Transport Canada Transports Canada

Aviation Safety

Vortex

Learn from the mistakes of others; you'll not live long enough to make them all yourself . . . **Issue 2/2002**

The More Things Change…

Have a quick look at these:

- **Ontario**—While practicing autorotations, the tail rotor struck the ground during the flare and the helicopter spun violently, coming to rest on the runway. The pilot suffered serious injuries.
- **Manitoba**—The helicopter was being used in a timber cruising role for a local pulp and paper company. During the flight, the pilot noticed a temperature problem with the engine and decided to land the float-equipped helicopter on a small lake to investigate. During the landing, on glassy water, the aircraft overturned and was destroyed. The pilot and the lone passenger managed to get out, and escaped injury.
- **Saskatchewan**—During a spray run near the edge of a field, the main rotor struck a utility pole and control was lost. The aircraft crashed into the field, but the pilot was uninjured.
- **British Columbia**—While spraying an orchard, the helicopter struck wires and landed hard. Again, the pilot was uninjured.

Here we have four classic examples of helicopter accidents: a misjudged flare while training, a Controlled Flight Into Terrain (CFIT) accident due to poor reference on glassy water, a main rotor strike, and a wire strike. *"What's so special about that?,"* you might ask. Well, the thing that makes these mishaps interesting to me is that they are the first four helicopter accidents in Canada, and they happened in 1947. If they sound familiar, that's the point—there are no new accidents, just new ways of having them. See *Early Lessons Learned* on page 4 for a closer look at these historic accidents.

The Smallest Detail

It's fire season again….

The two Jet Rangers had been bucketing for a couple of hours. One pilot had noticed the other make three or four attempts to fix what appeared to be a cable snag on his water bucket. After filling from the nearby pond, the first pilot once again saw his friend kneeling by his bucket trying to make an adjustment or repair. He gave a couple of blasts on his siren to see if he could be of help—the fellow on the ground waved him off, indicating that he had the problem under control. When the first pilot returned about four minutes later, he saw the other helicopter lying on its side with smoke coming out of it. He immediately landed, ran to the other helicopter and found the seriously injured pilot pinned inside the wreckage. As he was unable to remove his co-worker from the aircraft, he took off to get help. By the time he returned, the trapped pilot had died of injuries.

The helicopter had crashed when it took off with one of the bucket cables caught on the right bearpaw and skid tube, causing a lateral centre of gravity (CG) shift sufficient to interfere with the pilot's cyclic control. It appeared that the pilot had punched off the bucket, but because it was snagged, the helicopter was rendered uncontrollable.

Sometimes we get so involved in the operation that we're distracted from those little safety checks that we normally carry out as second nature. One small cable snag can cause the most horrifying consequences.

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Freewheel Units

The Transportation Safety Board (TSB) has released an Aviation Safety Advisory in response to an accident involving a Eurocopter SA315B Lama, which was engaged in logging operations near Cranbrook B.C. The helicopter was lifting a log when it experienced a loss of rotor RPM and descended quickly to the ground, fatally injuring the pilot.

The investigation into this occurrence is ongoing, but TSB has determined the helicopter's Input Freewheel Unit (IFWU) malfunctioned because of excessively worn contact surfaces, spalling of the cams, broken pins and a broken retainer. This caused a loss of drive and rapid rotor RPM decay. During the course of investigation, IFWUs from two other Lamas involved in heavy lift operations were examined and both revealed signs of extraordinary wear. These failures are believed to be the result of repeated reengagements under power, and cycle accumulation that may have been far beyond what the manufacturer assumed in design. We'll tackle the topic of cycle accumulation in an upcoming issue of *Vortex*.

Why should you be aware of these problems if you don't fly a Lama?

In the event of a total engine power loss, all helicopters have the potential to get back to Earth without the deathly violence that Wilbur Wright predicts in his statement below. To aid in this process, helicopters employ a mechanism to automatically disengage the dead engine from the transmission to eliminate the extra drag it would create. This mechanism may be called a freewheeling unit, an overrunning clutch, an IFWU, or a sprag clutch. Since 1987, other accidents involving freewheel unit malfunction have resulted in two fatalities and four serious injuries in Canada.

