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Aviation Safety

Vortex

Learn from the mistakes of others; you'll not live long enough to make them all yourself... **Issue 2/2000**

Are Helmets a Good Investment? You Bet They Are!

All hazards were identified in a thorough reconnaissance of the job site prior to landing and the identified hazards were again reviewed on the ground before starting the work. The sky was clear, wind calm, temperature 12°C, and humidity 32%.

The spray job was in a rectangular 40-acre field with a power line on the west side running north and south and a row of mature trees on the north and south sides running east and west. A barbed wire fence surrounded the entire field.

The field was seeded to corn and the crop was about three inches high. The circumference of the field was bordered by a 30- to 40-ft. strip of barley. The chemical used that day was MCPA and we were using an ultra-low-volume application.

All equipment was tested before starting the work and both the helicopter and spray gear were operating as expected.

I flew one orientation pass from south to north (the longest side of the rectangular field), noting the power line, which was about 50 ft. away on my left. I turned right, away from the power line, and started to apply the product to the field. I had made three passes when I realized that I did not have enough product to do another full pass.

Because of the trees at either end of the field, I decided to spray a headland pass to give me more room to pull up at the treed end of the field. I figured I had enough product remaining to do one headland pass before heading back to refill.

I pulled up and flew out of the field to determine how best to approach the headland pass. Flying to the west would bring me too close to the power line at a high rate of speed, so I decided to fly away from the power line. I manoeuvred into position with the power line behind me. I had settled into what I thought was a stable hover but, as I moved slowly forward, I heard a loud bang and the helicopter started spinning violently. I closed the throttle and prepared for impact.

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When all the parts stopped moving, I found myself partway outside the cockpit door opening (both doors had been removed), restrained by my seat belt. The top of the door frame had landed on the temple area of the left side of my head with enough impact force to dent the top of the very rigid door frame. I was firmly pinned under the machine between the door frame and the ground. I undid the chin strap and slid out of the helmet with little effort, as the helmet did not deform or compress enough to trap my head. There was a large black impact mark on the helmet but no visible damage. There is no doubt in my mind that my helmet saved me from serious injury and quite probably death.

When I originally considered purchasing a helmet, I was somewhat deterred by the price. It didn't take me long to figure out that it was the prudent thing to do and now of course, I'm glad I made the choice—the right choice—to buy one.

We have a rigid policy in our company—no one will ride in or fly our helicopter without a helmet. We provide a generic style for our passengers to wear. We will not hire pilots unless they have and agree to wear proper head protection. I discussed this policy with another operator and he indicated that he felt he couldn't legally force his pilots to wear helmets—something to do with their freedom of choice. Be that as it may, we remain resolved in our decision that it is our freedom of choice that helmets are mandatory if aircrew want to work with us.

Helmets save lives. In this pilot's opinion, there is no acceptable substitute.

John Baswick

Assume Nothing—Murphy Never Sleeps!

Upon reading about the latest winner of the NVP [Not Very Professional] Award and the item on Murphy's Corollaries, I was reminded of a time when I came extremely close to nominee status myself.

I was younger and less experienced then, and I had the naïve optimism that seems to go hand-in-hand with total times of under 1000 hr.

I had just arrived at a small forest fire in a remote corner of B.C. after a two-hour flight from my base. I was bucketing with an unfamiliar Jet Ranger with which I had been dispatched in very great haste. When I neared the end of my useable fuel, I called to the forest service straw boss and made arrangements for refuelling. The local forestry crews had driven four barrels of jet B from their compound to the fire on the end of a very long, rough logging road. When they talked me in to their fuel cache, the four barrels were smartly standing in a row, each propped on a stone to tip them slightly, and the straw boss stood, back to the wind, arms outstretched, indicating my landing orientation. It seemed like a professional arrangement.

Once I was on the ground, I got out to examine the barrels—although I was low-time, I *was* cautious. I was immediately suspicious because the barrels were not sealed, but they were very new looking and they were clearly marked "jet B" by the manufacturer. But that wasn't good enough for me. I reached for my tiny flashlight on my flight-suit sleeve and went to do my usual barrel check: *Can I see the bottom of the barrel through the fuel and is there any water?* Of course, the batteries gave up at that very moment. I sighed, but wasn't really concerned. I always carried a regular flashlight on the hat rack for my pre-flight. I opened the door and reached in . . . nothing . . . *Agghh!* I'd left in such a hurry in this aircraft, which was not my regular aircraft, that my back-up flashlight had been left behind at my base. I had a decision to make and I made it quickly.

