FLIGHT COMMENT

MAY • JUNE 1972

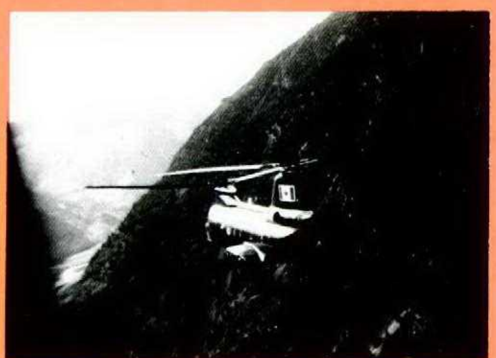
Helicopter Mountain Operations—page 2

Comments

A recent incident in which a technician was struck and knocked to the ground by the rotor blades of a CH113A, illustrates the need for caution in making assumptions. As the message related the incident, "He was aware that the rotors were turning when he started climbing the pylon but *thought* they would be stopped when he reached the top. He was incorrect."

The importance of proper emergency reaction to oxygen problems has been recognized by the implementation of the Standard Emergency Oxygen check. Incidents of failure to follow the standard checks continue to occur. So far we have been fortunate that serious consequences have not resulted.

Seatpacks seldom get more than a cursory glance from pilots, in spite of the fact that they could mean the difference between life and death in some circumstances. An alert technician at one base recently discovered that the contents of a seatpack had been stolen. Worse still, the person responsible had arranged the pack so that it appeared at a glance to be serviceable.



FRONT COVER A CH113A Voyageur of 450 Sqn Detachment, Namao, approaching Salmon Arm B.C. after a flight through the Rogers Pass.

CANADIAN FORCES HEADQUARTERS — DIRECTORATE OF FLIGHT SAFETY

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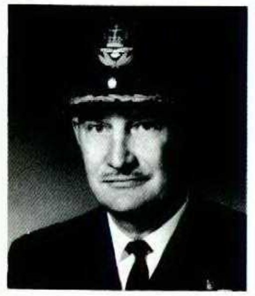
A Positive Approach



One of the keys to success in any venture is a positive mental attitude. In the accident prevention business one of the ways we try to establish and maintain this attitude is by keeping people informed – the more timely the information and the more general its applicability, the better. Through various channels of communication we endeavour to relay the results of investigations, the corrective measures initiated, new ideas gleaned from various sources, significant trends established as a result of the conscientious reporting of seemingly isolated incidents, and so on. The more we are able to improve conditions, the better for all of us.

This effort can be thwarted because of apparent reluctance to initiate any corrective action or to admit to new ways. Too often, much effort and time are expended in defensive attitudes or attempting to justify a position, rather than seeking improvement. One can only speculate on what could be accomplished were it possible to invest those efforts expended in maintaining the status quo into something more meaningful. Let's accentuate the positive!

COL R. D. SCHULTZ
DIRECTOR OF FLIGHT SAFETY

HELICOPTER MOUNTAIN OPERATIONS

by Capt R. N. Cadorette
SOFS-2, MOBCOM

The helicopter's ability to land in otherwise inacessible areas has made it the ideal vehicle for operations in mountainous terrain. This capability will most certainly be exploited to an ever increasing degree, given the growing helicopter inventory in the Canadian Forces. Canada's terrain (even east of the Rockies!) is such that mountain operations will be encountered in Northern Quebec, Ontario, Labrador and the North West Territories.

The power available in present day turbine powered helicopters may lead some to think that the lessons learned in the piston era no longer apply. NOT SO! This is the type of thinking which has in the past, caused our fixed-wing friends to end up in the overrun off 12,000-foot runways – because they didn't require drogue chutes.

In all likelihood, the extra power provided will only result in greater loads. Power reserves will remain essentially the same – insufficient if the wrong conditions are encountered. Since all relevant factors can't be covered in this article, I hope that a review of basic techniques will be of some assistance.

Wind, terrain and density altitude are the most important considerations in mountain flying. Higher density altitudes will generally result in decreased lift and power. Terrain will affect prevailing winds and may redirect it in a completely different direction. Wind, when properly assessed and taken into account, can compensate for the decrease in power and lift and allow for safe approaches, increased power margins, and successful mission completion.

THE APPROACH

Although the maximum amount of power available is fixed for a given density altitude, helicopter peculiarities can be taken into account to use this power to best advantage. The best performance can thus be obtained by carrying out a nearly flat approach, with a gradual speed reduction to maintain sites. This technique has the following advantages:

- the benefit of ground effect is obtained prior to losing translational lift
- minimal and gradual application of anti-torque conserves power for use where it is most needed
- results in a slower rate of descent – which can be stopped more easily
- recognition of lack of power is easier and space to overshoot if necessary, is then greater
- the need for a flare is eliminated along with the risk to tail rotor strike on rough terrain.

The use of a flat approach as well as the possibility of inaccurate wind assessment leads to another requirement for mountain approaches – THE DROP-OFF. "This" means having sufficient vertical ground clearance to enable the pilot to dive his helicopter to regain airspeed and effective translational lift. It should be a consideration in every recce since there is usually a BEST approach which will provide a drop-off, among the choices available.

WIND

Wind must be assessed for *every* approach and location. For various reasons prevailing winds may not necessarily apply to a given landing zone:

Convection Wind will generally be upslope on the sunny side, and downslope in the shadowed side of hills or valleys. In glacier areas or snow fields, the cooled air will flow downwards

River Valley or local wind normally flows up valley when heated, diminishing gradually and finally reversing at night

Boundary Wind or prevailing wind – affected by terrain features

Combinations of the above two or three types will cause great variance of wind direction and speed from one location to another or over a given period of time.

The number of factors which affect wind direction is such that it can vary considerably over a short-time or short distance. The danger posed by downdrafts, particularly during the final portion of the approach make a wind recce for every approach MANDATORY.

THE RECCE

There are two basic types of recces for Mountain Approaches:

a. the Circling Type; and
b. the Figure 8 Type.

The Circling Type is carried out when the pilot has no indication of wind direction and the landing site is one which can be circled safely. (See Fig 1)

The Figure 8 Type is preferable when you have a general idea of the wind direction or the approach is to be made to a ridge which cannot be circled. This method allows you to avoid the downdraft side completely. This should be planned so that turns are made away from rising ground. When carrying out the recce you should fly a steady airspeed (usually the "minimum power required" for the aircraft type), a constant altitude and always maintain a drop-off. This constant airspeed and altitude will provide a basis for comparing groundspeed, drift and power requirements during the recce and provide clues from which wind direction can be determined. The drop-off will allow you some flying space in case you find yourself in a strong downdraft.

