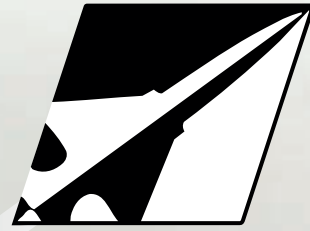




National  
Défense  
Defence  
nationale

SUMMER 2001



# Flight Comment



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Canada 

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## Flight Comment

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# Dirty Dart

Riding high as a junior co-pilot on the CP-140 Aurora, I was involved in a near crash which has affected my approach to flying ever since. At the time of the incident, I had about 600 hours on type and 800 hours total. We had launched out of Greenwood early one morning for a submarine exercise (SUBEX) against one of our Oberon submarines 250 nautical miles off of the coast of Nova Scotia.

Approximately three hours into the flight we were deep into the “localize and track” phase with the #1 engine loitered. This engine does not support a generator in the Aurora and is often loitered as a matter of course under VMC conditions. We were operating at 300 feet over a relatively calm sea and I was the flying pilot sitting in the right seat. Our weight was close to 110,000 pounds which gave us a loiter speed on three engines of 190 knots and a 1.52 vs safety speed of 185 knots. I was maintaining 210 knots with 1600 SHP on #2,3, and 4 engines. The autopilot was not engaged.

The tactical navigator entered an expendable point into the computer at eight o'clock for 1½ nautical

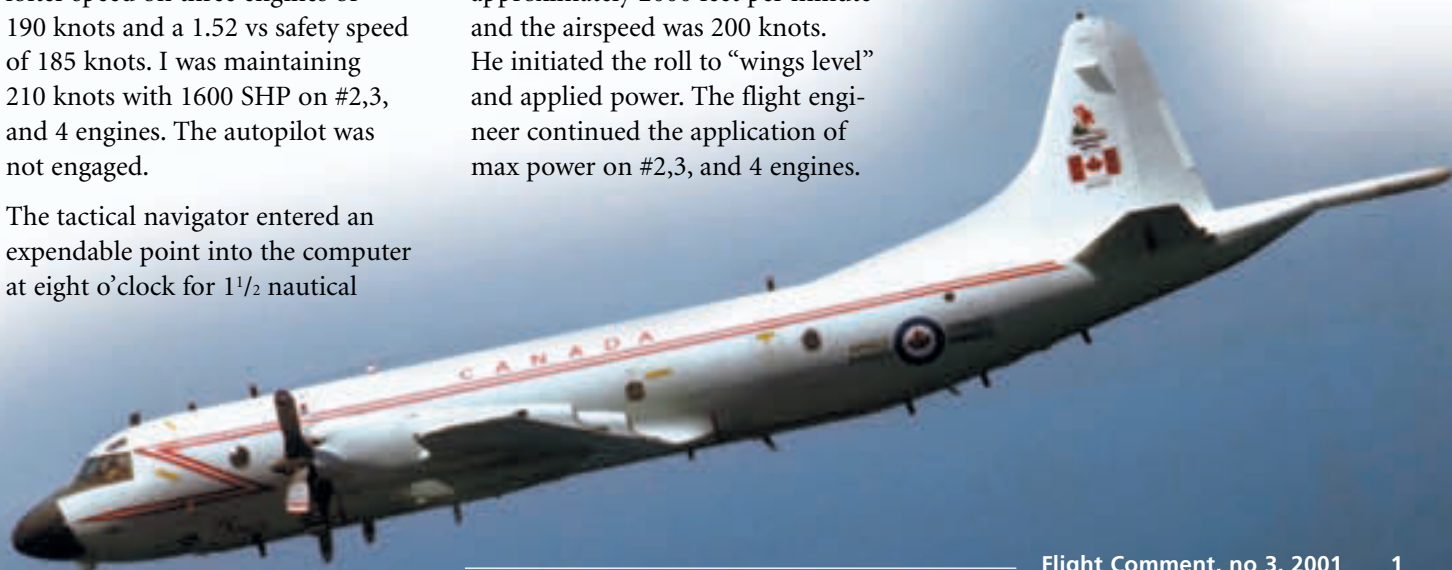
miles. This is a point that we must hit in order to drop a sonobuoy and is displayed on our instrumentation. The TAC had called “any heading” on the expendable and I elected to go right for the 270° return and established a right bank of about 30°. The co-pilot, or non-flying pilot, who was actually my AC said “you can make it, go hard left.” I accepted this and reversed my turn intending to roll to 60° left. I managed to call “Manoeuvring” on the ICS but did not compensate with elevator through 30° left and the result was an immediate slice towards the surface. At the same time, I applied a touch of power in order to maintain airspeed, which actually increased my roll rate due to the asymmetric flight condition.

The AC realized that I was not correcting the slice and took control. The rate of descent was approximately 2000 feet per minute and the airspeed was 200 knots. He initiated the roll to “wings level” and applied power. The flight engineer continued the application of max power on #2,3, and 4 engines.

This had two effects; it corrected our decreasing speed but reduced the corrective roll rate. The AC applied 2.6 G to arrest our descent and the aircraft entered stall buffet. The lowest altitude reached was 160 feet. He recovered the aircraft and we continued tracking the sub after a short pause to catch our breath.

Poor judgment and complacency on my part had resulted in a near fatal crash. I was quite tired that morning having been up late the night before. My mind was just not keeping up with the rapidly changing flight characteristics through the reversal. Fortunately, we walked away from this incident and I was given the opportunity to learn and to recognize the inherent dangers of a complacent approach to flying. I became a better pilot as a result of this. Hopefully, you can gain the same insight from this account without your own dirty dart at Mother Earth! ♦

*Capt. Huddleston*





# But...

## I Was Just a Private

Many, many years ago I worked on what I consider the best aircraft we ever had, the F-104 (okay, I know I'm old)! It seemed to be a pretty straightforward aircraft with no real surprises — except for the leading edge of course. Well, one day while jacking, the rear Main Landing Gear (MLG) door was damaged. Ordinarily this was not a big deal, except that there was the perception that it had to be hidden from the eyes of the grownups. Well, this didn't seem proper to me, but, what the heck... "I was just a Private!" With other guys around with ten to fifteen years of experience, who was I to pipe up?

Although entries were made in the books, it wasn't on the stats board and all concerned were briefed that a particular Captain would be most interested and annoyed if he heard tell of the damage. We robbed a door from one of the queens and had it installed just in time for the other crew to take over. (This just wouldn't be an air story without the infamous "other crew.") My bosses briefed their bosses and arrangements were made for them to fit the door that night with us doing the retractions early the next morning. So far, so good, right? Not exactly!

We arrived early the next morning and while the hydraulics were connected, the paperwork was perused to ensure that all of the entries were signed off. This was no problem so far, except that no one had bothered to actually look at the work done and compare the five entries in the book with the six maintenance procedures actually carried out. Oops!

As I climbed into the cockpit, it still sort of bothered me, all of this clandestine stuff, but it was not my place to question because, hey "I was just a Private!" Everything was in place: the hydraulics were on, the power was on, there were enough safety spotters...we were ready to go. "Gear Up" was the command and, with a flick of my hand, we started. Everything went fine for just about a second until the bang and corresponding violent rocking alerted my keen, young senses. Slamming the handle back down, I looked through the windscreen just in time to see my boss having what appeared to be a massive stroke. My first thought was that someone got caught, but I simultaneously wondered "it wouldn't bang — just squish." As it turned out, we had missed something (a minor little thing called an actuator) which had been disconnected and lock wired

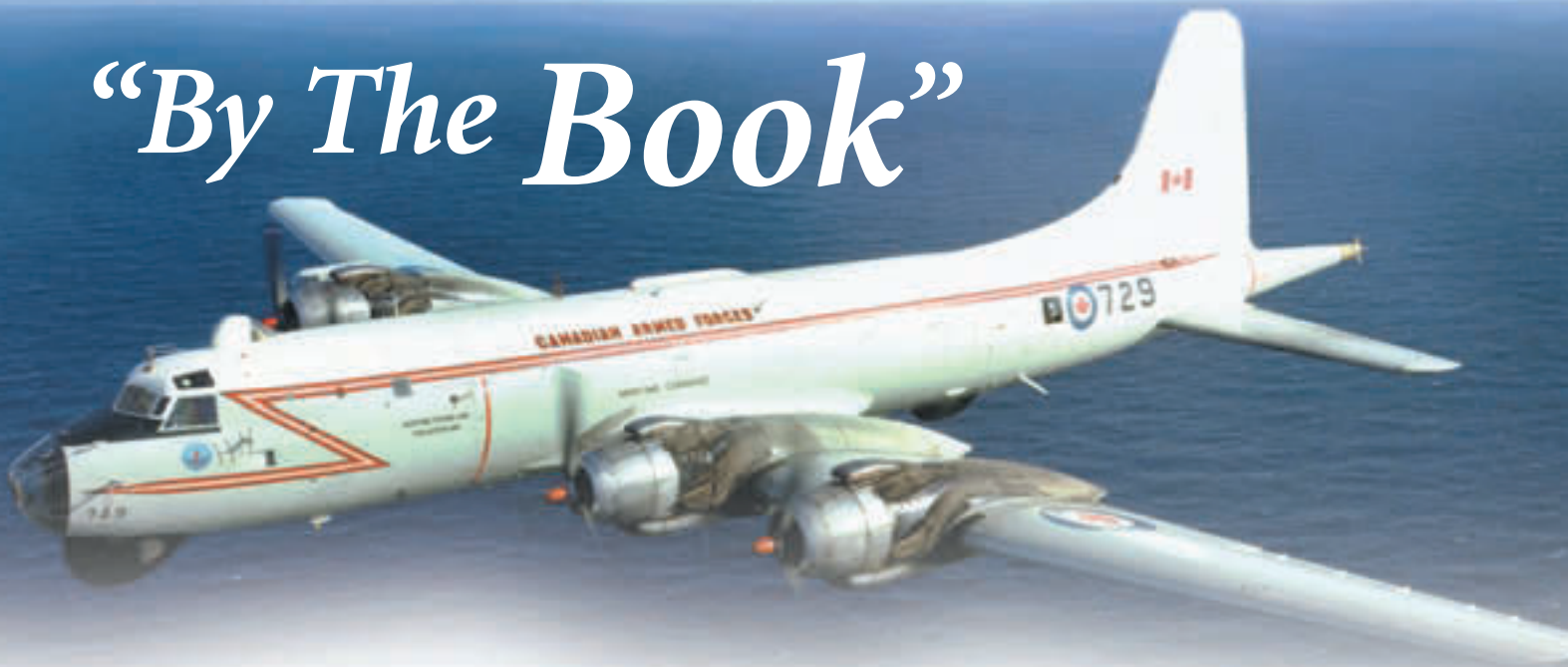
out of the way. No entries had been made (see — "Other Crew"). When the handle was positioned up, everything worked as advertised until the lock wire broke. The end result was another rear door, a forward door, and a couple of tie-rods.