The IFWU is designed to engage when the engine is driving the transmission and to automatically disengage when the engine output speed is less than the transmission speed. Freewheeling occurs when aerodynamic or other propelling forces drive the rotor rpm (Nr) above the engine power turbine speed (Np). We're all familiar with this in one form or another, as it is also what happens in a 'needles split' autorotation with the engine(s) throttled back or shut down. On twin engine helicopters we see it when one engine is running at higher Np speed, like in 'one engine inoperative' (OEI) training or when starting the second engine. Pilots of twins are told to look for a 'smooth engagement' when the Np meets the Nr.

In flight, freewheeling may occur as a result of many normal manoeuvres like practice autorotations, flaring turns toward the advancing blade, or rapid descents. It is exacerbated by high gross weight, high density altitude, low inertia rotor systems and improper autorotation rpm adjustment. Some helicopters are more likely to experience it than others, and the odd Nr creep above the Np is not cause for immediate concern. During its logging operations, however, the Lama in the accident referred to above was subject to frequent Nr excursions above Np. In this case, the severity and frequency of the reengagements had obviously taken their toll over time and repeated cycles. Some companies mandate procedures such as a minimum torque setting during descent to maintain engagement during operations that may result in excessive freewheeling.

Manufacturers and regulatory authorities do their best to provide limits that provide a good balance of safety and profitability. Often, operators come up with ways to use helicopters that venture outside what these bodies may have considered 'normal use' in design. If you're flying a job that you believe takes you out of that environment, be sure and treat your aircraft appropriately. You may lose a few seconds in the turn, but the payback is in hours.

Wilbur Wasn't Always Wright

"Like all novices, we began with the helicopter (in childhood), but soon saw it had no future and dropped it. The helicopter does, with great labour only what a balloon does without labour, and is no more fitted than the balloon for rapid horizontal flight. If its engine stops, it must fall with deathly violence, for it can neither float like a balloon nor glide like an airplane. The helicopter is much easier to design than an airplane, but it is worthless when done."

Wilbur Wright
(January 15, 1909)

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Letters

Having spent 28 years in aviation, I really understand the triangular relationship between the customer, operator and pilot (Helicopter Risk Management, Vortex 1/2002).

In James Bay, I had a customer say to me "You mean you're not going to fly today Art? The last pilot flew in weather a lot worse than this." He even threatened to call my boss in Montreal, and I said "Lets go, where's your telephone!" He backed down, and perhaps this is why I am still enjoying my retirement today.

The weather was foggy with freezing drizzle, but the client convinced another young pilot to fly that dreadful morning. Pilot, machine and four passengers were all found two days later on the side of a mountain. They did not get to enjoy their retirement.

Fellows, don't ever let a customer intimidate you. If the firm you are flying for lets you go, then they were not worth working for in the first place. Please fly safe at all times.

Art Read, Retired Helicopter Pilot

Words to the wise from someone who's been there. —Ed.

Vortex Back Issues on CD-ROM

We now have a CD-ROM (TP 202 CD) containing all English and French issues of *Aviation Safety Vortex* from 1976 to 1999. The CD is in PDF format, and for those who don't already have it, you can download Adobe Acrobat 3 or 4 right from the disc. The search function makes this an invaluable training tool for flight schools and training departments.

The unit price, including tax and shipping, is $18.13. Order your copy from the Civil Aviation Communications Centre at 1-800-305-2059, in the National Capital Region at (613) 993-7284, or by e-mailing services@tc.gc.ca .

