Transport Canada Transports Canada

TP 185E
Issue 4/2007

AVIATION SAFETY LETTER

In this Issue...

Learn from the mistakes of others;
you'll not live long enough to make them all yourself ...

TC-1002328

Canada

The *Aviation Safety Letter* is published quarterly by Transport Canada, Civil Aviation. It is distributed to all holders of a valid Canadian pilot licence or permit, to all holders of a valid Canadian aircraft maintenance engineer (AME) licence and to other interested individuals free of charge. The contents do not necessarily reflect official government policy and, unless stated, should not be construed as regulations or directives.

Letters with comments and suggestions are invited. All correspondence should include the author's name, address and telephone number. The editor reserves the right to edit all published articles. The author's name and address will be withheld from publication upon request.

Please address your correspondence to:

Paul Marquis, Editor
Aviation Safety Letter
Transport Canada (AARTP)
330 Sparks Street, Ottawa ON K1A 0N8
E-mail: marqupj@tc.gc.ca
Tel.: 613-990-1289 / Fax: 613-991-4280
Internet: www.tc.gc.ca/ASL-SAN

Change of address or format:
To notify us of a change of address, to receive the *Aviation Safety Letter* by e-Bulletin instead of a paper copy, or for any related mailing issue (i.e. duplication, request to be removed from our distribution list, language profile change, etc.), please contact:

The Order Desk
Transport Canada
Toll-free number (North America): 1-888-830-4911
Local number: 613-991-4071
E-mail: MPS@tc.gc.ca
Fax: 613-991-2081
Internet: www.tc.gc.ca/Transact

Sécurité aérienne — Nouvelles est la version française de cette publication.

ISSN: 0709-8103
TP 185E

Publication Mail Agreement Number 40063845

Table of Contents

GUEST EDITORIAL

Safety Management Systems (SMS) Take Root in Canada

I recently had the opportunity to attend an industry/regulator seminar in Gatineau, Que. Sponsored by Transport Canada Civil Aviation (TCCA), the Canadian Aviation Executives' Safety Network (CAESN) meeting attracted some 80 senior executives, representing virtually all of Canada's larger air operators, airports, approved maintenance organizations (AMO) and manufacturers. The forum promoted a free-flowing discussion on the direction of the aviation industry—both nationally and internationally. In that sense, speakers promoted future thinking, as opposed to "rear-view" lamenting, and a move beyond the "if it ain't broke, why fix it" approach to managing.

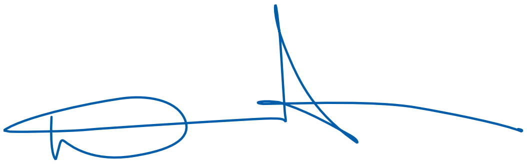
I was struck this year by the universal agreement that SMS is already showing results—in the form of reduced incidents, and in some cases, huge savings from preventing incidents from happening. One operator, for example, cited savings of several million dollars *per month* in reduced damage to property and equipment alone. Savings such as these don't happen by themselves—just as accident reduction doesn't materialize without a change in the way we do things, the way we think, and the way in which we manage systems and human factors within an organization.

SMS is now in force for the country's air operators who operate under *Canadian Aviation Regulation* (CAR) 705. These early reports from the industry are testimony to the intention and projected outcomes of the SMS regulatory framework. It is also evidence of a cultural shift from activity management to a very structured systemic approach to managing operations to achieve optimum results, i.e. reducing incidents and accidents.

One of the keynote speakers at this year's CAESN, Dr. Peter Gardiner, underlined the results that are now emerging. Dr. Gardiner made the obvious point that "good" safety leads to "good" financial results. In his presentation, he made a very definitive and persuasive link between SMS and bottom-line profit. His challenge though, for line managers, was to convince the boss, in 15 min or less, to provide the up-front funding to implement the tools necessary for the shift to systemic management.

The number of accidents in Canada has halved between the years 1990 and 2006. This enviable record places Canada in the top ranks of the world's safest aviation industries. Collectively, we are proud of this record and we need to shout it from the highest tower whenever we have the chance. But…there is evidence to suggest the progress is flattening, which gives us one more reason to change the way we think and do things.

In the next year, SMS will come into force for small air taxis, AMOs, airports, flight training units (FTU) and other certificate holders. While at first glance implementation may appear daunting, I encourage you to seek out your colleagues in the CAR 705 world to hear first-hand their experience and results with SMS. Each region in TCCA has an SMS specialist who can also provide you with guidance on the requirements. And finally, think about the business case for SMS. A successful approach will bring about the most welcome result of a reduction in the number of incidents and accidents.



David Nowzek
Regional Director, Civil Aviation
Pacific Region

Use of current documents by pilots

Dear Editor,

Very few of my recreational flying acquaintances use a current copy of the *Canada Flight Supplement* (CFS). Current VFR charts seem to be even more rare. I fear the Transport Canada *Aeronautical Information Manual* (TC AIM) is in the same situation. It would be very revealing to know what percentage of pilots do have current copies of these documents. I am involved in various general aviation activities, including ultralight flying and instructing, part-ownership of a Cessna 172 and air show management.

It is difficult to convince people to voluntarily part with several hundred dollars each year for current documents. Perhaps we should consider the inclusion of document subscriptions with the cost of our licence renewals. Landing fees bug me, but I understand they are an appropriate form of user-pay. Shouldn't it be the same for charts and the CFS?

Aird Flavelle
Abbotsford, B.C.

Thank you for writing. I can only urge your flying acquaintances to get access to current and adequate pre-flight and in-flight information. Documents are indeed expensive, but they are part of the costs of flying. On your suggestion to include an automatic subscription to the CFS as part of the licence renewal fee, this would certainly not be an acceptable solution economically, and would result in higher fees and an enormous waste of CFS copies. —Ed.

Early crosswind turn got me too close for comfort

Dear Editor,

I would like to share with the readers, especially newer pilots, an experience I encountered, as it is one that can happen anytime there is more than one aircraft in the circuit. I was a student pilot on a solo flight, doing circuits on a beautiful clear day in Hamilton, Ont. I had completed my run-up and was holding short of Runway 30, which uses right hand circuits. I called the tower to advise ready for takeoff, as the other traffic in the circuit had just called turning on final.

The controller gave me the following instructions: "[Alpha Bravo Charlie], you'll be following company traffic now on short final for a touch-and-go." Shortly after they cleared the runway, I was given my take-off clearance.

Of course, I was going through the safety items inside the cockpit…full power, airspeed is alive, rotation speed…and shortly thereafter, found myself at 500 ft. Checking fuel pressure and raising flaps, I was ready to start my crosswind. I turned right and looked downwind to see if I could spot the traffic ahead. I could not. This puzzled me somewhat, but I felt that once I turned downwind they would either come into view, or I'd hear their call turning on base.

As I began my turn downwind, which I had kept in tight until I could locate the traffic ahead, the tower advised that my traffic was at 12 o'clock at 1/2 mi. I looked downwind but could not see anything, and then came to realize that when the radio call came, I was still in the crosswind. As I looked to my present 9 o'clock position, I found the traffic 1/2 mi. away. We were flying side by side in a circuit, and for a moment, this made very little sense to me.

At that time, the tower radioed the following message "[Alpha Bravo Charlie] I cannot impress strongly enough how important it is for you to follow company traffic." I recognized his firm but calm message, and in the following instant realized that he was awaiting me to correct the situation. I requested a "right 360" to get back in line and I was cleared to do it. I got back in place and completed two circuits before returning to the hangar. By that time, I had put the pieces together of what had happened.

As I had progressed along my takeoff, I had in place a mental picture of the poster of the circuit that is seen in every airport—a perfect sharp rectangle centered on the runway. I had assumed that the other aircraft would be in this perfect geometric figure, just ahead of me, since they had passed me by just one minute sooner, on the active.

Since we had identical airplanes, and since the other plane was on a take-off roll further down the runway (due to his touch-and-go), and of course there were two people in that aircraft, I assumed it would not have been possible for the traffic in front of me to have achieved 500 ft as quickly as I did. Their crosswind would have been much further upwind than mine was, meaning that, when I was ready to turn crosswind, they would be on my left, not my right!

A couple of things worked to my advantage on that day. First, I was at a controlled airport and had another set of eyes working for me. Next, I found out later that the instructor had seen my mistake and took his plane further out to avoid conflict. If I had been at an uncontrolled airport, and had the traffic in the circuit not been aware, it could have been a very tragic mistake.

From this event, I learned that the circuit pattern is quite dynamic. I also decided that, uncontrolled or not, I would not ever turn from the departure path without knowing where the other leading traffic was. ATC would definitely favour a radio call that I had lost sight of the traffic and could have cleared my turn to crosswind, or otherwise extended my outbound leg.

This was a very easy lesson that was learned early in my flying days. It reinforced the competence and professionalism of our air traffic controllers, and certainly gave me a clearer appreciation of the dangers in circuit flight.

Pat Turcotte
Caledonia, Ont.

Thank you for sharing this interesting account. Indeed ATC would have led you safely behind your traffic had you asked; if this had been an uncontrolled aerodrome, the traffic itself would have gladly informed you of its location. This is unfortunately a common mistake made by many in the circuit. Situational awareness is paramount, even if only two aircraft are present in the circuit. Also, don't be shy to use the radios to ask where the traffic actually is. Too many pilots shun the radios for fear of embarrassment. —Ed.

Drowning still a grave concern in water-related occurrences

Dear Editor,

After reading *Aviation Safety Letter* (ASL) 1/2007, I felt compelled to write regarding water-related occurrences. In this quarter alone, I noted six separate incidents that ended in water, with a total of 13 persons on board. Four people died on impact, three drowned in the airframes, unable to egress, and six escaped with minor injuries.

Each year in Canada there are numerous aviation water-related injuries and fatalities involving light recreational and commercial aircraft, as well as helicopters. At the flight controls of each of these machines was a qualified pilot, trained for emergencies such as stalls, engine failures, and other in-flight situations. While egress issues are discussed in training, many are still unwilling to practice a forced-landing scenario that would result in a true water-upset experience. Several years of instructing underwater egress to students have shown me that a very small percentage do well the first time out in a warm pool environment; now imagine a real event in a cold lake or river. Even when mentally-prepared and coached on the effects of disorientation, few were able to contain their emotions without panic on the first staged dunking. However, by the end of the day, all students had experienced several inversions in water and felt better prepared to handle themselves effectively, and even assist others, given the option.

The natural (and wrong) response to a dunking is to immediately release the seat belt, which is holding the individual inverted; this results in righting the body, which is now upside down relative to the airframe. Once this has happened, the reality of being trapped in a box creates fear, followed by panic and frenzied search for the elusive door handles. Finding exits can be very difficult, and then to open them once inversion is complete often exceeds the person's ability to hold their breath. Door handles can be torn off while attempting to rotate the device backwards to its design, sealing both cockpit and cabin from exit. In a panic situation, and strengthened by adrenalin, a person's thought process may not recognize that the handle is inverted and must be rotated the opposite way than for normal operation. Many door handles are unguarded from reverse rotation, which makes them vulnerable to breaking or jamming if forcefully moved the wrong way.

Without training, and with the limited vision available in the best underwater conditions, the exits are very hard to find by the unexpected accident victims. Underwater egress training provides not only personal life-saving skills, but also the ability and know-how to assist other occupants, who could well be our loved ones. A detailed pre-flight briefing on location and operation of door handles and exits does help a lot, but nothing beats having taken and practiced the plunge in a controlled environment.

Bryan Webster
Victoria, B.C.

Looking for *AIP Canada (ICAO)* Supplements and Aeronautical Information Circulars (AIC)?

As a reminder to all pilots and operators, the AIP Canada (ICAO) *supplements as well as the* AIP Canada (ICAO) *AICs are found online on the NAV CANADA Web site. Pilots and operators are strongly encouraged to stay up-to-date with these documents by visiting the NAV CANADA Web site at* www.navcanada.ca*, and following the link to "Aeronautical Information Products". This will take you directly to the site of the current* AIP Canada (ICAO).

PRE-FLIGHT

The Canadian Business Aviation Association Column —Success Through Safety

The safety culture of an organization is the product of its values, attitudes, competencies and patterns of behaviour, which determine the commitment to, and proficiency of, its safety programs. An organization that is infused with the safety mentality will have a positive safety culture, characterized by communication founded on mutual trust, shared perceptions of the importance of safety, and confidence in the efficacy of preventative measures.

If safety culture is to be successfully implemented in an organization, certain factors will always present themselves. Foremost among these factors is the leadership and commitment of the chief executive, complemented by the involvement of all employees in the organization. The success of a safety management system (SMS) rests on how well it is understood, and if everyone in the organization consistently incorporates it into day-to-day operations. Every employee will have an understanding of the safety guidelines, and will accept the responsibility of providing input to create change where improvements can be made and safety promoted.

In a strong safety culture, safety information is disseminated throughout the organization. Everyone has a responsibility for safety and should be willing to identify unsafe conditions or behaviours, and confident to correct them without fear of reprisal. This necessitates effective communication and a responsiveness to change in order to meet changing safety attitudes. Good safety culture implies a constant assessment and re-assessment of the safety significance of events.

Establishing and developing positive attitudes toward safety culture in an organization is cost effective. An organization with a strong safety culture will experience few at-risk behaviours. Consequently, they will experience low accident rates, low turn-over, low absenteeism, and high productivity.

Creating a safety culture takes time and effort by everyone in the company. To achieve a comfort level so that all employees are part of proactive change, senior management needs to be an active participant in promoting safety culture and embracing the processes established in the company SMS manual. Employer and employee commitment are hallmarks of a true safety culture where safety is an integral part of daily operations.

To be successful, every employee of an organization has to contribute. The first step in developing a safety culture may be to raise the level of safety awareness, and later, to address specific hazards. Contributions and suggestions for change or amendments to the SMS should be solicited and should be assessed equally and fairly, capturing as much input from all employees as possible. Through daily activities, everyone should be encouraged to report their observations of situations where increased safety is required, which processes are not implemented effectively, and how increased safety could be more effective.

Over time, the norms and beliefs of the organization will shift focus from eliminating hazards to eliminating unsafe behaviours, and building systems that proactively improve safety conditions. Safety and doing things the right way begins to take precedence over short-term pressures. The result is an enhanced level of excellence developed within the organization.

Successful implementation of a change process for safety will focus on the process rather than individual tasks. The initial phase of implementation entails ensuring that top management fully understands the need for change, and is willing to support it. The direct or indirect costs of accidents affecting bottom-line costs to the organization will more than pay for the needed changes. The next obvious step is creating a partnership between management and the employees. Everyone in the organization should have a clear understanding of what changes are needed, why they should be implemented, and how the proposed actions will affect them.

Accountability for safety should become the responsibility of everyone in the organization. With identification of safety items, and a shared responsibility within the organization, no restriction should be placed on who initiates the SMS change process. Suggestions for change should be assessed on individual merit and its impact, if the issue had not been identified. Everyone should have a voice; otherwise, there will be a reluctance to "buy in" to the process.

There is also a need for a clear distinction between data collection of incident reports and the reporting of unwarranted risk-taking that might produce avoidable errors and trigger disciplinary proceedings. The value of non-punitive reporting is that it encourages everyone to raise safety-related issues. Analysis of near-miss and incident reporting and the remedial actions becomes lessons learned company-wide. Failure to mitigate the risks is kept to the level that is as low as is reasonably achievable.

A successful safety culture includes effective involvement by everyone in the organization. Positive communication in the form of feedback from senior management to employees instills a sense of value and accomplishment, while promoting continued growth in company safety culture. An organization's SMS will continually measure performance, communicate the results, and celebrate the successes. Anticipating possible errors and rehearsing appropriate recoverable actions at all levels is a hallmark of a high-reliability operation.

It is clear that basic faults in organizational structure, climate, and procedures may predispose an organization to an accident. Human fallibility is an inescapable reality. Safety culture is an on-going evolution of rules that change as the operational requirements change. It is a convergence of attitudes, beliefs and behaviours subject to human influences, best described as the things you do when no one is watching. It is not just making safety a priority, because priorities change. It is making safety a value, as values are less likely to change. △

COPA Corner—Runway Incursions—Your Part

by Adam Hunt, Canadian Owners and Pilots Association (COPA)

The year 2007 marks the 30th anniversary of the Tenerife disaster—the worst runway incursion accident in aviation history, when two Boeing 747s collided at Los Rodeos Airport in the Canary Islands. It was the worst aviation accident of any kind, resulting in 583 deaths. Good progress has been made in reducing runway incursions in Canada, but there is further room for improvement.

One situation that leads to a runway incursion is when an aircraft enters the protected area of a runway when it is not authorized to do so. Separation is lost and there is the potential for a serious accident.

The two most common elements in runway incursions are runway layouts that the pilot is not familiar with, and inadequate communication. Different scenarios happen at airports of different sizes. At large airports, with complex layouts, lots of taxiways and runways, and air traffic control (ATC), a pilot typically becomes uncertain of where they are while taxiing, and ends up being somewhere they shouldn't be.

Small, uncontrolled airports, with simple runway layouts, typically require aircraft to backtrack after landing or to position for takeoff. Incursions can happen when landing traffic and backtracking aircraft don't know about each other, or misjudge the speed and time it will take to get where they are going, and get too close for comfort.

So, as a pilot, what can you do to avoid these situations? The answer is simply airport layout familiarity and communication. How do you familiarize yourself with an airport layout when you have never been there before? There are lots of tools to help you. The runway diagrams in the *Canada Flight Supplement* (CFS) and the *Canada Air Pilot* (CAP) can be a great starting point. NAV CANADA also distributes airport diagrams under the title *Canadian Airport Charts* (available on NAV CANADA's Web site: www.navcanada.ca). This Web-based publication is available free to everyone for download, and contains the airport diagrams for every airport that has IFR procedures available. You can simply print the charts in advance for the airports you plan to visit.

Another great source of runway orientation information is COPA's *Places to Fly*. Found on the COPA Web site (www.copanational.org/PlacesToFly/), this publicly-available, user-editable, airport directory has information on almost 800 airports, and is growing quickly as pilots and airport managers add information daily. The features of *Places to Fly* are designed to increase airport orientation and reduce runway incursions. Many of the airports listed have aerial photos of the airport that COPA members have taken and posted on the Web site. Some are vertical photos that show runway layout, while others show the point-of-view from an aircraft on final approach. In many cases, a second version of the photo is posted with the runways, taxiways and other features, such as the location of the fuel pumps, labelled. These are great tools to show what you will see from the circuit, where the taxiways are, and where you will ground manoeuvre your aircraft.

Many of the *Places to Fly* airport pages also have links to satellite photos that show good vertical photos of the airport layout. Many of these are high-resolution so that lots of detail is available. A few minutes reviewing the aerial photos and satellite photos should give most pilots the knowledge needed to avoid runway incursions, even at airports they have never been to before. Best of all, the photos can be printed and carried in the aircraft.

The second part of the equation is communication. If you are at a small, uncontrolled airport, make sure you are on the right frequency, make the required calls, and communicate with all other aircraft to work out your separation. Always watch out for no radio (NORDO) traffic at uncontrolled airports—they can be there too.

At controlled airports, you have help available—don't be afraid to ask ATC ground control for vectors to the runway or ramp to avoid ending up in the wrong place.

