Transport Canada Transports Canada

Aviation Safety Letter

Learn from the mistakes of others and avoid making them yourself... **Issue 2/2000**

The Human Element

On August 22, 1997, a float-equipped Piper Aztec with three occupants on board attempted to take off from Squaw Lake, Quebec, under visual flight rules. The pilot first tried to take off northward, but had to abort the takeoff because a fuel tank cap was open. A few moments later, he began the take-off run southward; the aircraft travelled about 8000 ft. before becoming airborne. The aircraft did not attain a high rate of climb, but continued its flight at about 100 ft. above the trees.

The flight service station (FSS) specialist, who was following the aircraft visually, noticed a brief power outage at his work station then saw a cloud of smoke rising on the horizon. He tried unsuccessfully several times to contact the aircraft by radio. He then asked a helicopter flying over the area to go to the source of the smoke and check whether an accident had occurred. The helicopter pilot arrived a few minutes later and confirmed that the aircraft had crashed after striking a high-voltage line.

Following the crash, an intense fire erupted, but the pilot was able to evacuate the aircraft by the left forward door, passing through the flames and suffering serious injuries. The two passengers were unable to evacuate and were fatally injured. This synopsis is based on Transportation Safety Board of Canada (TSB) Final Report A97Q0183.

The pilot had little rest in the 48 hr. before the flight. He had been busy preparing his hunting camps for the season that was just opening. Logistics and monitoring his employees took up a great deal of his time. He had slept for only about three hours on each of the two nights preceding the flight. On the morning of the occurrence, the pilot left his home at around six o'clock to take a commercial flight from Dorval to Schefferville, Quebec. From Schefferville, he was to fly his private aircraft to take two cooks to two different camps. The clients of the pilot's hunting camps had already taken off and were en route to their destinations.

Artist's impression of choices faced by the pilot, who was unable to climb properly after takeoff.

The aircraft was loaded by the pilot's two employees at the Air Saguenay dock while he was busy preparing the aircraft for the flight. No baggage or cargo was weighed on the scale available on the dock. According to the TSB, two weight and centre of gravity (C of G) estimates were calculated. The first estimate was evaluated by the pilot, and it showed that the aircraft was not overloaded and that the C of G was within the envelope. The maximum zero fuel weight, which is 4400 lb., was exceeded by 113 lb. A second evaluation was done according to the statements of the employees who loaded the aircraft. According to that evaluation, the aircraft was overloaded by 322.5 lb., and the C of G was 5.97 in. aft of the aft limit and outside the envelope. In that configuration, the maximum zero fuel weight was exceeded by 630.5 lb.

The position of the C of G plays a very important role in longitudinal stability. If the aircraft is loaded so that the C of G is too far aft, the aircraft will tend to adopt a nose-up attitude rather than one that is nose-down. Inherent stability will be lacking, and even though it is possible to correct this situation by moving the elevator down, longitudinal control of the aircraft will still be difficult, or impossible in some

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cases. Weight affects the aircraft's stall speed. Additional weight forces the aircraft to maintain a greater angle of attack to produce the lift necessary to sustain flight. Thus, the critical angle of attack will be attained at a higher speed. The greater the angle of attack, the greater the drag will be. At a specific angle of attack, the aircraft enters the slow-flying range. In the slow-flying range, if the angle of attack is increased, lift does not increase further; on the contrary, it decreases and drag increases. A slight increase in angle of attack may result in a stall.

A few minutes after the occurrence, the Squaw Lake winds were from 120° True at 3 kt. According to the pilot, there was a light tail wind on the takeoff toward the south. Squaw Lake is oriented northwest/southeast and is about 2½ mi. long. To the southeast, at the end of the lake, there is a valley between two hills. The elevation of the lake is 1616 ft. above sea level (ASL), whereas the elevation at the first point of impact of the aircraft was 1800 ft. ASL.

The aircraft apparently covered about 8000 ft. before lifting off and flew for about 8000 ft. before striking the ground. The pilot stated that he realized that the aircraft was not achieving its usual performance during the initial climb. During the take-off run, the aircraft travelled for a longer than normal distance before taking off. The pilot attributed that situation to the tail wind.

Normally, once the aircraft was flying, the pilot lowered its nose to retract the flaps and allow the aircraft to accelerate at the best rate of climb. In this case, the pilot could not retract the flaps because of the shoreline and the obstacles that were quickly approaching. He pulled back on the controls and tried to gain altitude while maintaining a speed of approximately 80 mph, with the flaps still down 15°.

The pilot attempted to clear the obstacles on his flight path, but when the high-voltage wires appeared ahead, he could not take evasive action to clear the obstacle. The aircraft struck the high-voltage lines and a wooden pole, then went nose down and pivoted around the pole before crashing on the ground.

According to an experienced pilot with many flying hours on the same float-equipped aircraft type, the aircraft requires a distance of about 3000 ft. for takeoff when loaded to the maximum weight of 5200 lb. with the flaps at 15°. For example, on a lake a mile and a half long, if the aircraft does not lift off within the set limits, the loading must be revised to distribute the weight better and the floats must be checked to make certain they do not contain any water. According to this pilot, the most critical factor is not to exceed the 150-lb. limit in the aft baggage hold so as not to move the C of G aft outside the envelope; that would cause the aircraft to be nose up, both during the take-off run and when airborne.

Analysis—The pilot had not taken enough rest when preparing for the flight and had not allowed enough time to prepare his camps for the hunting season, placing himself under pressure. He was highly stressed because of the very tight schedules he had set for himself. The pilot, pressed for time, did not check the cargo weight on the scale available on the loading dock and decided to take off with an aircraft that was overloaded and whose C of G was too far aft. Because he knew that his clients were already flying to the camps and that the cooks had not yet arrived, the pilot was determined to take off on his second attempt. The aircraft used a greater than normal distance before lifting off. At any time during this second attempt, the pilot could have aborted the take-off run and revised his load, but he decided to continue.

