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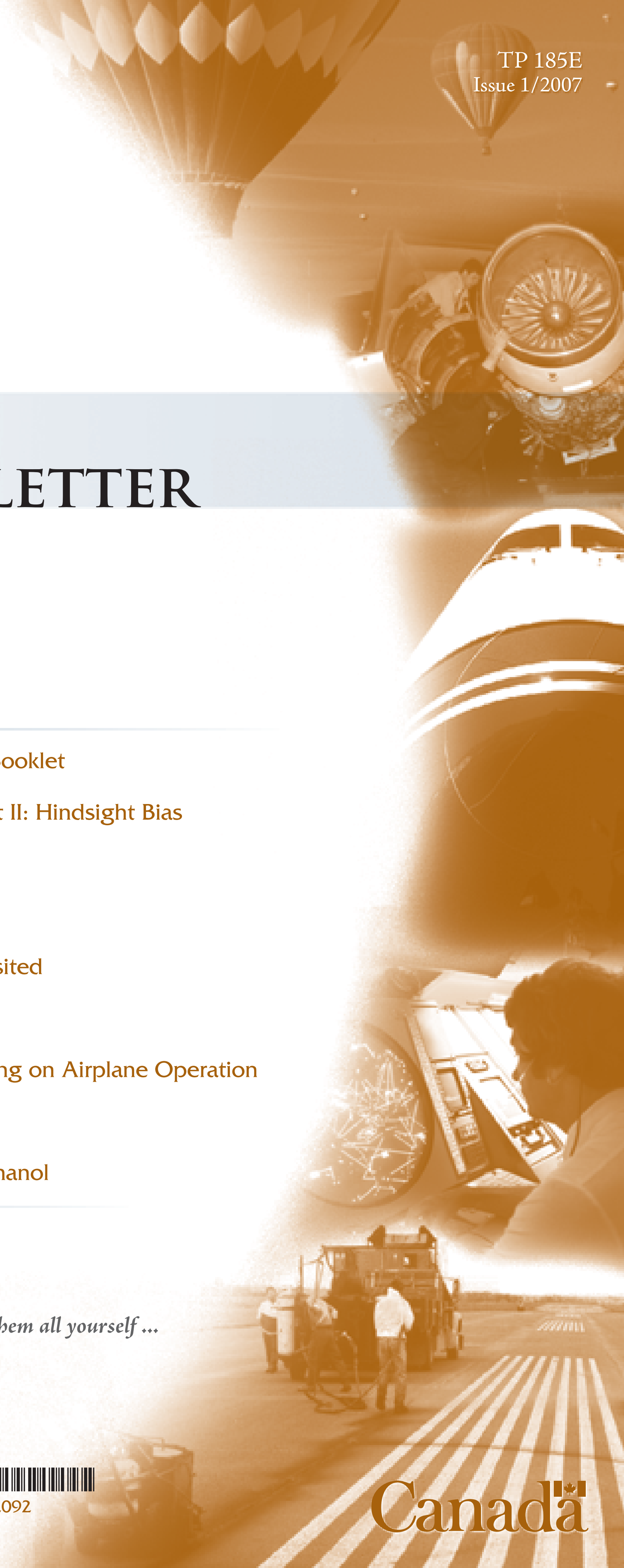

AVIATION SAFETY LETTER

In this Issue...

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

TC-1002092

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, and to all holders of a valid Canadian aircraft maintenance engineer (AME) licence. The contents do not necessarily reflect official 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.

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GUEST EDITORIAL

The air navigation system (ANS) is a complex grouping of elements—procedures, equipment, criteria, facilities, and most importantly, people. When everything works smoothly, it is invisible—and this is how it was designed to be. The ANS comprises everything a pilot needs in order to get from point A to point B—from pushback at origin to pulling into the gate at destination. It involves the development of IFR procedures, designation of airways, location of NAVAIDs, frequencies, classification of airspace, ATC procedures, weather services, and dissemination of aeronautical information.

Although the responsibility for the provision of air navigation services was transferred to NAV CANADA in 1996, the Minister of Transport remains accountable for the safety oversight of the ANS.

The National Operations Branch in Transport Canada (TC) is responsible for the safety oversight of all air navigation service providers. This is accomplished by conducting monitoring activities, inspections and audits with the aim of verifying compliance with Parts VIII, IV and VI of the *Canadian Aviation Regulations* (CARs). Beginning in 2007, this will also include the assessment and validation of the air navigation service providers' safety management systems (SMS).

In addition to the regulatory inspections, the Branch also participates, through a partnership approach with NAV CANADA, on a safety oversight committee where we provide early identification of any potential safety issues. Whenever NAV CANADA plans to reduce or terminate the level of service at a location, they conduct an aeronautical study that is reviewed by TC to satisfy ourselves that there will not be an unacceptable increase in risk as a result of the action. The classification and structure of Canadian airspace are regulated; however, NAV CANADA is responsible for the planning and management of airspace—therefore, if they need to change the classification or structure of a given segment of airspace, the Minister must approve the action.

NAV CANADA has led the world in the area of satellite navigation, life-cycle maintenance of Communications/Navigation/Surveillance (CNS) and air traffic management (ATM) systems, human factors awareness in ATC performance, and non-punitive occurrence reporting, also in the area of ATC.

Canada has an ANS with a safety record that is one of the best in the world. That doesn't happen overnight, and it doesn't happen without hard work, dedication and commitment on the part of the service provider and the regulator. Since NAV CANADA recently celebrated their 10th anniversary, it is appropriate at this time to congratulate them and to say that we look forward to another 10 years of partnership and to the refinement of an SMS approach to operating an ANS.

Jennifer J. Taylor
Director
National Operations

Return to the runway

Dear Editor,

I have never contributed to the *Aviation Safety Letter* (ASL), although I read it without fail, and never trivialize the value of the information it provides. As I write this, it has been about 6 hr since I heard the last frantic words of a pilot before his aircraft plunged into a grass field after taking off from Runway 35 at the Brantford, Ont., airport. I had just left the Grimsby, Ont., airport at 12:30 p.m., enroute to a private field near Delhi, Ont., and planned to have lunch at Brantford afterward. I switched to the Brantford frequency to determine the active runway for the return from Delhi and after about 10 min of "chatter" I heard "Mayday, Mayday..." and then silence. Brantford UNICOM responded, but there was no further call from the aircraft in distress. I switched to 121.5 MHz in the hope of getting more of the emergency call and possibly offer assistance (flying a Maule taildragger, a close-field landing is often possible), but there was only silence.

After a short time, Brantford UNICOM responded to an inbound aircraft request and confirmed that the downed aircraft location was known and help had been dispatched. At the time of the distress call, I was probably less than 20 mi. from Brantford. I returned to the Brantford airport about 30 min later, and was able to determine that the plane was a Ryan Aeronautical Navion with a man and woman on board. I also learned that a witness had reported seeing the aircraft losing control after the engine failure, and then crash nose first into the field. The possibility that the pilot may have been attempting a return to the runway was raised.

My departure from Brantford coincidentally took me near the crash site, and it was clear to me that there was no chance of survival. The location of the accident also disturbed me. It was about 1/2 mi. from the end of the runway and within the first 1/4–1/3 of a grass field which ran in the same direction as Runway 35. On most days, this could be a field of choice for an emergency landing. The wind was almost directly in line with the field at about 10–12 kt. Basic flight training stresses and re-stresses the risks associated with an attempt to return to the runway after an engine failure; yet, pilots of all experience levels get caught trying to do it, often with fatal results.

Early in my flight training, and thanks to excellent flight instruction, I developed a habit of including emergency landing preparation in my take-off checklist. I look down the runway, determine if trees or obstacles will require a deviation from a straight line landing, or if the wind favours a left or right turn to another runway, if available. And then I tell myself that I will not try to return to the runway if the engine quits—I will fly the airplane to the best possible forced-landing site available and live with the consequences. My concern will be for my life, and the lives of my passengers, and not for the aircraft. As the years have gone by, and my experience has grown, I've sometimes felt that I am being too careful and worry too much.

I can only express an opinion at this time with the limited information available. I offer my sincere condolences to the families, friends, and flying acquaintances who will be touched by the loss of these people. I did not know them, but I owe them a terrible debt of gratitude. I will never question my own careful habits again. I hope there are other pilots out there who feel the same. If not, there should be.

Greg Wallis
Caledon, Ont.

Thank you so much for writing. Your strong testimonial is much appreciated, and your introspection into this accident, admittedly based on preliminary information, reflects how many of us learn from the misfortune of others. The Transportation Safety Board of Canada (TSB) is nearing completion of its investigation into this occurrence (TSB file A05O0258), and the ASL will report on its findings after the final report is released. The TSB permitted me to say that the investigation could not ascertain whether the pilot made an attempt to return to the airport. Nevertheless, I have also long advocated great care in this controversial topic. Most agree that it is a very dangerous manoeuvre, yet some argue it can be done. I refer all readers back to ASL issue 1/2005, which had its cover story about the 180° turn. —Ed.

Send Your Stories...

The *Aviation Safety Letter* (ASL) is looking for more personal learning stories, such as the one above. We would like to hear about any situation or event—from the seemingly insignificant to the more severe—in which a lesson was learned. Send your accounts of mistakes you have made yourself, or witnessed others making, so we can all learn from them.

Transport Canada Update—Personnel Licence Booklet

by the Personnel Licensing Division, General Aviation, Civil Aviation, Transport Canada

Introduction

A Canadian Border Services (CBS) study on document security risk analysis of 50 federal documents, determined that current Canadian aviation documents (licences and medical certificates) fall into a high-risk category. The CBS made recommendations to address the security-related risks.

Based on these recommendations, Transport Canada Civil Aviation approved the design and implementation of a new format for aircrew and air traffic controller licences. The licence booklet will be similar to the present-day Canadian passport.

The licence booklet will be issued to all current licence holders and will conform to international standards. Transport Canada plans a "phased-in" approach for the initial booklet issue, which is expected to be completed by spring 2008. Transport Canada will begin issuing licence booklets to airline transport pilots and air traffic controllers, followed by other licence holders. In consulting with our industry partners, we have determined that there will be no cost to licence holders.

The licence booklet

The new licence booklet will consolidate all Canadian aviation personnel licensing documents and will also include the holder's photograph and signature, licence and medical labels, a language proficiency rating, a competency record and security features for positive authentication. It will be divided into four sections:

1. **Administrative**
    - This section will provide licence booklet instructions, abbreviations and definitions.
2. **Personal Data**
    - This section will contain the licence holder's photograph and signature.
    - Personal information currently found on existing licences will also be included: the holder's name, address, licence number, radio operator certificate number and citizenship.
    - In accordance with the CBS recommendations, the licence booklet will have an expiry date.
3. **Licence Label**

Note: The licence will no longer be a stand-alone document, but will be attached to the licence booklet in the form of a licence label.

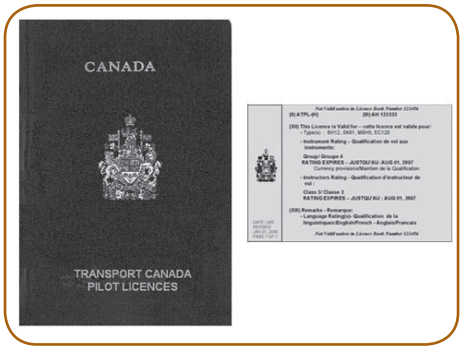
- The licence label will indicate the type of licence and ratings held by the individual and will also include a language proficiency rating.

4. **Medical Label**

Note: The medical certificate will no longer be a stand-alone document, but will be integrated within the licence booklet in the form of a medical label.

- The medical label will specify the holder's licence number, medical category and any health-related restrictions or limitations.
- This section will also allow space for medical renewals.
- In order to validate the new licence format, a valid medical label must be attached to it.

Proposed example of the personnel licence format



(not to scale)

What's next?

Information on the new personnel licence booklet will be updated on the Transport Canada General Aviation Web site and in various aviation organization publications.

An instruction handout will also accompany the licence booklet when it is mailed out to holders. △

Thoughts on the New View of Human Error Part II: Hindsight Bias

by Heather Parker, Human Factors Specialist, System Safety, Civil Aviation, Transport Canada

The following article is the second in a three-part series describing some aspects of the "new view" of human error (Dekker, 2002). This "new view" was introduced in issue 3/2006 of the Aviation Safety Letter *(ASL) in an interview with Sidney Dekker.*
The series presents the following topics:
Thoughts on the New View of Human Error Part I: Do Bad Apples Exist? (published in ASL 4/2006)
Thoughts on the New View of Human Error Part II: Hindsight Bias
Thoughts on the New View of Human Error Part III: "New View" Accounts of Human Error (to be published in ASL 2/2007)

Hindsight Bias

Have you ever pushed on a door that needed to be pulled, or pulled on a door that needed to be pushed—despite signage that indicated to you what action was required? Now consider this same situation during a fire, with smoke hampering your sight and breathing. Why did you not know which way to move the door? There was a sign; you've been through the door before. Why would you not be able to move the door? Imagine that because of the problem moving the door, you inhaled too much smoke and were hospitalized for a few days. During your stay in the hospital, an accident investigator visits you. During the interview, the investigator concludes you must have been distracted, such that you did not pay attention to the signage on the door, and that due to your experience with the door, he cannot understand why you did not move the door the right way. Finally, he concludes there is nothing wrong with the door; that rather, it was your unexplainable, poor behaviour that was wrong. It was your fault.

The investigator in this example suffered from the hindsight bias. With a full view of your actions and the events, he can see, after the fact, what information you should have paid attention to and what experience you should have drawn from. He is looking at the scenario from outside the situation, with full knowledge of the outcome. Hindsight means being able to look back, from the outside, on a sequence of events that lead to an outcome you already know about; it gives you almost unlimited access to the true nature of the situation that surrounded people at the time; it also allows you to pinpoint what people missed and shouldn't have missed; what they didn't do but should have done (Dekker, 2002).

Thinking more about the case above, put yourself inside the situation and try to understand why you had difficulty exiting. In this particular case, the door needed to be pulled to exit because it was an internal hallway door. Despite a sign indicating the need to pull the door open (likely put there after the door was installed) the handles of the door were designed to be pushed—a horizontal bar across the middle of the door. Additionally, in a normal situation, the doors are kept open by doorstops to facilitate the flow of people; so you rarely have to move the door in your normal routine. In this particular case, it was an emergency situation, smoke reduced your visibility and it is likely you were somewhat agitated due to the real emergency. When looking at the sequence of actions and events from inside the situation, we can explain why you had difficulty exiting safely: a) the design of the door, b) the practice of keeping the fire doors open with doorstops, c) the reduced visibility, and d) the real emergency, are all contributing and underlying factors that help us understand why difficulty was encountered.

According to Dekker (2002), hindsight can bias an investigation towards conclusions that the investigator now knows (given the outcome) that were important, and as a result, the investigator may assess people's decisions and actions mainly in light of their failure to pick up the information critical to preventing the outcome. When affected by hindsight bias, an investigator looks at a sequence of events from outside the situation with full knowledge of the events and actions and their relationship to the outcome (Dekker, 2002).

The first step in mitigating the hindsight bias is to work towards the goal of learning from the experience of others to prevent recurrence. When the goal is to learn from an investigation, understanding and explanation is sought. Dekker (2002) recommends taking the perspective from "inside the tunnel," the point of view of people in the unfolding situation. The investigator must guard him/herself against mixing his/her reality with the reality of the people being investigated (Dekker, 2002). A quote from one investigator in a high-profile accident investigation states: "…I have attempted at all times to remind myself of the dangers of using the powerful beam of hindsight to illuminate the situations revealed in the evidence. Hindsight also possesses a lens which can distort and can therefore present a misleading picture: it has to be avoided if fairness and accuracy of judgment is to be sought." (Hidden, 1989)

Additionally, when writing the investigation report, any conclusions that could be interpreted as coming from hindsight must be supported by analysis and data; a reader must be able to trace through the report how the investigator came to the conclusions. In another high-profile accident, another investigator emphatically asked: "Given all of the training, experience, safeguards, redundant sophisticated electronic and technical equipment and the relatively benign conditions at the time, how in the world could such an accident happen?" (Snook, 2000). To mitigate the tendency to view the events with hindsight, this investigator ensured all accounts in his report clearly stated the goal of the analyses: to understand why people made the assessments or decisions they made—why these assessments of decisions would have made sense from the point of view of the people inside the situation. Learning and subsequent prevention or mitigation activities are the ultimate goals of accident investigation—having agreement from all stakeholders on this goal will go a long way to mitigating the hindsight bias. △

Dekker, S., *The Field Guide to Human Error Investigations,* Ashgate, England, 2002.

