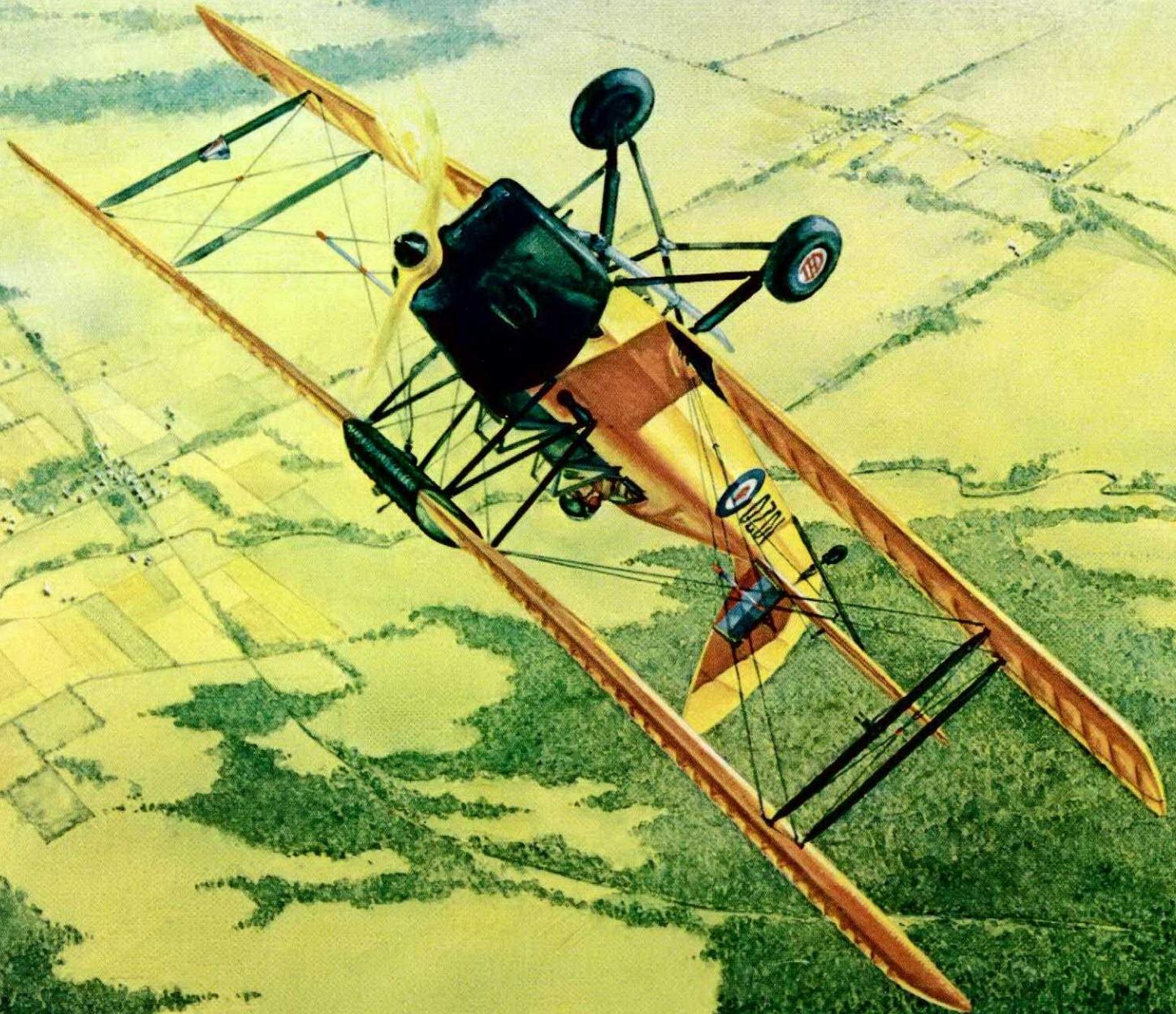




# FLIGHT COMMENT

THE FLIGHT SAFETY DIGEST OF THE CANADIAN ARMED FORCES

EDITION 3 1976



*J. Dubord*  
76

# Ric O'Chet



## strikes again

by Capt W. G. Walton

"After landing from a weapons mission, the pilot was informed he had picked up a ricochet in the right-hand intake. The engine showed FOD damage beyond repair capabilities of unit resources."  
— CF210, Feb 75

"During a strafing mission on a tactical target, engine received ricochet damage. Engine was returned to contractor."  
— CF210, Oct 75

Without question, "Ric O' Chet" is a very dangerous fellow!! And expensive, too! Worse still, it would seem by the CF210s being received, that after a lengthy absence, he has joined our ranks once again.

One might tend to think that two ricochet strikes in one year are not too bad but now that we are more heavily committed to a conventional weapons role, the potential for us to write ourselves and our equipment off at a vastly increased

rate is unnerving, to say the least. The experience of other air forces gives us some idea of the potential. For example, during the period 1962-67, the Hunter aircraft of the RAF received a total of 102 ricochet strikes. In the French Air Force every year between twenty and thirty aircraft are damaged by ricochets — and almost every year they lose an aircraft because of ricochets. And here's a quote from the USAF Aerospace Safety publication (Jan 76):



"Over the past 10 years, we have lost two fighters and officially recorded 271 such (ricochet) incidents (156 F-4s). In the past 3-1/2 years, the USAF has spent 1.3 million dollars on aircraft parts alone to repair ricochet damage incurred during routine practice strafing missions".

Now that's a lot of dollars in anyone's air force!

Over the years, many articles have been written to define the term "ricochets", and also, to describe their cause and effect. However, to a fighter pilot, a "ricochet" can never be Old Hat! So here's a Quickee Refresher on the subject.

A "ricochet strike" is the unplanned and unrehearsed meeting of an aircraft with either a bullet, which the pilot has just fired and has ricocheted off the ground (these we call Direct Ricochets), or any foreign body to which the bullet gave part of its kinetic energy (these we call Indirect Ricochets).

Bullets reach the ground with their speed a function of aircraft speed, muzzle velocity and slant range; a rotational velocity to the right; and, at an angle slightly greater than the aircraft dive angle. The bullet will penetrate the ground to a varying depth as it loses all or part of its energy, either progressively or abruptly, depending on impact soil conditions. Its trajectory in the ground will normally be deviated upwards by the ground itself and the bullet will leave the ground following a trajectory which is dependent primarily on the impact angle and impact velocity of the projectile and the physical properties of the impact medium.

Many variable ricochet parameters exist, consequently, generalizations are sometimes erroneous; however, several truisms are emerging from the previous ricochet data void. For example, a shallow dive angle of 5° to 10° (compared say, to 15° to 30°) will result in more ricochets travelling a longer distance but with a lesser azimuth deflection angle; the delivery parameter which has the most effect on the ricochet hazard potential is *minimum pull-out altitude*; emergent ricochet characteristics are primarily a result of three basic inputs: impact velocity, impact angle, and nature of the impact medium.

The indirect ricochet is the most dangerous due to its unpredictable dispersion pattern (particularly from irregular or mixed terrain). Aircraft, while over the impact area, are most vulnerable to this type of ricochet as these high angle "pop-ups", depending on their mass, shape and energy received, usually travel at a low velocity and can reach altitudes of several thousand feet.

Few ricochets will result when firing onto calm water with a dive angle over 10° and ricochets off this medium are eliminated entirely with dive angles over 16°. Under 10° dive angle, the greater portion of the bullets will ricochet with a trajectory of about twice the dive angle, their speed very much reduced, and the top of their trajectory seldom above 300 feet (but don't lose that horizon, if using large bodies of water, and watch for waves as different ricochet characteristics result).

When using sand, there are ricochets at all practical dive angles and the percentage of bullets which is relatively high (10° dive angle — app. 80%; 15° — app. 55%, and 30° — app. 21%). But even here, precise computations are elusive as ricochet mechanics in soils is closely tied to the energy dissipation capabilities of the impact medium. "Bottoming out", which can be interpreted as the condition which occurs when continued downward displacement is limited by the upward lift forces acting on the projectile, is based upon the microstructure of the soil. For example, a sharp rise in the dynamic force is required to penetrate saturated dense sand. This type

of sand has a *potentially* large energy dissipation capability, however, due to its incompressible nature, chances are the projectile will "bottom out" before sufficient energy has been dissipated and a ricochet will result. On the other hand, saturated *loose* sand which implies a limited range of particle sizes, provides a good ricochet retardant as the absence of small particles to fill the interstitial voids allows the projectile to penetrate and "bottom out" deep into the sand.

Pure clay, due to its cohesive structure is a poor impact medium. Although clay could potentially dissipate a large amount of energy if significant penetration occurred, the medium resistance hinders penetration and consequently promotes ricochets.

On varied terrain, the angle with which the bullet touches the surface varies considerably with the irregularities of the ground. The main principles are the same but the result is a wide dispersion of ricochets. In fact, bullets may ricochet over successive surfaces and leave at 90 degrees (or even greater) to the axis of arrival, but with a very slow speed thus creating a very dangerous zone all around the impact point. It therefore logically follows that the more the surface is irregular (holes, slopes) and the more the ground is mixed (stones, spent projectiles), the worse are the results compared to flat, homogeneous materials (sand, water).

At times in the past, ricochet strikes have been defined as "random events" and therefore a risk which must be accepted as a part of fighter training. Such rationalization is faulty and unacceptable. Loss of life and equipment, which inevitably results in a reduction of operational capability, can never be accepted as a part of the exercise in peace time. Each occurrence must be thoroughly investigated and, if possible, the cause found and the condition corrected.

One main aim of this article therefore is to provide a brief glimpse into the near-future as to what preventative measures are planned in this field, and also, to outline various methods which must continue to be used to reduce and control this hazard.

