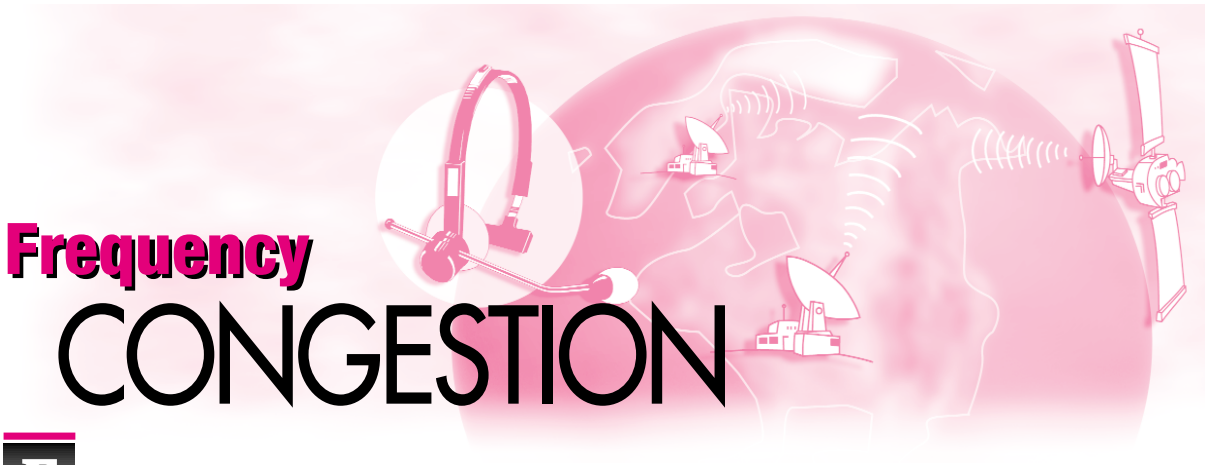
safety promotional efforts, safety awareness programs, and regional education programs have focused on the respect of weather.

The TSB also recommended (A96-12) that pilots involved in air taxi and commuter operations receive specialized training in making prudent decisions under deteriorating weather conditions. Pilot decision making (PDM) has been addressed in the SATOPS Report, which recommended that TC review the Commercial Air Service Standard authorizing operations in reduced visibility (provided that the pilot has taken a PDM course), to determine if one-time attendance at the PDM course is sufficient. As a result, TC was preparing a Notice of Proposed Amendment (NPA) that will require annual PDM training for companies that hold the Operations Specification for operations in reduced visibility; this will apply to operators subject to CARs 702, 703, and 704 (helicopters only).

A combined TC and industry study group has been reviewing the safety data and issues surrounding approaches in poor weather. Regulatory recommendations concerning approach bans in the form of an NPA were submitted to the General Operating and Flight Rules Technical Committee of TC in December 1999.

TSB CONTINUING STUDIES

The Board is concerned about the frequency of accidents involving airworthy aircraft and fit pilots conducting instrument approaches in low visibility and/or low ceilings. The TSB is currently analyzing 19 such accidents that have occurred in Canada since 1994. The most recent of these was a fatal accident involving a Beech 1900D aircraft at the Sept-Îles airport in Quebec. The pilots flew the aircraft well below the MDA for the published NDB approach. Further work is in progress to determine the nature and extent of any safety deficiencies evidenced by these accidents.



Frequency CONGESTION

Following an engine failure just after take-off from Calgary International Airport, Alta., on 14 September 1988, a Martinair Holland Boeing 767-300 returned for an uneventful landing at the airport.

Report No. A98W0192

After taxiing clear of the runway, the captain brought the aircraft to a stop. An airport emergency response team (AER) met the aircraft and placed chocks around the main wheels, then used fans to cool the wheels. Shortly after the aircraft came to a stop, three tire fuse plugs melted and the three tires deflated. After the wheels had cooled sufficiently, an air-stair was put in place; the 272 passengers and cabin crew deplaned and were transported to the terminal by buses.

After the aircraft came to a stop on the taxiway, communications with the

AER commander were conducted initially on Calgary ground control frequency and later via intercom. The captain was also communicating with the tower ground controller and with the Martinair office in Amsterdam, Netherlands, via ACARS (automatic communications and reporting system). Once the aircraft cleared the runway, air traffic control (ATC) resumed normal operations at the airport.

COMMUNICATIONS WERE COMPLICATED

Communications on the Calgary ground frequency were complicated due to the unresolved nature of the occurrence, the aircraft crew's need to maintain communications with the AER team and the ATC ground controller, and the need for continuing operation of aircraft using the ground frequency while taxiing to and from the terminal. The frequency congestion did not compromise the safety of the passengers, crew, or aircraft during this occurrence. However, the volume of transmissions did cause the flight crew concern that they might miss vital communications that could have jeopardized the safety of the passengers, AER ground crew, and flight crew. A separate frequency would have permitted the crew to communicate directly with the AER team.

A separate frequency would have permitted the crew to communicate directly with the AER team

As a result, Transport Canada has been working, through membership on an International Civil Aviation Organization working group, toward the establishment of a discrete frequency for communication between the aircraft flight deck and senior fire officer responding to an aircraft emergency.

AVIATION SAFETY

Expecting the UNEXPECTED

We've written before in *Aviation Safety REFLEXIONS* about how pilots, air traffic controllers, and other people in the flying business can become so accustomed to routine that they fail to pick up on the unexpected. Such was the case in Calgary, Alta., on 21 April 1998. An air traffic controller expected an aircraft to do one thing, but it did something else. The result was a risk of collision.

Report No. A98W0079

At the time of the occurrence, a two-runway system was being used at Calgary International Airport. Based on standard operating procedures, north- and eastbound traffic was being released from runway 34, and south- and westbound traffic was being released from runway 28. Canada 3000 flight 368 (CMM368), an Airbus A320, was eastbound for Toronto, Ont., and requested and received clearance to depart from runway 28. N48BA, a Rockwell International 690C turboprop headed for Kallispel, Montana, was taxiing from the south end of the airport and was cleared to depart from runway 34. These

clearances resulted from the controller's willingness to shorten the taxi distances for both aircraft but resulted in a change to the normal flow of departure traffic.

On contact with Calgary Departure, CMM368 was cleared to climb on runway heading to maintain flight level (FL) 250. When it contacted Calgary Departure, N48BA was cleared to climb to FL 210, and was given two right turns, the last to a heading of 150° magnetic (°M). During initial climb, CMM368 was given two left turns and then cleared direct to Empress Intersection; the heading was 090°M.

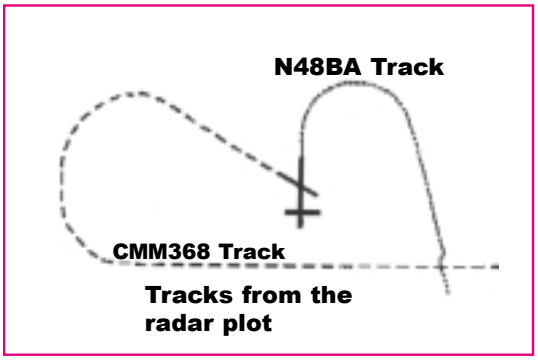
FLIGHT PROFILE CHANGED

On initial climb off runway 28, CMM368's speed and rate of climb were about 190 knots indicated airspeed (KIAS) and 3,200 feet per minute (fpm). Once on course to Empress Intersection, and in the absence of any air-speed restrictions, the captain selected a managed speed to 320 KIAS, which resulted in a rate of climb of about 800 fpm while the aircraft was accelerating. N48BA was climbing at about 180 KIAS and 1,800 fpm.

Once the air traffic controller turned CMM368 east towards Empress Intersection and turned N48BA south, he checked their respective altitudes and ground speeds. Based on his experience controlling other A320 aircraft departures at Calgary, he expected the A320 to continue its climb rate of about 2,500 fpm, thus achieving greater-than-the-minimum separation require-ments for the two aircraft during their crossing. He did not anticipate that the pilot of the A320 would change his flight profile and reduce the aircraft climb rate to about 800 fpm while increasing the speed by about 100 knots. He assumed that certain flight profiles would be flown and did not recheck the progress of either aircraft.

