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Flight Comment

ISSUE 3, 2010

SÉCURITÉ DES VOLS FLIGHT SAFETY

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Canada

Views on Flight Safety

By Colonel Dave Cochrane, Commander 8 Wing, Trenton

In 2009, Major General Yvan Blondin, Commander, 1 Canadian Air Division/ Canadian NORAD Region, wrote in this space and described the challenges facing many communities throughout the Air Force at length. Experience levels at operational units are decreasing and existing capabilities are being expanded, yet we are implementing new platforms at an unprecedented rate. MGen Blondin also wrote that though future missions will entail more risk, flight safety must not be compromised.

At 8 Wing/CFB Trenton, with seven aircraft fleets in total, we are facing all of the aforementioned challenges and are endeavouring to achieve nothing less than an unwavering and strong flight safety program and culture. While we remain mindful that flight safety incidents will occur, we continue to learn from them and make every attempt to ensure they are not repeated. When I took command of 8 Wing/ CFB Trenton last February, I communicated to my staff that my top three priorities while in command were:

1) continued operational success,

2) people, and

3) Air Force transformation. Flight Safety is a common theme that, if compromised, can easily cause any or all three of these areas to fail – further enhancing the responsibility I have to promote a robust, healthy culture of incident reporting and situational awareness.

Our 8 Wing Mission: To provide responsive and flexible Air Mobility, Search and Rescue, and globally deployable, combat capable Expeditionary Forces serving Canada's interests.

The year 2010 demonstrated a significantly high operational tempo for the Air Force and also 8 Wing/CFB Trenton, especially with deployed operations. Op HESTIA in Haiti highlighted the quick response and the broad range of resources available from our Canadian military in support of global operations. People across the CF rose to the challenge, with personnel at the tactical level, implementing SAFE and effective flying operations for Air Mobility, SAR and other Air Force communities. This strong safety environment was also consistently demonstrated throughout this demanding year, with Ops PODIUM, CADENCE, NANOOK and the on-going commitments and sustainment operations to Op ATHENA (Afghanistan).

Expanding current capabilities has also been a key endeavour that 8 Wing personnel are undertaking. Until recently, the CC150 *Polaris* was limited to flights below mid-arctic latitudes due to technical limitations. Through a comprehensive team approach and key mitigating strategies, we were able to devise a means to safely overcome this limitation and successfully flew to the high-arctic regions this past summer. The structured RARM (Record of Airworthiness Risk Management) risk assessment process, combined with key weather considerations, was critical to safely progress this capability. In addition, through comprehensive analysis and subject matter expertise, we have also successfully expanded the CC177 capabilities to include Semi Prepared Runway Operations, as was frequently demonstrated in Alert and Resolute Bay over this past year.

These are indeed exciting times to be a member of the Air Force, and more specifically, 8 Wing Trenton. The implementation of new CC130J *Hercules* and CC177 *Globemaster III* airframes have posed a number of challenges to 8 Wing personnel. For example, maintenance must be meticulously carried out through the application of safe and effective work methods to ensure the successful segregation of components between the legacy and new J-model CC130 *Hercules*

(continued on page 6)

Cover page:
22 November 2009 –
Red Sea, HMCS Fredericton

Corporal Dan Perry, from 423 Squadron, Shearwater, Nova Scotia, wheels a MK 46 Torpedo off the flight deck of Her Majesty's Canadian Ship (HMCS) Fredericton. Aircrew onboard the Fredericton require a monthly "hot load" proficiency test. The proficiency test involves attaching the torpedo's to the CH-124 *Sea King* helicopter while the *Sea King* is flight ready (rotor blades turning) within a specific time limit.

Photo: Cpl Shilo Adamson

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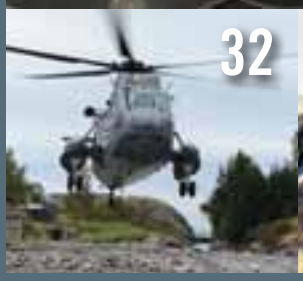

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Dossiers

Lessons Learned

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For Professionalism

For commendable performance in flight safety

Mr Daniel Penton

On the 4th of August 2008, during a daily inspection of *Cormorant* CH149915, Mr Daniel Penton went above and beyond the call of duty by identifying and actively seeking out the source of an unusual sound, and in tracking down a small piece of metal FOD on the engine deck.

The aircraft post flight inspection was done following a weekend SAR (Search and Rescue) mission with a recovery crew of only three technicians instead of the normal nine person team. Mr Penton had just completed the number three engine inspection and was closing the panel, when he heard a sound amongst the typical engine cooling noises that attracted his attention. Although the sound was minute and very similar to the characteristic "ting" that is heard as metal contracts and expands he chose to re-open the panel and investigate further. During this search he discovered, hidden behind the #3 engine, a piece of the engine inlet guide vane actuator lever which had changed position when he closed the engine cover. Due to the position of the actuator, it is virtually impossible to see this area during an inspection and the piece was only found by virtue of the sound it made when it moved.

Mr Daniel Penton's attention to detail and determination to investigate thoroughly is commended. His actions prevented CH149915 from flying with an unserviceable engine and helped avert a potentially serious in-flight condition resulting from FOD. ◆

Mr Penton works as an aviation technician with 103 SAR Squadron, 9 Wing Gander.

Mr Neil Harding and Mr Brian Boettger

In February 2010, Mr Harding and Mr Boettger, both technicians for Transport Canada, were attempting to de-snag a minor problem with the auto-throttle system on a CC144 *Challenger* jet based out of Ottawa International Airport at 412 Transport Squadron.

During the course of the inspection, they observed a subtle noise with the movement of the airplane's throttles. They worked tirelessly to find the source of the seemingly benign fault in a small, cramped and uncomfortable space under the aircrafts avionics panel. After a very extensive check of the airplane's mechanisms, they found the source of the noise to be some chaffing between the airplane's throttle rods and the elevator cross torque tube. The location of the chaffing is impossible to detect using normal inspection techniques.

Professionalism, technical expertise and sincere effort was demonstrated by the two individuals in noticing the damage, as the geometry of the area in question makes for very difficult access and trouble shooting. The problem was thereafter rectified by changing the geometry of components beneath the throttles so as to provide the necessary clearance between the rods and the elevator torque tube. Bombardier, the airplane's manufacturer, was notified of the incident and is currently in the process of approving significant product changes and improvements to *Challenger* fleets all over the world in order to prevent a reoccurrence for other operators.

It is clear that Mr. Harding and Mr. Boettger's displayed exceptional effort and professionalism in preventing significant operational delays for the squadron. They are truly deserving of this For Professionalism award. ◆

Mr. Harding and Mr. Boettger both work for Transport Canada based in Ottawa.

Captain András Hajási

On 9 September 2009 Capt Hajási (a Hungarian Air Force Pilot at NFTC Moose Jaw) was conducting an Instructor Upgrade training mission on another CT155 *Hawk* pilot. While downwind in the traffic pattern and under control of the junior pilot, the aircraft ingested a bird and experienced a total loss of thrust. The pilot flying began a zoom manoeuvre. Capt Hajási took control of the aircraft and commenced the "Engine Surge or Overtemp" red page checklist procedure, including an engine relight while continuously assessing his energy state for the forced landing pattern. His location in the pattern dictated that he had to put the gear and flaps down immediately at the top of the zoom while simultaneously carrying out the red page emergency actions, and making calls to tower for the forced landing pattern. He was able to relight the engine shortly before touchdown however it was running much hotter than normal. As the aircraft was on glide profile, no power was required from the engine and it was shut down at touchdown. The total time between bird strike and landing was only 66 seconds.

A teardown of the engine revealed that one of the first stage blades broke on impact and was ingested into the engine causing additional cascade damage. All nine stages of the compressor sections, turbines blades and stators were compromised. The engine was sent back to the contractor for repair and it assessed that the engine was incapable of producing enough thrust to sustain flight.

The forced landing pattern is a practiced manoeuvre because it is highly demanding in the *Hawk* fleet. The incident location, abeam

the threshold in the traffic pattern, allowed the absolute minimum time to carry out all necessary actions to recover the aircraft safely. Capt Hajási's superior judgment and ability in controlling the aircraft, completing the emergency response and flying a successful forced landing pattern preserved a valuable aviation resource. He is most deserving of this For Professionalism award. ◆

Captain Hajási is a Hungarian Air Force Pilot serving with 2 Canadian Forces Flying Training School, 15 Wing Moose Jaw.

Mr Lloyd Barrow

Mr Lloyd Barrow is employed as a civilian aviation technician at the CH149 *Cormorant* maintenance contractor at 19 Wing Comox. On 17 Dec 09, while checking the main rotor-head as part of a Daily Inspection on *Cormorant* CH149909, he noticed that the Teflon washer between the yellow position lag damper and the securing bracket appeared to be slightly misaligned.

Upon preliminary investigation, he observed evidence of wear debris around the damper and the bracket securing hardware. Determined to find the origin of the wear debris, Mr Barrow took the initiative to function the rotor blade and established that there was excessive play at the attachment bracket of the yellow lag damper.

On further assessment, it was discovered that the bolt and bushings connecting the damper to the bracket had suffered substantial wear and were the source of the unusual wear debris. Wear had reduced the retaining bolt diameter by ten percent and the bracket bushings had completely worn through. The damper assembly had accumulated 45 hours since installation and was not due to be inspected for another five hours during which time it was possible that assembly could have failed completely.

Mr Barrow's inquisitive nature and attention to detail averted what could have been a catastrophic event. The failure of the retaining bolt or the attachment bracket would have induced flight control problems potentially resulting in an accident. He is commended for his diligence in identifying and investigating

this extremely serious hazard and is clearly deserving of this For Professionalism award. ◆

Mr Barrow is an Aviation Technician with 442 Squadron, 19 Wing Comox.

Views on Flight Safety *(continued from page 2)*

fleets. Crews transitioning to the new aircraft also face a new cockpit paradigm thanks to the technological integration in the new advanced cockpits. I am proud to report that thus far, this transition has been successfully accomplished. As we prepare for the first CC130J model to be deployed to Afghanistan in early 2011, the significant force generation training activities occurring are underpinned with comprehensive flight safety oversight. Leadership must set the example with safe training practices and procedures and a consistent reminder that flight safety remains paramount and is everyone's business.

In addition, 8 Wing/CFB Trenton is experiencing an unprecedented level of construction and infrastructure development. Construction activity on the airfield started in 2008 and will continue for many years as most of the buildings and hangars are replaced. The requirement to continue operations during this prolonged period has resulted in the establishment of a close working relationship between the operations and construction engineering branches. They have worked together to continue safe operations despite heavy equipment and large construction cranes surrounding the airfield. Strict oversight of contractor movements on the airfield has been, and will continue to be, instrumental to mitigate potential flight safety incursions. I am confident that as further work sites start to encroach directly on our ramps and taxiways, that this close working relationship will lead to risk mitigation and aid in error prevention.

In summary, critical aspects for flight safety and the Air Force remain openness and honesty. With a strong, positive flight safety culture communicated across the Wing at all levels, I foresee this approach as a true force multiplier in its implementation. My continued emphasis on lessons learned, I trust, will help mitigate, to the greatest extent possible, reoccurrences from taking place.

This is truly a wonderful period of time for the professional and dedicated men and women at 8 Wing with the revitalization of infrastructure, hangars and also the transition to some of the new Air Mobility aircraft fleets. Although a very high operational tempo remains the constant and some challenges do exist, personnel remain quite motivated and very safety oriented. Clear blue skies ahead ladies and gentlemen. Safe flying operations! ◆

The Editor's Corner

The Cover

I couldn't possibly forget my first and only ride in a *Sea King*. The year was 1977 and our group was on an aircraft familiarization tour prior to pilot training. I distinctly remember thinking two things: first, how *old* the aircraft was; and second, how can this thing possibly get airborne? Now, 33 years later, the aircraft is serving in more roles than ever, even as its inevitable retirement looms closer. Over the years, this editor with a 'trash hauler' background has developed a healthy respect for this venerable aircraft, but even more so for the men and women who operate and maintain them. It is with this respect that the cover of this month's issue features the CH124 *Sea King*.