Fig. 1 Circular Recce

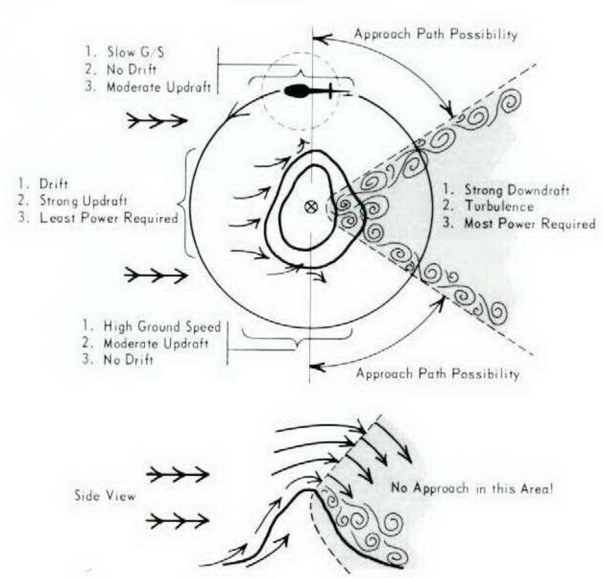
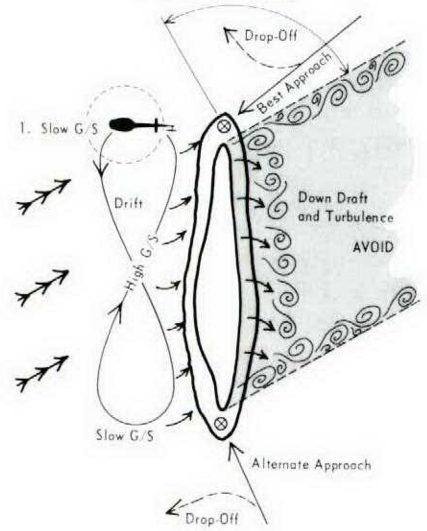


Fig. 2 Figure 8 Recce



THE APPROACH

Once wind direction is determined, the downdraft area can be avoided by carrying out a crosswind approach. Since peaks generally have updrafts on approximately 270° of their circumference, this will keep you in upflowing air which will assist rather than endanger the approach. The crosswind approach also allows you to maintain a drop-off when landing on a ridge.

The aircraft should be turned into wind during the final portion of the approach to provide a wind direction reference for takeoff. Of course, if you shut down for anytime – re-assess the wind prior to start-up to avoid downwind takeoffs.

DOs AND DON'Ts OF MOUNTAIN FLYING

ALWAYS:

- *Maintain a drop-off during the approach.*
- *Fly on the sunny side of valleys on calm days.*
- *Use updrafts to speed up your climb to altitude. This will also help you stay out of downdrafts.*
- *Carry out a dummy approach and overshoot. This will allow you to estimate power requirements and assess the suitability of the exact landing site.*
- *Use smooth positive control movements since abrupt handling results in spilled air and reduced lift.*
- *Approach a ridge at a 45° angle or less to facilitate turning away from it if a downdraft is encountered.*
- *Anticipate the wind – but verify it by a recce to landing.*
- *Use the aircraft performance charts.*

NEVER:

- *Land from a bad approach.*
- *Turn towards rising ground during a recce.*
- *Approach a mountain peak directly into wind no matter how lightly the aircraft is loaded. This would put you right in a downdraft. (A 30 knot wind will result in a 2640 feet per minute downdraft and you may not be able to outclimb that before reaching the side of the hill).*
- *Say no if you are offered the Mountain Course.*

CAPT Cadorette joined the Royal Canadian Army Service Corps in 1962. He was selected for pilot training in 1964 and attended courses on Chipmunk, L19 and CH112 aircraft. Following completion of pilot training, he was assigned to ground jobs in Quebec City and Valcartier for 18 months and was then transferred to 450 Heavy Transport Helicopter Squadron where he flew CH112 and CH113A helicopters until May 1970. He held the appointment of UFSO during his last two years with the squadron until he was posted to Mobile Command Headquarters as SOFS-2.

the 436 Sqn record...

Good Luck or Good Management?

1971 was a memorable year for 436 squadron. Their Hercules flew 18,000 hours, the most hours flown by any CF squadron; and it marked the completion of an outstanding 11-year accident-free flight safety record.

Granted a lot of these hours were logged at 20,000 feet over the Atlantic, but others involved some pretty demanding conditions. Over one-third of the Squadron's flying is done in the Arctic, and 436 is responsible for the weekly supply run to Alert, a 5,500 foot gravel strip just 420 miles from the North Pole. It was a 436 Squadron crew which was involved in UN relief in East Pakistan and another which airlanded a 20,000-lb. bulldozer on a 3500-foot gravel strip when fire threatened Moosonee last summer. The Squadron also has a tactical role which involves low level nagivation, formation flying and para dropping. Even the trans-Atlantic trips are not without hazard for they sometimes involve "midnight" departures and approaches to instrument minimums after an 18-hour duty day.

This all raises the question, worthy of study by all aircrew and supervisors, how has 436 Squadron achieved such an enviable safety record? Has it been good luck, or good management?

SELECTION

If you have the impression of a heavy transport squadron being a collection of pipe smoking, grey-haired, "old sweats", a visit to the daily briefing at 10 hangar in Trenton would change you mind. The average age of 436 pilots is only 33, and there are 14 aircraft commanders less than 30 years old.

On the other hand, ATC Orders state that before being selected for Hercules a candidate must have had at least one previous flying tour and aircraft commanders must have had a total of over 2500 hours. Therefore, although the average age is young, the experience per pilot is quite high, around 4500 hours. Personnel selection is very important.

Other crew members must also be considered for their experience, trade proficiency, and so on. Flight engineers are selected only from proven aircraft technicians. Navigators and loadmasters are likewise mainly experienced personnel.

Over Cyprus.

TRAINING

Another factor contributing to a low accident rate is probably the extensive conversion training given by 426 (T) Training Squadron, also based at Trenton. Prospective first officers get 96 hours of technical instruction in ground school, 36 hours of flight simulator, and 77 flying hours before their proficiency check and handover to the operational squadrons. Candidates for aircraft commander (AC) come back to the Training Squadron for another four weeks of concentrated simulator training, local flying and a long range overseas "route check".

The continuation training requirements on squadron call for a further nine hours simulator and three hours supervised flying training each four months. First officers get an additional local flying session each month. Further, on every operational mission maximum training value is gained; first officers fly the left seat on alternate legs; practically every approach is flown on instruments to IFR minimums.

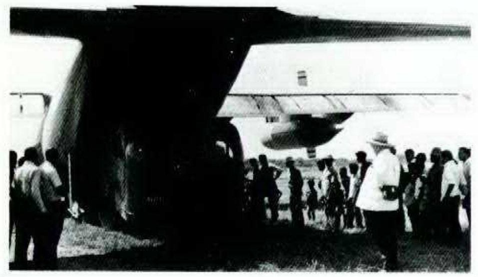
Beyond this training, which is required by ATC instructions, 436 Squadron has set up a system of refresher technical lectures for both flight engineers and pilots. The Hercules is a complex aircraft and in spite of excellent technical support from the CFB Trenton Maintenance Wing, it develops snags both in the air and away from base. Without the expertise of the flight engineers many operations would rapdily grind to a halt.

It is squadron policy backed up by Base and Command, that when aircraft are assigned to various missions, those assigned to the training role take priority. The first aircraft on the line each day is the local "trainer", which is utilized for continuation and first officer training, standard checks and tactical proficiency. When an aircraft assigned to a transport mission goes unserviceable, it is natural to consider substituting the trainer, yet the Squadron resists, even if it means that the occassional scheduled flight is delayed or cancelled.

Ramp at Yellowknife during CF/RAF OPERATION CROSSCHECK, 1970.

Loading at Namao.

Landing on a 50' x 6000' strip at Letham, Guyzna.



Unloading at Letham.