Dekker, S., *The Field Guide to Understanding Human Error,* Ashgate, England, 2006.

Hidden, A., *Investigation into the Clapham Junction Railway Accident,* Her Majesty's Stationery Office, London, England, 1989.

Snook, S. A., *Friendly Fire: The Accidental Shootdown of U.S. Black Hawks over Northern Iraq,* Princeton University Press, New Jersey, 2000.

COPA Corner—A Different Look at Accidents

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

CANADIAN OWNERS AND PILOTS ASSOCIATION

Historically, when anyone in Canada looks for trends in aircraft accidents they work with the data collected by the Transportation Safety Board of Canada (TSB). However, while TSB data are very useful, they aren't the only data available; another source of accident reports is the aviation insurance industry.

Insurance reports are different from TSB reports for a number of reasons. One reason is that some accidents that result in insurance claims don't meet TSB criteria to be reported, and so, the TSB will not have heard about them. Insurance reports should not be considered better than TSB reports, but they do show what is costing insurance companies money, and therefore, what will affect future premiums.

I recently received statistics concerning all insurance claims filed with the COPA aviation insurance program from 2002 to mid-2006. The program covers more than half the privately-registered aircraft insured in Canada. Claims reported during this period total over 300—about 1% of insured aircraft per year. This means that 99% of pilots did not file a claim during that time, which is good news.

Not all the reports resulted in insurance benefits, as some claims were not covered, some were withdrawn and some are still being considered or are before the courts. Many of them were for very small amounts of damage; only a small number were major accidents. Nevertheless, all the reports were a result of some sort of aircraft accident and the picture that emerges, when the data is analysed, puts a new perspective on where the risks lie in personal flying these days, and what is costing aircraft owners money in insurance premiums.

The accident reports were all analysed using the Human Factors Analysis and Classification System (HFACS), designed by Douglas A. Wiegmann and Scott Shappell, as described in their book, *A Human Error Approach to Aviation Accident Analysis* (Ashgate Publishing, 2003). This system uses Dr. James Reason's "Swiss cheese" model of human error and turns it into a useful tool for classifying accidents. Broadly, HFACS identifies accidents by layer. The first layer is "Unsafe Acts of Operators" and includes errors and violations that directly cause accidents. The second layer is "Preconditions for Unsafe Acts" and includes adverse mental and physiological states, along with personnel and environmental factors. The third layer is "Unsafe Supervision." The fourth layer is "Organizational Influences," and this includes poor aircraft design, regulatory oversight and company culture issues. The HFACS system is the current global standard for accident classification and is used by the Canadian Forces.

Each insurance report was classified using HFACS, and then the numbers were added up to look for trends. Accidents that could not be classified with a high level of confidence were marked as "undetermined" and totalled 7.7%.

The remainder fell into 42 classifications. The following list summarizes the top 12 factors:

1. Physical Environment—Windstorms: 12.6%. Windstorms were the cause of the greatest number of claims. There was ground damage to the aircraft in

all cases. The good news is that no one was injured in these accidents.

2. Skill-based Errors—Poor Technique—Loss of Control on Landing: 11.9%. These accidents were all likely due to lack of skill or recent practice—and not lack of original training, as when the pilot did the licence flight test they had the skills to land safely. Many of these accidents involved crosswinds and the pilot's apparent inability to deal with them.
3. Technological Environment—Engine Failure: 10.0%. This number is surprisingly high.
4. Physical Environment—Hail Damage: 9.4%. Again, these accidents were all ground damage cases and no one was injured.
5. Perceptual Errors—Misjudged Distance or Clearance: 5.8%. These were mostly taxiing accidents where the aircraft was too close to another plane or object and hit it, although one was a wire strike on landing.
6. Skill-based Errors—Poor Technique—Loss of Control During Take-off: 4.5%. These were similar to the landing accidents described above, and probably show a lack of skill and recent practice.
7. Decision Errors—Inappropriate Manoeuvre or Procedure: 4.2%. These were mostly poor decisions to taxi aircraft on unsuitable surfaces that resulted in prop strikes.
8. Human Environment—Theft: 3.9%. The majority of these were break-and-enters to steal radios and loose equipment, although a few attempts to steal engines, props and even whole aircraft were noted.
9. Skill-based Errors—Poor Technique—Stall: 3.2%. Like the take-off and landing accidents, these seemed to be mostly due to lack of skill and practice. Accidents resulting from stalls are often fatal because they occur at low altitudes; otherwise, they wouldn't be reported as insurance claims.
10. Skill-based Errors—Omitted Step in Procedure—Gear-up Landings: 3.2%. Proper and consistent use of checklists can often prevent these very costly events.
11. Human Environment—Vandalism: 3.2%. These cases reported intentional damage done to parked aircraft.
12. Physical Environment—Snow Load Damage: 2.6%. Surprisingly many of these accidents involved floatplanes that sunk under snow loads while still on the water. Go figure!

An honourable mention goes to those accidents caused by starting the engine with the tow bar attached; they accounted for 1.0% of claims.

There are some definite trends here! First, 33.9% of the accidents were a result of skill-based errors, compared to only 6.5%, which were assessed as based on poor decision-making. Assuming that these pilots had the necessary skills when they passed their flight tests, it would seem that their skills degraded to the point where landings and even takeoffs were not assured. These pilots need more practice to ensure that they maintain their skills. So, if you are rusty, invest wisely in a checkout with an instructor and make sure you fly regularly to maintain your skills.

The second trend is that a lot of damage is happening to aircraft when they are on the ground and tied down—windstorms, hail, theft, vandalism and snow loads are significant factors. Most of these aircraft were damaged while parked outdoors; so storing the aircraft in a secure hangar would go a long way in solving most of these issues. (There were accidents that occurred while putting aircraft in hangars—hangar doors were closed on aircraft and a racoon even fell from the rafters and damaged a wing quite seriously—but overall, aircraft fare much better indoors than outdoors.) In many parts of Canada there is a serious shortage of hangarage—this is an issue that needs to be tackled locally at airports around the country—let's get those aircraft indoors!

A third item to note is the high number of engine failures. Most of these were not on ultralights powered by two strokes—they were on certified aircraft. Are owners getting the planes properly serviced when they should?

Finally, there are some accidents that would be easily prevented if we followed our checklists carefully, such as gear-up landing and starting the engine with the tow bar attached. These could be easily prevented, if we would simply slow down and not allow ourselves to be rushed. After all, "tow bar checked—stowed" is the first item on your pre-start checklist, isn't it? △

New Air Traffic Surveillance Technology to be Deployed, Starting in the North

NAV CANADA

NAV CANADA is taking the first step in the evolution from conventional radar to satellite-based position technology, known as automatic dependent surveillance-broadcast (ADS-B).

The first ADS-B deployment will be in northern Canada, with a $10 million investment to provide surveillance and communications in the 250 000 NM^2 of airspace over Hudson Bay.

The initial deployment promises to save customers well over $200 million in reduced fuel costs over 15 years, through more flexible and fuel-efficient flight routes. Further savings and customer benefits from ADS-B are expected as it is deployed elsewhere in Canada.

An ADS-B installation is the size of a filing cabinet

ADS-B ground stations receive signals from appropriately equipped aircraft to report their GPS-derived position, identification and altitude, as well as other information that can be coded into a target message. These messages are then processed and displayed to air traffic controllers, with a full picture of all aircraft in a given area.

The ADS-B equipment consists of a simple antenna, a receiver and a target processor, and telecommunications links to send information back to the appropriate area control centre (ACC). The technology is digital, solid state, with no moving parts and a minimal support infrastructure that costs much less than a typical radar site. In addition to being low-cost, the signals on which it is based are more accurate than radar reports. (The accuracy of radar reports decreases as a function of the distance from the radar source.)

Because there is no radar coverage over Hudson Bay, aircraft are forced to fly using procedural separation rules that keep them flying 10 min apart (or about 80 NM). ADS-B will allow minimum separation distances of 5 mi. for equipped aircraft.

Some 35 000 flights per year cross the airspace over Hudson Bay and the Baffin Island area as they follow the routes connecting North American to destinations in Europe and Asia, and vice versa.

ADS-B will be implemented in the Hudson Bay Basin in 2007–2008. Subsequent deployments will be in the rest of Nunavut, the Northwest Territories and northern B.C., where there is no radar coverage today, and eventually in the rest of Canada as a replacement for, or complement to, conventional radar. △

2006 David Charles Abramson Memorial (DCAM) Flight Instructor Safety Award

Jane and Rikki Abramson presented the 2006 DCAM Flight Instructor Safety Award to Mr. Simon Garrett on November 6, 2006, at the Air Transport Association of Canada's (ATAC) Annual General Meeting and Convention held in Victoria, B.C. Mr. Garrett is the Operations Manager and Chief Flight Instructor (CFI) at the Rockcliffe Flying Club in Ottawa, Ont., and the Airport Manager for the Ottawa/Rockcliffe Airport. Mr. Garrett leads by example, as he is a strong advocate for promoting and advancing Canadian aviation safety. An accomplished aviator, he is a member of the Canadian Precision Flying Association, and won a Silver Medal at The National Championship in 1999 and a Bronze Medal in 2000. He also competed in the 2000 World Championships in Sweden. The deadline for nominations for the 2007 award is September 14, 2007.

For details, please visit www.dcamaward.com.

From left to right : Rikki Abramson, Wayne Gouveia (VP Commercial General Aviation, ATAC), Simon Garrett, Jane Abramson.

The Canadian Business Aviation Association Column—SMS and Communication

Of the many facets of a safety management system (SMS) that is sound, appropriate and effective for its organization, the key to success will always be communication. First and foremost, the requirements of a generic SMS are fulfilled in a communication plan that summarizes the following concept: say what you do; do what you say; document what you say and do.

Within many integrated management systems (IMS), such as quality management systems and the International Organization for Standardization (ISO), there is heavy reliance on communication; SMS is no different. Application of SMS methods will vary from simple to complex. Simple methods will evolve and grow over time to reflect the ever-changing face of an organization. No matter its complexity, an SMS is intended to be based on clear instruction.

Once everyone in the organization understands SMS and its root principles, an open, two-way interchange of ideas is possible—rather than a dictation of instruction. SMS relies on this two-way dialogue to ensure that the best possible ideas may be implemented.

Until now, smaller organizations have conducted business based on historical successes, or simply based on tradition (i.e. "we have always done it this way, and it works"). These approaches, however, may break down in the face of difficulties where no precedence has been set. Larger flight departments definitely have an advantage over smaller operations because they generally have the time and potential resources to put together the necessary processes to accommodate new issues that arise.

Because something has been done for a long time without incident does not necessarily mean it is the best way; documenting the current method allows for discussion, evaluation and improvement. The key is having all personnel understand and follow a daily routine that can be observed and quantified.

Consider, for example, a new pilot who is unfamiliar with the inherent risks to a particular operation. While a potentially risky situation has always been successfully mitigated in a particular way, unless that mitigation is clearly documented and communicated to all personnel, including the new pilot, the operation assumes an unnecessary risk. Effective documentation illustrates the means of preventing a recurrence of hazardous incidents. It can also demonstrate the company's explicit intent to ensure a safe and secure operation.

Communication, in its many forms, has proven to be the basis for success in many businesses where an understanding of day-to-day activities is kept in balance, and where any existing problems are understood and quickly resolved. SMS ensures that effective communication is maintained and routinely improved upon, leading to the efficiency, safety and overall health of the organization.

Properly documented communication can ensure that traditionally successful methods will continue to be successful and allow for the department's continued growth as new employees are introduced to proven procedures and systems. Lessons learned will be recorded, showing improvement and reducing negative performance.

An SMS is an evolving entity that is always looking to improve through re-evaluation and re-examination of systems and processes. Documenting procedures and conveying them to all personnel is one of the best ways to guarantee that all personnel understand how to identify potential risks and mitigate hazardous incidents before they occur. △

CASS 2007 Reminder

The 19th annual Canadian Aviation Safety Seminar, CASS 2007, will be held at the **Hilton Lac-Leamy, Gatineau, Quebec**, April 30–May 2, 2007. The theme for CASS 2007 is ***Counting the Accidents You Don't Have…Evaluating safety performance in a risk management framework.***

Measuring safety is all too often reduced to counting accidents. However, accidents are rare, so this only tells a small part of the story; the whole story is more complex. Linking safety performance to outcome measures, such as accident statistics, leads to a *reactive*, rather than *proactive*, approach. Through a series of interactive workshops and a plenary session, CASS 2007 will explore how to evaluate safety performance, including, but not limited to, risk, human and organizational factors, system effectiveness, and safety culture. Our goal is to further our understanding of this necessary aspect of safety management, and look at how to apply this in a real-world setting. For information on CASS 2007 please visit www.tc.gc.ca/CASS.

BLACKFLY AIR ON SMS

Blackfly Air on Fleet Expansion

The action continues at Blackfly Air! The company seems unstoppable, as it has acquired a completely different aircraft type for its fleet to meet market demands. Expansion is both exciting and challenging for an operator, but the transition can be hazardous if not carefully planned and executed. Where to start if this is in the cards for your operation?

Suppose an important client were to ask for different services that you couldn't readily deliver with your existing fleet. Would this be an opportunity for growth or the loss of potential contracts? Would the expansion be sustainable? Most operators have faced this situation as they expanded. While the decision is initially based on a business case, it always equates into an operational one as well.

There are several regulatory issues to be dealt with in this regard, such as aircraft certification and registration, qualifications for flying and maintenance crews, the Operating Certificate, and more. Your Transport Canada Principal Operating Inspector (POI) is the appropriate person to call in order to discuss and coordinate the regulatory requirements associated with your planned fleet expansion.

The process of acquiring and implementing a new aircraft type within a company, whether it is permanent or seasonal, will benefit from being properly documented as part of the company's overall safety management system (SMS). If fleet diversification is a favourable option in the future of your company, it may be advantageous to research and document the process now and incorporate it into your SMS. When you're ready to expand, it may just go a lot smoother. △

Role of Pilots in Wildlife Management

This excerpt from Chapter 10 of *Sharing the Skies* (TP 13549E) discusses the role pilots play as stakeholders in an airport wildlife management plan. Information is provided to heighten awareness among pilots and to describe actions that can be taken as part of an overall strategy to reduce the risk of strikes. While the information provided here is based on well-documented best practices, this information is not meant to take precedence over any procedures contained in approved pilot operating handbooks (POH) or aircraft operating manuals (AOM).

Pilots can reduce the probability and severity of bird and mammal strikes through prudent flight planning and the use of appropriate aircraft operating techniques. By observing and reporting wildlife movements to ATS providers and wildlife management personnel, pilots can also help protect other aircraft operators.

Pilot general flight-planning and operating principles

All pilots should plan and operate flights according to proven wildlife-strike risk-reduction techniques. The following strategies and observations apply:

1. Plan your flight to operate at the highest possible altitude; the probability of bird strikes decreases dramatically above 3 000 ft AGL, and emergency situations are more challenging at low altitudes.
2. Reducing speed also limits the severity of bird strikes—impact force increases as the square of the speed (TP 13549E, Chapter 12, Table 12.1).
3. Avoid planning and flying routes:
   - over areas known to attract birds, such as sanctuaries, landfill sites and fish packing facilities;
   - along rivers and the shorelines of lakes and oceans, particularly at minimum altitude.

Birds, as well as pilots, use these geographic features as navigational aids;
- over inland waterways and shallow estuaries at minimum altitude. Large numbers of gulls, wading birds and waterfowl frequent these areas throughout the year. These species of birds may make regular flights at dawn and dusk;
- at minimum altitude over geographical features such as offshore islands, headlands, and cliffs. These areas are frequently used as colonial nesting sites.

4. While most bird species are active primarily during the day, bear in mind that many birds such as owls and migratory waterfowl regularly fly at night.

5. Birds tend to be more active at dawn and dusk. Many species have predictable daily flight patterns; they travel to feeding sites at dawn and return to roosting sites at dusk.

6. In Canada, bird-strike risk peaks at three times throughout the year:
   - during spring migration in March and April;
   - in July and August, when many inexperienced young birds are present, and the flying abilities of adults may be impaired due to moulting; and
   - during fall migration in September and October.

7. Be aware that a significant percentage of the North American Canada Goose population remains in urban areas—and therefore often in the vicinity of many airports—throughout the year.