The New DFS 'Doc'

I would like to formally welcome Major Helen Wright to the DFS team as our in situ Flight Surgeon. (I use the term 'in situ', but in fact she is rarely seen and apparently in huge demand!) She brings a great deal of medical background into the flight safety fold and presents her first *Flight Comment* article entitled 'Antihistamines' – a piece that every member associated with aviation should read.

Checklist Errors

A friend of mine once related to me an incident that occurred while serving as a second officer and the reader of the checklist. During the pre-takeoff routine he read out "flaps" and received the correct response from the captain as "set". He then read out "flaps" again and received the same response - only louder this time. The third time he read out "flaps", the captain turned around and said "what is your ******* problem". The problem, of course, was that the flaps were *not* "set". Have you ever given the correct response to a checklist item without the item being in the described position? I know that I have – more than once. The guest article "Designing a Better Error Trap", from *Aero Safety World,* discusses why these kinds of errors occur and what we can do to minimize them.

The Calendar Poster

With our resident image technician on course and unavailable to produce the calendar poster, and with yours truly lacking the suitable skills, I was forced to look further afield. After some cajoling, convincing and pleading, Mr Derek Scharf, a pilot instructor and Contractor Flight Safety Officer with Allied Wings, agreed to take on the task along with some assistance from Sgt Alain Martineau, an image tech with Public Affairs. Thanks Derek and Alain - nice job! (If you need more copies for your office, drop me a line).

The Back Page

You'll notice that the last page of this issue is called . . . well . . . *The Back Page*. Its purpose is to highlight items of interest to our readers, and in that vein, I will be looking to each of you to send in your photos, stories or latest squadron operation. With this issue, we provide a tribute to the CC130 *Hercules* and its 50th anniversary with the CF.

On behalf of everyone in the Directorate of Flight Safety, may I pass along our best wishes and a safe 2011. ◆

Letter to the Editor

Good day.

Recently, I was reading a few articles in your *Flight Comment* magazines when, after carefully checking the pictures, I found some abnormalities.

2010 Issue 1 pages 26 and 27, 2009 Issue 3 pages 34 and 35, and 2009 Issue 2 pages 15 and 23. It's strange but on these selected pictures, nobody is wearing safety glasses!

The CCOHS (Canadian Centre for Occupational Health and Safety) (**http://www.ccohs.ca/oshanswers/prevention/ppe/glasses.html**) and Z94.3.1-09 "Selection, use and care of protective eyewear" by the Canadian Standards Association 2009, are giving us all related info concerning safety glasses and face protectors. Also, there is a text in the Safety Digest 2008/2 about eye protection!

Question: Is it possible, for any future magazine edition, to pay more attention while choosing your pictures?

Regards,

Harold Tremblay
3 Air Maintenance Squadron
3 Wing Bagotville

Response

Mr Tremblay:

First, I would like to thank you for taking the time to write to us with your safety concern. As you point out, some of the technicians depicted in the images you mentioned are not wearing eye protection. That said, not all tasks require technicians to wear safety glasses or other protective equipment.

As detailed in the General Safety Program, there are certain tasks for which personal protective equipment (PPE) must be worn to protect against burns, cuts, splinters, eye irritation, etc. Generally speaking, the PPE shall be worn where an employment hazard cannot be eliminated or controlled within safe limits and the wearing of that PPE may prevent an injury or reduce its severity. For those cases, it is the responsibility of the department to ensure that each employee who is exposed to an employment hazard wears and uses that equipment.

After review, we can confirm that the images referred in your letter are within the current Canadian Forces standards detailed in the General Safety Program; however, your point about the importance of eye safety and how it is depicted in our publications is well taken. We can always do more to promote the best safety practices. Thank you again for taking the time to write to us with this concern.

Captain John W. Dixon
Editor, *Flight Comment*

From the Flight Surgeon

Antihistamines and Flight Safety

By Major Helen Wright, Directorate of Flight Safety, Ottawa

"The pilot of the Bell 206B helicopter was conducting water-bucketing operations in support of forest-fire suppression activities near Wabasca, Alberta. The helicopter contacted trees adjacent to a shoreline, broke up, and came to rest in an inverted position. The pilot, the sole occupant, was fatally injured.

The pilot was observed to be suffering from allergy-like symptoms before the flight. Two hours before the occurrence the pilot was given two tablets of cetirizine (Reactine®) by the camp medic for his allergy symptoms. A different bottle (Reactine® 10 mg) was found at the accident site with one pill remaining in it. The pilot was very slow to prepare his aircraft for the intended flight and had difficulty picking up the first water load. Radio contact was lost while the pilot was picking up the second load and the wreckage was discovered.

The investigation suggests that the pilot was filling the water bucket near the edge of the lake and drifted toward the shoreline, where the left skid tubes contacted the trees. This then resulted in the loss of control of the aircraft, ending up in a dynamic rollover condition. The investigation found that allergy symptoms and/or antihistamine likely impaired the pilot, and that the pilot did not have the required training and experience[1]."

You have heard it many times – aircrew should take medication only on the advice of a flight surgeon. One reason for this is to prevent aircrew from taking medications that can have side-effects that impair performance. **Antihistamines obtained without prescription are the most frequent form of self-medication for allergic diseases, colds and insomnia even though they have potentially dangerous effects.**

Antihistamines are a group of medications that are often seen as safe since they are widely available and often used. Antihistamines are commonly taken for allergy, cold and sleep. Many of those that one can purchase without a prescription in Canada are known as "first generation" or sedating antihistamines. Examples such as diphenhydramine (Benadryl® or Allernix®) are found alone or part of a mix of medication in all sorts of pills, capsules and cough/cold syrups. Antihistamines are useful for things like environmental allergies, but, despite what you see in the advertisements, antihistamine taken for the common cold is of minimal benefit and those are outweighed by side-effects[2].

Antihistamines cause "central nervous system depression" which means the drug may influence your brain function leading to impaired physical or mental abilities. Few of us want to be sleepy and clumsy at work, but for aviation operators or maintainers difficulty thinking can be disastrous. Cautions about performing tasks which require mental alertness (e.g., operating machinery or driving) are often right on the container. These medications have been implicated in civil aviation[3], motor vehicle and boating accidents[4]. Some studies have found that antihistamine interferes with driving performance at least as much as alcohol and that drowsiness is not a good predictor of impairment (in other words, just because you don't feel sleepy does not mean you are not impaired)[5].

First-generation antihistamines also work in the part of the brain that controls nausea and vomiting. This is why they can help prevent motion sickness (dimenhydrinate/Gravol® is an antihistamine), but the side-effects mean that many antihistamines can not be used for motion sickness in aircrew.

Second-generation antihistamines (non-sedating) are a newer, distinct group and are much less likely to cause these side-effects. Some second-generation antihistamines are acceptable for use by aircrew with mild or moderate allergic symptoms or other situations requiring an antihistamine due to well documented lack of adverse side-effects[6,7], including sedation. If you suffer from allergies you should see your flight surgeon or MO who may prescribe loratadine (Claritin®) or fexofenadine (Allegra®). You will need to take them for a non-flying trial period of at least 7 days to ensure you have no side-effects.

Did you know?

There is evidence that vitamin C (200-500 mg daily) prevents colds; but, vitamin C does not appear to help once you have the cold. Echinacea studies indicate that it neither prevents nor treats the common cold. ◆

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Antihistamines may not work for the common cold, but what over-the-counter medications do work for a cold? There is evidence supporting Dextromethorphan (DM) containing cough syrups to relieve cough symptoms – but Aircrew should not self-medicate with cough syrups. Detromethorphan can have hallucinogenic and dissociative effects, and there may be other troublesome ingredients in cough syrups such as codeine (a narcotic) or antihistamines.

Grow old with me

Flight Comment November-December 1959

Recently I took what I am sure is my last flight as a pilot of a military aircraft. I was a member of an outfit which was eliminated in the defense expenditure cutback, and I have ranked and aged myself out of active reserve duty. I would be less than human if I did not at this time look back on my years of flying and try to evaluate the factors which operated to keep me alive, as well as those mistakes which might have killed me.

I felt a resurgence of the impulse to buttonhole the boys and girls just beginning, whether in private or military flying, and say the magic words which will keep their bones intact, and send them home each evening, a joy to spouse and children.

I can say what I have to say without pride or arrogance, because I was a mediocre pilot. I learned slowly; I was not by any stretch of the imagination a "Natural". My awareness of my limitations, I am sure, is one important factor to which I owe my life. I did not have the skill to toy with chance and stretch my craftsmanship beyond its capabilities. I would not slow-roll at less than five thousand, because I scooped out at least half the time; nor would I practice spins unless I had so much altitude that the ground seemed as remote as the moon.

There are two kinds of pilots who get hurt: clever ones and poor ones. The clever ones gradually acquire a confidence which may mislead them, and tempt them to cross the safety margin once too often; the poor ones are merely incapable. But there is one common attribute which both types possess: they lack imagination. Their thinking is narrow; they fail to consider the possible consequences of a breach of flight discipline, or an overextension of their abilities.

They assume that all conditions at all times will be normal. They assume that the ground is flat without obstructions, that the old altimeter setting is good enough, that there is no other plane in the air, that the weather will hold, that the obsolete chart is reasonably accurate, that the fuel tank was topped, that the field is open, that the mags will clear in the air.

These are foolhardy assumptions, resulting from laziness and wishful thinking. If there is one thing we can be sure of in this journey through the cosmos on this thin-skinned pea of an earth, it is that change is constant, nothing is ever the same. It is apparent to me that the human race is invincible. You need only consider the fact that a man who knows he has only one life to live will offer it to eternity because he is too lazy, or too unimaginative, to take an extra minute to ask a mech how much oil was put in. Courage like that exceeds the tiger's.

I distilled a single rule from the pot-pourri of experience, a rule which contains just about all there is to flight safety. It is, however, a mere phrase, unless we extend it through every flight activity. It is simply "Never take anything for granted." There are plenty of things which we are forced to take for granted without adding to the list. We must accept the evidence of our eyes and nose that the liquid in the tank is aviation gas, that the length of the runway is 8000 if Enroute-Supplement says it is, and that the propeller is pitched at the proper angle to pull the plane forward. We lean heavily on properly trained authorities for vital information, and if they fail us we cannot help it.

But there are those factors which can be checked personally, which should never be taken for granted. I learned one lesson fairly early, and the nearness with which I came to killing, not myself, but another pilot, had an extremely sobering effect.