The aircraft took an abnormally long distance before rising out of the water because of its nose-up attitude, which was caused by the fact that the C of G was outside the envelope and displaced aft, and because of the excess weight. This nose-up attitude of the floats in the water caused drag that prevented the aircraft from accelerating within the normal distance during the take-off run. After 8000 ft. of take-off run, which is over twice the distance normally required, the aircraft lifted off, partly because of the ground effects phenomenon.

Then, seeing the approaching obstacles on the shoreline, the pilot pulled back on the controls to try to clear them. The aircraft was travelling at 80 mph, which is well below the recommended climb speed of 120 mph and even below the speed for the best climb angle of 107 mph. Because of its configuration, the aircraft stall speed was higher than normal. It can thus be concluded that the aircraft was in the slow-flying range. The more the pilot pulled back the controls, the greater the drag. Thus, the aircraft could not attain a climb rate sufficient to clear the obstacles on its flight path and it struck the high-voltage lines and a pole.

The TSB concluded that as a result of its excessive weight and its C of G outside the envelope, the aircraft lifted off only after a long run and it could not maintain a rate of climb sufficient to clear the obstacles on its flight path. Contributing to the occurrence were the pilot's stress, disorganization and fatigue.

Now, although technically accurate, was this *really* a C of G accident? Or was it a human accident? What truly allowed the events to unfold as they did? We, as pilots, have the ability to control, to a certain degree at least, the sequence of events. Let's call it *The Human Element*—the most important of them all. △

Transport Canada / Transports Canada

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Flight 2005 — A Civil Aviation Safety Framework for Canada

As noted in issue 1/2000 of the *Aviation Safety Letter* (ASL), this first segment on Flight 2005 is intended to keep you informed of some elements of our five-year plan to push to a higher safety standard. Transport Canada Civil Aviation has established six "Evolving Directions," and the term "evolving" is used because these are, in some cases, a new direction that will evolve and mature as we progress over the next five years. These directions represent the principal adjustments that need to be made to the Civil Aviation program in order to cope with the many challenges that it now faces.

The first evolving direction is the need to adopt a data-driven approach in developing strategies to enhance safety. Generally, data sources have not been sufficiently sound to use as a reliable basis for adjusting program priorities, evaluating the effectiveness of program activities, and initiating research. Planning has tended to be reactive (e.g., to the recommendations of accident investigations, Ministerial inquiries, internal audits). Increasingly, as safety information systems become more integrated and accessible, it is becoming possible to conduct more sophisticated analysis in order to pinpoint where safety interventions are most needed. These interventions need to be based on sound risk-management techniques so as to ensure the greatest potential for enhancing safety.

The second evolving direction consists of using a risk-based approach to resource allocation for regulatory activities. This represents a progression from the traditional approach of allocation to the areas of the program showing the greatest shortfall of resources. Emphasis will be placed on developing efficient ways of deploying Civil Aviation resources to those activities with the greatest safety benefits. The next issue of ASL will review the third and fourth evolving directions. For a complete look at the Flight 2005 plan, visit http://www.tc.gc.ca/aviation/2005/toc.htm today! △

One More Take at Pilot Use of Cellular Phone

What started as a "Letter to The Editor" in Issue 1/99 of the *Aviation Safety Letter* is now a permanent change in *A.I.P. Canada*. A new paragraph in the communications section, COM 5.14, has been added in amendment 2/2000 of the A.I.P., which addresses pilot cellular phone usage during a radio communications failure. It says that in the event of an in-flight radio communications failure, and only after normal communications failure procedures have been followed, the pilot-in-command may attempt to contact the appropriate NAV CANADA air traffic service (ATS) unit by means of a cellular phone. Before the pilot commences using a cellular phone to contact ATS in the event of an in-flight communications failure, transponder-equipped aircraft should squawk Code 7600. The reference to cellular phones in COM Annex B 1-1 has also been removed. Finally, the phone numbers of area control centres, control towers and flight service stations (FSS) will be published in the *Canada Flight Supplement*. △

Full Flap Takeoff on Wet Grass—Maybe Not . . .

On July 27, 1998, a pilot and three passengers were departing in a Piper PA 28 on a visual flight rules (VFR) flight from Espanola West to Ottawa, Ontario. The runway surface was grass on uneven, sandy soil, made soft from recent rain. The pilot made two excursions down the runway before the aircraft became airborne on the third excursion. After the aircraft became airborne, it struck trees to the left of the departure path and crashed into a wooded area. An intense fire immediately broke out and consumed the aircraft cabin. One infant passenger perished in the aircraft fire, while the pilot and the other two passengers escaped the burning aircraft but died later from their burns. This synopsis is based on Transportation Safety Board of Canada (TSB) Final Report A98O0190.

The pilot held a valid private pilot licence and was qualified for the flight. He had approximately 350 hr. of total flying time. Visual meteorological conditions (VMC) existed in the area at the time of the occurrence and the temperature was 23° C. It had been raining earlier in the day, and the pilot had delayed his departure until the weather improved.

The runway, approximately 2900 ft. long, was surrounded by trees and was oriented on a heading of 283° M. There were patches of ground on the runway surface where the soil was very soft. The grass had been cut recently and was two to three inches long. It was learned from an operator familiar with the airport that they did not permit their tricycle-equipped aircraft to use the airstrip after rain had fallen because the soil becomes very soft when wet. Higher ground is located at the end of the departure runway and to the west.

Witnesses reported that the aircraft's engine seemed to be developing considerable power and that they did not note any change in the sound of the engine until after the aircraft struck the trees. The aircraft's flight after liftoff was described as floating and hovering. The nose of the aircraft was then observed to lower, and the aircraft started to bank to the left just before it struck the first tree. An intense fuel-fed fire erupted on or immediately after impact.

The wreckage was examined at the site. The propeller marks on the trees and the condition of the propeller showed that the engine was producing high power. Although much of the aircraft was burned away, durable materials, such as hinges, steel cables, and heavy metal, remained. All the aircraft flight control surfaces were accounted for, and the control cables were intact at the time of the crash. The flaps were completely burned away; however, the flap control handle was found locked in the 40° position (full flaps).

The maximum allowable takeoff weight for the aircraft was 2325 lb. The TSB was unable to determine the exact weight at takeoff because the baggage was never weighed and the exact fuel quantity is not known. However, the weight at takeoff was estimated to be between 2300 and 2400 lb.