Data available indicates that the elimination of debris in the impact area of formal ranges through meticulous maintenance is the key to the reduction of ricochet damage. Current regulations required that surface debris be removed daily and the sub-surface sanitized at least weekly. However, during the winter months, the impact area sand is frozen solid thus increasing the number of direct ricochets and making range maintenance all but impossible. To help overcome this problem, a trial will be conducted on the strafe impact area of the Cold Lake Range during the winter of 76/77. Its purpose will be to determine the feasibility of using powered equipment to rupture and break-up the frozen sand so as to renew the bullet absorption qualities of the sand. In preparation, the depth of the impact area sand will be increased to 30 inches during the summer of 1976. This should enhance the projectile absorption qualities, provide a surface soil composition which can readily be broken up and sanitized, and also, provide a sand surface of sufficient depth that, when broken up during the winter months, lower-lying soils will not be brought to the surface. At the same time, it will be necessary to exercise caution to ensure the ricochet hazard is not, in fact, increased by such range winter maintenance procedures.

Secondly, when automatic strafe scoring systems are installed on formal air weapons ranges, *all* strafe targets will be equipped so that spent projectiles are dispersed over a larger area thus reducing the concentration of range debris.

Another area presently under investigation at Cold Lake, Alberta, is the use of small bodies of water as tactical target training sites. It is anticipated that their potential may be severely limited in Canada as such waters are usually ice-covered six to seven months of the year. Notwithstanding, potential summer benefits make this an interesting and viable project.

Finally, a study is being conducted by NDHQ into the feasibility of designing and using ammunition with a frangible-type projectile which would simulate the ballistics of the real thing but break up on impact.

These actions are now in progress but in the meanwhile, it is imperative that all other forms of positive controls be implemented.

Aircrew must be educated as to the Rules of the Game. Strict discipline must be maintained. Minimum firing distances must be completely understood and never violated. "Pressing the target" does not help a man who cannot shoot and a good gunner doesn't need to break the foul line to score. And remember! The bullet will normally re-emerge from the impact soil at an angle greater than the dive angle and deviate to the right (usually 0° - 30°) by projectile spin.

It is essential that Range Safety Officers (RSOs) strictly enforce range rules.

Targets must be sited on level, or preferably, slightly negatively sloped ground (0 to -5 degrees), without any banking (natural or man-made) behind the targets.

Keep that dive angle 1-o-o-w-w! Between 7° and a maximum of 12° is recommended for strafing. Although greater dive angles result in fewer ricochets, the ones that *do* occur are travelling at a low velocity and at a high "pop-up" angle (and maybe right in your flight path).

Damp *loose* sand is your ideal impact medium whereas saturated dense sand, or clay, will result in a high percentage of ricochets.

Ricochets normally will not occur when firing onto CALM water if the impact angle is greater than 10°. On the other hand, waves will cause an unpredictable ricochet dispersion.

Hard targets, such as military tanks, should be avoided for attacks using ball ammunition.

Foul lines (normally 2,000 feet) must be well identified to minimize "pressing".

Film assessing is a necessity for an effective gunnery program.

Special care must be taken when siting tactical targets. The surrounding area must be free of rocks and other ricochet-causing debris, and should not have a positive slope. And don't forget, actual distance from the target is difficult to determine on tactical ranges, so adjust your minimum pull-out altitude to suit your dive angle:

- 300 feet AGL for 0 to 10 degrees
- 500 feet AGL for above 10 to 30 degrees, and
- 1,000 feet AGL for above 30 degrees

As you can see, that old time villain "Ric O' Chet" is definitely with us once again but the sooner he's retired out to pasture, the better off we'll all be. The irony of a pilot "shooting himself down" would be bad enough - but couple this with the risk to life and limb and the tremendous financial loss incurred in the destruction of a fighter aircraft and the potential is intolerable.

In this article we have attempted to identify and describe some of the factors in the strafe ricochet problem. Personnel in the Field are invited to comment and to submit suggestions on possible solutions. We need your help.

## Why?

Why am I alive today  
When so many friends have had to pay  
The ultimate price  
For foolishness?  
Is it because I care  
For little things besides the big  
That I'm aware of everything  
That goes on happening around me?  
Too long it seems,  
The bright young things,  
Don't give a damn.  
Then it's too late to take back  
That one more mistake.  
Is that why I'm alive?  
It's too late you know  
And sad you know  
To stand around the bar you know,  
And reminisce  
'bout good old Joe  
Who should have known  
What was amiss, but didn't  
Know or even care.  
So be aware, of little things  
Besides the big  
They bring you down with  
As big a crump  
With as big a cost - and  
There's no going back to  
Try again.  
So stick around my friends -  
This life is good my friends -  
Too good to toss away  
On "So What's" and "Who Cares".  
So come drink with me -  
To pleasant things - not  
Long lost friends of yesteryear.

By Capt P.A. Growen  
BFSO CFB North Bay

# ENGINE FOD

## -villain of 75!

by Maj G. M. Hopkins, DAEM 4-3

Foreign Object Damage (FOD) to jet engines ran rampant in 1975, all the way from a contractor's plant in Scotland to the flight lines in Canada and Germany. A total of 58 engines were removed because of this insidious problem, which gave FOD the dubious honour of being the number one cause of premature engine removal. (That didn't include bird strikes either). The sad breakdown by type looked like this: CT114 Tutor (3), CF116 Freedom Fighter (13), CF104 Starfighter (22), CC115 Buffalo (3), CC109 Cosmopolitan (1), C130 Hercules (2), CC137 Boeing 707 (8) and all helicopters (6). That placed the 1975 FOD bill for compressor repairs alone at over a million dollars.

What hurt as well was the extra workload placed on hard pressed maintenance organizations required to remove the damaged engines then build up, inspect, install and ground run a replacement. FOD made more work for everyone and defeated the previous efforts of a whole team of people trying to get aircraft into the air and on to their mission.

And how about the loss of operational capability while this was going on? One less aircraft on the line and one less engine spare available for every FOD. A typical FODed engine was lost to the CF for up to six months or more while repairs were made by a contractor.

Fortunately, engine FOD didn't cause the loss of an aircraft but it certainly could have. More than one pilot in single engine fighters has had anxious moments caused by a burbling compressor as the blades gaily chewed themselves to pieces on a variety of extraneous objects taken along for the ride.

During the year there were a number of devious ways that foreign objects found their way into engine innards. The engines in two CF104s and a CF5 swallowed a piece of the CC137 basket during an air-to-air refuelling exercise. A towel mysteriously floated from a Tutor cockpit into the J85 engine when the canopy was opened with the engine running. A helmet bag exhibited the same power of flight from the rear cockpit of a CF5D at another base under the same circumstances. Fortunately no damage resulted in these latter two incidents but the potential was there. How about the incident at Sri Lanka (Ceylon) when a friendly commercial airliner blasted sand into the intakes of a parked CC137? The precautionary quadruple engine change set a current record for the CF which all involved would like to forget.

Then, of course, engines continued to receive their foreign fodder through the old standby methods. A CF104 technician again proved that the shortest distance between his hand and the cockpit is via a J79 engine if he holds a ground safety pin near the engine inlet. Two CF5 pilots verified once more that water freezes at altitude, and that the J85 engine does not tolerate ice ingestion without serious indigestion. And then the perennial prize winner of tools, screws, nuts and other objects of heartburn left in engine inlets or overlooked by mainten-

ance personnel of all faiths and creeds. No less than 36 suspected cases last year. This high incidence of FOD, which occurred after maintenance activity in the vicinity of engines and engine intakes, should have told our supervisors something. Runway debris, a common producer of FOD, was confirmed as the culprit in only one case; a CF5 picked up a stone.

Determining the source and type of FOD was one of the most frustrating aspects of FOD control. After an object had been through as many as 17 compressor stages rotating at 7,000 RPM there wasn't much left to identify. 50% of the objects that caused engine removals fell in this "unknown" category.

There was no shortage of excuses to use for FODed engines. Deteriorating condition of the airfield, MSE vehicles, environment and acts of God remained old favourites. There was some element of validity to these proffered reasons so runway sweeping, FOD containers, special inspections and praying all remain essential preventative actions. But nearly all occurrences eventually boiled down to one cause - personnel and their attitude. Poor housekeeping, short cuts in maintenance practices and momentary carelessness of flight line personnel from the MSE driver and aircraft technician to the pilot all took their toll.

Changing personnel attitudes is tough but obviously necessary. It's a big help if FOD awareness begins at the top and permeates through every level of base and squadron organizations. Base FOD committees, set up per the CFTO "Prevention of Foreign Object Damage to Aircraft Gas Turbine Engines", must be taken seriously by senior management, not used as a "joe job" for inexperienced officers, and given sharp teeth to say and do what has to be done. More importantly, supervisors at all levels must exercise more authority and responsibility in carrying out and preaching the fundamentals of effective FOD control. If all this is done, then at the technician level common sense, self discipline and alertness with respect to FOD will be of a high, consistent standard. Even the most ironclad control is dependent upon the individual on the job maintaining a professional attitude.

Today's aircraft engine is a brilliant application of engineering knowledge and ingenuity. Safe, powerful, reliable engine operation is the culmination of the efforts of a lot of CF people. Unfortunately these same engines have a super sensitive diet and one thoughtless action can turn them into a pile of junk.

Intensive, imaginative FOD education at all levels and from all angles is the only way of preventing this one simple act and repeating the enormous waste of money, manpower and other resources which constituted the staggering CF FOD bill in 1975. ■

The 1975 Annual Aircraft Accident Analysis published by NDHQ Directorate of Flight Safety included the following critical observation:

"A survey taken over the last 10 years shows 1975 to be, by far, the worst year for air incidents involving PERSONNEL — MAINTENANCE/CANADIAN FORCES cause factors. The 292 factors assigned, far outstripped the 1972 total of 249, which had been the previous high for the 10 year period, and was 59 more than the 1974 figure. As in previous years, INATTENTION, assigned in 131 cases, and TECHNIQUE, in 119 cases, continued to predominate.

"As has been pointed out in previous years, in cases of equipment failure it is often difficult to determine whether the materiel was at fault or if the failure was personnel-induced. Consequently it is most probable that some incidents assigned a MATERIEL cause factor could well have had a PERSONNEL origin, and that the PERSONNEL-MAINTENANCE cause factors are even more numerous than shown.

"It is interesting to note that over one half of all air incidents assigned MAINTENANCE/CF cause factors in 1975



# WHO IS RESPONSIBLE?

by Col W. G. Doupe, CFB Trenton

were the result of INATTENTION or CARELESSNESS and could have been avoided with the exercise of more care and professionalism."