By working together and doing our part, we can make 2007 the year that we really make a marked decrease in runway incursions. COPA can be found at www.copanational.org. △

This runway incursion prevention poster is one of six full-size posters produced jointly by Transport Canada and NAV CANADA. The six posters were widely distributed and can still be ordered through our order desk at 1-888-830-4911, or online at www.tc.gc.ca/civilaviation/systemsafety/posters/menu.htm.

Does Your Group Think Safety?

by Gerry Binnema, Civil Aviation Safety Inspector, System Safety, Pacific Region, Civil Aviation, Transport Canada

Most of us fly as part of a group. This group might be a flying club, a soaring association, a group of people who share an airplane, or a commercial flying operation. Regardless of what it is called, or how big or small it is, any group will establish a set of norms that serves to provide a code of behaviour for people in that group. I'm not saying that people sit down and decide how they will behave in the group. Normally, this is something that develops as the various people relate together; some behaviour is accepted and works, while other behaviour doesn't work very well within that group. This set of norms or behaviours is sometimes called the group's culture, and can have a profound effect on the safety of that group.

In the last issue of the *Aviation Safety Letter* (ASL), I looked at some of the ways that we humans tend to think. I talked about hindsight bias, attribution error and invulnerability. By way of review:

- Hindsight bias refers to our tendency to believe that what has already happened was more or less inevitable and should have been predicted by people beforehand. We all have 20/20 hindsight, and this makes is easy to be critical of other people's decisions, when we know they didn't work out very well.
- Attribution error refers to our tendency to attribute the errors of other people to their own personal shortcomings rather than to the situational factors that often play a major role in producing an error.
- Invulnerability refers to our tendency to believe that accidents happen to other people, but not to ourselves.

Because all humans are susceptible to these patterns of thinking, it is common for them to find their way into the beliefs and norms of a group of people. I would like to look at a few areas of aviation culture in this article, and would ask you to consider your own group to see if your norms contribute to safety, or work against it.

Human error—how does your group respond to human error? People often respond by being critical of the person making the error. Error is believed to be evidence of incompetence. When someone in your group makes an error, are they subject to ridicule? When you discuss accidents that have happened to others, are you very critical of the people involved? This kind of attitude will drive errors underground. People will hide their errors. As a result, systemic conditions that lead to errors will never be brought to light.

Human error is most often the result of systemic conditions, and if one person can make the mistake, any other person in the same set of circumstances could do the same thing. If your group can accept this notion, error will be seen as a potential symptom of a problem in the system, and the group will want to identify errors in order to fix potential problems. The group will need to make a conscious effort to avoid criticism of people making errors, and learn how to look for systemic issues within, and beyond, the group.

Expecting the unexpected—how does your group plan? Do you expect everything to go pretty much as expected, or do you build in some margin for unexpected things to happen? Remember that the aviation industry is working to maintain an accident rate of 1 in 1 million. Therefore, we have to be ready for any event that could happen, even when the probability is low. Sometimes safety measures seem extremely conservative. People might take issue with a regulation or safety advisory, pointing out that the events at issue are so unlikely that it seems silly to pay money to prevent them. However, we need to consider how best to prevent events, even if they are only remotely probable.

Risk management—this leads naturally to a discussion on the best way to control risk. In your group, if someone mentions a potential hazard, how does everyone else react? All too often, people are reaching for the nearest piece of wood to touch, as if simply talking about a hazard is bad luck. People are often uncomfortable with an honest discussion of the hazards in a given operation. However, it is important to consider hazard scenarios and calculate the probability and severity of those scenarios, in order to make intelligent choices on how best to keep risks to a minimum.

A group that works towards safety views human error as a symptom of a deeper problem. The group tries to learn from error, and make changes when appropriate. When making plans, the group thinks about unusual events, as well as the everyday, and tries to build in resilience to error and other unexpected events. The group also considers what could go wrong, and tries to build in safeguards to keep risk to a level as low as reasonably possible. How does your group measure up? △

A Just Culture—Enhancing the Reporting of Safety Information

by Ann Lindeis, Manager, Planning and Analysis, Safety and System Performance Development, NAV CANADA

NAV CANADA

In any industry, the effectiveness of a safety reporting system relies on the willingness of front-line workers to provide essential safety information—and that often means reporting their own errors or mistakes.

The quantity and quality of information is directly influenced by a country's legal framework, organizational policies and procedures, the availability of feedback to the reporting community, and a common understanding of the purpose of the safety information.

These factors can work constructively to foster a "just culture," which Professor James Reason has described as "an atmosphere of trust in which people are encouraged, even commended, for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour."

In recent years, a number of different industries and organizations have been exploring the benefits of a "just culture." NAV CANADA recently undertook an initiative toward formalizing a just culture policy in air traffic services (ATS), and this article provides an overview of some of the questions that arose during the initial steps of the project.

Who should be part of the Just Culture Working Group?

In January 2006, a Just Culture Working Group was formed to develop a framework for the assessment of human behaviour or events that may have contributed to an air traffic control (ATC) operating irregularity.

An operating irregularity is a situation in which ATS are being provided and a preliminary investigation indicates that safety may have been jeopardized, less than minimum separation may have existed, or both.

The scope of the Working Group was limited to operating irregularities where it was determined that ATC services contributed to the negative outcome.

Establishing credibility and trust in a framework to assess acceptable and unacceptable behaviour requires working in a collaborative environment with members of the organization directly affected by the framework.

Given the focus on ATC services, the members of the Working Group at NAV CANADA consisted of three representatives from the air traffic controller union (the Canadian Auto Workers/Canadian Air Traffic Control Association [CAW-CATCA]); three management representatives; and a chairperson.

The Working Group's mandate was threefold: first, to propose a just culture policy statement; second, to establish criteria for acceptable versus unacceptable behaviour; and third, to develop procedures for determining culpability.

How do current practices compare to recommended practices?

One of the first steps undertaken by the Just Culture Working Group was to conduct a gap analysis of recommended practices and current policies, procedures, and practices regarding aviation occurrence reports in general, and more specifically, the operating irregularity process.

The gap analysis revealed target areas where enhancements could be made to further support the principles of a just culture, and potentially enhance the quantity and quality of the safety information provided by controllers.

For example, a target was set pertaining to aviation occurrence reports to increase education, awareness, and feedback to controllers regarding why their reports are important, who sees the reports, and how the information in the reports is used by NAV CANADA, Transport Canada, and the Transportation Safety Board of Canada (TSB).

Important targets regarding operating irregularities were to:

- change the perception that a controller involved in an event is a "bad" controller, and instead create an environment where operating irregularities are seen as a tremendous opportunity for individual and organizational learning;
- increase education of managers and controllers on human error, and what constitutes acceptable and unacceptable behaviour;
- increase understanding by controllers on what to expect when they are involved in an operating irregularity; and
- develop procedures for consistent and transparent handling of individuals involved in events.

How do we get "there"?

A six-month trial period commenced in the summer of 2007 at one area control center (ACC) and one tower to test the recommendations from the NAV CANADA/CAW-CATCA Just Culture Working Group. This trial period will be used to collect feedback from controllers and managers regarding the just culture policy, principles, and procedures.

Following an assessment of the trial feedback, consideration will be given to a broader implementation of the just culture.

What are the expected benefits of a just culture?

The collective experience of a number of organizations has demonstrated three key benefits of a just culture, when compared to a culture of blame or a culture of no accountability.

It is anticipated that the just culture initiative at NAV CANADA will improve performance in all three areas—namely, increased safety reporting, trust building, and more effective safety and operational management. △

Recommended readings:

GAIN Working Group E and Flight Ops/ATC Ops Safety Information Sharing, *A Roadmap to a Just Culture: Enhancing the Safety Environment*, Global Aviation Information Network (GAIN), 2004.

Reason, J., *Managing the Risks of Organizational Accidents*, Ashgate Publishing Limited, Hampshire, England, 1997.

Be Prepared: What If an Emergency Happened to You? Part II

by Karen Smith, Inspector, Cabin Safety Standards, Commercial and Business Aviation, Civil Aviation, Transport Canada

It happened so quickly

We were taking off at night, and I was sitting on my jump seat at the front of the DC-8 aircraft. It was winter, and the departure was from what is now called the Montréal/Pierre Elliott Trudeau International Airport. As the aircraft rolled down the runway for takeoff, I remembered feeling that something just wasn't right when the aircraft began to lift. Then I felt the aircraft start to sink when it should have been climbing. Looking to my right, I saw the lights of homes along the shore of the West Island of Montréal, Que. The next thing I remembered was sudden darkness, getting out of my jump seat to look out the window, and seeing water. We had crashed into the river. I began yelling to the passengers to put on their life preservers and get out of the aircraft. I opened the aircraft door and couldn't believe the sight. There were large chunks of ice floating on the water and the sound of metal rubbing and groaning. People were screaming. I could hear other crew members yelling commands and I could smell fuel. I hated telling people to jump into the dark cold water, but I knew we had to get out. Then the moment came when I had to leave the aircraft. My heart was pounding and I held my breath as I jumped.

The shock of the icy cold water as it soaked through my uniform was numbing. I was grabbing for something, anything, to hang on to—a piece of metal, broken ice—I was desperate. Then I woke up. Yes, it was a dream.

I have been told that many crew members have dreams related to crashes because they spend so much of their life on aircraft. That dream was back in 1988, but I can still remember the details so vividly, and how jumping into the cold water took my breath away. Of course, luckily for me it was only a dream, but it certainly made me wonder what a real crash would be like, and how I would react. I think, as crew members, we like to believe that we would perform as expected, and that our training would come through and make for a successful evacuation. But, how would you react? Would you *be prepared*?

In the last issue of the *Aviation Safety Letter* (ASL), the article "Be Prepared: What If an Emergency Happened to You? Part I" examined the procedures in place to prepare an aircraft for a flight, and how the preparations that are made prior to every takeoff have an impact on the outcome of a survivable crash. This article looks at the crash scenario, the types of emergencies—prepared and unprepared—and the post-evacuation duties of crew members.

Prepared or not prepared: that is the question!

Basically, there are two types of evacuations: prepared and unprepared. Either the crew has sufficient warning of an emergency and they are able to prepare the passengers, or the emergency is so unexpected that the evacuation is called without preparation.

In a **prepared evacuation**, the crew has some advance warning. It could be as little as 10 min, or it could be hours. The flight attendants will follow their established procedures and begin to ready the passengers and secure the cabin for the evacuation. These procedures, or steps, are arranged in order of priority to allow the more important duties to be completed first. During this time, flight attendants will brief and assist passengers, and ensure passengers know how to take a brace position. The proper brace position can minimize injuries during impact due to flailing and secondary impact. Flight attendants will verify that seat belts are tightly fastened across the hips, baggage is securely stowed, life preservers are properly donned (if necessary), infants are secured, and if time permits, flight attendants will answer questions and calm passengers. Some passengers may have started to panic and others may be in denial and unwilling to cooperate. Flight attendants must deal with the human and procedural aspects of the evacuation preparation and maintain control of the situation. This is multi-tasking at its maximum! If, during any of the steps, the situation dictates that the preparations must cease, or that there is no time left available, then the flight attendants will immediately ready themselves by going to their jump seats and taking a brace position. Once seated, they will start their silent review and go through the mental checklist of procedures as they wait for the signal from the flight deck to evacuate.

An **unprepared evacuation** does not automatically mean disaster. The evacuation can still be successful, depending on whether there is damage to the aircraft structure upon impact, the conditions inside and out of the aircraft, and the readiness of the flight attendants. If the passengers have been well briefed prior to takeoff with a thorough pre-flight safety briefing, and more importantly, if they were paying attention to the information provided, they have the knowledge necessary to help them evacuate an aircraft. In interviews with passengers who have survived aircraft evacuations, many comment on how they wish they had paid closer attention to the safety briefing prior to takeoff.

The unprepared evacuation scenario can be one of the most difficult for crew to manage, as everyone is taken by surprise. Time management is critical and affects survivability in accidents, so proper training and knowing procedures are essential. In the end, whether the crew is faced with a prepared or an unprepared evacuation, the task remains the same—to get everyone out as quickly as possible.

Whether the crew is faced with a prepared or an unprepared evacuation, the task remains the same—to get everyone out as quickly as possible.

The real thing

Once an evacuation begins, quick and precise actions by the crew are required. Is the exit usable and safe? Should the passengers be redirected to another exit? The environment inside the aircraft cabin during an evacuation can best be

Pre-flight

described as chaotic. Passengers may need to climb over seats or crawl to exits in order to get out, the fuselage might be ripped open and seats may no longer be attached to the floor. People may become jammed at exits trying to get out, and others may bring baggage with them in attempt to save precious items; all this can seriously affect the evacuation flow. In other situations, once at the aircraft exit, some people freeze. The height of a door from the ground can be daunting for many people, especially if they are being told to jump out into the unknown, or worse, are surrounded by smoke and flames. Flight attendants must be assertive and forceful in order to keep the evacuation flow moving, the tone of voice and words used have a big impact on getting passengers to exit. A flight attendant will shout, use body language, push and pull, if necessary—whatever it takes to evacuate an aircraft—and all this with a cabin possibly filling with smoke. Flight attendants will shout commands to give directions in the cabin and to tell passengers to move away from the aircraft after they have exited. Once all passengers have been evacuated, and if conditions inside permit, the flight attendants will run through the aircraft, checking that nobody is left inside. They verify that lavatories are empty, and check the flight deck and any other areas that passengers may have gone to in a state of panic. At this time, they may come across injured people who were unable to move, or people who may be unconscious or frozen with fear and in need of assistance to evacuate. Flight attendants will check if other crew members need assistance and then they will exit last.

The next step—post evacuation

For a flight attendant, the evacuation does not end with clearing the aircraft. If the accident has occurred at the airport, help may arrive within minutes from local authorities and rescue services. If, on the other hand, the crash site is in a remote area, assistance could take hours, or even days. In this case, flight attendants will usually grab emergency and survival equipment, such as first aid kits, blankets, water, and then exit the aircraft. Some passengers may have injuries that will need to be attended to immediately; others may be in a state of shock or confusion. Some will be separated from family members and desperate to find their loved ones, they may even try to re-enter the aircraft to look for other passengers or to retrieve belongings. Flight attendants will use their crowd control skills to keep people calm and from potentially injuring themselves. Grouping people away from the aircraft and upwind from smoke is the next step. A passenger count will be taken, if possible, in order to establish if all passengers and crew have been evacuated.

As a passenger, you can increase your chances for survival in an accident by being informed. Pay attention to the pre-flight briefing, be aware of your surroundings, and follow the directions of the crew. Travel by air is one of the safest modes of transport, but it never hurts to be prepared. △

Answers to Self-Paced Study Program *(tear-off)*

1. The lesser of the height above ground or water of the base of the lowest layer of cloud covering more than half the sky or the vertical visibility in a surface-based layer which completely obscures the whole sky.
2. Land and Hold Short Operations
3. Key the activating sequence when commencing your approach, even if the airport lighting is on.
4. unreliable; it transmits
5. NOTAM
6. 50
7. "G"
8. Advise ATS, and, if necessary, revert to using traditional aids for navigation.
9. No
10. 20 miles north of Toronto; 20 DME north of Toronto.
11. readable with difficulty
12. 122.75
13. follow normal communications failure procedures; 7600
14. NAV CANADA flight information centres (FIC)
15. PIREPs
16. To notify pilots of potentially hazardous weather conditions not described in the current graphic area forecast (GFA).
17. 200 ft overcast
18. After 1300Z.
19. Greater than 6 SM.
20. When there are lower sector visibilities, which are half of or less of the prevailing visibility.
21. en-route; is not
22. is not; the target will be lost on the ATC radar screen
23. the current altimeter setting of that aerodrome; if the altimeter setting is not available, to the elevation of that aerodrome; standard pressure (29.92 inches of mercury or 1013.2 mbs)
24. 45; normal cruising speed; 20; normal cruising speed
25. 200
26. FISE; SAR action
27. 1-888-226-7277; 2; 48
28. 5; UTC; 5
29. 30
30. 7700
31. A replacing or a cancelling NOTAM must be issued.
32. NAV CANADA; Transport Canada
33. a maintenance schedule, approved by the Minister
34. Bonding prevents sparks by equalizing or draining the electric potentials.
35. 3 000 ft
36. refraction error
37. at or above; beyond
38. Identify themselves as the holder of a pilot's licence.
39. night vision; reaction time
40. 48 hr

The Decision To Fly

by John H. Enders, former Flight Safety Foundation (FSF) President and Chairman

This article was originally published in the Flight Safety Foundation's Accident Prevention *newsletter, Vol. 44, No. 12, December 1988. We feel its safety message is as valid today as it was in 1988. Reprinted with permission of the Flight Safety Foundation.*

Icing has contributed to major air carrier accidents that have resulted in personal tragedy and grief, in addition to the major economic losses they impose on the aviation community. The aviation community continues to gain knowledge and understanding about the nature of icing hazards, but on-going communication and education are integral to success in reducing aviation's vulnerability to ice, as well as other hazards.

[This article was prepared from the author's keynote address to the Society of Automotive Engineers, at the Ground De-icing Conference, in Denver, Colo., September 20–22, 1988.]

Flight Safety Foundation has found that the fatal accident rate per million departures over the past decade is the same for takeoff icing accidents as it is for wind shear accidents. While more lives have been lost in wind shear accidents, both cases have occurred at the same rate. The exposure to risk is therefore the same. With this situation in mind, contrast the different degree of attention given to research, education and communication concerning these two serious problems.

Three years ago, Flight Safety Foundation, with the support of Finnair, conducted a three-day Regional Workshop in Helsinki, Finland, on the topic: "Safe Operations in Cold Weather." It was well-attended by more than 120 delegates from Europe, South America, Southeast Asia, the Far East and Middle East. The U.S. and Canada were under-represented. This was unfortunate, because much valuable knowledge and information was shared by our European and Nordic members who have very successfully operated in harsh winter weather with an enviable safety record. A session devoted to ground operations previewed what I am addressing now. I am pleased to report that significant progress has been made in ground de-icing since the meeting in Helsinki.

I chose this title, "The Decision to Fly," because it represents the crucial transfer point where responsibility for the success of the flight passes from the ground engineer to the pilot. Successful preparation of the aircraft for flight is the essential starting point for the pilot as he or she assesses all of the factors bearing on committing to take off.

The chains of events that comprise preparing an airplane and its crew for flight, the decision to fly, and the flight itself, are long series of tasks that must be carefully performed by many people of high skill, good judgment and having dedication to thoroughness and quality. The mixture of technical tasks and human subjective behavior makes these tasks very difficult. As countless accident investigations have shown, any interruption in these chains of events provides opportunity for error. The error may be trivial; it may be serious. It may be recognized and remedied, or it may go undetected, until it causes another error, and another, and another, until their accumulation destroys the safety margins and they coalesce into an accident. Because we have learned from our mistakes, for the most part, we have laboriously built up our technologies and have established procedures through painful trial and error to where we believe that we have assured safety. That is a perception, and it may or may not be true.

The statistics reflect our overall success. The statistics also show our remarkably few failures. The reliability of today's commercial aircraft is phenomenally good. Only 3–5 percent or so of the fatal accidents in air carrier operations involve mechanical failures or maintenance errors as primary factors. Some 70 percent, on the other hand, involve the cockpit crew as a primary factor. However, we cannot simply dismiss these so-called crew errors as of no concern to maintenance and engineering. As one pilot not long ago summed up his report to the Aviation Safety Reporting System: "In the final analysis, the error was mine and I take full responsibility for it; but I did have a helluva lot of help along the way in making it."