Not a stellar moment for snags, I hazard to say, but if there is one bright spot, no one got hurt. All through this operation I had comforted (or should I say excused) myself with the knowledge that with all of the experience floating around, who was I to rock the boat. The ARO on the other hand had absolutely no qualms about rocking the boat, but to his credit, it became more of a learning experience than the expected witch-hunt.

Since that moment I've always voiced my opinion. It probably didn't put me on any Christmas card lists, but I have been vindicated on several occasions, so it can't be that bad. Knowing when and how to listen is just as vital as it encourages incoming or younger technicians to come forward and teach us old dogs some new tricks. Quite often, new, innovative, and safer ways of working are the end result. ♦

*MCpl Weir*

# “By The Book”



When I first joined the military, I had an excellent MCpl that made sure that we always learned “by the book.” At times, I thought this was stupid as the book was wrong. We then learned the proper way to have the book amended.

Nothing was ever pencil-whipped; it didn’t matter who did the work. Before you signed your name on the form, you would go out and make sure that the equipment was properly secured. Some may think this is bothersome since avionics technicians only replace black boxes... what can go wrong with that?

My experience started when my MCpl retired and I had to start training personnel to do the job I was doing. This is difficult when you’re used to doing it your way and can do it faster than showing the new Private how to do it “by the book” three or four times. If you don’t, however, who will do your job when you are gone? As luck would have it, my retired MCpl came back to work as a Class “C” reservist on my crew. I now had my old boss working for me...what could be nicer?

One day when I was on the early shift, I came in to find that my retired MCpl was waiting for me. They had a ramp snap. The aircraft had started up and went unserviceable so he had changed an FI-214 tape recorder. Now he wanted me to sign the inspected/pass block so that the aircraft could take off, without inspecting the work. What would you do?

Here was my old boss, fully qualified and knowledgeable, asking me to pencil whip something so that an aircraft could launch. He wanted me to break the teaching of what I had learned before...“never sign without inspecting the work.” Should I insult him by demanding to inspect the work? After arguing about my reasons to inspect the work and explaining that I wasn’t insulting him but was just following the teaching I had got from him, I delayed the aircraft from taking off. Climbing on board an Argus, fully loaded with anxious aircrew waiting to take off, can be very intimidating.

I inspected the work and found everything connected electrically.

What were missed in the heat of changing the equipment were the four bolts mounting this 200-lb tape recorder to the table. I notified the aircrew that a further delay was required, left the aircraft, and got the tools to fix the problem. Upon entering the Servicing area, I notified my retired MCpl of the finding and watched all of the colour drain from his face. The first left bank this aircraft made would have caused this recorder to come crashing down on someone, possibly injuring or even killing them.

Now we have gone to one signature, to work like the civilians. The danger of this type of problem increases without that second set of eyes. Are you insulting people by reviewing their work...I don’t think so. All you are doing is ensuring an accident isn’t going to happen. Make sure everything you do is by the book and no corners are cut. It may be your own life that you save. ♦

*WO Moyer*

# CRM:

# Just For Aircrew?

Whether we like it or not, monitoring trainees is a fact of life in Air Traffic Control. On a particularly busy day, I was monitoring a controller who was returning to the tower after a few years in the IFRCC. We were not having a very good day. We had already had one closed-door debriefing. I felt he wasn't being aggressive enough and he felt that I wasn't giving him enough room to control the way he wanted to. This controller had more ATC experience and had been at this Wing longer than I had. The only advantage I had over him was that I currently held a valid ATC

license as an Aerodrome Controller at this tower and he didn't.

We were in the midst of a COMAO (Combined Air Operations) recovery. The weather was VFR but the fighters were returning in a mixed IFR/VFR package. This increased our already heavy workload. The PAR controller had just made the ten-mile call for an F-4 on radar final when a formation of four F-16's called initial for a touch-and-go. The trainee sequenced the F-16's number one. This was not going to work. I decided to give the trainee his "room" and let it go a

little longer to see if he would notice the problem when the F-16's rolled out on downwind leg. Too late! The PAR controller had just started his four-mile call when the lead F-16 turned base. I quickly overrode the trainee to take corrective action when the back-seater in the F-4 noticed F-16's turning into them and warned his pilot. The F-4 moved out of the way and the F-16's continued without further incident. The F-4 crew felt the risk of collision was great. I didn't think it looked that close. The trainee and the F-16 pilots never saw a thing.

In the days that followed, the trainee continued his tower checkout and his career in ATC. I, after numerous discussions with the UFSO and a rather forceful debriefing from the WATCO, was also allowed to continue my career in ATC. In an effort to appease a more experienced controller and to avoid further confrontation I had placed my career, and more importantly, the lives of numerous aircrew in jeopardy. I was in charge that day; I was the licensed controller. Like the cockpit crew of an aircraft, it doesn't matter whom our co-pilots or trainees are. We have a duty to speak up when we see something wrong. After all, Crew Resource Management applies in the tower as well. ♦

# If You Think Flight Safety is Costly, Try an Accident.



The Air Cadet Gliding Program is one of the largest flying programs in the world. The program consists of both flying and ground school and lots of tests. It is a very intense program especially when you consider that these cadets arrive at the beginning of the summer knowing nothing and leave as glider pilots in only six short weeks. Unfortunately, the program is very dependant on the weather and it takes very little in the way of high winds and low ceilings to put the course behind schedule.

The day could not have started any worse and we were already a week behind due to poor weather. Once again rain and low ceilings were going to push us farther behind schedule. The first flight did not fly that day and we were placed on stand-by as the forecast for later in the day looked promising. The weather continued to improve and shortly after supper, we set off for the airfield. After a day of sitting around, it was hard to build the

motivation to go, but we were all eager to finish.

Everything looked promising until the bus broke down. There was a great amount of pressure to get to the airfield and fly, so we shuttled cadets and staff in a van. When we arrived at the airfield, cadets were briefed and told to finish the DI's quickly. We proceeded to the runway and both the first and second launches went without a hitch. My student and I were third in the rotation and we moved up for the hook-up. Everything seemed to be normal as we began to roll down the runway; the glider lifted off, and then, so did the tow plane.

However, we were not climbing out as fast as normal. Suddenly, the tow pilot called for an "abort launch" so the glider released and both aircraft landed. Once again, the operation was shut down. When the tow plane was checked out, it was discovered that the pitot tube cover had been left on, making the instruments inoperable. At that time, the flight

commander began to see the links in the chain developing and elected to call it a day.

Looking back at the incident, it is easy to see the links as they developed. Being behind schedule can put a lot of pressure on all people involved. Cadets fear that they will not get their wings and the boss begins to worry about the costs of an extension.

When these things begin to happen, we have to remind ourselves to step back and look at the situation and ask ourselves "is what we are doing safe?" At the time, the emphasis was on finishing and keeping costs down. As we can clearly see, the time saved by shaving off a few minutes did not really save that much time or money. If anything, we lost more due to the shut down. It could have been much more costly and it reminds me of the old saying..."If you think flight safety is costly, try an accident!" ♦

*Lt. Smith*

# Creatures of Habit



We are creatures of habit. We all develop a pattern of behaviour acquired from repeated actions, without having to consciously think much about them. But, although most of these habits have developed through training and have resulted in safer flying operations, we must never forget that we will always be at the mercy of complacency and expectancy.

A good example is a recent ground incident that took place in my squadron on a CH 146 Griffon helicopter. Although young, the Griffon fleet has had too many incidents involving the accidental omission from crews to remove “bungs” from respective engine intakes prior to start. For aircrews not involved in operational and tactical helicopter operations, the solution may seem too simple; a normal pre-flight inspection should get rid of the problem once and for all. But for some reasons, it doesn't.

Operational theatres like Bosnia are sometimes forcing aircrews to cut corners in order to expedite the mission. Also, dark camouflage bungs stuffed deep into dark camouflage engine intakes are not exactly the best way to remind us to “remove before flight.”

Although my unit had not been involved with the recurrence of these incidents, I remember suggesting to my UFSO the implementation throughout the fleet of a simple, very low cost idea to solve the problem. We could change the colour of the bungs to red, and link both the engine air intake bung and the engine cooling intake bung with a wide red strip of material that just could not go unnoticed. This measure was implemented only in our squadron, and, although very effective, has been one of the main causes for our only “bung incident.”

Our unit had been tasked to refit the combining gearbox of all the Griffon helicopters. Other units fly in for a couple of days for our maintenance crew to do the work. Once completed, a ground run is conducted by one of our pilots and the helicopter is flown back to the home unit. On this particular incident, when this Griffon (from another unit) was towed on the ramp for an acceptance ground run, its dark green bungs were stuffed deep into the intakes. A newly qualified Griffon pilot conducted his pre-ground run inspection, but never saw the bungs. Remember — “creatures of habit!” I was his instructor for half of his flying training. Together, we never saw our squadron wide, red link tying the red bungs.

In this case, it only cost a complete engine rehaul (turbine temperature exceeded limits on start), but it could have been worse. When you develop new SOP's or new kits at your unit that make sense, demand a wing-wide implementation. It is always surprising to see how little differences between units operating the same aircraft can potentially lead you into undesirable situations. Finally, although our basic human nature of being creatures of habit is usually in our favour when it comes to safety, don't open the door to complacency. ♦

*Capt. Michel Thériault*





# MAINTAINER'S CORNER

Do you want to participate in **your** magazine? Do you have anecdotes, photos, or article ideas on maintenance-related topics? If you do, send them to DFS for review and possible inclusion in the magazine. Send your submissions to Sgt Anne Gale, DFS 2-5-4, via e-mail (Intranet or Internet at [ad064@debbs.ndhq.dnd.ca](mailto:ad064@debbs.ndhq.dnd.ca)) or regular mail.

## Routing and Clamping

First, lets be clear on the terms used.

- Routing refers to the placement of a line, or the path a line has to take in a circuit (electric, hydraulic, oil, fuel, or air), to avoid damages such as chafing or rubbing to the line and surrounding components.
- Clamping means the correct installation of appropriate clamps on lines, at specified intervals to, once again, avoid damages to the line and surrounding components.
- Lines include electrical wires, bundles, or cables; hydraulic, oil, or fuel lines; and bleed air, air conditioning, or heat conduits.

Second, in the Flight Safety Information System, we regroup under the "routing and clamping" banner the following actions:

- Lines misaligned at connecting points
- Lines under- or over-torqued
- Lines improperly routed
- Clamps not installed
- Wrong clamps installed

## Statistics

In 2000, there were 117 cases of routing and clamping occurrences reported. It's everyone's guess as to how many more incidents of this nature are rectified without being reported. Some of the consequences are insidious; a misaligned line can cause intermittent, recurring snags requiring many maintenance hours before the problem can be located. Other consequences have serious or even catastrophic repercussion; in April 1994, a chafed fuel line on a CH124 SeaKing started spraying atomized fuel on a hot surface that caused an inflight fire. The helicopter crashed, killing the pilot and co-pilot.