- The fuel was supplied by the forestry;
- The barrels looked brand new. (I even stuck my nose in the barrel and it

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

had the distinctive jet fuel smell.);
- The fire was aburning; and
- What are the odds of getting bad fuel the ***one time*** I am without my flashlights?

So I plunked in my pump, complete with WIX sight glass and go-no-go filter, and began refuelling. The pump didn't run long before it began to sound as though it were trying to push toffee through a straw and the sight glass went solid black! I think my verbal description of the scene could have been heard by my base manager back in town.

What had gone wrong? The local ranger had requested two new foresters to drive out the required fuel. They had chosen to ignore the 50 full, sealed barrels of jet B in front of the warehouse and decided to grab the four barrels from behind the warehouse, where the used crankcase oil and off-spec fuel slop was stored over the winter. The ***one time*** I was caught without either flashlight I thought I could risk the use of fuel I hadn't personally inspected. Besides, the government was supplying the fuel, so it must have been good. (Yes, yes, I was young and naïve.)

I never did try to fly with the mixture, but the process of ensuring that the fuel cell was uncontaminated was long and involved, especially since it all took place on the end of a very remote road. The really frustrating part was that after this incident ***everyone*** in the company took me aside at one time or other to caution me on the prudence of carrying a flashlight, emphasizing that I should always check my fuel! But I always carry a flashlight—it was just that one time I was caught short. An alarm bell sounded on Murphy's switchboard and he acted swiftly.

Hope this might be of interest or use to you.

Sincerely,
Ross Campbell
British Columbia

Survival Kit—Don't Leave Home without It

Deep in the dark recesses of almost every helicopter resides a small container, as required by the *Canadian Aviation Regulations* (CARs). CAR 602.61 states the following: Subject to subsection (2), no person shall operate an aircraft over land unless there is carried on board survival equipment, sufficient for the survival on the ground of each person on board, given the geographical area, the season of the year and anticipated seasonal climatic variations, that provides the means for

a) starting a fire;
b) providing shelter;
c) providing or purifying water; and
d) visually signalling distress.

We seldom give it much thought and many times its physical condition reflects this lack of concern. I am

referring, of course, to the survival kit.

There are two significant problems with survival kits. Firstly, as pilots, we seldom think of them until we really need them. Secondly, helicopter manufacturers do not allow much space for carrying emergency equipment, so survival gear ends up in a less-than-ideal location. It suffers by being jammed in with wobble pumps and oil cans and takes on a tattered appearance early in the game.

Some larger operators have an inspection cycle on computer and a safety specialist on staff to ensure that the contents meet the need and the time of year and are in good condition. Smaller companies can't afford to retain a safety specialist and may designate a pilot or engineer to conduct the same duties. Unfortunately, because of other duties, a minimum effort may be expended in assuring that the kits are fit for use.

One company designed and fabricated containers that cleverly fit into the framework of a folded Jet Ranger litter kit. The pilots were made responsible for the inspection procedure. The kits showed a long list of signouts through the years, resembling an aluminium autograph book. However, upon opening these mini-coffins, the contents revealed long-term neglect. Many of the metal articles were badly corroded, or missing, and the food was very questionable. Any food found in containers that are painted army green with the imprint of a soldier exhorting "Victory in '45" should probably not be eaten!

Okay. After some searching and emptying of the cargo compartment, you have located an oil-soaked container that doesn't belong to any of the customers. This will be the survival kit. Try to locate a sign-out tag. If this is unreadable, or out of date, you will have to face the music and unpack and inspect the kit yourself. A roll of grey duct tape and some patience may be required.

Check the contents and be critical; if any item appears questionable, throw it out. If your helicopter has the room, freeze-dried foods can be added to the kit but remember, something to eat is not as important as fire, shelter, pure drinking water and signalling devices. Most missing items can be located at outdoor supply or sports outfitter's shops.

When you open the kit, you are probably wise to chuck it all and start fresh should the crumbling contents resemble death offerings from King Tut's tomb. Several companies around the globe sell survival kits and offer inspection service (with reminders) at the required six-month intervals.