8. On hot summer days, many bird species—such as raptors and gulls—harness thermals and soar to considerable heights.

9. Birds of prey have been reported to attack aircraft.

10. Bird size can be estimated by observing the wing-beat rate; the slower the beat, the larger the bird—and the greater the potential for damage. Remember: large and flocking birds present considerable risk to aircraft; large, flocking birds are extremely hazardous.

11. Be aware that birds may not hear quiet aircraft in time to avoid collision.

12. If you encounter birds, the most effective evasive action may be to climb above them while maintaining a safe speed. Biologists have observed that some birds break downwards when threatened. Other recent studies indicate that some birds may view aircraft as immobile objects, and turn slowly away when at a perceived safe distance.

13. If a bird strike does occur:
    - Maintain control of the aircraft. Remember that the sound of a bird strike may be disproportionately greater than the resulting damage.
    - Refer to checklists and carry out applicable emergency procedures.
    - Assess damage and its effect on aircraft landing performance.
    - Land at the nearest suitable airport.
    - Enlist the assistance of ATS providers and airport emergency personnel.
    - If structural and control-system damage is suspected, consider an aircraft controllability check prior to attempting a landing.
    - Control-surface damage and flutter are not readily apparent on fly-by-wire aircraft, which lack direct linkage from control surface to pilot. As a result, there is no physical feedback of aerodynamic flutter, while electronic control position indicators lack sufficient fidelity to depict surface flutter.
    - If the windshield is broken or cracked, follow approved procedures contained in the POH or AOM.
    - If the windshield is penetrated, slow the aircraft to reduce wind blast. Consider the use of sunglasses or smoke goggles to protect your eyes from wind, precipitation and flying debris.

14. Following a bird or mammal strike—and before returning to the air—have the aircraft thoroughly inspected, preferably by an aircraft maintenance engineer (AME). Pay careful attention to the following:
    - Ensure the strike has not damaged or blocked the engine intake, exhaust and cooling and airflow ducts.
    - Check landing gear, brake hydraulic lines, landing-gear downlocks and any landing-gear switches.
    - If damage to the airframe or control surfaces is suspected, thorough inspections should be carried out by maintenance personnel to ensure structural integrity; minor exterior damage may disguise serious underlying structural damage.
    - Turbine engines that have suffered bird strikes deserve careful attention. In several incidents, basic visual inspections failed to reveal damage that affected subsequent flights.

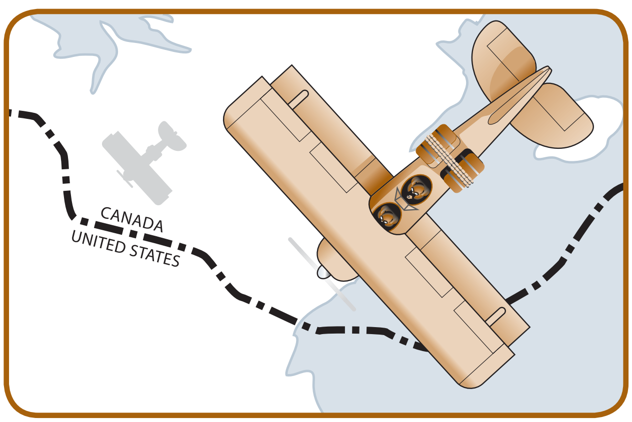
Operational necessities may preclude some of the above-recommended best practices. As a matter of fact, like many of you out there, I happen to enjoy flying along rivers and the shorelines of lakes and oceans! So what's the answer? Awareness and readiness. For detailed information, including the entire online version of Sharing the Skies, *visit the Wildlife Control Web site at:* www.tc.gc.ca/civilaviation/AerodromeAirNav/Standards/WildlifeControl. *—Ed.*

Pre-flight

Transborder Flights Without a Flight Plan—Revisited

by Edgar Allain, Civil Aviation Safety Inspector, System Safety, Atlantic Region, Transport Canada

The last time we addressed the subject of flight plan requirements for transborder flights was in issue 3/2004 of the *Aviation Safety Letter (ASL).* It was reported that over a two-year period, some 82 alleged violations were observed nationally of aircraft crossing the border with flight plans that were either inactive or simply not filed. There were about 20 from the Atlantic Region, but the vast majority of contraventions concerned flights originating from the Pacific Region. A national search of the Civil Aviation Daily Occurrence Reporting System (CADORS) revealed 76 similar occurrences, between September 2000 and September 2003, with most flights originating in United States. Another interesting note is that in most cases, customs arrangements were made for the flight.



Flying across the border? No problem, but plan for it!

A more recent search of the Transport Canada Civil Aviation enforcement database shows that during the period of January 2003–June 2006 there were approximately 157 occurrences nationally, giving a national average of about 80 occurrences a year, with the highest number of incidents being in the Atlantic Region. The Atlantic yearly average is approximately 23 occurrences. It appears that in spite of the best intentions in raising the awareness bar, little progress has been made in this area. One has to ask why this continues to occur and what steps need to be taken next in order to effect a behavioral change in our respective pilot populations.

Previous articles written on this subject appear to make the assumption that because the majority of incidents occurred with aircraft arriving from the United States, the awareness issue must be mostly a south-of-the-border problem. Albeit that there are an increasing number of airplanes and visitors arriving from the United States, I feel there exists both latent and active weaknesses on both sides of the border that may be contributing to this ongoing issue.

Before we review the procedure for conducting transborder flights between Canada and the United States, I think it is important to visit how each country carries out domestic flights. Then I will outline several sources of information on the topic of transborder flights.

In the United States, although highly encouraged, VFR flight plans are not required by the *Federal Aviation Regulations* (FARs) for domestic flights. The Federal Aviation Administration's (FAA) *Aeronautical Information Manual* (AIM) makes reference to VFR:

> FAA AIM, 5-1-4
> Flight Plan—VFR Flights
> a. Except for operations in or penetrating a Coastal or Domestic ADIZ or DEWIZ a flight plan is not required for VFR flight.

If a VFR flight plan is filed:

> FAA AIM 5-1-4
> e. Pilots are encouraged to give their departure times directly to the FSS serving the departure airport or as otherwise indicated by the FSS when the flight plan is filed. This will ensure more efficient flight plan service and permit the FSS to advise you of significant changes in aeronautical facilities or meteorological conditions. When a VFR flight plan is filed, it will be held by the FSS until 1 hour after the proposed departure time unless:
>
> 1. The actual departure time is received.
> 2. A revised proposed departure time is received.
> 3. At a time of filing, the FSS is informed that the proposed departure time will be met, but actual time cannot be given because of inadequate communications (assumed departures).
>
> f. On pilot's request, at a location having an active tower, the aircraft identification will be forwarded by the tower to the FSS for reporting the actual

departure time. This procedure should be avoided at busy airports.

So, in effect, a VFR flight plan has to be activated before it becomes in effect or minimally, contact must be made with an ATS to advise of an assumed departure. After discussions with both FAA and industry pilots in the United States, it is my understanding that, although infrequent, it is not uncommon for VFR flights to be conducted in the United States without flight plans being filed—especially where the following conditions exist: high density traffic areas, numerous airports, accessible flight following with air traffic control, and/or the flight is relatively short. Under these conditions, one can see how the perceived importance of a VFR flight plan could diminish, with little regard to search and rescue (SAR) implications.

In Canada, it is mandatory that a flight plan or itinerary be filed and the activation is automatic, based on an assumed departure, as outlined in the *Canadian Aviation Regulations* (CARs), as follows:

Requirement to File a Flight Plan or a Flight Itinerary

602.73(1) Subject to subsection (3), no pilot-in-command shall operate an aircraft in IFR flight unless an IFR flight plan has been filed.

(2) No pilot-in-command shall operate an aircraft in VFR flight unless a VFR flight plan or a VFR flight itinerary has been filed, except where the flight is conducted within 25 nautical miles of the departure aerodrome.

Filing of a Flight Plan or a Flight Itinerary

602.75(1) A flight plan shall be filed with an air traffic control unit, a flight service station or a community aerodrome radio station.

(2) A flight itinerary shall be filed with a responsible person, an air traffic control unit, a flight service station or a community aerodrome radio station.

(3) A flight plan or flight itinerary shall be filed by

(a) sending, delivering or otherwise communicating the flight plan or flight itinerary or the information contained therein; and
(b) receiving acknowledgement that the flight plan or flight itinerary or the information contained therein has been received.

So, effectively, while Canada and the United States have similar procedures, the combination of mandatory versus optional flight filing and assumed departures versus required activation has created some degree of confusion, as evidenced by recurring transborder flight plan incidents.

Two types of failures seem to be at play: latent and active. The latent failure is that the two countries have very similar aviation systems with a difference in how VFR flight plans are activated. This difference is embedded in the documents and procedures and, without careful research, can be missed. The active failure is that pilots are either unfamiliar with VFR flight plans, due to a lack of usage, or simply have a pre-conceived expectation that flight plans will be automatically activated in the United States as they are in Canada. In either case, it behooves pilots flying in both countries to become familiar with the regulations pertaining to VFR flights in each country.

Regulatory requirements are specific. CAR 602.73(4) reads: "Notwithstanding anything in this Division, no pilot-in-command shall, unless a flight plan has been filed, operate an aircraft between Canada and a foreign state." U.S. FAR 91.707 reads: "Unless otherwise authorized by ATC, no person may operate a civil aircraft between Mexico or Canada and the United States without filing an IFR or VFR flight plan, as appropriate."

Four additional sources offer various levels of hands-on information on the topic: The Transport Canada *Aeronautical Information Manual* (TC AIM), the *Canada Flight Supplement* (CFS), the FAA's *International Flight Information Manual* and a publication produced jointly by the Canadian Owners and Pilots Association (COPA) and the Aircraft Owners and Pilots Association (AOPA) called The *AOPA/COPA Guide to Cross Border Operations* (United States/Canada). The AOPA/COPA guide is available to its members. Here is a short summary of their content:

- The TC AIM RAC, sections 3.6.1 to 3.6.4 specify when a flight plan is required, how it can be filed, and the means by which it can be opened. References to appropriate CARs are listed.
- The CFS does include information on how to file a flight plan and how to file an arrival report, but not how to open a flight plan.
- The Flight Planning Notes section of the FAA *International Flight Information Manual* provides specific information on the purpose of international flight plans and the filing process. However, no information could be found concerning how to open and close international flight plans.
- The *AOPA/COPA Guide to Cross Border Operations* (United States/Canada) is a comprehensive guide

Operations

consisting of five chapters, four appendices and a checklist for trans-border operations. The guide covers a wide range of topics, including everything from pre-flight planning to customs procedures and in Chapter 5 addresses flight plans, required information, filing, and closing of VFR flight plans, but falls short of addressing flight plan activation and the differences between the USA and Canada in this regard.

In closing, occurrences remain quite frequent, and do not yet show an appreciable downward trend. Valuable enforcement resources are tied up investigating a large number of cases, while enforcing regulations that have a minimal impact on aviation safety (although the activation of an alerting service constitutes an important safety feature of a flight plan).

Today's current border security concerns should also be a consideration. We, as aviators and responsible citizens, should do our part in maintaining the freedoms we enjoy between the two countries by providing necessary information and applying the proper procedures to ensure the efficiency of the seamless system that we sometimes take for granted. Tying up SAR, flight service station specialists, controllers and both FAA and Transport Canada inspectors unnecessarily is a cost we should consider before planning our next trip. Do the research and plan well. Proper planning is well worth it, and everyone benefits! △

Preventing Ramp and Ground Accidents

by Tony Pringle. Tony has worked as an aviation safety officer for several Canadian carriers. He is a current airline transport pilot, safety consultant and writer, based in Hong Kong.

Aviation safety has improved dramatically over the past decades. At the beginning of the jet era, around 1960, the worldwide commercial jet fleet suffered over 2.6 accidents per million departures annually. This number has now dropped down to 1.3 accidents per million departures annually worldwide (the U.S. and Canadian accident rates are only about 0.5 accidents per million departures). Still, the annual value of all damaged equipment in commercial and general aviation has increased in the past few decades. Why has this been the case, if the number of aircraft accidents has steadily declined? The reason is because most accidents happen on the ground, not in the air, according to the Flight Safety Foundation (FSF).

Industry costs

In 2000, the Airports Council International (ACI) reported that US$3 billion in losses were caused by airport ground vehicles hitting aircraft, each other, and other unforgiving objects around the airport. In early 2003, the FSF estimated that worldwide airline industry losses from ramp accidents had ballooned to US$5 billion! John Goglia, an outspoken former board member of the U.S. National Transportation Safety Board (NTSB), has postulated that the best investment that major airlines could make to improve their chronic lack of profitability is to significantly reduce ramp accidents.

Direct costs are those related to the cost of actually repairing the damage to equipment and property. Indirect costs include lost revenue, lost work time, disruption of flight schedule, and negative customer reaction to accidents. The direct cost of property damage and personal injury are much more obvious than the indirect costs that are related to each incident, but the FSF has calculated that the indirect cost typically reaches four times the value of the initial direct costs.

Potential for injury

The costs of ramp damage are high even on a global scale, but much worse, is the potential for serious injury or loss of life.

The aircraft flight line is a high-risk area. It is full of high-energy sources that can produce a disaster if not respected and controlled. These sources include propellers, prop-wash, fuels, chemicals, electricity, ground vehicles, and combinations thereof. In most operations, ramp personnel need to deal with low wings and protuberances such as sharp static wicks, blade antennas, pointy Pitot tubes, long propeller blades, and strakes. They do so in a noisy environment, in all weather and light conditions, in day and night. They are under pressure to complete often physically-demanding tasks within a tight time frame, often with limited communication with other groups involved in ramp operations, such as pilots, fuel handlers, customer service agents, etc. In the airline industry, we often categorize accidents as "flight" or "ground." Those that occur in the air are well-reported and investigated, while those that occur on the ground are seldom reported outside of the company, unless they involve serious injury or death. They may or may not be investigated, and are often just assumed to be a "cost of doing business." Accidents that happen on the ground are interestingly not considered to be part of aviation safety, but industrial accidents. Data for such incidents is often difficult to obtain and, in many cases, staff involved in such situations are not airline employees, but work for airports or contractors.

However, the data that does exist paints a regrettable picture. In fact, when compared to other industries, the scheduled air transport industry is not doing well in terms of safety incidents. Consider U.S. industrial safety statistics: in 1998, the lost-workday incidence rate per 100 employees showed an average of 1.9 across all industries. The corresponding numbers were 3.2 for the construction industry, considered to be a high-risk workplace, and a staggering 8.2 for the scheduled air transport sector (see table, below). Recently released U.S. data for 2004 shows a rate of 8.0 lost workdays per 100 employees. Thus, in the past eight years, even though the aviation industry has seen large increases in productivity, the advent of new technology aircraft, and new airlines, there has been absolutely no significant improvement in injury rates!

Incidence of Non-Fatal Occupational Injuries by Industry— Number of Injuries per 100 Full-Time Workers

(Lost Workday Cases with Days Away From Work)

All Industry	1.9
Finance, Insurance, Real Estate	0.5
Mining	2.1
Manufacturing	2.1
Agriculture, Forestry, Fishing	3.1
Transportation—All	3.1
Scheduled Airline Transportation	8.2

Source: U.S. Department of Labor Statistics

Dupont, a chemical company often cited as a leader in workplace safety despite the risks associated with chemical manufacturing, manages a low 0.03 rate of lost-workday incidents per 100 employees, by using a comprehensive safety management program (see its principles of industrial safety, right).

The FSF has long recognized that flight safety is not just a matter of safe flight, but also involves safe ground operations by aircraft, ground vehicles and the people who operate them. In other words, flight safety begins on the ground. An airline that has procedures and a culture in place to eliminate incidents, and accidents on the ground can go a long way towards eliminating them in the air.

Similarly to flight accidents, analysis of ground aircraft accidents by the FSF has shown that they are almost always the result of a chain of events, which more often than not, is influenced by human errors. These human errors are not just those committed by the line person who makes mistakes that lead to an accident. They can also include failures caused by the organizational outlook of a company, including improper training and providing inappropriate facilities, equipment and other resources.

One way of dealing with human errors is to implement standard operating procedures (SOP), similar to those in place for flight crew. Once safe procedures have been identified, they must be followed with discipline, for every flight, every day.

Dupont Corp.'s Principles for Industrial Safety

1. All accidents, injuries and occupational are illnesses avoidable.
2. Management is directly responsible for the avoidance of injuries and illnesses.
3. Adhering to safety regulations is a basic requirement of the labour-management relationship.
4. Avoidance of injuries and preventive health care increase business success.
5. Safety during free time is as important as safety in the workplace.
6. The critical factor for success of a safety program is the person.
7. Training is an important element of safety in the workplace.
8. Safety inspections must be carried out.
9. All safety defects must be prevented or immediately eliminated.
10. All unsafe acts and incidents must be investigated.