The *Pilot's Operating Manual* (POM) for the aircraft contains performance figures for takeoff from a paved, level, dry runway at the maximum gross take-off weight of 2325 lb. Using a temperature of 23° C and the preceding conditions, the take-off run was calculated to be 1255 ft. using no flaps and 965 ft. using 25° of flap. The take-off distance to clear a 50-ft. obstacle at the end of the runway, using 25° of flap, was 1760 ft. A Transport Canada brochure, entitled *Light Aircraft Operating Tips* (TP4441E), provides supplementary information to a manufacturer's approved take-off performance charts for conditions not covered by the manufacturer's tests. The publication suggests that the take-off ground roll should be increased by 10% for a runway surface that is rough, rocky, or covered with short grass (up to four inches). It further suggests that the ground roll should be increased by 75% or more for a runway with a soft surface (mud, snow, etc.). With the flaps set at 25°, the combined penalties would result in a required take-off ground roll of at least 1858 ft. and, to clear a 50-ft. obstacle, at least 2653 ft. There are no take-off performance charts available for the aircraft if it is operated above the maximum gross take-off weight.

The POM notes that takeoffs are normally made with the flaps up; however, for short field takeoffs and for takeoffs under difficult conditions, such as deep grass or a soft surface, take-off distances can be reduced appreciably by lowering the flaps to 25° and rotating at lower airspeeds. However, the POM does not recommend nor contain any performance charts for takeoffs with full flaps. Extending some flap during takeoff will generally result in a shorter take-off run and a better angle of climb; however, using full flaps results in a low ratio of lift to induced drag and a reduced climb angle. When effectively performed, the soft field take-off technique will result in a shorter take-off ground roll; however, any attempt to force the aircraft into the air prematurely results in an increased take-off distance and a degraded climb performance.

Analysis—The winds were generally from 270° to 300° at

10 to 15 kt. with gusts. As the runway take-off direction was 283°, it is unlikely that the aircraft was greatly affected by the wind conditions and the local topography, except that a head-wind would have increased aircraft take-off performance.

Based on the three excursions down the runway, the witnesses' descriptions of the engine noise, and the examination of the engine, it was concluded that the engine was producing the required power. There was nothing found in the wreckage to indicate that there was any aircraft malfunction before the crash.

The aircraft was at or near the maximum allowable weight and would, therefore, require the maximum calculated take-off distance and possibly more. The runway surface conditions and the fully extended flaps further increased the take-off distance and the distance required to climb to an altitude to safely pass over the trees. The first excursion down the runway **may have** been made by the pilot in an attempt to establish runway surface conditions and the second and third excursions may have been take-off attempts. Based on witness accounts and the fact that a pilot would normally change some parameter of the aircraft configuration after experiencing a failed take-off attempt, if the first excursion down the runway was a take-off attempt, it is probable that the first attempt was conducted without any flaps extended and the second attempt with the flaps extended to 25°, the manufacturer's recommended flap extension for a soft-field takeoff. It was concluded that the flaps were set at 40° during the last take-off attempt because of the manner in which the flaps are operated and the lever locked in position. Takeoffs with flaps extended fully are not a recommended practice, but the aircraft did become airborne. However, with the flaps fully extended, the high drag resulted in a loss of climb performance, which made it impossible for the aircraft to climb fast enough to clear the trees at the end of the runway. In an attempt to clear the trees, the pilot probably raised the nose of the aircraft, but because of the low speed and high drag, the aircraft stalled.

Corrections can be made to published take-off distance estimates using published information; however, there is no manufacturer's published take-off performance information available for the conditions of the occurrence flight. It is not possible, therefore, to estimate the take-off run required or the distance required to reach 50 ft. above ground at the end of the runway for an aircraft above the maximum certificated take-off weight with full flaps extended. The distance required to clear a 50-ft. obstacle at the end of the runway with full flaps extended would undoubtedly be more than it would with the flaps set to 25°.

The impact was survivable, most probably because the impacts with the trees and the angles at which they were struck absorbed most of the aircraft's momentum and because the passengers were wearing their restraints; however, the fire that followed the impact led to the fatalities.

In the end, the TSB determined that the pilot attempted to take off in conditions where a successful takeoff could not be made; the conditions being the high aircraft weight and the soft, grassy runway. The fully extended flaps contributed to the occurrence when they prevented the aircraft from climbing quickly enough to safely pass above trees at the end of the runway after the aircraft became airborne.

This tragic and preventable occurrence should serve as a lesson for all of us who will fly from similarly short, unimproved strips in the coming spring and summer. To obtain a copy of TP 4441E, contact you regional Transport Canada office or the editor of the ASL. △

More Underwater Escape Training Providers

Some colleagues tease me about my overindulgence in promoting underwater egress training, and I am now known as the "underwater egress editor"! Nevertheless, the point has been made to industry.

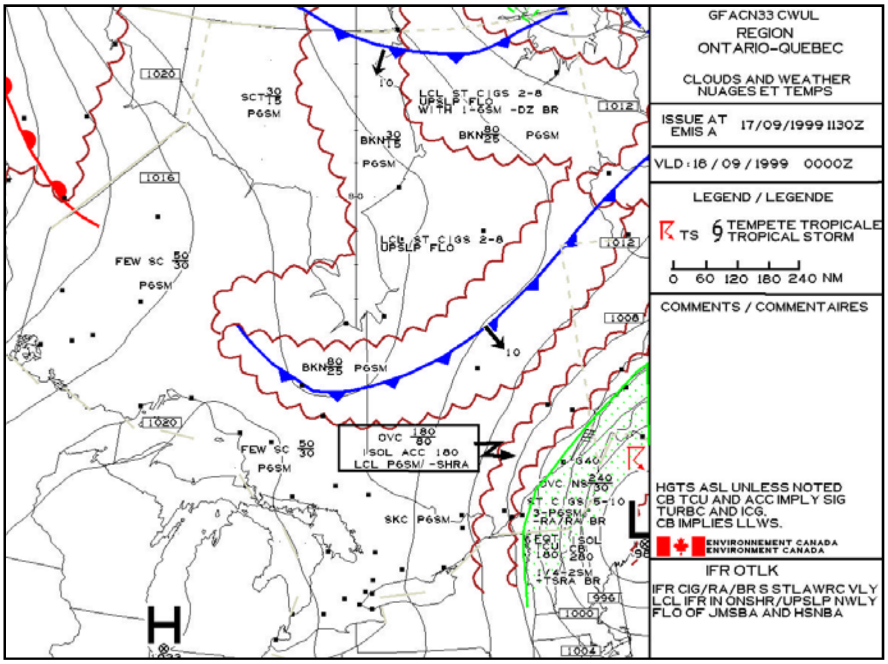
Two new companies based in British Columbia are now providing underwater escape training and sea survival techniques for both helicopter and fixed-wing passengers and crews at very affordable rates. They are *Pro Aviation Safety Training* in Langley, B.C., (604) 514-1630, and *Aviation Egress Systems*, in Victoria, B.C., (250) 704-6401. △