The same publication further observed that:

- "Maintenance factors were assigned in three air accidents in 1975 compared to only one in 1974"; and
- "In 1975 there were 293 reported ground occurrences compared to 264 in 1974; the difference being largely the result of a significant increase in occurrences during the MAINTENANCE PHASE where the number of incidents jumped from 114 in 1974 to 145 in 1975" or 27%.

WHO IS RESPONSIBLE? WHO IS RESPONSIBLE for 1975 being the "worst year for air incidents involving PERSONNEL — MAINTENANCE/CANADIAN FORCES cause factors, outstripping the previous high for the 10 year period"? Is the individual worker less interested and therefore less responsible than his predecessor? Is the individual maintainer less intelligent or less capable in an age of generally higher standards of living? Is the recruit less well-educated upon entry or less amenable to training — both classroom and on the job? Is the maintainer working in a language of communication in which he is less-fluent and therefore handicapped in his understanding and competence?

IS THE MAINTAINER TOO BUSY TO BE SAFE? Do Leadership Courses, Base Defence Forces, Language Training, Maternity Leave, etc distract him/her from his work or interrupt his professional (technical) learning? More important, is the maintainer too busy because there are too few of them to do the job, and too little rank to resist the pressures to turn out a certain number of aircraft? Have the reductions in maintenance personnel at operating bases and other levels reached

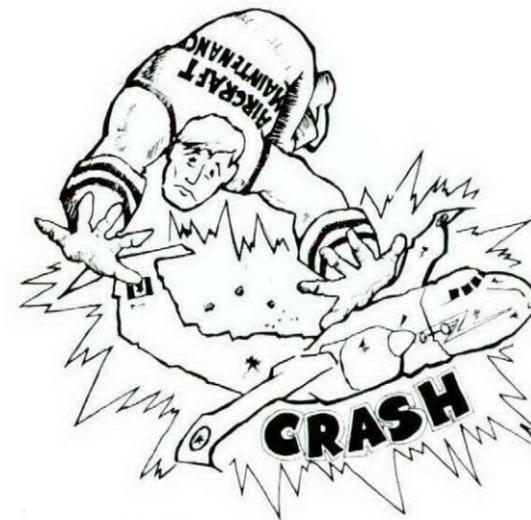
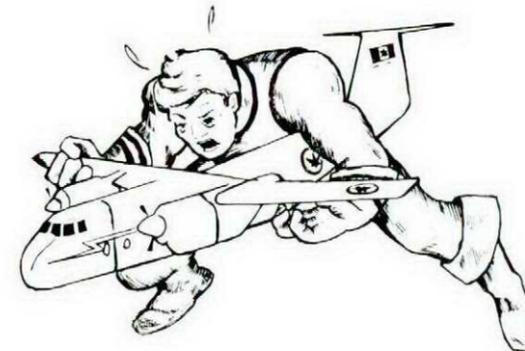
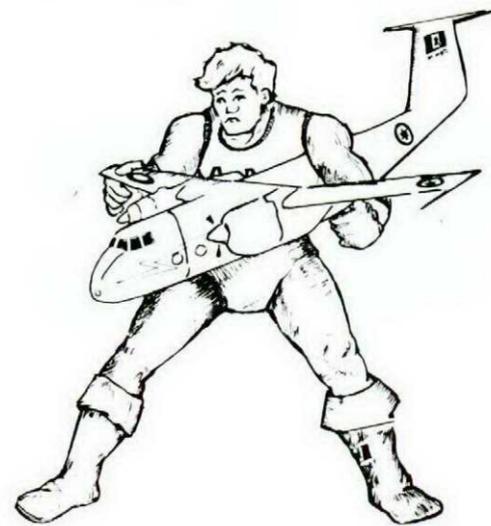
the point of diminishing returns with the result that 1975 produced a loss of at least three aircraft, and 43 more air incidents than ever before in exchange for the reductions in aircraft maintenance technicians and officers?

IS THE MAINTAINER LESS WELL-TRAINED? Are so many skilled technicians departing the Canadian Forces that the overall level of proficiency is diminishing, or is the present maintainer's training basically inadequate? Is the overall 48 month training period for an aircraft maintainer too long, or is the training he receives during that period unsatisfactory? If his training is deficient, are the few weeks he spends in the classroom inadequate, and on-the-job training failing to fill the large remaining gaps? Are there now too few maintainers at each operating base to meet the daily commitment for aircraft and also train on-the-job the increasing numbers of recruits? If on-the-job training graduation statistics can be shown to be satisfactory, can the results be validated? Does the OJT pass rate signify success or cop-out? Is there an objective standard of achievement above the subjective impulse of the local and perhaps harassed supervisor? Is the 1975 aircraft accident and incident record the long-sought OBJECTIVE STATEMENT?

WHO IS RESPONSIBLE? Was 1975 an aberration that will right itself, or is 1975 an ominous omen of things to expect in 1976 and beyond? Can the Canadian Forces take a chance on it being the former? Will a few directives to the remaining maintainers to "buck-up" serve the purpose? How frequently can the advice to "buck-up" be coupled with reducing personnel, additional workloads, questionable training and perhaps reduced motivation, and still produce the anticipated desired result?

If chain letter directives to maintainers to be more know-

ledgeable, more attentive and more responsible are insufficient in 1976, then what is to be done? WHO IS RESPONSIBLE for finding a surer, lasting fix? Who is to discover and correct the basic faults? Can Base Maintenance or any level of Operating Base Management isolate the problems, document the



reasons and offer solutions touching on the activities of 9,800 aircraft maintainers in 14 different trades spread over 17 Bases? Can the Colonel Deputy Chief of Staff for Maintenance in Air Command find the clues to the problem among his reduced body of support at Command Headquarters level and have steps implemented to reverse the 1975 accident pattern?

Or does it fall upon the Director General of Aerospace Engineering and Maintenance (DGAEM) at NDHQ to take action to ensure that 1975 does not repeat itself?

WHAT CAN DGAEM DO? Is he responsible for Maintenance "errors" leading to aircraft accidents and incidents? Does his responsibility for the content of maintainer's trades specifications make him responsible for the shortcomings of the 9,800 maintenance personnel throughout the Canadian Forces? Can he depend on the recruiting and training system to satisfy his specification requirements? Can he depend on the system to provide sufficient numbers of adequately trained maintenance personnel at the Bases to produce the desired maintenance output and thereby validate his technical trade specification? How does DGAEM diagnose the problem posed by the 1975 aircraft accident and incident record with less staff than he had available before the problem arose, as well as perhaps less clearly defined responsibility since the introduction of Air Command?

WHO IS RESPONSIBLE? Is DGAEM as the senior maintainer in the Canadian Forces ultimately responsible for the 1975 accident/incident record? Can he discover causes of personnel shortcomings in the field by requesting that exhaustive investigations and analyses be conducted by:

- his own reduced staff;
- ADM(PER) reduced "all-purpose" staff;
- Air Command reduced Technical staffs; or,
- the Canadian Forces Training System "all-purpose" Headquarters staff, and Trades Training Schools?

Perhaps of all the agencies involved, the Training System should know its products best and the reasons for their 1975 failings. But can the Training System ever attempt to know anything more than the theoretical base of its student product? Where is the Training System's opportunity to see and evaluate the total environment in which its product performs? Who in these "all-purpose" institutions with integrated staffs and ever-changing balances of trade knowledge and military interests could reasonably be expected to sort out the causes and solutions to 1975's worrisome aircraft accident/incident record.

WHO IS RESPONSIBLE? If, as it seems, by the process of elimination, no one reasonably can be expected to determine the responsibility for the 1975 results, then it has to be hoped that 1975 was truly an aberration and not a sign of the misfortune to come. However, if it is not to be accepted that the management of aircraft maintenance in the Canadian Forces is to be reduced to chance, then what is to be done next? Having exhausted the in-Service professionals, will in-Service "all-purpose" personnel be used — or the extraordinary expedient of outside consultants be adopted?

Is the help of an OUTSIDE CONSULTANT EXPERIENCED IN AIRCRAFT OPERATIONS AND MAINTENANCE inevitable in view of the diminishing number of in-Service professionals, their increased workload and diffused authority and responsibility? If the use of outside consultants is inevitable then can the Canadian Forces logically await another year's catastrophies to find the answers to the pressing questions 1975's aircraft accident and incidents have raised regarding maintenance in the Canadian Forces today.

ULTIMATE CONUNDRUM — WHO IS RESPONSIBLE for deciding on the need for, approving, and selecting a respectable consultant and secondly, who would decide what to do with the consultant's report? There may be other alternatives but who would hear of them?

WHO WILL BE RESPONSIBLE?

#### CPL R.J. MELUCK

While assigned to carry out a turn around inspection on a CF104 aircraft, after completion of air test, Cpl Meluck operated the throttle to check for proper movement. He detected a restriction, and an audible squeak when the throttle was advanced to the maximum A/B position. The squeak appeared to be coming from behind the pilots seat. Upon questioning the pilot Cpl Meluck was assured that all seemed normal during the test flight.

Cpl Meluck was not satisfied and returned to the aircraft to further investigate the malfunction. He lubricated the throttle cable pulleys but could not rectify the problem.

The Avionics section was then requested to remove all equipment from the electrical bay to facilitate a more extensive investigation. Cpl Meluck then discovered that a screw had not been installed on the T.R.U. mounting bracket, thus allowing the bracket to assume such a position that it was making contact with the throttle cable turnbuckles.

The extra time and effort, plus the desire for perfection displayed by Cpl Meluck, could very well have prevented a serious flight hazard. His performance on this occasion is indicative of his professionalism.

#### CPL R.J. HAWES

While performing a Last-Chance-Inspection on a CF104D Cpl Hawes was asked by the crew to investigate the cause of a generator malfunction and on opening the generator cooling door he discovered flames coming from one of the generators. Cpl Hawes immediately signalled the pilot to shut down the aircraft and then rechecked the generator. He found the fire was now burning quite intensely and instructed the crew to abandon the aircraft. Cpl Hawes then stopped a passing vehicle and told the driver to radio for the fire fighters. When the fire trucks arrived Cpl Hawes directed the firefighters to the generator compartment of the still burning aircraft.