## Final Note

As with most maintenance related incidents, the majority of the reported cases could have been avoided had the orders been followed. Even if you know the job well because you have done it so often, use the CFTO to ensure the job is done according to the rules. Don't let complacency or inattention creep in ahead of alertness and professionalism. It could ruin your day! ♦

*Sgt Anne Gale  
DFS 2-5-4*



# JUST

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## Experienced Enough

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*While my partner closed his eyes, I would position the plane in a fairly drastic attitude and/or airspeed and then let him recover.*

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It is almost a cliché to say that all safe flight takes place within an envelope. Of course, the closer you get to the edge, the narrower the margin or error. The following incident also demonstrates how, at some point early in one's flying career, one is "just experienced enough to be dangerous."

I revealed the truth of these axioms quite emphatically a couple of years ago during a "mutual" flight on the Slingsby primary flight trainer. Both of us involved were post multi-engine wings awaiting further training, and enjoyed the chance to brush up on some basic flying skills in the interim.

During the flight in question, I suggested that we perform "unusual attitude" recoveries (UA's) to start our (unbriefed) VFR flight in the training area. While my partner closed his eyes, I would position the plane in a fairly drastic attitude and/or airspeed and then let him recover. He did the same to me.

Then I took control back to allegedly practice high-speed stalls. In a steep turn riding the stall buffet, I handed him control suddenly, treating it ultimately as a UA evolution and began to look out for traffic. Instead of unloading the stick and recovering as I expected, he continued to ride the buffet a bit further until it flopped violently into a spin opposite the direction of the turn.

At this point, I was surprised that he had decided to enter a spin given that we were well below the minimum altitude for spin entry — although I knew that we still had lots of time and saw out of the corner of my eye that he was recovering. It was when the plane then snapped into a second spin in the opposite direction that I realized that these spins were not intentional.

The Slingsby is fussy about precise spin recovery inputs and upon trying again, my partner finally recovered as I continued to watch the ground

get *really* big. We had lost an alarming amount of altitude during two recovery attempts and I was convinced we were going to hit the ground. I can still see clearly the snow-covered patch of farmer's field where we were headed. As I glanced at the altimeter immediately following the recovery I heard "you have control." We returned to base early in stunned silence, thankful to be alive.

Checking a topographical map some time after landing, we deduced that we had recovered a little below 260' AGL!! In a spin, this is not very far! I was just experienced enough to feel too confident to bother communicating my intentions to give my partner another UA. If I had, he would have simply recovered then, prior to entering the spin. This, in concert with a dicey spin recovery, quickly erased whatever margin of error we had, and very, very nearly cost us our lives. ♦

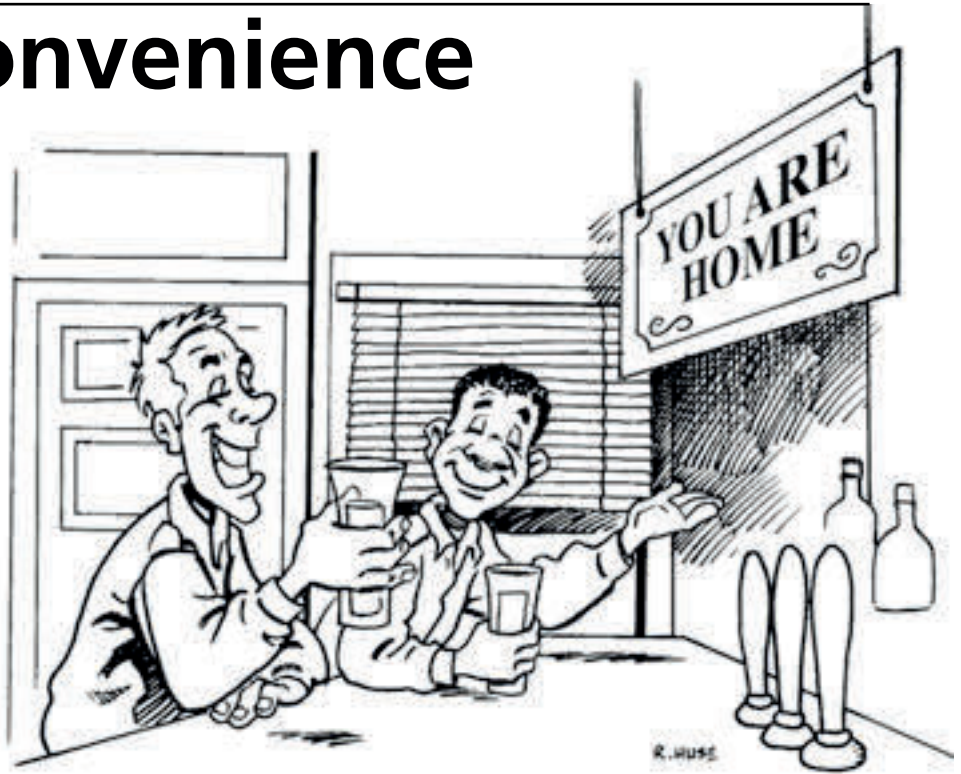
*Captain Riou*

# ...JUST For Our Convenience

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*We were lucky on that day and, I think, next time we will have our post-flight beer at some emergency airfield rather than taking an unpredictable risk just for our convenience.*

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The following episode happened about four years ago during embargo enforcement operations in the Adriatic. My squadron was deployed to Elmas on the island of Sardinia, Italy. The standard mission duration was about ten hours including two hours of transit into the operational area, six hours on task, and two hours back home.

I was a co-pilot on one of our Brequet 1150 "Atlantics." It was a normal mission and after just about six hours of low level overseas flying, we were cleared to return to base. When I pushed in climb power to join the airway back home, the engine vibration light illuminated for about two seconds. We reduced power on that engine and worked

the engine vibration checklist. This procedure had us check engine parameters and, if they were abnormal, shut down the engine.

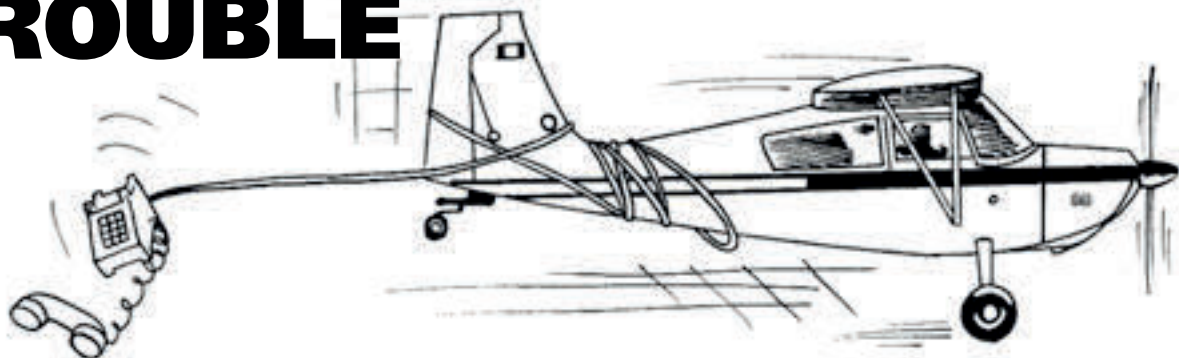
All engine parameters were normal except for a slightly increased indication on the engine vibration gauge for #1 engine, but it was still in limits. Therefore, we decided to keep the engine turning and head back home. I have to admit that we didn't like the idea of spending a night at our emergency alternate waiting for spare parts and that this thought influenced our decision.

Nevertheless, during the flight back to our operating base no further discrepancies were observed and about two hours later we landed

uneventfully in Elmas. We recorded our observation in the forms, briefed the Technical Officer (TO) and went for the debriefing. Later that night, the TO informed us that the compressor of #1 engine was completely stuck because the inner coating of the compressor case had partially loosened.

Internal damage to the engine could have resulted at any time possibly causing structural damage to parts of the wing. We were lucky on that day and, I think, next time we will have our post-flight beer at some emergency airfield rather than taking an unpredictable risk just for our convenience. ♦

# Plane + Tow Rope + Telephone Pole = TROUBLE



All right people, fly safe and fly smart,” the morning briefing ended. It was back to the grindstone and it promised to be one of “those days.” The temperature was forecast to be 30°C and the winds were going to be at the aircraft limits. The morning shift went well with all people doing their jobs like the professionals they were. We took a break for lunch where all commented on how hot and humid it was starting to get. After lunch, feeling refreshed, we all went back to work.

Our operation, as always, consisted primarily of providing familiarization flights to the local Air Cadet Squadrons to show the cadets the

fundamentals and joy of flight. All was going well and, for a change, the forecasters had actually gotten the weather right. The temperature was 29°C and the winds were gusting right up to the aircraft limits.

One of the lower time tow pilots took over command of the tow plane after a scheduled pilot change. On the first approach he was high and long, those hot days when you float forever sure keep a pilot honest. However, the second approach was a different story. As he turned on to final, everyone commented that he was low. When we went to hook up the next glider we noticed the snapped towrope.

Investigation revealed that the 200-foot towrope, which will typically hang up to 75 feet below the tow plane on approach, had wrapped around a telephone pole 1/4 mile back from the button of the runway. We gave the pilot another check ride, to correct technique, and the day continued without further incident.

This was a humbling experience for all involved and reminded everyone of the dangers of pressing and complacency especially after a long, hot day of flying. ♦

*Capt. Pierce*

## Dear Editor,

With reference to *Flight Comment* no.1 2001...on page 7 you have a picture of a gray electronic warfare CE-600 Challenger once belonging to 414 Squadron depicted in your article. The flight safety article itself involved a white CL-601 Challenger (tail #144613) from 412 VIP Squadron, Ottawa. I was involved with the recovery efforts of aircraft #613 in Shearwater years ago. The aircraft sustained category “A” damage and currently sits at the head of one of our runways in Greenwood as scrap.

I believe that all flight safety issues should be reported with the utmost accuracy and honesty (warts and all). Your caption at the head of this article (“Lessons Learned”) is misleading. I was wondering if it was common practice for you folks to put any old picture on top of your articles or if you simply ran out of file pictures of white VIP Challengers?

*Corporal E. Johnson  
434 (CS) Squadron  
CFB Greenwood*

## Dear Corporal Johnson,

To tell the truth, I had no idea that the article referred to a white VIP Challenger as opposed to a gray one. In the article itself, it doesn’t refer to a tail number or to a colour so, basically, how was I to know.

Thanks for pointing out my mistake.

*Captain Tammy Newman  
Editor, Flight Comment*

It

**WORKED** as

**ADVERTISED**

In November 1986, I was crewed aboard a CP-121 Tracker, one of a three-ship component that was scheduled to depart Summerside for Bermuda on a long-range navigation exercise. During the pre-flight walk-around on the ramp, I noticed what appeared to be fresh hydraulic fluid at the tail of our aircraft. This was the lowest point of the airframe and any significant amount of fluid would indicate a possible leak in the hydraulic system. I dutifully pointed out the fluid to our first officer, a young lieutenant preparing for his AC (Aircraft Captain) check ride. He assured me that the small amount of fluid present did not warrant further investigation. We departed under good weather conditions for a single leg direct to Bermuda.