On our web site (www.tc.gc.ca/vortex) *we have back issues from 1997 to 1999 available in HTML. Starting at 1/2000, they are posted in both HTML and PDF formats. —Ed.*

In This Issue

Early Lessons Learned

On May 8, 1946, Type Certificate number H-1 was issued to the Bell Aircraft Company for its Model 47 marking the first time that a helicopter was permitted under US Federal Licence to carry passengers for "hire and reward" commercially. Company president, Larry Bell, advised his staff that the commercial utilization of the Bell 47 helicopter was to be exploited to the fullest in order to lay out the groundwork for an industry that could flourish in peacetime as well as war. Sikorsky Aircraft was not far behind with Type Certificate number H-2 issued for their four-place S51.

Ten pre-production Bell 47s were built and used in research and development, initial training, and in demonstrating the capabilities of the helicopter. Larry Bell sent his own team of employees out on the road to prove that the helicopter could earn its keep across the United States, Canada, and Europe. Bell started the first commercial school for the training pilots and mechanics in the summer of 1946.

The Royal Canadian Air Force were the first to import helicopters into Canada, and the first to suffer an accident with one. Flying Officer, Tom Wallnutt, obtained training during February, and flew the first Sikorsky S51, serial number 9601 into Canada on March 12, 1947. This was the first three S51s ordered for use in training and search and rescue roles. Wallnutt continued to build up flight time on the new helicopter at the Air Force Base in Trenton, Ontario. During one 'touch and go', while practicing autorotations on March 28, the wooden tail rotor brushed the runway. The pilot received no indication of this happening and opened the throttle to complete another circuit. At about 200 ft, the tail rotor splintered apart and the vibration tore the entire gearbox from the tail. The rotorcraft entered a violent spin and crashed on the runway. Wallnutt was thrown through the left side of the aircraft and onto the runway where he was struck by a main rotor blade. His flying suit and the aircraft wreckage were saturated with gasoline, but luckily there was no fire. Tom Wallnutt's injuries kept him out of flying for nine months.

photo: Canadian Forces (RCAF)

In 1947, the first commercial helicopters were imported into Canada. Three companies were formed with plans to use rotary-wing aircraft for agricultural work and the helicopters started arriving in spring.

The first to be delivered was CF-FJA, a Bell 47B3, to Photographic Survey Co., part of the Hunting Aviation Group in Toronto, Ontario. Al Soutar obtained his pilot training, and Bill Finlay did the mechanic's course at Bell in preparation for delivery. Soutar then ferried the aircraft from Buffalo, N.Y., into southern Ontario, making CF-FJA the first Canadian commercial helicopter. The ship spent late spring and early summer doing crop dusting demonstrations for farmers in southern Ontario. Later that summer, it was contracted by the Ontario Department of Lands and Forests.

CF-FQR and CF-FQS arrived by rail at Skyways Services Ltd. in Winnipeg, Manitoba. Pilots Jim Sampson and Paul Ostrander, and engineer Arthur Limmert attended the Bell school in Buffalo for training. Skyways' third 47B3, CF-FZN, arrived later.

Okanagan Air Services in B.C., purchased CF-FZX from Central Aircraft in Yakima, Washington. Carl Agar learned to fly at Central and flew the helicopter into Canada in the summer of 1947 with the intention of spraying orchards in the Okanagan Valley.

The first generation of helicopters were underpowered, somewhat unstable, had limited payload and required a lot of maintenance per flying hour (some would argue that still holds true!). They were also much more difficult to fly than fixed-wing aircraft. Problems with the dusting and spray gear plagued the operations in the early days, and flying the helicopter was very demanding on the pilots. As a result, 1947 was not a good year for accidents. Of the five agricultural spraying configured Bell 47B3 helicopters that started the Canadian helicopter industry, only three were still flying by the end of December. Two had been written off, while one required extensive repairs. Only Photographic Survey Company's helicopter (FJA), and the third Skyways Services machine (FZN) survived the first season without damage.