He assumed that certain flight profiles would be flown and did not recheck the progress of either aircraft

When CMM368 was at about 12,000 feet and 300 KIAS, a traffic alert and collision-avoidance system (TCAS) Traffic Advisory



The controller assumed that the A320 would continue to climb at 2,500 fpm. But in the absence of any speed restriction, the captain increased speed and reduced the aircraft's climb rate, which was not noticed by the controller.

was received, with the target displayed at the 11 o'clock position at three to four miles, 700 feet below and climbing. Immediately thereafter, a Resolution Advisory (RA) was received with the command "DESCEND CROSSING DESCEND". The captain initiated a descent. At this time, the pilot of N48BA sighted CMM368, turned right, and increased his rate of climb. At about the same time, a second RA commanded the pilot of CMM368 to "INCREASE DESCENT". CMM368 came within 500 feet horizontally and 500 feet vertically of N48BA in an area where either three nautical miles horizontal or 1,000 feet vertical separation is required.

CMM368 came within 500 feet horizontally and 500 feet vertically of N48BA

When commissioned in the early 1980s, the Radar Modernization Project (RAMP) system was to have a conflict alert capability to warn the controller that a loss of separation was imminent and that action was required to resolve it. Technical problems, which persist to this day, have prevented the conflict alert system from being implemented. Conflict alerting systems are operational in other parts of the world. This type of tool would provide an additional safeguard, much as TCAS does, to avoid losses of separation or midair collisions.

A Case of Poor Maintenance

A modification to the cabin heating unit inconsistent with the manufacturer's recommendations and aviation regulations caused an engine fire in the right engine cowl of the Air Nunavut Ltd. Piper PA-31-350 Navajo during the initial climb. The pilot shut down the engine, but the aircraft could not maintain a positive rate of climb and impacted the ground. The two pilots and two passengers were uninjured in the 20 January 1988 accident at Sanikiluaq, NWT.

Report No. A98Q0007

The investigation revealed that the exhaust muffler on the right side of the engine and the exhaust pipe became disconnected because two stainless steel collars were installed on the far aft side of the No. 5 cylinder exhaust pipe to prevent the exhaust muffler from coming into contact with the No. 5 cylinder baffle. The technician who performed the installation did not deem that there was a risk in making that modification.

Installation of the collars was not prescribed in the modification for supplemental type certificate (STC) SA-240. Also, the way the collars were installed contributed to a considerably greater risk of fire.

COWL MELTED BY FLAMES

Following the accident, the exhaust muffler and exhaust pipe were found butted up against each other, jammed together end-to-end, with only about half their respective diameters connecting. In this position, the exhaust gases could not be expelled normally and were projected onto the end of the exhaust muffler, then directly onto the engine cowling. The exhaust gas temperature was estimated at approximately 1,400°F (760°C). The fibreglass cowl skin could not withstand such high temperatures and was melted by the flames. With the two stainless steel collars positioned as they were, the exhaust muffler could only be inserted less than 1/4-inch (.63 cm) over the pipe; these parts were designed to overlap by more than 1 1/2 inches (3.8 cm) into one another.

No one was at the airport and no one was aware of the accident

When the aircraft crashed about a mile (1.6 km) beyond the end of the runway, no one was at the airport and no one was aware of the accident. The pilots and passengers had to walk across large snow-covered fields to reach the shelter of the terminal, which had been left open.

At the time of the accident, the Community Aerodrome Radio Station (CARS) employee (observer/communicator) was not on duty because the flight was after usual business hours. When an aircraft lands or takes off outside of usual business hours, additional fees must be paid by the aircraft operator. The pilot had elected not to call the CARS employee, thereby depriving himself of services such as flight monitoring, which would have allowed the occupants of the aircraft to be rescued more rapidly.

RECORDS INCOMPLETE, INADEQUATE

Each time, the aircraft continued to operate until the required parts were delivered

The investigation found the record keeping and files for the subject aircraft to be incomplete and inadequate. A review of the aircraft logbook revealed that the persons in charge of maintenance had authorized the aircraft to be used while some deficiencies had not been corrected, including an unserviceable fuel regulator shut-off. Each time, the aircraft continued to operate until the required parts were delivered.

From 1992 to 1996, the company was monitored by Transport Canada (TC), Quebec Region. The Val d'Or office monitored maintenance. During this period, the maintenance department was reviewed only once, in September 1994. In November 1996, when the new Canadian Aviation Regulations (CARs) came into effect, responsibility for monitoring was transferred to Winnipeg Region for company operations and to Yellowknife for maintenance. The first inspection by airworthiness inspectors was on 30 January 1997; no aircraft inspections were done at that time. In June 1997, inspectors from the Enforcement Division conducted an inspection and, after interviewing a pilot, noted several major operational deficiencies. No report was found in the company files to indicate that any follow-up action was taken. An entry in the aircraft logbook on 14 December 1997 refers to maintenance work on the right engine. This work was for the replacement of the right rear exhaust pipe, the same exhaust pipe that was found disconnected after the accident.

In 1997, three different people held the position of Director of Maintenance. At the time of the accident, the Director of Maintenance position at the maintenance base was vacant. A post-occurrence review of the maintenance department by TC resulted in temporary suspension of the company operating certificates.

The aircraft flew a lot of hours and were not to be kept on the ground very long for maintenance

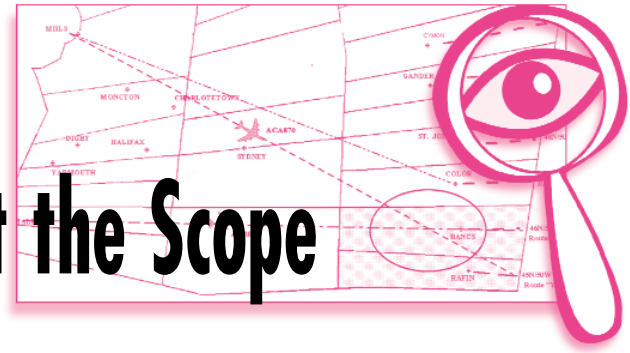
Due to the frequent staff changes, it was difficult for company personnel to properly follow up on aircraft records. The aircraft flew a lot of hours and were not to be kept on the ground very long for maintenance. In this remote area, TC inspections are infrequent, which is confirmed by the information found on file.

As a result of the TSB investigation, TC took immediate action by suspending the aircraft maintenance organization certificate of Air Nunavut Ltd.

Both the operating certificate and the maintenance organization certificate have since been restored.

Modifications to the cabin heating unit that were not done "by the book" led to an engine fire on take-off.

Inattention at the Scope



A Boeing 747-400 with 279 persons aboard would have apparently collided with an Airbus A340 with 249 persons aboard over the Atlantic Ocean on 20 July 1998 if the onboard traffic alert and collision-avoidance system (TCAS) had not provided a warning. As it was, the two aircraft closed to approximately 400 feet (121.9 m) vertically and 1.9 miles (3.05 km) horizontally. The required separation in that airspace, about 125 nautical miles (nm) south of St. John's, Nfld., is 1,000 feet (304.8 m) vertically or 5 miles (8 km) horizontally.

Report No. A98H0002

Air France flight 033 (AFR033), the A340, was en route from Houston, Texas, to Paris, France, at flight level (FL) 370 with a routing of WHALE, BANCS and 46°N 50°W (Oceanic Track X). Air Canada flight 870 (ACA870), the 747, was en route from Montréal, Que., to Paris at FL370 with a routing of MIILS, COLOR and 47°N 50°W (Track W). ACA870 was recleared from MIILS direct to 45°N 50°W (Track Y). The new routing placed ACA870 on a converging track with AFR033.

The new routing placed ACA870 on a converging track with AFR033

The original flight progress strip for ACA870, designated D1, was posted under the COLOR header in the flight progress board of the appropriate sector. When the oceanic clearance was changed, necessitating a reroute, the D1 strip was amended by the data controller in the COLOR sector by stroking out the fix identifier COL (COLOR) and writing in the new fix identifier, RFN (RAFIN), which is the fix associated with 45°N 50°W. The strip was then passed to the affected sector, BANCS. A new oceanic clearance flight progress strip was then printed, together with an amended sector strip designated D2, and passed to the BANCS sector for posting under the RAFIN header.