FLYING RATE

In 1971 the average hours flown per crew member was 750. The aircrew have complaints about time spent away from home, but there is seldom a complaint about not being current. On the other hand, this high flying rate and the length of the trips has its adverse effects. The UFSO complains that the most aircrew he is ever able to assemble for a Flight Safety meeting is 60% of the 150 Squadron members.

SUPERVISION

Whenever flight safety success, or lack of it, is considered, supervision is always an important factor. Aircrew accustomed to shorter range aircraft might at first consider that there is a low level of supervision on a squadron such as 436. Aircraft commanders away from base are encouraged to make their own decisions on how best their mission can be accomplished. In the Arctic where distances are great and communications are poor, it has to be that way.

Mainly because of an aircrew shortage, the crew system is not normally used in 436; however, the aircraft commander is still considered a first level supervisor. He writes trip comments on all crew members assigned to him for a mission; these reports are reviewed by the applicable section head, eg. flight engineer leader. A first officer's capability is monitored closely and an on the job training plan is utilized to guide progression toward AC status.

Perhaps another factor in the safety record of all of Air Transport Command is the close guidance and monitoring which is done by ATCHQ. Senior Staff Officer Training and Standards (SSOTS) sets down the standards which aircrew must meet, keeps detailed files on individual progress and conducts annual evaluation visits to the squadron. In the past the staff under SSOTS has become deeply involved in aircraft operating techniques but the emphasis is shifting; more responsibility for methods and standards are being placed upon squadron commanders.

Thus, although the emphasis in 436 Sqn is on individual responsibility, most observers would agree there is an appropriate level of supervision.

TECHNICAL SUPPORT

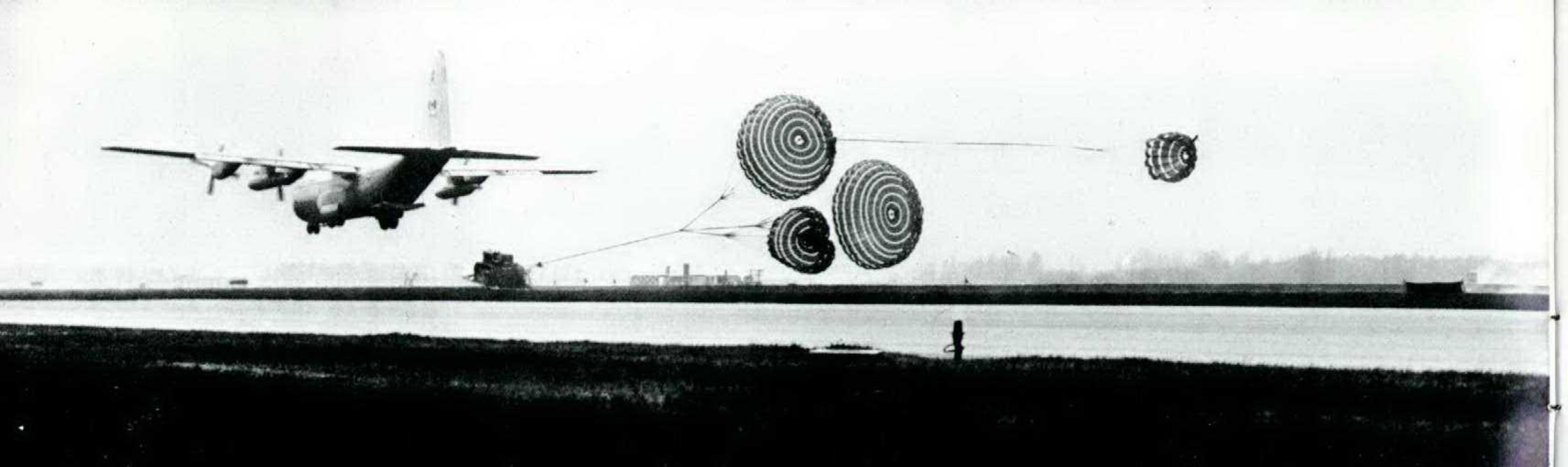
Behind any flight safety success story inevitably are the ground crew. Even though the C130s are becoming just a little tired under their high usage rate, the serviceability factor averages 75% which is considered very good when compared to C130 used in other countries. The recent move of 436 from Ottawa to Trenton caused some hardships and necessitated numerous on-the-job-training programs to get Trenton technicians qualified on the aircraft, but these went very well with little or no appreciable decrease in serviceability. One complaint by 436 aircrew is that mainly because of the "geography" of CFB Trenton, they miss the relationships they enjoyed with servicing ground crew at Uplands.

In addition, 436 aircrew deserve part of the credit in the serviceability rate. They are especially keen on writing up their "snags" in the "L 14" and set an example in their filing of flight safety occurrence reports. For 1971 alone more than 155 reports were filed by 436 aircrew.

... AND A LITTLE BIT OF LUCK

As in most things, compiling an enviable record involves a bit of luck. The Squadron had a close call not long ago when the brakes failed on a parked Hercules at Alert. It was rolling toward a hut when a pilot standing nearby ran to the hydraulic hand pump. He broke his finger in the rush, but got the aircraft stopped in the nick of time.

Perhaps the Canadian Forces and 436 Sqn have been lucky in having professionals like that, who put duty before personal considerations. A squadron lucky enough to have that kind of people is bound to have success. What would you say, was it "good luck", or "good management"?



FLAMEOUT vs POWER LOSS

This article deals primarily with the T56 engine of the Hercules, however it has wider significance as the basic principles apply to all turbo-prop engines.

Picture in your mind a C130 on a maximum effort landing roll with propellers transitioning into reverse thrust on a hot day. Interphone silence is broken by the report, "Number Two just flamed out". The pilot moves the throttle to ground idle and the engine accelerates to "on speed". Was it a "flameout" or a "power loss?" Are "flameout" and "power loss" synonymous? The answer to the last question is "No", only the initial indications are similar. For C130 operators and maintainers there is a decided difference between the two, and both conditions require immediate corrective action.

From a mechanical point of view let's discuss the two. What constitutes a flameout? A flameout can only be caused by cutting off fuel to the engine burner cans and is usually caused by a mechanical malfunction in the fuel system, foreign matter in the fuel system, or a deliberate positioning of engine controls to stop fuel flow. Engine instruments and indicators may or may not reflect an impending flameout condition. Fortunately, flameouts are a rare occurrence and when they occur, the propeller negative torque system (NTS) goes into operation and the Emergency Engine Shutdown Procedure is the proper corrective action.

Now, let's take a look at a "power loss". Power loss is a condition where power demands by the propeller exceed the power available from the engine and result in an RPM drop. Under most conditions, power loss can be predicted and action by the flight or maintenance crew can lessen the probability of its occurrence. Some power losses are caused by improper operator or maintenance procedures rather than equipment malfunctions. For instance, a power loss could occur during landing ground roll as a result of the propeller reverse pitch blade angle demanding power in excess of engine capability. To further explain this situation, let's recap for a moment: high ambient temperatures cause reduced engine performance; also, high ground roll speeds require greater engine power to drive the propeller into full reverse pitch. Now, add some other problems; a plugged or restricted ram air sensor in the engine inlet will cause a lean fuel schedule, mis-rigging of the engine propeller controls will adversely effect engine power output and a deteriorated engine (eroded or dirty compressor, for example) can reduce engine performance, causing a constant power deficiency.