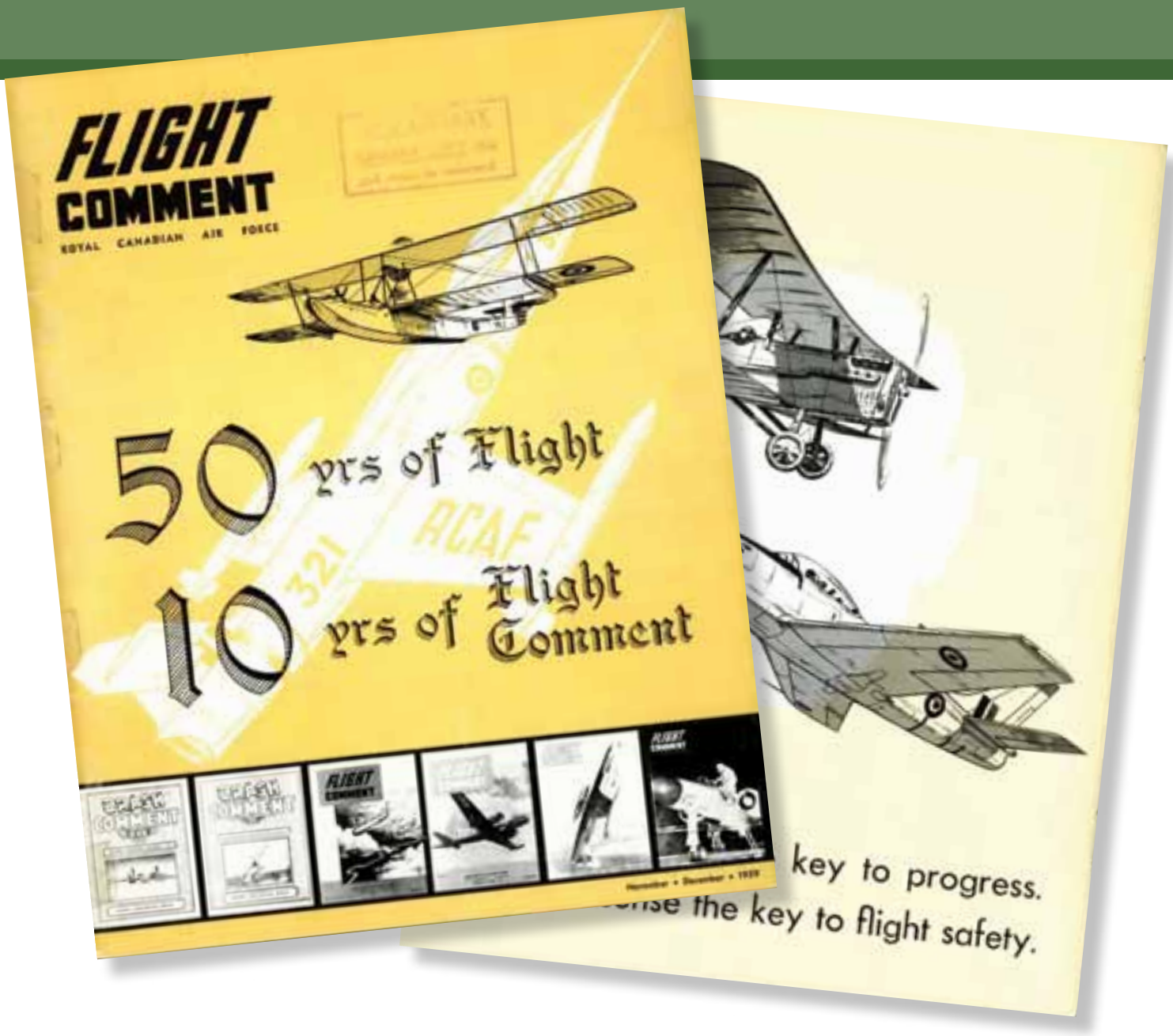
I was lined up on the runway's center-line with a student under the hood in the rear cockpit, preparing for an instrument takeoff, Another plane was lined up in front, for the same purpose. My student was on the brakes, ready for full throttle when I gave the order. While I could not see over the nose of my plane, I did observe the wings of the first plane recede and disappear as it started down the runway. After a decent interval I told the student to roll, and I stayed on interphone to advise and correct him. He did so, and a few seconds later my guardian angel stepped in.

"Now look, buttonhead," he said to me. "The first plane started rolling, and you figure that he is airborne at the end of the runway by now, But you don't see it. You're just taking it for granted."

I popped the hood, took over, hit the brakes and throttled back. My aircraft stopped twenty feet short of the number one plane, which had aborted, probably because the student was veering off heading. I would unquestionably have chewed through at least one cockpit if I had continued. I would have had a memory very uncomfortable to live with.

I owe to a certain vice of mine a good bit of credit for the fact that my wife was cheated out of ten thousand dollars of NSLI insurance: I am an experience thief. I steal the experience of others.

Your own experience is the worst possible teacher despite the famous dictum. It is much too expensive. I enjoy the nasty habit of appropriating that of other pilots. Every time I read or heard of an accident I would ask myself: "Do I fly in such a way that it could have happened to me" If the answer was yes, I did my best to correct my habits.



I know two pilots whose tragic exits I was able to predict. One was a clever man, with an enviable skill and a superb practical and theoretical knowledge of aerodynamics. The other was a wise guy. I loved Casey, the first one, like a brother. He taught me much about flying, and he was for me Saint-Exupéry and Jimmy Doolittle rolled into one. But he couldn't subtract. He didn't know when his units of safety were reduced to a dangerous minimum. His skill was his murderer.

He could roll at two hundred feet and never scoop out. His aircraft was as his own body. This is a fine thing, but there are possibilities over which your skill has no control. Engine failure is one of these, and engine failure when inverted at two hundred feet is a troublesome event. A parachute is useless and your choice of pasture is severely limited, even if you complete your roll. Casey did not complete his, and scattered gas, guts, and gaskets over five hundred feet of ripening corn.

I was such a mediocre pilot that I never had the courage to attempt such intrepid maneuvres. I mourned the death of Casey, but my grief didn't help him. He has been long gone; and I am here tonight, as I write, watching the scarlet leaves of the maple drift by my window in the moonlight. And yet his craftsmanship far exceeded mine.

But I love to stunt. You should see my triple sequence: the split-S, loop, and Immelman, coming right out on the original heading. I start it at ten thousand feet. I'm very proud of it.

The other pilot I shall call Grant. He was a likeable youth, but he lacked humility, He wore his cap on the side of his head,

and made sharp turns to a landing. He would argue aerodynamics with pilots who had more hours of night flying than he had altogether. Can you imagine yourself advising Saint Ex on the best route to Dakar? Grant could have done it. One day I said to him, after a particularly disheartening discussion (I think he was insisting that a plane in the air would weather-cock): "Grant, it matters not to me whether I win the argument, but if you fly like you talk you will kill yourself," He snorted, re-tilted his cap to a more rakish angle, and stalked off whistling, "Off we go, ta-ta-ta-tum-tum-tum-tum."

I had no car, and he picked me up every morning to drive to the field. One Monday morning, two weeks after my melancholy prediction, he failed to show, and I had to hitchhike. No bus.

The CO was on the phone when I loped in, an hour late. I was nervous and furious; we were flying a very tight schedule. I started blabbing when it was apparent that the CO was waiting for somebody at the other end. "That damn Grant didn't pick me up this morning! It ain't my fault!" I pounded on the desk. The CO started talking on the phone, and being versatile like Caesar, wrote a note for me on the pad, "Grant was killed yesterday." I had the psychic feeling of inevitability you sometimes get in a poker game when the card you draw is exactly what you expected. "Of course," I said to myself, "what else could it be?" He had his brother, a visiting cadet, in the rear seat when he pulled the wings off the trainer over Biscayne Bay. "The only two boys in the family and what did his mother think?" I wondered. "And what did his father say?"

I said that Casey didn't know how to subtract. I referred to my formula for safety. According to my ingenious reckoning a safe flight is maintained only when you stay above a certain number of what I call safety units. When you have trouble in an airplane, there are at best a fairly large number of life-saving alternatives. As far as I am concerned, there are more of them in the air than on the highway, where an oncoming car on your side of the road, passing on a curve, may reduce your alternatives to almost zero. These units are your treasure, money in the bank, the buffers against chance, fate, bad weather, or even your own fallible judgment . . .

. . . When the hangar-flying drifts around to hairy stories, be proud that your narrative is too dull to relate. Let nothing happen to you worth telling about. Go thou and grow old and stodgy. Get your excitement emphatically by observing the curdling exploits of Jimmy Stewart and John Wayne on the magic silver screen. Titillate your wife by an impassioned account of how the manager of the airport grill threatened to arrest you when you tried to kick your dime back out of an empty candy dispenser.

Now I am a private pilot only, I look forward to dancing the skies on laughter-silvered wings, to winging to my destination in a safe, straight line, far above the twisting hazards of the increasingly expensive highways. There are no toll-roads up there in the blue, no bill-boards on the clouds, no speed traps, no traffic lights. There is only the challenge to my imagination, and to my good common sense.

I must finish now. The ashes are glowing in the fireplace. Cynthia has the coffee on, and I have marshmallows to toast.

– Anonymous ◆

Designing a Better Error Trap

By Benjamin A. Berman and R. Key Dismukes

This story is taken from an issue of Flight Safety Foundation's journal, AeroSafety World. A free subscription to the digital version of that publication is available though the signup form on the Foundation's Web site home page, www.flightsafety.org

Early morning at the gate, powering up the jet from cold. Flow-scan the overhead panel, as you have done so many times before. Up and down, left to right. All the switches are in their usual positions. Last is the air panel – six switches and two rotary selectors. A quick glance shows they are good. You call for the checklist. The first officer's first challenge is – "Pressurization?" Your eyes go to the landing altitude rotary selector on the air panel. "Set," you reply.

It is still dark after takeoff. Climbing through 3,000 ft, the first officer, the flying pilot, calls, "Flaps up, 'After Takeoff' checklist." You run your hands around the overhead panel, turning off the ignition and auxiliary power. Pressurization check: A peek at the differential gauge shows that it is off the lower peg. Just then the controller instructs you to contact departure. After acknowledging, you pick up the checklist. "Pressurization?" Remembering your earlier glance at the gauge, you reply, "Checked." Through 15,000 ft now, and an insistent beeping jars your senses. The takeoff warning horn. Why now? While you think about this, the master caution light comes on, indicating an equipment cooling fan failure. As you get out of your seat to check the fan's circuit breakers, you tell the first officer to keep flying. You stand up, turn around and feel a bit woozy. The last thing you remember is deciding, for some reason, to sit down in the narrow aisle behind the pilot seats.

Accident investigators comb through the wreckage for clues and determine you did not notice that the pressurization system selector on the air panel had been left on "MAN" (manual) by the maintenance department. The pressure differential had increased enough in manual mode to let you see the gauge off zero but not enough to maintain a liveable atmosphere as the aircraft climbed. It is likely you forgot that the takeoff warning horn, which you had heard during systems tests before every flight, doubles as a cabin altitude warning. The conclusion: Both pilots succumbed to hypoxia because they did not identify, or react to, a lack of pressurization.

A sequence much like this occurred on Aug. 14, 2005, as a Helios Airways *Boeing* 737 climbed out from Larnaca, Cyprus (ASW, 1/07, p. 18). Automation kept the aircraft aloft and on its programmed flight plan until the fuel was exhausted over Grammatiko, Greece.

Although such accidents are extremely rare, they point to the crucial roles played by checklists and monitoring in helping pilots catch system malfunctions and human error, and manage the challenging situations that sometimes arise on routine flights.

Line Observations

To find out how checklists and monitoring work in actual practice, we observed line operations during 60 flights conducted by three air carriers from two countries.[1] We used a structured technique to observe and record checklist and monitoring performance, and situational factors that might affect performance. Because an important function of checklists and monitoring is to catch, or "trap," operational errors, we also recorded deviations in aircraft control, navigation, communication and planning. When a deviation was observed, we tracked whether crewmembers identified and corrected it, and whether there were any consequences that might affect the outcome of the flight.

During the 60 flights, we recorded 899 deviations, of which 194 were in checklist use, 391 in monitoring and 314 in operating procedures (Table 1, p. 14). The total number of deviations per flight ranged from one to 38.

Many of the deviations we observed were errors. For example, one airline had a mixed 737 fleet, with a few aircraft requiring the first officer to place the pressurization system in flight mode during the flow portion of the "After Start" checklist procedure. On one flight, perhaps reverting to the procedure required for the more common aircraft, the first officer omitted this during the flow check. The pilots then did not notice the incorrect system configuration while conducting two subsequent checklists, both of which included verification of the relevant panel settings.

Some deviations, however, were not necessarily intrinsic errors. For example, several involved a standard operating procedure (SOP) at all three airlines that required the monitoring (nonflying) pilot to make a callout 1,000 ft prior


Photo: Cpl David Hardwick

to reaching each assigned altitude during climb and descent. We observed 137 instances of pilots omitting this callout or making it late. Climb and descent are busy periods, and at times a pilot may need to give priority over a callout to other tasks, such as air traffic control (ATC) communications. Consequently, omitting or delaying this callout may sometimes be a strategic workload management choice rather than an error.

This is not to suggest that the 1,000- ft callout is trivial. On the contrary, it ensures that both pilots concur about the altitude target, directs the attention of a flying pilot who might be distracted back to the impending level-off and draws both pilots' attention to what the autopilot is supposed to be doing.

Airlines should examine their SOPs to specifically define the objectives of each procedure and to determine whether it is realistic to assume that pilots can perform the procedure reliably under actual line conditions. Pilots must be aware that in deviating from any procedure, they might be giving up safety margin that is not apparent.