Transport Canada's Canadian Aviation Safety Seminar

CASS 2000, May 8–10, St. John's, Nfld.

http://www.tc.gc.ca/aviation/syssafe/cass2000/homepage.htm

The Weather Is About to Change . . . For The Better!



GFA: Clouds and Weather Chart

On April 20, 2000, NAV CANADA will introduce a graphic replacement for the alphanumeric area forecast, a product that first entered service 50 years ago. This new product, called a graphic area forecast (GFA), will contain the same amount of information as the alphanumeric area forecast, but is designed to be a more intuitive product, making it easier for pilots, weather briefers and dispatchers to use.

This will be the first official GFA service in the world, provided by NAV CANADA, the country's provider of civil air navigation services. NAV CANADA is also responsible for the provision of aviation weather services in co-operation with Environment Canada, who produces aviation weather forecasts under contract to NAV CANADA. As a graphic product, the GFA will allow for increased detail and precision in the final product, especially during complex weather situations.

The GFA consists of a series of temporally adjusted weather charts, which graphically depict the most probable meteorological conditions between the surface and 24,000 ft. over a given area at a specific time. Each issue of the GFA is really a collection of six charts; two charts valid at the beginning of the forecast period, two charts valid 6 hr. into the forecast period and the final two charts valid 12 hr. into the forecast period. Of the two charts valid at each of the three forecast periods, one chart depicts clouds and weather while the other chart depicts icing, turbulence and freezing level. An IFR outlook for an additional 12-hr. period will also be included in the final clouds and weather chart.

The coverage area of the GFA consists of seven forecast areas that together cover the domestic airspace for which Canada is responsible for the provision of air traffic services. The seven areas consist of the Arctic, Yukon–Northwest Territories, Nunavut, Pacific, Prairie, Ontario–Quebec and Atlantic regions. A GFA for the oceanic area to the west of the Arctic area will be only produced and disseminated "on request."

Four Environment Canada meteorological centres in Kelowna, Edmonton, Toronto and Gander will prepare regional depictions covering the entire country. These depictions will be transmitted to the Meteorological Co-ordinating Office (MCO), in Montreal, which will integrate the regional depictions into a nationally consistent suite of area forecast products. Environment Canada will be taking advantage of the latest advances in technology to produce and distribute the GFA.

Like the alphanumeric area forecast, the GFA will be routinely produced and disseminated every six hours so as to reach the user approximately half an hour prior to the beginning of the forecast period. Issued at 2330, 0530, 1130 and 1730 UTC, the GFA will be valid at 0000, 0600, 1200 and 1800 UTC respectively. Each issue of the GFA will cover a period of 12 hr. with an IFR outlook for an additional 12 hr. Amendments or corrections to the GFA will be issued as required.

The GFA will be easily accessible to pilots via several means. Colour versions of the GFA will be available on the flight planning page of the NAV CANADA Internet site (www.nav canada.ca/flight/indexe.htm). Black and white versions of the product will be available, via fax, from flight service stations that provide weather-briefing services.

Additional details about the GFA will be posted on the flight planning page of NAV CANADA's Internet site for pilot reference. NAV CANADA is also in the process of revising and reprinting the popular *Aviation Weather Services Guide* to include reference information about the GFA and other routinely used aviation weather products. Look for this handy reference guide at most flight service stations in mid-March 2000. △

Attitude Indicator

Dear Editor,

I would like to respond to the essay on Kennedy's fatal spiral dive accident, published in *Aviation Safety Letter* 4/99. Developing a new attitude indicator that combines a moving horizon and miniature aircraft would make little difference to whether a pilot would be able to recover from a spiral dive. The fact is that, typically, the pilot misinterprets its indication (no matter what the design) and fails to cross-check with other instruments—this is a question of training and proficiency. If the pilot gets more comfort from seeing the little airplane in a banked attitude, he or she can look at the turn co-ordinator.

If the accident was indeed a result of a spiral dive as a result of disorientation, the emphasis of the investigation should be on the human aspects so others can to learn how to break the chain of events that led to the tragedy. This means recognizing the pressure to get to a destination, especially when behind schedule. Often we do not want to disappoint our passengers and this self-imposed pressure can push us to fly into adverse conditions; this is known as *"get-home itis."* We also need to recognize the environment we are getting into, including the weather and the type of aircraft; recognizing our own limits against this backdrop of pressure and environment may be the key to prevent such occurrences. Let's get the training to enhance our abilities or be prepared to say "no" if conditions exceed them.

James Greenhill
Montreal, Quebec

Thank you Mr. Greenhill. Indeed your comments about self-imposed pressure, environment (night VFR among others), and the pilot's own abilities are crucially important, and likely responsible, in some part, for that accident. We can learn a lot from your letter alone. However, I do not believe the article by Dr. Roscoe meant to ignore those issues, rather to discuss a very specific instrument and how it could be improved. It's like "thinking outside the box" and it probably deserves more scrutiny. In fairness to all, here are the main points of Aero Innovation's response to your letter.—Ed.