Education. Communication. Are we doing enough? No, or we wouldn't see the types of accidents that are happening today.

Several years ago, I wrote an article for the Flight Safety Foundation's *Flight Safety Digest*, expressing concern that many of today's pilots are unaware of the hazards of ice on the wing or other parts of the airplane. Aerodynamic penalties of meager amounts of ice escape their awareness. Why do our crews ignore these known and proven facts to press on with routine operations? Schedule or economic pressures? Macho thought (i.e. I can handle that little bit of snow or ice)? Or just plain ignorance? It makes no sense at all to invest tens of thousands of dollars in developing a skilled pilot and then permit an operation where such crucial factors can be ignored.

The engineering community seems to understand to a great degree the appropriate processes for applying proper formulations of de-icing fluids over a range of climatic conditions. Is this adequately translated to the ground crews? Is a quality check maintained on the actual application? Does the cockpit crew understand the process and its limitations? I think the answers must be "no" in too many cases. Why?

De-icing is not inexpensive. Deciding its use is a judgment call. Added to the cost of the fluids themselves is the cost of delay, inconvenience and environmental protection. Type II fluids are more expensive than Type I, but have more "holding time." Are the decisions to use Type I or Type II rationally made? Does the pilot have enough basic information to make a rational decision in all cases? What of economic pressures? Schedule pressures? How does one trade off the cost of delay with savings of fluids use? How does one rationalize the saving of a few thousand dollars of de-icing services with the cost of a wrecked airplane, loss of passengers' lives and loss of a trained crew? Does a deregulated air transportation system accommodate the rationalization of precautionary expenses? Especially when competing carriers' overall route structures differ and may favor one over the other in the number of de-icing applications annually? I mention these points because I think they need to be continually reviewed so that the duty of care imposed on us all is carried out properly.

"Aerodynamic penalties of meager amounts of ice escape their awareness. Why do our crews ignore these known and proven facts to press on with routine operations?"

FAA identifies nine serious part 121 and 135 accidents in North America since 1968 that are ground de-icing related. Every one of them represents a mistaken decision to fly. Why? Was the pilot in possession of all the information needed to make a proper decision, or was ignorance the culprit? Where was the communication? The education?

I visited the United Kingdom's Accident Investigation Board's wreckage hangar facility at Farnorough a year ago. There, grouped on the hangar floor were the sad remains of once-proud, functioning aircraft and helicopters. Each of these 14 or so piles of twisted metal and fractured structures represented loss of life, resulting somehow from judgment errors or ignorance on the part of the human element in the overall system. They ranged from a single-pilot ultralight whose main support structural member had fatigued, to the Manchester B-737 fuselage and wings.

Don Cooper, chief investigator, guided me through the hangar, stopping at each grouping of wreckage and pointing out the main factors and circumstances. Two wrecks were icing-caused, an F-227 and a Shorts Skyvan. When we were through, Don looked at me and said, "You know, Jack, every one of these accidents is one that 'couldn't have happened.'" Hindsight exposes the deficiencies of foresight. It should sharpen the intellect.

I began my professional years 36 years ago at National Advisory Committee for Aeronautics (NACA) Lewis Flight Propulsion Laboratory in Cleveland, Ohio, just as their extensive icing research program was winding down. This flight and ground facility research program provided basic understanding about the meteorology of icing, aerodynamics of ice formation and shapes, aerodynamic penalties with the then in-use airfoils, ice accretion processes and de-icing techniques. Airline engineering departments, strong and highly skilled at that time, translated the information into operational and maintenance procedures designed to educate pilots and ground crew and to minimize hazards. Manufacturers also used the information in ice protection designs.

The advent of the jet transport in the late 1950s brought a wide expectation that icing problems were over. The powerful jet engine, less susceptible to icing than piston engines, provided rapid climb through icing layers and comfortable cruising above weather. The excess power of the jet engine allowed pilots to sometimes "get away with" a meager amount of surface roughening on the wings on takeoff, masking the subtle aerodynamic lift and drag penalties. In time, the hazards of icing receded from many pilots' and ground engineers' consciousness. Icing research in the laboratories was terminated, only to be revived somewhat later as helicopter development pressed it towards bad weather operation.

Occasional icing accidents continued to occur. Most were due to failure to prepare the aircraft for flight in icing conditions. As air traffic continued to expand, the jets began to spend more time at icing levels in the terminal area, and about 12 years ago, the National Aeronautics and Space Administration (NASA) undertook a revival of the icing program in cooperation with the U.S. Federal Aviation Administration (FAA) to re-examine data from the earlier program for application to today's situation. They wanted to evaluate, with better sensors, measurement techniques and analysis methods, the nature of ice formation and its effects. New de-icing methods were explored. Last year I had the pleasure of addressing a 10th anniversary workshop at NASA Lewis, commemorating the first international workshop convened there in 1977 that restarted the program. Many new approaches to de- and anti-icing had been discovered and tested. Promising new on-board systems, such as the electro-impulsive technique, for one, may ultimately reduce the present dependency on chemical fluids and provide a less-expensive constraint protection for the aircraft of the future. Research is continuing in the field.

But for now, we must work with what we have. I am disappointed that it has taken so long for the North American side of the Atlantic to show serious interest in the potential benefits of Type II de-icing fluids and their derivatives. Its potential and acceptance within the European community were well demonstrated at the Helsinki Workshop, and one U.S. airline representative who attended, immediately made plans for exploratory use of it in the U.S. Again—we need to communicate to educate.

"Airline engineering staffs are smaller these days, with precious little additional time to help communicate engineering and performance information within the organization. That notwithstanding, we still need to communicate and to educate."

The Flight Safety Foundation has regularly communicated icing hazard information to both mechanics and pilots. Our publications go to nearly 480 member organizations in 64 countries. Yet, in-company distribution of this information varies from a few airlines that flood their flight and maintenance crews with reprints to many others, where the bulletins end up, never read, neatly-filed in FSF binders on someone's bookshelf. We have many requests from member company personnel trying to obtain a bulletin that may reside in such a bookshelf only a few office doors from them!

The Office of Technology Assessment's recent report, "Safer Skies for Tomorrow," echoes the FSF's long-time concerns in identifying the need for greater government and industry effort to educate air and ground crews about icing. Sharpened economics in a deregulated environment make this a more difficult task, as newer, less-experienced flight and maintenance crews enter the workforce. Airline engineering staffs are smaller these days, with precious little additional time to help communicate engineering and performance information within the organization. That notwithstanding, we still need to communicate and to educate.

I visited an airline two years ago where my host, the assistant director for flight operations, had prepared the usual visit schedule for me. It was a comprehensive tour of flight training, dispatch, crew emergency training and cabin safety facilities. I asked if it would also be possible to visit their maintenance and engineering facility and see their engine overhaul shops and their quality control laboratory. My host looked at me, surprised for a minute, and readily agreed, remarking that he didn't know that I would be interested. I pointed out that safety begins with preparation of the airplane. He laughed and asked if he could accompany me on the visit. I of course agreed, and we had an interesting and thorough 2-hour tour and briefing of the airline's excellent facility. The spirit and attitude of the staff showed a professional dedication to high-quality work. When we returned to flight operations, my host said that he was glad I had made my request, because he had not physically visited the maintenance facility in over two years! He was so impressed with his airline's technical department that he was going to schedule each of his flight crews to visit the facility over the next six months. When I saw him this summer, I asked if he had indeed done what he said. He replied that he had, and the effect was positive. Maintenance squawks had diminished and maintenance time on some squawks had been reduced because the crews now better understood the maintenance people's problems in assuring them of an airworthy airplane. This was one very graphic demonstration of the benefits of communication and education.

And after all, good communications and education are the only ways that a proper decision to fly can be made. The duty of care that each of us has in aviation extends to the business of communicating proper procedures, education about the best methods and techniques for de-icing aircraft, and seeing that the tasks are performed in a competent, thorough way so that the airplane is presented to the crew in condition that will make the decision to fly a safe one. △

Helicopter Operations: The Icing Factor

by Matt Davis, Cougar Helicopters, Halifax, N.S.

The Canadian atmospheric conditions could be considered some of the most challenging in the world to aviation. Cold, dry air masses in the north combine with east- and west-coast maritime moisture, as well as warm, southerly air masses from the U.S., which keep all those involved in aviation vigilant to forecasting and flight planning. Of all the weather experienced in Canada, the most hazardous to aviation safety is icing. Icing could be looked at as a hazard to aircraft in all phases of flight, with varied degrees of dangers and results. Most pilots in Canada have experienced at least one form of ice, be it frost on a sitting aircraft, or severe clear ice while in flight. The common factors with all forms of icing conditions are aircraft damage or loss if the conditions are not treated with the respect they demand.

Most IFR passenger-carrying aircraft in Canada are equipped to handle in-flight icing. Of all IFR aircraft, there are only five civil de-iced rotorcraft operating in the country: two Eurocopter AS332 Super Pumas—one operated by CHC Helicopters in Halifax, N.S., and the other by Cougar Helicopters in St. John's, N.L.—and three Sikorsky S92s, all operated by Cougar Helicopters. Eighty-five percent of all traffic at St. John's International Airport is conducted under IFR, with Cougar making up ten percent of those flights. Cougar has been operating as an offshore oil and gas service provider in St. John's since 1997, with multiple planned offshore departures to distances of 200 NM or more, to the Grand Banks. Operating challenges on the Grand Banks are numerous, the three main being high winds, dense fog, and ice. Both Gander International and St. John's International airports have the highest frequency of freezing precipitation in North America. In order to understand the scale amount of freezing precipitation these locations experience, all we have to do is take a quick look at the science. The total annual days of freezing precipitation for Gander is 39.07, for St. John's is 38.62, and for Halifax is 12.96. These numbers mean little until compared against the total Canadian average of 10.2 days. These icing rates reduce as you move west across the country.

Front left of Puma with ice accretion

In daily planning of offshore flights, all Cougar employees must be aware of certain practices and restrictions. Maintenance knows to open hangar doors, allowing the helicopter to cold soak prior to moving to the flight line. Dispatchers study forecasts for freezing precipitation, freezing levels, and winds to find the best routing, and plan for alternate aerodromes. Pilots must take full advantage of all information available: graphic area forecasts (GFA), aerodrome forecasts (TAF), aviation routine weather reports (METAR), significant meteorological information (SIGMET), and pilot weather reports (PIREP). They must also look at cloud types, being vigilant of cumulus clouds of vertical development and the location of troughs of warm air aloft (TROWAL) and warm fronts. When conducting a flight at the limits of your fuel range, you become acutely aware of fuel consumers. Things such as engine anti-ice and blade de-ice systems don't come without a cost to fuel consumption. Additional fuel burns can be from four to eight percent higher than normal with de-ice systems functioning.

Air intakes iced-up with clean blades

From the cockpit of an S92 or Super Puma, the effects of in-flight icing are more apparent than in most IFR aircraft. Visual cues, along with ice detector indications, inform you of icing conditions. Visible ice on exterior components, such as mirrors, wipers, and antennas, give clues as to what kind of ice is present and the rate of accumulation. At night, pilots have to be aware of other indications in addition to those obvious during the day, such as changes in airborne vibrations from blades shedding ice; reduced stability around the pitch and yaw axis; and torque increases to maintain airspeed. A quick check with a landing light will usually allow you to see where you sit in the cloud formation. With vertical-developed cumulus cloud present, the worst place to be is skimming the tops, where a greater amount of moisture is present, and very rapid rates of accumulation can occur. With all these factors in mind, pilots must be aware of overall degraded performance, especially single-engine or no engine. Autorotational capabilities are drastically affected by ice. Increased weight gives higher rates of decent and unstable rotor RPM. Single-engine performance can be affected by increased weight, and functioning de-ice systems affecting single-engine climb performance, in some cases from 700 ft/min climb down to 200 ft/min.

Ice build-up on the mirrors of Puma

In 1997–98 Cougar had seven consecutive days of no-flight conditions due to freezing precipitation. With these conditions present so often, annual ground training for surface contamination is a must. Yearly thorough ground training is conducted utilizing PowerPoint presentations, videos, manufacturer data, and exams to ensure all pilots are fully educated on the hazards of ice. Yearly simulator training will usually confirm the pilot's knowledge by an instructor introducing icing conditions to see that the pilot recognizes the signs of icing onset.

All the knowledge and training can only prepare a pilot for flight in icing conditions, and what decisions to make; it's up to the pilot to make them. All the best plans are those with contingencies in place. Where am I going if I encounter ice? What is the fastest route out? Can the aircraft systems handle the rate of accumulation? These are just some of the questions pilots should be asking themselves prior to, and during, a flight. The answers depend on where the flight is conducted, geographical limits, and performance. The overall best way to deal with in-flight icing is to avoid it all costs. △

Cougar Helicopters Inc. is among a small group of helicopter operators who fly regularly in IFR and icing conditions in one of our harshest climates—the Atlantic East Coast. I am very grateful for their contribution, and I invite other operators to write to me and share their expertise for the benefit of all. —Ed.

Airworthiness Notice—Safety Information Regarding Ground and Airborne Icing

Ref.: AN-D008, Edition 1, 14 November 2006

www.tc.gc.ca/civilaviation/maintenance/aarpc/ans/d008.htm

Purpose

The purpose of this Airworthiness Notice (AN) on ground and airborne icing is to highlight the fact that continued aircraft operations in icing conditions introduces additional risks.

An aircraft flight manual (AFM) may indicate that the aircraft is "approved for flight in icing conditions" or "approved for operations in atmospheric icing conditions." However, this does not automatically imply that the aircraft can safely dispatch, take off and operate in all foreseeable icing conditions.

Discussion

Flight in icing conditions is an inescapable fact of life for Canadian air operators conducting all-weather operations. As is discussed below, and in greater detail in Commercial and Business Aviation Advisory Circular (CBAAC) 130R, there are many factors involved in determining an aircraft's capability to operate safely in icing conditions, and not all aircraft are equal in this regard. Nevertheless, there is questionable benefit in continuing operations in icing conditions, regardless of the aircraft's de-/anti-icing capability. Pilot workload is increased, performance and controllability are degraded, and fuel consumption increases through operation of engine and aircraft anti-ice systems.

Ground and airborne icing are very complex issues. There are environmental aspects, aircraft design features, and flight phase factors that determine the type and severity of the ice accumulation.

For example, transport category aeroplanes in Canadian commercial air service certificated for flight into known icing conditions are certificated to the standard contained in Appendix C of U.S. *Federal Aviation Regulation* (FAR) 25. The Appendix C icing envelopes are the design standards for the ice protection equipment. However, potential icing conditions inside or outside of cloud, such as freezing rain/drizzle, exceed the Appendix C icing condition envelopes. Currently, the design and certification of aeroplanes, including the anti-icing and de-icing equipment, is conducted only with respect to the requirements of Appendix C.

The parameters that are used to define the Appendix C icing conditions do not relate directly to the more pilot-familiar meteorological terms for freezing precipitation, such as freezing rain (FZRA), and freezing drizzle (FZDZ). In practical terms, this means that the ice protection equipment on some aeroplanes certificated to Appendix C may not be adequate to cope with all icing conditions encountered.

Ground icing operations require the coordinated effort of numerous highly-specialized people so that the aircraft arrives at the take-off point in a "safe for flight" condition.

Recommendations

Transport Canada is reviewing the interpretation and application of current regulatory requirements related to takeoff and flight in icing conditions. In the interim, operators and flight crews are strongly encouraged to:

a. Ensure that the aircraft is certified for flight into known icing conditions (if necessary, contact the manufacturer for clarification);

b. Review the limitations section of the AFM to determine whether there are specific prohibitions with respect to flight into freezing drizzle, freezing rain or other atmospheric conditions, and comply with any such limitations;

c. Consider that the operation of certain aircraft types in icing conditions poses a greater risk (e.g. operation of reciprocating or turbo-propeller aeroplanes with pneumatic de-icing boots and unpowered controls pose a greater risk than larger turbojet aeroplanes with powered flight controls, leading edge high lift devices, and thermal anti-icing systems);

d. If possible, avoid dispatch or takeoff during freezing precipitation (freezing drizzle, freezing rain, etc.) conditions. This cautionary action is more applicable to those aircraft whose AFM recommends exiting those types of icing conditions as soon as possible after they are encountered, or for reciprocating/turbo-propeller aeroplanes with pneumatic de-icing boots and unpowered controls;

e. Further to d., consider the severity and horizontal/vertical extent of icing conditions and assess safe exit strategies (the best alternative may be to wait it out on the ground);

f. Ensure that the aircraft is properly de-/anti-iced prior to departure, and that the flight crew has determined immediately prior to takeoff, or in accordance with an approved ground-ice program, that contamination is not adhering to the critical surfaces;

g. Ensure that the ramps, taxiways and runways are suitable for use and, if appropriate information is available, adjust take-off performance for reduced runway friction;

h. Consider that *Holdover Time (HOT) Guidelines* have not been defined for certain weather conditions (e.g. moderate and heavy freezing rain) because the protection times are expected to be of such short duration that they are operationally unusable;

i. Consider the appropriate course of action relating to possible failure conditions, such as a critical engine failure during the take-off phase. △

2007–2008 Ground Icing Operations Update

In July 2007, the Winter 2007–2008 *Holdover Time (HOT) Guidelines* were published by Transport Canada. As per previous years, TP 14052, *Guidelines for Aircraft Ground Icing Operations*, should be used in conjunction with the *HOT Guidelines*. Both documents are available for download at the following Transport Canada Web site: www.tc.gc.ca/civilaviation/commerce/holdovertime/menu.htm. If you have any questions or comments regarding the above, please contact Doug Ingold at ingoldd@tc.gc.ca. △

BLACKFLY AIR

Instructor Corner

by Dan Cook, Flight Training and Safety Committee, Soaring Association of Canada (SAC). This article was originally prepared for the SAC's internal newsletter, Free Flight

Pssst! Let's talk. Recent gliding accidents have indicated that not all instructors are comfortable determining when they should take control from a student during flight instruction. Some instructors have argued that many instructors take control too soon and don't give the student enough latitude to practice. This problem may be true in some situations, but it has the potential to quickly lead to an unsafe situation. Worse still, some instructors never stop manipulating the controls while the student practices the air exercise. Usually there is a fear that the student will put the instructor in an unsafe situation. Unfortunately, the student never gets a true feel for the glider's response, and learning the necessary handling skills is very much slowed. To assist instructors in understanding how far is too far, we will examine a risk management model that describes comfort zones.