However, safety on the ramp must go beyond the adherence to SOPs. It needs to be part of the operating culture. Workers need to know that they will not be ridiculed or blamed for raising safety issues.

This concept should be highlighted in the safety policy statement, which requires employees to work according to their respective procedures, report all incidents, and guarantees that they will not be disciplined for raising safety concerns.

Ground staff need to be strongly encouraged to contact their managers and/or a safety committee with any concerns they may have.

Disturbingly, most operators have, at some time, experienced aircraft damage that had gone unreported, and that was only discovered on pre-flight checks. These events cause significant financial losses to the organizations, unacceptable operational inconvenience for passengers and crews, but more importantly, a threat to aviation safety. An effective safety management system (SMS) will include a detailed and comprehensive ramp safety program, which, if understood and applied by all, will ensure proper reporting and prevent ramp incidents and accidents. △

The Adverse Aerodynamic Effects of Inflight Icing on Airplane Operation

by J.C.T. Martin, Flight Test Engineer, Aircraft Certification, Civil Aviation, Transport Canada

Despite efforts to improve airplane safety, inflight icing accidents continue to occur involving airplanes certified for flight in icing conditions. With knowledge of the aerodynamic effects of ice accretion on aerofoil surfaces, and the limitations inherent in ice protection systems, a better understanding of icing accidents can be made. This knowledge and understanding is essential for improving airplane design practices and certification standards for approval of flight in icing conditions.

For airplanes of conventional design, the main aerofoils are the wing, horizontal stabilizer and vertical stabilizer. For maximum efficiency, aerofoil cross sections are characterized by a relatively blunt leading edge and a sharp trailing edge. As the aerofoil travel through the air, the air stream is deflected above and below the wing with a point on the leading edge, known as the stagnation point, where the air directly impacts the leading edge (see Figure 1).

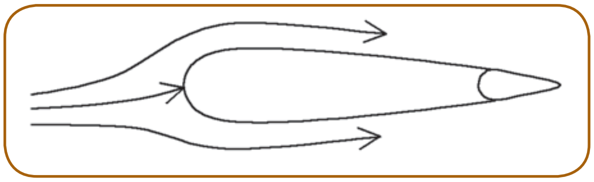


Figure 1: Air impacting stagnation point

In icing conditions, the air contains water droplets, which, although at a temperature at or below freezing, are still liquid. These supercooled droplets have more mass than air particles and are not as easily redirected as the aerofoil flies through an icing cloud. The droplets impact the surface, not only at the stagnation point, but both above and below the stagnation point. When the water drops strike the surface, part of the drop freezes into ice and adheres to the surface. The initial buildup of ice is around the stagnation point, but as more ice builds up, the aerofoil section effectively changes, thus changing the flow around it and affecting subsequent ice buildup (see Figure 2).

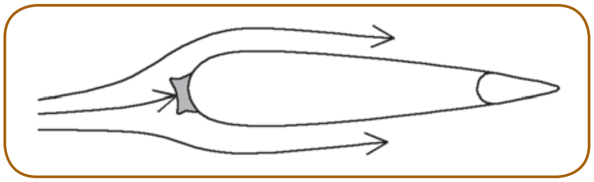


Figure 2: Ice droplets impacting and freezing around stagnation point

There are many factors that affect the size and shape of the ice accretion, including:

a) *The icing atmosphere*. For certification purposes, the icing atmosphere has been characterized in terms of envelopes of altitude, temperature, liquid water content, droplet size, and cloud horizontal extent. It is important to note that, although these envelopes encompass most icing conditions likely to be encountered, it is possible to encounter icing conditions that exceed the certification envelope.

b) *The aerofoil section and size*. Different aerofoil section shapes and physical size affect the ice accretion. Due to the temperature depression effects of accelerating airflow around the leading edge of an aerofoil, local temperatures can be lower than the ambient temperature. Hence, it is possible to get ice accretion at ambient temperatures above 0°C. This is one of the reasons that icing conditions are defined in the aircraft flight manual (AFM) of some airplanes, as existing when the static air temperature is at or below +5°C, and visible moisture is present.

c) *The flight condition*. Of particular importance are the angle of attack (AOA), the airspeed, and the time spent in the icing condition. The AOA of an airplane wing is a function of the airplane weight, load factor, thrust or power, airspeed and slat/flap configuration. The AOA of the horizontal stabilizer, which is negative, is a function of the wing AOA, but is also significantly affected by the wing slat/flap position due to the effects of airflow downwash at the tail (see Figure 3).

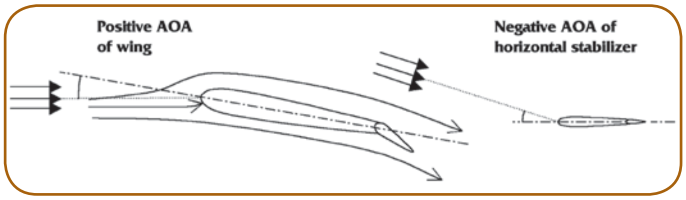


Figure 3: AOA at wing and horizontal stabilizer

From the above, it is evident that in any operational flight involving icing conditions, most of the above parameters are continuously varying. Hence, the size and shape of ice accretion on aerofoil surfaces during flight operations cannot be readily predicted. However, by making certain simplifying assumptions, and through the use of computational fluid dynamics based icing codes and/or through the use of icing wind tunnels, conservative estimates of expected ice accretions can be made.

The fundamental aerodynamic characteristics of an aerofoil are the lift, the drag and the pitching moment. Since conventional control surfaces (e.g. elevators, ailerons, rudder) are located on the trailing edge of aerofoils, the surface hinge moment characteristics (i.e. the moment or torque required to deflect the control surface from its neutral position) are also important.

Different aerofoil sections and planforms result in different aerodynamic characteristics. However, the effect of ice accretion is always adverse. In particular, maximum lift is decreased, the AOA for maximum lift is decreased, and drag is increased.

The lift and drag characteristics of an aerofoil can be quantified using non-dimensional coefficients that are dependent on the AOA. The lift coefficient is the ratio between the lifting force and the dynamic pressure of the air multiplied by the wing area. Figure 4 shows the classical relationship between the lift coefficient and the AOA for an aerofoil section without ice accretion. Aerodynamic stall is indicated by the decrease of the lift coefficient with increasing AOA. The lift coefficient of the wing is the major contributor to the lift coefficient of the airplane.

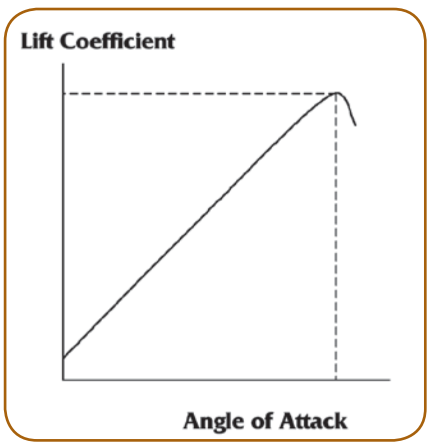


Figure 4: Lift coefficient versus AOA showing stall

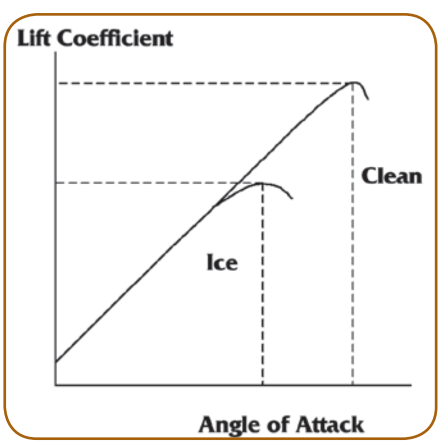


Figure 5: Effect of ice on maximum lift coefficient and AOA for stall

Figure 5 shows the effect of ice contamination on the leading edge. Not only is the maximum lift coefficient decreased, but the AOA for stall is also decreased. The loss in lift coefficient and stall AOA is dependent on the depth, shape and texture of the ice accretion in relation to the aerofoil section.

Figure 6 illustrates the effect of increasing the depth of contamination on the loss of maximum lift coefficient. Although this is only an illustration, the important aspect to note is that the decrease in maximum lift with ice contamination depth is not linear. Most of the adverse effects occur with relatively little depth. In fact, the decrease in aerodynamic performance can be very significant for small, rough textured ice accretions. Figure 7 illustrates the effect of an increasing ice depth on increase of the drag coefficient. This is much more linear in nature, with the increase in drag being proportional to the depth.

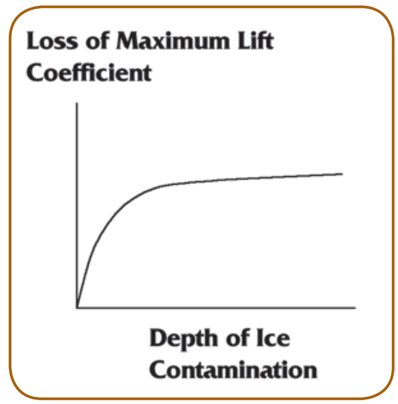


Figure 6: Effect of increasing ice accretion on loss of maximum lift coefficient

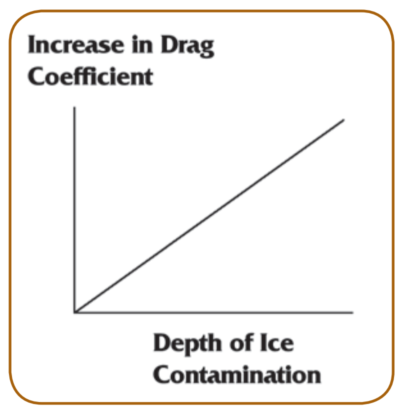


Figure 7: Effect of increasing ice accretion on increase in drag coefficient

Considering the airplane as a whole, the adverse aerodynamic effects of ice accretion on its aerofoil surfaces can be summarized as follows:

a) Due to ice accretion on the wing leading edge, the maximum lift coefficient is decreased and the AOA for stall is decreased. The consequence of a loss in maximum lift coefficient is an increase in stall speed.

Because stall AOA is decreased, stall warning and stall protection systems that activate at fixed preset values applicable to the clean wing, will not function correctly with ice accretion.

b) Due to ice accretion on the horizontal stabilizer leading edge, the maximum downward balancing force is reduced and the AOA for stall is reduced. The consequence is the potential for a stall of the horizontal stabilizer, commonly known as tailplane stall.

c) Due to ice accretion on wing, horizontal and vertical stabilizer leading edges, the drag of the airplane is increased. The drag is also increased due to ice accretion on other forward-facing surfaces, such as the radome, engine pylons, landing gear struts, etc. The consequence is a loss of climb capability, loss of the ability to maintain level speed, or loss of the ability to make a controlled descent and landing.

d) Due to ice accretion on the leading edges of wing and stabilizer aerofoils that support trailing edge control surfaces, control hinge moment discontinuities at these surfaces can occur. For fully-powered flight controls, the pilot's control force is dependent on the artificial feel system characteristics. For unpowered controls, the pilot's control force is proportional to the hinge moment of the surface. Hinge moment anomalies at the surface can result in pulsing of the pilot's control, and in the extreme, a reversal in the direction of the pilot's force can occur. That is, the control will automatically deflect to an extreme position, and pilot effort will be required to return the control to a neutral position, which is known as control overbalance.

e) Ice accretion on the aerofoil surfaces and other surfaces adds weight to the airplane, thus increasing the stall speed and the drag for a specified airspeed.

f) Ice accretion on propeller blades will increase the drag and may decrease the lift of the blades. Increased power will be required to maintain propeller speed. Eventually, thrust will be decreased because of reaching power limits and/or loss of lift on the blades.

As noted previously, the size and shape of ice accretion on an aerofoil leading edge are dependent on a large number of factors, including the aerofoil cross section. However, with all other conditions remaining the same, a smaller wing will tend to pick up ice quicker than a larger wing of exactly the same aerofoil section. Not only that, but the adverse effects of the same amount of ice accretion are more severe in smaller wings than in larger wings. These scale characteristics partly explain why there are relatively few inflight icing accidents involving large airplanes.

Clearly, the hazard associated with flight in icing conditions is dependent on the exposure time. In general, icing conditions are more prevalent at lower altitudes. Propeller-driven airplanes generally cruise at altitudes conducive to icing conditions. Furthermore, they have limited excess power to enable them to climb out of icing conditions, should the need arise. This problem is more acute for single engine versus multi-engine airplanes.

On the other hand, multi-engine turbojets spend limited time climbing through icing conditions, and cruise at altitudes well above icing conditions. On an exposure basis, propeller-driven airplanes are at a much greater risk.

Due to the adverse aerodynamic effects of ice accretion, critical surfaces must be protected to ensure operating safety in icing conditions. However, as noted above, depending on the size and design of the airplane, not all aerofoil surfaces need to be protected. It is common for the entire wing leading edge, the horizontal stabilizer leading edge and the vertical stabilizer leading edge to be protected for small turbojets (e.g. Cessna Citation II) and most propeller-driven airplanes (e.g. Bombardier DHC-8). For larger business jets (e.g. Bombardier Challenger CL-604), the horizontal stabilizer may not be protected. For large turbojets (e.g. Airbus A320), it is common for the wing leading edge not to be protected inboard of the wing-mounted engine nacelles.

There are many design issues associated with whether or not to protect a surface. For example, a manufacturer may choose to protect the leading edge of a horizontal stabilizer with the attendant issues associated with the protection system design and operating cost. Or, the manufacturer may choose to simply incorporate a larger and/or redesigned stabilizer surface that does not need to work at as high an AOA to balance the airplane, and hence, is less likely to stall.

Ice protection systems are generally classified as either de-icing systems or anti-icing systems. A de-icing system is intended to remove ice once it has accreted, whereas an anti-icing system is intended to prevent ice accretion in the first place.

The most common de-icing system, especially on propeller-driven airplanes and small turbojets, is pneumatic boots. The boot covers the leading edge and is comprised of a number of air chambers that are kept flat by applying suction to the air chambers. When pulsed, the tubes are inflated with high-pressure air. The physical expansion in the shape of the leading edge fractures the ice, and dynamic pressure overcomes any remaining adhesive bond between the smaller fragments and the surface. Most of these systems work on a timer that periodically cycles through different surfaces or parts of a surface.

Pneumatic boot de-icing systems should be able to keep the protected surfaces free from large amounts of ice buildup. However, there will always be ice accretion between boot cycles while the airplane is in icing conditions. In addition, it is rare for all accreted ice to be removed without repeated boot cycles. Hence, normal operation will result in a small amount of ice on the protected surfaces, commonly called residual ice.

One problem that has been identified with this type of protection is that the chordwise extent of the boot protected area may not have considered the full operational range of flight and icing atmosphere variables, thus resulting in ice accretion aft of the protected area. This can be particularly hazardous when a residual ridge of ice is left just aft of the boot on the upper wing after boot operation to break off ice (see Figure 8).

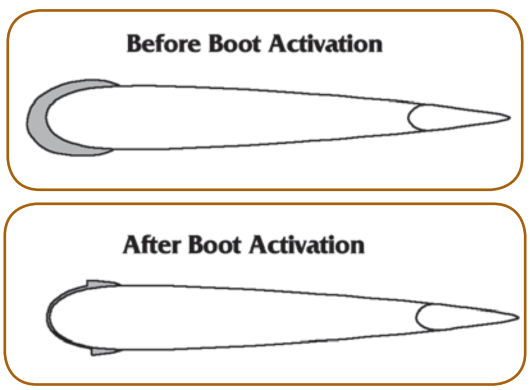


Figure 8: Residual icing ridge formed aft of boot protected surface due to boot inflation

The most common protection system used on large turbojets is thermal anti-icing, using engine compressor bleed air. The bleed air is ducted to the wing, directed to the inside of the leading edge from holes in the ducting tube, and then vented overboard. The temperature of the leading edge is regulated to maintain adequate thermal performance, without compromising the structural strength. The hot surface prevents ice accretion by either vaporizing the supercooled water droplets, or by heating them to a temperature above freezing. In the latter case, the water will form droplets that "run back" from the leading edge due to the airflow. Once beyond the heated area, these droplets can then freeze on the cold upper or lower aerofoil surfaces. In general, this "run back" ice forms chordwise streaks, and is not as hazardous to flight characteristics as the spanwise ridge that can form aft of pneumatic boots.