ROUTE OF THE "CUTTER"

ACA870, now rerouted and known locally as a "cutter", crossed several other active tracks, including the WHALE-TO-BANCS track, which was very active on the night of the occurrence, from the north-west to the south-east. ACA870 passed approximately 13 nm abeam BANCS, while its closest approach to RAFIN was approximately 28 nm. No flight progress strip was printed for posting under the BANCS header. There is no requirement for such a posting in local procedures, and there is no provision for the printing of an extra strip for this purpose. Aircraft joining southern oceanic tracks from the North American mid-west generally cut south-eastbound across other established tracks and are a relatively common occurrence.

The route of AFR033 took it directly over BANCS and on to 46°N 50°W to follow Track X. The flight progress strip for AFR033 was posted under the BANCS header.

FLIGHT STRIPS NOT UPDATED

The Gander Area Control Centre (ACC) Operations Manual directs: "When aircraft are cleared direct and this results in the aircraft going abeam a fix, the fix shall have "A/" written to the upper left of the affected fix." The flight progress strip used by the BANCS and south sector for ACA870 was not marked with the "A/" to the upper left of the fix indicator, RFN, on either the D1 or D2 strips. The Manual specifies: "If a particular route requires attention: ... the fixes to the right of the aircraft ident shall have a box placed around

ACA870 was approximately 9 nm from AFR033 and converging on a track of 116°M

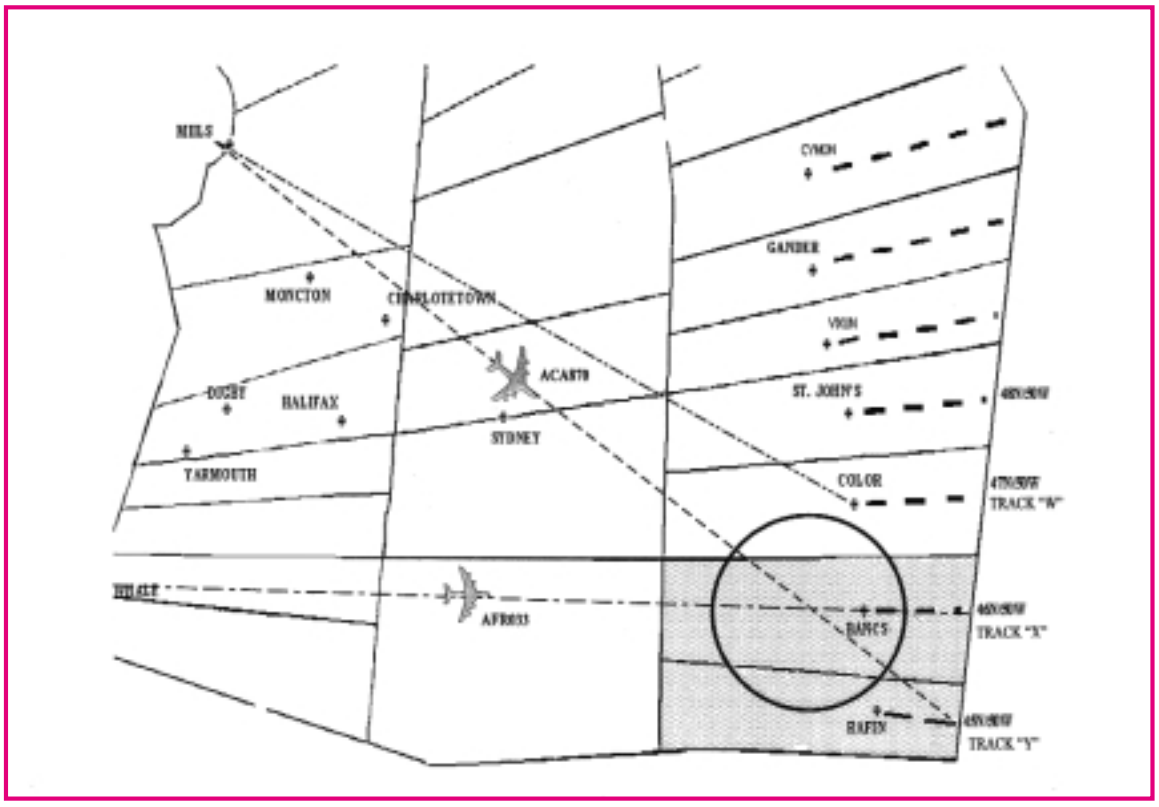
them on all strips." No box was placed around the fixes to the right of the aircraft identification on either the D1 or D2 flight progress strips of ACA870. The Manual also directs: "If there is a radar confliction also include fix under which the traffic is posted." There were no other fixes indicated on the flight progress strips of ACA870 to indicate that there might be a radar conflict with traffic on the BANCS track.

The two aircraft were being controlled by the Gander ACC high domestic controllers responsible for the combined sector BANCS and south, the two south-easternmost sectors of the Gander domestic airspace, in which the coast-out points BANCS and RAFIN are located. ACA870 had been issued its amended oceanic clearance prior to handoff to the BANCS radar controller. ACA870 contacted the radar controller at 0151:15 UTC, outside the geographic boundaries of the BANCS sector, and crossed the sector boundary at 0207. Position estimate information was provided by ACA870 to the radar controller, indicating that the aircraft was level at FL370 and estimating 45°N 50°W at 0227.

AFR033 had been handed off to the radar controller at 0158:32. AFR033, established on the route WHALE direct BANCS, was level at FL370 and estimating BANCS at 0217. Its track was approximately 076 degrees magnetic (°M).

"PAN, PAN, PAN"

At approximately 0211, as ACA870 approached 40 nm west of the BANCS intersection en route to 45°N 50°W, it was advised by the radar controller that radar service would terminate at 50°W and to contact Gander radio on 126.9 MHz. At this time, ACA870 was approximately 9 nm from



Routes of ACA870 and AFR033. BANCS and south sector shaded.

AFR033 and converging on a track of 116°M. No action was taken by the radar controller. Approximately one minute and thirty seconds later, at 0212:33, when the radar controller was communicating with another aircraft, ACA870 received a TCAS Resolution Advisory (RA) and attempted to contact the radar controller but was cut off by another transmission. Seven seconds later, at 0212:40, ACA870 declared, "Pan, Pan, Pan". The radar controller issued a clearance to descend to FL360. ACA870 replied that it was climbing as a result of the RA and that it was on a collision course. The radar controller advised ACA870 to follow the advisory.

Immediately thereafter, AFR033 declared, "Pan, Pan, Pan," and advised the controller that the aircraft was descending as a result of the TCAS RA. AFR033 received an initial TCAS Traffic Advisory (TA) at 0211:34 and an RA to descend at 0212:47.

On receiving the TCAS RA, ACA870 began an immediate climb to FL380. Seventeen seconds after the end of the AFR033 "Pan, Pan, Pan" transmission, ACA870 advised that it was directly overhead the Air France aircraft and that the two aircraft would have collided.

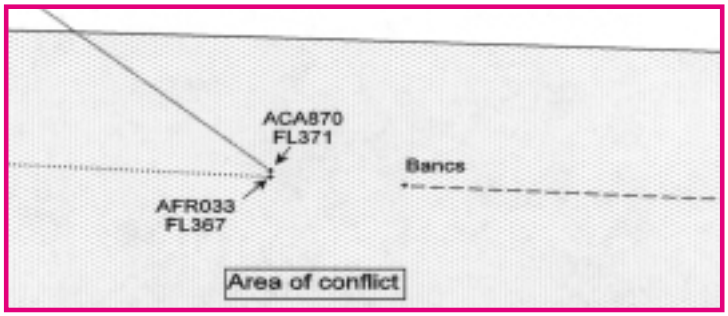
Four previous occurrences resemble this occurrence. In each one, the radar controller did not detect aircraft conflicts on his indicator module (IM). While strip scanning for potential conflicts is necessary, the increasing prevalence of direct off-airway routes, which do not lend themselves to the relatively structured environment for which flight progress strips were designed, puts a premium on the necessity to actively and constantly monitor the IM. While NAV CANADA does provide direction on scanning techniques to all controllers, that subject matter is more oriented to flight progress strip scanning procedures than to definable techniques associated with how to maintain full-time attentive radar flight monitoring.

The controller did not recognize the conflict and did not provide air traffic control radar separation

In this occurrence, the radar controller's full-time attentive flight monitoring procedure did not meet the level of attentiveness required to provide an adequate level of safety to the aircraft under his control. As a result, the controller did not recognize the conflict and did not provide air traffic control radar separation between the two aircraft.