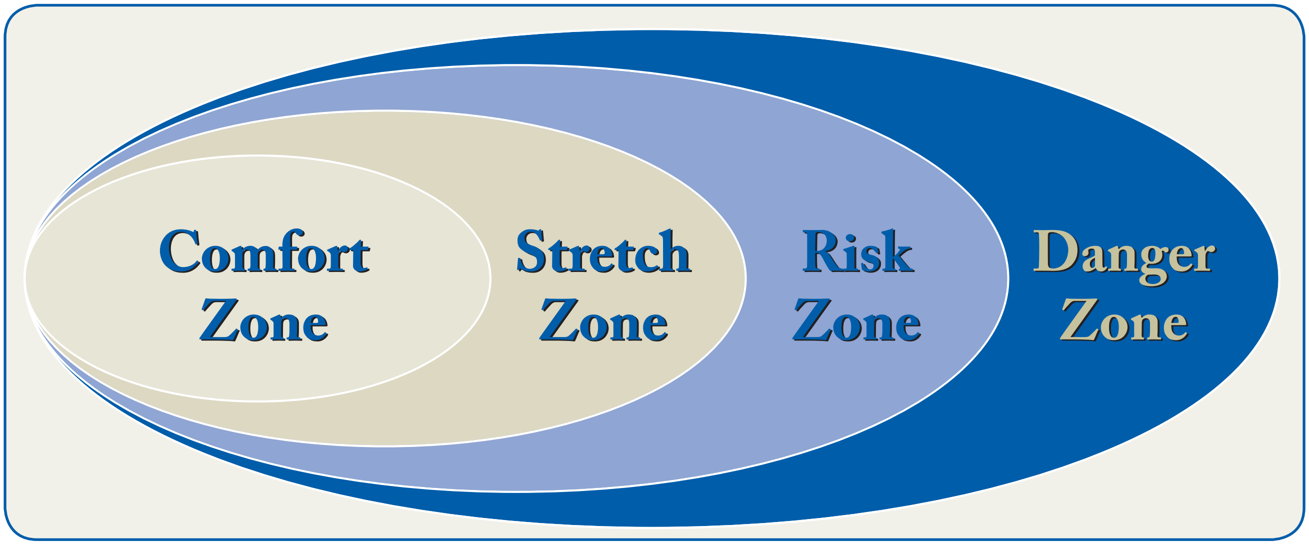


Figure 1: The comfort zone principle

The comfort zone model illustrates how challenging situations can have both positive (expanding) and negative (reducing) effects upon a participant's personal view of their own experience. The large goose egg represents a pilot's overall total knowledge, skill, and experience. The comfort zone represents one's personal level of satisfaction with the risks in flying. These are the elements of safety that protect us and make us feel comfortable. As long as pilots operate the glider within their personal comfort zones, they should be able to conduct the flight safely. The stretch zone represents flying activity that is beyond their normal experience and skill level, and therefore, outside their normal comfort area. Flying in this range under supervision can be safe. However, the new experience will develop a pilot's capabilities, introducing them to new experiences, skills, and knowledge. The risk and danger zones illustrated are beyond the pilot's normal range of capabilities; flight exercises attempted in these zones may not have suitably safe outcomes. Based on the law of primacy, if the instructor takes a student into the risk or danger zone, this could be a negative learning experience (example: stall/spin exercises too early will likely inhibit later training).

A good glider instructor will use the knowledge of their student's capabilities (zones) to allow the student to experience flight in their stretch zone, thus learning from new experiences. The instructor will take control from the student when the flight moves towards the limits of the student's capability to handle the exercise safely (risk zone). The instructor must never allow the flight to progress to the danger zone, where the student is not capable of maintaining the flight safely. Of course, the instructor has more experience, knowledge, and skill than the student does. The instructor's comfort zone should easily encompass the student's stretch zone. If the instructor allows the student to go into the instructor's risk zone, the flight is not being conducted safely.

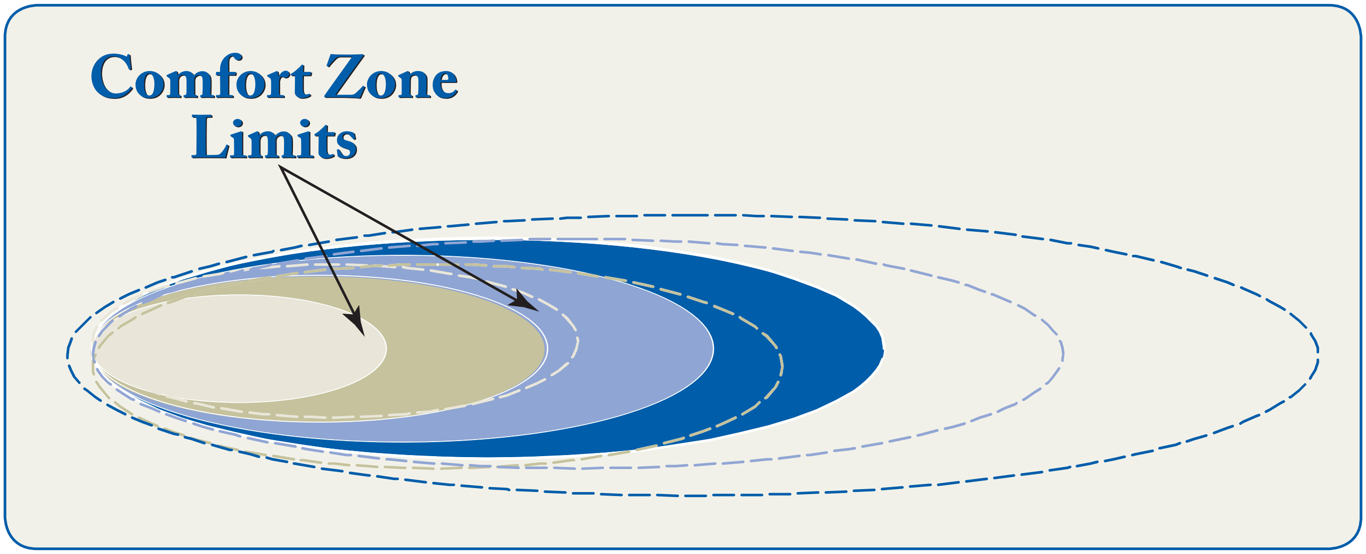


Figure 2: Possible relative size of a student's zones (solid colours) vs. relative size of an instructor's zones (dashed lines)

This model is only good if instructors can identify these zones in themselves and in their students. How do you tell the limit of your perceived risk zone, let alone your student's?

When you are in your comfort zone, you might experience personal symptoms similar to those described in Table 1. This table is based on observations made by instructors. These symptoms may or may not be evident in an instructional flight, nor are they limited to those expressed. Everyone is different, and all instructors need to learn about their own symptoms, as well as those of their students, to develop their own criteria. The table will give you references to help you start measuring the transition between comfort and stretch zones. Body language, physiological responses, speech patterns and tone, and the ability to communicate are indications that a person may be transitioning from one zone to another.

When nearing critical times in a flight lesson (e.g. the landing phase), the instructor may ask questions about the flight to find out indirectly what zone the student may be in. If the instructor listens to what is said, and notices how the student responds, more information becomes available. Lack of response is a bad sign, and taking control is recommended until you find out what the problem is. At a critical point in the flight, if a verbal prompt is made to the student and there is no immediate response, the instructor must take control.

An instructor will often look for head movement. Proper scan procedure is one of the first techniques to deteriorate near the end of a student's stretch zone. If possible, one can also look at the back of the ears or neck for colour of skin and signs of sweat.

As an instructor, any time a student takes you into your own stretch zone, you should take control and put the flight back into your comfort zone. Escalation of zones can also progress very quickly; for example, in spin recovery exercises, you may find yourself in your risk area quickly. Anticipation and prompt response are necessary. However, more often than not, it will be a student or another pilot who is performing well that will surprise you. Also, moving from the student's stretch zone to risk zone may be subtle. Don't let your guard down, stay alert, and keep looking for clues from your student.

Last, but not least, we need to mention the instructor/student syndrome described in the *Glider Instruction Manual*. Do not fall into the trap where the student realizes some aspect of the flight is not correct or ideal and continues in the expectation that the instructor will prompt a correction, and the instructor is waiting for the student to correct the problem and does not issue a prompt in time.

In summary, please remember that a serious accident with an instructor on board is never acceptable. We are in the aircraft to fly safely first, and to instruct second. Stay in your comfort zone if you are instructing, and keep your students out of their risk or danger zones!

Many thanks to Kevin Moloney, of the British Gliding Association (BGA) Safety Committee, who presented this model at the International Scientific and Technical Soaring Organisation (OSTIV) Training Safety Panel in 2005.

Comfort (minimal learning)	Stretch (good learning)	Risk (marginal learning)	Danger (no learning)
Personal Symptoms			
• Good feeling about flight • Alert but relaxed • Easily managing flight and manoeuvres • No stress symptoms	• Slight butterflies in pit of stomach • Heightened alertness • Start asking yourself questions or thinking about options and mentally providing answers to yourself • Some stress symptoms —hair standing on end, goose bumps	• Burning in pit of stomach or nausea • Easily distracted or may have difficulty focusing on problems • Asking yourself questions but no longer providing answers to yourself • Under stress, sweating, increased heart rate	• No feeling, numbness or extreme nausea • Tunnel vision starts to set in, you are only able to focus on one thing • Loss of situational awareness (airspeed, traffic, etc.) • High stress, rapid or irregular heartbeat
Instructor-Observed Student Symptoms			
• Student communicative • Student notices elements or situation of flight without prompting • Handles all tasks • Relaxed, noticeable head movement, looking around	• Less talkative or may ask more questions • May express lack of confidence or request assurance • Weaker scan technique • May have to focus on new task and need promoting to complete others • Becomes a bit restless or may mention feeling uncomfortable	• Stops asking questions or may seem distracted • Has difficulty answering questions or has a nervous voice pattern • May not respond quickly to verbal or physical control prompts • Head fairly still • Sweating visible, pale, clammy skin, colour behind ears or deliberate breathing	• Does not respond to questions • May stop flying and become passenger • No response to verbal or physical prompts on controls • No head movement • May freeze on controls • White skin tones or irregular breathing

Table 1: Safety zone symptoms

Flight Instructor Refresher Courses

by Jim Dow, Chief, Flight Training, General Aviation, Civil Aviation, Transport Canada

Flight instructor refresher courses have been part of the history of Canadian flight training since they were established by Order-in-Council in October 1951, in partnership with the Air Transport Association of Canada (ATAC) and the Royal Canadian Flying Clubs Association (now known as the Aero Club of Canada [ACC]). Canada was at war—the Korean War. There were fewer than 7 000 pilots in Canada, and aviation was growing. The federal government believed that investment in pilot training would be good for the country. Flight schools were given a grant of $100 for each individual granted a private pilot licence from their school. Each individual receiving a private pilot licence was also given a grant of $100. A further $100 was available for those who were subsequently accepted in the air component in any of the three military services (only available for male British subjects).

The flight instructor refresher courses were fully funded through a grant to industry. Instructors did not have to pay for the course, for their travel to and from the course, for their accommodation and meals, or for the flying that was part of the course. Upon completion of the course, their ratings were extended, rather than renewed, according to a complex formula that depended on when your rating was going to expire. Industry administered the courses and Transport Canada provided the instruction. It all worked, until 1992. That was the year the federal government announced in its economic statement that all grants and contributions would be phased out over a period of three years.

The refresher course funding in 1992–93 was $112,000. At that time, the courses were available to 120 aeroplane instructors and nine helicopter instructors. Two aeroplane instructor courses were held in western Canada and two in eastern Canada, while the helicopter course alternated each year between east and west. The loss of funding seemed like the end of the line for the courses. Without the grant, industry was no longer interested in being involved. The situation seemed impossible, but a decision was made to carry on with the courses in a different way. Transport Canada would take on the administration of the courses—they were already providing the instructional staff—reduce them from five to three days, eliminate the flying, and offer them in major centres, closer to where instructors lived and worked. Instructors would have to pay their own expenses, but there was no fee for the course itself. Many people wondered if anyone would show up!

Instructors *did* show up—in even greater numbers. Ironically, the loss of funding increased the participation. In the last year of the courses run by Transport Canada, 164 aeroplane instructors participated. Thirteen instructors attended the last helicopter course in 2005. But the model was not sustainable. It ran counter to our operating principles. The assumptions of the 1950s could no longer be used to support the delivery of training directly to industry on a continuing basis. We knew the courses were important. We knew that instructors thought they were valuable—they told us this, and many instructors participated even when they didn't need to renew their ratings.

On April 1, 2007, with the coming into effect of General Aviation Advisory Circular 421-001—*Flight Instructor Refresher Courses—Aeroplane and Helicopter*, procedures were set out for authorizing industry to conduct aeroplane or helicopter flight instructor refresher courses. The door is now open for industry to step in and take them into the future. There will be a period of transition as the procedures are refined and as industry gains confidence in the approach. In total, there are about 1 800 pilots with aeroplane flight instructor ratings and about 180 helicopter instructors. Many of these are not actively instructing. In a 12-month period, about 250 aeroplane instructor rating renewal flight tests are conducted and about 40 helicopter instructor rating flight tests are conducted. Add to this the renewals by refresher courses (about 160 per year) and the renewals by experience (about 30 per year), and good potential can be seen for continued interest in the courses, even allowing for the fact that a fee will be charged by the course providers.

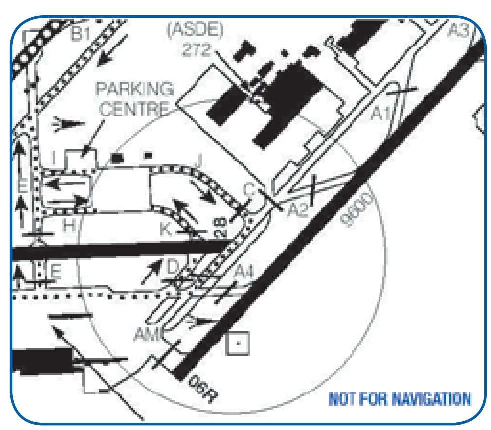
Transport Canada will still be involved in the refresher courses. Prospective course providers have to submit a training course outline for approval, and the initial courses will all be monitored. Up to four hours of each course can still be filled by Transport Canada presenters. There is room in the standards for a wide range of topics. For each topic, there must be learning objectives identified. There must be a quality system to control and continuously improve the course quality. We hope to see more courses in more places than Transport Canada was able to provide. We hope to see instructors embrace this new model and to continue to participate and to see the courses as important instruments for their professional development.

Note: Since this article was written, the first delegation to conduct a flight instructor refresher course was given to Seneca College of Applied Arts and Technology. △

Warning! Special Configuration at the Montréal/Pierre Elliott Trudeau International Airport (CYUL)

Taxiway Juliett is a curved taxiway that links the de-icing pad at CYUL to Taxiway Alpha. Because of the taxiway's special configuration and the need to meet the requirements of TP 312, *Aerodromes Standards and Recommended Practices*, the stop line for Runway 28 is located on Taxiway Juliett. Pilots therefore find themselves holding at an angle of 180˚ to the runway instead of the usual 90˚.

As for Taxiway Alpha, it is not completely perpendicular to the threshold of Runway 28. In addition, when approaching Runway 28 on Taxiway Alpha, the runway threshold is not visible because the taxiway does not cross the actual threshold, but is juxtaposed with the runway threshold. This closeness is the reason behind the stop lines on Alpha, which are required in order to protect arrivals and departures



Note the two stop lines on Alpha, immediately north and south of Runway 28. This sketch is taken from the Canada Air Pilot *(CAP 5)* Low Visibility Taxi Chart *for CYUL.*

These two special configurations are conducive to runway incursions. Following several runway incursions in 2001–2002, Transport Canada, Air Canada, the *Aéroports de Montréal* and NAV CANADA met in order to find solutions. Each stakeholder had implemented various mitigating action, which were published in an article in *Aviation Safety Letter* 4/2002. The situation had greatly improved. Unfortunately, the 2006–2007 season had its fair share of runway incursions.

Working together

The same stakeholders, along with representatives from other air carriers, met in the spring of 2007 to study the situation, and made a commitment to take the following action:

- Use phraseology that will draw attention to the special configuration of Taxiway Juliett.
- Offer the possibility of including a reminder on the automatic terminal information service (ATIS) about the position of the stop lines on Juliett when the de-icing pad is being used.
- Offer the possibility of adding indications on the ground to draw attention to the stop lines on Juliett.
- Publish hot spots on the aerodrome charts contained in the *Canada Air Pilot* (CAP), so that other aviation publication suppliers can also include them in publications used by air carriers.
- Publish articles in various aviation publications to raise awareness of the problem.

Safety is everyone's business. Be careful when approaching Runway 28; an incursion can happen in the blink of an eye… △

MAINTENANCE AND CERTIFICATION

The National Aircraft Certification Branch, Project Management Division

by J. David Turnbull, P.Eng., Chief, Project Management, National Aircraft Certification, Civil Aviation, Transport Canada

The Project Management Division is the primary point of contact within the National Aircraft Certification Branch for individuals or organizations seeking type certification for their aeronautical products in Canada. These products are designed by Canadian companies, as well as foreign companies seeking to sell their products to Canadian operators. As such, the Division is the voice of the Branch on both the domestic and international stage. With approximately 22 employees, consisting of engineers and technical support staff, the Division provides a project management function for all matters related to aeronautical product certification.

The Chief, Project Management oversees five project management teams and one additional team responsible for type certificates and project information systems. The five project management teams, each led by a senior project manager, are divided by aeronautical product type, that is, large transport fixed wing, executive/business, general aviation, rotorcraft, and engines/propellers/appliances/supplemental type certificates (STC). With dozens of certification projects running concurrently in each of the product types, each project management team will juggle several issues with many different clients on any given day.

The certification of aeronautical products is a process, and you could say that the Project Management Division is the owner of that process. Being the owner, the Division establishes, implements, manages and constantly develops the process elements and tools that are used in the complex activity known as aircraft certification. The process may start with a phone call from an operator or manufacturer, and culminate in the issuance of a type certificate for a new aircraft (the prerequisite for the aircraft to achieve its first certificate of airworthiness) several years later.

Project managers in the Division assemble and coordinate teams of technical specialists from the engineering, flight test and maintenance disciplines at Transport Canada. These specialists work with their counterparts in industry to ensure that new and modified aeronautical products comply with appropriate design standards and regulations, which is essentially what the type certificate represents. Project managers in the Division are themselves engineers with backgrounds in various disciplines, and all have experience in the design, maintenance or operation of aeronautical products. In fact, many have previously worked elsewhere in the National Aircraft Certification Branch as technical specialists themselves. This technical background is crucial for project managers, to allow them to effectively facilitate technical challenges, to formulate sensitive and effective correspondence on highly technical subjects, and to inherently understand the needs of the technical specialists within their teams.

The Project Management Division's clients consist of the general public, type certificate and STC applicants, airlines and operators, and other divisions within the National

Aircraft Certification Branch, most typically Engineering and Flight Test. As managers of the process in which these clients are key players, the effectiveness of the Division's project managers within any given certification project depends on an understanding of a set of expectations:

- Have and display detailed knowledge of process elements and tools;
- Be a guide to technical specialists on all matters related to the certification process and project information;
- Be facilitators, as required, in technical disputes amongst internal resources or with applicants;
- Apply appropriate filtering/buffering between technical resources and applicants/operators;
- Perform technical vetting of decisions prior to delivery to clients;
- Lead the project, yet at the same time serve the needs of technical specialists;
- Proactively pursue solutions to problems (systemic or project-specific) that impact progress.

The Type Certificates & Aeronautical Products Group is responsible for the preparation of all certificates issued from the National Aircraft Certification Branch, the accompanying type certificate data sheets that define the limitations, the accompanying approved documentation for any given certificated product, as well as managing the National Aeronautical Product Approval System (NAPA). This is a national database of project information and is in fact the system from which type certificates and STCs are issued. The Aircraft Certification Regional Offices use this system as the backbone of their project management activities.