Once the survival kit has been renewed and reinstalled, don't relax just yet. In evaluating survivability we need to look at the big picture. You are flying along in an isolated area and the flame goes out. The autorotation is just barely successful and the machine rolls on to its side and, you guessed it, it rolls on the side where the luggage compartment is and yes, the survival kit is in the luggage compartment. Did I mention that you broke your arm in the crash and your customer is unconscious? If you can't get at the gear, it's not much use to you. What if a fire breaks out after the parts stop moving. You need to get your customer, the survival kit and the emergency locator transmitter (ELT) out as quickly as possible. If all the seats are full of customers then you are forced to put the kit in the luggage compartment.

What if you are forced to leave the helicopter with only your customers and the ELT, what then? You should be prepared to survive with what you have on your back and in your pockets and so should your customers. You should have on warm clothes and should carry (in your pockets or in a vest) a simple survival kit—enough to keep you alive indefinitely.

Remember that the survival kit itself represents the minimum standard. The CARs currently state that you, as pilot-in-command, are responsible for ensuring that your aircraft has on board, "survival equipment sufficient for the survival on the ground of each person on board, given the geographical area, the season of the year and

anticipated seasonal climatic variations." Your area of operations may require some specialized equipment: extra fly dope, a survival rifle, etc., can supplement the gear in the official kit. Orange garbage bags take up no room and make emergency rain coats or containers for all sorts of gear and they stand out like a sore thumb for search and rescue, especially on the tundra. A bit of imagination can make a large difference to your comfort. Like the Boy Scouts say, "Be Prepared!"

Finally, check all the inspection dates and make sure you are completely familiar any emergency equipment carried on board. And don't forget to share this knowledge with the passengers!

Many thanks to Rob Freeman

What You See Is Not Always What You Get

Visual illusions

Visual illusions and other disorientation phenomena are important because in certain situations normal visual inputs cause abnormal sensations and reactions on the part of a pilot. Most of these phenomena are experienced when visual acuity is decreased by conditions such as darkness, rainfall, fog, haze, or the pull of gravity on the ocular system. Not all pilots experience these illusions, but they are frequent enough that the aviation community should be familiar with them. The exact cause of these illusions is not completely understood but the fact that they present a risk to flight should be appreciated.

Autokinetic illusion

An individual in virtually total darkness observing a point-source of light that is not moving will report that the light is moving. Some have also reported apparent movement when looking at a stationary black target against a homogeneously illuminated visual background. This perceived movement of a fixed spot of light or a black target is known as autokinetic illusion and, under certain circumstances, most people will experience the illusion. The autokinetic illusion produces a very dangerous situation during night flying. Pilots have followed lights on the ground thinking these lights were from other planes. If they were to keep the light in the same relative position on the windshield, the result could be deadly.

Autokinetic illusion can generally be blamed on the involuntary movement of the muscles that control the eye. Under normal conditions the perception of apparent motion of an object is controlled by other objects around it in the visual field. During night flying, the visual field is limited and small light sources appear to be moving when they are not. Since training is ineffective against the illusion, pilots must understand that it can happen and learn to deal with it when it does.

Oculo-agravic illusion

The oculo-agravic illusion occurs in conditions that produce brief periods of reduced or zero-gravity forces. As an aircraft enters a reduced-G condition, a fixed visual target will appear to rise. When the aircraft reaches the zero-G phase, the target moves downward; during the recovery phase, it appears to rise again. Commercial helicopter pilots will probably never encounter this illusion (I hope).

Prism effect

Distortion of images has been reported when viewing objects through a windshield covered with rain. The cause of this is a surface of water that is thicker near the bottom (nearer to the windshield), causing a prismatic effect. When you look through this condition it's like looking through a base-down prism, which tends to make objects look higher or closer than they actually are, causing errors in distance and height judgment. This could cause a real problem for a helicopter entering a confined area or conducting slinging operations.

Waterfall effect

Many helicopter pilots have experienced this illusion when hovering or

when in slow flight at low altitudes over the surface of water. The downward blast of wind from the rotor blades causes the air to pick up water and to displace it upward at the periphery of the blade arc and downward directly under the blades. Pilots might look out the cockpit and see drops of water going downward in their field of vision. This would result in a climbing sensation, causing pilots to make a corrective manoeuvre to descend, which would put them in the water.

Sloping runways

Sloping runways can cause illusions in altitude judgment for aviators attempting to land. When the runway slopes away from the runway threshold, visual cues tend to make pilots come in high and land long. If the runway slopes toward the runway threshold, visual cues tend to make pilots come in lower than they should, with the chance of landing short of the runway. Aviators should be advised to monitor their altimeter closely when landing at airports with sloping runways. Helicopter pilots could encounter this condition when operating in hilly or mountainous regions.