Among other TSB findings:

- The flight progress strips for ACA870 were not marked with the various symbols specified in the Gander ACC Operations Manual to indicate that the flight required special attention.
- The placement of the two flight progress strips under two separate fixes did not overtly warn the radar controller that the two aircraft at the same altitude would be in close proximity in the vicinity of one of those fixes.
- Though planned for implementation to meet traffic needs in the early 1990s, a functioning automated conflict-alert tool was not available.



Aircraft positions at 0212:54. Horizontal distance 1.9 nm, vertical distance 400 feet.

A Series of Misjudgements

The pilot was flying as a single pilot in a newly purchased aircraft, which was uncertified for flight in icing conditions. The flight was at night, in adverse icing and turbulence conditions, and the pilot was relying on outdated approach charts to conduct an unfamiliar precision instrument approach. He was unfamiliar with the aviation weather patterns and was not sufficiently knowledgeable or cautious regarding the detrimental effects of aircraft icing.

Report No. A98A0038

The pilot escaped with minor injuries, but his passenger suffered a serious leg injury when the Piper PA-23-250 Aztec descended into the trees while on approach to runway 16 at St. John's, Nfld., on 20 March 1998.

The aircraft had recently been purchased by four Israeli citizens and was being ferried to Israel by the pilot under its American registry. The pilot held an Israeli commercial pilot licence with an instrument flight rules (IFR) endorsement and had 5,000 hours flying experience. He also held a U.S. commercial pilot licence valid for multi-engine aircraft but with visual flight rules (VFR) privileges only.

He had flown in icing conditions on only about three occasions

The pilot's flying experience was primarily accumulated in Israel where, he stated, icing was seldom a concern. He had flown in icing conditions on only about three occasions, encountering light icing in cloud. He indicated that he anticipated encountering some light icing during his descent into St. John's but that, if his time in cloud was kept to a minimum, the icing should not have presented any significant difficulties. He was surprised at the amount and the effect of the icing.

THE WEATHER

The St. John's area forecast (FA) for the time of the occurrence indicated altocumulus clouds as well as mixed conditions of visibilities as low as one-half mile in light snow, light ice pellets, and light freezing rain. Moreover, the FA forecast moderate-to-severe clear icing below 2,500 feet above sea level (asl) in the freezing rain, moderate mixed icing in the altocumulus cloud, and otherwise light-to-moderate rime icing in cloud above the freezing level. Moderate mechanical turbulence was also forecast due to strong, gusty surface winds.

The terminal area forecast (TAF) for St. John's, covering the aircraft's expected arrival time, included forecast visibilities of 1 1/2 statute miles (sm) in light snow, and surface winds from the east at 15 knots gusting to 25 knots. According to the TAF, the freezing precipitation was not forecast into St. John's

until four hours after the aircraft's expected arrival time, at which time the visibility was expected to be 2 sm in light ice pellets and light freezing rain.

The pilot was aware that his aircraft was not equipped for flight in icing conditions

The pilot received two extensive weather briefings prior to his departure from Bangor, Maine, which included the above-mentioned FA that highlighted the probability of encountering icing in cloud. Moreover, he was aware that his aircraft was not equipped for flight in icing conditions. His decision to undertake the flight and accept the risks posed by a descent through known icing in clouds may have been influenced by his previous successful experience flying in light icing conditions.

The pilot departed Bangor in visual flight, but without filing a transborder flight plan required by regulation. Once in Canadian airspace, the pilot contacted the Moncton (N.B.) Control Centre and indicated his intention to continue to St. John's VFR while remaining on top of clouds. In light of the IFR weather conditions prevailing at St. John's, the pilot was informed that VFR over the top could not be approved, and he was issued an IFR clearance.

During the approximately four-hour flight, the pilot requested and received actual and forecast weather information from both the Moncton and Gander (Nfld.) Area Control Centres (ACC), which indicated light snow and freezing fog or ice pellets and visibilities of 1/2 sm.

Approaching St. John's, the pilot requested an instrument landing system (ILS) approach to runway 16 with a continuous descent to minimize the time spent in the icing conditions in cloud. The Gander ACC cleared the aircraft to descend to 2,100 feet asl and vectored the aircraft to the localizer. During the descent, moderate turbulence was encountered, and some clear icing developed on the windscreen, but no ice was observed on the wings, which were painted white. When the pilot attempted to level off at 2,100 feet asl, the aircraft continued descending to 1,900 feet asl and, despite full application of power, the aircraft took a long time to climb back to 2,100 feet. Once established on the ILS approach, the pilot was able to maintain a 90-knot approach speed and remain on the glide slope until approximately 100 feet above decision height. At this point, the aircraft suddenly rolled left 30 to 45 degrees. The pilot managed to re-establish a wings-level attitude by using aileron and rudder.

The pilot of this Aztec had little experience with flight in icing conditions and was surprised at the amount of icing and its effects.

This was immediately followed by a similar roll to the right and recovery to wings level. The nose then dropped, and the aircraft hit the trees.

The St. John's automatic terminal information service (ATIS) broadcast throughout the approach and descent included the most recent weather observation—visibility 1/2 sm in light snow, ice pellets, freezing fog, with the visibilities varying from 1/4 sm to 3/4 sm. In addition, it included the remarks that a Beech 200 had landed on runway 16 a little earlier. The pilot reported that from 5,000 to 2,500 feet asl in the descent he encountered continuous light-to-moderate turbulence with airspeed fluctuations of 10 to 15 knots, and from 2,500 feet on down he encountered a 60-knot headwind. The St. John's tower controller informed the accident pilot that "information Quebec" was on the ATIS, but the pilot did not listen to the ATIS information.

The pilot did not listen to the ATIS information

BADLY OUTDATED CHARTS

This accident occurred on 20 March 1998. Two of the three Canadian low en route charts had effective dates of 14 November 1991 and 04 January 1996, although these charts are revised every 56 days. The chart used to conduct the ILS 16 approach was dated 02 February 1995, whereas the most current chart had an effective date of 26 February 1998. The use of outdated IFR charts and/or publications is an extremely dangerous practice.

The absence of high-frequency radio equipment mandatory for transoceanic flight and the use of outdated IFR charts were not considered factors in the occurrence. When viewed with other elements of this flight, however, the pilot's understanding of North American and transoceanic flight regulations must be questioned. For example, the pilot's decision to commence the transborder flight without filing an appropriate flight plan, his decision to continue the flight in cloud despite the VFR restriction on his American licence, and his intention to conduct the VFR flight over the top despite the absence of requisite weather suggest the pilot's knowledge of rules and regulations may have been flawed. Because aircraft and pilot inspections prior to transoceanic flights were cancelled by Transport Canada as a cost-saving measure on 10 October 1996, these shortcomings are less likely to be detected.

REFLEXION

The odds stacked against this pilot were of his own making.

Poor Flight Management

The Avionair Inc. Piper PA-31-350 Navajo was unable to land at La Grande Rivière, Que., following the flight from Rouyn because of weather on 14 May 1998. A missed approach was executed, and the aircraft proceeded toward the alternate, La Grande 4. About 15 nautical miles (nm) north of La Grande 3, the engines misfired. The fuel selector lever was reselected, and the engines operated normally for about five minutes, then stopped. The pilot-in-command declared an emergency and proceeded toward La Grande 3 for an approach. The aircraft broke through the cloud layer at approximately 300 feet above ground level (agl), and the pilot set the aircraft down in some trees. One of the passengers suffered minor leg injuries.

Report No. A98Q0069

As the three-day flight to northern Quebec was being planned in Montréal, the acting chief pilot helped the pilot-in-command enter the data in the FliteStar computer flight planning software without referring to the aeronautical charts. Although the acting chief pilot mentioned several times that the data for refuelling at Rouyn, La Grande, and Kuujjuaq should be entered, the pilot-in-command apparently did not make the association between the exercise on the computer, assimilating the information, and using that information in the overall management of the flight.

Consequently, the aircraft was not refuelled in Rouyn. On departing Montréal/Dorval International Airport, he still had not checked the actual distances that he had to travel.

The co-pilot, who was not present for the flight planning, leafed through the planning documents briefly before departure, but he was preoccupied with secondary duties not related to the management of the flight. He took off from Dorval without really understanding the details of the trip and subsequently did not look at the flight itinerary.