Cpl Hawes's calmness and decisiveness in this emergency were truly professional and prevented what could have become a very serious ground accident.

#### CPL C.A. ROE

Cpl Roe, who is employed with 450 Sqn Det Namao was conducting an AB Check on a CH113A. While waiting for the maintenance crew to complete adjustments of the forward rotor head (in preparation for a test flight) Cpl Roe continued his inspection. On inspecting the Sync Shaft (not called for in a AB) he



Cpl G.W. Thomas



Sgt W.E. Hounsome



Cpl R.J. Meluck



Cpl R.J. Hawes

found the Lord Mount of # 3 shaft had separated, allowing the Lord Mount housing to ride on the bushing. This movement allowed the bearing housing excessive up and down motion.

Due to Cpl Roe's professional attitude and his perseverance for Flight Safety, he averted an impending catastrophe.

#### SGT W.E. HOUNSOME

While performing a final Product Verification check on a CF104 aircraft prior to its acceptance test flight from a contractors facility, Sgt Hounsome discovered that the cotter pin was missing from the bolt which connects the stabilizer push rod assembly to the control column.

Sgt Hounsome's alertness is highly commendable in that the PV checklist he was working to did not specifically direct his attention to this particular area.

For averting a possible serious flight incident and for his dedicated attention to detail while performing a routine inspection.

#### CPL G.W. THOMAS

While troubleshooting a nacelle pre-heat snag on a CC130 Hercules aircraft, Cpl Thomas discovered a wire bundle in the cockpit overhead electrical panel chafing against the Flight Engineer's Oxygen regulator. One of the wires had worn through and shorted on the regulator assembly. The wire was repaired, the bundle clamp repositioned and the snag was rectified.

Cpl Thomas was not satisfied with merely rectifying the snag at hand. He suggested and received permission to inspect the remaining CC130 aircraft on the base and found four more aircraft with a similar condition. In one case, a wire had already been partially worn through. A Vital Special Inspection was originated by BAMEO Trenton advising all CC130 users of the problem and suggesting a recommended fix.

The expert and professional manner in which this

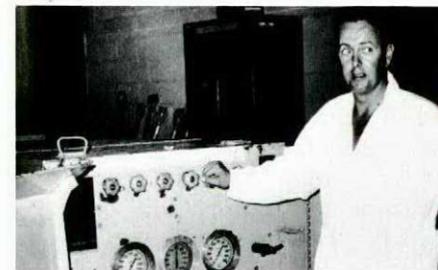
technician carried out his job and his initiative in instituting effective and timely follow-up action reflects credit upon himself and his fellow tradesmen. His performance in detecting and rectifying a serious and hidden hazard to flight is worthy of service-wide recognition.

#### MAJ C.L. MILLER USAF exchange officer, 437 Sqn

Maj Miller was Aircraft Commander of a CC137 tanker conducting an Air to Air Refuelling mission with two CF5 fighters. The mission proceeded uneventfully from home base of the fighters at CFB Bagotville until arrival over Rankin Inlet on the northwestern shore of Hudson's Bay, where the CF5s were to do a photo recce. While deploying the refuelling hoses for a final top-up prior to descent, the starboard boom and hose assembly extended to its maximum with a severe thump. Subsequent attempts to retract the hose were unsuccessful and the assembly remained jammed at approximately 32 feet extension.

The fighters were topped-up from the port refuelling pod, carried out their mission and were escorted back to home base using the port pod for en-route refuelling. After exhausting all possibilities to retract the boom and hose assembly and verifying the safe handling characteristics of the aircraft at approach speeds, Maj Miller and crew flew the tanker to home base and carried out a low approach and overshoot to allow visual examination of the jammed pod by technical personnel.

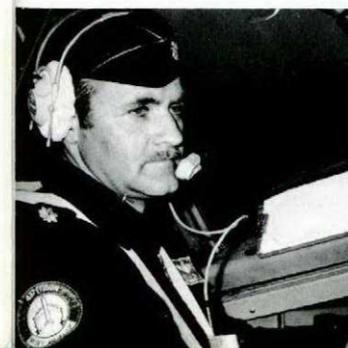
Maintenance personnel verified that nothing additional could be done to retract the assembly and emergency vehicles were alerted for the subsequent landing in the event that residual fuel in the hose caught fire. Maj Miller landed the aircraft to the right of the runway centerline, allowing the starboard wingtip and refuelling hose to extend over the grass, touching down and stopping so that



Cpl M.T. Cameron

Maj C.L. Miller

MCpl R.B. Mercer



the hose and refuelling basket did not make contact with any part of the runway. The skillful landing resulted in no damage to the aircraft, refuelling hose assembly or aerodrome lighting facilities.

Investigation revealed that the hose response strut had failed, causing the drogue assembly to travel, damaging and jamming the internal mechanism of the refuelling pod.

The resourcefulness and professional skill shown by Maj Miller and his crew in troubleshooting a serious in-flight emergency and in effecting a safe emergency landing deserves Service-wide recognition for a job well done.

#### MCPL R.B. MERCER

MCpl Mercer, an AE Tech, was contacted by the duty airman with regard to some fuel on the hangar security inspection. MCpl Mercer could see where the fuel had dripped from the aircraft, run across the hangar deck, and pooled near the bulkhead. The fuel was dripping from the drains at the bottom of the aircraft. A thorough inspection was conducted to determine the source of the fuel leak. MCpl Mercer's persistence and in-depth knowledge of the aircraft engine resulted in the discovery of a crack in an almost inaccessible section of the engine combustion chamber. Because the fuel was leaking from the drains, it could very easily have been assumed to be overflowing. Only by conducting a comprehensive visual inspection, which included the very difficult places to see and get at, was the potential danger of an inflight engine failure/fire averted.

#### CPL M.T. CAMERON

Cpl Cameron had replenished the oxygen system and was completing his DI on CC13809 when he noticed that one of the oxygen bottles was still cool even though the system gauge indicated that all bottles had been charged. Normally, the bottles warm up as they accept their charge and Cpl Cameron suspected the cool bottle was still empty. Careful investigation of the system, to the extent of cross-checking each part number, revealed an incorrect check-valve in the line to the suspect bottle. This type of valve was peculiar to the long nose (Series 300) version of the Twin Otter and should not have been installed in the CC138. A check through the records showed this check-valve had not been disturbed throughout the life of the aircraft and had probably been installed at the factory.

The thorough and effective troubleshooting carried out by Cpl Cameron resulted in a Special Inspection being recommended and carried out on all CF Twin Otters. His extra close attention to detail and timely follow-up action uncovered an insidious and hitherto undetected deficiency in the aircraft oxygen system which could have had serious consequences for the flight crew during a high-altitude mission. His professional approach to his job deserves service-wide recognition.

**SGT R.A. BURTON  
SGT R. HUGHES**

On Tuesday, 06 May 75, the crew of a 434 Sqn, CF-5D aircraft flying at 14,000' MSL experienced control linkage failure where the left aileron became locked in the full down position. Limited control of the aircraft was regained at 16,000' MSL with both pilots holding extreme pressure on the left aileron and rudder. A controllability check was carried out and revealed that the aircraft could be held level and turned right, but no left turns were possible. After this check, it was decided that a penetration and landing would be attempted. Weather was 3400' overcast topped at 13,000' AGL. An emergency was declared and Cold Lake Arrival was called and the situation explained to Sgt Hughes. He immediately assessed the situation, and knowing that the CF-5D could only turn right, brought the aircraft in perpendicular to glide path then had it make a wide right 270° turn back around to the oncourse. The aircraft was turned over to Sgt Burton as final controller and a precision approach was made continually correcting to the oncourse from the left hand side. The aircraft broke out at eight miles and the approach was continued visually at the pilots request.

Both Sgt Burton and Sgt Hughes are to be commended on their quick and accurate assessment of a most difficult situation. They showed a great deal of good judgement and ingenuity in dealing with a hazardous aircraft emergency.

**PTE T.X. REGAN**

On reporting for duty at the MSE Aircraft Refuelling Section on 21 October 1975, Pte Regan checked the report of refuelling activities during the previous shift which included an Argus refuelling. He then displayed initiative and attention to detail by reviewing the vehicle dispatch records and noticing that no 115/145 tender had been utilized during the previous shift. He reported this fact to his supervisor who immediately initiated an investigation which revealed that 380 gallons of JP4 had been delivered to an Argus. Pte Regan's vigilance and interest in the operations of his section resulted in the discovery of an extremely hazardous condition in an aircraft which was about to be flown.

**SGT K.H. OSLIE**

While assisting with the periodic check of an Argus, Sgt Oslie noted no visible drain holes in the flap track support tubes. Recalling from his experience in non-destructive testing that a similar situation on the Yukon aircraft had led to internal corrosion of the tube, he investigated further and found that the drain holes were in the center of a rivet. Not satisfied that this would provide adequate drainage, Sgt Oslie pursued the matter further and requested permission to conduct non-destructive testing. X-rays of the tubes revealed moderate corrosion of all tubes in that aircraft. This information was passed to higher authority and led to an extensive X-ray program and the discovery of some instances of severe corrosion inside the tubes.

Sgt Oslie's initiative and persistent individual effort led to discovery of a defect which could have resulted in a serious in-flight emergency.



Cpl G.R. Mitton



Pte T.X. Regan



Sgt K.H. Oslie



Sgt R.A. Burton



Sgt R. Hughes.

**WO W.H. LAFOSSE**

Within days after arriving at UNMOGIP for duty as Senior Technical supervisor, WO Lafosse decided to find out what, if any, special effects local flying conditions had on those areas of the aircraft hidden from normal view. Although beyond established inspection requirements, he removed the main landing gear fairings of the unit CC138 Twin Otter and discovered advanced corrosion at the "Y" assembly of the left landing gear strut. In view of the regular and rigorous STOL operations of this particular aircraft, early discovery of this defect was particularly important as it eliminated a potential landing gear failure. Without WO Lafosse's conscientious probing this defect would likely have remained undetected until failure or until formal inspection of the area became due.