To give a more detailed explanation, the ram air sensor in the engine air inlet housing is used by the fuel control to automatically compensate for the aircraft forward velocity. This ram air sensing pressure is felt in a bellows chamber of the fuel control. Since the ram air sensor uses intake air, it is subject to clogging by dust and dirt. Plugging of this orifice results in a loss of ram air sensing. The fuel control then, cannot provide a richer fuel schedule when required or automatically compensate for the aircraft forward velocity causing a loss in power availability. Anything that can lean the fuel schedule during the critical landing approach should be corrected. A clean and unobstructed air pressure sensing line to the fuel control is a must for proper engine operation. Symptoms of a plugged ram air sensor are an increase in negative torque sensing indications during the landing approach, or an exceptionally low TIT if the TD system is switched to NULL while at altitude.

Dirt adhering to the compressor blades will cause an engine's performance to deteriorate. If you visualize each compressor blade as a wing fouled with snow and ice, you can readily see that the wing's capability to produce lift is impaired. So is the compressor's ability to pump air when the blades are dirty. The result is lower mass air flow and lower horsepower. For this reason, compressor cleaning equipment is available and instructions are contained in the applicable tech orders. This same low power can be a result of bleeding the engine excessively or leaks in the bleed air ducting. These possibilities should be investigated before a decision is made to clean the compressor. Whenever the compressor is cleaned, the abrasive action of the cleaning compound also erodes away some of the base metal of the blades and vanes. A badly eroded compressor also results in low power, so indiscriminate cleaning of the compressor should be avoided.

These variables, singularly or in combination, may create a condition where power demands from the propeller exceed power available from the engine, hence, "power loss". Should the power loss cause engine RPM to decrease below 94 percent, the acceleration bleed valves open and the engine will not transmit any usable power to the propeller. Since power losses usually result from exceeding engine capability the following three precautions are recommended:

1. Operate the aircraft within the established limits as stated in the flight manual.
2. Know the approximate performance level of each of the four engines on the aircraft. Although this knowledge will not prevent a power loss, it will provide the flight crew with prior knowledge of which engine(s) may lose power if excessive demands are made, and what the best corrective action might be.
3. Since exceeding available engine power causes a power loss, careful manipulation of the throttle (such as a momentary hesitation at ground idle) can prevent power loss at the cost of a slight increase in landing ground roll. When armed with the knowledge that one or more engines are incapable for producing rated power, you have the upper hand and can match your throttle technique to the occasion.

In conclusion, a power loss is not necessarily a flameout. Although, the early indications are the same, a power loss can also be caused by demanding more power from the engine than it can produce. Since this situation is predicable, it means that generally, power losses should not come as an operational surprise. The effects of a power loss can be countered by application of proper, pre-planned procedures. And a slightly increased landing ground roll distance is a small price to pay for the assurance of stopping while still on the runway.

(from TAC ATTACK)

CAUTION
Do not assume that NTS action is solely the result of a stopped up fuel control inlet sensing line because NTS action can result from a number of causes and it plays a very important part in the corrective control of the T-56 engine.

Are you legal?

You are cleared to land on Runway 28R at Moose Jaw. The weather is clear. The runway surface is dry. But there's a 35-knot wind reported from 325°. Suppose your maximum allowable crosswind component is 26 knots. Are you legal?

In many cockpits this question is generally followed by a scene of gyrating crewmen plunging into the frustration of unearthing their wind component chart. Which manual? What section? What page? Find the intersection of wind angle and velocity. Follow the line down. Whoops, is that the one? Let me retrace it...

Sound familiar?

One airline captain offers a "quickie" guide to reduce this rain dance. A crosswind component is calculated by multiplying the wind component velocity by the sine of the angle between runway and wind heading. With this in mind, the captain has memorized the sine of angles 30°, 45° and 60° (i.e., .5, .7 and .9 respectively). He can then make a rapid calculation of his crosswind component using his given wind and the sine of the angle closest to the actual wind angle. If the wind angle varies somewhat from his representative angles of 30°, 45° and 60°, he can make a reasonably accurate mental interpolation.

Using our hypothetical case at MJ, the wind angle is 45°. The sine of 45° is .7. The wind velocity of 35 kts multiplied by .7 computes to a 24.5-knot crosswind component. Thus, in this situation you would be legal.

Let's suppose the wind shifted to 340°: same velocity. This makes a 60° wind angle, the sine of which is .9. The wind velocity of 35 knots multiplied by .9 computes to 31.5, and so in this situation you would not be legal.

This principal can be used in quickie tailwind/headwind component computations, too, except that you would use the cosine of the three angles. Since the cosine numbers are the reverse of the sines, they're easy to remember.

Given:

Wind Angle	Sine	Cosine
30°	.5	.9
45°	.7	.7
60°	.9	.5

Formula:

Wind Angle Sine X Wind Velocity = Crosswind
Wind Angle Cosine X Wind Velocity = Tailwind/Headwind

adapted from Flight Safety Foundation Bulletin

Good Show


Capt L.F. Best


Capt D.W. Paxton


Cpl K.L. Martin


MCpl R. Scott


Cpl G.H. Buffett Cpl J. Weedon
Sgt L.B. MacDonald


Cpl D.H. Rideout

CAPT L.F. BEST CAPT D.W. PAXTON

During the 1971 autumn migration period Capt Best and Capt Paxton, pilots on 441 squadron, encountered separate bird strikes which shattered the windshield of their CF104 aircraft. In each instance, the aircraft was being flown in a wingman position on a four-plane conventional attack mission and sustained the birdstrike during low level run-in to target at an indicated airspeed of 540 knots. Both pilots reacted immediately, initiating a climb and reducing speed and then assessing the damage to the aircraft. The wind-blast and flaking particles of windshield glass made the remainder of the flight very uncomfortable. In addition they knew that their aircraft had possibly sustained engine damage.

Despite the discomfort and the poor visibility for landing, Capt Best and Capt Paxton displayed professional competence in landing their aircraft successfully.

SGT L.B. MACDONALD
CPL G.H. BUFFETT CPL J. WEEDON

Sgt MacDonald, Cpl Buffett and Cpl Weedon were on the flight deck of a Hercules performing a pre-flight inspection and repairing a sextant mount when a ground power unit connected to the aircraft exploded and began burning. Sgt MacDonald gave the alarm and the men immediately evacuated the aircraft.

Once outside, Cpl Buffett removed the CO_2 fire extinguisher from the burning power unit and attempted to control the fire, Cpl Weedon disconnected the unit from the aircraft and, assisted by Sgt MacDonald, pulled the unit to a safe distance. The fire was eventually extinguished with the aid of other fire extinguishers sent out from the hangar.

The immediate response by Sgt MacDonald, Cpl Buffett and Cpl Weedon prevented further damage to the power unit and possibly averted destruction of the aircraft.

CPL K.L. MARTIN

Cpl Martin was Flight Engineer on a scheduled 412 Sqn Cosmopolitan flight from Ottawa to Andrews AFB Washington, and return. During the flight to Andrews the aircraft's UHF radio had been intermittent; on the return flight the transmitter became completely inoperative, and the Aircraft Commander directed Cpl Martin to check the UHF circuit breakers, located in the rear baggage compartment behind the passenger cabin. When he opened the door to the baggage compartment, Cpl Martin noticed smoke coming from the vicinity of the UHF inverter. He immediately closed the door to contain the smoke and prevent further combustion, and returned to the cockpit to disconnect the electrical power. He advised the Aircraft Commander of the situation and then returned to the rear of the aircraft with a fire extinguisher which he used to prevent a possible fire in the tail section of the aircraft.