Dear Mr. Greenhill,

Your comments on the decision to go flying or not are relevant but do not address the reasons pilots, despite their level of experience, risk calculation, and flight planning, fail to recognize spirals when they occur, and why pilots hold full ailerons in the direction of turn all the way to ground impact (a fact known when flight data recorders (FDR) are present). In the U.S. alone, this happens more than twice a week, sometimes to highly experienced and current pilots.

It is not only reasonable but also a duty to improve poorly engineered instruments if the improvements prevent pilots from inadvertently entering spiral dives and/or ease the recognition of a dive and/or suggest proper recovery procedures. This is more than just a training issue, as all of us eventually meet a level of mental saturation triggering instinctively humane reactions not always in accordance with good airmanship or past (sometimes distant) training. This is what human factors are all about. Thank you for sharing your views with us.

Jean LaRoche
President of Aero Innovation

NVFR Awareness Campaign

A recent DC3 accident at Mayne Island, British Columbia, raised some serious concerns regarding the practice of night visual flight rules (NVFR) flights by commercial operators. Following a Coroner's inquest, Transport Canada was asked to stress, through education, briefings, seminars and other media, the dangers involved in NVFR flight, especially in mountainous terrain, as well as the hazards involved in changing flight plans from IFR to VFR at night. As a result, System Safety is developing new promotional materials on the hazards associated with night flying.

In the meantime, it is strongly suggested that before your next night flight you re-familiarize yourselves with *Commercial and Business Aviation Advisory Circular* No. 0153, "Requirements Concerning Operations in Night Visual Flight Rules (NVFR)," issued March 12, 1999. This document should already be in your company's possession, but can also be found at http://www.tc.gc.ca/aviation/commerce/ADVISORY/Acacsu-e.htm or by calling your regional TC office. Whether you plan to fly NVFR for business or for pleasure, make sure your skills and qualifications are up to it, and always reconsider the appropriateness of cancelling an IFR flight plan at night in order to complete the flight in NVFR conditions. △

What Commercial Pilots Need to Know About Certification

by Shawn Coyle, Engineering Test Pilot, Transport Canada

The *Canadian Aviation Regulations* require that every aircraft used in commercial operation have a type certificate. Type certificates are issued as the final part of an aircraft certification process, once it has been demonstrated that the aircraft meets the minimum design requirements of a recognized specification.

The type certificate includes a type certificate data sheet (TCDS). This document includes the equipment needed to operate the aircraft to meet the requirements of the type certificate. From the TCDS, the limitations are developed and the certificate of airworthiness (C of A) is issued. The C of A will state "when operated and maintained in accordance with the TCDS" the aircraft is airworthy. Therefore, if you overload an aircraft (i.e., operate outside the design and the stated weight limitations), **your C of A will be invalid.**

Serviceability of Installed Equipment

Normally, pilots would not have access to the information on the TCDS. As a general rule, however, it is considered that if a piece of equipment is referred to in the basic flight manual for the aircraft, that piece of equipment must be serviceable to continue to meet the basis of certification. For example, in order to observe the engine limitations, all those gauges must be serviceable.

For many aircraft, a list of equipment that may be unserviceable for a limited time may be developed. This is called the minimum equipment list (MEL). The MEL is derived for each operator's configuration from a master MEL generalized for the aircraft type. The MEL is developed by the operational authority and is used to permit dispatch, with limitations, with unserviceable items, thereby reducing the uncertainty of when and under what conditions dispatch is permitted. Additionally, a configuration deviation list (CDL) may be developed to cover minor items that may be missing or damaged, such as small access panels.

The basic aircraft certification will not include all the possible modifications and supplementary equipment that could be added to the aircraft. So what should be considered supplementary equipment or modification? As a basic rule, if it is not cargo, and it is used during the flight, interacts with the aircraft's controls or systems (including the electrical system), affects the performance, aerodynamics or handling, it requires a supplemental type certificate (STC). STCs are used to cover such changes and may include a flight manual supplement to cover changes that affect the basic flight manual or require pilot knowledge or action.

The flight manual must contain the operating limitations, normal, abnormal and emergency procedures, and performance data. The regulatory authority responsible for the aircraft's certification will indicate which pages of the manual are required to be included with the words "TC Approved" in small print on the page.

It should be noted that the "Limitations" section of the manual must be followed in order to maintain the C of A. Limitations are typically based on performance, weight, C of G, types of operation, airspeed or structural requirements, and ensure that, when obeyed, the aircraft has acceptable characteristics and meets the minimum requirements in force at the time of certification. Manufacturers are not required to explain why a particular limitation is included in the flight manual.

The "Normal," "Abnormal" and "Emergency Procedures" sections of the flight manual are the recommended methods of operating the aircraft. Although they are not mandatory, operators who wish to change these procedures must be prepared to establish that the alternative procedures achieve an equal or greater level of safety.

Larger operators have aircraft with unique configurations or specialized equipment. Rather than try to have aircrew attempt to cross-refer through a large number of documents on the aircraft, the operator often will produce a flight crew operations manual (FCOM). This will contain all the necessary information for day-to-day operation of the aircraft and will be based in part on the original flight manual and appropriate supplements.

Equipment for use on aircraft must be designed and tested to be suitable for installation. In many cases, a standard has been established that determines the testing necessary. In the U.S., these standards for aircraft are known as Technical Standard Orders (TSO). They set forward the performance and quality control standards that equipment must meet to be suitable for installation on an aircraft. When the equipment has met this standard, a TSO approval is given. This means the equipment is suitable for installation in an aircraft. It does not mean that no further work is necessary to obtain a satisfactory installation of that equipment, nor does it mean that any installation would necessarily be acceptable. Transport Canada does not issue TSOs. Some equipment may be given an appliance type approval, which is the Canadian equivalent of a TSO.

Contact your Transport Canada Regional Aircraft Certification office for any question related to aircraft certification. △

Wayne Harper Receives ICAS Award

On Dec. 4, 1999, at the International Council of Air Shows (ICAS) Chairman's Banquet and Awards Presentation, a Special Merit Award was presented to **Wayne Harper** of Transport Canada's Special Flight Operations Division. The audience provided a thunderous round of applause as Wayne received a plaque in recognition and appreciation of his "outstanding contributions to the air show industry."