Just past the halfway point, the first officer and I switched seats so that I could enjoy a few minutes looking out over the Atlantic. Shortly after switching seats, Base Operations in Summerside contacted us via HF phone patch with an urgent message: a pool of hydraulic fluid had been discovered on the hangar floor where one of our three aircraft had been parked the previous night. Looking up at the hydraulic system gauges on the console overhead the co-pilot's position, I verified that the left gauge was indicating a drop in pressure of fifty percent and that the right gauge was beginning to drop as well. We definitely had a problem!

The first officer and I returned to our respective seats and the crew began assessing the situation. We had an emergency hydraulic reservoir available for such occasions;

flaps, landing gear, and brakes would be available for landing. The problem was with the pump that drove the main hydraulic system; it was engine-driven and could not be shut down. In the event that the hydraulic system had become contaminated with metal particles, for example, fire could break out if the pump overheated.



Having discussed the possibility of an on-board fire, the crew began preparations for ditching in the event that we could not make Bermuda. Although conditions were perfect for ditching — a warm day, no wind, and a calm sea — this was not an eventuality that any of us looked forward to. Our fears were allayed when we finally reached our destination and landed without further incident. The emergency hydraulic system worked as advertised and we enjoyed a week in sunny Bermuda while we awaited repairs to our aircraft.

I have often reflected on the events that led up to this incident and

asked myself what I might have done differently at the time to prevent its occurrence. As a young Corporal, I was hesitant to question the response that I received from the first officer when I first informed him of the problem. Had I been complacent in accepting his response too readily without investigating further? Should I have informed the

aircraft captain after considering that I had not received a more satisfactory response to my concern? Should I not have brought the matter to the attention of a technician?

CRM (Crew Resource Management) practices are ideally suited for answering these questions as long as we have policies, training, and evaluation in place. Units must back up their Flight Safety and CRM programs with clear policies and guidelines. Everyone must receive effective and timely training that reinforces the important role that we each play in preventing accidents. And, finally, we must continually evaluate the effectiveness of our safety programs and whether they are reaching all of our people with the message — “You, too, can save lives.” ♦

*Captain McCarthy*

# Ready to Play

It was a fine day for GCI assisted air-to-air combat training. Two F-106's from Great Falls, Montana were to travel into Canadian airspace to work with "Gladstone Control," the air defense unit based in the Underground Complex (AKA "The Hole") in North Bay, Ontario. The crew's senior Weapons Controller was on scope to show the newbies, myself included, how a "real" weapons controller ran a close control mission. As fresh graduates from the Weapons Controller School, our heads were full of "School-isms" and we didn't really know how to control airplanes.

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***The aircraft disappeared from our scope for a couple sweeps, and when it returned, it was in a climb and heading in a different direction.***

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The mission began as any other — the F-106's crossed the border into Canada, the controller assumed control of the planes, completed his normal check-in procedures, and split the flight to get set up for the first intercept. The mission briefing called for a visual identification of the target, with the designated target aircraft to be cleared Level 4 Evasion — basically, anything goes.

Once both pilots called "Ready to Play," the controller sent the target on a target run. The target aircraft immediately began a rapid descent from "Angels 30" (flight level 300) and started a series of maneuvers in an attempt to defeat the fighter aircrafts' radar system. As the target passed through "Angels 6" (6,000 feet), radar coverage became rather

intermittent. Our old Pinetree Radar was obviously having trouble tracking the plane at that altitude.

Our controller explained that in a situation such as this, the correct procedure was to perform an "IFF Locate" — an interrogation of the radar data to determine the Mode 3 Transponder Code of the track. This was to ensure that the "blip" on the scope was indeed the aircraft that he thought it was. The controller performed the IFF Locate, and sure enough, the reply came back with the proper Mode 3 code. All was good under the heavens.

The aircraft disappeared from our scope for a couple sweeps, and when it returned, it was in a climb and heading in a different direction. Hmmm. It was also about 150 knots slower than it had been. Hmmm. Perhaps it was time for another IFF Locate, just to make sure that we were still tracking the right plane. "Nah," said the Controller, I just did one, besides, he's cleared Level 4 Evasion. Okay, said the newbies. (Hmmm, at the Controller School, they told us that an F-106 couldn't fly that slowly.) It must be

another one of those "School-isms" that we kept hearing so much about. Boy, I couldn't wait to become a real controller.

Well, who do you think was more surprised at the completion of the intercept? The controller? The pilot of the F-106? The pilot of the target aircraft, who, by the way, was 50 miles away from the F-106 at the completion of the intercept? Or, the pilot of the twin engine commuter aircraft that just had an F-106 pull up along side of him for a visual identification?

Murphy was in fine form that day. What are the odds that one airplane would descend out of radar coverage at the same time and place that another airplane would climb into radar coverage? Luckily, the two aircraft had just enough separation between them so that they did not become one with each other.

What did we learn? Trust your gut feel. If you have a nagging question or doubt, investigate it. Don't be complacent. If you're uncomfortable with a situation, press the issue. ♦



# So, You're Just a Passenger, Eh?



Like many CF reserve members, I have another job. Mine just happens to be with an airline and that tends to give me a unique perspective of flight safety in both the civilian and military world.

Recently, I was travelling as a passenger on a Boeing MD-80 flight. After having checked in, gone to my seat, stowed my carry-on, and taken a quick look at the emergency information, I had a look around the aircraft. As I looked out the window, I noticed something I hadn't seen before; there was a line across the window. It kind of looked like a crack. Upon closer inspection I noticed that the seal between the inner and outer windows had "bubbled up" across the window.

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***Five minutes went by and the First Officer came to the back of the cabin to have a look. The look on his face told the whole story, as well as the "OH MY GOD" that had escaped his lips to settle any lingering doubts.***

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We were still at the gate and had not yet started engines, so I had time to think. I knew that the aircrew had already done a walk-around of the cabin as well as the rest of the aircraft, so they must have seen what I

had seen. Then the thought went through my head "well, I'm sure they've seen it and I'm not qualified on this aircraft; besides, *I'm just a passenger.*" I had visions of a sudden explosive decompression going through my head (with me sitting right next to it)! I decided to tell the lead flight attendant BEFORE we left the gate.

I strode to the back of the aircraft and mentioned to the lead flight attendant what I had seen and where. She listened to me and went over to have a look. She didn't seem too concerned with what happened, or so I thought. "Well," I said to myself..."I've said my piece so I've done my part. Right? Five minutes went by and the First Officer came to the back of the cabin to have a look. The look on his face told the whole story, as well as the "OH MY GOD" that had escaped his lips to settle any lingering doubts.

The captain then went back and sent for maintenance to have a look, and, as a result, my flight was cancelled. A little inconvenient perhaps, but the alternative could have been much worse.

I really started thinking about it when the Captain thanked me and mentioned that if there had been an ordinary (i.e. non-aircrew) passenger there, we may have flown with the problem. That was my first WHAT IF?

My second came when I was recounting the story to a colleague who happens to be an MD-80 First Officer. He asked me WHAT IF the lead flight attendant hadn't appeared to do or say anything about it? Would you have pursued the issue with the Flight Deck crew, he asked?

I thought about it after that and figured that since accidents usually happen due to a number of things, the fact that I spoke up may have severed the chain that could lead to an accident.

Whether you are a passenger in an airliner, Hornet, or glider, if you see something that may be wrong, speak up and give the flight crew a hand. CRM doesn't only include the crew on board, but also the passengers in the back. The worst thing that could happen is that you are smiled at and maybe chuckled at later. The alternative, however, may not be as funny.

Flight crew, keep in mind that others may have seen what you have not. When in doubt, check it out. The extra set of eyes is always a great help, even if they belong to JUST A PASSENGER. ♦

# *Playing Chicken With a*

Well, there I was, early December, in St-Jean, PQ with a Cessna 172 from the contractor at my disposal for five hours worth of flying. I intended to fly to Toronto Island to RON (remain over night) and visit family. I hadn't seen them for two years. I had this all planned and lined up for a few weeks now, and my wife had initially given her blessing. But, our first child had been born only a month before. The night before departure, my wife turned anxious and resentful. This trip would leave her alone with the baby for a day, a night, and most of the next day — a first! On the other hand, the flying program called for a solo cross-country and I wanted to see my family. I promised I would remain only one night and get back as early as I could the next day.

The trip to Toronto was VFR and uneventful. I did a cursory weather check for the next day and it called for lower ceilings and a chance of freezing rain for the late afternoon around Montreal. A warm front was coming. The arrival call to the wife from my brother's wasn't good. It turned downright ugly when I explained the weather and the chance of delay. I promised that I would get to the Island Airport the earliest that I could the next day and fly home. The time with family wasn't that great — I had tomorrow's problems looming and kept sneaking peeks at the weather channel.

The next day, there I was checking the weather, straining really hard to find something good about it. It was a winter warm front — perfectly VFR here in Toronto and lowering ceilings around Kingston. There was a risk of freezing rain from Ottawa to Montreal and points further east. Well, I thought, it's just a "risk" and it wasn't due to start until an hour after my ETA. I wanted to cancel but here I was in Toronto, feeling like a heel. I couldn't phone the wife, so I thought that I would just go and take a look.

East of Kingston, the sky filled up and the clouds started coming down. FSS (Flight Service Station) said that Ottawa was freezing rain and Montreal and St Hubert were light snow. Fifteen minutes later, FSS called up and said that Montreal was freezing rain now and St Hubert had issued an amended forecast, calling for freezing rain sooner than expected. I was approaching Cornwall. Hmmmm...looking outside, the sky was getting darker but I could see for miles. No precipitation. I carried on. FSS called back and asked if I was going to land at Cornwall rather than St-Jean.

"No, I'll carry on, thank you."

I flew over Cornwall and with the favourable winds I was just twenty minutes out from St-Jean when I called FSS again for weather. Freezing rain in St. Hubert, no reports or pireps from St-Jean. It was the weekend and the tower was closed. FSS strongly urged me to divert to Cornwall. I reported no precipitation, but lowering ceilings. I decided to press on and ten minutes later I was down to 800 feet AGL. Off to the north it looked very IFR with dark shafts of rain and mist. The south was the same, but it looked further away. I looked straight ahead towards St-Jean and it looked pretty good. (I'd say that my sucker factor was very high by now!)



# Warm Front

In the circuit, I became warm and fuzzy and then landed with immense relief. I was getting out of the airplane when the freezing rain started. Down the line, I finally discovered what all those guys were doing around that Cessna 152. There was a group standing around watching two others knock and scrape ice off of it. It was caked. The windscreen must have had almost one-quarter inch of ice on it. I had nothing.