Cpl Martin's immediate appraisal of the situation and his quick response prevented a possible in-flight fire.

CPL D.H. RIDEOUT

Cpl Rideout was checking the rear cockpit during an A Check on a T33, when he noticed the tip of a small screwdriver lying inside the left floor pan. Since the location is poorly lighted and a 0.60-inch diameter hole is the only means of viewing the interior of the pan, and since a check of this area is not called for in the "book", this was an example of thorough checking at its best. Had the screwdriver travelled forward beyond the pan, it could conceivably have become lodged in the flight controls.

Cpl Rideout's comprehensive inspection eliminated a flight safety hazard.

MCPL R. SCOTT

MCpl Scott was conducting an "A" check on a CH113 when he discovered a broken clamp on an engine centrifugal fuel purifier. This filter turns at 4000 rpm during operation and if the broken clamp had gone undetected a serious engine fire probably would have ensued.

MCpl Scott's demonstrated a thorough inspection technique in uncovering a concealed defect that was not specifically listed as part of his check.

Misguided Missiles

ANYTHING in or around operating aircraft should be carefully secured to prevent accidents and injuries. Certain areas, such as the flight line and hangar, have been given considerable attention by written word, audio-visual means and posters. However, one area which perhaps has not been emphasized enough is the inside of aircraft. The myriad of unsecured items found in most operating aircraft can be potential accident makers and injury producers.

Most aircraft capable of carrying cargo have many attachments and tie-down rings to facilitate the carrying of cargo. In addition, there are other considerations to be taken into account – such as weight of the item with regard to the C of G of the aircraft or weight limitations in certain compartments of the aircraft. It may be perfectly acceptable to position a 2000-pound load in an aft compartment when there is other weight forward, but to load the same weight in an aft compartment with nothing forward, could exceed the aft C of G limits of the aircraft. For example, a CH-46 was loaded internally with a heavy, bulky load. The crew chief supervised the loading, and after the load had been carefully winched, pushed, pulled, and successfully positioned inside, he aided in tying down the load. As events unfolded, the load should have been worked forward, just one more foot, to keep the aft C of G of the helicopter in limits. But it wasn't. When the pilot lifted into a hover (total weight was no problem) the tail of the helicopter became homesick for the ground. The strain of the load was too much for two of the forward tie-downs which let go; the weight shifted aft and the crew chief was pinned to the bulkhead when he tried to correct the situation. The pilot eased the helicopter back onto the deck and with forward cyclic was able to keep the H-46 level enough to release some pressure of the load against the crew chief. Not only did the crew chief narrowly avert being crushed, but also the rear rotor narrowly escaped making contact with the concrete. Only the thinnest of margins separated injury and damage from death and probable strike.

Not nearly as dramatic as the above incident, but one which resulted in serious injury, concerns a coffee pot. Coffee pot? Yes! A big "mamoo" (transport type) landed at a foreign base, and during rollout the pilot applied normal reverse thrust. A large multicup coffee pot tipped over spilling hot coffee on two nearby strapped-in occupants. One of them was badly burned by the hot coffee. He received second degree burns to the lower waist and upper thighs.

Some time ago, the crew of a VP aircraft placed an unsecured extra box of ammo on the deck of the after station. While flying their regular patrol the pilots had to fly through a cold front. During the transit, heavy turbulence was encountered and the ammunition box was upset. It inflicted a painful ankle injury on the waist-station lookout and bent one bulkhead stringer almost 45 degrees.

These and many other similar incidents are sufficient to start a campaign to eliminate hazards within aircraft. It wouldn't be too far wrong to make a SWAG (scientific, wild, accurate guess) that an inspection of aircraft in any squadron will reveal many unsecured items lying around – real booby traps just waiting for the right conditions to cause injury or damage. Let your imagination run wild, but to get started you might look for:

- Dangerously located or unsecured coffee pots, thermos jugs
- Shoes, hats, or old flight suits stuffed somewhere, or rags lying around
- Pencils, screwdrivers, or other sharp pointed objects "temporarily" stowed between wiring or stuck somewhere
- Maps, charts, notebook pads, magazines, or other paper items lying in wait to cut a finger or sail up into someone's face
- Extra cans of engine and hydraulic oil or empty cans and containers of any kind just "in the plane"
- Loose lifejackets, chutes, and liferafts
- Unsecured boxes for stowing tolls, engine covers, and other loose gear
- Loose or broken stowage fittings for tail steadies, ladders, and other heavy items

You know, it's amazing when you stop to think about it – just how many different kinds of hazards there are to airframes and people lying around in aircraft. If a concerted effort is made to clean up these potentially dangerous items, a dual benefit may occur. An inspection could reveal corrosion pockets, loose or cracked ducting, insulation, tubing, and wiring which might have otherwise gone unnoticed.

"It is not necessary to wait for some apparently inconsequential item to return to haunt us. The interior of any aircraft becomes the living area for many people for varying periods of time, and therefore each item in the living area (cockpit, crew compartment, passenger cabin) must be examined for its effects on the inhabitants." So stated the CO of the squadron involved in the coffee pot incident.

'Tis true! Everyone knows that sudden stops make missiles out of anything not properly secured – you, the toolbox, the coffee pot or . . .

USN approach

FATIGUE

Considering that we spend one third of our lives in the sleeping state, man has done little research into the nature of the phenomena until the last decade. Sleep laboratories have recently made considerable advances in this field co-related with mood, behaviour, performance, development, sanity, psychosis, health and illness.

LCol M. G. Kinghorn
Senior Staff Officer Surgeon
ATCHQ

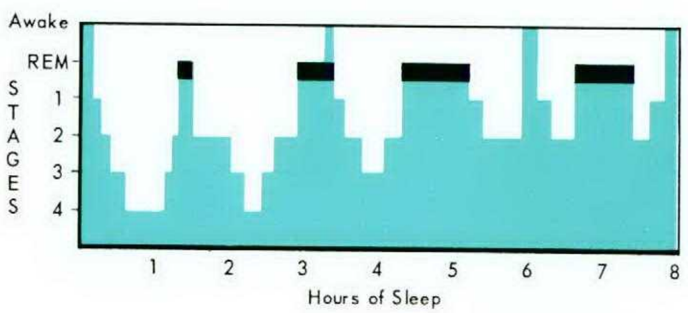
In the military sphere, the abuse of the 'unproductive' sleep period has been traditional. The dauntless red-eyed destroyer skipper, the intrepid long-range patrol aircraft pilot, the exhausted 48-hours-in-battle infantryman, are stereotyped portrayals of the resolute dedication to duty with which we are all familiar.