During mid June, Skyways Services flew CF-FQR from Winnipeg to the Kenora area in western Ontario to carry out timber cruising surveys with the Ontario Minnesota Pulp and Paper Company logging division. On June 19, 1947, pilot Paul Ostrander was flying between Red Lake and Fort Francis when the Franklin engine cylinder temperature gauge started to creep up into the hot range. Ostrander decided to set the float-equipped helicopter down on a small lake to check out the problem. As he approached the glassy water, the right float hit first, and the helicopter overturned into the lake. Ostrander and his passenger, Mr. N. Golder, were both able to release their seatbelts and exit the cabin safely. Paul's entry in his logbook for June 19 indicated 5.45 hr of flight time and the remarks

"Crash—complete write-off—Hell Lake." This was Canada's first civilian helicopter accident.

photo: Mr. Arthur Limmert

The second occurred in July 1947. Skyways Services chief pilot James Sampson had brought CF-FQS over to Regina, Saskatchewan, to carry out crop dusting on farms near the city. On July 13, he was busy spraying crops on Stan Walker's farm, 18 mi. SW of Regina. During a dusting run along the edge of the field at about 4 to 6 ft above the ground, the main rotor struck a telephone pole and lost a one-foot section of blade. Sampson lost control of the helicopter due to the resulting severe vibration, and the rotorcraft struck the ground. He was fortunate to emerge from the wreck unhurt. Skyway Services' second helicopter was declared a write-off.

photo: Mrs. Betty Simpson

CF-FZX, belonging to Okanagan Air Services, was involved in the third accident on September 12, 1947, near Kelowna, B.C. Carl Agar was spraying Andy Duncan Sr.'s orchard and during one pass, the helicopter came in contact with a power line. The aircraft settled onto the line, broke the two wires, and the helicopter impacted the ground. Agar was unhurt and managed to escape the damaged machine without being electrocuted. The helicopter required major repairs in order to be flyable again, and was out of service until mid December.

photo: Okanagan Helicopters Collection

And thus began the industry in Canada, which today has over 1800 helicopters registered. We owe a debt of gratitude to the pioneers of this business for their contributions to the growth and acceptance of the helicopter. As mentioned in the introductory piece, this look back also points out the fact that we are still having the same accidents we did over 50 years ago! Remember— *"Learn from the mistakes of others, you'll not live long enough to make them all yourself ."*

The Editor wishes to thank Mr. Robert Petite for his invaluable contribution of historical data and photographs for this article. For more on the Bell 47 helicopter, and a comprehensive history of the 47 in Canada, check out:

http://cellmath.med.utoronto.ca/B47/history/47Canada.html

Ahmmm, does he mean us?

"I find that if this machine made with a screw be well made—that is to say, made of linen of which the pores are stopped up with starch—and be turned, swiftly, the said screw will make its spiral in the air and it will rise high.

When force generates swifter movement than the flight of the unresisting air, this air becomes compressed after the manner of feathers compressed and crushed by the weight of the sleeper. And the thing which drove the air, finding resistance in it, rebounds after the manner of a ball struck against a wall."

Leonardo da Vinci (1505)

Vertical reference flying was once the mystical domain of a few Jedi Masters engaged in specialty operations. Those of us who came behind them would secretly marvel at the precision with which they could set their loads. How things have changed. Long lining is now perhaps the preferred method of delivering external loads in Canada, and has become a necessary skill for pilots looking to work in utility operations. It has gained widespread acceptance from pilots, operators, and customers alike for its precision, efficiency, and many would argue—safety. It is not, however, without its own unique risks.

The Hughes 500D was employed to transport seismic bags from one cut-line to another, using a 100 ft longline and carousel. The day's operation started in a wooded area of 40 to 80 ft spruce trees, and gradually progressed into taller forest with a uniform tree height of about 100 ft. During the third lift of the day, the bag runner (the person responsible for hooking up the seismic bags to the carousel) alerted company personnel when he noticed the helicopter had not returned, and they attempted to contact the pilot by radio. When no response was received, three other helicopters working in the area were called upon to conduct an aerial search. Forty-five minutes later, the aircraft was found in a ravine, approximately 30 ft deep, and 75 ft across. It had been substantially damaged, and the pilot had sustained serious injuries. Investigation of the accident site revealed damage to several trees along the descent path. All five main rotor blades had impact damage throughout their length and all had separated from the main rotor hub. Burn marks on the ground behind the exhaust stack indicated that the engine had been running on impact, and examination of the sling equipment revealed no pre-impact damage.