The pilot-in-command was on his first flight for the company in that capacity, and his first flight as pilot-in-command with a co-pilot. This was the co-pilot's fourth flight for the company, his first flight with this pilot-in-command, and his first flight in northern Quebec. The company did not consider it necessary to assign the pilot-in-command to fly with a co-pilot who had more experience flying in northern Quebec. The crew had not received training on the standard operating procedures that detailed their individual duties.

The pilot-in-command said he noticed before departing from Dorval that the fuel gauges were reading slightly below full, although the aircraft had just been refuelled. He thought the gauges

He thought the gauges were defective

were defective. Although the gauges indicated a steady decrease in fuel level throughout the trip, the pilot-in-command continued to suppose that they were defective and were indicating less than the actual fuel level.

CHECKLISTS NOT USED

During the flight, the crew did not use the checklist or the other documents from the flight plan. If the crew had used them, they would have seen that fuel-related items appear 12 times on the checklist. Further, after each flight segment, the crew should have noted and recorded the fuel status on the flight plan documents. All flight plan documents are tools that standardize work and serve as aides-memoire. The crew demonstrated sloppy work habits; they should have been more diligent because the pilot-in-command believed the fuel gauges were not working properly. The crew did not calculate their fuel consumption to confirm the quantity used.

The crew demonstrated sloppy work habits

According to the company, the maximum endurance of the aircraft is approximately 4 1/2 hours. The aircraft exhausted its fuel supply after four hours, 39 minutes of flight. The total time includes cruising flight, time on the ground (where fuel consumption is lower), the two take-offs, and the missed approach (where consumption is significantly higher than in cruising flight).

Prior to the accident, Avionair had decided to appoint a pilot as an aviation safety officer, which it subsequently did although this program is not mandatory for this type of operation. In addition, the company now places less emphasis on the co-pilot's secondary duties and places greater emphasis on flight management.

The Navajo pilot did not believe what the fuel gauges were telling him, and the fuel tanks ran dry.

AVIATION OCCURRENCES
1994-1999

	1999	1998	1994–1998 Average
Canadian-Registered Aircraft Accidents[1]	340	385	371
Aeroplanes Involved[2]	285	316	301
Airliners	7	14	8
Commuters	12	10	13
Air Taxis / Aerial Work Aircraft	92	128	121
Other Commercial Air Services[3]	11	-	-
Private/Corporate/State	163	164	159
Helicopters Involved	45	56	59
Other Aircraft Involved[4]	15	17	14
Hours Flown (Thousands)[5]	4 100	4 000	3 877
Accident Rate (per 100,000 hours)	8.3	9.6	9.6
Fatal Accidents	35	31	39
Aeroplanes Involved	29	24	31
Airliners	1	0	0
Commuters	2	1	1
Air Taxis / Aerial Work Aircraft	6	9	13
Other Commercial Air Services	0	-	-
Private/Corporate/State	20	14	17
Helicopters Involved	4	6	7
Other Aircraft Involved	4	2	1
Fatalities	67	83	84
Serious Injuries	43	48	49
Canadian-Registered Ultralight Aircraft Accidents	35	39	41
Fatal Accidents	12	5	6
Fatalities	18	9	9
Serious Injuries	8	7	8
Foreign-Registered Aircraft Accidents in Canada	24	22	20
Fatal Accidents	6	5	4
Fatalities	9	236	56
Serious Injuries	1	4	3
All Aircraft: Reportable Incidents	701	782	677
Collision, Risk of Collision, Loss of Separation	176	185	180
Canada, N.W. Atlantic. - Airborne Air Proximity[6]	138	151	140
- Loss of Separation[7]	98	116	87
Declared Emergency	207	229	191
Engine Failure	157	173	167
Smoke/Fire	85	111	73
Other	76	84	66

1 Ultralight aircraft excluded.

2 As some accidents may involve multiple aircraft, the number of aircraft involved may not sum to the number of accidents.

3 Category broken out from Air Taxis / Aerial Work Aircraft.

4 Includes gliders, balloons, and gyrocopters.

5 Source: Statistics Canada (1996, 1997, 1998 and 1999 hours flown are estimated).

6 This category includes incidents in Canada or Canadian-controlled North Atlantic airspace in which an aircraft was unintentionally operated in close proximity to another.

7 This category includes those in which established separation criteria were violated in controlled airspace.

(1999 figures are preliminary as of 19 January 2000 and subject to change)

Source : Transportation Safety Board of Canada

Aviation Occurrence List

This summary list contains preliminary information on occurrences as reported to the TSB between 01 July 1999 and 30 April 2000. Final determination of events is subject to the TSB's full investigation of these occurrences.

DATE	LOCATION	TYPE OF AIRCRAFT	PHASE OF FLIGHT	OCCURRENCE NO.
JULY 1999				
04	35 nm NW of Kaslo, B.C. *Power loss, collision with terrain.*	Bell 214B	Manoeuvring	A99P0075
11	2 nm SE of St. Andrews, Man. *Stall, spin, collision with terrain.*	Mooney M20F	Take-off	A99C0157
11	Saint-Mathias-de-Richelieu Airport, Que. *In-flight wing failure.*	Cosmos Phase II ES	Manoeuvring	A99Q0134
13	Kitchener-Waterloo Regional Airport, Ont. *Runway incursion.*	Piper PA-44 / Cessna 421C	Taxiing/Take-off	A99H0004
AUGUST				
01	St. John's Airport, Nfld. *Runway overrun, collapsed nose gear.*	Fokker F28	Landing	A99A0100
05	Jowit Intersection, Alta. *Loss of separation, risk of collision.*	Boeing 747-200 / Boeing 747-200	Cruise	A99W0144
12	Sept-Îles Airport, Que. *The aircraft landed short of the runway.*	Beech 1900D	Approach	A99Q0151
15	10 nm W of Squamish, B.C. *Sightseeing flight, collision with terrain.*	Eurocopter AS 350BA	Manoeuvring	A99P0105
20	Penticton Airport, B.C. *Midair collision.*	Mooney M20C / Cessna 177B (RG)	Manoeuvring/Take-off	A99P0108
29	5 nm N of Princess Harbour, Man. *In-flight fire, forced landing.*	Piper PA-31	Cruise	A99C0208
SEPTEMBER				
24	St. John's, Nfld. *Unexpected turbulence, aircraft landed short of displaced threshold.*	Airbus A320	Landing	A99A0131
26	Vancouver Harbour, B.C. *The aircraft struck a pleasure boat.*	de Havilland DHC-2	Landing	A99P0136

DATE	LOCATION	TYPE OF AIRCRAFT	PHASE OF FLIGHT	OCCURRENCE NO.
OCTOBER				
02	6 nm N of Pickle Lake Airport, Ont. *Engine failure, forced landing.*	de Havilland DHC-2	Approach	A99C0245
10	1 nm SW of Bancroft, Ont. *Collision with terrain during unpublished IFR approach.*	Cessna 172M	Approach	A99O0242
13	6 nm S of Temagami, Ont. *Collision with communications tower.*	Cessna 185F	Cruise	A99O0244
15	Halifax International Airport, N.S. *Loss of separation event, runway incursion.*	ATR 42-300 / de Havilland DHC-8-100	Approach/Landing	A99H0005
NOVEMBER				
20	Cloverdale, B.C. *Midair collision.*	Erco 415 C / Cessna 152	Manoeuvring	A99P0168
22	Dryden Regional Airport, Ont. *Runway overrun, collision with approach lighting and poles.*	Fairchild SA227-AC	Landing	A99C0281
DECEMBER				
24	Calgary International Airport, Alta. *Engine surges, post-landing fire.*	Airbus A320-200	Cruise	A99W0234
28	1 nm S of Abbotsford Airport, B.C. *Stall, collision with terrain.*	Cessna 208	Take-off	A99P0181
JANUARY 2000				
13	20 nm NE of Vancouver, B.C. *Operating irregularity, risk of collision with terrain.*	Beech 1900D	Cruise	A00P0009
13	Lake Adonis, Que. *Sightseeing flight, collision with terrain.*	de Havilland DHC-2 MK 1	Unknown	A00Q0006
20	Downton Lake, B.C. *Power loss, collision with terrain.*	Aerospatiale SA-315	Cruise	A00P0010
FEBRUARY				
07	Peace Reach Arm (Williston Lake), B.C. *Collision with terrain in marginal visual meteorological conditions.*	Piper PA-31	Cruise	A00P0019
21	20 nm S of Prince George, B.C. *Power loss and autorotation into trees, forced landing.*	Schweizer 269C (300C)	Manoeuvring	A00P0026
27	5 nm W of Stony Rapids Airport, Sask. *Collision with terrain.*	Piper PA-31-350	Approach	A00H0001