In summary, the Project Management Division within the National Aircraft Certification Branch is responsible for all process and project management matters dealing with the certification of aeronautical products at Transport Canada Headquarters. The Division plays a key role in facilitating the issuance of approvals for all aeronautical products that operate in Canada, and for Canadian products operating in Canada and abroad. △

Why "Simple" NDT Is Not All That Simple!

by John Tasseron, Civil Aviation Safety Inspector, Standards, Civil Aviation, Transport Canada

Most aircraft maintenance engineers (AME) are somewhat familiar with the term "non-destructive testing" (NDT), and know that it encompasses the penetrant, magnetic particle, eddy-current, ultrasonic and radiographic inspection methods. In many cases, AMEs also have some specific knowledge of the penetrant and magnetic particle methods, which are frequently thought of as the "simple methods" of NDT. This has mainly come about as the result of economics; both of these methods have been in use for over fifty years, are relatively cheap to utilize, and are therefore cost-effective ways of adopting a higher level of inspection for surface defects. In the aerospace industry, penetrant inspection in particular has flourished, since it answers the need for finding surface flaws in non-ferrous material, and is "simple to use." This last statement deserves some analysis in order to place the use of the word "simple" in perspective, since there are misconceptions about what the word means, and how it affects the performance of this inspection method.

We've all seen the advertisements for penetrant products in the aircraft maintenance trade publications, and many of us know where to find these products in our shops or hangars—especially those of us who have just determined that there may be a defect in the surface of a part we've just inspected visually. When we locate the spray cans, a quick read of the product labels is all that is needed to refresh the memory and proceed with making a determination of acceptance or rejection of a suspect part. What could be more helpful than a quick spray of penetrant on the part surface, followed by a short wait to allow the dye to enter the suspect flaw, then a quick wipe to remove excess penetrant, and finally the application of the developer to see if a defect indication appears? True, this might be acceptable for doing a so-called "confirmation inspection" to settle doubts about evidence revealed during general visual or detailed (visual) inspections, but it certainly won't do for penetrant inspections called out on a work card or in the scheduled maintenance section of a maintenance manual! It's just not that simple.

Doing it, and doing it right

Way back in 1963, Carl E. Betz wrote in the preface to his book, *Principles of Penetrants*, about how the first fluorescent penetrant introduced by the Magnaflux Corporation in 1942, proved to be a simple solution to finding surface defects. The reason was that there was only one kind of penetrant! Mr. Betz then went on to describe (in over 450 pages of text) how complexity was subsequently designed into the process. Granted, the introduction of a large selection of different kinds of products contributed to this complexity, but there was also the small matter of recognizing how each of the various processing steps made it absolutely imperative to develop a disciplined approach during their application. This really became the hallmark of the penetrant method of inspection: the ability to stick to the precise requirements of each step of the process. Take the pre-cleaning of parts that are about to be inspected, for instance. There are still arguments about how best to achieve this! The objective is to ensure that whatever cleaning approach is used, it should not introduce factors that would prevent the penetrant from entering the surface defects that must be found. Flaws open to the surface can easily be contaminated by foreign material introduced by cleaning! So we need to think carefully about the kinds of cleaning products we choose, and the means for applying the necessary actions to remove surface contaminants. More than one defect has been missed because the cleaning actions chosen were not the right ones, and succeeded in blocking the flaw opening. And what about the possibility of contaminating a part by using red colour-contrast dye penetrant instead of the fluorescent penetrant called for in the inspection task? For final aerospace inspection applications, only the fluorescent products should be used. The red dye products may not be sensitive enough to find small flaws, and once trapped inside of a potential defect, they can reduce or eliminate the ability to find that defect using fluorescent products.

The disciplined approach may be somewhat less subject to error when we talk about parts being inspected in quantity through the use of a penetrant production process. Here we have the benefits of more controls being put in place by whoever establishes the various parameters for the process. The theory is that all parts will receive the same treatment, with little chance of process variance. Sounds simple, until one looks at the large number of variables that can affect each step of the process. How well-trained are the operators? Do they understand and practice the discipline of following the process instructions? Are the work areas free from potential contaminants? Is the timing of each step carefully adhered to? Does the quality system governing the operation function well at all levels? It can happen that persons doing the work do not even know (or care) what types of penetrant products they are using, or that nobody in the shop has been made responsible for monitoring cleanliness (including taking out the garbage!). Or what about an operation where the quality control measures being practiced by the workers are of a different standard than those prescribed by the company quality system? Believe it or not, sometimes the workers apply a higher quality standard than that practiced by the managers!

Simple it isn't

It all starts with the regulations governing the application of NDT. They require that persons doing penetrant inspections must be trained and certified to rigid standards designed to instill a disciplined approach to doing the work. They also demand that inspection tasks must clearly state what is to be inspected and which procedures are to be followed. The work itself must be done under controlled environmental conditions to ensure that the parts and the penetrant materials are not contaminated. Finally, there must be accept/reject criteria for the parts being inspected to reduce the chances of rejecting parts unnecessarily and to ensure that parts being returned to service will not fail prior to being reinspected.

Certification of penetrant inspectors involves provision of a training program, including theoretical and practical training objectives. Candidates who successfully pass the necessary examinations, and obtain a minimum level of work experience, may be certified to specified levels of expertise. Additional training and work experience will permit certification to higher levels, eventually including the authorization to write the actual inspection procedures. The procedures for doing most penetrant inspections are already available in various recognized industry standards, but where the inspection method is being applied to portions of a large assembly, there must be well-defined steps stating the exact areas to be inspected. Simply calling up the inspection method in accordance with an industry standard will not do!

Most difficult, is the matter of controlling the environmental conditions under which inspections are done in situ. The AME will be challenged to meet the need for maintaining cleanliness and controlling the visible light levels to avoid detracting from the quality of the inspection process, especially when using fluorescent penetrants in areas not designed for doing these kinds of inspections. It usually means having to erect a temporary (visible) light-blocking enclosure, large enough to permit adequate shielding of the area and light adaptation by the operator. The tendency is often to convince oneself that the background lighting is not serious enough to detract significantly from doing the black light inspection! In one case, this problem actually arose on a penetrant production line. Radical upgrading of the entire penetrant process resulted in the introduction of computer terminals in the final inspection areas. It was discovered that the background lighting from the computer screens, coupled with the light colour of the computer monitor casings, introduced unacceptably high levels of visible light (rest assured, this is not why so many computers are now coloured black).

Flaws vs. defects—accept or reject?

You've just finished applying the developer to the part, and have waited the agonizingly-long time of 20 min, so now you're ready to commence the inspection with your trusty black light! Are you confident that the light is not producing too high a level of visible light? And is there the required intensity of black light? A quick perusal of the light intensity check records should dispel any doubts (of course the intensity checks were done!). A careful look at the part reveals a fluorescent indication, so now the fun begins. The aim is to confirm whether the indication can be interpreted to be a defect. Careful handling of the evidence will permit this determination to be made. It means having to use just the right amount of penetrant/developer removal skills, so that the surface is prepared to permit "redevelopment" of the indication. Too much removal, and the indication may be lost (thus making it necessary to effectively redo the entire inspection procedure). The idea is to be able to redevelop the indication by re-applying a light coating of developer and watching to see how quickly the indication reappears.

If it is hard to redevelop an indication, it could mean that the flaw is not a defect (i.e. does not warrant rejection of the part). Flaws frequently do not have sufficient depth to permit storage of enough penetrant. Only defects permit redevelopment of an indication, when stored penetrant repeatedly makes its way out of the defect to the surface. We're not only talking about cracks here, but other anomalies, such as corrosion pits or laps, as well. None of this is simple! Years ago, a jet trainer lost its horizontal stabilizer when a critical (aluminum) structural fitting failed in flight. Subsequent penetrant inspections of other aircraft in the fleet revealed at least one other defective fitting. During the analysis of this fitting, other inspectors working at a different location declared the part defect-free! Subsequently, much was learned about how difficult it can be to duplicate test results. It all had to do with discipline, patience and working with an open mind.

What ultimately makes things a lot easier is the availability of accept/reject criteria. For penetrant inspections, this usually means a statement, such as "no cracks allowed." Of course, if other anomalies exhibiting defect-like properties are found, they need to be addressed in some manner as well. This is usually achieved by documenting the findings using text and illustrations (the so-called inspection report), and passing this information on to a higher level. Frequently, reinspection by using penetrants, or by some other inspection method, will enable a final decision to be made.

Report the findings!

For most AMEs, "doing the paperwork" is often the hardest part of the job. NDT is no exception. We would all prefer to continue getting our hands dirty and leave the administrative duties to someone else. This attitude persists despite the knowledge that, without a record of the inspection results and the correct disposition of the defective parts, it is possible that such parts will find their way back into service. Fortunately for the NDT specialist, there is often a reporting form provided as part of the inspection procedure. This form should describe (with the aid of diagrams, if necessary) the nature of flaws or defects found. The customer certainly appreciates having a record of the work done! Reporting should follow established company procedures to ensure that the information provided is clear and accurate. A system that identifies who did the work, and gives a clear indication of acceptance or rejection of a part, are of paramount importance.

Use the method wisely

From the above, it is clear that the use of penetrants requires sound judgement. To do a confirmation inspection may be alright in many cases, but can cause problems if the area where red dye-penetrants are being applied is also being inspected by subsequent use of fluorescent penetrants. Red dye, as a potential contaminant, therefore, goes from being an asset to becoming a liability. More significantly, the temptation to push penetrant inspection to the limit as a "simple" inspection method, invites disaster. Allowing its use for final inspection on aerospace equipment, by AMEs who are not certified to the appropriate levels, or who are inadequately supervised during its application, likewise invites major trouble. If failure of a critical aircraft component occurs because of a "false call" following penetrant inspection, and it is determined that the inspection was carried out by unauthorized persons, regulatory investigation may be the outcome. The wise application of this inspection method will be ensured as long as it is given the same status as the other NDT methods, by those who call up its use, those who supervise its application, and those who do the work. △

Call for Nominations for the 2008 Transport Canada Aviation Safety Award

Do you know someone who deserves to be recognized? The Transport Canada Aviation Safety Award was established in 1988 to foster awareness of aviation safety in Canada, and to recognize individuals, groups, companies, organizations, agencies or departments that have contributed to this objective in an exceptional way.

You can obtain the *Aviation Safety Award Nomination Guide* (TP 8816) brochure explaining award details by calling 1-888-830-4911, or by visiting the following Web site: www.tc.gc.ca/CivilAviation/SystemSafety/brochures/tp8816/menu.htm. The closing date for nominations is December 31, 2007. The award will be presented during the 20th annual edition of the Canadian Aviation Safety Seminar (CASS 2008), which will be held April 28–29, 2008, at the Hyatt Regency hotel in Calgary, Alta.

The following summaries are extracted from Final Reports issued by the Transportation Safety Board of Canada (TSB). They have been de-identified and include the TSB's synopsis and selected findings. Some excerpts from the analysis section may be included, where needed, to better understand the findings. We encourage our readers to read the complete reports on the TSB Web site. For more information, contact the TSB or visit their Web site at www.tsb.gc.ca. *—Ed.*

TSB Final Report A04P0314—Collision with Water

On August 13, 2004, a Robinson R-22 Beta helicopter was on a short, daytime, VFR flight from Campbell River, B.C., to a private airstrip near McIvor Lake, B.C. As the helicopter approached McIvor Lake, the engine noise increased with increased engine rpm, and the helicopter pitched up, and then entered a steep descent. The helicopter remained both directionally and laterally stable as it descended toward the lake. There were some popping or banging noises heard during the descent. In the latter stages of the descent, the forward motion of the helicopter slowed, and the vertical descent rate increased. There was no apparent flare before water contact, and the helicopter struck the lake surface with high vertical velocity and low rotor rpm. The helicopter sank in about 30 ft of water. The pilot, who was the sole occupant of the helicopter, was fatally injured. The accident occurred at approximately 12:32 Pacific Daylight Time (PDT).

Findings as to causes and contributing factors

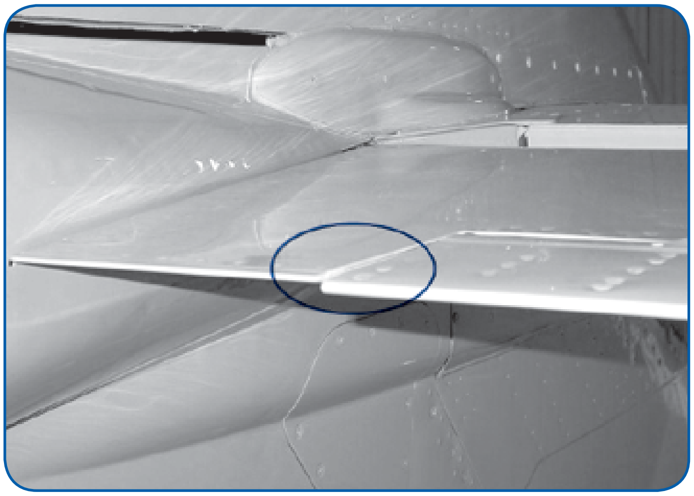
1. At some point after installation, both V-drive belts were subjected to changes in dimension, probably as a result of shrinkage due to excess heat. Any changes to belt length would increase the risk of the belts coming off the sheaves and disconnecting the engine from the rotor system.
2. Corrosion on an in-line fuse end, and improper connection of the fuse holder, raised the resistance in the electrical circuit to the belt-tensioner and slowed the operation of the belt-tension actuator motor. This slower operation would have caused an increase in tensioning time and in belt temperature during engagement/disengagement, which likely precipitated the belt shrinkage.
3. During the latter stages of the autorotation, the helicopter's main-rotor rpm was allowed to drop below safe limits, resulting in insufficient rotor energy to arrest the descent.

Findings as to risk

1. Use of a work-around procedure to engage the actuator motor (tapping the motor) increases the risk of component failure and, in this case, masked the actual cause of the engagement problem.
2. Use of a 10-amp fuse in place of the required 1.5-amp fuse in the electrical circuit to the belt-tension actuator motor eliminated the intended defence and, under certain circumstances, could have allowed the actuator to over-tension and damage the belts.

TSB Final Report A05O0112—Mis-Rigged Elevator Trim Tabs

On June 2, 2005, a Raytheon 800XP aircraft was on its first flight following painting and reassembly at an aircraft repair facility. The aircraft departed Peterborough, Ont., for Buffalo, N.Y. During the initial climb, as the aircraft speed neared 190 knots indicated airspeed (KIAS), the aircraft ran out of nose-down trim authority. The speed was kept below 190 KIAS, and the crew hand-flew, diverting to the Lester B. Pearson International Airport in Toronto, Ont., to inspect the aircraft. During the approach to Toronto, the rudder began to vibrate and seize, and the flight crew declared an emergency. The aircraft landed at approximately 13:48 Eastern Daylight Time (EDT) without further incident. An inspection revealed that the elevator trim controls were incorrectly rigged.



Circle shows the trim tab with the rigging pin in place. The trim tab should be flush with the elevator, not 1/4 in. down

Findings as to causes and contributing factors

1. The elevator trim tabs were not rigged in accordance with the aircraft maintenance manual, resulting in a mis-rigged condition and a lack of sufficient nose-down trim authority.

2. Maintenance was performed without adherence to the applicable standards of airworthiness, as required by section 571.02 of the *Canadian Aviation Regulations* (CARs).

3. The independent control inspection was not carried out in accordance with the standards described in the CARs or Airworthiness Notice (AN), resulting in the mis-rigged controls being undetected.

4. Incorrect maintenance release statements were entered in the aircraft documents.

Safety action taken

As a precautionary measure, Transport Canada issued a notice of suspension to the aircraft repair facility on June 10, 2005; conducted a special audit on June 14, 2005; and issued an amended suspension on June 21, 2005. On June 27, 2005, Transport Canada rescinded the notice of suspension, subsequent to immediate corrective actions being implemented.

On August 22, 2005, Transport Canada received a corrective action plan from the aircraft repair facility, which addressed long-term corrective actions.

Following the occurrence and subsequent audit by Transport Canada, the aircraft repair facility hired a director of quality assurance and designated this person as the person responsible for maintenance (PRM). The company then amended or implemented various processes involving aircraft maintenance, as follows:

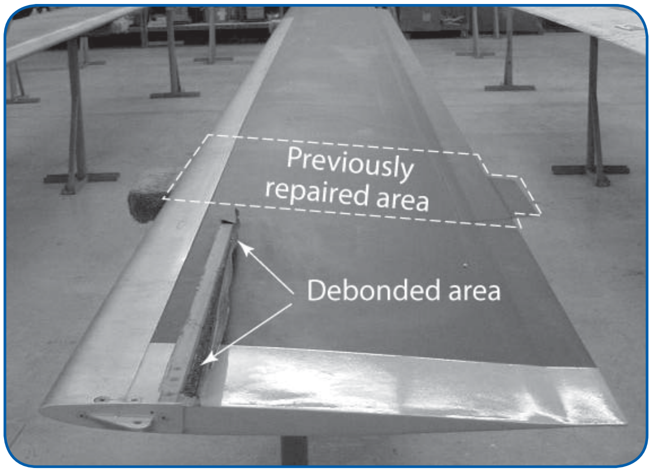
- amended its quality assurance program to ensure closer scrutiny in all aspects of maintenance than was previously possible;
- implemented a process for regular discussions on process control;
- implemented the process of a full control-travel check before disassembly; consequently, this process revealed that many aircraft that had been received to work on had controls that were not rigged within the specified limits;
- implemented additional training on human factors, improving the reporting of potential problems; and
- the company is in the process of implementing a safety management system (SMS).

TSB Final Report A05O0115—Main Rotor Blade Failure

On June 10, 2005, a Bell Textron 212 helicopter was being ferried from Bolton, Ont., to Richmond, B.C. The recently-purchased helicopter was being flown by the company's chief pilot with two passengers on board. At 12:20 Eastern Daylight Time (EDT), the helicopter was at an altitude of 1 500 ft above sea level (ASL) with an airspeed of 100 kt, when there was a series of loud bangs immediately followed by severe airframe vibrations. The pilot had difficulty controlling the helicopter for the next 10 to 15 seconds.

The pilot immediately lowered the collective, pulled back on the cyclic control, and brought the engine throttles to idle. He regained control of the helicopter, but the banging and vibrations continued. Every time one of the advancing main rotor blades came forward, it would climb off track abnormally. The vibrations and banging became more severe as the flight continued. The pilot proceeded toward a large ploughed field for an emergency landing. As the airspeed decreased, the helicopter became more controllable, and a successful landing was carried out. There were no injuries to the occupants. The helicopter was substantially damaged from the in-flight vibrations.

Post-flight inspection revealed that one of the main rotor blades had sustained damage. A small section of skin near the blade tip, aft of the spar doubler, on the lower surface of the rotor blade had debonded. The skin was raised and curled, but had not separated from the blade (see photo, next page). The debonded skin measured 25 in. by 2 in. between stations 263 and 288. In early 2005, the same blade had been damaged while the helicopter was parked in a hangar. The blade was then shipped to an authorized rotor blade repair shop. While paint was being stripped from the rotor blade in preparation for repair, deep corrosion pitting was discovered on the lower skin surface between stations 243 and 262, just inboard of where the debonding later occurred on the occurrence flight. Because the pitting pattern exceeded the allowable limits, the repair shop proposed a repair procedure to Bell Helicopter and received approval. The repair procedure included removing the damaged skin and replacing it with a bonded external doubler. The trailing edge trim tab was also replaced. The skin-to-inner core bonding procedure required using a bladder and heater blanket tool. This tool ensures proper curing of the adhesive by applying heat and pressure to the area being repaired. This type of repair is performed regularly to repair damaged rotor blades. The bladder and heater blanket tool that was used covered the rotor blade from its tip to a point inboard of the repair area, which included the area where the debonding took place on the June 10 flight. Following the repair using the bladder and heater blanket tool, the blade was in service for approximately four flight hours before the lower skin debonded on the occurrence flight at the spar doubler between stations 263 and 288.