ICAS is a U.S.-based association of air show professionals. Its membership includes many Canadian performers, air show sponsors and other members of the air show industry. ICAS also offers support and safety education for air show performers, sponsors and others.

Since the early 1990s, Wayne has been instrumental in the harmonization of air show regulations and procedures among Transport Canada, the Federal Aviation Administration in the U.S. and Canada's Department of National Defence. Wayne is looking out for the safety of those who attend air shows and has a clear vision of how this second-largest spectator sport in North America can be made even better. Wayne is respected by his peers and he is often consulted by regulators, sponsors and performers.

His professionalism is proof positive that it really is possible to enforce safety regulations and standards in a way that captures the respect of those we regulate. It is particularly gratifying to see that Wayne's hard work is also recognized by the industry in this partnership called "aviation safety." △

Upcoming Regional Events.

The following schedule for upcoming courses and/or workshops is tentative. Please contact your regional office for exact location and cost.

CRM: *Crew Resource Management*. CASO: *Company Aviation Safety Officer*. PDM: *Pilot Decision Making*. HPIAM: *Human Performance in Aviation Maintenance*.

Atlantic Region

CASO — June 21–22 St. John's

HPIAM — June 20–21 St. John's

PDM — May 25 Gander
May 28 Charlottetown
June 20 St. John's

Courses and workshops are available on demand. For further information, please contact Rosemary Landry at (506) 851-7110.

Quebec Region

Skills Review Seminars (all in French)
April 26, Quebec City; April 27, Dolbeau; April 28, Trois-Rivières; May 5, Mascouche; May 10, St-Hubert; May 26, Montreal.
For more information or to register, please call (514) 633-3249.

Ontario Region

No scheduled events for Ontario Region at press time.
For information on the Toronto area Monthly Aviation Safety Seminars schedule, please contact Nicole Nel at (416) 952-0175.

Prairie & Northern Region (PNR)

PDM
This course is available on request with a minimum of 12 participants.
HPIAM *(call (780) 495-2258 for exact dates)* September, Calgary; October, Winnipeg; November, Edmonton.
For information on courses and workshops in PNR, please contact Carol Beauchamp at (780) 495-2258; fax (780) 495-7355 or e-mail: beaucca@tc.gc.ca.

Pacific Region

CRM April 26–27 Abbotsford
October 17–18 Kelowna

CASO April 18–19 Richmond
June 7–8 Victoria

PDM Third Thursday of every month Richmond.
September 25, Nelson; September 26, Cranbrook; September 27, Invermere; September 28, Golden; October 16, Kelowna,
For information on courses and workshops in Pacific Region, please call: (604) 666-9517; Fax: (604) 666-9507.

Scraped Wingtip on Landing

On March 18, 1998, at 04:10 Eastern standard time (EST), a Boeing 727 cargo jet landed firmly on Runway 12L at Hamilton, Ontario, following an instrument landing system (ILS) approach. The crew taxied the aircraft to the ramp, and damage to the outboard underside section of the aircraft left wing was discovered while inspecting the aircraft. The left wing had scraped the runway surface on touchdown, damaging the leading and trailing edge flaps. The accident occurred during night hours at an elevation of 760 ft. above sea level in instrument meteorological conditions (IMC). This synopsis is based on Transportation Safety Board of Canada Final Report A98O0054.

Surface weather observations for Hamilton airport were not taken while the aircraft was en route from Winnipeg; however, the flight crew monitored the Toronto and London observations and planned for reduced visibility in fog for their approach at Hamilton. When in communication with the Hamilton Control Tower at 04:04, the crew was advised that the runway visual range (RVR) for Runway 12L was 5500 ft. with the runway lights set at strength five. The crew was also advised that the tower visibility was three quarters of a statute mile in light snow grains and fog.

The aircraft was radar-vectored for a straight-in ILS approach, Runway 12L, and intercepted the localizer 13 mi. back from the runway. The first officer, who was at the controls, disengaged the autopilot after intercepting the localizer and hand-flew the aircraft using the aircraft's flight director system for guidance throughout the approach. The aircraft was configured for landing with the trailing edge flaps extended 30° and the landing gear extended when it crossed over the ILS outer marker, 3.7 NM from the end of the runway. Landing clearance was issued at 04:08, at which time the RVR was reported at 5000 ft. with the runway lights at strength five, and tower visibility was three quarters of a statute mile. The wind was from 070° M at 10 to 15 kt.

During the final descent, airspeed was maintained between 136 and 146 knots indicated airspeed (KIAS). The rate of descent averaged 700 ft. per minute with slight engine power adjustments. The aircraft was crabbed left, generally three to four degrees, with minor heading variations noted during the descent. Approximately 12 seconds prior to touchdown, the aircraft engine power was reduced to flight idle through approximately 50 to 60 ft. above ground level (AGL).

On short final, several minor track corrections were made. The aircraft subsequently rolled from right to left through wings level, passing through the runway heading of 118° M just prior to touchdown. The roll rate increased through wings level as the aircraft continued to roll left. The aircraft touched down firmly with a vertical deceleration of approximately 1.5 g at 126 KIAS. At touchdown, the aircraft was banked left 11.5°, and the heading was decreasing through 116° M. The wings were immediately levelled and the nose landing gear lowered onto the runway. Following nose landing gear touchdown, the heading was re-aligned with the runway track and reversers were deployed. The aircraft cockpit voice recorder (CVR) was not functioning during the occurrence flight.

The flight crew reported that the captain called "approach lights in sight" at 250 ft. AGL and the approach continued. At 200 ft. AGL, the captain had the approach and runway end lights in sight and called "decision," meaning the aircraft had descended to the decision height (DH). The first officer looked up and saw the approach and runway lights and called "runway in sight, landing." The aircraft was aligned with the runway centreline on the glide path and localizer at that time. At 150 ft. AGL, the captain observed the aircraft above the glide slope on the glide slope indicator and remarked to the first officer "you're getting high." The first officer acknowledged. At 100 ft. AGL the second officer began to call out the aircraft altitude from the radar altimeter. He called "100"; at about that time, the first officer reported encountering some turbulence and the aircraft began to drift to the right of the runway centreline. The second officer called "50" and then "30" but noted that the aircraft stopped descending at 30 ft. At about this time, the captain observed that the aircraft was right of centreline and not descending, and he called "I have control." He took control of the aircraft, and applied hard left rudder to bring the aircraft back to the centre of the runway. The aircraft landed firmly slightly right of runway centreline. The landing roll was normal with the use of reverse engine thrust.