Pilot fascination

Fascination is defined as a condition in which pilots fail to respond adequately to a clearly defined stimulus situation despite the fact that all of the necessary cues are present and the proper response available to them. A study of pilot experiences in the 1950s (Clark, Nicholson, and Graybiel, 1953) classified these experiences into two categories: type A and type B fascination.

Type A fascination is fundamentally perceptual in nature. The individual concentrates on one aspect of the total situation to such a degree that he rejects other factors in his perceptual field. Target fascination is of this type and has been a fairly frequent cause of aircraft accidents. The pilot becomes so intent on hitting the target in an air-to-air gunnery run that he fails to observe the tow cable and collides with it. On an air-to-ground mission, he may become so intent on getting his bomb on target that he fails to observe his altimeter and pulls up from his dive too low. The following is an example of Type A fascination:

My instructor was teaching me how to make emergency landings on a small field. I had made one or two tries and hadn't been very successful. The next time, I was determined to make a good approach. Both the instructor and I were so completely engrossed in the task that we failed to hear the landing gear warning horn. Consequently, we landed with the wheels in the up position.

In **Type B fascination,** the individual may perceive all the significant aspects of the total situation, but still be unwilling or unable to make the proper response. The following is an example of Type B fascination:

I went into a skidded turn stall during a short field landing. I knew I was in unbalanced flight during the last turn, but as I recall, I was so determined to get things straightened out before hitting the field that I didn't seem to care what happened. The plane stalled and the instructor took over.

Fascination has apparently been experienced by virtually all pilots. The aviator must be made aware of such hazards and periodically reminded of them.

Although illusions and other disorientation phenomena are not as prevalent in the cause of accidents as the lack of scanning and poor depth judgment, they are potentially dangerous.

Flicker Vertigo

A steady light flicker occasionally causes an unusual pilot response. Despite its rarity, doctors and pilots should be aware of it and its devastating effects. A steady light flicker at a frequency between approximately 4 to 20 Hz can produce unpleasant and dangerous reactions, including nausea, vertigo, convulsions, or unconsciousness, in normal subjects. The exact physiological mechanisms underlying such reactions are not known. However, it is believed that susceptibility is increased when the pilot is fatigued, frustrated, or in a state of mild hypoxia. The following is a dramatic report of the manner in which flicker vertigo can occur:

After flying for some time at an altitude of 16,000 ft., the pilot made a perfect

landing. However, he did not taxi the plane to the hangar. Instead, the plane remained motionless, its **propeller** revolving slowly. The pilot was found slumped over the controls, unconscious. At first, it looked as though the pilot had not used his oxygen mask. However, in this case, the pilot had lapsed into unconsciousness after making a good landing. The rays of the low-lying sun were shining on the slowly turning propeller blades. Reflected flashes of light were being thrown on the pilot's face at a rhythmic rate of about 12 per second.

Night myopia and night presbyopia

Night myopia (myopia is nearsightedness), also known as *twilight myopia*, is a phenomenon that causes some individuals with a small degree of myopia in daylight to become more myopic after dark and to have moderate symptoms of myopia.

Night presbyopia (Presbyopia is a vision condition in which the crystalline lens of your eye loses its flexibility, which makes it difficult for you to focus on close objects.) Also known as *red light presbyopia*, night presbyopia occurs in presbyopic individuals when subjected to red light. This is frequently encountered in the cockpits of aircraft during night operations. Red light has the longest wavelength of all lights in the visual spectrum. When one tries to read instruments or charts in red light, the demand for accommodation is more than if one were using white light. This causes difficulty reading small print in presbyopes. When aviators complain of these difficulties, it is usually wise to prescribe a pair of flight glasses with a stronger add for night operations than the add indicated for day operations.

Space myopia

The term space myopia is used to describe the myopia experienced by aviators when there is nothing to look at outside the cockpit. One example of this would be the pilot who is flying VFR on top. The clouds prevent her from seeing the ground, and the light reflected from the cloud layer beneath her aircraft puts her in an environment where there are reduced visual cues. Her eyes, having nothing else to focus on, will tend to lock-in on the aircraft instruments and remain fixated for this distance. When she looks outside the cockpit, her eyes remain fixated on near distances because there are no targets for her to observe. This myopic situation could prevent her from being able to see other aircraft when they would otherwise have been seen. To alleviate this myopia, it is recommended that an aviator look at the wingtips (if she has any) of her aircraft from time to time to allow relaxation of her ciliary muscles (the muscles that control the shape of the lens for near and far vision.)