I walked into the office, and the manager and my instructor looked at me with that “what the hell are you doing here” look. Based on the

weather, they didn’t expect me back that day. I told them about my flight and all the outs and contingencies I had planned. They seemed satisfied. They told me that the ice caked 152 had come up from the south and had briefly been caught in some rain. To the east, someone had declared an emergency and landed at Bromont because of icing. Everything was shut down to the north. My route from the west turned out to be the only ice-free area until my arrival.

Well, at first I felt fairly proud. I had just played chicken with a classic winter warm front and got

off unscathed. On the walk home, I slipped on the new ice in front of my apartment building and landed flat on my back. Once inside, away from everything, I started feeling really stupid. I felt stupid for my poor judgement and for my pressing...and for what? There was no mission; it was just continuation flying training. So what if I would have been in the doghouse for a few days. That would have been better than being upside down in a field with a bunch of rubberneckers gawking at my misfortune. The wife and I have talked since. ♦



# RESPECT THE WEATHER

The critical phases of flight are undeniably the take-off and landing, simply for the fact that they are close to the ground. Any emergency occurring during these two phases, or any mishandling, requires immediate recognition, decision, and action. Failure often results in late reactions and worse, wrong decisions, and, worse still, another statistic for CFIT (Controlled Flight Into Terrain).

Safe take-offs and landings are subject to weather and terrain. The weather is the most important factor in the end result. Precipitation reduces visibility and so does haze, fog, mist, etc. The invisible yet deadly wind shear and microburst can also affect safe take-offs and landings. The terrain decides on the take off distance, rate of climb, and maximum take-off weight. It becomes very critical if an engine fails whilst attempting to clear terrain. The combination of poor weather and high terrain areas are deadly. In such situations, the criticality of pilot alertness and handling will decide on the survival of the crew.

I recall one incident when I was a junior instructor on a light, single propeller aircraft. I was with a student in our traditional training area about 40 miles from our base. I could see weather was building up around my base and the surrounding areas. I didn't think much of it at that stage. As I continued with my instructional sortie, I realised that weather build-up had gotten worse. Not realising the seriousness of the situation and not wanting to be ridiculed as "chicken feet" if I abandoned the sortie, I foolishly carried on with my sortie. There was a false sense of security as I knew there was another senior instructor operating in the area with me.

Not long after, we were both recalled back to home base. As we headed back to base, we received weather information and were informed that the weather conditions on our base as well as the surrounding bases were below our weather minimums for recovery. I was starting to panic as I realised we did not have enough fuel to hold off until the weather cleared. Two options were open to us. We could either press back to the base to land or hold off until the weather cleared and be prepared to ditch in the water if we ran out of fuel. There were no other alternatives.

The instructor in the other aircraft must have sensed my panic and, sensing the need to guide me, asked me to "join hands" for a radar precision approach for landing. The next 20 minutes were frightening. We entered turbulence when we approached the towering CB's and soon after, we were enveloped in rain. Visibility dropped sharply and I had to peer through the rain and grey background to keep sight of my instructor in the other aircraft. The up and down drafts tossed our aircraft around like rag dolls and my heart missed many beats on the few occasions when I thought I would collide with the other aircraft. But I hung on close to him and didn't allow anything else to distract me. My student was very white and quiet, but I could not find the voice to speak to him or reassure him.

All the time during the talk down, I was praying for the weather to clear and for us to break out of the clouds, but I knew it would not be so. We managed to lower our flaps and gear and continued our descent to the runway. It was a struggle to keep the aircraft on the glide path and I added

10 knots to my approach speed as I knew that I would be encountering lots of turbulence. I was also prepared mentally to "peel off" from the other aircraft if I thought I would overtake him and if the runway didn't appear.

I scanned the aircraft on my left and the window ahead of me all the time hoping to have a glimpse of the runway lights. Passing though 400 feet and no sight of the runway. Our decision altitude was 245 feet and I knew there was a water tank of 300 feet to the right of the runway. We continued descent and I was watching the altimeter winding down slowly. We passed 250 feet and were told to take over visually for the landing.

My worst fears were confirmed when I could not see the runway but the instructor in the other aircraft said he was "visual with the airfield." To this day, I am sure he had no sight of the runway. Being scared and desperate at that time, I followed the other aircraft and continued on the descent. At about 100 feet, I saw the lights of the runway. It was still raining fairly heavily and the runway was wet but, miraculously, I managed to put the aircraft down on the runway for a "pairs" landing.

It was only after clearing the runway that I began to relax. I realised my hands were cold, wet, and gripping the controls very tightly. How I survived that day is still a mystery. Perhaps my stupidity and foolishness in not executing a missed approach saved me. But, I have learned my lesson. I will never tempt fate again as I know I may not be so lucky next time. I have come to respect the weather and have set my own limits. I still want to live! ♦

# NO SUCH THING AS A SIMPLE MECHANISM

Few machines as complex as an aircraft are *always* flawless from start-up to shut down. Depending on the aircraft type you fly in, you may find this statement obvious or absurd. Now, when I tell you that I fly Sea Kings, you may say to yourself — oh yeah, that figures — but I think my lesson learned could apply to any aircraft or aircrew in the CF.

On one occasion while strapping in, the seat height selector was a little sticky. After a couple of attempts, the seat seemed to lock where I wanted it. As a precaution, I shook the seat extra vigorously. It seemed to hold, so I made a judgement call and continued with the sortie.

All went normally until I slowed through the vibration of translational lift for final landing. With approximately 15 degrees nose up, abeam the aft edge of the flight deck, and about 40 feet of altitude, the vibration caused the seat to drop to the bottom and sequentially slide full aft. At that moment I lost control of the aircraft. My arms yanked the controls to pitch the nose even further up with a simultaneous drop of precious altitude. A split second later, the motion of the seat stopped, so I extended my arms and legs to their limits and struggled to regain control. With control regained, and my finger now able to reach the ICS switch, I called to pass

control over to the other pilot and to answer the expletives of my crew.

Afterwards, the technicians closely examined the seat and discovered that the actions of the locking pins were erratic. At best, one of two pins partially locked in both the vertical and longitudinal directions.

Despite my best efforts to make a good decision to assess the risk, I did not foresee the full consequence of what appeared to be a benign malfunction of a simple mechanism. The lesson...when in doubt, particularly for a routine peacetime sortie, delay the trip in order to have it fully checked out. ♦

*Captain McCarthy*



# I WAS LUCKY, WILL YOU BE?

I was in charge of a crew of three technicians responsible to carry out maintenance on the CF188 Weapon System during a “Star Fighter” exercise in Europe. That particular evening, we were tasked to replace a M61A1 gun system on an aircraft returning from a mission. Now, I was pretty confident in my ability to do this task since I had done more gun changes in my career than I could care to count. Well, let me tell you, when you think you have it all figured out, something is going to prove you wrong.

Everything was going nice and smooth until we removed the last

bolt holding the gun system. The aircraft nose suddenly started to move up and I thought for sure the aircraft was going to sit on its tail. I saw my career flash in front of my eyes, and then the aircraft stopped. In my confidence I had neglected to check the Aircraft Servicing Set. Had I done so, I would have noticed that the aircraft had not yet been refuelled. The CFTO’s give a warning to position an aircraft jack under the tail hook in low fuel conditions to prevent injury or damage to personnel or equipment. I was lucky that evening, there was enough fuel

on board to prevent the aircraft from lifting any further and possibly cause serious damages.

Yes, there was a time factor at play, and maybe that was part of the problem, but I believe the real cause was my assumption that it was just another gun change and I failed to verify all aspects of the task at hand. I learned a lesson that evening... complacency will eventually lead to trouble. I was lucky, will you be? ♦

*Sgt Fontaine*



# I LEARNED ABOUT HYPOXIA FROM THAT



**M**y first posting many years ago was to Comox and that most famous SAR squadron that lives there. Long before the days of the SarSat, I found myself in the back of the Buffalo enroute to a search in the interior of British Columbia. Some time into the flight we began a track crawl along the lost aircraft's flight plan with the hope of hearing an ELT. Now, I had been on numerous flights prior to this day, but had never had to strap on the oxygen mask. We climbed to around 16,000' as the Flight Engineer handed out the oxygen masks to the passengers. I never gave it much thought other than "I must look rather silly with this tube and bag on my face." I remember my mother telling me when I was younger that this was a bad idea!

Sometime later nature called, so without a second thought, I pulled off my bag and headed to the ramp where the relief tube/emergency

intercom was located. The sight out of the aircraft window was spectacular. There was not a cloud in sight and the mountain peaks were crystal clear. I'm not sure how long I spent looking out at the scenery until I was reminded by my bladder of the job at hand. Unzipping my flying suit and standing lopsided on the ramp, I sighed a deep breath of relief.

My first clue that something was not right was the sweating and the slight tingle in my mouth. This was followed by a whole bunch of coloured dots dancing in front of my eyes. "How strange," I thought, as the sound of the engines and my vision both disappeared. It must have been quite a sight for the SAR-tech who saw me fall. Still continuing the job that I had started out to do only now uncoupled from the relief tube, I spiralled into the ramp. After they had finished laughing and I had finished my fountain impression, they got a mask on my face. I came to rather

quickly and was dazed, confused, and a little wet. I zipped up, sat down, and had a relaxing flight not really sure of what had happened but knowing that I would not take that mask off again for anything.

Only many years later on a high altitude indoctrination (HAI) course did I learn the whole story of hypoxia and how dangerous it could be. Cramped in the tiny little chamber drawing my circles and Christmas trees and waiting for my symptoms to appear, I once again had the taste in my mouth and when I saw that first purple dot, I slammed my hose in and selected 100% so fast that my instructor showed concern and asked me if I was OK. "Yes fine" was my answer, "just didn't want to pee all over myself," I said. He gave me a funny look and went on to the next student. ♦

*MCpl Rusta*

# If You Don't CONSULT, You Will



The ready room squawk box bel-  
lowed “Scramble 033, Scramble  
033.” It was that time of the year  
again when the headquarters’ staff  
came to evaluate the squadron’s  
ability to accomplish their many  
tasks. The area that was of most  
concern today was to launch aircraft  
as quickly as possible.

This was day four of the evaluation.  
Marc, my partner, and I slipped into  
our protective gear as we raced to  
the aircraft. This was getting to be  
routine. Marc was the crew chief of  
number one servicing crew. He had  
been working on the Voodoo for  
over ten years. I was the squadron’s  
OJT co-ordinator and, as such, was  
responsible to ensure that all squad-  
ron personnel were current on  
Voodoo servicing procedures. Talk  
about an experienced start crew.

A scramble start required two peo-  
ple and, as you would expect, was  
strictly regimented. The number  
two person, Marc, was responsible  
for moving the chocks from the left  
main wheels to the nose wheels.  
When the aircrew had climbed into  
the cockpit, Marc removed the lad-  
ders from the left side of the aircraft  
and positioned himself under the  
left wing, ready to remove the

down-lock from the landing gear  
when the number one engine rum-  
bled into life. The number one  
person started the electrical power  
unit, applied the electrical power  
to the aircraft, and turned the high  
pressure compressor valve to the  
“on” position, which allowed air to  
flow to start the engine. These items  
of equipment were located on the  
right side of the Voodoo. After com-  
pleting these tasks, I took up a posi-  
tion at the front of the aircraft to  
monitor the start.