Debonded lower surface of rotor blade and repair area (blade resting upside down)

Finding as to causes and contributing factors

1. A section of the main rotor lower blade skin detached during flight, causing the helicopter to develop severe vibrations, and resulting in an emergency landing.

Finding as to risk

1. The second area of blade damage likely occurred during the manufacturing process, but was not detected at that time. No information is available to assess how this type of damage affects blade integrity and the associated consequences during operations.

Other finding

1. Although the detachment took place within the area where the bladder and heater blanket was used, the investigation could not confirm whether the heat and pressure cycle had any adverse effect on the section of blade that delaminated.

TSB Final Report A05W0127—Incorrect Loading / Centre of Gravity (C of G)

On June 24, 2005, a de Havilland DHC-3T (Turbo) Otter water-taxied from the company dock at Yellowknife, N.W.T., for a charter flight to Blachford Lake, N.W.T. The aircraft was loaded with two crew members, seven passengers, and 840 lbs of cargo. Before the flight, the pilot conducted a pre-flight passenger briefing, which included information about the location of life preservers and emergency exits. During the take-off run, at about 19:12 Mountain Daylight Time (MDT), the aircraft performed normally. It became airborne at about 55 mph, which is lower than the normal take-off speed of 60 mph.

The pilot applied forward control column to counter the pitch-up tendency, but there was no response. He then trimmed the nose forward, but the aircraft continued to pitch up until it stalled at about 50 ft above the water, and the left wing dropped. The aircraft struck the water in the East Bay of Great Slave Lake in a nose-down, 45° left bank attitude. On impact, the left wing and left float detached from the aircraft, and the aircraft came to rest on its left side. The crew was able to evacuate the passengers before the aircraft submerged, and local boaters assisted in the rescue. There were no serious injuries to the crew or passengers. The aircraft suffered substantial damage.

Aircraft wreckage during recovery

Findings as to causes and contributing factors

1. The aircraft was loaded in such a manner that the C of G was beyond the rearward limit. This resulted in the aircraft's aerodynamic pitch control limitation being exceeded.
2. A weight and balance report was not completed by the pilot prior to departure; consequently, he was unaware of the severity of the aft C of G position.

Finding as to risk

1. The weight of the passengers was underestimated due to the use of standard weights. This increased the potential of inadvertently loading the aircraft in excess of its maximum certified take-off weight (MCTOW).

Safety action taken

The operator adopted the following action items and policy changes to address the issues identified in the course of the investigation:

- It will no longer use fuel as ballast to adjust the weight and balance of an aircraft when towing.
- It increased operational oversight and conducted pilot briefings to ensure weight and balance calculations are completed prior to departure.
- It adopted and implemented a new procedure for weight and balance calculation.
- It elected to adjust the Transport Canada standard weights. The standard passenger weights

will not be discounted for the lack of carry-on baggage. Adult male passengers will be assigned the standard weight of 200 lbs in the summer and 206 lbs in the winter. Adult female passengers will be assessed as 165 and 171 lbs, respectively, for summer and winter weights. The carry-on baggage that is not allowed within the passenger compartment will be weighed as part of the cargo and stowed in the cargo compartment.

TSB Final Report A05O0125—Power Loss and Collision with Terrain

On June 25, 2005, a Progressive Aerodyne, Inc. SeaRey amphibious aircraft (referred to here as SR 1) was taking part in the Canadian Aviation Expo at the Oshawa, Ont., airport. The flight was planned as part of a two-plane demonstration with another SeaRey aircraft (SR 2). The plan was to take off in formation, with the SR 1 leading, climb to 1 000 ft above ground level (AGL), turn left, and join a left downwind leg for Runway 30. When south of the airport, the aircraft were to split and perform a coordinated series of non-aerobatic manoeuvres that had been briefed and practised. Before takeoff, SR 1 had radio problems, so SR 2 led the takeoff, and SR 1 was in a right-echelon wingman position. The aircraft were cleared to take off in formation on Runway 30 from the intersection of Runway 04/22. After takeoff, the lead aircraft climbed out the extended centreline of the runway. SR 1 made a left turn as if leaving the formation toward the southwest, then turned to the right to again follow the lead aircraft. SR 1 then pitched nose up, and appeared to stall and spin to the left. The propeller was turning as the aircraft descended. The aircraft continued in a descending turn to the left until it struck the ground in a residential construction area. The aircraft was destroyed, and the pilot was fatally injured. There was no post-impact fire.

Ground and flight path of occurrence aircraft, as illustrated in the TSB Final Report

Findings as to causes and contributing factors

1. Discrepancies in the fuel system most likely allowed air into the fuel line, causing a partial loss of engine power.
2. While the pilot was turning back toward the airport, the flaps were raised, probably inadvertently, causing an increased rate of descent so that the pilot had insufficient altitude to manoeuvre to an open area for landing.
3. The aircraft struck a concrete sewer casement, causing high deceleration and overloading the common attachment point of the seat and shoulder belts. As a result, the pilot struck the instrument panel and received fatal injuries.

Safety action taken

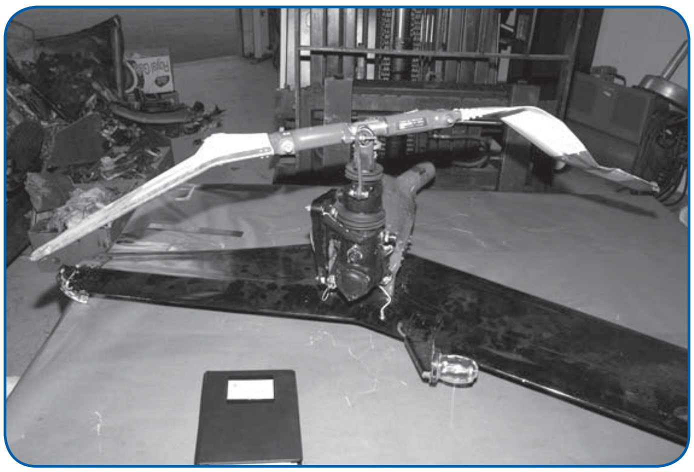
The Canadian distributor of SeaRey aircraft has taken the following safety actions:

- Information describing the dangers of using the Ray Allen Company G205 stick grip to actuate trim and flaps has been posted on the SeaRey technical Web site (a private Web site from which SeaRey owners and operators in North America, Europe, and Australia have access to technical assistance in building, operating, and maintaining their aircraft).
- The Recreational Aircraft Association has been asked to warn its members about the use of Ray Allen Company stick grips, and to contact the Ray Allen Company for a solution to the problem of inadvertent activation by incorporating switch guards on stick grips.
- A recommendation has been posted on the SeaRey technical Web site that fuel manifolds with return-to-tank fuel lines be incorporated into all Rotax installations.
- The Canadian distributor for Rotax engines has been asked to request Bombardier-Rotax GmbH to configure new engines with a fuel manifold with return-to-tank fuel lines.
- A recommendation has been posted on the SeaRey technical Web site that auxiliary fuel pumps be incorporated in all high-engine/low-tank Rotax 912 installations for the following reasons:
  - They provide a backup pump to supply the carburettor float bowls if the engine-driven pump should fail.
  - They prevent low pressure (suction) upstream from the engine-driven pump, perhaps helping to prevent air from entering the fuel line at a loose fitting, and possibly preventing the formation of a vapour lock.
  - They provide a way to pressurize the fuel lines during pre-flight to check for fuel leaks.

TSB Final Report A05P0184—Loss of Control

On August 2, 2005, an MD500D helicopter departed the Terrace Airport, B.C., at 15:59 Pacific Daylight Time (PDT), to retrieve a geological survey crew from a mountain 35 NM northwest of the Terrace Airport. The pick-up point was on a 25° slope within a bowl-like feature, commonly referred to as a cirque. The steepness of the slope required the pilot of the skid-equipped helicopter to conduct a toe-in procedure at the pick-up site. During the attempt, there was a loud bang, and the helicopter dropped tail-low. The helicopter subsequently began an uncontrolled right turn and struck the terrain 30 yd. downhill from the pick-up point.

The fuel cell compartments ruptured from impact forces, and a fire ensued. The geological survey crew assisted the pilot from the burning helicopter and performed emergency first aid until the air ambulance arrived at 18:40. The pilot, the sole occupant on board the helicopter, was seriously injured. There were no injuries to persons on the ground. The helicopter was destroyed by impact forces and the intense post-crash fire.



Tail rotor during post-accident examination

Findings as to causes and contributing factors

1. The reason for the tail drop and corresponding tail rotor strike could not be determined.
2. Once the tail rotor contacted the ground, the tail rotor drive shaft sheared and the helicopter began to yaw rapidly clockwise. Control of the helicopter was lost, and given the terrain, a successful emergency landing was not possible.
3. The fuel tank ruptured during the crash sequence, spraying the cockpit area with fuel. This resulted in an intense post-crash fire, which severely injured the pilot and destroyed physical evidence.

TSB Final Report A05Q0208—Tree Impact Without Loss of Control

On November 5, 2005, a Cessna 172M was chartered by the Quebec *ministère des Ressources naturelles et de la Faune* (Department of Natural Resources and Wildlife) for night aerial surveillance of poaching activities. The pilot and two wildlife protection officers were on board. At about 21:45 Eastern Standard Time (EST), the aircraft took off from the Saint-Frédéric, Que., aerodrome for a VFR flight. Shortly after takeoff, due to foggy conditions, the chief of operations on board the aircraft redeployed the ground teams to an area more to the south of the surveillance area that was originally planned. The aircraft was reported missing at about 23:00 EST. It was found three days later in a wooded area 7 NM southwest of the Saint-Georges, Que., aerodrome. After striking the treetops, the aircraft crashed in an inverted position and caught fire. The three occupants sustained fatal injuries.

Finding as to causes and contributing factors

1. The VFR night flight was conducted in marginal VFR conditions, at an altitude below the minimum obstacle clearance altitude (MOCA) prescribed by the *Canadian Aviation Regulations* (CARs) for night flight; the aircraft struck trees with no loss of control.

Findings as to risk

1. The aircraft was not equipped with instruments that could have alerted the pilot before impact that the Cessna was close to the ground, nor are such on-board instruments required by the existing regulations.
2. Although the regulatory requirements for flight following were complied with, the company was not aware of the aircraft's take-off time, its flight itinerary, or its diversion to Saint-Georges.
3. The aircraft proceeded towards Saint-Georges without the knowledge of the operator or the wildlife protection officers on the ground; as a result, the search took longer because the aircraft crashed outside the agreed surveillance area.

4. The CARs do not require that a pilot's work time as an instructor be recorded in a log. Consequently, although the pilot mentioned that he was tired before the flight, his level of fatigue could not be assessed due to a lack of information.

Other findings

1. No emergency locator transmitter (ELT) signals were received because the ELT was destroyed after impact. If the aircraft had been equipped with an ELT model that transmits on the frequency 406 MHz, the emergency signal would have been picked up and instantly relayed to a ground station.

2. The Quebec *ministère des Ressources naturelles et de la Faune* had not specified any meteorological or operational criteria for night aerial surveillance of poaching activities; consequently, the wildlife protection officers had no meteorological references to aid them in deciding whether the mission was feasible.

Safety action taken

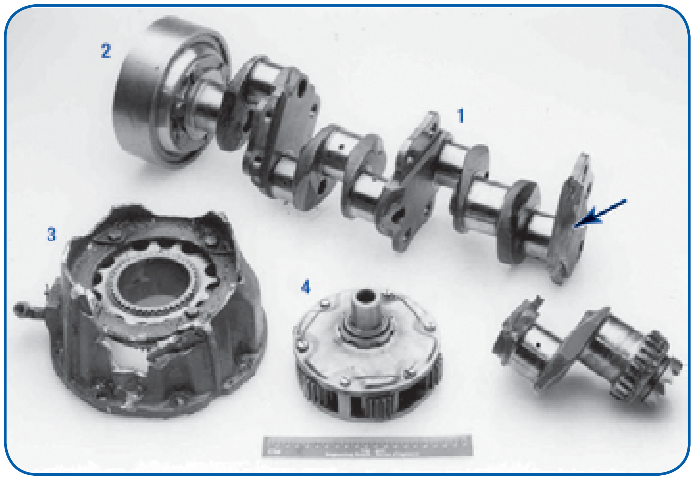
As a result of the accident, the operator amended its company operations manual. The minimum altitude for anti-poaching surveillance flights is 1 000 ft above the maximum elevation figure (MEF).

As a result of the accident, the Quebec *ministère des Ressources naturelles et de la Faune* initiated an administrative investigation. An action plan was submitted, to include the following:

- A safe work procedure was proposed to provide a better system for aerial surveillance operations. The procedure identifies the associated risks and the safety precautions to be considered for this type of operation. It also describes the training required for employees, and the equipment and work methods to ensure employee safety.
- The guide concerning the use of aircraft at the *Société de la faune et des parcs du Québec* is being revised to include a section specifically for aerial surveillance operations by wildlife protection officers.
- Communication systems for rapidly locating an employee in distress are under review.
- A provincial operating procedure designed to improve monitoring of employee travel during work activities has been prepared.
- Future operation plans for aerial anti-poaching activities will be governed by a new provincial operating procedure.
- The Quebec *ministère des Ressources naturelles et de la Faune* has updated its safety guide for employees working at remote locations, which includes an emergency plan for employees in distress.

TSB Final Report A05O0258—Loss of Control—Collision with Terrain

On November 20, 2005, the pilot of a privately-owned Ryan Aeronautical Navion B aircraft departed Burlington, Ont., under visual meteorological conditions (VMC), for a breakfast fly-in at Brantford, Ont. An en-route stop was made in Guelph, Ont., to pick up a passenger. At approximately 12:30 Eastern Standard Time (EST), the pilot and passenger boarded the aircraft and taxied for a departure from Brantford. The aircraft departed Runway 23 at the intersection of Taxiway Bravo, and climbed on the runway heading. During the climb, the engine failed, and the aircraft stalled and entered a spin. A single mayday call was heard on the Brantford UNICOM frequency. The aircraft struck the ground in a nose-down attitude, with the right wing striking first. The aircraft cart-wheeled and came to rest 94 ft from the initial impact point. The occupants were fatally injured. There was no post-impact fire.



Shown here are parts comprising the crankshaft (item 1) and parts of the engine to propeller reduction gearbox (items 2, 3, and 4). The failure location at the forward fillet radius to the number six connecting rod journal bearing is shown by the small arrow.

Findings as to causes and contributing factors

1. A fatigue crack developed in the engine crankshaft as a result of corrosion pitting and the absence of a case-hardened layer on the fillet radius of the number six connecting rod journal. The fatigue failure of this section of the engine crankshaft resulted in a complete loss of power.

2. Control of the aircraft was not maintained during the power loss event, and consequently the airspeed decreased below a safe flying speed. The aircraft stalled and entered a spin from which there was insufficient altitude to recover.

Findings as to risk

1. A previous propeller ground strike incident was not recorded in either the aircraft journey log or the technical logs, and there is no indication that the

aircraft was inspected afterwards to determine its airworthiness.

2. After the overhauled propeller was installed, the aircraft was flown five times before receiving a certified maintenance release. Until such a release is obtained, there is an increased risk that the aircraft may not be airworthy.
3. Transport Canada recency requirements allow pilots to fly for extended periods of time without retraining in critical flight skills. The gradual erosion of these skills reduces a pilot's preparedness to react appropriately during emergency situations.
4. The fuel selector valve revealed internal leakage during testing. Although not a factor in this occurrence, continued use of a component for which the manufacturer has recommended replacement poses a risk to the safe operation of the aircraft.

Safety concern

Currently, the recency requirements in Canada allow pilots engaged in recreational flying to continue to exercise the privileges of a licence without having to regularly demonstrate proficiency to another qualified person. Therefore, a pilot may continue flying for years without reinforcing, through practice, those skills considered essential for the initial issuance of a licence (for example, dealing with an engine failure or landing in a crosswind).

In this occurrence, the pilot's flying activity and attendance at the Transport Canada safety seminars exceeded the minimum requirements of sections 401.05 and 421.05 of the *Canadian Aviation Regulation* (CARs). However, it is unlikely that critical flight skills and emergency procedures were practised since his initial licensing in 1974. The absence of pilot recency is also listed as a finding in TSB report A05O0147.

The TSB is concerned that there is no requirement for a private pilot to participate in periodic recurrent flight training, such as a biennial flight review. This presents the risk that pilots will not be prepared to deal with unusual or critical flight situations when they arise. △

Accident Synopses

Note: All aviation accidents are investigated by the Transportation Safety Board of Canada (TSB). Each occurrence is assigned a level, from 1 to 5, which indicates the depth of investigation. Class 5 investigations consist of data collection pertaining to occurrences that do not meet the criteria of classes 1 through 4, and will be recorded for possible safety analysis, statistical reporting, or archival purposes. The narratives below, which occurred occurred between February 1, 2007, and April 30, 2007, are all "Class 5," and are unlikely to be followed by a TSB Final Report.

— On February 1, 2007, a **Boeing 737-700** aircraft had just completed the pushback from Gate 5 at Kelowna, B.C., for a flight to Victoria, B.C. During the turn out of the gate area, the crew felt a small shimmy. While taxiing to Runway 16, the crew was informed by the lead flight attendant that a passenger reported that the wingtip of the aircraft had contacted the tail of a Regional Jet (RJ) parked at the adjacent gate. The tower confirmed the wing tip contact and the aircraft returned to the gate. The RJ had arrived from Edmonton, Alta., and was about to disembark passengers. The 737 sustained a scratch to a winglet. The horizontal tail of the RJ was substantially damaged. *TSB File A07P0038.*

— On February 10, 2007, a student pilot had returned in a **Diamond DA 20-C1** from a VFR cross-country night flight, landing on Runway 29 at Moncton, N.B. The aircraft was instructed to exit the runway at Taxiway Bravo with no delay, due to a CRJ on a three-mile final. The aircraft subsequently exited the taxiway and collided with a snowbank west of Taxiway Bravo, south of Runway 29. The CRJ was instructed to go around for landing on Runway 24. There was substantial damage to the nose wheel and right gear assemblies. *TSB File A07A0020.*

— On February 10, 2007, the pilot of a privately-operated **MD600N helicopter** was approaching the landing pad in front of a hangar after a local flight inspecting construction projects. At about 150 ft above ground level (AGL), and slowing through about 40 kt as the pilot started to arrest his descent, the helicopter suddenly started to rotate to the right and the cyclic began to move to the left. Control was not regained before the main rotor blades and the nose of the helicopter contacted a steel post that supported the windsock. The pilot, the sole person on board, received minor injuries, and the helicopter was substantially damaged. Two ground witnesses confirmed that the helicopter appeared to be on a normal approach until it suddenly began spinning to the right and continued spinning until it descended out of sight below trees. *TSB File A07W0032.*

— On February 11, 2007, a privately-operated **Robinson R44 II helicopter** was conducting a recreational flight approximately 12 NM north of Vegreville, Alta.