Checklist Deviations

Among the most common deviations in checklist usage was incorrect application of the flow and check procedure implemented by the three airlines. The procedure involves using a memory-based flow pattern for setting systems and controls, and then following up with verification using a printed or electronic checklist.

In 48 of the 194 checklist deviations recorded, the flow and check procedure was not performed correctly. One or both pilots tasked with the flow procedure did not do it or attended to only some of the flow items. As a result, most items were performed only while using the checklist, eliminating the protective redundancy designed into the flow and check procedure; other items — those that were in

"Crew observations show that checklists and monitoring are not as effective as generally assumed."

TABLE 1 – **Deviations Observed on 60 Line Flights**

Category	Deviation	Number
Checklists	Flow-check as read-do	48
	Responded without looking	43
	Item omitted/incomplete/incorrect	42
	Poor timing	31
	Performed from memory	17
	Not initiated	13
	Total	194
Monitoring	Callout late or omitted	211
	Not monitoring aircraft state or position	67
	Verification omitted	113
	Total	391
Primary procedures	Systems configuration	62
	Contingency planning/execution	57
	Crew — crew coordination	56
	Automation — FMS	40
	Crew — ATC coordination	33
	Automation — MCP	18
	Conducting unstabilized approach	10
	Crew — ground personnel coordination	8
	Profile planning/execution	7
	Lateral path control	7
	Crew – flight attendant coordination	6
	Aircraft configuration	4
	Vertical path control	3
	Automation — head-down	2
	Airspeed control	1
	Total	314
Grand total		**899**

ATC=air traffic control; **FMS**=flight management system; **MCP**=mode control panel
Source: Benjamin A. Berman and R. Key Dismukes

the flow procedure but not repeated in the checklist — were not completed.

Many people find it difficult to force themselves to carefully check something twice within a brief period. A pilot may consider it wasteful of limited time and attention, and less efficient than combining the flow and the checklist into a single sequence of actions. If airlines want to maintain the error-trapping value of a redundant flow and check procedure, they must explicitly acknowledge this human tendency and explain to pilots why they are asked to check things twice. Airlines should clearly define which items should be double-checked and which responses can rely on a memory of having performed the item during the flow. Airlines also should review normal checklists to eliminate excessive repetition of items on the flow and the checklist.

Looking Without Seeing

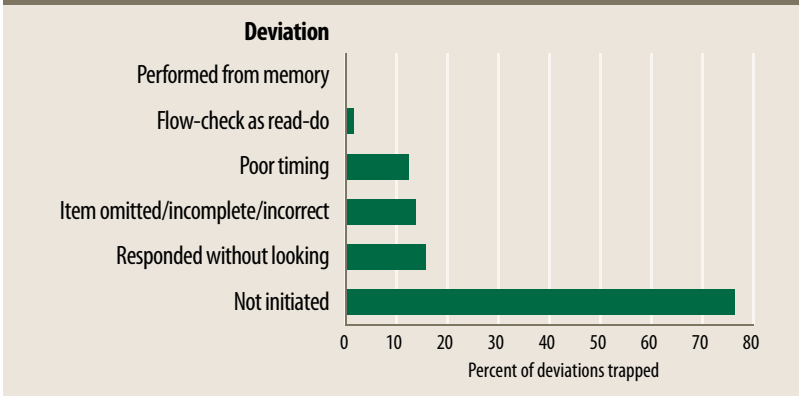
We observed 43 instances in which checklist items were responded to without effective visual verification. In some cases, the responses were incorrect. For example, a first officer challenged, "Doors?" and the captain responded, "Closed," although the aft cargo door was actually open, as indicated on the overhead panel. The captain was looking down at his flight bag when he responded. The first officer caught the error, however.

On another flight, the captain responded, "On," to the challenge "APU [auxiliary power unit] bleed?" but the bleed was off. Because the captain was looking at the bleed switch when he made the incorrect response, this may have been an instance of "looking without seeing," in which we see what we expect to see, rather than what is actually there.

We observed a pilot using a nice technique of pointing to each item on the overhead panel as he gave the response. This makes the checklist more reliable by drawing both pilots' attention to the items being verified, and it can also slow the pace of checklist execution just enough to make checking more effective. In general, taking a few extra seconds to perform an error-trapping procedure in a deliberate manner — that is, carefully and thoughtfully — makes it much more effective. The "point and shoot" technique is worth adopting, and airlines should promote and train deliberateness.

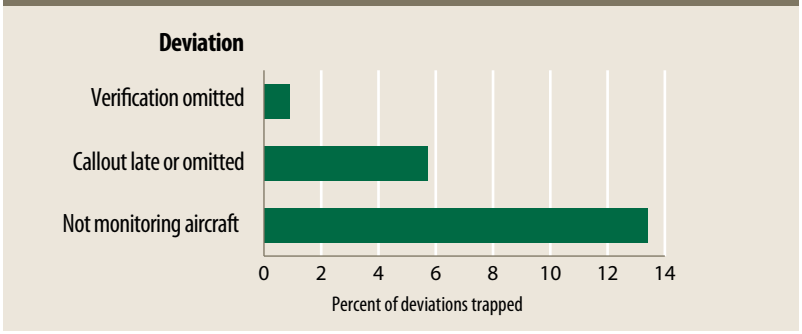
"This makes the checklist more reliable by drawing both pilots' attention to the items being verified..."

FIGURE 1 – **Trapping of Checklist Deviations**



Note: 14.4% of all checklist deviations were trapped.
Source: Benjamin A. Berman and R. Key Dismukes

FIGURE 2 – **Trapping of Monitoring Deviations**



Note: 5.6 percent of all monitoring deviations were trapped.
Source: Benjamin A. Berman and R. Key Dismukes.

Checklist items were omitted or performed incompletely or incorrectly in 42 instances. For example, the checklist item "hydraulics" had a specified response of "Set and checked," referring to setting the pump switches on the overhead panel to the "ON" position and checking the pressure gauges on the forward instrument panel. Some pilots looked only at the overhead panel before making the specified response, omitting the other item, the gauge indications, that was to be verified. This shows the vulnerability to error of checklist designs that include more than one item on a single challenge-response element, and the subtlety of breakdowns in this area. We suspect that many of the pilots involved in this kind of deviation were not even aware of the omission.

Another common checklist deviation was initiating a checklist at a bad time. We observed this in 31 instances. Some were delayed initiations, with heavy workload a key factor; others involved pilots calling for a checklist when it interfered with other tasks and posed a significant distraction or workload spike. For example, a captain called for the "Taxi" checklist just as the aircraft was approaching a runway intersection, drawing the first officer's attention away from visually clearing the taxi path from his side of the flight deck. This is an example of an errortrapping procedure that can potentially detract from safety when not handled properly. Pilots can reduce this risk by exercising proactive workload management, deliberately choosing the optimal time to perform a checklist (within the guidelines of the SOP) so as to minimize interference with other tasks. Airlines should train this mode of workload management, and reinforce it in line checks and line observations.

Deviations in Monitoring

Among the 391 monitoring deviations that we observed, 211 involved callout omissions. Callouts are the outward manifestations of monitoring that are scripted into SOPs and are easier to observe than other aspects of monitoring. Some omitted callouts more clearly undermined flight safety than the "1,000 to go" callouts previously discussed. For example, a flight crew was engrossed in increasing the descent gradient to accommodate a "slam dunk" ATC clearance when the monitoring pilot omitted the callout at 1,000 ft above airport elevation. This illustrates the tendency of pilots to shed monitoring when primary control task workload is high and the corollary that monitoring tends to drop out of the picture just when it is needed most.

Verification omissions occurred in 113 instances. In one case, while descending through Flight Level (FL) 310 (approximately 31,000 ft), the flight crew received clearance to FL 240. The first officer set and called out the new altitude, but the captain was distracted by conversation and did not verify the new altitude on the primary flight display. There was no adverse outcome because the first officer had set the altitude correctly.

Potentially more consequential was an instance in which the first officer transposed the digits of a heading assigned by ATC while the captain was occupied with taxiing the aircraft onto the runway. The captain did not verify the heading selection at this busy time. The error was not trapped. In this case, the observer spoke up about the heading mis-selection to reduce the risk of a traffic conflict after departure.

Another frequent deviation was not monitoring the aircraft, observed in 67 instances. Both the flying pilot and monitoring pilot are required to

(continued on page 39)

Paperwork – The 'Achilles Heel' of Operations?

By Major Sylvain Giguère, Directorate of Flight Safety, Ottawa

This story begins with a situation that seems common in the Air Force: Few journeymen, fewer technicians authorized for maintenance release (Level "A"), and an expanding workload. On that night shift, very few Level "A" technicians had to divide their attention between multiple tasks. Of course, one of these had to go wrong. The task was simple enough, replacing a rotor brake micro-switch on a CH146 *Griffon*.

The task was assigned to a trusted journeyman who did not need constant supervision. As expected of him, he followed the technical publications detailing the procedure for the replacement of the micro-switch up to the point where more space to work was needed. He proceeded to disconnect a chip detector on the main transmission. Once the chip detector was disconnected, the rest of the rotor brake micro-switch replacement procedure was followed to completion.

To facilitate access, the technician affected another system on the aircraft. The removal of the chip detector is not included in the procedure that they were working on. The technician should have recorded the removal of the chip detector on form CF349B (Support Work).

The technician signing for the maintenance release did a quick inspection of the micro-switch, but never thought of looking at the chip detector or elsewhere since the CF349 Aircraft Unserviceability Record did not have any support work entry. A thorough inspection would have found the chip detector still disconnected.

The following morning, the Flight Engineer proceeded with his pre-flight inspection and missed the disconnected chip detector. A few minutes into the flight, the main transmission drained itself, and the helicopter was forced to land at a nearby airport.

The story above was related to *Flight Comment* by a participant to one of the Basic Flight Safety Course (BFSC) serials held by 1 Canadian Air Division in 2009. After I read this story, I was intrigued and decided to conduct a review of the flight safety occurrences for the CH146 *Griffon* fleet to find out if this was an isolated occurrence. I was surprised to find that the CH146 fleet experienced one such occurrence just about every year. Don't be fooled into thinking that it only happens to the CH146 fleet; all aircraft fleets experienced similar types of occurrences.

From a maintenance perspective, the cause of an occurrence is often perceived to be the result of incorrect assembly, incorrectly diagnosing defects, putting wrong fluids into vital systems, and/or due to foreign objects. For the occurrence involving the uninstalled chip detector, the cause could be associated with an incorrect assembly,

Photo: MCpl Tom Trainor

however, the real cause is better categorized as a cognitive error (memory failure) and a deviation (not filling the required CF349B "Support Work").

Each of us runs the risk of memory failure (or memory lapse) every time we try to keep a critical task step in mind to perform later, without any reminder. Memory failure can introduce inaccuracies (misidentified parts, incorrect technical information, etc.) and lead to maintenance reporting discrepancies that might result in a flight safety occurrence. It can also result in forgetting a task that had to be performed. Filling out the CF349B "Support Work" is a layer of defence against memory lapses.

A review of the investigations conducted into occurrences where chip detectors were found to be uninstalled did not reveal why, in all cases, the technicians opted not to complete the CF349B "Support Work". We will never know for sure but it could be a well-intended attempt to complete a task quickly in the face of time pressures or other challenges. It could also be due to complacency. We may have the propensity to break rules and take short cuts in performing tasks if it is the norm in our organization and/or implicitly condoned by our supervisor.

The preventive measure implemented for all previous occurrences of uninstalled chip detector was to brief technicians on the importance of the CF349B. This approach may work as a short term measure but is not likely to be very effective in the long term. For one thing, we tend to retain only about 20 percent of what we hear. In addition, new personnel joining the organization would be oblivious of the issue. A briefing only goes so far. The follow-up is what counts. In essence, it is necessary to "walk the talk". Years ago, old grumpy Crew Chiefs would say: "If you take care of the small things, the big things take care of themselves". Over the years, the safety culture has changed but the Crew Chiefs still need to convey the message that supervisors have to give attention to details and this includes ensuring that subordinates complete the CF349B "Support Work" at all times.