Although designed to operate effectively with a defined envelope, thermal anti-icing may not be effective in real life icing environments that exceed the certification envelope.

The ice protection systems for some components, such as pitot/static pressure sensors and the windshield, are always operated in flight. However, for economic and other reasons, airframe (and engine) ice protection systems are not normally operated when not in icing conditions. Hence, there can be ice accretion during the period from entering icing conditions, recognition of icing conditions, activation of airframe ice protection and the ice protection system working effectively.

In this regard, the incorporation of ice detection systems has helped to reduce both the exposure time and the amount of ice accretion during this transition time interval. Depending on the design, when ice is detected, an alert is provided to the flight crew and the ice protection systems are activated by the flight crew. In some systems, the ice protection systems are automatically activated by the ice detection system.

For those airplanes without ice detection systems, significant ice accretion can occur prior to operation of the ice protection systems, either through lack of awareness of the icing condition (e.g. night), or through non-adherence to the AFM procedures.

Another cause of ice accretion on protected surfaces is system failures. Depending on the sophistication of the design, not all failures may be indicated to the flight crew, nor readily detected. The most critical of the protected surfaces that cannot be readily observed from the flight deck is the horizontal stabilizer leading edge.

In summary, although the critical surfaces of an airplane may be provided with ice protection, there are a number of reasons why ice can be accreted on these surfaces, which ultimately can affect flight safety.

With an understanding of the adverse effects of ice accretion and why ice can occur, not only on unprotected surfaces, but also on protected surfaces, the technical reasons for icing accidents become apparent. In general, there are four main types of accidents: wing stall, tailplane stall, lateral control overbalance, and uncontrolled descent/landing.

Wing stall

Due to ice accretion on the airframe and, if applicable, ice accretion on propeller blades, the airplane begins to slow down from its initial steady state condition. Stall occurs at a much higher speed than expected due to the increased weight of the airplane and the decrease in maximum lift coefficient. Aerodynamic stall can occur prior to operation of stall protection systems intended to prevent aerodynamic stall because of the decrease in stall AOA. If the decrease in stall AOA is large enough, a stall can also occur prior to activation of stall warning with little or no natural stall warning.

A common element in this type of accident is that the airplane is climbing with the autopilot engaged in pitch or vertical speed mode, or that the airplane has just levelled out from a descent with the autopilot engaged in an altitude hold mode. Without an autothrust system, airspeed is not controlled, and the flight crew does not readily identify the speed decrease. As the airplane slows down, it will usually develop some sideslip and will be out of trim. The immediate stall characteristic is a rapid wing drop. The autopilot generally disengages during the departure from controlled flight, with accompanying aural alerts; the stall warning may or may not function and the stick pusher, if applicable, may or may not activate. The departure takes the flight crew completely by surprise, as one moment the airplane is in autopilot controlled normal flight, and the next moment the airplane has departed controlled flight. In some incidents, the flight crew has managed to recover, but with significant altitude loss. Unfortunately, in quite a few cases, control was never regained prior to impact with the ground.

Tailplane stall

This type of accident is due to ice accretion on the leading edge of the horizontal stabilizer. The horizontal stabilizer in a conventional airplane provides a net downward force to maintain the airplane in longitudinal balance and works at a negative AOA. The AOA that the horizontal stabilizer experiences is dependent on many factors, such as:

a) The greater the wing flap extension, the greater the (negative) AOA at the tail.

b) The higher the airplane speed, the greater the (negative) AOA at the tail.

c) A nose-down pitching manoeuvre also generates a greater (negative) AOA at the tail.

d) Power effects (from propellers) are also important with increasing power causing increased slipstream effects at the tail.

With ice accreted on the horizontal stabilizer, it is possible to stall the tail due to the AOA exceeding the stall AOA. This has two immediate effects. First, stalling the tail reduces the net downwards force on the tail, resulting in the airplane pitching nose down. This exacerbates the stall, as the nose-down pitch further increases the negative AOA on the horizontal stabilizer. Second, the stalled horizontal stabilizer creates significant hinge moment anomalies on trailing edge elevators. For unpowered elevators, this can result in the elevator self-deflecting to the airplane nose-down stop (elevator trailing edge down). Again, this further increases the negative AOA.

A typical scenario for this type of accident is when the flight crew selects full landing flap late in the approach, usually close to the flap limiting speed and while making a pitch-down correction to recover to an instrument landing system (ILS) glideslope. Elevator control pulsing is experienced, and the airplane continues to pitch down despite corrective control inputs. The control column is then suddenly snatched from the pilot's hands and goes to the forward stop. The flight crew is unable to recover from the nose-down pitch attitude prior to impacting the ground.

Due to widespread training information on this phenomenon, there is now an abundance of training material available to help flight crews identify and recover from tailplane stall. In general, the material suggests retracting the flaps, reducing power, and applying maximum airplane nose-up elevator control. Unfortunately, these very procedures are those that would tend to induce or deepen an airplane wing stall. As some of the characteristics of the two types of departures are similar, it is easy to see why flight crews could be confused.

Although accidents due to tailplane stall are associated with airplanes with unpowered elevators, incidents have been reported with trimmable horizontal stabilizers and fully-powered elevators. In general, the flight crew has noted either an inability to maintain trim on landing approach, or running out of airplane nose-up trim authority.

Lateral control overbalance

This type of accident has not been as common as the first two types. It has occurred due to ice accretion on the wing upper surface, just aft of the leading edge and in front of the trailing edge ailerons. Conventional ailerons are balanced, that is, in normal flight with the lateral control centred, the hinge moment in one direction on one aileron is compensated by the hinge moment on the opposite aileron. The net force on the pilot's lateral control wheel is very low. However, should the compensating hinge moment on one side change significantly, the ailerons will automatically self-deflect to roll the airplane.

In one accident of this type, the airplane was in autopilot control during a hold, with the flaps partially extended. The flaps were then retracted. The increase in the wing AOA due to the flap retraction caused a flow separation at the wing tip due to the ice accretion. There was perhaps a partial stall of the wing at the wing tip. The flow separation caused a hinge moment discontinuity at the aileron, which in turn caused the ailerons to self-deflect to full deflection. The autopilot was unable to correct the overbalance, and the airplane had a lateral departure from which recovery was not accomplished.

It is important to note that in this scenario, the autopilot is not able to give any indication of the impending potential for the overbalance occurrence. That is, until the flow on one wing tip is disrupted, the ailerons are still reasonably balanced, and the autopilot is not holding a sustained out-of-trim condition.

Uncontrolled descent/landing

If the drag increase and/or thrust decrease due to ice accretion is excessive, continued level flight may not be possible, and a descent will be required in order to maintain airspeed. This has resulted in controlled flight into terrain (CFIT) types of accidents in mountainous areas. There has also been some recent evidence to suggest that the inability to maintain the glide path during approach to landing has been a factor in accidents. In general, uncontrolled descent/landing accidents have been more prevalent in non-transport category airplanes, particularly reciprocating twin-engine airplanes.

Conclusion

The hazards associated with inflight icing are complex, with many independent variables. Ice accretion on critical airplane surfaces, both protected and unprotected, continues to be a contributing factor in many accidents. With better knowledge of these adverse effects, and with improved design procedures, ice protection systems, ice detection systems and certification criteria, airplanes will be better equipped for inflight icing in the future.

However, it is not practicable to redesign and re-certify current airplanes. Flight crews, particularly of propeller-driven airplanes with pneumatic boot de-icing systems, should always try and avoid icing conditions when it is reasonable to do so, exit icing conditions as quickly as is reasonably possible, and always operate the airplane in accordance with the flight in icing conditions procedures outlined in the AFM.

Particular care should be taken to always maintain minimum recommended operational speeds for flight in icing, avoid climbs with the autopilot engaged in vertical speed or pitch modes, monitor airplane speed closely with the autopilot engaged in altitude hold mode, avoid abrupt pitch down manoeuvres in the approach and landing configurations, and generally be aware of the hazards of flight in icing conditions. △

MAINTENANCE AND CERTIFICATION

Independent Check of Flight Controls

by Steve MacNab, Regional Manager, Aircraft Maintenance and Manufacturing, Prairie and Northern Region, Transport Canada

During recent oversight activities involving aircraft operators and aircraft maintenance organizations (AMO), it was noted that there has been an increase in findings pertaining to independent checks of flight and engine controls. The records reviewed show an inconsistency in performing checks, as well as errors in documenting activity.

All of us should note several things:

The maintenance release cannot be signed until after any required independent check has been completed and the technical record contains the signature of both persons who conducted the independent check. The regulatory chain is clear on this:

- *Canadian Aviation Regulation* (CAR) 571.10(1) requires that all requirements specified in section 571.10 of the *Airworthiness Manual* be met before the maintenance release is signed.

- Subsection 571.10(4) of the CARs Standard, item "d" of the "Types of Work" table, requires an independent check and completion of the technical record with both signatures.

- Every technical dispatch system should ensure that flight crews know if maintenance has been done, and if it has, a reasonable outline of what maintenance was done. The journey logbook is the most common source of maintenance information to flight crew. However sophisticated the technical dispatch system, the logbook makes information available to flight crew if they are to satisfy the regulatory requirements.

- The flight crew has an obligation to make note of the maintenance done, just like they have an obligation to make note of deferred defects. An understanding of what was done, and an awareness of control systems, either directly affected or potentially affected by the access and egress involved in the maintenance, will assist the flight crew if there are unexpected observations during subsequent flight segments. This obligation is imposed by good airmanship, if by nothing else.
- The meaning of "potentially affected" is subtle, but significant. Maintainers generally recognize the need for an independent check when they disturb a control. But if disturbing the control system was not the object of the maintenance task, the fact that it was disturbed may be forgotten and a proper independent check not done. Examples include installation of rigging pins, control locks or clamps, to facilitate work. Wire bundles and flexible lines could be pushed into controls (to provide access for a task), but not returned to a proper configuration when the aircraft is closed up at the end of the job. Tools or material could also be left behind.
- If control system involvement was either necessary to the maintenance, or possible while gaining access or closing up, flight crew should be especially vigilant in verifying satisfactory control functions.
- Complacency is the enemy; it is easy to assume that modern aircraft are so reliable that the next flight segments will be uneventful...

Consequently, this is a reminder to aircraft maintenance personnel to continue to emphasize the importance of good technical records, independent checks and maintenance releases; and for pilots to review recent maintenance, deferred defects and minimum equipment list (MEL) items, as a routine part of pre-flight preparation. Someone, some day, will be glad they did. △

Spring Review—Best to Avoid Misrigged Flight Controls!

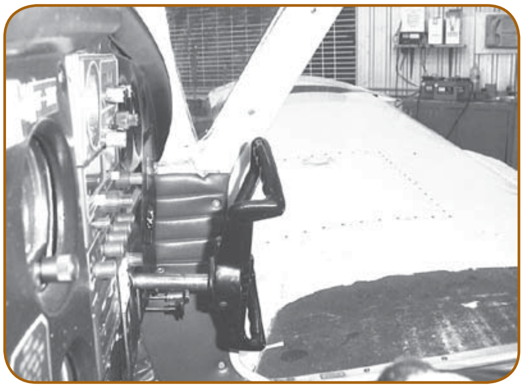
As the spring and summer flying seasons will soon be upon us, annual inspections, float changeovers and commercial aircraft maintenance will be carried out at many airports and seaplane facilities. After maintenance, an aircraft may require a test flight to ensure the system or systems are performing to the required specifications. Hopefully, the pressure of a test flight combined with the rustiness of seasonal pilots does not force them to become test pilots going beyond their competency.

Aircraft maintenance engineers (AME), or the persons performing maintenance on those aircraft to be test flown, must take the time to ensure entries into technical records and logbooks are written in a clear and concise manner. Prior to the test flight, AMEs should make every effort to review the work completed on the subject aircraft with the pilot.

The pilot who will test fly the aircraft must also decide whether they are qualified and competent for the task at hand. If any doubt exists as to the pilot's qualifications or currency, a different pilot with the proper experience should perform the flight. The pilot must be briefed thoroughly on the extent of the work done on the aircraft.

This is important not only for private pilots and AMEs who perform work outside an approved maintenance organization (AMO), but also for commercial pilots and AMEs who work within an AMO. Several accidents and incidents have taken place over the past few years. These were the result of inadequate pre-flight inspections after maintenance was carried out. At the time the inspections were carried out, it seemed that everything was done to the best of the maintenance and flight personnel's abilities. However, by looking back on these accidents and seeing where and what errors were made, we are able to incorporate some suggestions into our own pre-flight inspection methods—both with regards to maintenance and flying.

The following occurrences involved misrigged flight controls and are documented on the Transportation Safety Board of Canada (TSB) Web site at www.tsb.gc.ca: a Convair 340/580, TSB report number A97O0077, at Hamilton, Ont.; a Cessna 172, TSB report number A00Q0043, at Maniwaki, Que.; and a Piper Cherokee, TSB report number A01Q0009, at Mascouche, Que. Misrigged flight controls occurrences are not uncommon, and unfortunately, odds are that they will happen again.



What's wrong with this picture?
Would you want to see this during your run-up?

Transport Canada issued *Airworthiness Notice No. C010, Edition 2*, dated 10 October 2001, entitled "Inspection of Control Systems," which explains the regulations applicable to the maintenance of engine and flight controls, and outlines the applicable standards for control systems maintenance. (see Notice at www.tc.gc.ca/civilaviation/maintenance/AARPC/ANs/C010.htm). The document emphasizes the requirement that the person performing the dual inspection be independent of the original work and that the inspection include a verification of the range of operation of the control system.

In *Aviation Safety Maintainer* 4/1997, the article "Exploring the Problem of Misconnected Controls" used the circumstances of a DHC-2 Beaver occurrence to raise the question of why so many people might miss such an important item as the integrity of flight controls. The article concluded by urging the reader to develop a methodology that uses all available tools to avoid lapses that might result in misrigged controls.

Here are some examples of what AMEs and pilots can do to manage some risks:

- be uncompromising in ensuring correct logbook entries and signatures;
- perform thorough visual inspections;
- follow all of the manufacturer's recommended procedures to the letter;
- establish and review emergency procedures **before** getting in the air.

Flying, just as driving a car, is an activity that involves distinct risks. From the time the aircraft is prepared for a flight, to the time the pilot walks away after the flight—risk control (or risk **management**) must always be our top priority. △

Dangers of Automotive Gasoline Containing Ethanol

by Brian Kenney, Senior Advisor Fuel Quality and Additives, Petro-Canada

This article was originally published in COPA Flight*, June 2006. Reprinted with permission.*

This is meant as a warning to pilots who are using automotive gasoline, that times are changing. The use of ethanol in gasoline is proliferating and is, or soon will be, mandated in some provinces. Ethanol use in Saskatchewan was mandated to start in the fall of 2006. Therefore, starting sometime around October, gas stations that previously dispensed hydrocarbon-only gasoline may have been forced to supply gasoline containing some ethanol. The conversion was to take about six months. Ontario has similar plans for 2007. Ethanol use in Quebec is also increasing, with the support of the government—which means that at least one major oil company will be selling gasoline with 10% ethanol, starting sometime in 2006. These are new initiatives and therefore add to the existing ethanol use in Canada. A regional oil company and a number of independents in Ontario are already selling gasoline containing ethanol (GCE). Similar trends have started in the west. The federal government has a target to make 35% of the gasoline in Canada contain 10% ethanol by 2010.

One consideration that has not yet been determined by fuel suppliers is whether a non-ethanol gasoline will be available in all areas. This is not guaranteed, and if the worse case scenario evolves, it may be impossible to buy gasoline without ethanol in large areas of the country. This would actually eliminate the practice of many pilots buying gasoline at local service stations and bringing it to the airport to fuel their airplanes. This would also cause a problem for certified aircraft owners using a supplemental type certificate (STC) for unleaded automobile gasoline: most, if not all, of the STCs prohibit the use of ethanol in gasoline. In fact, this would make the only legal fuel for aircraft 100LL in some areas of Canada.

Since there is a cost advantage to using automotive gasoline, some may continue to use it anyway. If the pilot owns an amateur-built aircraft, this is not illegal. In both cases, the pilot that uses GCE is in danger of becoming an accident statistic.

Before explaining why it may be dangerous to use GCE, let me state that it is possible to design an aircraft that can operate safely using it. The problem is that at the moment there are virtually no aircraft designed to run on GCE, whereas car companies have been designing cars to use it for years.

So what are the dangers?