Since the outcome of military operations is becoming increasingly dependent on the effective thinking of the individual, it is time that the limiting human factors are given the consideration that they deserve. There is little doubt that lack of sleep, the associated fatigue and the resultant performance decrement leave the individual incapable of most effectively utilizing the sophisticated machine in his "man-machine loop". In times past, the simpler demand of the situation may have been met by an operator whose performance was grossly impaired by fatigue. This has led to the 'can-do' phenomena; the individual, in spite of regulations and adverse factors gets the job done. He takes pride in this capability and is regarded by his superiors as a reliable and capable line performer. Experience must influence current thinking but the conservative perpetuation of some methods of approach must be tempered by reason when we attempt to equate man with a more complex machine. The USAF term "Brown Shoes", refers to the old Army Air Corps personnel who tend now to be in senior positions and who tend to equate the job in hand with 'the way things used to be'. Any human comforts or automated modern aids are regarded merely as easements of an unchanging workload. It is the younger servicemen who will not attempt the unrealistic challenges which the "Brown Shoe" individual views as a personal challenge to his pride and capability.

There must be a compromise between the individual capability, his idea of his capability, the regulations, and the task in hand if we are to assure safe flying practice in peace and in emergency situations. Flight Safety does not inhibit operational requirements, rather it ensures that non-operational losses are minimized and thus contributes greatly to mission accomplishment. When we consider for example, the American experience in Southeast Asia, where a very high percentage of aircraft losses have been non-combat and of these, a high percentage are related to human factors, the military impact of individual performance can be viewed in its true economic and loss-of-life perspective.

Let's have a look at sleep. Sleep is a complex cyclical physiological phenomena of circadian rhythmicity which eliminates the effects of the individual's activities during the preceding wake period.

It can be divided into 5 stages by electrical monitoring. Stages 1 to 4 are characterized by an increasing depth of unconsciousness and these are interspersed with necessary periods of REM (Rapid Eye Movement) Sleep (Fig. 1)



Following sleep deprivation, there is an increase in the amount of stage 4 and an increase in the overall sleep period. Specific deprivation of REM sleep results in a compensatory increase in REM sleep during subsequent sleep periods. It is evident then that this complete multi-stage recharging process is necessary to pay back the biochemical debt and that this cannot be foreshortened. The average man requires eight hours of continuous sleep in a 24-hour period.

The performance of an individual has been shown to fall as the sleep allowed falls from 8 to 2 hours per night. More significantly the performance after 48 hours between individuals having had two cycles (a 6 + 6 and an 8 + 4) is similar. In other words, cumulative fatigue does occur, and is proportional to the total sleep lost irrespective of the variations in the aggregating periods.

Fatigue is a state of reduced mental arousal brought about by continuous activity past a critical point where rest or sleep would normally occur. Acute fatigue refers to the 24-hour frame while accumulative fatigue is built up over a number of inadequate sleep cycles (such as might be experienced by aircrews) and this is normally eliminated by 3 cycles of sleep at the home base. Neuromuscular fatigue is alleviated and mental alertness restored by sleep in favourable surroundings. Noise, temperature extremes, excitement and worry adversely affect the restfulness and diminish the benefits of sleep.

The following are some of the stressors facing those involved in air operations: mission work, physical and mental; the 30-hour day; circadian conflicts; altered sleep schedules; off-duty activities; variations in sleep environment; the situational stress of time-zone translocation; enroute ground time; and others which cannot be identified. 'Operational Fatigue' has been coined to cover the combination of stress, anxiety and boredom associated with prolonged flying. Basically the problem falls into two classes: the duty-rest ratio; and the upset of diurnal cycles. Prolonged work should be based on an 8/16 ratio while a 6/8 may be expected for short periods. If we exceed this we have additionally upset the diurnal cycle. The tolerance to flight co-incident with the adapted sleep period is considerably less than to flights during the adapted day.

Morale, motivation, physical fitness, sense of accomplishment, and the worthwhile nature of a mission are all pertinent factors which will delay or prevent the onset of fatigue or minimize its extent. The onset may be rapid or gradual, immediate or delayed and those in chronic fatigue are more susceptible to an acute episode.

One researcher found that, as fatigue increased, performance standards deteriorated, yet pilots showed increased euphoria. Although pilots accepted poor performance, they did not realize that their performance was suffering. Timing at first improved and then deteriorated. Gross errors appeared, continuity of performance was lost, and peripheral information was ignored. In addition, fatigue may result in general irritability, gastric disturbance, insomnia, deterioration in reasoning and judgment, sensory and motor hyperactivity, shortness of breath and lowered morale. In studying workload and speed stress investigators have emphasized the problem of workload stress effects and speed stress on skill proficiency. Errors of omission are a logarithmic function of speed, errors increase with load stress. Prolonged periods of intense work without adequate rest cycles, and fatigue, danger, and associated conditions of fear and anxiety, may present major problems to performance reliability, especially when combined with task requirements which require prolonged attention and concentration.

Certain guidelines have evolved from the many investigations carried out:

- Rest periods must relate as much to the pilot's next duty period as his last;
- Rest periods must impose minimum distortion on the pilot's sleep pattern (periods of 24 hours impose maximum distortion);
- Rest periods of three days allow accumulated sleep deficit to be made good. Such periods must intersperse any schedule in which sleep deficit has been demonstrated, or is likely;
- Rest periods in the order of 12 hours fit well into the sleep pattern. However such periods, if used successively, would not enable the pilot to regain operational fitness if on any occasion his sleep was inadequate;
- Time-zone crossing imposes a distortion on the sleep pattern for which allowance must be made;
- Duty periods in excess of ten hours have been shown to lead to high levels of subjective fatigue.
- A duty period of ten or less hours is more likely to be concomitant with a satisfactory sleep pattern. The present statutory limit, 16 hours, must be regarded as incompatible with the standards normal in aviation, since no evidence has been offered to demonstrate that human performance can be sustained at a satisfactory level, and with adequate reserves, over such a length of time.

Another researcher, in his extensive investigations, has been able to co-relate fatigue directly to a measurable biological quantity. There is at present no better method of measuring fatigue and fitness for duty than the pilot's own subjective assessment. However, since critical discrimination is lost as fatigue advances (similar to alcohol) it would be helpful to have a simple yardstick relating his present sleep debt to his workload in assisting him in determining his degree of fatigue.

Using a simple questionnaire, an attempt was made to quantify fatigue in Air Transport Operations. It was noted that at a point co-inciding with minus eight hours of sleep deficit, subjectively and objectively the subjects were fatigued to a point where further duty would be hazardous. This point which is normally accumulated in several cycles is equivalent to missing a night's sleep and remaining awake until 1600 hours. This may be a high cut-off point but we should certainly not attempt to exceed it.