DATE	LOCATION	TYPE OF AIRCRAFT	PHASE OF FLIGHT	OCCURRENCE NO.
MARCH				
06	Calgary International Airport, Alta. *Runway incursion.*	British Aerospace BA 31-12 / de Havilland DHC-8-300	Taxiing/Landing	A00W0062
13	18 nm NE of Toronto Island/ City Centre Airport, Ont. *Midair collision, forced landing.*	Cessna 172 / Cessna 337	Cruise/Manoeuvring	A0000057
17	Ennadai Lake, Nun. *Collision with terrain.*	McDonnell Douglas DC-3C	Landing	A00C0059
17	10 nm SE of Smoothstone Lake, Sask. *Landing gear malfunction, loss of control, collision with terrain.*	Cessna 180J	Approach	A00C0060
17	Vancouver International Airport, B.C. *Aircraft damaged by component malfunction, forced landing.*	Airbus A330-200	Take-off	A00P0040
22	Fox Harbour, N.S. *Collision with trees, diverted landing.*	Israel Astra SPX	Approach	A00A0051
23	Innisfail Airport, Alta. *Collision with terrain, fire.*	Rotorway Exec 90	Unknown	A00W0072
31	5 nm N of Victoria International Airport, B.C. *Loss of separation, risk of collision.*	de Havilland DHC-6 / Cessna 172F	Cruise	A00P0047
APRIL				
11	95 nm NNW of Sydney, N.S. *Loss of separation, risk of collision.*	Airbus A340 / Airbus A340	Cruise	A00H0002
11	Maniwaki Airport, Que. *Flight control malfunction, forced landing.*	Cessna 172M	Cruise	A00Q0043
12	Calgary International Airport, Alta. *Aircraft icing, collision with building.*	Cessna 310I	Approach	A00W0079
15	Fox Lake, Y.T. *Collision with terrain.*	Cessna 172RG	Cruise	A00W0080
27	Beloeil, Que. *Loss of control, collision with terrain.*	Bell 206B-III	Manoeuvring	A00Q0046

Aviation Occurrence Summaries

The following summaries highlight pertinent safety information from TSB reports on these investigations.

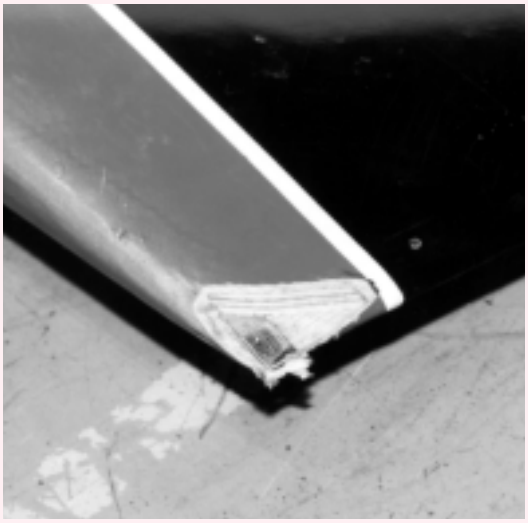
A SCRAPE AND A BREAK

01 May 1998, Skyhopper (amateur-built), 2 mi S of Smiths Falls-Montague Airport, Ontario

Report No. A9800104

Aircraft wings do not come apart in the air unless their design limits have been exceeded. That can happen from something that at first appears somewhat innocuous—such as a scraped wingtip during a previous flight.

The design strength and construction of the aircraft wing was found to be adequate, and there was no sign of deterioration of the wing material that would contribute to the in-flight failure of the Skyhopper's wing. There was also no reported weather phenomena on the day of the accident that would result in any excessive load or stress on the wing in flight. Yet, the starboard wing did come apart, and the aircraft crashed, fatally injuring the experienced pilot.



The wingtip scrape that caused this abrasion also weakened the wing spar.

Investigators found a freshly ground-off surface on the bottom side of the aircraft wingtip that was typical of damage resulting from a wingtip contacting the ground during a ground loop or severe swerve to the left. The lack of dirt or debris on the scrape mark indicated the damage occurred from contact with an asphalt or concrete surface. Although it was not possible to quantify the forces applied to the wing as a result of the tip scrape, it was obvious, from appearance alone, that the forces applied at the time of the scrape were sufficient to crack and weaken one or both of the right wing spars. The lack of any sign of rubbing on the fractured surfaces also indicated that any cracking of the wing spars was recent, possibly as recent as the last take-off or landing.

REFLEXION

A scraped wingtip can appear to be minor but is deserving of a close inspection before the next flight.

WET SNOW ON RUNWAY WET SNOW ON AIRCRAFT

22 October 1997, Piper PA-46-350P Malibu, Saint-Mathieu-de-Beloeil Airport, Quebec

Report No. A97Q0222

The Malibu was only a few feet off the ground when the engine misfired and the aircraft began to shake. The aircraft struck the ground on the main landing gear, bounced, then struck the ground again, shearing off the main gear. It came to rest in a cornfield located

450 feet (137 m) beyond the end of the runway. The two occupants sustained minor injuries.

It is possible that the filter froze during the take-off run and blocked the supply of air to the engine

The actual causes of the engine misfire could not be determined, but the atmospheric conditions at the time of the accident were conducive to the formation of frost or ice. The filter in the air intake system was found to be saturated with water to over three-quarters of its thickness, so it is possible that the filter froze during the take-off run and blocked the supply of air to the engine. The pilot did not select the alternate air intake system when the engine misfired because the Malibu *Pilot's Operating Handbook* does not suggest that this be done while operating on the ground.

On the day of the flight, snow had begun to fall two hours before the aircraft took off, and the runway was contaminated with wet snow.

Between 20 and 25 minutes elapsed from the time the pilot moved the aircraft out of its hangar to the take-off. When initiating the take-off, the pilot did not inspect the critical surfaces of the wing as prescribed in the *Canadian Aviation Regulations*. The pilot had noticed that snow had accumulated on the wings, but at 60 knots the snow had blown away. He supposed that if the snow had dissipated from part of the wings when he accelerated on the ground, the same thing would happen on all other critical surfaces.

The aircraft was not producing sufficient lift to sustain flight; consequently, the aircraft stalled immediately after the rotation for take-off. The following factors may have contributed to the accident: a runway contaminated by wet snow; an aircraft contaminated by precipitation; and engine misfires, which may have been caused by a filter saturated with water.

REFLEXION

The occurrence record shows that despite experience, education, and regulations, snow- or ice-induced take-off accidents continue to occur. Why? What more can the industry do to prevent these accidents?

CARBON MONOXIDE?

04 October 1997, Cessna 152, 4 nm S of Vanscoy, Saskatchewan

Report No. A97C0195

The 10,000-hour instructor and student instructor pilot were practising spins, stalls, and slow flight. The Air Traffic Services (ATS) radar information indicated that during the last vertical manoeuvre, originating at about 4,000 feet above sea level (asl), the aircraft descended rotationally at a high descent rate. The observed low speed indicated that the aircraft was in a spin and not a spiral dive. The last three ATS radar returns showed the aircraft continuing its descent while tracking in a westerly direction, while a ground witness said the aircraft appeared to be momentarily level on a westerly heading. These observations support the hypothesis that at least one of the pilots may have succeeded in recovering from the spin and was attempting to recover from the ensuing aircraft descent. The subsequent wing drop and nose-down descent seen by the ground witness shortly prior to ground impact indicate that a secondary stall was induced during the attempted spin recovery. The very low altitude precluded recovery from the stall. Both pilots were fatally injured.

It is not known why a spin would have been continued below 3,700 feet asl. Based on the experience level and the reputation of the instructor, it is unlikely that he would have engaged in a dangerous training practice or intentionally allowed the aircraft to continue spinning below the minimum altitude specified in the *Canadian Aviation Regulations*. It is more likely that some other factor intervened and caused recovery action to be delayed until ground contact was imminent.

The only technical anomaly found was an exhaust leak at the number 4 cylinder that could have potentially leaked past the firewall and introduced carbon monoxide into the cabin. The carbon monoxide saturation levels found in the pilots—both nonsmokers—are not normally considered of significance to an individual's performance; however, when a factor of four per cent is added because of the effects of decreased oxygen availability at 4,000 feet asl, some effect cannot be ruled out.