1. Fuel starvation
2. Fuel leaks or fire
3. Power loss or failure
4. Reduced aircraft durability

What is the risk? I can't state for sure what the potential risk is for any one aircraft. However, I would like to make an analogy to drunk driving: you may get away with drunk driving once or twice—some may get away with it every time—but, sooner or later most people end up in serious trouble. It is only a matter of time. It is just not the right thing to do because of the dangers involved.

I don't have space in this article to define all the potential problems or tell you how to convert your amateur-built to use GCE, but here are some things you should consider if you decide to ignore the advice and use GCE anyway:

- Ethanol is a great solvent that often attacks elastomers and dissolves sealants and sloshing compounds. It will dissolve old gasoline gums that may plug screens or filters. Therefore, introducing GCE may interrupt your fuel supply in several different ways—assuming your fuel doesn't immediately start leaking. It took about an hour for a friend's fuel tank to start leaking after he used GCE in his amateur-built.

- Ethanol is corrosive to aluminum, terne-plate and galvanized steel under particular conditions. Aluminum needs to anodize in order to be free from corrosion.

- Ethanol contains oxygen and will lean the engine. This can burn valves, blow pistons and cause power loss. Because it contains less energy, it needs higher fuel consumption for the same power, and therefore, may also require fuel-system modifications.

- Ethanol can be extracted by water and lose octane as a result. The engine may detonate or suddenly stop if this happens.

- When GCE is mixed with gasoline that does not contain ethanol, the vapor pressure increases to be greater than the separate fuels. Therefore, while separately the products may meet specifications, mixed together they may not. (This is why some cars may experience driveability problems if you switch from one type of gasoline to another.) In an aircraft, this could contribute to vapor lock problems.

So, hopefully, I've convinced you that the danger is real.

So, how do you protect yourself if you are not sure whether or not gasoline contains ethanol? Some companies, including the one I work for, will put a label on the GCE pump, stating the gasoline contains ethanol. However, this practice is not universal. Therefore, you should determine a reliable brand that you know does not contain ethanol, or will label it if it does. If you are in an area where most stations have ethanol, you should assume that others likely do too.

The safe practice is to test your gasoline to see if it contains ethanol. This is easy to do because adding water to a gasoline sample will extract the ethanol and increase the water phase volume. The test methods are shown in the box below. Safe and enjoyable flying! △

Brian Kenny is a fuel quality expert with a major oil company. He is responsible for automotive and aviation fuel specifications. He owns and operates both an amateur-built and a certified aircraft with an STC for automotive gasoline use.

Test Methods for Determining the Presence of Alcohol in Fuel

(Ref.: Airworthiness Manual Advisory 549)

The two methods described here are equivalents. They are based on the property of alcohol to combine with water or ethylene glycol, and therefore, separate from gasoline. Alcohol fuels could damage fuel systems and engines, and therefore, should not be used.

(a) *Water method*

(1) In a small-diameter transparent cylinder, put approximately 10 mL of water, and clearly mark the level.

(2) Add approximately 100 mL of test fuel.

(3) Shake vigorously, then let stand.

(4) If, after settling, it is apparent that the water volume at the bottom has increased, alcohol is present.

(b) *Ethylene glycol method*

(1) In a small-diameter transparent cylinder, put approximately 100 mL of test fuel, and clearly mark the level.

(2) Add approximately 10 mL of ethylene glycol.

(3) Shake vigorously, then let stand.

(4) If, after settling, it is apparent that the fuel volume at the bottom has decreased, alcohol is present.

Oh! Oh! What About the O-Rings?

On August 8, 2006, a Cessna 170 was conducting a full-stop landing at Fort McMurray, Alta., when the engine stopped and the aircraft had to be manually pushed off the runway. The owner had filled the tanks about three weeks prior to the incident. He had drained the tanks and got some water from the left tank. When he drained the right tank he didn't realize that the contents in the sample tube were entirely water. Upon inspection, it was discovered that the right tank contained about a gallon of water. It was determined that the O-rings (gaskets) in the filler caps were unserviceable. Rainwater had most likely displaced the gasoline. This incident serves as a good reminder for aircraft maintenance engineers (AME) to carefully check the condition of the fuel cap seals anytime they perform an inspection, and for pilots to ensure that all the water is drained from the tanks when they do their walk around. △

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 A03P0247—Loss of Engine Power—Collision with Terrain

On August 17, 2003, a Bell 204B helicopter was involved in forest fire suppression at Bonaparte Lake, B.C. At about 11:05 Pacific Daylight Time (PDT), the helicopter departed a staging site, eastbound, slinging an empty water bucket on a 100-ft longline. Shortly after takeoff, the helicopter emitted a high-pitched, oscillating sound. The flight path and behaviour of the helicopter were normal as it went out of view over some trees. Immediately thereafter, there was a pronounced slap sound of the main rotor blade, followed by sounds of impact with the trees. The helicopter struck the ground just short of a small clearing adjacent to a fire road, about 0.25 NM southeast of the staging site. A post-impact fire ensued, which destroyed the helicopter. The main driveshaft assembly remained attached to the engine and transmission input quill assembly. The water bucket was found in a tree, detached from the longline, on the approach to the accident site. The longline was wrapped around another tree and lay in a direct line to the helicopter. The pilot was fatally injured.

Circle indicates where the bucket got caught

Findings as to causes and contributing factors

1. An imbalance of the engine compressor rotor assembly developed during the operation of the engine, resulting in contact between the rotor and stator assemblies. The contact led to the destruction of the compressor rotor assembly and engine failure. No conclusion could be reached with respect to the mode of failure that caused the imbalance.
2. The combination of altitude, terrain features and the trailing longline, negatively affected the pilot's ability to complete a successful emergency landing in autorotation.

Findings as to risk

1. Some procedures used in the engine overhaul process were not in accordance with the manufacturer's overhaul manual; failure to comply with the manufacturer's instructions could compromise the integrity of the assembly and result in failure.
2. Field adjustments to the engine fuel control take-off trim without the confirmation of an N1 topping check for accuracy, introduce a risk of frequent or continuous operations at gas generator speeds and internal temperatures beyond established limits.
3. An inconsistent placement of the external cargo release switch increases the risk of pilot confusion during an emergency when trying to activate the external cargo hook-release mechanism, possibly complicating an emergency landing.
4. The foot pedal backup quick release is an approved system. However, its effectiveness is reduced because it requires the pilot to take one foot off of a primary flight control in an emergency.

Safety action taken

In December 2003, a Federal Aviation Administration (FAA) inspection of the engine overhaul company's facilities and procedures was conducted. It was determined by the FAA that, at the time of the inspection, the inspectors "[were] confident that the company [had] the data, experience and knowledge to properly overhaul the engines for which they are rated."

All Canadian operators of the T5311B engine were advised of the safety concerns identified during the overhaul process at the company's facilities.

The helicopter operator has standardized the cyclic grips in all of its aircraft (excluding the Robinson 44s, which are incompatible for such a modification), so that the switches are the same in each type. It has also moved the emergency (manual) release to the collective in its Eurocopter AS350 and is searching for supplemental type certificates (STC) applicable to the rest of its fleet. The rationale is that the emergency-release systems (isolated pull handles or foot pedals) in the other aircraft also require the use of either hands or feet for operation; therefore, requiring the pilot to let go of a flight control in order to release an external load via the emergency release. With the manual release on the collective, activation is possible without requiring pilots to remove their hands or feet from primary flight controls.

TSB Final Report A04C0098—Loss of Control and Collision with Terrain

On May 18, 2004, at approximately 17:00 Eastern Daylight Time (EDT), a de Havilland DHC-2 Beaver aircraft with one pilot and three fish camp guests departed the company's water base, 22 km south of Sioux Lookout, Ont., on a day VFR flight to a remote fish camp located at Fawcett Lake, Ont. A second company DHC-2 Beaver arrived later with more guests, only to discover that the first group had not arrived. The accident aircraft was found overturned in the lake and authorities were alerted. Ontario Provincial Police divers recovered the bodies of the pilot and the three passengers. The aircraft sustained substantial damage. There was no fire.

View of the wreckage during recovery operation

Findings as to causes and contributing factors

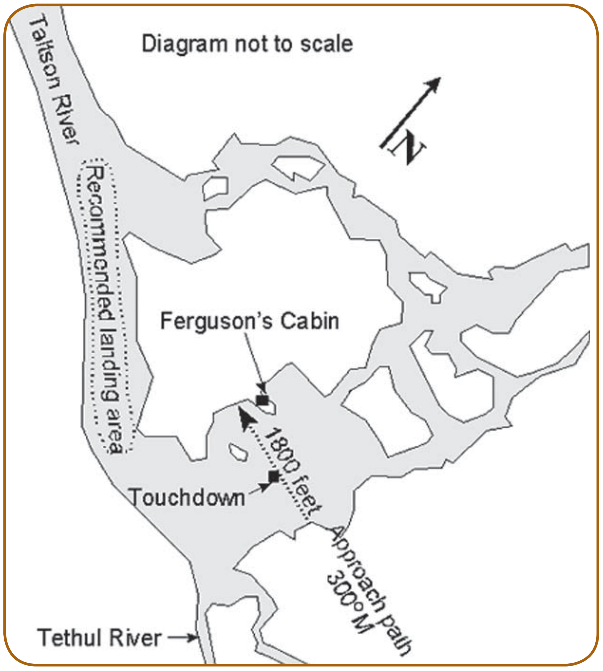
1. The pilot flew a high-drag approach configuration for which his proficiency was not established.
2. The pilot most likely allowed the airspeed to decrease to the point that the aircraft stalled on approach at an altitude at which recovery was unlikely.
3. The impact was non-survivable because of the high impact forces.

Findings as to risk

1. The pilot did not secure the cargo prior to flight, which allowed the cargo to shift forward on impact.
2. The weight and centre of gravity (C of G) were not indicated in the operational flight plan and load record, and the aircraft's weight and C of G could only be estimated.

TSB Final Report A04W0114—Upset on Water Landing

On June 4, 2004, a Cessna A185F seaplane departed Four Mile Lake, Alta., on a VFR flight to Taltson River, N.W.T. The purpose of the flight was to transport three passengers to a site on the river known as Ferguson's Cabin. At approximately 17:00 Mountain Daylight Time (MDT), as the aircraft was landing on the water near Ferguson's Cabin, the left float dug in, and the left wing struck the water. The aircraft immediately cartwheeled and came to rest floating inverted in the river, with only the bottoms of the floats visible at the surface. The pilot and the front seat passenger sustained serious injuries; however, they managed to exit the submerged and damaged aircraft through a broken window in the left cabin door. Four fishermen in boats responded to the accident, removed the survivors from the cold water and transported them to a warm shelter. The rear seat occupants drowned. One decedent was found inside the aircraft and the second decedent was found two days after the accident, outside the aircraft, near the position where the aircraft had crashed, in 55 ft of water.



Landing area at Ferguson's Cabin

Findings as to causes and contributing factors

1. For undetermined reasons, the aircraft contacted the water in a nose-low attitude on landing or entered a nose-low attitude shortly after touchdown. As a result, the left float dug in and the aircraft cartwheeled.
2. The survivors were unable to locate the interior door handles after the seaplane became inverted and submerged in the water, thus preventing them from using the doors as emergency exits.

Findings as to risk

1. Seaplane passengers who do not receive underwater egress information during a pre-flight briefing or on a safety-feature card may not be mentally prepared for an emergency exit from a submerged aircraft.
2. The life preservers were not stowed in an area that made them easily accessible to the occupants.
3. The pilot and front passenger were not wearing their available shoulder harnesses during the landing, as required by regulation.
4. The baggage was not secured in the baggage compartment, which increases the risk of injury to the occupants during the crash or could impede their exit from the aircraft.
5. The weight of the baggage in cargo area 1 probably exceeded the compartment's structural limit and increased the probability of damage to the aircraft.

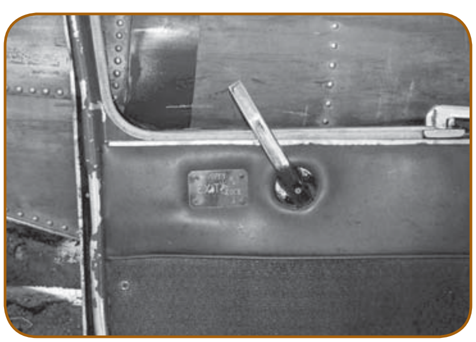
Safety action taken

Transport Canada (TC) published a comprehensive article on underwater egress in the *Aviation Safety Letter* (ASL) 1/2005 and updated safety promotion material. The Department also reviewed the safety-feature card/placard information required under section 703.39 of the *Canadian Aviation Regulations* (CARs), and this information was deemed appropriate for seaplane operations.

Safety concern

Risk of Drowning in Survivable Seaplane Accidents

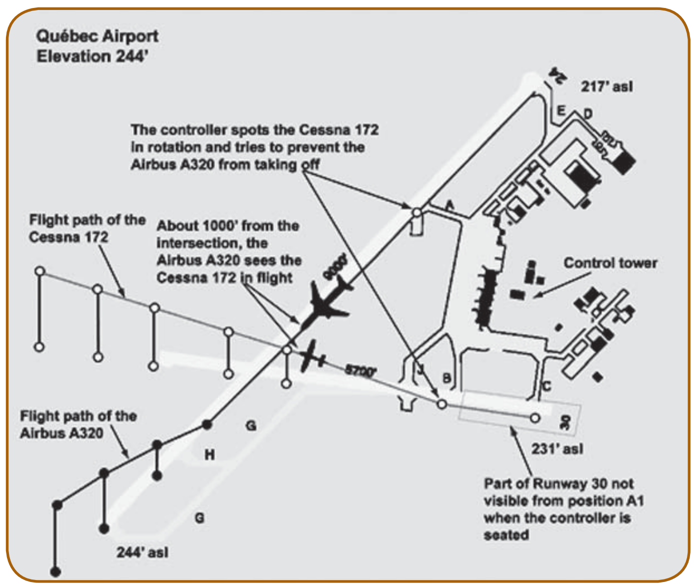
Based on historical data, occupants of submerged seaplanes who survive the accident continue to be at risk of drowning inside the aircraft. The TSB believes that existing defences against drowning in such circumstances may not be adequate. In light of the potential loss of life associated with seaplane accidents on water, the TSB is concerned that seaplane occupants may not be adequately prepared to escape the aircraft after it becomes submerged. The Board is also concerned that seaplanes may not be optimally designed to allow easy occupant egress while under water.



Pilots must clearly instruct all passengers on the location and usage of all door handles and emergency exits.

TSB Final Report A04Q0089—Risk of Collision Between Airbus A320 and Cessna 172

On June 13, 2004, at 09:33:44 EDT, an Airbus A320 was cleared for takeoff on Runway 24 of Québec/Jean Lesage International Airport, Que. Sixteen seconds later, the controller instructed a Cessna 172 to taxi to position on Runway 30. At 09:34:50, the controller saw the Cessna 172 roll and take off toward the intersection of Runways 30 and 24. Immediately, the controller ordered the Airbus A320 to abort takeoff twice. Seeing that the Airbus A320 was continuing its take-off run, he ordered the Cessna 172 three times to turn left. None of these attempts to contact the pilots was successful because the transmit function of the airport control radio had been previously disabled by the controller in an attempt to improve radio reception quality. Approximately 1 000 ft from the intersection, at rotation speed, the captain of the Airbus A320 saw the Cessna; he immediately ordered the co-pilot not to take off until they had crossed Runway 30. The Cessna flew over the Airbus A320, about 200 ft above it, at the intersection of the two runways. There were no injuries.



Findings as to causes and contributing factors

1. The Cessna 172 took off without clearance from Runway 30, causing a risk of collision with the Airbus A320.
2. The controller instructed the Cessna 172 to taxi to position on Runway 30, but did not instruct it to wait and did not advise that the Airbus A320 was taking off on Runway 24. The controller did not anticipate that the Cessna 172 might take off without clearance, causing a risk of collision with the Airbus A320.

3. Given that the controller deactivated the transmit button for the air frequency, neither the Airbus A320 nor the Cessna 172 could hear the controller's instructions to abort takeoff.

Findings as to risk

1. The *Air Traffic Control Manual of Operations* (ATC MANOPS) does not clearly define criteria for numbering aircraft in the departure sequence.
2. Some controllers in the Québec tower misunderstood the operation of some functions of the radio console.
3. Canadian and U.S. phraseologies used to clear an aircraft onto a runway are similar in wording to International Civil Aviation Organization (ICAO) phraseology to hold an aircraft short of a runway. Those similarities open the door to misinterpretation by crews, with potential for catastrophic consequences.