The future may bring us new tools to better manage and record maintenance activities. The use of an iPad as a means to access up-to-date technical publications and to record maintenance conducted on the spot, at the aircraft, may not be so far fetched. These advances may help in reducing human errors. We are not there yet. For the time being, we still need to focus on the basics. ◆

Memory Failure: Rather than forgetting about the past, the technician forgot to perform an action that he intended to perform at some time in the future.

Deviation: Common rule violations include intentional non-completion of the required aircraft records, failing to refer to approved maintenance documentation, abbreviating procedures, or referring to informal sources of information such as personal "black books" of technical data.


Photo: Sgt Paz Quillé

Not by the Book

by Lt. Joshua Fulcher, U.S. Coast Guard liaison officer and instructor pilot, serves as the 314th Airlift Wing flight safety officer, Little Rock Air Force Base, Arkansas

The following two related articles were originally published in the May/June 2010 issue of Torch magazine. It is reproduced here with the kind permission of the staff of the United States Air Education and Training Command.

5/1/2010 - **LITTLE ROCK AIR FORCE BASE, Ark.** – *"... Arrow 96, wind 240 at 11, cleared to land." "Roger, cleared to land, Arrow 96. ... Alright guys, this is it. If the gear collapses, I'll do what I can to keep it on the runway. 'Co,' if the plane starts to settle, feather the props as soon as you feel it lean. If that happens, once the aircraft stops, everybody get out as quickly as you can – a fire will most likely be on the right side of the plane, so crew entrance door is the primary exit. Alright (deep breath), let's do it ..."*

As many have discovered in the history of aviation, there are sometimes situations where "the book" simply doesn't help. A case in point happened one semi-sunny Arkansas summer afternoon at the Little Rock Air Force Base, Ark., C-130 Center of Excellence "schoolhouse."

The mission for the day was rather routine: Get the mighty C-130J "*Super Hercules*" airborne, fly a couple of low-level tactical routes, and end the day with some touch-and-go/assault landing practice.

The students on board the aircraft that day were at both ends of the experience spectrum. The co-pilot student, Captain David Snow, was a high-time Canadian C-130E/H-model pilot who was in town to get qualified in the new J-model *Hercules*. Loadmaster student Airman 1st Class James Year, by contrast, was a young Airman with little aviation experience. In fact, it was only his second flight ever in a military aircraft (welcome to aviation young man; hope you brought your thinking cap!).

"As many have discovered in the history of aviation, there are sometimes situations where 'the book' simply doesn't help. A case in point happened one semi-sunny Arkansas summer afternoon at the Little Rock Air Force Base, Ark., C-130 Center of Excellence 'schoolhouse'."

Major James McAlevey served as the instructor pilot and aircraft commander, while Master Sergeant Patrick Carter led operations in the back of the aircraft as the instructor loadmaster. The crew had completed two tactical low-level routes without incident. Both instructors were impressed with the performance of their students and were returning to base to complete the pattern/assault work and call it a day. The mission was going smoothly, and both students were looking at great write-ups. ... But the flight was far from over.

Cleared inbound on the visual overhead approach, McAlevey called for "gear down." Snow moved the gear handle to the down position, and that's when the "smooth" mission got rough.

The C-130J's gear system shows a safe "down-and-locked" indication by the illumination of three green lights. If the gear is in transit or doesn't register as down and locked, the corresponding light will simply not light up. Only two green lights were on that day – the nose and left main gears.

The J-model has cool technology called the Advisory, Caution, and Warning System that provides visual and audible indications when malfunctions are detected. Hearing the "caution" sounds through their headsets, the pilots looked down to see "RIGHT GEAR NOT DOWN" on their flight management system displays.

"The right gear light is not on, eh," the Canadian co-pilot said.

"Roger, let's get a place to hold and run the checklist," McAlevey responded.

The crew contacted air traffic control, and five minutes later found themselves holding at a nearby navigational aid running the "Landing Gear System Failure" checklists. Among a host of other things, these checklists require the loadmaster to visually inspect the landing gear assembly from inside the aircraft.

That was easier said than done.

The aircraft had a significant load in the cargo compartment that was to be used for ground training once the flying portion of the event was complete. To reach the landing gear access panels in the cargo compartment, Carter and Year had to move the pallets while the plane was in flight no easy task on an airborne aircraft in a holding pattern. Despite the difficulty of the challenge at hand, the loadmasters moved the loads, removed the panels and performed the visual inspection in accordance with the checklist.

Faced with a unique landing gear malfunction, a C-130J crew had to get innovative to return home safely.

Once eyeballs were on the affected landing gear, the loadmasters knew they had a significant problem on their hands. Not only had the gear not moved from the up position, Carter noted multiple broken components on the gear itself.

The next 20 minutes were spent following the checklist guidance and trying to get the gear down via alternate methods in the book, but none of them worked.

In the process of trying to lower the gear, the crew contacted multiple ground agencies, including Lockheed Martin technical support, which offered suggestions on how to best deal

with this emergency. Using an iPhone camera, the crew sent pictures of the structural damage to the maintenance professionals on the ground, which were analyzed and used to help guide them.

Finally, the loadmasters managed to partially lower the gear. Each of the C-130J's two main landing gear is comprised of a forward and aft gear assembly; the right forward gear was full down, but the aft gear was still about 4 to 5 inches up.

Turning Lemons into Lemonade

by Lt. Joshua Fulcher, U.S. Coast Guard liaison officer and instructor pilot, serves as the 314th Airlift Wing flight safety officer , Little Rock Air Force Base, Arkansas

How did the Little Rock Air Force Base, Ark., C-130J crew turn a potentially catastrophic emergency, not covered in technical orders, into a relatively routine landing? The answer: training, teamwork and innovation.

Training

The fact that this emergency took place at the C-130 Center of Excellence "schoolhouse" is significant. The crew, as with nearly all who fly with the 314th Airlift Wing at Little Rock, was only "half" qualified. "Half" meaning that because of the students on board, the only fully qualified crewmembers on the aircraft were the instructor pilot and instructor loadmaster.

This was especially significant in the back of the aircraft.

Remember, the student loadmaster was only on his second flight in a real airplane. Yet because of the quality of training he had received prior to arriving at the flight line, he was able to skilfully assist his instructor and be part of the solution. Working together to move pallets, remove covers and run checklists, the loadmasters gave a clear picture of the situation at hand to the pilots who relayed it to the ground agencies that were helping solve the problem. Were the student not as well trained, the situation could have been that much more difficult for no more reason than the evolution in the back of the aircraft would have taken much longer to complete.

Teamwork

Many different entities contributed to the crew's success that day. Had the crew been forced to deal with this emergency completely on their own, they may not have had the same happy ending.

Air traffic control was the first player involved. Getting the aircraft under radar coverage, moved to a safe holding area and clear of other traffic allowed the crew to concentrate on the emergency rather than dodging the swarm of other C-130s in Little Rock's radar and visual patterns. The base launches and recovers more than 50 C-130 training sorties per day.

All said and done, the aircraft held for two hours, losing fuel weight, prior to the crew making the rather tense final approach and landing. The loadmasters' innovative method to secure the gear (see "Turning Lemons into Lemonade"), not covered in the J-model flight manual, worked swimmingly, and the gear did not collapse. It was later found that the right-side main landing gear had moved up a few inches after the plane landed, but the fix held and the plane sustained no further damage.

The crew shut down the aircraft on the runway and walked safely away from only a minor mishap.

It could have been far worse.

For instance, one of the worst situations a C-130 crew can find themselves in is when the landing gear on one side collapses. The outboard propeller of a Hercules is only about 6.5 feet off the ground and sits nearly 30 feet from the aircraft's centerline. Thus, it will impact the ground if one of the main landing gear collapses and the other stays down and locked. The wing extends another 20 feet or so beyond the outboard propeller and will also hit the ground in this situation. Having the prop and wing tip hit the ground at a C-130's landing speed (about 100 knots or 115 mph) means only one thing ... disaster.

Instead, the crew used training, teamwork and innovation to come home safely. ◆

Next was the supervisor of flying, Captain Bryan Huffman.

Upon learning of the impending emergency, Huffman took over as the single point of communication between the crew and all the required support entities on the ground. He handled a multitude of tasks that contributed to the crew's success. One of the first things he did was contact the J-model squadron's director of operations, who in turn, came immediately to the control tower with his flight manual in hand. With the DO's technical expertise, Huffman was better able to coordinate response and provide the crew the help they needed.

Additionally, Huffman established a phone patch with yet another player in the mix: Lockheed Martin technical support services in Georgia. Being able to talk to the Lockheed engineers, the crew got expert advice from structural authorities on ways to deal with that day's unusual emergency.

Innovation

Remember that the situation the crew found themselves in that day was not fully covered by any emergency procedure in the flight manual. There are procedures for lowering the landing gear when the normal hydraulic systems fail, but none of the written guidance was able to fully extend the aft landing gear to the full down and locked position.

So, the instructor loadmaster relied on two tools: his experience and his iPhone.

The sergeant's extensive experience as a former "E" and "H-model" C-130 loadmaster gave him one great advantage in this situation: He had used chains to secure unsafe landing gear in the past. Using chains for landing gear malfunctions is not covered in the J-model flight manual because of a different tie-down mechanism specifically designed for that aircraft.

The right main aft landing gear was still about 4 to 5 inches from full down. This seemingly small distance would not allow the J-specific tie-downs to work. But the quick-thinking instructor was able to get chains around both the forward and aft gear assemblies and secure them in place for landing.

Rewind the clock 10 minutes. The fact that the gear was even as far down as it was can be attributed to the other aforementioned tool: the loadmaster's iPhone. The iPhone allowed the instructor to take and e-mail a picture of the landing gear damage to maintenance crews.

Here's the twist: Use of cell phones in flight is prohibited. But let's also consider one of the first sentences in the C-130 flight manual, "... This manual provides the best possible operating instructions under most circumstances, but is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures."

The iPhone pictures provided maintenance crews a much better understanding of the extensive gear damage and enabled experts on the ground to provide accurate, timely and sound advice to the crew.

Everything came together that day and the outcome speaks for itself; a relatively minor mishap, with minimal damage to a very expensive aircraft. Were it not for the professionalism and skill of all players, capitalization of modern and relevant training, base organizational synergies, and the innovative use of technology, the outcome may have been tragically different.

Nevertheless, if you're ever in an extreme situation and nothing seems to work, ensure the batteries in your cell phone are fully charged. Fly strong! ◆

Contracted De-icing Services at 8 Wing Trenton

By Mr Matt Godbout, Iceman with Petro Air Services, 8 Wing Trenton

The importance of an efficient and effective de-icing program, in the context of flight safety, cannot be over-emphasized. According to Transport Canada's research and development, they define the significance of de-icing and anti-icing as follows:

"Frost, ice or snow on critical surfaces of an aircraft such as wings, propellers and stabilizers can have a significant impact on the operation of an aircraft. The aircraft can be affected in two ways:

1. The formation of frost, ice or snow changes the airflow over the wing, reducing lift and increasing drag; and

2. The additional weight of the ice or snow adds to the total weight of the aircraft, increasing the lift required for the aircraft to take off. The combination of reduced lift, increased drag and increased weight from even small quantities of ice, snow or frost, can affect performance and handling qualities that can result in negative consequences."

In the name of safety, Transport Canada has stringent regulations on the removal of frost, snow and ice on the critical surfaces of wings, tail and propellers for all aircraft prior to takeoff. These regulations include an inspection program in accordance with the operating and flight rule standards.

Amongst numerous items within this program, are procedures for aircraft inspection, de-icing, anti–icing and training. De-icing is performed by spraying heated Type 1 glycol aircraft deicing fluid (ADF) on frost, snow and ice to melt and remove contaminant from the critical surfaces. If precipitation is ongoing after the Type 1 application, then a non-heated Type 4 glycol aircraft anti-icing fluid (AAF) application is necessary to prevent build-up of further contaminant before takeoff. The Type 4 application is only effective for an allotted period of time known as the hold-over time. This time is derived from a table based on the outside conditions and/or precipitation that can result in contamination to re-form on the critical surfaces. If the hold-over time is exceeded, both applications must be re-applied to achieve takeoff within the new hold-over time guidelines.