Approach lights for the runway were category 1, centre row, high intensity, with runway identification and threshold lights. The runway edge lights were high intensity and there was a two-bar visual approach slope indicator system (VASIS). All runway lighting was set at maximum strength for the approach. The visibility was deteriorating during the early morning hours at Hamilton. The first weather observation recorded by the Hamilton weather office at 06:00 reported one quarter of a statute mile in light rain and fog. The visibility remained at one quarter of a statute mile throughout the morning with one observation reporting one eighth of a statute mile.

Analysis—Available data shows a normal approach and normal handling of the aircraft until it descended to about 150 ft. AGL and was approaching over the end of the runway. At that point, the first officer's attention was diverted to controlling the aircraft as it encountered some turbulence and possibly a wind shift close to the ground. He allowed the aircraft to drift to the right of the runway centreline, and it appears that he may have started to flare the aircraft early, stopping the descent at about 30 ft. AGL. At this point, the captain, with the engine power at idle and the aircraft close to the ground, felt they were committed to a landing but was concerned that the aircraft had stopped descending and was right of centreline. Because fog was reducing his visibility along the runway, he was not able to determine how far the aircraft had travelled down the runway and, therefore, wanted to get the aircraft on the runway as quickly as possible. He took over control of the aircraft and applied hard left rudder to bring the aircraft back to the runway centreline. The left rudder caused the aircraft to roll left sufficiently for the left wing to contact the runway surface on touchdown.

The first officer transitioned to visual flight when the aircraft reached the DH, 200 ft. AGL, and was approaching the high intensity approach lights. Once the aircraft passed the approach lights, it is likely that forward visibility was more restricted. In conditions of reduced visibility, it is desirable to have the aircraft set for landing and only be required to flare to land before passing the high intensity approach lights. In this instance, several control inputs were required to position the aircraft, and a transfer of control between the flight crew members took place after the aircraft passed beyond the approach lights, likely in reduced forward visibility.

Among its findings, the TSB determined that visibility along the runway was reduced by fog and the aircraft drifted above the glide slope and right of the runway centreline as it passed over the runway threshold. The captain took control of the aircraft and applied hard left rudder at 30 ft. AGL. The aircraft rolled left and landed firmly on the runway with 11.5° of left bank, and the aircraft's left wing contacted the runway surface on touchdown. △

ASL Safety Caption Contest

This aircraft recently took a bath. Send us your photo captions of what you think the crew said to each other after this landing. The captions that reflect the most astute safety messages will be published in a future issue of ASL.

Fire, Smoke and Toxic Gases On Board *cont. from p. 12*

Nevertheless, a rag placed over the nose and mouth offers protection against the particles found in smoke. If the rag is moist, it can absorb more water soluble gases (hydrogen cyanide and hydrogen chloride). Ventilating the cabin will reduce the concentration of combustible gas. A small amount of knowledge about the risks and good preparation can increase the chances of surviving an aircraft fire. A small portable fire extinguisher can, for example, effectively combat an electrical fire under the instrument panel. An elaborate inspection of the heating system and periodical maintenance can also prevent carbon monoxide fumes in the cockpit. As always, emergency procedures planning will help the pilot react faster and better if the situation deteriorates.

Remember!

- In the moments after an accident, fire is the greatest hazard to the survivors.
- Fire generates smoke, heat, flames and light.
- Inhaling toxic gases is the major cause of death during a fire.
- Carbon monoxide and hydrogen cyanide are the most noxious gases found in smoke.
- Carbon monoxide is also emitted from faulty heating systems.
- A moist rag is an efficent makeshift protection against smoke.
- There should always be a portable fire extinguisher on board. △

Fire, Smoke and Toxic Gases On Board

Original by Dr. André Sénikas with a French adaptation by Mr. Richard Saint-George.

This article first appeared in the January–February 2000 edition of La Brousse; *reprinted with permission.*

An in-flight fire is one of the most dreaded situations for flight crews. It's every pilot's recurring nightmare! Most often electrical in origin, fires sometimes smoulder for a long time before they break out. Fires are deceitful, ruthless and difficult to control. In addition to their flames and heat, their toxicity is fearsome. Here is why you should all be afraid of this ravenous and noxious enemy.

Fire is part of our daily life and smoke is one of its elements. Domestic fires are also a daily reality; they result in severe human and material losses. The spectre of a fire while in the air has been a nightmare that has haunted pilots since the early days of aviation. In the days of biplanes made of wood and fabric, there were only a few minutes between the start of a fire and total loss. Modern airplanes, however, are made of fire-resistant materials, and the extinguishers are more reliable. In fact, in-flight disasters are quite rare. Nevertheless, in the closed space of the cabin, the presence of smoke indicates an emergency. If controlling the flames is a priority, removing the smoke as quickly as possible is equally vital.

Inhalation of toxic gases is the primary cause of death from fires. This is true whether you are on board an aircraft, in a home, or in a skyscraper. Confinement in a smoke-filled area could cause pilots—even exprienced pilots—to make fatal errors. Since each fire should be considered a serious incident, here is what you need to know about fire and smoke.

Fire—Fire is a complex, dynamic and physico-chemical phenomenon. It is the result of a quick chemical reaction generating smoke, heat, flames and light. The composition of the smoke and heat emitted depends on the type of incandescent material and the environmental conditions. Every fire is different.

Smoke—Smoke is a complex substance made from a variety of burning invisible gases and vapours that are being emitted from the fire. Smoke can diminish light and, consequently, visibility. Fumes from gases can be toxic.