Other findings

1. The absence of simulation of emergency situations and equipment failures in ongoing training contributed to the controller's inability to solve the problem that he was confronted with.
2. A review by the TSB of NAV CANADA's evaluations revealed that the division responsible for NAV CANADA's evaluations did not realize that some controllers were not complying with standard practices and procedures.

Safety actions taken

NAV CANADA has indicated that the following safety actions have been taken since this incident:

1. Improvements have been made in the area of individual competency verifications in the Québec tower in the last year. Observations of operational skills application are to be of a minimum of four hours, based on major operational duties as per the unit task analysis. Any discrepancies identified as being critical, result in removal from operational duties followed by retraining, as required. Activities related to the monitoring of the application of operational communication skills have also been bolstered, and results are mathematically calculated according to a grid based on the errors detected and the relative seriousness of each error. In all cases where individual controllers do not maintain unit standards, they are removed from operational duties and provided with remedial training, as required.
2. As a result of a NAV CANADA Head Office Unit evaluation, the Québec tower manager has issued *Operations Bulletin Number 04 40*, published on 15 July 2004, outlining the results of the recent Head Office evaluation concerning identified deficiencies in phraseology. In addition, the control tower supervisors were instructed to increase their monitoring and to make direct interventions whenever it was observed that controllers were not conforming to approved phraseology. Supervisors were also directed to be more rigorous in the evaluation of communication skills, and a grid was implemented to facilitate the rating of individual performance in this area and facilitate the establishment of corrective actions when required.
3. Through recent changes implemented in the operations safety investigations reporting process on staff utilization, NAV CANADA will further assess the decision-making processes of operational supervisors and implement changes where necessary.
4. NAV CANADA undertook a major rewrite of the basic visual flight rules air traffic control (VFR ATC) training course delivered at its training facility and implemented the new curriculum in June 2004. Emergency procedures are taught using instructor-led classroom activities that include the associated phraseology. Non-compliance situations by a pilot are taught in the classroom and are practised in a number of exercises in the dynamic 360-degree airport simulator throughout the course.

TSB Final Report A04H0004—Reduced Power at Takeoff and Collision with Terrain

On October 14, 2004, a Boeing 747-244SF was being operated as a non-scheduled international cargo flight from Halifax, N.S., to Zaragoza, Spain. At about 0654 coordinated universal time (UTC), 3:54 Atlantic Daylight Time (ADT), the aircraft attempted to take off from Runway 24 at the Halifax International Airport. The aircraft overshot the end of the runway for a distance of 825 ft, became airborne for 325 ft, and then struck an earthen berm. The aircraft's tail section broke away from the fuselage and the aircraft remained in the air for another 1 200 ft before it struck terrain and burst into flames. The aircraft was destroyed by impact forces and a severe post-crash fire. All seven crew members suffered fatal injuries.

Findings as to causes and contributing factors

1. The Bradley take-off weight was likely used to generate the Halifax take-off performance data, which resulted in incorrect V speeds and thrust setting being transcribed to the take-off data card.
2. The incorrect V speeds and thrust setting were too low to enable the aircraft to take off safely for the actual weight of the aircraft.
3. It is likely that the flight crew member who used the Boeing Laptop Tool (BLT) to generate take-off performance data did not recognize that the data were incorrect for the planned take-off weight in Halifax. It is most likely that the crew did not adhere to the operator's procedures for an independent check of the take-off data card.
4. The pilots did not carry out the gross error check in accordance with the company's standard operating procedures (SOP), and the incorrect take-off performance data were not detected.
5. Crew fatigue likely increased the probability of error during calculation of the take-off performance data, and degraded the flight crew's ability to detect this error.
6. Crew fatigue, combined with the dark take-off environment, likely contributed to a loss of situational awareness during the take-off roll. Consequently, the crew did not recognize the inadequate take-off performance until the aircraft was beyond the point where the takeoff could be safely conducted or safely abandoned.
7. The aircraft's lower aft fuselage struck a berm supporting a localizer antenna, resulting in the tail separating from the aircraft, rendering the aircraft uncontrollable.
8. The company did not have a formal training and testing program on the BLT, and it is likely that the user of the BLT in this occurrence was not fully conversant with the software.

While we would have liked to publish the remainder of the TSB's extensive conclusions on this report, space considerations prevented us to do so. Therefore our readers are encouraged to read the complete Final Report of this major investigation in the Air Reports section of the TSB Web site: www.tsb.gc.ca/en/reports/air/2004/a04h0004/a04h0004.asp. *—Ed.*

TSB Final Report A05P0018—Control Difficulty Due to Airframe Icing

On January 19, 2005, a Beechcraft King Air 200, with two pilots and two paramedics on board, departed Prince George Airport, B.C., at 12:28 Pacific Standard Time (PST) on an IFR medical evacuation (MEDEVAC) flight to Cranbrook, B.C. The flight was dispatched to transport two patients from Cranbrook to Kelowna, B.C. During cruise flight at 15 000 ft ASL, the aircraft was in icing conditions. The aircraft's ice-protection equipment dealt effectively with the icing conditions until about 45 min after takeoff, when the aircraft began to accumulate ice at a rate that exceeded the capabilities of the ice-protection equipment. The airspeed decreased to the point that a descent was required and, despite the crew selecting maximum available engine power, the aircraft descended from 15 000 ft to 10 800 ft; below the minimum obstacle clearance altitude (MOCA) for the area. Vancouver ATC issued emergency vectors to guide the aircraft down the Arrow Lakes area to avoid high terrain. Several minutes later, the pilots advised that they were clear of cloud and proceeding to Kelowna. Accumulated ice, up to 6 in. thick, was shed during the approach to Kelowna, where an uneventful landing was made.

Findings as to causes and contributing factors

1. The pilot-in-command (PIC) did not review the available graphical area forecast (GFA) weather information and was not sufficiently informed to avoid the forecast icing conditions.
2. The severe in-flight icing conditions caused an ice accumulation that the aircraft's ice-protection systems were unable to prevent or remove. As a result, the aircraft entered a power-on stall condition and an uncontrollable descent.
3. The PIC did not detect the severe ice accumulation in sufficient time to alter the flight route to avoid the icing conditions.

Safety action taken

Following an internal investigation into the occurrence, the company, as an interim safety action, distributed a memorandum to advise flight crews to review all available weather data before flights. The company has since developed a syllabus, examination and emergency checklist regarding severe icing, and has implemented them as part of its training program to provide flight crews with more in-depth knowledge of severe icing conditions and exit strategies.

TSB Final Report A05O0147—Collision with Water

On July 18, 2005, the pilot of a Cessna A185F seaplane was on his first return flight of the season from his cabin at Norcan Lake, Ont., to his home near Constance Lake, Ont. This flight, conducted according to VFR, included a stop for fuel at Centennial/Black Donald Lake. After refuelling, the pilot took off and, at approximately 10:45 EDT, the aircraft was about 100 ft above the north shore of the eastern section of Constance Lake, proceeding in a southerly direction.

At approximately 10:50 EDT, the aircraft cartwheeled on the lake, travelling in a northwesterly direction and adjacent to the north shore of the eastern section of the lake. The aircraft came to rest inverted in the lake with most of the aircraft visible. It floated approximately 500 ft east, then came to rest on the bottom of the lake, with only the bottom of the floats visible. Some local residents attempted a rescue, but they were unable to get the pilot out of the aircraft. The pilot had manoeuvred himself into the right seat, but he was unable to exit the aircraft, and drowned.

Findings as to causes and contributing factors

1. For undetermined reasons, the aircraft cartwheeled after contacting the water and came to rest in an inverted position.
2. The pilot was unable to exit the aircraft, and drowned.

Findings as to risk

1. The pilot had not flown a training flight with an instructor for more than four years. This likely resulted in a degradation of his skills and decision-making processes.
2. The current recency requirements in Canada allow pilots to go for extended periods without retraining on critical flight skills, presenting a risk that pilots will be ill-prepared to deal with unusual or critical flight situations when they arise.
3. The design of the door lock mechanism on the Cessna A185F prevents opening the doors from the outside when locked from the inside. This same design is currently being used in all of Cessna's new production single-engine aircraft.
4. The exterior door handles are not easily discernable when the handles are closed and visibility is poor.
5. The pilot was not wearing his prescription glasses while flying.
6. The emergency locator transmitter (ELT) switch was not in the armed position, preventing activation on impact.

Other finding

1. It could not be determined whether the pilot had complied with the recency requirements of subsection 401.05(2) of the CARs.

Safety concern

The following safety concern is similar to the one published in report A04W0114, described earlier in this article. Based on historical data, occupants of submerged seaplanes who survive the accident continue to be at risk of drowning inside the aircraft. Existing defences against drowning in such circumstances may not be adequate. In light of the potential loss of life associated with seaplane accidents on water, the TSB is concerned that seaplane occupants may not be adequately prepared to escape the aircraft after it becomes submerged. Of equal concern is that the rescuers, in this occurrence, could not access the cabin from outside. △

New Video on the Web: Keep Your Eyes on the Hook!

Transport Canada's newest aviation safety video, *Keep Your Eyes on the Hook! Helicopter External Load Operations—Ground Crew Safety* (TP 14334), is now available to view on the Web at www.tc.gc.ca/CivilAviation/SystemSafety/Videos/tp14334.htm.

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 between May 1 and July 31, 2006, are all "Class 5," and are unlikely to be followed by a TSB Final Report.

— On May 1, 2006, a Canadian-registered **Robinson R44 Raven II helicopter**, with the pilot and one passenger on board, was en route from Torrance, Calif., to Blenheim, Ont., when it crashed near Desert Center, Calif. The accident pilot had taken delivery of the new helicopter from the Robinson Helicopter Company factory in Torrance on the day of the accident. The pilot and passenger were fatally injured and the aircraft was destroyed. Preliminary reports suggest the tail boom had separated from the fuselage. The U.S. National Transportation Safety Board (NTSB) is investigating (NTSB identification: LAX06FA156).
TSB File A06F0072.

— On May 4, 2006, a **float-equipped Piper PA18-150** had a hard landing on Canim Lake, B.C., resulting in substantial damage to the aircraft. There were no injuries and the aircraft did not sink. At the time of the accident, the weather was clear with no wind. The lake surface condition was reported to be wave-free (glassy).
TSB File A06P0072.

— On May 6, 2006, a **Piper PA-28-161** aircraft, flown by a rental pilot, was carrying out a crosswind landing on Runway 24 at Hamilton, Ont. (CYHM). During the flare, the aircraft drifted left and landed on the grass beside the runway. The aircraft then struck a hold short sign and was substantially damaged. There were no injuries.
TSB File A06O0109.

— On May 6, 2006, a privately-operated **Piper PA-18 Super Cub** was departing from a 900-ft-long beach on the west shore of Dillberry Lake, Alta., with the pilot and one passenger on board. The direction of takeoff was to the south. The aircraft became airborne after a longer-than-expected ground run, and a left turn was immediately initiated to avoid high trees at the end of the beach. Subsiding air and tailwind conditions were encountered during the turn, and the right wing struck a post. The aircraft veered to the right and descended into brush, and the main gear collapsed. The pilot and passenger were uninjured; however, the aircraft sustained substantial damage. The surface wind at the beginning of the take-off area was estimated to be southwest at 5 kt; the wind above the trees was estimated to be west at 25 to 30 kt. *TSB File A06W0060.*

— On May 14, 2006, an **advanced ultralight Rans S-9 Chaos** was on final approach to the Glen Valley Airstrip (a practice area near Fort Langley, B.C.), when its main landing gear caught a power line. The aircraft somersaulted and landed in a ditch, right side up. The pilot suffered no injury except for a bruise from his shoulder harness, but the aircraft sustained substantial damage. The power line broke and started several ground fires.
TSB File A06P0084.

— On May 18, 2006, an **M18A Dromader** was applying herbicide to a field 25 NM northwest of Speedy Creek (Swift Current), Sask. The aircraft struck the terrain while manoeuvring to position for a spray run. The aircraft sustained substantial damage and the pilot sustained minor injuries. There was no post-impact fire.
TSB File A06C0069.

— On May 21, 2006, a **Bell 206B helicopter** was being ferried from Slave Lake, Alta., to Wabasca, Alta. While en route, the pilot encountered deteriorating weather and performed a precautionary landing. During touchdown, the main rotor blades struck a tree. When the weather improved, the helicopter was flown back to Slave Lake for maintenance to determine the extent of the damage. Subsequently, the operator reported that although the mast passed the torsion yield test, one main rotor blade had to be replaced and the other required repair. The drive train also needed to be overhauled, as per the manufacturers directions. *TSB File A06W0066.*

— On May 27, 2006, an **amateur-built, amphibious Seawind 3000** aircraft was performing circuits on Lake St. Clair, approximately 15 NM northeast of Windsor, Ont. After a normal touchdown, the aircraft hit a wake created by a boat, which caused both sponsons to be torn from the wings. The aircraft did not flip over and it maintained its buoyancy. There were no injuries and the aircraft was towed safely to a nearby marina.
TSB File A06O0125.

— On May 29, 2006, a Canadian-registered **Eurocopter AS 350 BA helicopter** was returning VFR from Florida to Quebec. While on a leg between Camden, NJ, and Glen Falls, NY, during level cruise flight, the hydraulic system pump failed and the pilot attempted a landing in an open field near Goshen, NY. At about 30 ft AGL, the pilot lost control of the helicopter and landed heavily. At touchdown, the helicopter sustained substantial damage, but the two occupants were not injured. The NTSB is investigating. (NTSB identification: NYC06LA121). *TSB File A06F0084.*

— On June 5, 2006, an **ultralight Chinook II** had just taken off from Runway 36 at La Sarre, Que., when the Rotax 277 engine shut down. The aircraft was at an altitude of about 200 ft AGL. The pilot made an emergency landing in a wooded area. The right wing struck a tree and the aircraft came to a stop. The pilot was able to evacuate. When medical assistance arrived, he was immediately transported to hospital. The aircraft did not catch fire, but it sustained significant damage. *TSB File A06Q0088.*

— On June 5, 2006, a **Cessna 172P**, with a single pilot on board, was VFR from MacDonald Cartier Airport in Ottawa, Ont., to Mansonville, Que. When landing, the aircraft touched down too far along the 2 800-ft runway. The pilot was not able to stop the aircraft, and it ended up in a ravine at the end of the runway. The pilot was not injured. The aircraft's propeller, engine cowl, and nose wheel were damaged. *TSB File A06Q0089.*

— On June 7, 2006, a **Bell 206L-3 helicopter** was VFR from La Tuque, Que. to Val d'Or, Que. Nearly 30 min after takeoff, at a cruising altitude of 2 000 ft ASL, the pilot noticed fluctuating oil pressure in the Rolls Royce 250 C-30 engine. The pilot landed on marshy terrain. After checking the aircraft and consulting with a technician, the pilot restarted the engine and hovered; oil pressure was normal. The pilot then decided to head to the main road, about 1 km away. The oil pressure started to fluctuate again and the pilot heard an explosion. He made an autorotational landing. The pilot was not injured, but the aircraft sustained significant damage. *TSB File A06Q0091.*

— On June 11, 2006, the pilot of a **Cessna 170B** landed at a private grass strip west of Bowden, Alta., to pick up passengers. Due to soft field conditions, the takeoff was conducted on a paved road adjacent to the strip. During the take-off roll, the pilot lost control, and the aircraft departed the road and entered the ditch. The aircraft sustained substantial damage to the gear and wings; however, there were no injuries to the pilot and three passengers. Gusting crosswind conditions existed, and trees beside the road resulted in fluctuating wind velocity during the take-off run. *TSB File A06W0082.*

— On June 13, 2006, a **Eurocopter AS 350 B2 helicopter** was conducting a hover manoeuvre to land in a confined area to disembark an environmental survey crew. This was the fifth and final stop of the day at a touchdown area different than originally chosen. While backing up, the tail rotor struck an object and began to vibrate. The helicopter touched down on uneven ground and rolled onto its right-hand side. There were no injuries, but the helicopter was destroyed. The pilot turned on the emergency locator transmitter (ELT) and used a satellite telephone to notify the company. The company dispatched another helicopter to pick up the passengers and pilot. *TSB File A06P0104.*

— On June 14, 2006, the pilot of a **Piper J-3 Cub** was landing in a grassy field when the drag of the main wheels in the long grass caused the aircraft to flip over, nose first. The pilot and passenger sustained minor injuries and the aircraft was substantially damaged. *TSB File A06Q0095.*