With consideration for these guidelines and restrictions, 8 Wing Trenton has contracted Petro Air Services (P.A.S.) for their de-icing

and anti-icing requirements. P.A.S. has been in compliance with the Canadian Aviation Regulations since the company's inception, and has exceeded the standards in many instances. P.A.S. has taken further procedural steps, in conjunction with DND, by establishing a procedure to de-ice the C177 with engines running. This procedure saves time, fuel, and glycol use, making it more cost effective and environmentally friendly. The C177, however, is not without challenges of its own. The main difficulty is that the horizontal surface on the tail is at a height that standard de-icing trucks simply cannot reach (55 feet). The C177 has been operational in Trenton since the 2007 season, so a solution was needed that addressed all concerns for now and the future.

P.A.S. and Premier Engineering out of Wisconsin has designed and manufactured two custom made trucks equipped with an extended-reach that allows a maximum 80 feet lift, as well as 55 feet of working height, without the assistance of outriggers. Both unique trucks were developed and designed specifically for the C177, as well as other aircraft possessing critical surface heights that exceed standard truck limits. The immense size of aircraft (like the C177 *Globemaster*, C5 *Galaxy*, *Antonov* 124 and 225, among others) still make de-icing services challenging, even with the two extended-reach trucks, but the procedure has been made more efficient with the use of a de-icing pad.

8 Wing Trenton is the only Canadian Forces base with a designated de-icing pad. This step is yet another way DND has made allowances for safety and environmental control. With a strategically placed de-icing pad, the glycol used in any operation is confined to an area that is free of any other airfield traffic and no longer a threat that can be tracked into uncontrolled spaces. After an operation has been completed and the aircraft has taxied to the runway for departure, the glycol that remains on the ground is picked up with recovery trucks. The reclaimed glycol is then pumped into a tank that will be sent to a third party for recycling back into a useable product. This process would be more complicated, expensive, and more of a threat to the environment, without the de-icing pad. P.A.S. has also created a de-snowing process that clears snow from the critical surfaces before the aircraft arrives to the de-icing pad for spraying. This procedure, as simple as it sounds, saves time and massive amounts of glycol, which contributes to a better environment and a reduction in costs.

In order to deal with de-icing and anti-icing processes, P.A.S. ground crew requires a variety of training and preparation to deal with various situations that may arise. However, the complexities of the job are made far easier by the staff from the DND side of the operation. Flight crews and de-icing crews maintain an open line of communication that has developed into a relationship of trust, respect, and attention to detail that makes both sides successful - and most importantly - safe. ◆

GET HOME *ITIS*

By Major M.J. Graham, Wing Flight Safety Officer, 8 Wing Trenton

Photo: MCpl Robert Bottrill

It was a hot July afternoon in Ellsworth AFB, South Dakota as we engaged the engine starter and hit the stop-watch to time the start cycle. The density altitude on that day would have been well above the 3276 feet MSL (mean sea level) of the airfield and let's just say that the start cycle took a few 'potatoes' longer and was 'approaching' the maximum allowable EGT on the J85 turbine. Never the less, the engine parameters settled to within limits and things appeared normal. We both agreed that we would conduct an engine run-up prior to departure to ensure that the engine was operating normally.

The *Tutor* was a forgiving aircraft and the J85 a robust engine so neither of us were concerned as we taxied out and lined up on runway 13. The run-up went smoothly and all indications were that the engine was functioning normally; RMP (revolutions per minute), EGT (exhaust gas temperature) and oil pressure were all normal – "good to go".

As the non-flying pilot, I noticed that the acceleration performance after brake release was sluggish and rotation commenced well down the 13,500 foot runway. While neither of us said anything, we both chalked it up to the high density altitude as the cause of the poor performance. As the jet struggled into the air, the left seat pilot went to retract the landing gear but I stopped him momentarily; things didn't seem right and the aircraft wasn't accelerating normally. We might have to put the jet down in the remaining runway and abort the takeoff. Then, after a 'pregnant' pause, we started to accelerate in ground effect – "gear up". Was it our imagination? It's probably just the extreme heat and altitude. "Yeah that's what it is", we rationalized as we barely cleared the MacDonald's arches a half mile off of the end of the runway.

Climb to altitude took considerably longer than the normal climb schedule and as we levelled off, the aircraft wasn't accelerating. At this point, we pulled out the charts and it was clear that we had a problem. Apparently none of the other chain of events which lead to this epiphany was enough of an indication. The max airspeed we were able to accelerate to was a full 35 knots less than charted for the conditions.

"Ellsworth approach, Snapper 3 is declaring an emergency and requesting immediate vector for PFL (precautionary forced landing) Runway 13". As we descended on the PFL profile, my buddy said that he could hear a grinding noise from the engine. I listened and could hear it as well. It sounded like the engine was grinding every second or so. "Better move the profile up a couple grand to account for a seized engine dude". "Good call." I don't think a finer PFL had ever been flown. High Key - Low Key - Final Key - on altitude and airspeed - textbook. You can't teach that stuff!

As we taxied off of the active runway and shut down, the sequence of events started to play back in our heads. The first and most obvious indication that things were not normal should have been the engine starting limits. It was beyond the max allowable and this should have been the time when we shut down, went to Ops and called servicing in Moose Jaw. It would have been a much shorter story.

A technician arrived later that day on another *Tutor* MRP (mobile repair party) aircraft. The engine tech went out to examine the aircraft and came back a few minutes later to show us what he had found. He directed a flashlight up the tailpipe which revealed that more than a quarter of the second stage turbine blades were missing. There were also multiple score marks from when the turbine blades exited the tailpipe.

The severity of the events which had played out earlier in the day started to take hold. Both of us realized that the end result could have been much worse. We were both on the larger side of 200 lbs and the result from a low level ejection could have been disastrous.

Thinking back on that day, several questions spring to mind. Why did we take the jet flying when the start limits on the aircraft were exceeded? Did the 'warm' start cause the turbine damage? Were there perceived pressures from higher headquarters to get the jet home? I can say that at that time in the mid 90's, the purse strings were tight and flying units were feeling the pinch. There were constant threats of cancelling "out and backs" and "Quarterlies" for QFIs (Qualified Flying Instructors). Nevertheless, AOI (Aircraft Operating Instructions) limits are what they are. If they are exceeded, the aircraft is unserviceable.

After having flown larger transport aircraft, it often strikes me as odd that back then we never looked at performance charts in the *Tutor*. If we had done so on this particular day, we likely would have identified a performance deficit on the takeoff roll and not gone flying.◆

Gut Feeling

By MCpl Owen Hughes, Flight Engineer, 403 Helicopter Operational Training Squadron, Gagetown

I walked into the SAMS (Senior Aircraft Maintenance Supervisor) office one morning. He had summoned me to conduct an interview to determine if I was ready to be granted Level "A" maintenance authority. At the end of the interview, the SAMS shook my hand and congratulated me; I had just been granted my Level "A" maintenance authority! Before I left his office, he said one more thing; "You are still new and have much to learn, but remember this: listen to your gut. If it doesn't feel right, it probably isn't. Pay attention to that feeling because it may save someone's life one day." Profound words; at least they were to me. It wouldn't be long before these words spoken to me by a man with nearly 30 years experience actually sunk in.

I was working in Servicing at 407 Squadron in Comox on the CP-140 *Aurora*. The shift had started like any other. We recovered an *Aurora* following a routine mission. The Flight Engineer (FE) had a couple of snags to write up. No big deal, we would take care of them. The number 4 engine had a problem with the Reduction Gear Box (RGB) and the number 3 propeller had an issue. We were de-briefed by the FE and started work, checking the CFTO's (Canadian Forces Technical Orders) for guidance. My crew performed a ground run to confirm the snags and see what could be done. We had a few ideas and passed them on to the night shift. I left work confident that the night shift would take care of the snags.

I arrived the next morning to see the same aircraft on the line with the APU running and the FE doing his pre-flight. Being curious, I went to check the MRS (maintenance record set) to see what work had been done. When I opened the history page, I began to get the feeling in my gut something wasn't right. Both snags had been written up as "Ground Run Serviceable", but there was no support work nor mention of what work was done to rectify the snags. I didn't have a good feeling about what was going on. This aircraft was about to go flying and I believed it was still unserviceable. Since I was new, I wanted to make sure my fears were valid before I proceeded any further. I went to see a senior Sergeant (an engine tech working in maintenance at the time) and told him my concerns. I explained that these snags were not corrected and in the event that these problems were to arise again in flight, both engines may have to be shut down. This was the part that made me nervous: a four engine aircraft doesn't fly so well with two engines shut own on the same side. I recalled the story of an Aurora skidding off the runway in Greenwood when it landed in a similar condition.

I wondered if I was doing the right thing because I was contradicting senior techs who I respected, but the feeling wouldn't go away. The Sergeant listened carefully and took a moment to contemplate what I had said. He didn't like what he heard because he made his way, with me in trail, to the morning brief. The CO was there which made me more nervous than I had ever been before. The Sergeant explained to the CO what I had found and that the aircraft was on the ramp getting ready to go flying. The CO took the news calmly and simply said, "If she's broke then shut'er down and get'er fixed."

I knew that this was not the end of the story. I was the new guy. I had just caused a mission to get cancelled. I had contradicted the engine techs on the other crew and they were angry, to say the least. But those words of the SAMS kept ringing in my ears. I was sure I had made the right decision even though others may not have agreed.

After several days of trouble shooting and de-snagging, it was determined both the RGB and the propeller were unserviceable. They were subsequently removed from the aircraft and sent to shops for repair. Whether I was right or wrong, I made a decision based on the information at hand and my experience and knowledge of previous incidents. If you believe there is something wrong, safety dictates that you stand up and say so. ◆


Photo: Cpl Henry Wall

SHORTCUTS

Never a good reason for it

By Chief Warrant Officer Denis Cormier, Directorate of Flight Safety, Ottawa

It was a typical evening shift at the home of this Fighter Squadron training unit. The hangar was filled with broken jets, the result of over 55 sorties that day. In the early days of the *Hornets*, a flying program of that magnitude was fairly routine as we were in the process of standing-up units both in Canada and abroad. However, in order to maintain that many sorties every day, it was determined with certain accuracy that 70% of the unit's aircraft had to be serviceable and on the flight line ready for the day's schedule.

By 16:00 hrs on our fourth shift that week, the snag board was full again and the tow crew was starting to bring the broken jets into the hangar; to no one's surprise, we were in for another long evening. Work went relatively well that night with every technician attending to their area of expertise. We still had our old occupations back then and as Instrument Electrical Technicians, our specific expertise was solicited on a regular basis by the other occupations. Tonight was no different as we were helping out the Airframe Technicians in the troubleshooting of an airflow problem, since most of the mechanical parts had already been replaced; they requested that we replace the control panel. We agreed to the change as it was an easy task. Because it was approaching 02:00 hrs in the morning and supply had closed for the evening, we decided to borrow the control panel from a serviceable aircraft in the hangar without completing associated paperwork. We were not *robbing* the panel but merely borrowing it to confirm our problem. Although it was a non-authorized practice, we still went ahead with the plan as we were pressed for

time in order to get the magic number of 70% serviceability, and really, what could go wrong? (The removal and installation would take less than 5 minutes). Upon removing the serviceable panel we immediately installed it in our broken jet, following the applicable testing, and to our disappointment, the original snag was still present. We switched the panels back to their original locations and carried on a bit longer with our troubleshooting before we called it a night a few hours later.

I was awoken early the next morning by the ringing of my phone. It was the day shift supervisor asking if I knew anything about a missing control panel from a serviceable aircraft. He went on to say that the servicing crew had towed the aircraft outside for the day's flying schedule and upon performing the standard "B" check noticed the panel missing from the cockpit. I quickly came to realize that we were so involved in the repair of the broken jet, that we had failed to return the borrowed control panel to its original aircraft and instead had left it on the parts rack beside the aircraft. Had we filled in all appropriate paperwork, it would have been picked up by my crew or the desk sergeant before the end of our shift. Instead, our shortcut prevented the use of a valuable asset for the morning launch and taught me and my crew a very humiliating and embarrassing lesson. In this case no damage occurred and no one was hurt, as the missing part was noticed before the aircraft was started or even went flying, but what about the next time? Will it go unnoticed and result in an accident/incident? Remember that rules are in place to keep us out of trouble; under no circumstances is there a good reason for taking shortcuts. ◆

"We were not *robbing* the panel but merely borrowing it to confirm our problem. Although it was a non-authorized practice, we still went ahead with the plan as we were pressed for time in order to get the magic number of 70% serviceability, and really, what could go wrong?"