**CPL G.R. MITTON**

During an Argus detachment to Inuvik, N.W.T. in May 75, a request was made by the NCO i/c ground crew to the fuel agent for Jet B fuel to refuel the Canadian Forces APU. The agent mistakenly fueled a civilian single Otter.

Cpl Mitton, returning to the airport terminal after having repaired an electrical snag on the Argus, was approached by the fuel agent who was looking for someone to sign for the fuel. When Cpl Mitton determined that a mistake had been made, he advised the agent to find the owner of the Otter immediately and inform him of the error. Cpl Mitton then set out himself in search of the Otter owner. The owner was found in the cockpit of his aircraft preparing for start-up. The Jet B fuel was subsequently pumped out and many thanks were passed on to Cpl Mitton.

Cpl Mitton's alertness and professionalism in pursuing this incident undoubtedly save an aircraft and possibly a life.

# A tradition of Excellence

The cover subject for this, our first bilingual edition is the DeHavilland Tiger Moth, an aircraft which helped in the training of thousands of Canadian and Commonwealth aircrew during World War Two. Its reliability, sturdiness, and gentle handling characteristics have endeared it to several generations of airmen, and to many, it literally exemplifies the "biplane era", a time now past when you really did fly "by the seat of your pants", and were aided by the hum of the wind in the wires and the rustle of the slipstream around your face.

Those who have flown it will never forget the reflection of the sun off the mainplanes, the purr of its gypsy major engine, or the swish of its gear through the grass on touchdown.

One of those who have flown it is John Dubord, the illustrator and oft-times assistant editor of Flight Comment, who took to the air several times in researching the cover painting, and who has captured the "essence of Tiger" most effectively in this beautiful painting.

John's work is no stranger to the pages of Flight Comment in fact it has been appearing therein since 1953. Since that time he has supplied a succession of editors with thousands of illustrations — many of them the product of his highly creative imagination which has contributed much to the success of this magazine. It is one thing to produce a drawing to meet an editor's specifications, and quite another to conceive an original idea and then execute it on paper. John's value lies in his ability not merely to draw with great precision, but to initiate and then produce valuable educational material.

John's service with the Canadian Forces actually began when he joined the Army in 1942 and served with the Camouflage School of the RCE, the Royal Canadian Armoured Corps, and finally with the Cameron Highlanders of Ottawa in the army of occupation in Germany.

Following the war he graduated from art training at Sir George Williams University in Montreal, and eventually found his way to our drawing board. His avid interest in all facets of aviation is evidenced by the fact that in the early sixties he took a civilian flying course and is now a licensed pilot — a fact which undoubtedly aided him in creating over one hundred examples of the acclaimed "bird watcher's corner" series of drawings which occupied our inside back cover for almost two decades, and which, although no longer a regular feature will return from time to time in the future. Keen observers of these diagrams will doubtless note that whatever Rube Goldberg series of gears and levers that may be illustrated would actually work if it were created in metal and turned — a Dubord trademark for yea these many years.

In researching the cover painting John had the opportunity to meet another kind of aviation artist and compare notes. Engineer Elaine Summers of Golden Triangle Air Services of Russell, Ontario the girl who as one of Canada's two female licensed engineers maintains the Tiger and who had herself just finished "painting a Moth" is shown here comparing notes with John on some technical details. Both are familiar with the need for meticulous attention to detail in the field of aviation — and in fact both worked with paint applied on canvas over a wooden frame. Only the scale differs.

The Tiger Moth shown is the property of Capt J.D. Williams, editor of Flight Comment.



Engineer Elaine Summers of Golden Triangle Air Services points out technical details to artist Dubord at the Russell Airport near Ottawa.



Some of the many Bird Watchers Corners.

# THE WINGS OF A HELICOPTER

by Maj Robert L. Gardner  
Directorate of Aerospace Safety

Military helicopter crashes . . . Chopper was on a personnel transport mission when radar contact was lost. No May Day call was received; however, ground witnesses reported the helicopter appeared to break up and come apart in the air. There were no survivors among the crew of four and fifteen passengers on board.

Does this news bulletin sound familiar? Unfortunately, several accidents similar to this have occurred in the past two years. And what is the first suspect? You guessed it — main rotor blade failure.

Rotor blade failure is not a common occurrence and investigators seldom find it to be the cause of helicopter accidents. But when it does happen in flight, the results are catastrophic: loss of control ending with total destruction of the aircraft. Because of the lack of an in-flight escape system, death is the probable fate of those persons on board.

To a helicopter the main rotor blades are what the wings are to the conventional fixed wing airplane. The airplane

derives its lift from a fixed airfoil surface, while the helicopter derives lift from a rotating airfoil known as the rotor. As you might expect, the word "helicopter" is derived from the Greek words meaning "helical wing" or "rotating wing."

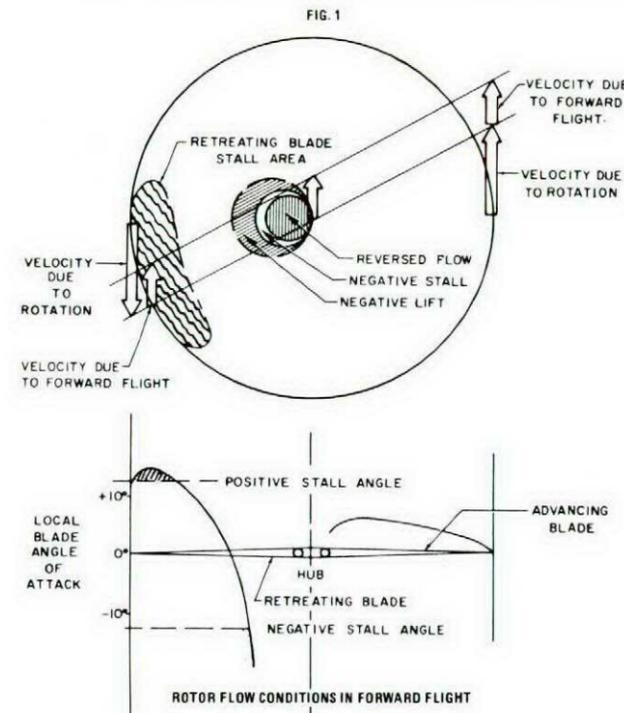
Lift generated by the rotating wing enables the helicopter to accomplish its unique mission of hovering motionless in the air, taking off and landing in confined or restricted areas and autorotating to a safe landing following a power failure. But the generation of lift by a rotating wing is also responsible for some of the unusual problems encountered by helicopters. For example, let's briefly look at some of the different and varying forces which act on a rotor blade.

The first point to realize is that the rotor is subject to the same physical laws of aerodynamics and motion that govern flight of the fixed wing airplane. But the manner in which the rotor is subject to these laws is much more complicated due to the complex flow conditions.

Figure 1 illustrates a typical variation of blade angle-of-

attack resulting in positive lift over the entire advancing blade. Immediately next to the hub of the retreating blade there is an area of reversed flow where the velocity due to the forward motion of the helicopter is greater than the rearward velocity due to the blade rotation.

The next area is a negative stall region where, although the flow is in the proper direction relative to the blade, the angle-of-attack produces a negative stall. Progressing out the retreating blade, the blade angle-of-attack becomes less negative, resulting in an area of negative lift. Then the blade angle becomes positive again, resulting in a positive lift region. The blade angle continues to increase until, near the tip of the retreating blade, the positive stall angle is exceeded, resulting in the stalling of the tip section. This wide variation in blade section angles-of-attack results in a large variation in



blade section lift and drag coefficients. The overall lift force on the left and right sides of the rotor disc are equalized by cyclically varying the blade pitch, but the drag variation is not eliminated. This drag variation causes a shaking force on the rotor system and contributes to the vibration of the helicopter.

This continuous changing of lift and drag forces causes the rotor blades to flex and bend like a snake on a hot tin roof. This is vividly portrayed by viewing high speed motion pictures of a rotating blade.

The point is, helicopter main rotor blades are subjected to repetitive cyclic stresses. A small scratch, a tiny corrosion pit or inclusion on a blade spar can quickly induce a fatigue crack. Continued operation, particularly at high airspeeds will cause a spar crack to propagate and may result in failure in a matter of hours. Some helicopters have a blade inspection method (BIM) system which detects blade spar cracks. Other helicopters do not have a detection system and must rely on visual inspection to insure airworthiness. No matter what type helicopter, the maintenance and aircrew visual inspections are of primary importance in determining proper condition of the rotor blades.

Not long ago a blade was removed from an H-53 helicopter due to a black BIM indicator. At the overhaul facility it was noted that the blade possessed obvious lightning damage at the leading edge of number six pocket and at two places on the trailing edge of the same pocket. The lightning strike damage at the leading edge point had burned a small hole in the pocket and pitted the spar. Teardown revealed that the spar had cracked at the pit caused by the lightning strike. This blade was at the point of total separation which would have been catastrophic.

In-cockpit BIM systems will be installed in Air Force H-3 and H-53 helicopters. In addition a low stress rotor blade is being developed for the H-53. Incorporation of these improvements will enhance the spar crack detection and integrity of the rotor blades on these helicopters.

Although these modifications will provide additional safety factors, we must still rely on strict compliance with preflight and postflight inspections to detect damage and condition of blades. That is up to us.

## Complaint



I have a serious complaint against a Canadian Forces jet pilot who passes over Victoriaville at an altitude that, in my opinion, is too low. My house shakes and the windows rattle. I think that when the pilot can clearly be seen in the cockpit he is not at a high enough altitude to fly over a city. This causes an infernal racket. The pilot passed over on Monday morning, 8 March, between 10:00 and 10:30 and on Tuesday, 9 March, between 4:15 and 4:30 p.m. Perhaps the fellow in questions is saying hello to his mother, because he always passes over the same house. If he misses his mother, it would be better for him to leave the Air Force and stay with his mother. This is not the first time; he did the same thing last summer. I hope that you will give consideration to this complaint and that action will be taken. Thank you in advance.