Air Forces tend to have been involved in these considerations out of necessity. But the man-machine relationship is just as important in other spheres of activity. We certainly would not contemplate using unserviced equipment or operating it at reduced voltage; why, then, do we insist on completing the loop with a

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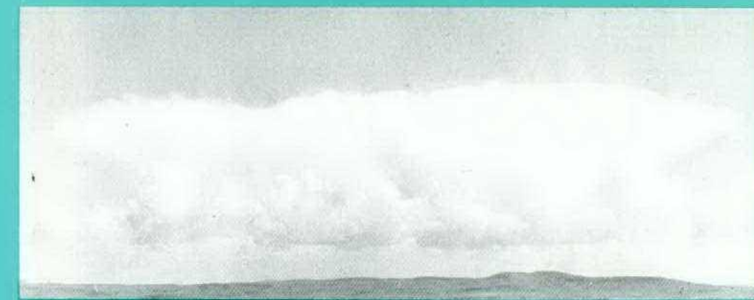
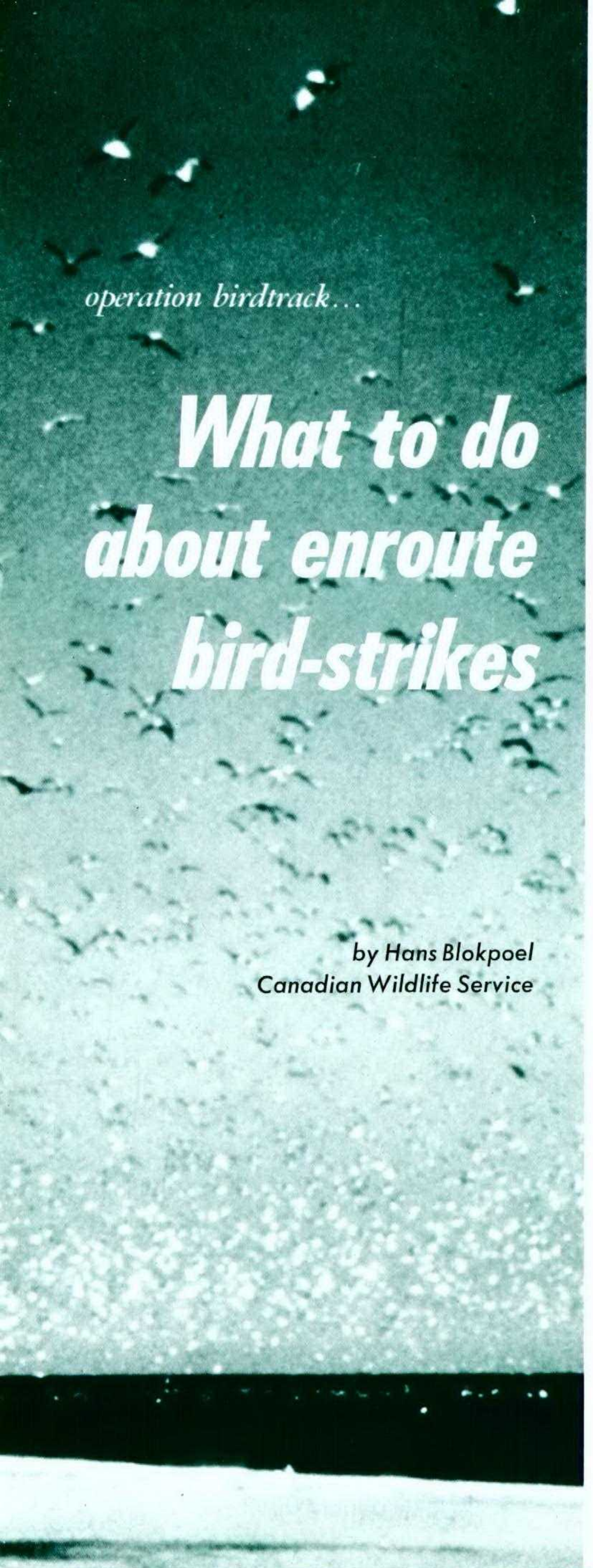
CBs





operation birdtrack...

What to do about enroute bird-strikes

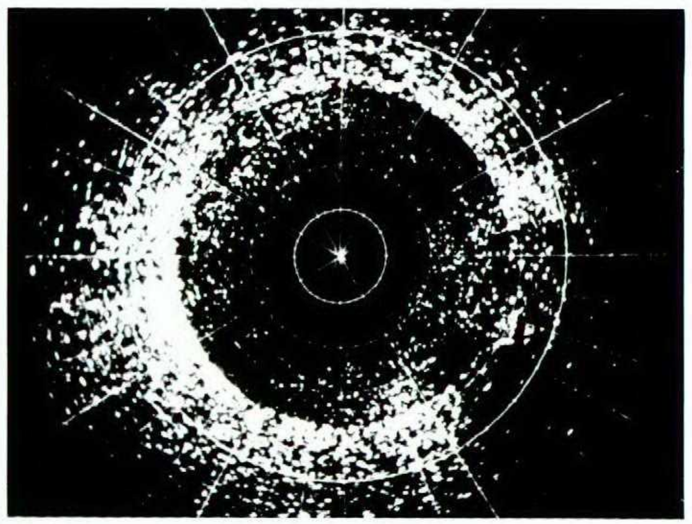
by Hans Blokpoel
Canadian Wildlife Service

When discussing birdstrikes (those unfortunate encounters between birds and aircraft that have caused the crash of ten CF104s), we are talking about two problems: birdstrikes at the airport, and collisions en route. The first problem can be solved by getting rid of the birds from fields and runways. This sounds easier than it actually is and all sorts of ingenious methods have been proposed (like the one to paint all runways blue, because that would scare the birds away). The best solution is probably to make the airport as unattractive to birds as possible (by removing food and water sources, cutting hedge rows and nesting trees, growing non-attractive crops, and so on) and then use an active scaring patrol to chase away the remaining birds. Shell crackers, recorded distress calls and a shotgun, used in combination and with imagination, usually give the best results.

The second problem is a different matter altogether and until bird-proof aircraft are in operation, we are going to have damaging strikes as long as we have low-level high-speed air operations. All we can do is to reduce the number of strikes by cancelling operations when the bird situation is very bad (like one might do in the case of very bad icing conditions) or to reduce the impact of a possible collision by flying as slow as possible during such periods. In either case, we need to know when the birds are flying in particularly large numbers and flight planners would like to have such information in advance.

The Canadian Wildlife Service and 448 Test Squadron have jointly carried out a project to develop a bird migration forecast system. CFB Cold Lake was a good place to start "Operation Bird Track" because many birdstrikes had occurred there and because the radar of 42 Radar Squadron could be used to study bird movements. We made time-lapse film (one frame for every sweep of the radar) from the scope during many migration seasons. When projecting the radar film, all events occur about 250 items as fast as in real time and one can easily see the bird echoes move across the screen.

Analysis of the radar films showed that the highest bird densities occur during spring and fall migration and that the bulk of migration and all very heavy movements take place at night. During such nights the bird echoes may virtually "white out" the scope, covering the entire screen. Migration often occurs in waves; a few nights with low density are followed by nights with very heavy bird density.



Bird echoes on the screen of the Cold Lake radar during medium heavy migration. Range 75 n. miles. Echoes in the centre suppressed or cancelled by radar adjustments. May 5, 1966.

The effect of the weather on the bird migration over Cold Lake was studied by John Richardson, now at Cornell University, and Dr. W.W.H. Gunn of Toronto, who started the project. The most important correlation they found between weather and migration density, was that birds tend to migrate with tail winds, that is, they fly the pressure patterns to economize on fuel (their body fat). The migration waves are a result of the fact that very few birds fly during a spell of unfavourable weather, and that very many takeoff when there is a sudden change to favourable conditions.

The bird migration forecast system is based on the seasonal and daily density patterns (as obtained from radar film) and correlations between weather and migration. The local weather forecast was provided by the Base Met Office and before making a migration prediction, the radar film for the previous night was examined. Migration forecasts were presented at the briefing for night flying. The pilots were initially rather skeptical but changed their attitude after hitting birds on well-forecast heavy-migration nights. In a few cases night operations were cancelled because of forecast heavy migration. The accuracy of the bird forecasts for nights with accurate weather forecasts is now between 80 and 90%. Routine operational forecasts were made in 1970 and 1971 by Cpl. P.P. Desfosses of 448 Test Squadron, who has been involved with all phases of "Operation Bird Track" since 1965.