The user directions for the carbon monoxide detector in the aircraft were printed on the back of the detector and are obscured when the detector is installed. Because the detector returns to its unexposed colour when the air freshens, checking the detector only during pre-start cockpit checks does not warn the crew of any previous carbon monoxide leaks into the cockpit. The detector would have to be checked periodically during flight to alert the crew of the presence of carbon monoxide. It is not known if the crew were aware of the detector's operating characteristics or whether the crew noted the condition of the detector during the flight.

REFLEXION

Do you include the carbon monoxide detector during your in-flight scanning of the instrument panel?

FUEL PUMP FAILURE

23 April 1998, Hughes 369HS (Helicopter), Waasagomach, Manitoba

Report No. A98C0070

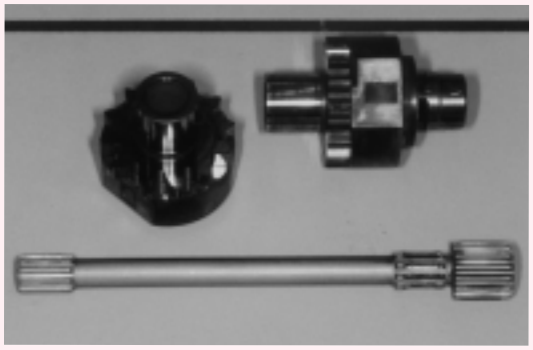
Ground-based observers heard unusual engine sounds and saw the helicopter, operated by Yukon Helicopters Ltd., slow down and descend about one-quarter mile (.40 km) from the intended landing site. When the helicopter was about treetop height above the frozen lake surface, the tail of the helicopter dropped rapidly, and the helicopter tilted abruptly to its left side, descended, and crashed onto the ice. The pilot and two passengers were fatally injured; two surviving passengers were seriously injured.

Inspection of the engine revealed wear on the drive splines of the No. 1 element of the fuel pump that resulted from the mismatching of chromed and non-chromed components and the progressive breakdown of a nitride white layer. Overhaul procedures for the Pesco/Sundstrand pump, amended in 1983, required replacement of the non-chromed components, but the pump had not attained time before overhaul limits during its 20-year in-service life, and no directives had been issued to require pre-overhaul replacement. Functional testing and repair of the pump, conducted in 1992, did not require complete disassembly and re-build. Consequently, the progressive wear went undetected.

No directives had been issued to require pre-overhaul replacement

When the No. 1 element drive splines disengaged and the No. 1 element check valve jammed open, pump flow from the No. 2 element recirculated within the pump and little or no fuel flow was provided to the engine. As failed spline pieces jammed between spline remnants in the No. 1 element of the pump, it is likely that momentary power reductions would be followed by short periods of normal power. Eventually, the wear would have progressed to a point that temporary engagement of the drive was impossible and the engine lost all power. The pilot was faced with power interruptions and engine indications that were initially difficult to analyze.

It is likely that the pilot was at the transit altitude of 500 feet when the engine problems began. Since he was flying downwind when the engine-driven fuel pump failure occurred, the correct procedure would have been to turn into wind to prepare for an emergency landing. It is not known why he did not do so. However, it is possible that the time he used to reassure the passengers and time that he may have spent analyzing the power interruptions resulted in an altitude or airspeed loss that eliminated the possibility of a turn into wind. Therefore, when the engine failed



From the crashed Hughes 369HS: No. 1 element drive spur gear (top right), driven spur gear (top left), and the drive shaft with the No. 1 (B) spline worn away.

completely, the pilot was faced with executing an autorotation with a strong tailwind, over a relatively featureless surface. His perception of forward speed and cues to judge height above the surface would have been significantly different from his normal experience in practice rotations.

There was little information as to the manner in which the pilot reacted to these abnormal conditions and flew the autorotation. However, the lack of main rotor system rotational energy at impact indicates that the pilot did not maintain rotor rpm throughout the manoeuvre. The available information indicates that the helicopter appeared to be flared, tail-down, at about treetop height before its final descent. Once this flight altitude was reached without engine power and low rotor rpm, there was insufficient airflow to sustain rotor rpm, and the pilot was unable to control the helicopter.

Following the accident, Yukon Helicopters discontinued using dual-element fuel pumps on its helicopters.

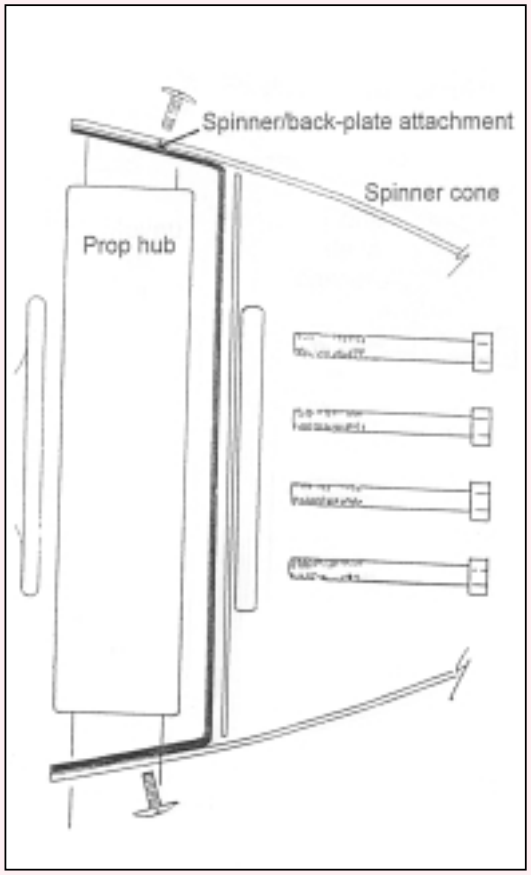
DESIGNER'S INSTRUCTIONS IGNORED

05 June 1997, Perella One Design, Boundary Bay Airport, British Columbia

Report No. A97P0151

The Perella One Design competition aerobatic aircraft first flew on 02 April 1997. By 23 April 1997 the aircraft had accumulated 25.4 hours. During a flight flown by the accident pilot on that day, the propeller spinner cracked but remained attached to the propeller. The pilot landed without further incident. On that occasion, the cracking was found to have originated at the propeller cut-outs in the fibreglass spinner. The aircraft did not fly again until the accident flight, which was conducted, in part, to test the new spinner.

The new spinner separated from the propeller hub just after take-off and passed through the propeller. The spinner may have



Propeller spinner assembly after the accident.

dislodged a portion of the propeller abrasion strip, resulting in a propeller imbalance and a significant vibration. A normal reaction to the noise and vibration would have been for the pilot to retard the throttle.

Since the aircraft was in a climbing, nose-up attitude, the airspeed would have been low. With the reduction of engine power in this aircraft, the airspeed would reduce rapidly and, if not corrected, the aircraft would enter a stall. Although he briefly regained control of the aircraft after it stalled, the pilot was unable to prevent it from stalling a second time, and the

The spinner had not been installed in accordance with instructions provided by the company

aircraft entered a spin with insufficient height for recovery. The pilot, who had 15,000 total flying hours, with 200 hours on types similar to the Perella One, was fatally injured, and the aircraft was destroyed

According to the spinner manufacturer, who examined the propeller hub and attached pieces of the spinner following the accident, the spinner had not been installed in accordance with instructions provided by the company. The method by which it was installed would, in the manufacturer's opinion, severely compromise the overall integrity of the spinner. Specifically, the spinner had been installed directly on the face of the propelller. The manufacturer's instruction sheet requires that if the cut-out will contact the propeller, a squash plate is to be installed to prevent the contact. Further, the manufacturer observed that the blade openings had been cut out flush to the back plate and that no spacer or squash plate had been used. The manufacturer's instructions for cutting or re-shaping blade openings require leaving a minimum of 1/8 inch between the back plate and propeller. Installers are instructed not to cut the spinner "above the line noted on the black plate" and are to "use a squash plate or spacer" if required.

In this instance, the spinner failed in overload.

REFLEXION

Why would the assembler of an amateur-built aircraft ignore specific installation instructions from a component manufacturer?