The pilot entered a hover into wind at approximately 100 ft above ground level (AGL). The pilot then turned to the right and experienced a rotation to the right. When application of full left pedal did not stop the rotation, the pilot commenced an autorotation. The helicopter landed hard, resulting in substantial damage. The pilot and two passengers were able to egress on their own with minor injuries. Two TSB investigators attended the accident site and did not observe any issues with the powerplant or dynamic system that would have contributed to the uncontrolled rotation. The weather at the time of the occurrence was described as clear, winds out of the northeast at approximately 12–15 kt and temperature -18°C. *TSB File A07W0034*.

— On February 17, 2007, a **Quad City Challenger II advanced ultralight** departed Corman Air Park near Saskatoon, Sask., on a local recreational flight with a pilot and passenger on board. On return to the airport, the pilot was unable to move the throttle cable and could not reduce engine power from the cruise power setting. On short final to Runway 27, the pilot shut the engine down and the ultralight touched down about 10 ft short of the runway. The left main landing gear and nose gear collapsed and the aircraft slid to a stop on its belly. *TSB File A07C0033*.

— On February 25, 2007, a **Piper Aztec PA23-250** was conducting a recreational flight with the pilot and three passengers on board. The aircraft was about to land at a fly-in at Lac William, Que., when, during the flare, the nose wheel struck the snowbank before the runway, and collapsed. The aircraft continued the run on its nose, and came to a stop at the end of the runway. The pilot and passengers were not injured. The two propellers and the landing gear were damaged. *TSB File A07Q0045*.

— On March 5, 2007, a **Robinson R22 helicopter**, with an instructor and a student-pilot on board, was hover taxiing over a snow-covered field north of Mascouche, Que., when one of the skids touched the ground, followed by a dynamic roll-over. Neither of the two occupants was injured. The aircraft sustained major damage. *TSB File A07Q0050*.

— On March 7, 2007, a **DHC-3 float-equipped Otter** aircraft landed on the water at Masset, B.C., after a flight from Eden Lake, B.C. The pilot turned into the channel to taxi to the seaplane base. The wind was from the south-southeast at 30 kt and gusty. When partially turned crosswind, using power, the tail suddenly lifted and the left wing and propeller struck the water. The aircraft righted itself and the engine remained running. The aircraft was towed to the seaplane dock by a fishing vessel. The pilot, the sole occupant was not injured. The aircraft sustained substantial engine damage. *TSB File A07P0064*.

— On March 12, 2007, a **ski- and wheel-equipped Sky Raider advanced ultralight** took off from Qualicum Beach, B.C., for Beadnell Lake, B.C., where the pilot intended to land on the snow-covered, frozen lake surface. On arrival at destination, the pilot made several circuits, inspecting the lake surface and evaluating the local conditions. The lake is surrounded on three sides by mountain peaks, oriented north/south with a length of about 4 500 ft. Although the wind was very light from the south, the pilot decided to land to the north. As the pilot turned from base to final, in close proximity to a mountain peak, he encountered a strong downdraft. He was unable to arrest the ultralight's descent, and made a hard landing on the lake surface, causing substantial damage. The pilot was not injured. *TSB File A07P0070*.

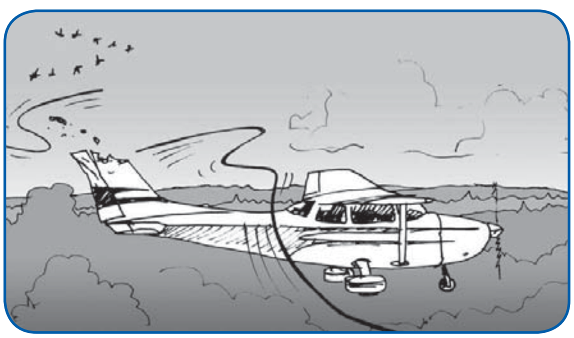
— On March 13, 2007, a **Cessna U206E** commenced a takeoff on Runway 02 at Matheson Island, Man., with the pilot and one passenger on board. During the take-off roll, the pilot's seat slid back and the pilot lost directional control of the aircraft. The aircraft veered off the left side of the runway and collided with a snowbank. Both occupants evacuated the aircraft without injury. The aircraft was substantially damaged. An inspection of the pilot's seat following the occurrence, revealed that the seat stop was located at the aft most position on the rail and that the seat had not slid off the seat rails. It was later learned that the seat was not properly engaged on takeoff and the seat slid back two settings. The seat locking pins engaged further down the seat rail, preventing the seat from sliding completely back. The seat rails were new and the seat locking pins were serviceable. *TSB File A07C0048*.

— On March 25, 2007, during takeoff from Runway 32 at Gods Lake Narrows, Man., the crew of a **Swearingen SA226-TC Metro II** aircraft had difficulty raising the nose of the aircraft. The aircraft overran the runway and struck a snowbank with the right main landing gear as the aircraft was becoming airborne. The drag braces on the right main landing gear were broken and hydraulic lines were ruptured, causing a complete loss of hydraulic pressure. The aircraft diverted to Thompson, Man., where the crew conducted a flapless landing with the left main gear and nose gear in the down and locked position. The right main gear collapsed as the weight came on it, and the aircraft slid to a stop off the right side, close to the end of Runway 23. Emergency response vehicles attended the scene and the passengers were deplaned through the left overwing emergency exit. *TSB File A07C0055*.

— On March 28, 2007, a **Pilatus PC12** was en route from Thompson, Man., to Tadoule Lake, Man. Local weather was reported as wind 160° at 11 kt with a 1 200-ft ceiling and reduced visibility in snow showers. The runway conditions were reported as 90 percent snow-covered, with recent wet snow and rain. The temperature had dropped before and after the occurrence. After visually acquiring the airport, the crew conducted a circling approach to Runway 07 and touched down approximately one-third to halfway down the 3 200-ft runway. Upon touchdown, the crew encountered poor braking conditions and used full brake and reverse thrust. The aircraft began to fishtail and the crew could not stop the aircraft. The aircraft eventually overran the end of the runway, damaging the propeller and breaking off the nose landing gear fork. The crew and seven passengers exited the aircraft uninjured. *TSB File A07C0058*.

— On March 28, 2007, the pilot of a **Cessna 177RG** was on a local flight from the Abbotsford, B.C., airport when he noted a sudden decrease in airspeed and increase in ambient noise. He checked an outside mirror and noted that the main landing gear was partially deployed and hanging at an approximate 45° angle. He attempted to deploy the gear fully, using the alternate system. This attempt was unsuccessful. The pilot then returned to Abbotsford, requested emergency response services (ERS) presence, completed a fly-by, and then landed gear-up on Runway 19. There were no injuries. *TSB File A07P0086*.

— On March 30, 2007, a **Cessna 172N** was on the final leg of a student solo cross-country training flight. While en route, at about 1 000 ft above ground level (AGL), the student-pilot observed birds at a lower altitude. The student descended and circled the birds to continue observing them, and about five minutes later continued the flight at a lower en-route altitude. A short time later, the student saw a power line at eye level, and descended to fly under the wire. The aircraft struck and broke the wire, sustaining substantial damage to the vertical stabilizer and rudder. The student was not injured, and continued the flight to Steinbach, Man., and landed without further incident. *TSB File A07C0061*.



Birdwatching under the wrong circumstances almost cost this student pilot his life

— On April 4, 2007, the pilot of a **Bell 206L-1 helicopter** was working in support of a hydro repair operation in the Prince Rupert, B.C., area. The pilot was asked to reposition the helicopter to the other side of the power lines, which was not the normal or routine side of the power lines from which the pilot was used to working. Thus on takeoff, the pilot flew up into the lines, and severely damaged the aircraft. There were no injuries. *TSB File A07P0093.*

— On April 4, 2007, a **Cessna 208B Grand Caravan** had completed loading cargo and was taxiing to the runway, when it struck a parked forklift on the ramp at Yellowknife, N.W.T. Damage was sustained to the leading edge horn of the left horizontal stabilizer. The lower skin and end cap of the elevator were also cut and deformed. *TSB File A07W0068*.

— On April 20, 2007, the left engine of a **float-equipped Beechcraft D18S** lost fuel pressure and power immediately after lift-off on departure from Jackson Bay, B.C. The aircraft yawed to the left, and when it touched down, the floats broke off. The pilot and all six passengers escaped with six life jackets, and held on to one float, which remained afloat. The aircraft sank within one minute. They were rescued in about half an hour. One passenger got a minor injury and they all suffered some levels of hypothermia. *TSB File A07P0113*.

— On April 21, 2007, a privately-owned **Cessna 150J** was departing a grass runway at Courtland, Ont. Shortly after lift-off, the engine momentarily lost power and the aircraft settled back onto the runway. The takeoff was continued; however, the aircraft settled back onto the runway once again. The aircraft became airborne for a third time; however, there was insufficient altitude to clear the trees located at the end of the runway. The aircraft collided with the trees and incurred substantial damage; the pilot was seriously injured. TSB investigators were deployed to the site. *TSB File A07O0101*.

— On April 24, 2007, a student and instructor were the sole occupants of a **Cessna 150**, and were conducting night circuits on Runway 09 at the Debert, N.S., airport. After several circuits, the aircraft had just touched down when the instructor noticed a deer on the runway. The instructor then attempted to manoeuvre the aircraft away from the deer; however, the left horizontal stabilizer struck the animal, causing the empennage to partially detach from the remainder of the aircraft. There were no injuries to the occupants. There is no perimeter fence around the Debert airport to prevent animals from wandering onto the field. *TSB File A07A0042*.

— On April 26, 2007, a **Bell 212 helicopter** was landing at Prince George, B.C., when the No. 1 engine suffered an uncontained failure. Engine components were ejected out of the exhaust system and struck the main rotor as well as tail rotor components. The aircraft landed safely. There were no injuries. *TSB File A07P0123*.

— On April 29, 2007, a privately-owned, **amateur-built Jodel D11-2** was on a sightseeing trip from Hinton, Alta., toward Buck Lake, Alta. As the flight left the main valley, a snow squall was encountered. The pilot turned back; however, the snow had overtaken the main valley also. Icing had developed on the aircraft and the pilot elected a forced landing into the trees before a complete loss of control occurred. The aircraft was substantially damaged on impact and there was no post-impact fire. Both occupants walked away from the site uninjured. *TSB File A07W0077*. △

Accident Synopses

REGULATIONS AND YOU

The Regulatory Solution

by Pierre-Laurent Samson, Civil Aviation Safety Inspector, Regulatory Affairs, Policy and Regulatory Services, Civil Aviation, Transport Canada

Modification of the *Canadian Aviation Regulations* (CARs)—by introducing new regulations, or amending existing ones—is the result of the combined efforts of many; representatives of the Canadian aviation industry, Transport Canada Civil Aviation (TCCA), the Department of Justice and Treasury Board of Canada Secretariat (TBS) are all required to participate in the process. This article will map out the steps a regulatory modification must follow to become an enforceable regulation.

The regulatory process starts with the recognition of an issue that must be resolved, and ends with the final approval of the new regulation by the Treasury Board Committee.

Civil Aviation uses a risk management approach to determine the need for regulatory change. Accordingly, any modification to the CARs must be supported by the findings of a risk assessment.

A risk assessment is a processed approach to problem solving that minimizes hazards and costs, while maximizing safety and benefits. The risk assessment team is composed of functional area specialists from Transport Canada (TC), but may also include stakeholders and experts from other departments or from the Canadian aviation industry. A risk assessment is not required when harmonizing Canadian regulations with the U.S. Federal Aviation Administration (FAA) (or with the International Civil Aviation Organization [ICAO] if it does not impact on bilateral agreements with the FAA); for issues already prioritized by the Civil Aviation Regulatory Committee (CARC); in the case of administrative or editorial amendments; or for ministerial directives.

If the risk assessment team determines that an issue should be corrected by modifying the CARs, two courses of action will be initiated simultaneously. On one hand, a Notice of Proposed Amendment (NPA) is drafted by the appropriate functional area for presentation and discussion at a meeting of one of the Canadian Aviation Regulation Advisory Council (CARAC) standing Technical Committees, which is attended by industry stakeholders and Civil Aviation. On the other hand, the Regulatory Affairs Division prepares a triage questionnaire that will determine the scope of the Regulatory Impact Analysis Statement (RIAS), which must accompany new regulation to *Canada Gazette*, Part I.

Once an NPA has been fully consulted through CARAC and approved by CARC, it is sent to the Department of Justice for legal drafting. The Regulatory Affairs Division coordinates the on-going discussions between the drafters and the technical experts within Civil Aviation.

While the NPA follows its route through the CARAC consultation process, the Regulatory Affairs Division must also prepare the triage questionnaire, which is a document presented to TBS to advise it of the recommended change to the regulation. The triage questionnaire provides a description of the issue that needs to be corrected through regulatory action, and the proposed solution. It also gives an estimate of the level of impact a proposed regulation will have on health and safety, the environment, the economy, social values, regional specificities, and public safety.

The initial evaluation of the expected level of impact will define the type of RIAS that must be prepared and presented to TBS in order to justify the selected regulatory solution.

The triage questionnaire is started early in the regulatory process, and the information it presents may change as new information becomes available and additional analyses and consultations are completed. Consequently, it may be revised and returned to TBS as a way to communicate the new direction a proposed regulation is taking.

The RIAS is a document that provides a description of what the government is going to implement, how Canadians have been consulted, and what they have said. It communicates the alternatives that have been considered, quantifies the impact of the proposed regulation with a cost-benefit analysis, and explains the procedures and resources that will be used to ensure the new regulation is respected.

A RIAS can be a modest affair of a few paragraphs if the proposed regulation is simple and has little impact. On the other hand, a regulatory solution that would affect any aspect of the Canadian fabric—be it economic, environmental, or health and safety—will warrant a complex exercise with a thorough quantitative cost-benefit analysis of the expected impact.

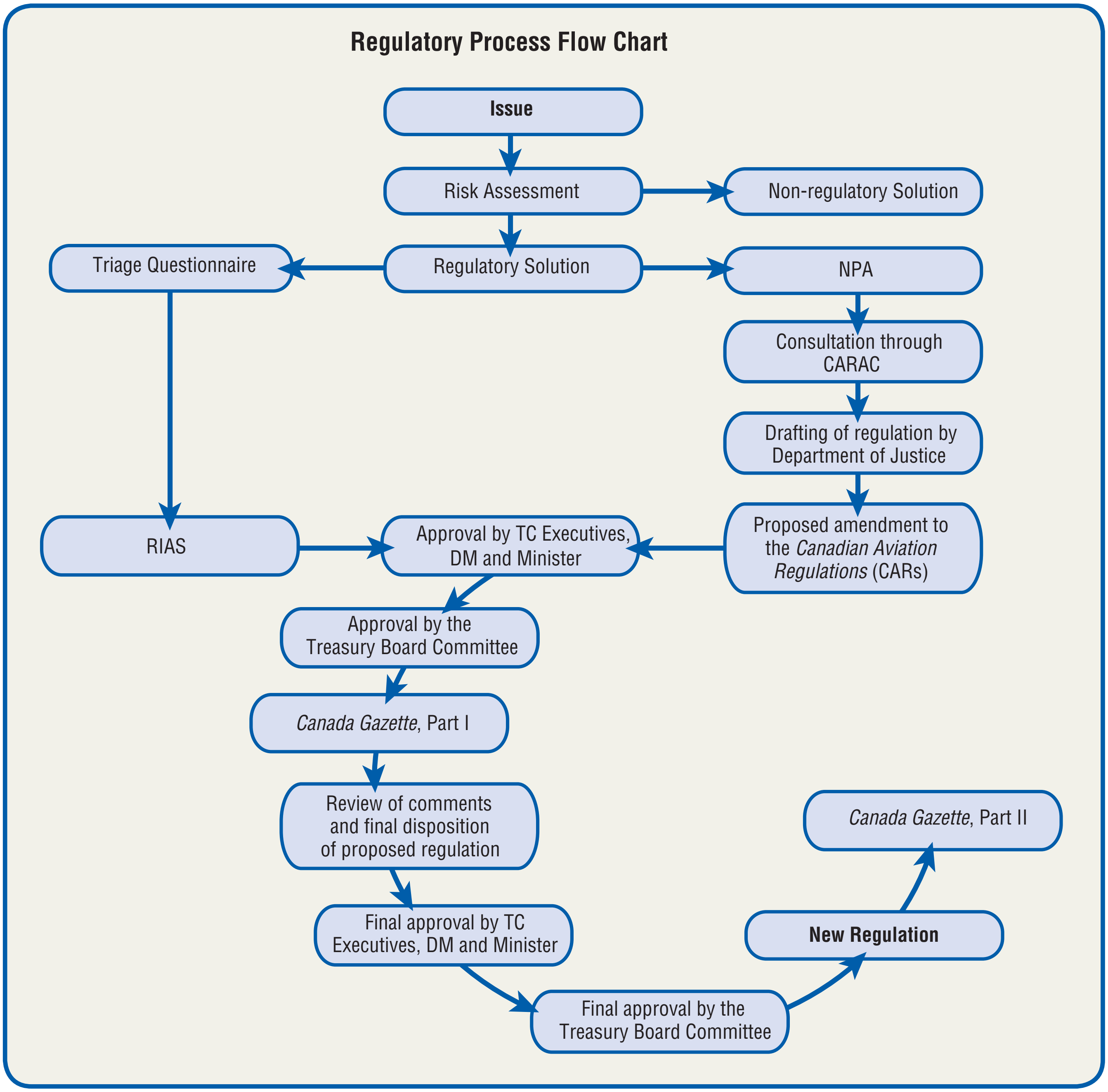
After all parties involved have agreed to a final version of the RIAS and the proposed amendment to the CARs, they are approved by TC executives, the Deputy Minister (DM), and the Minister, and are sent to the TBS to be presented to the Treasury Board Committee for approval.

Once approved, both documents are turned over to the *Canada Gazette* where the proposed regulations and the RIAS will be published in *Canada Gazette*, Part I (CGI) for a consultation period of 30 days. The *Canada Gazette* is the official newspaper of the government of Canada. CGI presents proposed regulations, government notices, and appointments that are required by statute to be published so as to disseminate information to the public.

Comments or dissents to the proposed regulation are returned to the Regulatory Affairs Division, who will address them. The RIAS and proposed regulation will be amended to answer these comments and dissents, and sent one more time for approval by TC executives, the DM, and the Minister.

The proposed regulation is then returned to the TBS for re-approval by the Committee members, and then moved forward to be registered by the Clerk of the Privy Council, under the authorization of the Governor in Council. It will appear in the *Canada Gazette*, Part II (CGII) to give notice to Canadians that what started as an NPA, and became a proposed regulation, is now a regulation.

For more information on Transport Canada's risk management processes, visit www.tc.gc.ca/civilaviation/risk/menu.htm. Information on the triage questionnaire can be found in the document *Framework for the Triage of Regulatory Submission* at www.tbs-sct.gc.ca/ri-qr/ra-ar/docs/aboutregs/process/imgtriage_e.pdf. Finally, for information on RIAS, you can read the document *RIAS Writer's Guide*, which can be found at www.tbs-sct.gc.ca/ri-qr/ra-ar/docs/publications/rias_e.pdf. △



Aviation Hypoxia

by J. Robert Flood, MDCM, CCFP (EM), Senior Consultant, Clinical Assessment, Civil Aviation Medicine, Civil Aviation, Transport Canada

In aviation medicine, as in other areas of general aviation, we look at safety management in terms of risk assessment. Whenever we discuss risk, we try to keep things in perspective. In life, we must get out of the habit of worrying excessively about mere possibilities, like catching bird flu, and focus more on real probabilities, such as the consequences of not using seatbelts or not getting the influenza vaccination. Things are no different when it comes to aviation and hypoxia. Hypoxia is still very much a threat in the aviation environment, as we are reminded from time to time by the doomed Helios aircraft last year and Payne Stewart's accident some years ago.