The Transportation Safety Board (TSB) states in *Aviation Investigation Report A00W0267* that the pilot has no recollection of the events surrounding the accident. During the investigation they came up with two potential scenarios. The first possibility was that *"The (bag) marker's location at the bottom of the ravine made it necessary for the pilot to descend vertically beside several large trees. Any lateral movement while doing so would have resulted in the main rotor blades contacting the trees."* They go on to say *"It is also possible that, during the vertical descent from about 250 ft above the ground, the helicopter entered vortex ring state."*

These scenarios have something in common in that they can both be the result of a temporary loss of situational awareness. I have often heard pilots say, "in long lining, you don't fly the helicopter, you fly the load." That line of thinking, unfortunately, will get you in trouble. While it is true that attention must be paid to the line and load, we cannot allow ourselves to concentrate so heavily on what's happening below, that the helicopter gets away from us. The majority of our vertical reference accidents are not related to mechanical failure, but are the result of a lapse in situational awareness. A quick look through files from past years reveals a number of examples.

- Main and tail rotor strikes
- Contacting an obstacle while landing
- Settling with power
- Snagged loads and lines
- Collision with terrain or wires
- Poor fuel management, and
- Taking off unaware of the longline being attached

Many companies currently run training programs in vertical reference techniques, and unlike the old days, most pilots now get an introduction to long lining before they're sent out to assemble a diamond drill. Exercises like "stick the cement ball in the rubber tire" are common, and while this type of training has its place, there other aspects to vertical reference flying that are even more important. Good instruction could include topics like,

- *situational awareness* and

good planning practices. These are critical in all aspects of flying, and vertical reference is no exception, given the nature of the work and high concentration levels.
- *physiological factors* like focal, peripheral and three dimensional vision. Learning how your brain *sees* will help you to provide it with the clues it needs.
- *good airmanship*, and the proper care, use and handling of sling gear. Believe it or not, even though the sling gear we use has a 5:1 safety factor or better, we still have accidents every year from equipment failures. Usually the result of mishandling of the sling gear itself.
- *basic pendulum physics*. No, this isn't how to fix your grandfather clock, but it'll help you handle that swinging load. Knowing *why* it's happening will help you learn to tame it faster and put it where you want it.
- *Aircraft performance issues.* The obvious ones are power train limitations and out of ground effect (OGE) hover performance. There's another big one, though—weight and balance. In some machines, there's a good chance you'll be at or beyond your aft centre of gravity (CG) limit, given the fact that we sometimes strip these aircraft clean to make them as light as possible.

Vertical reference flying is extremely rewarding. It's just you and the machine in a ballet with the ground crews, and at the end of the day you feel like you've actually done something. Given the reliability of today's helicopters, and the safe working load of the equipment, the reality is that human performance factors cause most of our accidents. Well structured training, along with good risk management skills, situational awareness and staying a few steps ahead of the helicopter could make our enviable accident record even better.

In coming issues of Vortex, I hope to explore some of these issues in greater depth. If any of you have any comments or things you'd like to see included in further discussions about vertical reference flying, drop me a line (pardon the pun). —Ed.

Have You Checked Your Long Line?

September 1988, Québec

Following a slinging operation, the pilot forgot to disconnect the long line. During the repositioning flight, he noticed a tail rotor vibration and conducted a precautionary landing to investigate the cause. After landing, he discovered minor damage to the tail rotor blades. No injuries ensued.

October 1989, British Columbia

The helicopter landed at the pad after completing a sling operation. Passengers boarded the aircraft, and it departed with a 50-foot long line still attached. The hook assembly snagged on the edge of the landing pad as the helicopter climbed out. The line recoiled under tension into the tail rotor. Directional control was lost, and the aircraft landed hard and rolled onto its left side. Two passengers were seriously injured.