The pilot quickly fastened and  
adjusted his many straps and, while  
doing so, signalled me to start the  
number one engine. The starter  
belched air, but the engine failed to  
light. No sweat. Signalling Marc that  
we were going to start the number  
two engine, I gave the pilot the “all  
clear” signal to start that engine as  
Marc ducked under the aircraft. As  
the number two engine smoothly  
started, Marc removed the down-lock  
from the right hand main landing  
gear. Operating a valve in the right  
hand side of the nose, I rotated the  
armament door. With number two  
engine running as advertised, Marc  
ducked back under the aircraft and  
removed the panel covering the  
starter for number one engine.

He tapped the start with his screw-  
driver; the standard practice to fol-  
low if you were scrambling an air-  
craft and the starter failed. He gave  
me the thumbs up, which was my  
cue to signal the pilot to start num-  
ber one.

The starter whined as the com-  
pressed air forced it to rotate. When  
the starter cut out and as the engine  
picked up speed, Marc replaced the  
starter panel. The pilot signalled to  
remove the electrical power and as  
I disconnected the cord, Marc scur-  
ried under the aircraft to first turn  
off the compressed air and then to  
remove the air hose. Moving to the  
front of the Voodoo, I signalled the  
pilot to determine if he wanted the  
chocks removed. With his affirmative  
reply, I moved to the nose wheels  
and removed the chocks. Marc was  
positioned at the right wing tip and  
I moved to the left side of the nose.  
I carefully scanned the aircraft to  
ensure all panels had been secured  
and that there were no fuel or  
hydraulic leaks. Marc was carrying  
out the same procedure on his side  
of the Voodoo. When the pilot and  
the navigator showed their seat pins,  
and after I had visually checked with  
Marc that he had not detected any  
unusual situations, I cleared the

# INSULT!

aircraft off the line. The Voodoo roared from its parking spot and quickly taxied down the ramp.

Feeling extremely satisfied that we had overcome the minor snag that we had encountered during the start procedure, Marc and I began the next task, which was to gather the equipment and place it in designated areas ready for the return of the Voodoo from its trip. Marc rolled up the air hose on the compressor and ensured that there was enough air pressure. I replaced the cable on the electrical power unit. Next came the chocks, the ladders, and finally the ground locks.

Only then did we realize that we had not communicated too well. There was only one ground lock, which meant that the Voodoo that I had cleared would never be able to retract its landing gear. Fortunately, we were equipped with a stop phone that was mounted on the outside of the servicing shack. Racing over to the phone, we were able to contact the tower immediately by lifting the receiver. ATC stopped the aircraft before it started its take-off roll and the servicing truck was dispatched so that the ground lock could be removed. Talk about being embarrassed!!!

The start procedure just described took about three minutes and due to its nature was time compressed with a fair amount of pressure to accomplish it correctly. That experience has been indelibly etched in my memory. A minor oversight had the potential to kill two people and destroy an aircraft worth millions of dollars.

There are some valuable lessons to be learned and remembered. These lessons apply in our everyday lives. The most obvious is that anytime a normal procedure is not followed there is a high probability that something will fall between the cracks. Another lesson learned from this experience is that any time a decision you make affects another person's area of responsibility, talk it over with that person. In the case of the Voodoo start, this was not possible. Do not put a person in a situation that they cannot control on

the strength of a decision that you have made. This has led me to coin an expression. If you do not consult, you will insult. There is one last lesson which is the least obvious. If you have made an error, don't be afraid to relate the error to others in the hope that someone will learn from your experience. ♦

*Jack Blair*

# Epilogue

**TYPE:** Schweizer 2-33 Glider  
C-GCLG

**DATE:** 26 Sep 1999

**LOCATION:** Iroquois Falls Ontario



The glider was being flown by the Arctic Watershed Gliding Centre in support of the Air Cadet Gliding Programme Fall Familiarization Session. The site was using a winch to launch the glider to provide familiarization and motivational flights for a group of local Air Cadets. The pilot was a qualified Familiarisation Glider Pilot who had already completed two flights without incident immediately prior to the occurrence.

With the pilot in the front seat and the cadet in the rear, the glider was once again launched and achieved an altitude of 800-900 ft at cable release. After a brief session of turns at altitude, the glider joined left downwind for Runway 18. The pilot did not notice that the wind at altitude had increased and proceeded to fly his circuit using the same check altitudes and ground references that had resulted in a successful approach and landing only seven minutes earlier on his previous flight. Once established on final he realised that, although he had added 20 mph to his final approach speed to compensate for the wind, he was barely making any headway towards the runway. The glider was instead descending towards trees just north of the airport boundary. The pilot elected to fly the glider between the trees and avoid stalling. The left wing struck a large pine tree approximately 25 feet above the ground and the glider came to rest on the ground with the left wing folded under the fuselage and the right wing parallel to and up against the trunk of another large pine tree. The pilot and passenger were not injured and were able to egress unassisted through the broken canopy.

The investigation determined that the pilot failed to properly assess the wind aloft and to alter his circuit accordingly, because his performance was impeded by his relative inexperience and by fatigue related to inadequate rest and nutrition before assuming his duties. The pilot had slept 4.75 hours on each of the two preceding nights due to civilian employment and had only consumed an Instant Breakfast 5 hours before the accident. Neither the Central Region Flying Orders nor the Air Cadet Gliding Program Manual, in effect at the time of the accident, included provisions to account for civilian employment in the length of the duty day. As a result of this accident, the Central Region Flying Orders now include limitations for duty day and crew rest. These limitations include both military and civilian work times in the calculation of the duty day. The National Cadet Authority will review these limitations with the aim of extending them to all regions.

The winch in use at Iroquois Falls is of a unique design. Being self-propelled, its engine is kept running constantly except during rest and meal periods. This fact defies the rule on rotating beacons as described in the A-CR-CCP-242, which is that the rotating beacon must be illuminated any time the ignition is on thereby warning personnel on the site that a glider launch is about to take place. If this winch were equipped with a rotating beacon, in accordance with regulations, its constant operation would desensitize personnel to the dangers for which it was designed for. Therefore, the direction contained in A-CR-CCP-242 with regards to the need for an amber light will be clarified for non-standard winches. Winches will be required to have a rotating beacon that will indicate that the operator is about to launch a glider.

All aspects of the site's emergency response plan were handled adequately. Unfortunately, this plan, and most other region's plans, does not include any direction as to the notification of the parents of cadets flying as passengers after an accident. As these family sessions are being conducted with very young passengers, it is understandable that some parents might become very upset if not notified immediately of their child's involvement in an air accident. As a result, all Gliding Sites Emergency Response Plans will be reviewed by RCA Ops Os to ensure they include provisions for the immediate notification of the parents of children involved in an air accident. As well, Regional Cadet Headquarters will be assigned responsibility to follow up on the care of individuals involved in accidents. ♦



# Epilogue

**TYPE:** CH-124A404 Sea King  
**DATE:** 19 July 1999  
**LOCATION:** Shearwater, NS



The crew of aircraft CH124A404 had just returned from a crew operational readiness exercise (COREX) and was in the process of shutting down on the Shearwater ramp. After rotor disengagement, three crewmembers deplaned, leaving the Co-pilot and the Navigator to conduct the remainder of the shutdown procedure. After attempting to cycle the rotor brake in accordance with the checklist procedure, smoke and flame developed in the forward part of the main gearbox. The ground crew advised the co-pilot of the fire and an emergency shutdown was performed. The co-pilot was unable to reselect the manual rotor brake. The ground crew commenced fighting the fire using four 50 lbs. dry chemical extinguishers retrieved from the surrounding area. The 12 Wing fire fighters arrived shortly thereafter with the foam truck and quickly extinguished the blaze. The aircraft suffered “B” category damage to the engine compartments and main gearbox area. There were no injuries in this occurrence.

The investigation concluded that improper installation of the rotor brake hydraulic line during MGB installation was responsible for the hydraulic line being in contact with the rotor brake accumulator housing. The automatic rotor brake pressure line chafed against the “rotor brake panel package accumulator housing” ultimately causing the line to rupture under pressure. Furthermore, the location of the hydraulic line and the lack of mandated opportunistic inspections made timely detection through routine inspection extremely unlikely.

Atomised hydraulic fluid from the damaged hydraulic line contacted the #2 engine exhaust cowling and ignited.

In response to recommendations made by the investigation team, maintenance personnel were briefed on their responsibilities during an aircraft ground fire and the Canadian Forces Fire Marshal is investigating a possible replacement of the portable fire extinguisher, with a more effective type of agent.

It was also recommended that :

- a. 12 Wing staff evaluate the benefits of equipping the local aircraft recovery crew with fire extinguishing equipment;
- b. 1 CAD investigate the feasibility of replacing the 50 Lbs. Dry Chemical extinguisher with the compressed air foam type extinguisher;
- c. DGAEPM consider procedures and/or orders which would decrease the probability of improper routing and clamping and increase the probability of detecting errors in routing and clamping — with priority given to helicopters of the same vintage as the Sea King; and,
- d. 1 CAD Orders be reviewed to identify regulations that may have been rendered confusing or impractical by changes to Sea King Operating procedures ♦

# How to Write for

Perhaps you've never written an article before. Don't let that scare you. It can be surprisingly easy, and the results can be quite rewarding. You don't have to be a professional writer to contribute to *Flight Comment*. Our authors come from all services, with ranks varying from private to general to civilian. But they all share one thing in common — they have something that they believe needs to be said.

In the Air Force, we often refer to shared experiences as “war stories” or “there I was...” stories. War stories are experiences that have left a lasting impression on you. Everyone has a war story because that's how we learn — by experience.