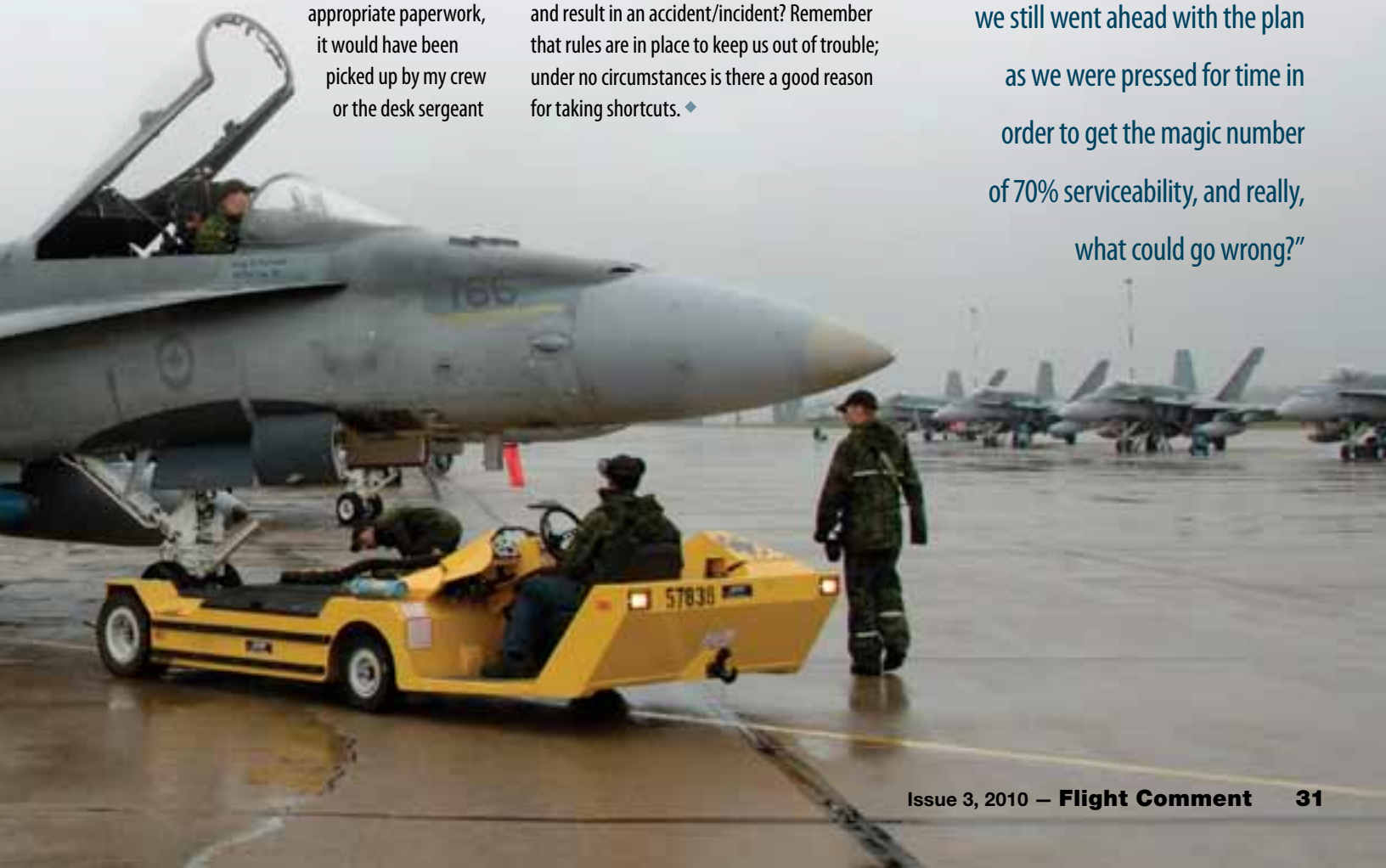


Photo: Cpl Shilo Adamson

If Things Are Going Too Fast

SLOW DOWN

By Captain Matthew Dukowski, 423 Squadron, 12 Wing Shearwater

Photo: MCpl Angela Abbey

As an aspiring co-pilot during a CH124 *Sea King* training flight at 406 Squadron, I engaged the rotor of the aircraft with a fireguard standing under the rotor disc – not an ideal situation!

Starting the *Sea King* is a two-pilot operation. Although the steps are read from the checklist, those with experience on type can effectively proceed at a quick clip; as a pilot new on the *Sea King*, I proved to myself that accuracy should not be sacrificed for speed.

After the number two engine is started, normally a "thumbs-up" is given to the fire guard to signify a good start, allowing him to leave his post at the side of the aircraft. The "thumbs-up" is not in the checklist, and on this occasion I failed to give it. This is the point where the "swiss cheese model" lined up. The Aircraft Commander (AC) was running through the checklist too quickly for me to effectively and accurately respond. Rather than asking him to slow down, I tried to keep pace.

Then the call was made to clear the right. I looked too quickly, verbalized that it was clear, and put my hand on the #2 Speed Selector Lever (SSL) for engagement. I verbalized that I was going to engage the rotor and paused for the time to be recorded. The AC recorded the time but did not signal for the rotor engagement. This was the second opportunity missed, since the marshaller would not have approved the engagement of the rotor with the fire guard standing under the rotor arc. After we engaged the rotor, the fire guard successfully left the area under the operating disc. Thankfully, no one was hurt.

I learned a tough lesson from this event, but it changed the way I conduct myself in the flight deck. As a new co-pilot at 423 Squadron, I always verbalize a thumbs-up after each engine is started, which is the accepted technique used by many pilots. My lesson learned is that if things are going too fast – slow down! ◆

FOD in the Cockpit

By Captain Shamus Allen, Unit Flight Safety Officer, 410 Tactical Fighter Training Squadron, 4 Wing Cold Lake

OH NO! Not another article about FOD! Well, it's understandable why you would probably turn the page and move on to the next article; FOD in any cockpit has long been the subject of flight safety. We probably know all there is to know about it, right? Well, that's not exactly true. Although many measures have been taken to prevent FOD from occurring, it still happens. Whether it's aircrew equipment that gets misplaced, broken or lost or non-flying equipment or even maintenance tools; there is always a risk of this same FOD becoming a hazard. We've seen examples throughout aviation history of many scenarios where the "swiss cheese holes" lined up, and an incident/accident has occurred due to FOD. Many preventative measures are currently in place to ensure that the potential is minimized, such as regulations concerning what can and cannot be brought into the cockpit and routine FOD inspections. So what else can be done?

The answer lies with YOU! The concept of all the proverbial "swiss cheese holes" lining up is that in order for an incident/accident to occur, multiple events must occur together. The holes represent failings or imperfections in equipment, safeguards, or even preventative maintenance. However, human factors such as improper communication practices, inadequate supervision or organizational influences, to name but a few, can play a major contributing role to the alignment of these "holes". It is with this in mind that the following story is based.

Photo: WO Serge Peters

The place is the fighting 410th Tactical Fighter (Operational Training) Squadron at 4 Wing Cold Lake AB. During what had become a very normal and common routine of extremely long work days (for the students of the OTU as well as the instructors and maintenance organization) due to the persistent pressure to graduate on time, missions were often rushed and some corners cut in order to save time. Amidst the chaos, a student who was recently airborne during a Basic Fighting Maneuvers mission (a mission with a lot of intense maneuvering) discovered airborne a piece of FOD floating around in the cockpit. Whilst he had the capacity to grab it, and place it under his kneeboard, somehow during the latter part of the mission it had become again dislodged. It was now again floating aimlessly in the cockpit out of sight to the

pilot, and without his knowing. Fortunately, the aircraft landed without further incident. However, it wasn't until the pilot landed, signed in his aircraft, completed his hour long debrief and went back to his crew room that he realized he did not have the piece of FOD he had found. Perhaps a bit of "out of sight out of mind" was at play, compounded with the pressures and pace of being a student on a very challenging course (organizational influences). Regardless, his next action was critical in preventing the "last hole" from lining up. The aircraft he had flown had already been refueled and sent on its way with a new crew, and was taxiing away from the squadron to take off. When the student informed the maintenance section about the FOD he had found and subsequently lost again, they immediately contacted the aircraft via radio and prevented it from taking off. It then was inspected, the FOD was found and the mission was able to continue safely.

What's the point? It's that we all have a significant part to play in not only our safety but the safety of others. If that aircraft had gone flying, would that piece of FOD found its way to the worst spot possible, or subsequently caused something else to fail? We can't know. But only one thing is for sure, and that's the process by which the student pilot contributed to the prevention of one more "hole" lining up was essential in eliminating the possibility for anything further from occurring. We all have our own way of contributing. By prioritizing safety, we actually become more mission capable and effective.

Ergo, one answer to avoiding the cumulative act effect lies with us as individuals and as a team. Our decisions and actions can make the difference. ◆

"The answer lies with YOU! The concept of all the proverbial "swiss cheese holes" lining up is that in order for an incident/accident to occur, multiple events must occur together."

Photo: MCpl Andrew Collins

From the Investigator

TYPE: CU170 *Heron* (170255)
LOCATION: CFB Suffield, Alberta
DATE: 16 July 2010

The mission consisted of a training flight to conduct Automatic Take-Off and Landing (ATOL) and Remote Auto-Landing Position Sensor (RAPS) landings. This was the second mission for the Unmanned Air Vehicle (UAV) but the first for the accident crew. The first mission was flown without incident. The occurrence mission plan consisted of three circuits, including two RAPS approaches and one ATOL approach, concluding with a landing. On the overshoot from the second RAPS approach, the outboard flaps remained in the down position with the associated "Servo Flap Right/OTR Fail" warning. This phenomena is a known issue with the Heron fleet and a Service Bulletin (SB MCM-026-2010) had already been released in an attempt to solve the issue. Throughout the circuit both the UAV and the Advanced Ground Control Station (AGCS) experienced multiple intermittent navigation systems failures. On final approach, the student Air Vehicle Operator (AVO) noticed the UAV flying too low and informed the AVO instructor, who immediately directed the student AVO to initiate an override altitude command to climb. The instructor noticed that the student AVO made an error in the screen button selection and immediately took control and gave the altitude override command. The UAV configuration was changing for the climb configuration when the UAV hit an electrical pole just east of highway 884. The UAV burst into flame and crashed on the west side of highway 884. The accident caused a power outage to the town of Ralston, AB, and CFB Suffield.

The crash location was approximately 800 metres north of the main entrance to CFB Suffield.

Two preventive measures (PM) have been implemented. They are:

- prior to conducting an ATOL approach the AVO shall set the minimum value for the "AMSL Low Alt Warning" to the MAP waypoint altitude
- in the event that a combination of dual DGPS and INS/GPS faults occur while on approach, the AVO should overshoot immediately and climb to a safe altitude. The AVO shall not commence an ATOL approach with these faults present.

The focus of the investigation is on navigation system failures and human factors concerning operations within a ground control station environment. ◆

From the Investigator

TYPE: CF188 *Hornet* (188738)
LOCATION: Lethbridge, Alberta
DATE: 23 July 2010

During an airshow practice at Lethbridge County Airport, *Hornet* CF188738 experienced a loss of thrust from its right engine while conducting a high alpha pass at 300 ft above ground level (AGL). Unaware of the loss of thrust but feeling the aircraft sink, the pilot selected military power on both throttles to arrest the descent. The aircraft continued to sink and the pilot selected afterburner on both throttles. The aircraft immediately began to yaw right and continued to rapidly yaw/roll right, despite compensating control column and rudder pedal inputs. At approximately 150 feet AGL and about 90 degrees of right bank, the pilot ejected from the aircraft. The aircraft continued to yaw/roll right with its nose descending in a tight right descending corkscrew prior to hitting the ground nose first.