(Actioned Officially)

Capt. J. Paquette

THE OPINIONS EXPRESSED IN THIS ARTICLE ARE THOSE OF THE AUTHOR AND ARE NOT TO BE INTERPRETED AS DFS OR CANADIAN FORCES POLICY. WE PRESENT THIS ARTICLE "FOR THE SAKE OF ARGUMENT".  
EDITOR.

# VASIS is great

## ... BUT DON'T GET SUCKED IN

by Capt. D. E. Moore,  
416 AW(F)

Dear Sir,

Please find enclosed an article which I have written entitled "Vasis is great . . . BUT DON'T GET SUCKED IN".

I have written this in the interests of flight safety and, if you find it satisfactory, would like it to be considered for publication in a future Flight Comment issue.

I was Captain of CF101038 which touched down short of the runway at CFB Chatham last April. I personally believe that I was "sucked in". After spending over 600 instructional hours in the back seat of a T33 I came to rely on vasis a great deal. The vasis I was used to had a glide path which would prevent a T33 or any other fighter type aircraft from touching down short. I was under the impression that every other vasis would accomplish the same result. Four months of flying with ADC taught me differently. Nighttime plus whiteout conditions caused by snow in the undershoot area effectively killed my depth perception and before I realized what happened it was all history.

For all those "out there" who have the impression I had, I have written this article. I have made no attempt to explain how vasis works. I wish neither to criticize nor explain the whys and hows of the different vasis set-ups and the ways they should be flown. Rather, I have attempted to bring to the attention of pilots:

- how dramatically different the vasis installations are at different CF bases;
- the information which GPH 205 contains with regards to vasis installations; and
- never to think you've got it made, that there is no device which can replace an aware and alert pilot.

I have been told the reasons why ADC vasis installations have been set up the way they are. When I was instructing I always hammered home to my students the old adage that it's better to go off the end of the runway at 20K-30K than to hit short at 180K. If nothing else I have proved that point. It's unfortunate that vasis, which was designed as a safety aid, became a liability rather than an asset.

Captain D.E. Moore  
416 AW(F) Sqn

All aircrew, especially pilots, are most probably very familiar with vasis. If you've gone through pilot training in the last 10 years most likely you've heard your instructor scream at you during your first night trip to get the hell back on the vasis. Why? It was probably hammered into you that if you were on the vasis you had it made — not too high, not too low — on the glide path. If you were on the glide path then that was the first step in getting the airplane safely on the ground.

Vasis has been accepted with mixed emotions; that it is anywhere from useless, to nice to have, to an excellent approach aid. Regardless of your opinion of vasis, just how familiar are you with it? For instance, have you always believed that all vasis set-ups were standard; have you believed that all vasis glide paths are standard; and have you flown the 3 bar system yet?

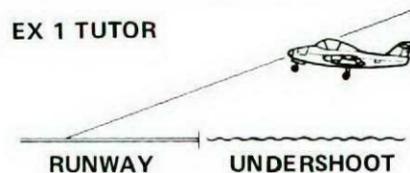
Everybody knows what vasis is, but what it is supposed to do is something which has not been defined. As a rule of thumb it can be agreed on that the general intention of vasis is for use as an aid in setting up an aircraft on a suitable visual glide path which will bring the aircraft safely down to the runway environment from which the pilot can land the aircraft.

CFP 148 Chapter 22 illustrates an example of the standard vasis installation.

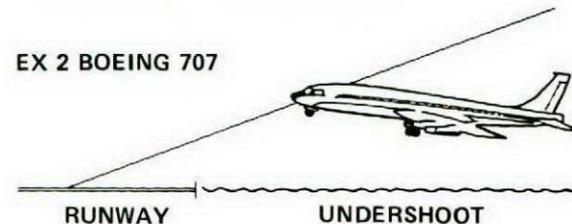
Now, let's take a look at the glide path which vasis provides, and also, how it affects the jocks of different aircraft.

Vasis provides a line of sight glide path. This means that when you are on the glide path it is actually your eyeballs that are on the glide path. Depending on the type of aircraft you are flying you may find that some of your aircraft is not on the glide path at all, but is dangerously below it. This is vividly illustrated in the diagrams below.

EX 1 TUTOR



EX 2 BOEING 707



Consequently, the 3 bar vasis was designed and for all intents and purposes has solved this problem by providing 2 glide paths: one for the smaller fighter type aircraft and the other more steep glide path for the long bodied transport type aircraft.

Vasis was never designed to be flown onto the runway. In the same light one can say as well that a general belief

illustrated below are 3 different vasis installations on 3 different Canadian Forces flying bases.

If the Tutor and Boeing 707, used in examples earlier, were to fly these glide paths right in to the runway then in Case 1 we can see that both aircraft would hit short of the threshold. If you thought vasis couldn't possibly get you into trouble you thought wrong.

prevails in which vasis will never, at any point, place an aircraft in such a position that it would, while on the glide path, hit anywhere short of the runway. That is why the 3 bar system was designed — to prevent long bodied aircraft from touching short while showing on the glide path.

It's a good bet that probably transport drivers have been aware of the problem existing with the 2 bar system and it is most likely that fighter types have never even considered it — that of an aircraft on a vasis glide path touching down short of the runway.

Referring to GPH 205 you'll find some new terms with reference to vasis:

TCH — threshold crossing height  
GPI — ground point of interception

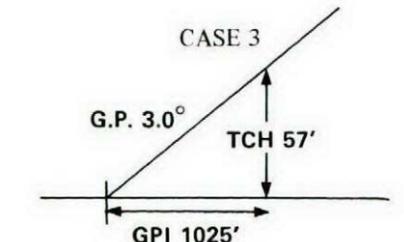
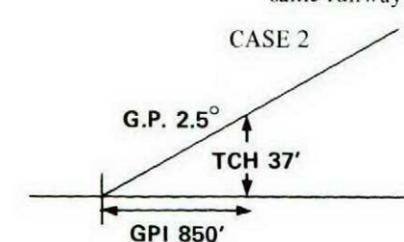
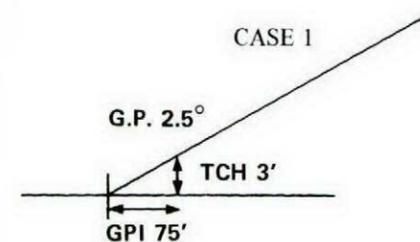
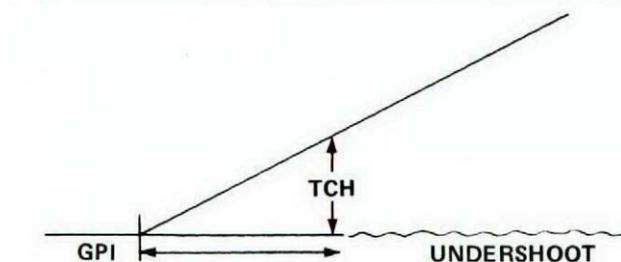
TCH is the height your eyeballs will, if on the glide path, cross the threshold of the runway.

GPI is the distance in from the threshold that the glide path intersects the runway.

This brings us back to a question posed earlier — have you always believed that all vasis set-ups were standard?

The insidious answer is yes, the presentation you'll see is standard, but the installation can and does vary from that depicted in CFP 148 Chapter 22 — sometimes dramatically.

If you thought in the past that there was no possible way that vasis could ever get you into trouble, then read on.



In Case 2 the Tutor would not touch short and it would be nip and tuck for the Boeing 707. In Case 3 the vasis glide path would prevent both aircraft from touching down short of the runway.

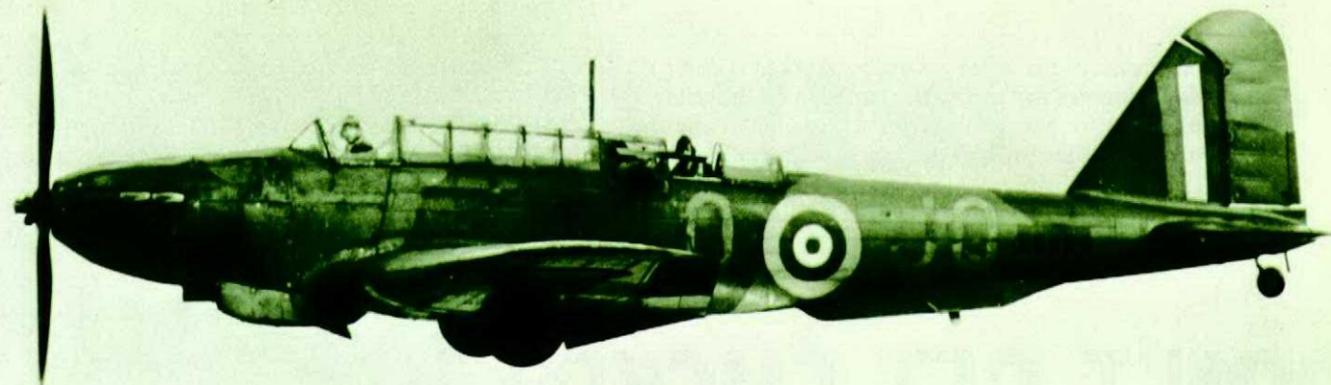
What conclusions can be drawn from this? Vasis, depending on how it is installed, can create the preconditions for an aircraft either touching down short of the runway or touching down on the runway. Without you in the cockpit wide awake and alert, it guarantees nothing.

Vasis was not meant to be flown onto the runway — this was mentioned earlier. It is a non-precision visual aid. If the vasis puts you too low one can assume that a pilot will have enough sense not to touch down short. When he realizes he's *that* low on final he should be able to remedy the situation. This same rationale applies in the case of a vasis bringing a pilot in on the high side and it must be concluded that this is the rationale for the non-standardization of vasis installations in the Canadian Forces.

But what if the pilot doesn't realize he is too low or too high in that last critical 1/4 mile until it is too late? Every pilot knows how susceptible he is to errors in judgement at night with regards to distance and height. He knows as well that his errors can be compounded further in whiteout conditions caused by snow; by optical illusions caused by speed, runway slope, precipitation and canopy refraction. Above all else, it is essential he remember that to err is human and nobody is more human than Joe Pilot. If you've felt in the past that vasis will solve all of these problems — beware!