— On June 17, 2006, a **Eurocopter AS 350 B helicopter** was slinging a net load of plywood on a 50-ft kevlar longline at about 35 kt, when the pilot felt an event and saw that the line had separated about midway. After landing, the pilot noted substantial damage to the right horizontal stabilizer and one main rotor blade, with evidence of contact with one tail rotor blade. Examination of the electronic swivel revealed it had seized. The line had separated in at least four places and one 9-ft section was not recovered. The swivel and line are to be examined by the TSB and the manufacturers. *TSB File A06P0109.*

— On June 19, 2006, a **Cessna 180H** was taking off from Lac-à-la-Tortue, Que., for Lac à Beauce, Que., with two pilots on board. During takeoff, the right wing suddenly lifted and the aircraft tilted towards the left, causing the left wing to touch the water and the aircraft to flip over. The two pilots escaped unharmed, and were taken by boat to the shore of the lake. The aircraft sustained significant damage. *TSB File A06Q0097.*

— On June 24, 2006, a student pilot in a **Cessna 172L** was landing at the Cooking Lake, Alta., airport when the pilot encountered winds. Three attempts to land were made and on the final attempt, during the roll out, directional control was lost and the pilot attempted a go-around. The aircraft was headed toward some low brush at this time and the pilot tried to clear it by pitching up, which resulted in the aircraft stalling and nosing over into the brush. The pilot was uninjured, but the aircraft substantially damaged. *TSB File A06W0097.*

— On June 30, 2006, a **Sundance Balloons International SBA210 hot air balloon** departed from Saskatoon, Sask., with a pilot and eight passengers on board. After a

1-hr sightseeing flight, the balloon was above farmland approximately 15 mi. southwest of the departure point. The pilot commenced a descent to land in a large, flat, grass-covered field. The balloon was traveling slowly and touched down softly on the grass. On touchdown, 1 or 2 in. of water began seeping into the bottom of the basket. The pilot applied the burner and the basket lifted out of the water and slid on the wet grass surface as it moved further down the field. The rectangular basket rotated slowly to an end-on aspect, then encountered an area of dry grass and ground. The pilot elected to land and he released air from the balloon envelope. As the envelope was deflating, the basket dragged and tipped up and slightly over. The burner frame came into contact with the ground and there was a short burst of flame from one of the burners. The pilot and three of the passengers went to hospital with burn or impact-related injuries. All four were released after treatment. The remaining five passengers were not injured. The burner frame was bent and required replacement. The remainder of the balloon was undamaged. *TSB File A06C0097.*

— On July 1, 2006, a **Bell 206L1 helicopter**, with a pilot and two passengers on board, was participating in a Canada Day fly-by in Fort Simpson, N.W.T. While manoeuvring after the first pass, the helicopter contacted a disconnected power line that dead-ended on a power pole. The power line struck a VHF antenna and the advancing pitch link. A severe vertical vibration resulted and the pilot immediately set down in an adjacent baseball diamond. There were no injuries. Maintenance found the red pitch link destroyed, scratches on the mast, damage to the swash plate and small scratches on the red main rotor blade and associated grip. Maintenance planned to replace both pitch links, swash plate and mast. *TSB File A06W0108.*

— On July 2, 2006, a **Wakerjet Spider Paraglider** was operating along the shore of Crescent Beach, N.S. The flight was uneventful until the onshore wind became gusty, which resulted in the aircraft drifting toward some power lines in the area. A turn away from the power lines was initiated at low altitude and the aircraft descended until it struck some rocks along the shoreline. The pilot was seriously injured. *TSB File A06A0069.*

— On July 7, 2006, the pilot of a **Nordic II** was investigating a loss of engine power (Continental model 0-200), which had led to a precautionary landing the previous day. He disconnected the high tension lead from the upper spark plug in the left front cylinder (No. 4) and connected it to a backup spark plug in order to check the setting at the time of sparking. He asked his wife to hold the spark plug against the cylinder so that he could observe the spark while he turned the propeller by hand. The engine has two magnetos, and since he had not disconnected the leads from the other cylinders, or cut off the other magneto, the engine eventually started up. The pilot's wife inadvertently moved her left arm forward and it intercepted the arc of the propeller. She was struck on the forearm and sustained a deep muscle laceration which kept her in hospital for several days. *TSB File A06Q0116.*

— On July 17, 2006, a **Eurocopter AS350 B-2 helicopter** took off from a clearing about 35 NM northwest of Slave Lake, Alta., for a local flight. A 100-ft longline, which was attached to the aircraft, snagged briefly on trees and recoiled into the tail rotor. The pilot slowed the resulting yaw by reducing collective pitch, and landed the helicopter upright in the clearing. The pilot was uninjured and the helicopter sustained substantial damage to the tail section and skid gear. *TSB File A06W0115.*

— On July 19, 2006, a **Cessna A185F** on floats was making a local flight. Soon after takeoff, one of the floats hit a passenger on a vessel that was on the lake. The injured passenger was hospitalized for three days. At the time of the accident, there was no wind and visibility was unlimited. The takeoff was from glassy water. *TSB File A06Q0128.*

— On July 20, 2006, two **Cessna 182** aircraft were moving on Taxiway Delta at the Baie Comeau, Que., airport, preparing to take off for a forest fire patrol. The pilot of the second Cessna was attending to the wind sleeve and did not notice that the first Cessna had stopped in front of him, prior to taking up its position on the runway. He was unable to stop in time and the two aircraft collided. The first aircraft sustained significant damage to the rudder and the lift. The second sustained damage to the propeller. No one was injured. *TSB File A06Q0127.*

— On July 22, 2006, a **Hughes 369D helicopter** had toed-in to a hillside in the Bonnet Plume area, Y.T., to pick up two geologists. One passenger stepped onto the right skid and the other intended passenger, who was crouching on slightly sloping terrain to the right and front of the helicopter, stood up and was struck by the main rotor. The person who was struck sustained fatal injuries, but there were no injuries to the other passenger or the pilot. There was minor damage to the helicopter, which returned to its base camp about 6 NM from the site of the occurrence. *TSB File A06W0122.* △

Enforcement Approach in the New SMS World

by Franz Reinhardt, Director, Regulatory Services, Civil Aviation, Transport Canada

As Transport Canada and the aviation industry set out to implement safety management systems (SMS), Civil Aviation must be proactive in developing a flexible enforcement approach to this evolving safety framework. The policy will provide a means of promoting voluntary compliance with regulatory requirements, without necessarily resorting to punitive action by Transport Canada. This can be done by providing certificate holders governed by an SMS the opportunity to determine, by themselves, proposed corrective measures to prevent the recurrence of a contravention, as well as the best course of action to help foster future compliance. However, intentional contraventions of the *Aeronautics Act* and the *Canadian Aviation Regulations* (CARs) will still be investigated and may be subject to enforcement action.

When a certificate holder governed by an SMS allegedly commits a contravention that is not deliberate, specific review procedures will be used. These procedures will allow the Transport Canada manager responsible for the oversight of the certificate holder the opportunity to communicate with the SMS-governed organization. This will give the organization a reasonable amount of time to develop proposed corrective measures and an action plan that will adequately address the deficiencies that led to the contravention. The purpose of this approach is to nurture and sustain a safety culture, whereby employees can confidentially report safety deficiencies without fear of subsequent punitive action. The certificate holder's management can then, without apportioning blame, and without fear of enforcement action, analyze the event and the organizational or human factors that may have led to it, in order to incorporate corrective measures that will best help prevent a recurrence.

Transport Canada, through the interaction of the manager responsible for the oversight of the certificate holder, will then evaluate the proposed corrective measures, or the systems currently in place to address the event. If these are considered appropriate, and are likely to prevent a recurrence and foster future compliance, the review of the alleged contravention will then be concluded with no enforcement action. In cases where either the corrective measures or the systems in place are considered inappropriate, Transport Canada will continue to interact with the certificate holder to find a satisfactory resolution that would prevent enforcement action. However, in cases where the organization refuses to address the event and provide effective corrective measures, Transport Canada will consider taking enforcement action or other administrative action regarding the certificate.

In order to support the implementation of SMS, Civil Aviation inspectors will continue to communicate openly with those certificate holders who are proactively engaging in SMS.

Transport Canada will not compromise safety, nor ignore any contraventions of the regulations, but will encourage the development of a safety culture as an essential element of the SMS framework. △

Feedback on ASL 4/2006...

The last issue of the *Aviation Safety Letter* (ASL 4/2006) led to some interesting e-mails.

- An error slipped into the answer key for the "2006-2007 Flight Crew Recency Requirements Self-Paced Study Program," published on page 38 of ASL 4/2006. The correct answer to question 1 is **30.14**.
- A reader commented on the answer to question 24 of the same questionnaire—the minimum advance notice of **one hour** to advise U.S. Customs when flying across the border. He commented that one hour is low, and some regional airports in the U.S. actually require two hours' notice. Common sense should prevail, and we also recommend two hours or more. It would be best to verify with your first port of entry.
- A few readers complained about the publication of a letter to the editor that criticized the crews of a CL-215 and an Astar helicopter for seemingly not monitoring the aerodrome traffic frequency (ATF) at the Lac La Biche airport, Alta. It was later discovered that, indeed, the facts were improperly reported, and there was no such lack of professionalism by either of these crews. The ASL apologizes to those involved.

Thank you to the many readers who contacted us. Your feedback is appreciated and very important to us. —*Ed.*

Civil Aviation Issues Reporting System— Transport Canada Civil Aviation Wants to Hear From You!

The Government of Canada aims to provide the highest quality of service to the public and is moving towards achieving this by modernizing government management. To accomplish this, *Results for Canadians: A Management Framework for the Government of Canada* was released in March 2000, which explains that our government's management philosophy should be based on four commitments: citizen focus, values, responsible spending and achieving results. Living up to these commitments requires all public service employees and organizations to put the interests of Canadians first and demonstrate daily attention to values and results.

To meet these commitments, Transport Canada Civil Aviation (TCCA) is implementing an integrated management system (IMS) to promote a well-performing public sector to serve Canadians. It is of note that the principles of IMS are similar to those of a safety management system (SMS); for example, an effective reporting culture is a necessary component of both IMS and SMS. Through the IMS, TCCA will address its long-standing priority of improving access to services and improving stakeholder satisfaction.

Recognizing the benefits of stakeholder feedback, TCCA had previously implemented the *Complaint Handling Policy and Procedure* in 1997, aimed at improving stakeholder relationships by listening to, and then resolving, identified issues. However, this policy had limitations, including the absence of tracking mechanisms to follow improvement opportunities and communication with correspondents. To address the limitations and meet the commitments of *Results for Canadians*, the *Complaint Handling Policy and Procedure* has now been replaced by the Civil Aviation Issues Reporting System (CAIRS).

CAIRS was launched on May 3, 2005, and made it possible for TCCA's internal and external stakeholders to raise a wider range of issues (concerns, complaints, compliments or suggestions for improvement) with management. The key principles of CAIRS are to foster a respectful work environment through the prevention, effective management and prompt resolution of issues at the lowest possible level in the organization; as well as to provide a basis for a reporting culture within the aviation industry. Such a reporting system creates a work environment where issues are seen as opportunities to continually improve the way TCCA does business.

CAIRS seeks to resolve issues at the lowest possible level before initiating formal or established redress mechanisms. Yet, this system is not designed to report immediate safety hazards or to substitute for formal consultations, such as the Canadian Aviation Regulatory Advisory Council (CARAC) process. In addition, it is expected that aviation industry issues first be reported and addressed through an aviation company's SMS, before being submitted to CAIRS. This system will also offer TCCA the opportunity to respond to other forms of legislation requirements.

CAIRS provides the means to track issues, ensuring that no issue is left unattended. It is expected that all issues will be responded to in a timely manner. Service standards for addressing CAIRS issues have been established and provide a structured and consistent approach to all issues.

Receiving feedback on how services may be improved is far more important than assigning blame. Individuals are encouraged to use CAIRS, as it gives TCCA the opportunity to continually improve while responding to stakeholders and their needs.

Anyone with a concern, complaint, compliment or suggestion for improvement is encouraged to complete the Online Request for Review Form, available at: www.tc.gc.ca/CivilAviation/QualityAssurance/QA/cairs.htm.

Further information can also be obtained from TCCA by calling **1-800-305-2059** or by e-mailing: services@tc.gc.ca. △

TAKE FIVE...

for safety

Five minutes reading could save a life

Aircraft Maintenance Operational and Functional Checks

The following are reminders for aircraft maintenance engineers (AME) prior to performing aircraft operational or functional checks. These do not, and are not meant to, replace aTC/FAA-approved aircraft flight manual, or the aircraft's pilot operating handbook (POH) operation checklist. Prepared by System Safety, Atlantic Region.

Before the task:

1. Confirm inspection sheets/package are completed and appropriately signed off.
2. Check records/worksheets for any special attention required during aircraft operation.
3. Confirm personnel are trained, current and appropriately endorsed on type.
4. Be familiar with airport operator's policies, procedures/practices, aprons, signage, runways, and designated ground-run areas.
5. Take along a copy of the aerodrome diagram for reference [from Canada Airport Charts on the NAV CANADA Web site, or from the *Canada Air Pilot* (CAP)].

Before start:

1. Always refer to the aircraft's POH operation checklist. Never rely on memory.
2. Conduct a walk around of the aircraft and area for foreign object damage (FOD), loose items, control locks, inlet plugs, covers, chocks, tow-bars and tie downs.
3. Check for personnel or parked aircraft nearby. Reposition the aircraft to prevent damage or injuries.
4. Verify that the nose gear torque links attachment is secure.
5. Verify all the aircraft fluid levels. Take fuel samples, as appropriate.
6. Ensure all panels and engine cowlings are in place and secured, as required for engine operation.
7. Check that all breakers and fuses are set.
8. Place a fire extinguisher nearby, and have trained personnel on visual watch, as required.
9. Be familiar with the location of on-board fire extinguishers.
10. Verify brake operation.
11. Be familiar with the aircraft communication equipment, frequencies, and radio licence requirements.
12. Always carry a reliable flashlight when doing functional checks at night.
13. Be familiar with the aircraft emergency procedure checklist.

During operation and taxiing:

1. Always maintain communication with ground or apron controller, and report intentions before moving.
2. Position aircraft into the wind for optimized engine cooling.
3. Consistently monitor engine parameters from left to right and top to bottom for irregularities.
4. Always remain within the aircraft operating limitations.
5. Maintain professionalism in the cockpit.
6. Do not RUSH!
7. Keep taxi speeds to a minimum.
8. While taxiing, keep hands and feet on controls at all times.
9. Be prepared to shut down the engines.

Secure the aircraft:

1. Again, refer to the aircraft's POH operation checklist. Never rely on memory.
2. Follow the recommended engine cool down period.
3. Ensure all switches are turned off, and breakers are checked.
4. Visually check fluid levels and surrounding areas for fluid leaks.
5. Properly secure the aircraft.

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Flying VFR in the Mountains

Flying VFR in the mountains calls for a few extras…

Flightplan for reduced power, prop efficiency and lift at the higher altitudes you'll meet in the mountains:

- the density altitude is the key
- a lightly-loaded aircraft is best—but carry enough fuel

Carefully study the terrain beforehand so you'll always know what's ahead:

- always use current charts and a valid *Canada Flight Supplement* (CFS)
- choose common VFR routes
- apply the right-hand rule in a valley for traffic separation and room to turn around
- keep map reading enroute so you'll always know exactly where you are
- do not rely solely on GPS for navigation

Get a good weather briefing:

- expect delays; a person in a hurry is a set-up to make the wrong decision to go
- ask for, and pass along, pilot weather reports (PIREP)

Set your own visibility limits well above the regulated minima, and always be prepared to turn back when it becomes less.

Know where the downdrafts are likely to be—and stay away:

- turbulence is a good signpost
- air descending over downwind slopes can exceed an aircraft's climb capability
- daytime heating of a valley slope can generate a downdraft on the shaded side
- constantly monitor your altimeter
- stay away from the violent turbulence of mountain waves and rotor zones—know the warning cloud types

Beware of the valley trap:

- study your charts ahead of time
- get to a safe traversing altitude before entering a valley
- keep at a safe height and avoid flying close to terrain
- as the valley narrows or climbs, turn around before your airspeed starts falling

Remain alert for the false horizon illusion:

- continually monitor your instruments
- suspect an illusion whenever you're surrounded by sloping terrain, i.e. when the horizon's hidden

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