The ejection and seat-man separation worked flawlessly but the pilot was injured when he touched down firmly under a stable chute. After landing, the parachute shroud lines became entangled around the pilot's left leg and the parachute re-inflated before it could be released, causing him to be dragged several hundred meters. The pilot was able to release the remaining Koch fittings just as members of the *Sky Hawks*, the Canadian Forces parachute demonstration team, arrived on scene to provide assistance. First aid was administered to the pilot who was subsequently transported to the Regional Hospital.

Field examination of the engines did not reveal any anomalies. Both engines were sent to the Quality Engineering and Test Establishment for a detailed inspection. Concurrently, photogrammetric analysis is taking place to ascertain certain flight and engine parameters which could not be recovered from the Advanced Memory Unit and other recording devices. Finally, modeling and simulation has been undertaken to better understand the factors (e.g., throttle splits, altitude) affecting the aircraft's recovery under various conditions.

The investigation will be focussing on the loss of thrust experienced by the right-hand engine, the factors that precluded an in-flight recovery of the aircraft, and CF18 demonstration pilot training. ◆

Epilogue

TYPE: CH147 *Chinook* (147204)

LOCATION: Kandahar Airfield, Afghanistan

DATE: 18 January 2009

Aircraft CH147204 was on a training mission out of Kandahar airfield. Subsequent to its departure, an aft rotor fixed droop stop was found on the ramp near where CH147204 was previously parked. A check of other aircraft determined the missing droop stop came from CH147204. Operations advised the occurrence crew of the situation and recalled the aircraft. Using a coalition partner's emergency shutdown procedure, a ramp was built to minimize aircraft damage, the crew set the parking brakes, secured the flight controls in place and exited the aircraft. After the engines stopped, due to fuel exhaustion, the rotors began slowing down until they eventually impacted the ramp, causing damage to the rotor blade system and fuselage. There were no injuries.

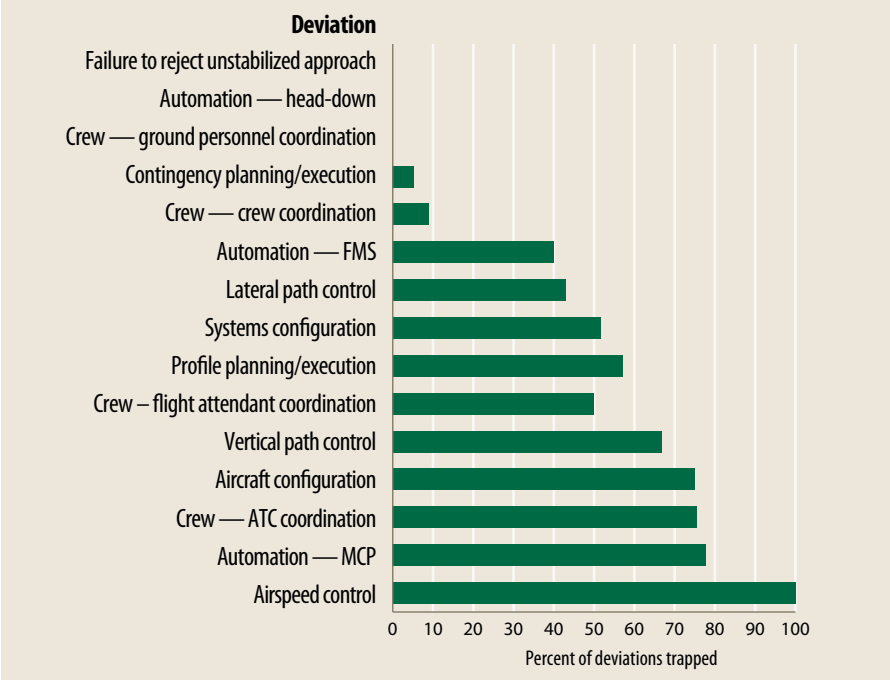
The droop restraint system supports the weight of the rotor blades on start-up and shutdown to prevent them from striking the fuselage.

The investigation revealed that the aft fixed droop stops were installed improperly causing metal fatigue of the attachment bolts that resulted in one of the aft fixed droop stops falling off and subsequent damage to the aircraft by the rotor blades on shutdown. Contributing factors were the markings "AFT ROTOR BOTTOM" having been applied to the wrong surface, the difficult visual differences between the large and small chamfers (the two bevelled edges of the droop stop block) and ambiguous technical instructions. The lack of a rotor brake system also contributed to the degree of aircraft damage.

Safety recommendations include the development of CF procedures for droop stop failures applicable to the CH147D *Chinook* and amendments to the operator's manual, checklist and technical instructions. A review of the droop stop painting process and the communication of the results of this investigation with CF coalition partners is also recommended. ◆

(continued from page 17)

FIGURE 3 – **Trapping of Primary Procedural Deviations**



ATC=air traffic control; **FMS**=flight management system; **MCP**=mode control panel
Note: 35.4 percent of all primary procedural deviations were trapped.
Source: Benjamin A. Berman and R. Key Dismukes

"Pilots trapped most erroneous mode control panel entries, most system misconfigurations and most failures to call for a checklist."

attend to the aircraft. We observed numerous instances of pilots looking elsewhere as the aircraft began turning or levelling off at an assigned altitude, most often while under autopilot control. Not monitoring the aircraft suggests over-reliance on automation, an understandable reaction to automation's high reliability. But accidents and incidents have happened when the automation was misprogrammed. Automation does fail occasionally, but because it generally is so reliable, pilots likely do not even realize when they may, at least at times, no longer be actively monitoring the aircraft.

Procedural Deviations

The 314 deviations in primary procedures included 62 involving configuration of equipment/ systems. An example was when a captain turned on the engine anti-ice system before the airplane entered the clouds in icing conditions but neglected to turn on the engine ignition.

Deviations in planning for, or responding to, contingencies occurred in 57 instances. For example, an airplane was at 6,000 ft and near the end of a flight when ATC transmitted, "Braking action fair reported by all types." The crew made no comment in response, and they did not recalculate landing distance for the reported braking condition. We recorded 56 deviations in crew-crew coordination. In one instance, a flight crew was cleared to navigate directly to a fix; the captain entered and executed the route change without waiting for the first officer to confirm the change.

Deviations in data entry or in use of the flight management system or the mode control panel occurred in 40 and 18 instances, respectively. An example was a first officer who did not arm the autopilot to capture the instrument landing system (ILS) localizer as the flight neared the final approach course.

Effectiveness of Trapping

Overall, only 18 percent of the observed deviations were trapped by the crew. However, the efficiency of the trapping varied dramatically among the deviation types. More than 14 percent of the checklist deviations were trapped (Figure 1), while only about 6 percent of the monitoring deviations were caught (Figure 2). The best performance was in primary procedural deviations, with more than 35 percent trapped (Figure 3). However, there were eight instances in which flight crews failed to reject unstabilized approaches before or upon reaching the point at which a go-around was required by SOPs, and there were 10 discrete deviations during these approaches in which crews then did not challenge or trap their continuation of the approach while unstabilized.

Pilots trapped most erroneous mode control panel entries, most system misconfigurations and most failures to call for a checklist. In contrast, they rarely caught deviations

Photo: Cpl Jean-Francois Neron

in contingency planning, crew-crew coordination, monitoring and most aspects of checklist execution. From the jump seat, we were not able to distinguish whether deviations by one pilot were not noticed by the other pilot or whether the other pilot noticed but chose not to speak up.

One of the key discoveries from our study was that, although primary procedures most often were performed as prescribed, checklists and monitoring currently do not trap all procedural threats and errors to the degree that the aviation industry generally assumes. For example, even though slightly more than half of the 62 instances of system misconfiguration were trapped, many of these events were not identified or corrected. The industry needs more reliable trapping for this and many other kinds of primary procedural deviations.

Most checklist and monitoring deviations were not trapped either by the flight crewmembers or by others. It appears that pilots are not likely to notice or take corrective action when checklists and monitoring have been weakened and their error-trapping functions cannot be relied upon. This may remain as a latent threat, allowing a primary procedural deviation to slip through.

Captains and first officers, and flying pilots and monitoring pilots, made about the same number of deviations overall. However, we found that first officers were significantly less effective at trapping errors while they were performing the monitoring role; they caught 12.1 percent of the deviations that captains made as the flying pilot, while captains caught 27.9 percent of deviations that first officers made as the flying pilot. Previous studies based on flight simulator observations and on accidents found a similar disparity. The greater difficulty that first officers face in challenging their captains (compared to the reverse) is clearly a stubborn problem for which a solution has not yet been found.

Implications

In our full report, we discuss factors that make even experienced, conscientious pilots vulnerable to the observed deviations. It is naïve to think that any crew can always perform perfectly in real-world conditions; nevertheless, our findings show that checklist

"Most checklist and monitoring deviations were not trapped either by the flight crewmembers or by others. It appears that pilots are not likely to notice or take corrective action when checklists and monitoring have been weakened and their error-trapping functions cannot be relied upon."

and monitoring performance can be improved. In responding to these findings, airlines must not assume that the deviations are the result of laziness. Pilots face interruptions and concurrent task demands during actual line operations, and idealized SOPs do not take these factors into account. Also, pilots cope with operating procedures and equipment designs that sometimes are poorly matched to the ways the human mind processes information. Finally, pilots may slip into rushing through procedures when they are under the time pressures now common in airline operations; neither pilots nor airlines may recognize just how much rushing undermines reliable performance.

For these reasons, simply admonishing pilots to follow procedures as written is unlikely to improve performance. Rather, we encourage airlines to analyze actual operations thorough line observations, revise procedures and practices as needed, provide training to help pilots understand the cognitive nature of vulnerability to error, and provide specific techniques to reduce that vulnerability. Pilots, flight managers, procedures designers, equipment designers and scientists should work together in this effort. The full report of our study provides detailed suggestions for reducing vulnerability and improving deviation trapping. ◆

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Note

1. This article is based on a study funded by NASA and the U.S. Federal Aviation Administration. When published, the full report, Checklists and Monitoring in the Cockpit: Why Crucial Defenses Sometimes Fail, will be available from <human-factors. arc.nasa.gov/ ihs/flightcognition/>.

Anatomy of a Workhorse: The CC130 *Hercules*

Information kindly provided by Air Force Public Affairs

The first CC130B *Hercules* entered service in Canada in 1960. In total, five B-models were purchased and traded back to Lockheed in 1965 in order to purchase newer E-models. Since then, 24 E-models and 16 H-models have been acquired by the CF. Currently the oldest of the E-models are being retired as the CC130Js are being delivered. CC130H models are expected to continue in service in the SAR role until 2017. The first of 17 new J-model CC130s have begun arriving to replace the oldest aircraft in the *Hercules* fleet. The current CC130 *Hercules* transport aircraft has been in service with the CF in support of the Afghanistan mission since January 2002, when three *Hercules* deployed to the Persian Gulf with flight crews and ground staff as the Tactical Airlift Detachment. By the end of Operation APOLLO, in October 2003, these aircraft had transported some 6,000 passengers and more than 6.8 million kilograms (about 15 million pounds) of freight to destinations in the theatre of operations, including Afghanistan. On Operation ATHENA, the CC130 *Hercules* continues to operate as part of the Joint Task Force-Afghanistan (JTF-Afg) Air Wing.

A new generation of *Hercs* – the CC130J

While on the outside the CC130J looks almost identical to the traditional *Hercules*, internally the J-model *Hercules* is essentially a completely new aircraft. The new *"Hercs"* fly faster, higher and farther, and they carry heavier loads while burning less fuel. They can use shorter landing and take-off fields and their climb time is reduced by up to 50 per cent compared to the older models. They deliver cutting edge technology to provide the CF with a modern, cost-effective, operationally-proven tactical airlift capability.

Not only is the new *Hercules* a more capable aircraft, it also requires fewer crew members than the older *Hercules*; it flies with a minimum crew of three – two pilots and a loadmaster – compared to five on the older *Hercules*.