Visual illusions exist and quite probably have contributed to a number of unexplainable accidents. Knowing that they exist and understanding the basics about them is a great defence against their associated hazards. —Ed.

With thanks to the United States Navy
Adapted from *Naval Flight Surgeon's Manual* Third Edition 1991

A Strange Tale *continued from page 8*

water away from the engine intake.

Once the nose of the helicopter was brought above the horizon to start decelerating and descending, the water might finally get to the engine intake.

The engine had failed just after the helicopter had crossed the highest point on the route and was descending. Was this the cause? We may never know since the fuel tank was split apart by the force of the landing and, of course, the fuel filters wouldn't show any water. The engine was of a type that did not permit airborne re-starts, and it had a superb reputation for reliability.

What's the moral?

If you leave your helicopter outside, make sure you leave it on a reasonably level surface so that any water will be detected when you drain the sump.

The other moral is that the evidence doesn't lie.

A Strange Tale

By Shawn Coyle, Engineering Test Pilot, Transport Canada

I was called to help the surviving members of a family that had been nearly decimated in a tragic helicopter crash in an Eastern European country.

The accident had happened over a year earlier, and the official report had just been sent through diplomatic channels. The next of kin were quite upset because one of their family members was being blamed for the crash. Ostensibly, because the cockpit fuel levers were in the OFF position, the passenger must have shut off the fuel since he was sitting next to the pilot.

There wasn't much else in the official letter, and the situation didn't look particularly good. Because we equate the overall technical level of a country with the quality of their motor vehicles, Eastern European countries did not have a good technical reputation.

I eventually ended up in the prosecutor's office and was greeted with a pile of reports. There were engine stripdown reports, maps, reconstructions of the flight path, witness statements—everything was there, as well as some aspects I had never seen, such as a mathematical analysis of the speeds and directions of flight based on the helicopter's impact with the trees. The engine had definitely stopped prior to impact.

I also discovered that the reasons for blaming the passenger were twofold. Under the laws of this country, someone had to be blamed. The other reason was due to some less-than-rigorous interpretation of photographs taken from cameras recovered from the wreckage, which had been imperfectly re-staged.

I met the special technical expert who had headed the investigation, and he professed to being completely unable to find out what had really caused the crash. He said that if I was able to help in any way he would be most grateful.

I asked a few questions at the preliminary inquiry and determined that the flight had been conducted in a thoroughly professional manner until the engine failed. Maintenance had been done, the pilot was experienced and up-to-date with checks, and the passengers had been briefed: all the marks of a well set-up and regulated operation.

Then we went out to sit in a similar model helicopter and view the wreckage. By demonstrating where the reconstructed photographs had been incorrect, and by measuring the forces necessary to move the control levers, I was pretty sure I was able to convince the prosecutor that it was extremely unlikely that the passenger had shut off the fuel. When we looked at the wreckage, I was even more convinced. The fuel levers in the cockpit appeared to be OFF if their position was taken against the rather bent and twisted metalwork around the levers. However, they appeared to be ON if the lever position was taken against the shaft that they turned on.

All of this had cleared up several aspects of the accident, and had probably exonerated the passenger, but it had not solved the cause of the accident. I admit to asking for a little Divine Intervention in finding a probable cause because it was not obvious to us earth-bound mortals.

Prior to the trip, the next of kin gave me a video of the helicopter being loaded up and taking off. As we drove back to the capital city that night, a possible cause did surface.

A noteworthy aspect of where the helicopter was flown from was that the helicopter was parked outdoors on a slope of about 7° nose down. I asked if a fuel sample had been taken the morning of the flight, and a clean sample had been found.

I still had a nagging feeling about something, and then it finally struck me. What if there was water in the fuel tank—would it have been found in the fuel sample? Probably not, given the construction of the tank and the slope.

Water tends to go to the lowest point of the fuel tank, and the engine intake was at the back of the tank. With the nose-down slope, the lowest point may not be at the sump. With the full load of passengers, the helicopter hovered, accelerated, climbed, and cruised nose down. This would keep the

continued on page 7