MORE VFR INTO IMC

20 February 1998, Diamond DA-20-A1 Katana, 3 nm NE of Kinosota, Manitoba

Report No. A98C0030

The Interlake International Pilot Training Centre (IIPTC) aircraft with instructor and student pilot aboard departed Gimli, Manitoba, on a 118-nm flight to Dauphin, Manitoba. It crashed onto the frozen surface of Lake Manitoba at considerable forward speed and at a high rate of descent. The two occupants were fatally injured.

Had their approval been required before departure, the flight would likely not have been dispatched

The available information indicates that the instructor and the student obtained the area forecast for the proposed route of flight between Gimli and Dauphin. Specific weather information for the Vogar area—about two-thirds of the way—was not available to them during their flight planning. They were therefore probably unaware of the fog that prevailed in the area of Lake Manitoba. However, the area forecast predicted scattered stratus ceilings 500 to 1,000 feet and visibilities as low as one mile, which did not meet the weather requirement of the *Canadian Aviation Regulations*. The instructor's decision to depart under these conditions left him little margin for any deterioration of the ceilings or visibilities from those mentioned in the forecast.

The student was planning to return home to Ontario on the following day, and the instructor and student were attempting to complete the cross-country requirements for a recreational pilot licence before the student's departure. It is likely that this would have increased the pressure on the instructor and the student to complete the flight to Dauphin.

IIPTC did not provide for routine monitoring of the flight-planning process, nor did it assist in regularly evaluating the available weather information. When the chief flight instructor (CFI) and the assistant CFI reviewed the area forecast after the accident, they indicated that they did not consider the weather to be suitable for the planned flight. Had their approval been required before departure, the flight would likely not have been dispatched. The importance of area forecasts in the flight planning process was not emphasized at IIPTC, as shown by the fact that the instructor was aware of the area forecast but chose to initiate the flight into an area of adverse weather and the CFI reviewed the observed weather but not the area forecast.

The instructor and student flew toward the area of increasing cloud cover from the east, where the cloud cover was higher and scattered and where better visual conditions prevailed. As the aircraft approached Vogar, the cloud thickened and the ceiling lowered. The white

surface of the lake provided little contrast with the broken cloud and probably removed what little visual reference was available to the pilot. The attitude of the aircraft as it struck the ground indicates that the pilots lost control of the aircraft and entered a manoeuvre from which they were unable to recover in the altitude available.

Following this accident, IIPTC changed its flight dispatch procedures. The flight planning for every cross-country flight is reviewed by the CFI or assistant CFI to ensure that the forecast weather will be suitable for the flight and that the weight and centre of gravity of the aircraft will be within the approved limits. (While the centre of gravity of the accident aircraft was not within approved limits, it was not likely a factor in this occurrence.)

The pilot lost control of the aircraft in deteriorating visibility and was unable to recover in the altitude available.

Transport Canada (Prairie and Northern Region) has reportedly changed its pilot and instructor check rides to place increased emphasis on a candidate's ability to correctly interpret weather observations, terminal forecasts, and area forecasts.

RELEASED REPORTS

The following investigation reports were published between 01 July 1999 and 30 April 2000.

DATE	LOCATION	TYPE OF AIRCRAFT	PHASE OF FLIGHT	REPORT NO.
97-03-14	Hamilton, Ont. *Collision with snowbank.*	Boeing 727-225	Landing	A97H0003
97-03-14	Hamilton, Ont. *Reversed elevator trim tab control.*	Convair 340/580	Take-off	A97O0077
97-07-28	Milan, Que. *In-flight break-up in vicinity of thunderstorms.*	Cessna 210F	Cruise	A97Q0158
97-09-01	Frankfurt, Germany *Loss of centreline landing gear.*	Airbus A340-313	Take-off	A97H0008
97-09-20	40 nm NW of Iqaluit, N.W.T. *Loss of separation.*	Canadair CL-600-2B16 / Boeing 747-400	Cruise	A97H0012
97-12-07	Mascouche Airport, Que. *Midair collision.*	Cessna 172M / Cessna 150H	Take-off / Approach	A97Q0250
97-12-09	Little Grand Rapids, Man. *Controlled flight into terrain.*	Embraer EMB-110P1	Approach	A97C0236
97-12-16	23 nm N of Mackenzie, B.C. *Collision with water.*	Cessna 402	Cruise	A97P0351
98-01-19	Cranbrook VOR site, B.C. *Loss of rotor rpm and forced landing.*	Eurocopter AS 350D	Climb	A98P0022
98-01-20	Sanikiluaq, N.W.T. *Engine fire, collision with terrain.*	Piper PA-31-350	Take-off	A98Q0007
98-02-01	30 nm N of Vancouver, B.C. *ATC operating irregularity.*	British Aerospace BAe 146	Descent	A98P0018
98-03-28	Québec/Jean-Lesage International Airport, Que. *Impact with the ground.*	Piper PA-34-200T	Approach	A98Q0043
98-04-17	*50 nm NE of Port Hardy, B.C.* *Engine fire in flight.*	Piper PA-31	Climb	A98P0100

DATE	LOCATION	TYPE OF AIRCRAFT	PHASE OF FLIGHT	REPORT NO.
98-04-23	Waasagomach, Man. *Loss of power, loss of control.*	Hughes 369HS	Cruise	A98C0070
98-05-14	4 nm SE of La Grande 3 Airport, Que. *Fuel exhaustion, forced landing.*	Piper PA-31-350	Cruise	A98Q0069
98-05-18	1.5 nm SE of Clarenville, Nfld. *Engine failure, forced landing.*	Pilatus PC-12	Cruise	A98A0067
98-06-08	Coppins Corners, Ont. *Loss of control, stall.*	Cessna 152	Unknown	A98O0139
98-06-17	Vancouver, B.C. *Tail rotor pitch link failure.*	Sikorsky S-76A	Approach	A98P0156
98-07-16	Ottawa/MacDonald-Cartier International Airport, Ont. *Main landing gear collapsed.*	Beech A100	Landing	A98O0184
98-07-18	56 nm SW of Grande Prairie, Alta. *Loss of control, hard landing.*	Bell 206B	Climb	A98W0155
98-07-20	125 nm S of St. John's, Nfld. *Loss of separation.*	Boeing 747-400 / Airbus A340	Cruise	A98H0002
98-07-22	20 nm N of the VOR, Watertown, New York, USA *Loss of a propeller in flight.*	Piper PA-31P	Cruise	A98F0033
98-07-27	Espanola West, Ont. *Stall, collision with trees.*	Piper PA-28-151	Take-off	A98O0190
98-08-06	Kasabonika, Ont. *Runway overrun.*	British Aerospace BAe 748-2A	Landing	A98C0173
98-08-31	22 mi S of Slave Lake, Alta. *Engine malfunction, hard landing.*	Eurocopter AS 350B	Approach	A98W0181
98-09-14	Calgary International Airport, Alta. *Engine failure shortly after take-off, return to airport.*	Boeing 767-300	Take-off	A98W0192

DATE	LOCATION	TYPE OF AIRCRAFT	PHASE OF FLIGHT	REPORT NO.
98-09-27	55° North Latitude and 10° West Longitude *Loss of separation.*	Boeing 747-238 / Boeing 747-400	Cruise	A98W0216
98-12-04	12 nm SW of Saint-Michel-des-Saints, Que. *Loss of control in whiteout conditions, collision with terrain.*	Bell 206L-1	Cruise	A98Q0193
98-12-15	2 nm W of Liverpool, N.S. *Collision with terrain.*	Cessna 172M	Approach	A98A0184
99-02-26	Entrance, Alta. *Collision with wire during aerial photography.*	Bell 206B	Manoeuvring	A99W0034
99-02-27	Calgary, Alta. *Runway incursion.*	Airbus A319-100 / Cessna 172	Take-off	A99W0036
99-03-31	St. John's, Nfld. *Injuries to person while deplaning.*	Boeing 767-200	Parked	A99A0046
99-04-23	Lac-à-la-Tortue, Que. *Obstructed elevator control.*	Cessna 172	Climb	A99Q0075
99-06-14	Thunder Bay Airport, Ont. *Loss of control after take-off.*	Beech A100	Take-off	A99H0002
99-07-13	Kitchener-Waterloo Regional Airport, Ont. *Runway incursion.*	Cessna 421C / Piper PA-44	Take-off / Taxiing	A99H0004

AVIATION SAFETY REFLEXIONS

2000 Issue 24

REFLEXIONS is a safety digest providing feedback to the transportation community on safety lessons learned, based on the circumstances of occurrences and the results of TSB investigations.

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