The next time you're coming down on the vasis, especially at night, don't think you've got it made for one instant. Make sure you've read the GPH 205 before flight and *know* what that vasis is telling you. Vasis is great . . . but don't get sucked in. I did.

By the way, CFP 148 also tells us that vasis "should have an angle and touchdown point coincident with any precision aid (ILS or PAR) serving the same runway". Don't get "sucked in" with that one either — one CF base has a *difference* of 31 ft. TCH and 525 ft. GPI between Vasis and PAR serving the same runway.



# THE FAIREY BATTLE

by Robert Rickerd/AIRDIGEST

Historians sometimes fall prey to hindsight, especially the chroniclers of war. It seems all too easy to second guess the leaders, strategists and builders of military hardware who could not seem to discern truths which have become clearer through the spectacles of time. But if one researches a subject thoroughly, the reasons for human inaction, action and reaction often become clear.

This is true in the enigma of the Fairey "Battle", an aircraft which entered World War II as Britain's first line light bomber and was subsequently slaughtered in the skies over Europe, together with many of its crews.

In World War I, the technology of aerial conflict was primitive and therefore new developments could be implemented quickly, denying the opponent an advantage for very long. However, by the later 1930's, the aeroplane had become a very complex piece of machinery. Not only were the tactical aspects of a possible second world war in doubt, but new aircraft were taking up to two years to progress from first flight to the service squadrons. In addition, if an aircraft type were cancelled, the skilled manpower which had developed it could disperse and be lost to the effort.

In April 1933, when the Air Ministry Specification which resulted in the Fairey Battle was issued, Hitler had become Chancellor, his followers had gained plurality in German elections, and the Enabling Act had given the Nazis virtual dictatorial power over Germany. Hitler had spoken in February of his aims of unqualified Germanisation in the East, and clandestine training schools begun in Germany and Russia as early as 1922 had already produced over 500 fully trained pilots to form the nucleus of the new Luftwaffe which was to help him realize his ambitions.

At this time, the British Royal Air Force consisted of aircraft conceived largely in the ten-year period following the first World War and as a result of the mounting political unrest in Europe, the pace of updating this equipment had quickened.

Britain's first line light bomber of that era was the Hawker "Hart", the outcome of a tender issued in May 1926 requiring an aircraft to enter service four or five years later and possessing a top speed of 160 m.p.h. The Hart first flew in 1928 and entered service with No. 33 Squadron in January 1930. At the time of its introduction, its performance was superior to that of most existing fighters. The nimble little biplane not only exceeded the speed requirement of its specification, but it could also tote 520 pounds of bombs at 21,500 feet for 240



miles and return to base. After several hundred Harts had been built, an improved version called the "Hind" was introduced in the latter part of 1934 and almost 600 of these were built also.

But time was rapidly running out for the biplane by the time the Hind had reached the service squadrons late in 1935. By 1930, the leading designers had begun to realize the advantages of single wing aircraft or monoplanes as they were called.

In the U.S.A., the Boeing Company, after a first tentative step which saw it experimentally remove one wing of its D-12 biplane and introduced the model 200; a smooth-skinned all metal low-wing monoplane with retractable landing gear designed for the air mail and cargo rôle. The "Monomail" as it was called, first flew in May 1930 and was followed in

August by the 221A, a six-and then an eight-passenger version also capable of carrying 750 pounds of mail. This was no mean feat for the time on only 575 horsepower without a controllable pitch propeller.

The Lockheed Company introduced the "Orion" in 1931 which also featured retractable landing gear and could cruise with six passengers at 165 miles per hour on only 550 horsepower. When Swissair put an Orion into service on the Zurich-Vienna route, the German airline Lufthansa reacted swiftly to the competition by commissioning Ernst Heinkel to build a fast passenger mailplane which was to be called the HE70 "Blitz" or Lightning. When the prototype emerged late in 1932, it was obvious that Heinkel's design team had been influenced by the Boeing Monomail. But a controllable pitch propeller, landing flaps and new refinements in streamlining permitted by the use of an inline liquid cooled engine made the Blitz a much better performer.

In March and April 1933, the Blitz set a number of world records, among them a distance record of 1,242 miles at 214 mph and a load-carrying record of 2200 pounds at 222 mph with an engine of less than 700 hp. Its maximum speed of 234 mph was the more remarkable because the world speed record for racing type aircraft was only 25 miles faster.

These events gave the British Air Ministry something of a fright not only because of the remarkable performance of the aircraft but because Erhard Milch, Lufthansa's managing director, was already in the Nazi camp and had been appointed deputy Reich Minister for Aviation under Goering in February. Moreover, the Blitz, with its cramped "passenger compartment" and clean lines looked and performed more like a fast light bomber than an airliner. There can be little doubt that the German aircraft had a great deal to do with the formulation of the tender that was to result in the Fairey Battle. Before the year 1933 was out a high speed attack bomber version had in fact been developed. As it turned out, the Blitz did not play a very important part in Goering's Luftwaffe although 18 examples served with the German unit in the Spanish Civil War and later Franco's Air Force. But the great strides in thinking, design, and engineering that the Blitz represented had wide-ranging effects. In England, Rolls Royce purchased a Blitz in March 1936 to test its new high performance engines and later The Heinkel 111 bomber used in the



Battle of Britain bore a very close aerodynamic resemblance to the He70.

Six firms submitted design proposals to the British bomber specification issued in April 1933, two of which were selected by the Air Ministry for prototype construction and evaluation. Armstrong Whitworth Aircraft Company received their contract in June 1934 and proceeded with a low wing two-place monoplane design powered by a 870 horsepower radial engine. The Fairey Company's proposal had a similar layout except that it was to be powered by the Rolls Royce PV-12

inline engine of 1030 horsepower, later to become famous as the "Merlin"

Before either prototype had flown, another specification was issued in 1935 and an order was subsequently placed with Fairey for 155 examples of their design which was named "Battle". The main difference between the Battle framed in the original specification and the model which won the production contract was the addition of a radio operator air gunner to the pilot and observer crew of the original design. The placement of the order wrote finis to the design "competition" and Armstrong Whitworth was out of the running.

The Battle was an aesthetically pleasing design by Marcel Lobelle and when it flew on March 10 it showed promise of becoming a potent warplane. It was 55 mph faster than the Hind it was to replace, and carried twice the bomb load; but on the other side of the coin the Battle with only a 60 per cent increase in power was a third larger, twice as heavy and no improvement had been made on the Hind's defensive armament of two small bore guns.

In France, Battle carried out daylight bombing raids at terrible cost, the first aerial Victoria Crosses of the war being won by 12 squadron crew members.

And so the Battle was relegated to bombing and gunnery training and target towing, the majority of the 2400 manufactured never seeing action.

Over 700 Battles were shipped to Canada. R7384, built by the parent company as a trainer, represents the design in the National Aeronautical Collection at Ottawa.



The Fairey "Firefly", a development of the "Battle", was used by the Royal Navy as a shipboard fighter-reconnaissance aircraft in the second half of WWII. It also served with distinction in the Korean war and was later relegated to a purely anti-submarine role. The "Firefly" was flown in the Royal Canadian Navy from 1949 to 1954.

# apparent logic can kill

It's pretty safe to say that getting killed, maimed, injured, or just shaken up in an accident can ruin one's entire day. I don't anticipate much argument from disbelievers as a result of making that statement.

So - I'll make another.

Getting killed, maimed, injured or shaken up specifically because you are trying to carry out an operation safely, would be the ultimate irony.

Arguments? Disbelievers?

Well, without further beating about the bush I am going to relate a tale which is sad but true, wherein colleagues of ours were killed while doing their very best to be safe. Furthermore, I think that the tale will shake you to your very boots, when you consider the apparently perfectly harmless and extremely logical action these colleagues were taking which led to their demise. The two men concerned were "inerting" a fuel bowser for shipment by air. What they intended to do was fill the bowser tank with CO<sub>2</sub> which would replace any explosive fuel vapor. Sounds logical. What they did was open up the access door to the tank and discharge a CO<sub>2</sub> fire extinguisher into the tank.

The bowser exploded, and they were killed.

Why?

Because the CO<sub>2</sub> rushing through the cone shaped outlet of the extinguisher created a static charge in the cone which eventually caused a spark. The spark occurred before sufficient fuel vapor had been displaced by CO<sub>2</sub> to render the mixture inert. An explosion occurred - and then men died.

It strikes me as tragic if any more lives are lost now that we are familiar with it. It is only unfortunate that two men died to emphasize the point - since we have been aware of the possibility for ages.

Apparent logic and a legitimate concern for safety got to them before we did.

Now, that would be bad enough, but research into this one accident has revealed another dangerous misconception which could lead to another equally tragic accident.

Some of our aircraft batteries are subject to thermal run-aways and other difficulties due to overcharging. The problem here is excessive *heat*.

Do you see what's coming?

Sure. One of the characteristics of the discharge of a CO<sub>2</sub> extinguisher is that it produces copious quantities of cold. What better way of combatting excessive heat than with cold?

Again *apparent* logic - again fatally incorrect if put into practice.

A thermal runaway or overcharged battery often gives off hydrogen as a product of its chemical reaction. Hydrogen is very explosive and all it takes is a spark to set it off. The spark can be provided by the very CO<sub>2</sub> extinguisher you're using to cool off the battery - and you can end up killed, maimed or injured.

All of this of course might lead you to believe that the old faithful CO<sub>2</sub> extinguisher is no good - which is quite wrong. If you find some fuel which is already burning you don't have to worry about sparks. If you arrive on the scene after an explosion it is great for cooling and for O<sub>2</sub> removal.

So here I am lecturing all and sundry on three dangers:

- 1) The danger of using CO<sub>2</sub> as an inerting agent. Don't
- 2) The danger of using CO<sub>2</sub> as a cooling agent for thermal runways - don't, unless actual flames are present, or unless the nozzle can be held at least two feet from the battery. In some cases water can be used for cooling, but consider what *else* is going to get wet. Perhaps in many cases time is the best coolant.
- 3) The danger of using *apparent* logic in lieu of the real thing.