People like to trade these stories because it gives them a chance to share experiences and possibly learn things they haven't encountered before. Sometimes we find ourselves in an emergency situation and our readers want to find out how we handled it. What were we thinking about? What was our first impression? What would we do differently if it happened again? Answering these kinds of questions holds the reader's attention. However, you don't have to be flat on your back, running out of airspeed, or in the middle of a fully loaded munitions storage area surrounded by a raging fire to have a valid war story. Many times we have an emergency or a problem; and although nothing exciting happens, a lesson

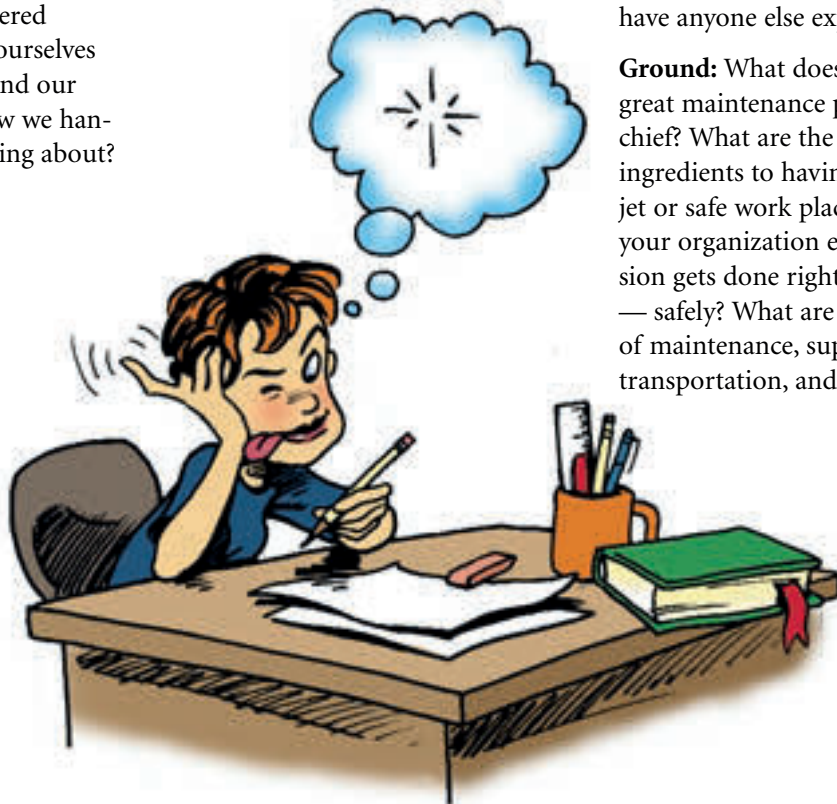
is learned. These first-hand experiences are extremely effective in teaching, proving a point, or supporting your way of doing things; and everyone can identify with them.

Sometimes we don't have a war story but rather a thought or idea about a better way to do something. Again, share these ideas and thoughts with others. If your thoughts or ideas are safety related in any way, write them down and send them to us. Don't prejudge the applicability of your article — we get paid to make those calls. Send us the material, and we'll decide if the theme is appropriate for *Flight Comment*.

Here's a quick potpourri of potential areas and subjects where we'd love to see articles:

**Flight:** Great ideas on how to keep from being that next flight mishap statistic, flying safely and effectively in the low-level/deployed/air-to-air/air-to-ground/over-water/bad weather/night/on the tanker/mass gaggle/on the range/in combat/clear VFR (certainly not all at the same time!) environment. How does your squadron pass along the hard-learned lessons from other flying incidents or mishaps experienced throughout the military? What does your squadron, wing, or direct reporting unit do effectively that seems to get the word out? What's the role of a good aviator, flight leader, element leader, wingman, flight commander, etc.? What have you done — unwisely or for whatever reason — that really got your attention (i.e., scared the wits out of you) that you'd rather not have anyone else experience?

**Ground:** What does it take to be a great maintenance person or crew chief? What are the important ingredients to having a good flying jet or safe work place? How does your organization ensure the mission gets done right the first time — safely? What are the safety roles of maintenance, supply, security, transportation, and operations



# “Flight Comment”

personnel as they all work together in accomplishing your unit’s mission? What sorts of experiences have you had in or around the flight line, office, hospital, dining hall, or work site that you don’t ever want to have again? What happens when complacency, misprioritization, lack of attention to detail, etc., get the upper hand in your life as you accomplish your job?

**Weapons:** Have you ever dinged a bomb/missile or damaged any munitions handling equipment? What could you have done to prevent it from happening? What does it take to operate day-in and day-out safely and mishap-free with training — as well as live — munitions? How can you ensure the most efficient and successful combat turns during aircraft operations? What lessons did some of you pick up on getting the mission done right during Operations?

Remember, you are writing for people just like yourself. How do you tell a story to your friends or family? It’s the same for the magazine. Most people don’t talk about the energy scaling of phase-conjugate solid-state lasers and the ramifications on eye protection while operating laser test equipment. So, don’t write like that for the magazine.

Figure out what point or lesson you’re going to try to relay to the reading audience and build your entire article around that idea. Don’t try to write about the entire history of CF maintenance or every possible sortie that can be flown by a CF-18. Just pick one idea and work on that. If we need to broaden it a little, we’ll tell you.

Don’t be afraid to tell it like it really happened. You get more points for spreading the word than you lose by admitting to an error. Tell the reader why you think you made a mistake. Give a good reason. By the way, no one has ever gotten into trouble by writing an article for *Flight Comment*.

We understand that few, if any, of you are trained journalists, but what we do ask all of you to remember when writing articles for our magazine are the basics we were all taught in school. You start with an introduction that hopefully grabs the reader’s attention and gives them an idea of what you’re about to tell them, then you go into detail with the main body, and finally wrap things up with the conclusion, where you summarize your main points and really drive them home.

There are no regulations, supplements, or directives concerning the submittal of articles. We are completely dependent on voluntary submission of articles written by people who care and have something to share with their team members. *Flight Comment* is published quarterly and is 32 pages in length. As a result, our need for new articles is high, and we are typically forced to live “month-to-month” on articles. In planning to write about specific topics, keep in mind that it takes four to six months to get an article translated and into print. In addition, as you select a subject to write about, be advised that some topics are purely seasonal. For instance, we wouldn’t print an article on SNIC (snow and ice control) procedures in July. Remember to consider the

lead-time for getting an article into print, and plan ahead.

We prefer to receive drafts via e-mail, but hand-written and sent by snail mail works just as well. Longer articles are as acceptable as shorter ones. The bottom line is, use whatever length is necessary to tell your story. Please include your name, unit, and telephone number when you send in your article. Articles can be published anonymously if you so indicate, but should we need clarification, it’s nice to know how to get in contact with you. Photo or artwork submissions to accompany articles are always welcome as well, but remember that there are many journalistic style regulations governing which photos are acceptable. Also, digital photos must be high resolution (at least 300 dpi) in order to be usable in our magazine. If at any time you have a question concerning your submission, give us a call at 995-7495 (AV: 845-7495).

Unfortunately, as a government publication, *Flight Comment* cannot offer monetary rewards for material published. What we can offer is the opportunity for you to make our Flight Safety culture better. By sharing your knowledge, you make a valuable contribution to those who need your information to do their jobs in a safer manner. It may sound trite, but your input — whether a long feature or a simple tip — might just save someone from injury. It might even save a life. ♦

*Adapted with kind permission from The Combat Edge*

## For Professionalism



**CAPTAIN DENIS BEAUMONT**

**CAPTAIN CLAUDE GAGNON**

While doing an instrument flight-training mission aboard CT-133610, Captain Beaumont and Captain Gagnon experienced a succession of unusual electrical problems as well as the loss of communication between the pilots and with the control tower. In addition, the problems caused the loss of other vital items such as the booster pumps, the flaps, and the speed brakes. The fuel quantity indicator for the main fuel tank and the trim indicator also became unusable.

Rapidly reacting to the situation and due to the small quantity of usable fuel remaining in the main fuel tank, Captain Beaumont wrote down his intentions to Captain Gagnon on a log card. He immediately maneuvered his aircraft towards the airport using minimum power, while at the same time, Captain Gagnon was trying to diagnose the problem and reestablish radio communications, without success. Captain Beaumont elected to carry out a practice forced landing pattern for the approach and landing, without the use of flaps and speed brakes. Due to their remarkable flying skills, the crew were able to complete the landing with a very low fuel condition, without further incident.

Captain Beaumont and Captain Gagnon are to be commended for their outstanding initiative and professionalism, undoubtedly contributing to the safe landing of the aircraft despite these unusual problems. Their immediate and flawless reactions coupled with their rapid assessment of a complex set of critical factors certainly prevented an ejection and the loss of a CT-133. ♦



**CORPORAL CRAIG HAIRE**

While awaiting the arrival of his assigned aircraft Cpl. Haire a 441, TFS AVS Technician observed an F18 from an adjoining unit taxiing for takeoff. He immediately noticed that a panel forward of the R/H engine was in the stowed or open position. Determining that the situation was critical he ran

to the adjoining flight line area and stopped the moving A/C. Utilizing hand signals he calmly informed the pilot of the situation. He then directed the pilot to shut down the # 2 engine so the panel could be secured. Once this was accomplished he supervised the re-starting of the engine and cleared the aircraft to proceed.

If left unnoticed, the panel 14R may have departed in flight or on takeoff and been ingested as the panel is directly in the airflow path with the R/H engine. Cpl. Haire's ability to recognize a potentially dangerous situation, rapidly develop and implement a rectification to the problem demonstrates outstanding professionalism and dedication to Flight Safety. ♦



**CORPORAL BRUNO SANTIN**

On 25 January 2000, Cpl Bruno Santin was assigned to replace the explosive cartridges in the engine fire extinguisher system of a CH146 Griffon. On check-

ing the parts history, he noticed that the cylinder inspection date recorded on the CF-358 did not match the date on the cylinder itself. The date on the cylinder was the date of manufacture, while the date recorded on the CF-358 was the date of installation.

Cpl Santin then did a thorough check of all the aircraft and made sure the fleet records were updated and the expired cylinders replaced.

Through Cpl Santin's vigilance and attention to detail, the potential for an unfortunate incident at 438 Squadron was eliminated. ♦

**CORPORAL CARL PHANEUF**

On 24 March 2000 Corporal Phaneuf was tasked to organize a maintenance crew to carry out a corrosion control inspection of CP140104 that had recently been ferried from Comox. Upon delegating the tasks that had to be performed, he proceeded to inspect the aft section of the aircraft by using the Simon Eagle (cherry picker) to get within reach of the vertical stabilizer. While carrying out a visual inspection on the upper section he noticed a deformity of the outer surface. After further investigation of the finding, he discovered that corrosion had taken place under the paint and that the affected area revealed a crack that needed immediate attention.

Corporal Phaneuf reported the problem to his crew supervisor and informed the ACS technicians to have a look at the affected area to know about the extent of the damage caused by the corrosion. After further discussion with the ACS technicians, it was determined that the corrosion must have started months prior to being discovered by Corporal Phaneuf.

On 26 March 2000, two days later, Corporal Phaneuf was performing an after-flight "A" check on CP140121 and, during the inspection of the wing, he noticed a cable that appeared to be improperly routed. Further investigation found that the aileron trim cable was off the pulley and chaffing against the cable guard. This



caused the cable not to be routed between the pulley and the guard and in contravention to the technical orders. The findings resulted in the replacement of the aileron trim assembly due to the damage caused to the cable. Undetected, this problem would have eventually caused the malfunction of the aileron trim operation.

Corporal Phaneuf is to be commended for his constant and unsurpassed professional approach regardless of the task at hand. The discovery of two problems in such a short period only proves the determination and exemplary initiative in recognizing potential flight safety conditions. ♦

## For Professionalism



CORPORAL JIM LEBLANC

Aircraft CF-188798 experienced a series of left-hand (LH) main wheel and brake problems, which stretched over a seven-month period and resulted in five flight safety occurrences. The problem seemed to be caused by overheating of the left main wheel assembly for an unknown reason. During this period three brakes, five main-wheel assemblies, three anti-skid control components, and one landing-gear axle assembly were replaced. Repairs were carried out on the aircraft by both 416 and 410 Squadrons, with no solution of the problem. After each repair, the aircraft was functional checked serviceable.