Gases from smoke—Carbon monoxide and hydrogen cyanide are the two main toxic combustible gases. Most material used to build cabins contains carbon, which, when it burns, emits carbon monoxide and carbon dioxide. Burning wool, silk, and any synthetic material containing nitrogen will produce severe hydrogen cyanide fumes. Irritant gases, such as hydrogen chloride and acrolein, are emitted through the combustion of electrical wiring and cockpit upholstry. In general, the level of carbon dioxide increases and the concentration of oxygen decreases when there is a fire.

The effects of smoke—Escaping from a fire can require more time if there is thick smoke. Irritant gases cause tears, pain and disorientation. Decreased visibility is evident. The subsequent effects of inhaling carbon monoxide and hydrogen cyanide—even if they are not noticeable—inhibit the body's physical capacity and eventually lead to death. From a toxicological standpoint, carbon monoxide combines with hemoglobin and interferes with the oxygenation of tissues, whereas hydrogen cyanide inhibits the carrying of oxygen to the cells. Carbon dioxide—a relatively inoffensive gas—enhances the respiratory rate and thus contributes to the inhalation of other gases. Remember that the human body cannot function normally if it is not getting enough oxygen and it is precisely a decreased level of oxygen that we experience in most fires! Continuing to inhale these different gases can cause severe hypoxia. At high altitudes, with oxygen thinning, the effects of carbon monoxide and hydrogen cyanide are multiplied.

Signs and symptoms—Carbon monoxide poisoning causes headaches, weakness, nausea, lightheadedness, impaired alertness, vision problems, and errors in judgment. Generally, a loss of consciousness ensues, then coma, then death. Although carbon monoxide causes deleterious effects on the nervous system, death can arise from cardiac toxemia. But be aware! Different people may not experience the same symptoms as a result of an exposure to noxious gases. Some people succumb quickly after a small does of carbon monoxide, whereas others will survive a strong concentration level of this same gas.

With regards to hydrogen cyanide poisoning, the signs and symptoms are weakness, lightheadedness, headaches, nausea, vomitting, coma, convulsions and death. Death is provoked by the arrest of respiratory functions. Hydrogen cyanide reacts fast and death occurs quickly.

Survival—There is no universal or sure-fire procedure to follow in the case of a fire on board an aircraft because no two fires are identical. Of course, you must try to put out the flames immediately. A second priortiy—just as important—involves inhaling as little smoke as possible. Large aircraft have oxygen masks for the flight crew, but this equipment is rare on aircraft primarily used for tourism.

cont. on p. 11

TAKE FIVE...

for safety

Five minutes reading could save your life !

Underwater Egress

Although the odds of experiencing a ditching event are extremely low, pre-flight preparation and knowledge are paramount to survival should it happen. The following items will enhance your chance of a successful egress.

1. Pre-flight Preparation

Ensure the pilot-in-command demonstrates the location and use of the emergency exits, life preservers, emergency equipment, life raft, and the proper brace position—before the flight. For extended over-water flights, consider wearing your life preserver. Make sure all baggage and cargo is secured so it does not block access to the emergency exits.

2. In-flight Preparation

If you are aware that you are about to ditch, do the following:

- Put on your life preserver but DO NOT INFLATE IT.
- Locate all emergency exits, note where they are in relation to your right or left hand, and visualize how to open them.
- Assume the proper brace position for your seat, as briefed by the crew.
- Follow the instructions given by the pilot-in-command.

3. Underwater Egress Procedure

- **Try to remain calm!**
- Take a deep breath prior to being submersed under water.
- OPEN YOUR EYES.
- Orient yourself in relation to your selected emergency exit.
- Get a firm grip on a fixed reference point.
- <u>If you are seated right next to your emergency exit</u>:
  - Wait until the water has filled three quarters of the cabin before you fully open the exit, then open it.
  - Release your safety harness.
  - Pull yourself free from the cabin.
  - Inflate your life preserver after exiting the aircraft.
- <u>If you are NOT seated right next to the emergency exit</u>:
  - Release your safety harness and proceed to your emergency exit.
  - Wait until the water has filled three quarters of the cabin before you fully open the exit, then open it.
  - Pull yourself free from the cabin.
  - Inflate your life preserver after exiting the aircraft.

Some of the difficulties during underwater egress include lack of oxygen; disorientation; in-rushing water; obscured vision; and floating debris. ***Don't panic***. You know you can hold your breath, so relax for a moment; open your eyes; find the exit; and egress. These are basic guidelines only, and your best defence is underwater egress training.

TAKE FIVE...

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TURN IT ON FOR SAFETY

Transponders are found in most aircraft today, yet many people do not turn them on unless required to do so by ATC. It is interesting that a piece of equipment that is often left turned off could save your life and the lives of many others.

There are two good reasons to turn your transponder on while in the air.

- The first reason is that ATC is able to "see" your aircraft and all others that have their transponders "on" and will be able to pass conflicting traffic information to all concerned. In addition, if your transponder is able to reply on Mode C, which is automatic altitude reporting, controllers can more quickly determine where potential conflicts could occur.
- The second reason is that aircraft (usually commercial and corporate aircraft) with a traffic alert and collision avoidance system (TCAS) installed and working will be able to detect all other aircraft that have their transponders on. TCAS-equipped aircraft **will detect your aircraft** and, if your transponder has an altitude reporting capability, **will take the necessary action** to avoid a collision with you.

You have to admit that avoiding mid-air collisions is in the best interests of everyone concerned. So the next time you go flying, plan to use your transponder. You will be safer because ATC and aircraft with TCAS will detect all transponder codes, so adjust your transponder to reply as instructed by ATC or in the absence of ATC instructions, as follows:

- VFR at or below 12,500 ft. ASL: Mode A, Code 1200, plus Mode C.
- VFR above 12,500 ft. ASL: Mode A, Code 1400, plus Mode C.
- IFR in low level airspace: Mode A, Code 1000, plus Mode C.
- IFR in high level airspace: Mode A, Code 2000, plus Mode C.

And just prior to takeoff, don't forget to "TURN IT ON FOR SAFETY."

Note: TCAS II, version 7, is the same as what ICAO refers to as "ACAS II." ICAO refers to this system as an "airborne collision avoidance system" (ACAS). Further, ICAO uses the term "traffic advisory" and not "traffic alert."