July 1994, Labrador

The pilot was in the middle of a drill move that had been delayed several days for bad weather. He landed at the camp to add a few gallons of fuel to complete the operation, and was met by two geologists with their packs who wanted to be dropped off at the top of a hill. In his haste, he told them to go ahead and get in. After refueling, he jumped in the helicopter, fired it up, and headed for the hill to drop his passengers. Just as they were clearing the pad, he felt a tug on the helicopter and to his horror, realized the long line was still attached. Luckily, it hadn't snagged on anything as they departed, and he proceeded to drop his geologist friends at their chosen spot. They carried on studying their rocks in blissful ignorance, not knowing what had almost just happened to them.

This pilot always "velcroed" a fluorescent orange aluminum flag that read LONGLINE ON to his instrument panel when the line was attached. He was religious about it. It was there on that day, as usual. However, he was pressured to complete the job, he was tired, his routine had been broken, and he missed something blatantly obvious, which almost caused a serious accident. *If you can guess who this pilot is, I'll send you a free Vortex.*

October 1997, British Columbia

A resident was in his backyard feeding his chickens when a 4 in. x 1.5 in. metal bolt fell from the sky, burying itself 6 ft in the ground. At about the same time, a helicopter was seen flying away at an altitude of about 1500 ft. Witnesses stated that the helicopter was trailing a (long) line attached to the belly. The resident heard the bolt hit the ground and later stated that it had missed hitting him and his chickens by inches.

'Chicken Little' was right— the sky is falling!

Tips and Tails

Tips and Tails is a forum for you to share information with your fellow pilots. We're looking for those little tricks you use to deal with a specific challenge, or more elaborate tales of how a lesson was learned. Because of the nature of this exchange, publication here does not imply that Transport Canada's endorsement of techniques or procedures. Pilots should use their professional judgment in assessing the value of these ideas for their individual operations. If you have something to contribute, refer to the editorial/credit bar on page 3 for details on how to contact us.

When Downwind is the Only Way

by Randy Greenhalgh

From our first flights in a helicopter, it is drilled into our heads that we should approach helipads into wind. So what do you do, when the only way into a pad is downwind? Anyone who has a little experience knows there are times when approaching and even landing downwind is the only safe option. A very experienced pilot demonstrated the following when I was still very new to Bell medium helicopters, and I've used it ever since.

Start off with a fairly normal approach, following the safest path in. It's important to keep your airspeed and your rate of descent under control while doing this approach. As you get closer to the ground, and to your spot, slow your rate of descent and airspeed. At approximately 50-100 ft back, and 20-30 ft above ground level (AGL) as you slow the helicopter below translation, ensure that you have stopped all downward movement of the aircraft. This will help prevent you from entering vortex ring state. You should now be at a walking pace and less than a rotor diameter from your spot. Watch the ground, as you want to see when your downwash passes you. Once the downwash has passed, you can then resume your descent and land at your spot.

Just remember, that when landing downwind, there are many points to remember and things to watch for:

- You must be certain that you have Hover Out of Ground Effect (HOGE) power.
- Make sure you minimize your rate of descent as your airspeed decreases.
- You may run out of aft cyclic with a forward centre of gravity (CG) and as you reach the helicopter's cross/tailwind limits
- Pay careful attention to aircraft limitations.
- The tail will be lower to the ground, so be careful of any stumps, bushes, etc.
- Be aware that the aircraft will want to weathercock, and will not be as stable in yaw
- As a result pilot workload will be higher when performing a downwind landing.

Landing downwind can be safely done, as long as you have planned it out in advance.

Sock It To Me

When long lining with an A-Star or Twin-Star, my flight suit sleeve would often impair my view through the vertical reference window in the floor. To remedy this, I cut the top off an old wool sock, and would wear it around my sleeve over the bicep area. This trick also works when vertical reference flying in other aircraft with the doors off, to prevent the sleeve from fluttering and distracting the pilot.

Pushing weather is dangerous—pushing weather *downwind* is even more so.