Concerned with the potential safety implications of a dragging wheel, which could include a wheel fire after takeoff, Corporal Leblanc began an in-depth investigation into other possible causes of the problem. Determined to check mechanical components that had not before been examined, Corporal Leblanc carried out a thorough check of the cockpit rudder pedal system. He noticed a barely discernable

difference in tension between the rudder pedals that was only present when the pedals were at their full forward position. This fault had gone undetected by many technicians at both Squadrons. The snag was passed over to the night shift and the rudder pedal assembly was removed. At this time, it was determined that the LH rudder cable was incorrectly routed, which caused a slight residual tension on the brake cable only when the pedals were in the full forward position.

Corporal Leblanc is commended for his superior initiative, independent thought and outstanding analytical skills in problem solving this difficult snag. Corporal Leblanc demonstrated professionalism, alertness, and dedication and his efforts showed exceptional attention to detail and an unwillingness to allow a seemingly corrected problem to go uninvestigated. His professional effort resulted in the detection and rectification of a serious safety hazard and saved further waste of wheel components. ♦

## FREEDOM 6 CREW

On 10 May 2000, the crew of Freedom 6 departed the KRWAU in Griffon helicopter #146470 to pick up four British soldiers of the Royal Regiment Fusiliers at a landing zone located within the city limits of Pristina. The helicopter subsequently departed the pick-up point and commenced a reconnaissance mission overhead the city.

The aircraft was flying at approximately 40 knots and 300' AGL, overhead Pristina, when #1 engine flamed out. Upon hearing the sound of an engine winding down, the flying pilot (Major Charpentier) immediately lowered the collective and increased airspeed in order to regain single engine parameters. The other crewmembers later noted that the AC's (aircraft captain) reaction was so quick that the single engine parameters were achieved before the #1 engine-out light had a chance to illuminate.

Within two to three seconds of hearing the engine wind down, the AC informed the other crewmembers that an engine had been lost. The crew had performed the usual preflight briefing and, thus, no further direction was required to deal with the emergency. The AC reacquired single engine parameters and regained altitude. While the AC was turning the aircraft toward Pristina airport, 14 kilometers from the incident location, the other crewmembers performed their respective duties in order to deal quickly with the emergency situation. All these actions occurred within the first two minutes of the engine flameout.

While enroute to the Pristina airport, it was rapidly concluded that not knowing why the #1 engine had failed, the second engine could possibly fail, at any moment; thus a closer landing zone had to be considered. With 20,000 known pieces of unexploded ordinance in the Canadian area of responsibility, there are only certain

landing zones that are deemed safe to land in, even within the city limits of Pristina.

At approximately six kilometers from the incident area, the aircraft was approaching a well-known secure landing zone known as "Tree Tops." It is a grassy area measuring 150 x 80 meters with 200-foot high industrial power lines on its eastern side. The Griffon checklist recommends that for a single engine landing, a shallower than normal approach to a wide and flat area should be made. Although less than ideal for a single engine approach, the crew agreed that a landing at "Tree Tops" was the best option given the circumstances. Recalling that there were light westerly winds, the AC decided that the best approach would be into wind, despite the industrial wires on the selected approach path.



The AC flew the approach in two stages. During stage one, he brought the helicopter to a point where it was at 60 knots and 15 feet over a post supporting these industrial wires east of the landing zone. Once the tail had cleared the obstacle, the AC maintained 60 knots and descended rapidly in order to maximize what was left of the 150 meter landing zone.

At the appropriate altitude, the AC slowed the descent rate and safely landed the aircraft with only a very small run-on, which resulted in no injury and no damage to the aircraft. He did so while remaining well within the single engine parameters.

In summary, this crew displayed excellent crew cooperation, exceptional alertness and, above all, outstanding technique when faced with a very difficult and unusual situation. Their timely and professional reaction prevented a possible catastrophic accident that could have cost the lives of a number of civilians, crewmembers and fellow KFOR members. ♦

## For Professionalism



**CORPORAL MARC FRÉCHETTE**

Corporal Fréchette is an Avionics Technician employed in the Snags/Service section at 425 Tactical Fighter Squadron (TFS). After aircraft CF-188902 had completed a flight, Corporal Fréchette was designated to carry out an after-flight (“A”) check inspection. During this A-check, while he was inspecting the area of the centerline pylon, he noticed that an unidentified object obstructed one of the two drain cavities of panel #36.

Troubled with the location of the object and wanting to understand what happened, Corporal Fréchette requested that the centerline pylon and panel #36 be removed. This would enable him to identify the object in question. As soon as the panel was removed, he identified the object as being a high torque socket. His initiative led to a flight safety investigation that revealed that the socket belonged to a unit toolbox and could have been misplaced as far back as 1995. Without Corporal Fréchette’s professionalism, the socket could have migrated to a more critical place leading to a very serious emergency.

Corporal Fréchette was very diligent in his professionalism and attention to small details. These attributes certainly contributed to eliminating a serious threat to the in-flight safety of this aircraft which, given time, could have had disastrous consequences. ♦



**SERGEANT DAVE ANDERSON**

While investigating another issue aboard a CH146 Griffon, Sergeant Anderson noted that the method of lock-wiring canon plugs may have contributed to faulty cockpit gauge indications. During the investigation of the transmission pressure transducer and gauge wiring, he found that the shelf for the oil pressure gauge transducer was loose. Sergeant Anderson then inspected the remaining aircraft and determined that three other aircraft shared the problem. A local supplementary investigation was raised to correct the incorrect lock-wiring procedure that caused the problem. Sergeant Anderson then developed a Technician Awareness Program to guide technicians in theatre on the proper procedure.

Sergeant Anderson demonstrated extreme professionalism in these circumstances. Not only did his diligence uncover a subtle glitch, he quickly found the cause of the problem, determined its extent within our fleet, and instituted a program to ensure that those past errors would not be repeated.

As Bosnia-Herzegovina is an inherently hazardous area due to extensive mining, it is a dangerous situation when an aircraft must land outside of approved landing zones. By detecting and remedying this snag, Sergeant Anderson has potentially saved aircrew from having to perform this action. His actions clearly demonstrate his professionalism and commitment. ♦



## Good Show

### MASTER CORPORAL JOHN DEMERS MASTER CORPORAL RÉGIS DESROSIER

While attending a Tactical support Initial Course at 426 Squadron on 23 October 1998, Master Corporal's Desrosier and Demers were performing their airdrop inspection for a heavy equipment platform they had just rigged inside a CC130 Hercules aircraft. While checking the length and proper positioning of the extraction slings attached to the load, they discovered one that was improperly marked.

Their checks include ensuring that these slings, which are used to pull the platform from the aircraft, are of equal length. This is done simply by comparing the markings on each to ensure that they are the same. Both were marked as "eight foot, three loop."

Master Corporal's Desrosier and Demers were not comfortable with the way that one sling, when positioned for the drop, was hanging lower than the other. Upon further investigation it was discovered that the sling was improperly marked and was in fact a "nine foot, three loop." Had this gone unnoticed, the platform may have



become jammed inside the aircraft during the dispatch and possibly caused the aircraft centre of gravity to be outside the safe operating limits.

Master Corporal's Desrosier and Demers extra diligence may have averted a serious aircraft accident. ♦

### CORPORAL STEVE GALLANT



On 17 April 2000, Sea King CH12430 was about to commence a post-periodic maintenance test flight. Concurrent with the application of ground power, fuel began to spill from the fuel dump tube onto the ramp area aft of the aircraft. Corporal Gallant, on duty as the Fireguard, immediately recognized the potential hazard presented by the situation and attempted to gain the pilot's attention.

After his initial attempts to do so failed, and realizing the urgency of the situation, Corporal Gallant quickly deduced that the best way to prevent further fuel dumping was to de-energize the pumps of the fuel dump system. In an extraordinary display of initiative, Corporal Gallant entered the aircraft and quickly located and pulled the correct three circuit breakers amongst the 177 circuit breakers in the cockpit.

No less amazing is the fact that Corporal Gallant is an Avionics (AVS) technician whose normal duties do not include working with fuel systems. Having stopped the dumping of fuel, Corporal Gallant then exited the aircraft and took the lead to minimize collateral environmental damage by initiating all appropriate HAZMAT procedures and by directing other technicians to call the base fire hall for assistance.

Corporal Gallant's outstanding initiative and quick reaction to this dangerous situation was instrumental in preventing injury to personnel and damage to the aircraft, and in minimizing damage to the environment. ♦

# Flight Safety Word Search

By: Captain JJP Commodore

HINT 8 LETTERS "MILITARY MEMBERS FINAL GOAL"

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | C | O | U | R | S | E | S | P | W | E | F | O | R | C | E |
| L | S | D | E | Y | N | U | C | L | E | A | R | S | K | O | T |
| R | D | T | S | N | C | O | P | L | A | Y | B | A | S | M | N |
| O | A | T | A | O | S | T | O | P | P | M | R | N | D | B | I |
| W | E | I | F | T | L | S | C | H | O | O | L | K | E | I | O |
| M | A | R | C | H | I | V | E | B | N | R | I | N | T | N | P |
| E | G | N | A | R | V | O | Y | A | G | E | T | O | A | A | E |
| C | A | L | M | E | I | E | N | S | U | R | E | I | C | T | R |
| S | D | A | E | A | N | I | E | E | E | E | R | T | I | I | A |
| D | G | G | R | T | G | C | M | D | D | A | A | A | D | O | T |
| N | E | E | A | H | N | A | I | V | E | D | L | U | E | N | I |
| A | T | L | T | A | R | R | A | Y | O | N | O | L | D | E | O |
| M | S | L | D | G | G | N | I | T | E | G | R | A | T | G | N |
| E | Y | I | O | N | O | R | D | A | U | Q | S | V | N | R | A |
| D | U | R | T | N | E | M | I | R | E | P | X | E | S | A | L |
| G | P | R | E | P | A | R | E | D | I | N | S | T | I | L | L |

ANORAK  
ARCHIVE  
ARRAY  
BOMBS  
CALM  
CAMERA  
COMBINATION  
COST  
COURSE

DEDICATED  
DEMANDS  
ENSURE  
EVALUATION  
EXPERIMENT  
FOCUS  
FORCE  
GADGETS  
GUIDANCE

ILLEGAL  
INSTILL  
LARGE  
LITERAL  
LIVING  
NAIVE  
NIGHTLY  
NUCLEAR  
ODD  
OPERATIONAL

PLAY  
POINT  
PREPARED  
PROGRAM  
RANGE  
RAYON  
REREAD  
RIDER  
SANK  
SCHOOL  
SQUADRON

STATIONED  
STOP  
SUPPORT  
SYSTEM  
TARGETING  
THREAT  
VOYAGE  
WATER  
WEAPON  
WORLD