If you only fly below 10 000 ft in the daytime or 5 000 ft at night, and never intend to go above these levels, then your risk from this hazard is manageable and your reading for today is complete. All other pilots should keep reading and keep thinking about the risk.

Most pilots will recall from their training that the risk to flight safety from hypoxia is incapacitation, and that the most common causes of hypoxia are either a sudden decompression or a slow, unrecognized loss of pressure at altitudes above 10 000 ft. We know that the effects of hypoxia vary from person to person and can also vary in the same person under different circumstances, so it can be difficult to precisely state a flight level at which hypoxic symptoms will occur. It is far more important to be aware that the problem can occur, recognize its symptoms, and know the effects that hypoxia will have on your flying skills. In this article, I will discuss the risk of hypoxia and its management.

Before getting to the technical aspect, think about this simple scenario that was presented in a recent hypoxia article in an aviation journal. It described a pilot flying a Grumman in the Lake Tahoe area at an altitude of 11 500 ft for a period of 30 min, followed by a few hours flying at 9 500 ft. The environment under the bubble canopy was warm, and the pilot experienced heightened anxiety, palpitations, light-headedness, and generally felt unwell. Some symptoms persisted later into the day. Clearly, the pilot should have been on supplemental oxygen for at least part of the flight. But were other factors at play here? Could all the symptoms have been attributable to hypoxia? How much of an effect can hypoxia have at 11 000 ft? Why and when should we be concerned? What do the rules say about intervals above 10 000 ft in terms of time on oxygen? And what other effects can hypoxia have on healthy subjects at the common cabin altitude of 8 000 ft? Can some of the issues encountered in flight, such as blood clotting, fatigue and air rage, be related to mild degrees of hypoxia?

Definition

Hypoxia, by definition, is a lack of sufficient oxygen for the body to operate normally. It is actually a state of dysfunction due to inadequate oxygen in the blood passing to the tissues and/or cells of our bodies. Mankind has known about this problem long before we took our first tentative leaps towards the sky. Oxygen is required for all the body's cellular activity. Some organs are more demanding than others. The brain and heart require large amounts of oxygen from the circulation, and cannot function efficiently when blood oxygen levels fall. Throughout the atmosphere, the concentration of oxygen remains the same (a little over 20 percent). The key is the partial pressure of oxygen and the effect from increasing altitude. At low altitudes, where the atmospheric pressure is higher, the partial pressure of oxygen is adequate to maintain brain function at peak efficiency. As one ascends to higher altitudes, atmospheric pressure declines, and with it, so does the partial pressure of oxygen. For example, at 18 000 ft, the partial pressure is half of that at sea level. At 10 000 ft above sea level (ASL) all pilots will experience mild hypoxia and some will become symptomatic.

Signs and symptoms

The most threatening feature of hypoxia is that it can have an insidious onset as one climbs to higher altitudes. Secondly, it may be accompanied by a feeling of well-being, known as euphoria. Even minor degrees of hypoxia impair night vision, motor skills and slow reaction time. The body's physiological responses can include an increased rate and depth of respirations and an increase in heart rate. With prolonged exposure to a hypoxic environment, oxygen supply to the brain is reduced and changes in functioning can start to occur. Early signs and symptoms of cerebral hypoxia include headache, nausea, drowsiness and dizziness. More serious hypoxia interferes with reasoning, gives rise to unusual fatigue, and finally, can produce unconsciousness and death. You can imagine flying at altitude without oxygen and starting to feel giddy, light-headed and out of it. Unless you have pre-programmed yourself to consider hypoxia, you could find yourself in trouble. As well, knowing what corrective actions to take would be of benefit.

In the case of rapid decompression, the human's ability and time to react has been closely studied. The term time of useful consciousness (TUC) has been coined and reflects the time from decompression to the loss of effective performance. At 40 000 ft, TUC has been measured at around 20 seconds, so donning an oxygen mask and starting a rapid descent cannot be delayed. Crews working in pressurized cabins at high altitude must be aware of oxygen system performance, should a rapid decompression occur. Above 33 000 ft ASL, the partial pressure of oxygen in the air, even supplemented by 100 percent oxygen, is inadequate to avoid hypoxia, so descent is essential.

Hyperventilation

Hyperventilation is a related concern, with symptoms that may be difficult to distinguish from those of hypoxia. Some circumstances may lead to a condition of breathing at a faster rate than normal. This rate in excess of the body's oxygen requirement can reduce the carbon dioxide in the blood, resulting in an acid-base imbalance in the blood, and leading to symptoms of dizziness, malaise, tingling and anxiety, which may mimic hypoxia.

The regulations

As a reminder, *Civil Aviation Regulation* (CAR) 605.31, states that we:

- do not require supplemental oxygen below 10 000 ft ASL;
- require oxygen for the entire period of flight exceeding 30 min at cabin-pressure-altitudes above 10 000 ft ASL, but not exceeding 13 000 ft ASL; and
- require oxygen for the entire period of flight at cabin-pressure-altitudes above 13 000 ft ASL.

So what is the solution?

Simple:

- Don't t fly above 10 000 ft ASL without supplemental oxygen or pressurization, and when you do, follow the regulations.
- Fly a well-maintained aircraft.
- Fly healthy—any lung problem puts you on the down slope of the oxygen curve, and decreases the threshold for hypoxia.
- Don't smoke.
- Avoid self-imposed stresses. Hypoxic symptoms can be more pronounced under stress, and anxiety may lead to hyperventilation. Monitor your rate and depth of breathing.
- Remain aware. Pilots operating at higher altitudes should be alert for unusual difficulty completing routine calculations, and should take corrective action if difficulties are noted.

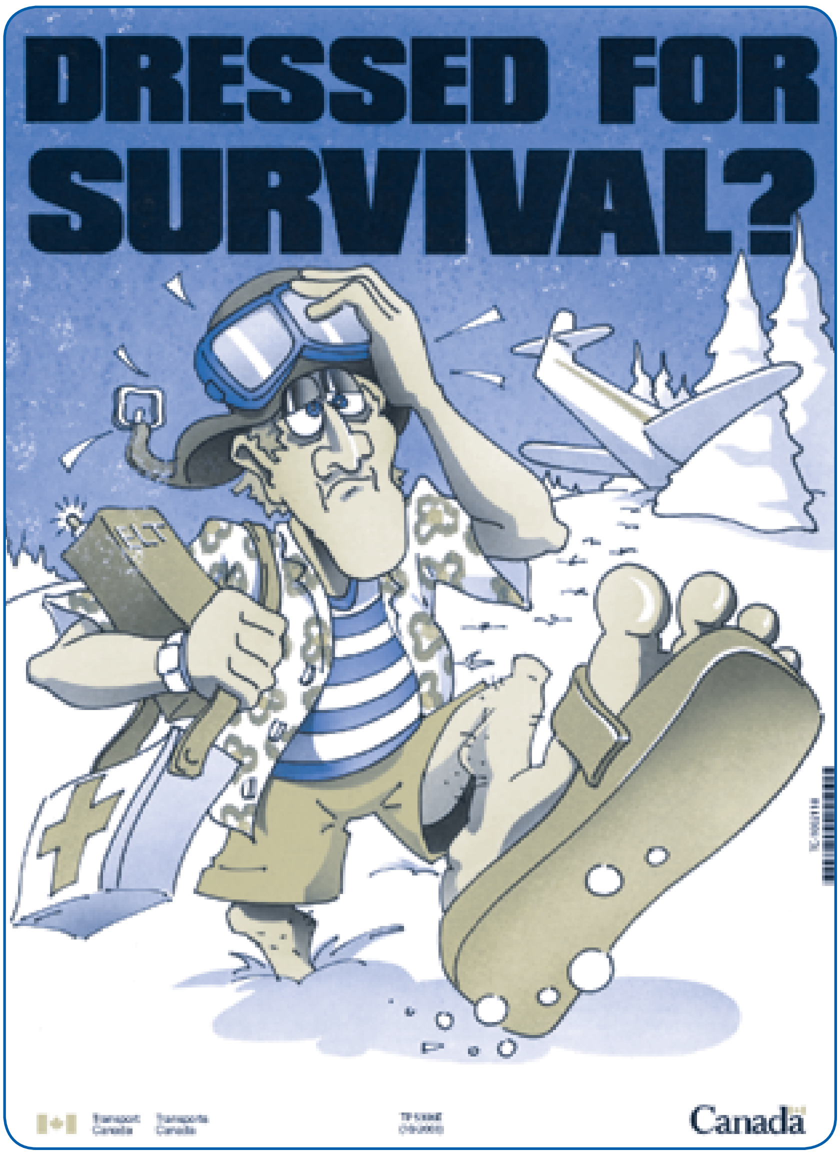
If you do a lot of flying at higher altitudes, get some hypoxia familiarization. The effects of hypoxia can be safely experienced under professional supervision. This may be done with an altitude chamber or a mask set-up, which provides a lower oxygen concentration. This will help you learn to recognize your own symptoms of hypoxia or hyperventilation. A pressure chamber offers the additional opportunity to experience rapid decompression, the effects of trapped gases, and related human factors.

And what are the take-home messages?

Hypoxia is a constant and dangerous companion while flying at higher altitudes. Although the onset and severity of symptoms may vary with individuals, no one can escape the effects of hypoxia, even patients and air medical flight crew.

Awareness, education and experience will reduce the risk of encountering hypoxia and result in safer flying.

And what about the issues of blood clotting, fatigue and air rage? You'll have to keep reading the *Aviation Safety Letter* for future updates! △



The Civil Aviation Secretariat

by Lucille Kamal, Director, Civil Aviation Secretariat, Civil Aviation, Transport Canada

The Civil Aviation Secretariat provides a one-stop service point for general information on the Civil Aviation Program.

Part of the group's responsibility is to manage the Civil Aviation Web site—the largest and most-visited site at Transport Canada—www.tc.gc.ca/civilaviation. A centralized Web team ensures that information is easily available to the public, is accessible to an increasingly diverse audience, and meets official language requirements.

In the spirit of continuous improvement, a major project is underway to revamp the Web site to improve the design of this important communication tool, which will allow us to better serve the needs of our stakeholders and better reflect important Program issues. Some of the changes proposed to date include expanding the Frequently Asked Questions (FAQ) section as well as creating a topical gateway, which would allow users to access all information on that topic with a single click. The revamp of the Civil Aviation Web site will also include a gradual transition to a new government standard, which will increase the width of the pages as well as incorporate new and improved graphics.

Feedback from stakeholders and the general public is important as this project evolves. A survey has been posted on-line and asks users if they find what they are looking for, or if they find it difficult to get the information they wish to view; how, in their opinion, can a particular aspect of the Web site be improved; what works well for them, and what does not; and if navigation is a problem, or if they find it user-friendly enough to get them to where they want to go. By providing feedback, users are helping to develop a restructuring plan that will allow better access to Civil Aviation information, products and services.

Comments can also be provided at anytime directly to the Civil Aviation Web team at civilaviationwebfeedback@tc.gc.ca, through the "Contact Us" button in the top menu on all Civil Aviation Web pages, or by phone at 1-800-305-2059 (North America) or 613-993-7284 (local). Stay tuned for changes to the site in the coming months, and visit often! △

CADORS—Now Available on the Internet

Transport Canada collects aviation occurrence information through the Civil Aviation Daily Occurrence Reporting System (CADORS). The purpose of the system is to provide initial information on occurrences—involving any Canadian- or foreign-registered aircraft—and events that occur at Canadian airports, in Canadian sovereign airspace, or in international airspace for which Canada has accepted responsibility. Transport Canada endeavours to ensure the accuracy and integrity of the data contained within CADORS; however, the information should be treated as preliminary, unsubstantiated, and subject to change. The Transportation Safety Board of Canada (TSB) is the official source of aviation accident and incident data in Canada. CADORS information can be found at: www.tc.gc.ca/cadors. △

Transport Canada Civil Aviation Jobs On-Line!

Transport Canada Civil Aviation is always on the lookout for highly motivated, professional individuals interested in applying their technical expertise and practical experience in the field of aviation.

If you are interested in viewing current job opportunities within Transport Canada please visit the Public Service Commission of Canada job Web site at www.jobs.gc.ca or call 1-888-780-4444.

For more information on Transport Canada's Civil Aviation program in general please visit: www.tc.gc.ca/civilaviation/menu.htm or call 1-800-305-2059. △

Flight Crew Recency Requirements
Self-Paced Study Program

Refer to paragraph 421.05(2)(d) of the Canadian Aviation Regulations *(CARs).*

This questionnaire is for use from November 1, 2007, to October 31, 2008. Completion of this questionnaire satisfies the 24-month recurrent training program requirements of CAR 401.05(2)(a). It is to be retained by the pilot.

Note: The answers may be found in the Transport Canada Aeronautical Information Manual *(TC AIM). TC AIM references are at the end of each question. Amendments to this publication may result in changes to answers and/or references.*

1. What is the definition of "ceiling"? (GEN 5.1)
____
____.

2. What does the abbreviation LAHSO stand for? ______________________. (GEN 5.1 and 5.2)

3. What should you do to ensure that the full lighting cycle is available for your approach and landing at an aerodrome using aircraft radio control of aerodrome lighting (ARCAL)? (AGA 7.19)
____.

4. Removing the identification of a non-directional beacon (NDB), VHF omnidirectional range (VOR), distance measuring equipment (DME) or instrument landing system (ILS) warns pilots that the facility may be __________ even though __________. (COM 3.2)

5. Before using any navigation aid (NAVAID), pilots should check __________ prior to flight for information on NAVAID outages. (COM 3.3)

6. Subject to shadow effect, VOR reception at an altitude of 1 500 ft AGL is about _____ NM. (COM 3.5)

7. Pilots using GPS who are filing VFR flight plans are encouraged to use the equipment suffix _____ to convey their ability to follow direct routings. (COM 3.16.7)

8. What should pilots do if they suspect GPS interference or other problems with GPS? ______________
____. (COM 3.16.15)

9. May VFR GPS receivers be used to replace current aeronautical charts? ***Yes/No*** (COM 3.16.16)

10. How would you state to ATC that you are 20 miles north of Toronto if you were using GPS? __________
____________. If you were using DME? ______________________. (COM 5.6)

11. In communications checks, level 3 of the readability scale means ______________________. (COM 5.10)

12. In the Canadian Southern Domestic Airspace (SDA), the correct frequency for two aircraft to use for air-to-air communication is ______ MHz. (COM 5.13.3)

13. Before using a phone to contact air traffic services (ATS) in the event of an in-flight communications failure, you should ______________________________________ and squawk code _____. (COM 5.15)

14. The Pilot Briefing Service is provided by ______________________________. (MET 1.1.3)

15. The presence of wind shear at Canadian aerodromes can normally be deduced only from ______________. (MET 2.3)

16. What is the purpose of an AIRMET? ____
______________________________. (MET 3.4.1)

17. **TAF CYJT 041136Z 041212 24010KT 1/2 SM -SHRA -DZ FG OVC002 TEMPO 1213 3SM BR OVC008 FM 1300Z 29012G22KT P6SM SCT006 BKN015 BECMG 2123 30010KT SCT020 RMK NXT FCST BY 18Z** What is the lowest forecast ceiling for CYJT? __________. (MET 3.9.3)

18. From the aerodrome forecast (TAF) above, when could you <u>first</u> expect to have VFR weather conditions at CYJT? (CYJT is in a controlled zone.) ______________. (MET 3.9.3)

19. From the TAF above, what is the forecast visibility for CYJT after 2300Z? ____________. (MET 3.9.3)

20. When will a prevailing visibility variation be reported in the remarks at the end of an aviation routine weather report (METAR)? ____
____________________________. [MET 3.15.3(g)]

21. Flight information service en route (FISE) is the exchange of information pertinent to the __________ phase of flight. Aircraft traffic information ***is/is not*** provided. [RAC 1.1.2.1(b)]

22. Selecting a transponder to "STANDBY" while changing codes ***is/is not*** acceptable because _______________ _________________________________. (RAC 1.9.1)

23. A pilot taking off from an aerodrome in the standard pressure region shall set the aircraft altimeter to _____ ____ or ______________________________________ ____. Immediately prior to reaching the cruising flight level, the altimeter shall be set to ____. (RAC 2.11)

24. An aircraft, other than a helicopter, operating VFR at night shall carry sufficient fuel to fly to the destination and then fly for ___ minutes at _____________________.
A helicopter operating VFR at night shall carry sufficient fuel to fly to the destination and then fly for ___ minutes at _____________________. (RAC 3.13.1)

25. Normally after landing, pilots should continue to taxi forward across the taxi holding position lines or to a point at least _______ ft from the edge of the runway if no holding position line exists. (RAC 4.4.4)

26. Pilots operating VFR en route are encouraged to make position reports on the appropriate _________ frequency to a flight information centre (FIC), where they are recorded and are immediately available in the event of _______________. (RAC 5.1)

27. On flights from the U.S. to Canada, pilots must make their own customs arrangements by calling __________ ____ at least ___ hours, but not more than ___ hours, prior to arriving in Canada. [FAL 2.3.2(b)]

28. Any testing of an emergency locator transmitter (ELT) must be conducted only during the first ____ minutes of any ____ hour and for a duration of not more than _____ seconds. (SAR 3.8)

29. If an ELT becomes unserviceable, the aircraft may be operated for up to ______ days, provided certain conditions are met. (SAR 3.9)

30. A pilot wishing to alert air traffic control (ATC) of an emergency situation should adjust the transponder to reply on Mode A/3 Code _____. (SAR 4.4)

31. What is the significance of the term "APRX" in a NOTAM termination time? _________________________ ______________________________________. (MAP 5.6.1)

32. Aeronautical information circulars (AIC) are available for viewing or downloading on the _____________ Web site and via hyperlink from the ________________ Web site. (MAP 6.1)

33. CAR 605.86 prescribes, in part, that all Canadian aircraft, other than ultralight or hang gliders, shall be maintained in accordance with ____, that meets the requirements of the *Aircraft Equipment and Maintenance Standard* (CAR Standard 625). (LRA 2.6.1)

34. Why should all fuelling equipment, including all funnels and filters, be bonded to the aircraft before the fuel cap is removed? ____ ____. (AIR 1.3.2)

35. When flying near a mountain range, the combination of mountain waves and non-standard temperature may result in an altimeter overreading by as much as ________. (AIR 1.5.8)

36. The presence of rain on the windscreen, in addition to poor visibility, introduces a ________________. (AIR 2.5)

37. In order to avoid wake turbulence, a pilot on approach behind a larger, heavier aircraft should aim to stay ___________ the preceding aircraft's flight path and land ______ the touchdown point of that aircraft if it is safe to do so. (AIR 2.9.2)

38. What does section 6.5 of the *Aeronautics Act* require pilots to do prior to the commencement of any examination by a physician or optometrist?____. (AIR 3.1.1)

39. Hypoxia is a lack of sufficient oxygen for the body to operate normally and even mild hypoxia can result in impaired ____________ and slowed _____________. (AIR 3.2.1)

40. A pilot should not fly for at least _____ after donating blood. (AIR 3.14)

Answers to these questions are found on page 12 of this ASL (4/2007).