In earlier days in this and other armed forces it was fashionable for higher ranking personnel to say to their subordinates "Don't think - I get paid for thinking not you - just do as I say." We hope that those days are long past. We want you to think, to use your initiative, to function as a total being rather than just an automaton. Balanced with this we want you to be aware of the thinking of others more qualified or experienced than you.

Now if we can just figure out a way of tying down all the branches of the trees around here, maybe we can get the wind stopped.

Meantime - have a look at this proof of what we've discussed.

## FIRE EXTINGUISHERS CAN CAUSE FIRES • *the proof-for those who doubt it*

By J. T. Leonard and R. C. Clark  
Naval Research Laboratory Washington, DC

SCIENTISTS of the NRL (Naval Research Laboratory) have proven that portable CO<sub>2</sub> fire extinguishers can generate sufficient static electricity to ignite flammable fuel/air mixtures. Although no hazard exists when the extinguishers are used for their intended purposes (i.e., extinguishing fires), a problem can arise when these devices are used to inert tanks containing flammable vapors.

To establish that a spark discharge from the horn of the fire extinguisher could indeed be an ignition source, NRL scientists assembled the apparatus shown in Fig. 1. A 6-inch section of the extinguisher horn is enclosed in a Plexiglas box containing a flammable mixture produced by evaporating fuel. A grounded spherical electrode positioned a distance of 1 cm from the horn forms a spark gap. As the extinguisher is discharging, a voltage builds up on the horn until the breakdown value of the mixture is reached and a spark jumps the gap, igniting the fuel vapor. The resulting explosion is sufficient to blow the lid off the chamber.

Although the use of portable CO<sub>2</sub> fire extinguishers to inert tanks that previously contained hydrocarbon vapors is prohibited at naval installations, NRL scientists feel that this demonstration adds convincing proof to the necessity of this ban.

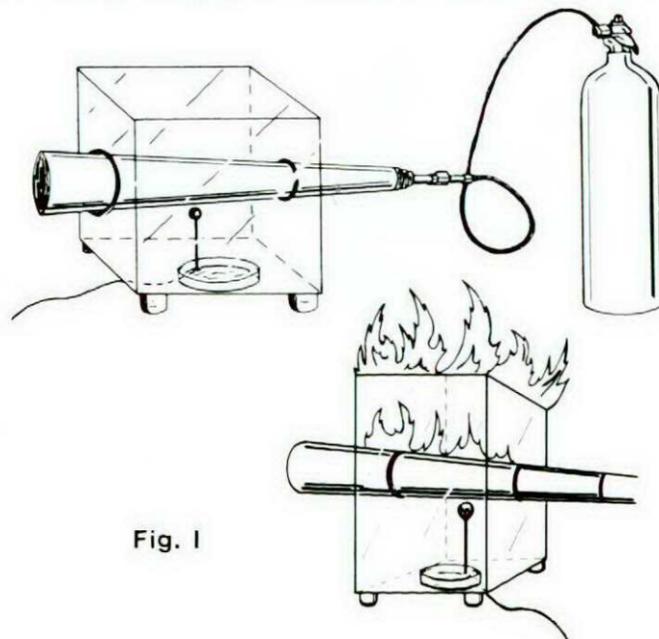


Fig. 1

## Comments

### EXTRA— FIRST BILINGUAL EDITION —EXTRA

As readers have undoubtedly noticed, this is a very special edition of *Flight Comment* in that it is our first bilingual effort. Henceforth we will continue to publish in both official languages and eventually both sections of the magazine will be identical in content. For a while however, we will publish in French certain articles which have already appeared in English - since we don't want any of our readers to have "missed out" on something worthwhile.

Nitpickers will note that translational difficulties make some common English phraseology seem a little stilted in French. We're working on that - but remember, we're blazing new trails in this area, and we are doing so without additional staff or physical resources - so instead of complaints, be so kind as to send us contributions and all will be all right in time. We always need articles and we have yet to get one initially written in French - so we don't know how things will translate in that direction.

We sincerely hope that "the field" has noticed a marked improvement in "Good Show" processing times. It is emphasized that if they are written up properly in citation form the first time they move a lot quicker.

We would also like to point out that an excellent Birdstrike film is now present in the NDFB library. By the time you read this 'twill be that time of year again so make use of it.

### RETRACTION

In the last edition we published an excellent article by Mr. Robert Rickerd entitled "UFO's, Fact or Figment? Unfortunately we included after the author's name the words "National Research Council" since that is where Bob works and we wanted to give credit where credit was due. At no time did Bob request this inclusion and unfortunately at no time did we ask if it was appropriate. Well, it wasn't. The opinions expressed were those of the author alone and the research for the article as well as the writing was done by him privately and on his own time.

Mr. Rickerd is a freelance writer with a longtime interest in aviation history. His work will be appearing regularly on our pages in the future.

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Education and analysis

L. COL. F.G. VILLENEUVE  
Investigation and prevention

- 1 ric o'chet strikes again
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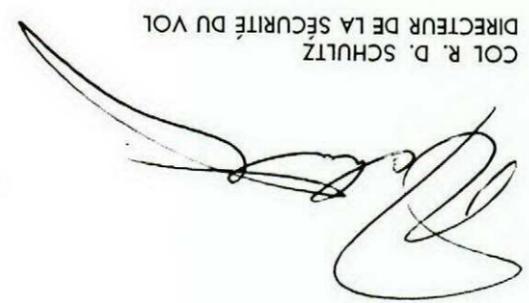
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COL R. D. SCHULTZ  
 DIRECTEUR DE LA SÉCURITÉ DU VOL



## CAN WE AFFORD — YOU

A long time ago during a bar discussion on the most recent decoration awarded to a very successful fighter pilot, one of the group sarcastically remarked "Our medal or Theirs?" The remark was in bad taste but the question posed had some validity since the ace's scores were about equal; theirs destroyed in combat, ours in accidents.

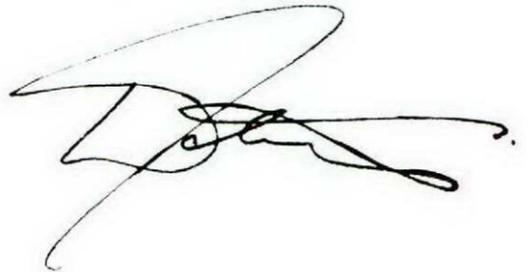
We may have come a long way in the accident prevention business since those days but the increasingly important question is what do we do about those people who contribute to our losses either through lack of ability or in spite or it. The record will show that more often than not little or nothing is done unless the individual's performance is so bad that it cannot be ignored. There are many reasons why those responsible are reluctant to take positive action even when the need is fairly obvious. These range from cost of training to the lingering fallacy that every outfit needs a character, or is it a tiger? Most often however the real reason is a human reluctance to come to grips with a person's weaknesses, particularly, when this may adversely affect his future. A compounding factor is the infinite number of combinations that can add up to a situation that makes an individual's real value to the operation questionable.

Just a few of those types we may not be able to afford are:

- those whose ability is just not quite up to the job even though they do their level best,
- those who have the ability but for some obscure reason have occasional lapses — with startling results,
- those who consider themselves above it all and push things beyond reasonable limits whenever the opportunity arises, and
- those who think that getting the job done justifies any means.

While this is a very cursory treatment of a controversial and complex subject it is an issue that demands the utmost effort on the part of those responsible for the selection, training, supervision and assessment of our air operations team. It is not suggested that doing what has to be done with individuals who repeatedly fail to measure up will ever be easy, however, as jobs get tougher and costs increase it becomes essential.

Stripped of all emotion it is clearly in the interest of the individual as well as the organization as a whole to ensure that only the best people get into air operations and that only the consistent producers stay.

COL R. D. SCHULTZ  
 DIRECTOR OF FLIGHT SAFETY

Il y a longtemps, au cours d'une discussion au bar sur la dernière décoration reçue par un pilote de chasse chevronné, on demanda sarcastiquement: "Notre médaille ou la leur?" La remarque était de mauvais goût, mais la question avait une certaine valeur étant donné que l'as avait accumulé à peu près autant d'accidents que de victoires.

Nous avons beaucoup avancé dans la prévention des accidents depuis ce temps, mais il y a une question de plus en plus importante qui se pose: "Qu'est-ce qu'on doit faire de ces gens qui contribuent à nos pertes soit par manque de compétence, soit par négligence. L'expérience nous montre que, plus souvent qu'autrement, on ne fait rien ou presque rien sauf dans les cas extrêmes que l'on ne peut ignorer. Il y a de nombreuses raisons pour expliquer l'hésitation des responsables à prendre les mesures qui devraient s'imposer. Elles vont du coût de l'entraînement jusqu'à la vieille croyance fallacieuse qui dit que dans chaque unité il faut un original... ou serait-ce un tigre? Cependant, le plus souvent, la véritable raison est la réticence naturelle à s'occuper des faiblesses d'une personne, surtout quand cela peut nuire à son avenir. En outre, de nombreux facteurs pourraient combiner à l'infini pour créer une situation qui mettrait en doute la valeur opérationnelle d'un aviateur.

Voici certains genres de personnes dont nous pouvons aisément nous passer:

- ceux qui ne sont pas tout à fait à la hauteur, même en faisant de leur mieux;
- ceux qui ont les capacités nécessaires, mais qui, pour des raisons obscures, ont parfois des lacunes, avec des résultats désastreux!
- ceux qui se considèrent au-dessus de tout et qui poussent les choses au-delà des limites raisonnables chaque fois que l'occasion se présente;
- ceux qui pensent que la fin justifie les moyens.

Cet exposé est très bref, bien que le sujet en soit controversé et complexe. Cette préoccupation exige les plus grands efforts de la part des responsables de la sélection, de la formation, de la surveillance et de l'évaluation de nos aviateurs. Nous ne disons pas qu'il est facile de prendre des mesures contre ceux qui n'atteignent pas les normes, mais les tâches deviennent de plus en plus difficiles et les coûts augmentent: il faut agir!

En regardant froidement la situation, il est clairement dans l'intérêt de tous et chacun de s'assurer que seuls et les meilleurs et les plus stables prennent l'air et s'y maintiennent.