One of the shortcomings of the forecast system is its lack of height information. We studied this aspect by filming the A-scope of an M33C track radar with its pencil-beam aimed vertically. This radar was installed at Primrose Lake Evaluation Range and the films were analyzed by Cpl Desfosses at the Data Centre of 448 Test Squadron. Birds were found to fly mainly below 5,000 feet, although some were recorded as high as 14,400 feet. Very few birds flew in clouds but many flew just above or below them. Cloud cover and wind direction were probably the main factors that influenced the height distribution of the birds. This height study is seriously complicated by the fact that big insects at short range can produce echoes (or "spikes") that are hard to distinguish from bird echoes.

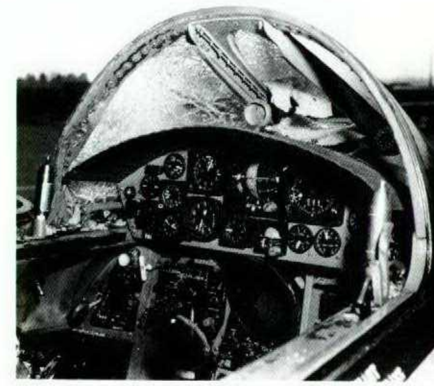
Another drawback of the bird forecasts is the fact that we are still not able to give the migration density in terms of exact numbers of birds. The density scale we use runs from 0 (no bird echoes) through 8 (the whole scope covered by bird echoes), but we do not know how many birds are represented by each step of the density scale. We attempted to find this out by making moonwatch observations (using a telescope trained at the full moon one can see bird silhouettes flap across its surface), but were frustrated by cloudy weather during the critical periods. The vertically aimed M33C provided an estimate of the actual number of birds aloft, but insect echoes complicated this matter as well. cont'd on next page

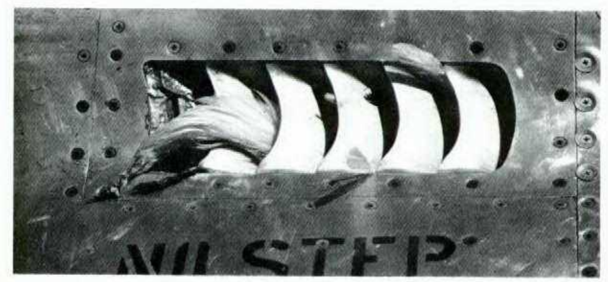
Inspection of the antenna of the M33C radar.

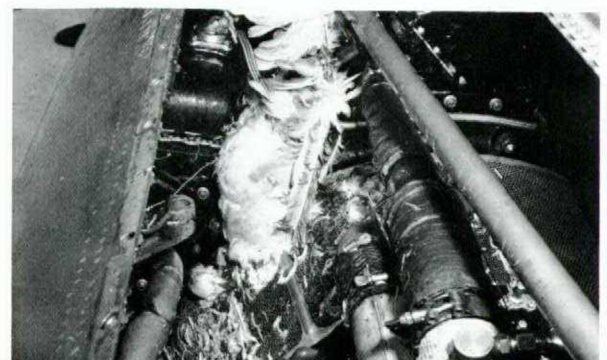
NRC van with modified Decca marine radar.

The M33C track radar at the Primrose Lake Evaluation Range.

Cpl Desfosses





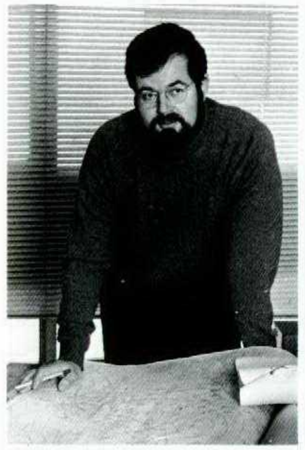


The need for good quality radar film is another drawback of the forecast system. The Cold Lake radar is used to detect aircraft and when this is hampered by the presence of many bird echoes, the radar is often adjusted so as to cancel the echoes that we are interested in.

Because bird forecasts and weather forecasts can be wrong, there will always be a tendency to continue flying until the first signs of the predicted hazard (be it birds or a hailstorm) appear. Thus, in the interest of flight safety, it would be well to use a device to monitor the actual build-up of night-time migration for use in a warning system to ensure that no flights will be cancelled on nights with little migration and, more importantly, no flights will be flown on nights with heavy migration.

A specially designed or modified radar installed at the airfield, with remoted controls and scope, and fitted with an automatic echo counter, should provide a quick and accurate estimate of the height and density of migration. Preliminary tests with a modified marine radar, provided by NRC and installed in a van, showed that the main problem will be to separate bird and insect echoes.

The so-called "radar signature analysis" makes it possible to do this, using the differences between birds and insects with respect to wing-beat pattern, radar echoing area and airspeed. This method involves many technical problems but the NRC radar field station in Ottawa provides all the required test facilities. Moreover, we are very fortunate that Dr. F.R. Hunt, an NRC radar engineer, has been assigned to "Operation Bird Track" to help design and test a suitable bird radar and chances are good that we will finish the job within the next few years. Using such a bird radar, either by itself or as a complement to the migration forecast system, and cancelling operations during heavy migration will prevent at least some, if by no means all, in-flight birdstrikes.



The author received his M.SC. degree in biology from Leiden University in Holland, following which he spent his 2-year conscription period at the Air Staff in The Hague working on the Dutch bird-strike problem. Since his emigration to Canada in 1967, he worked on "Operation Bird Track" at CFB Cold Lake and monitored the spring migration of snow geese over the Winnipeg area. He helped Dr. W.W.H. Gunn of Toronto with the drafting of a manual on radar bird detection for use at the Air Traffic Control Training School.

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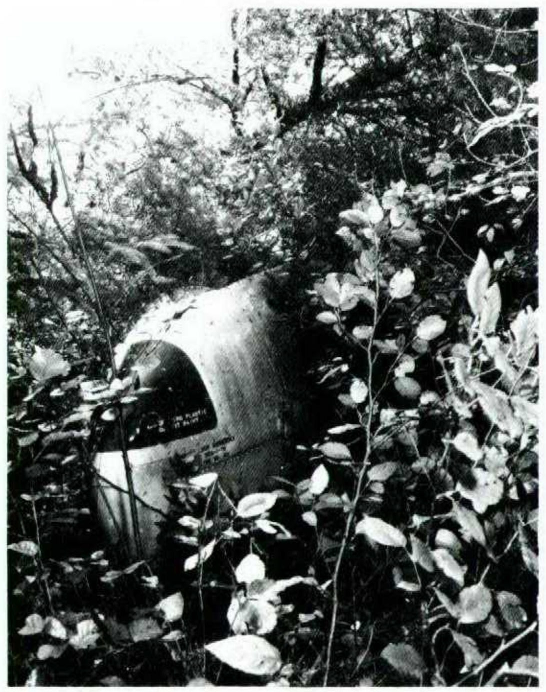
man whose performance is known to be temporarily below an acceptable standard? Man is capable of being highly trained, but his maximum output in relation to a complex system is limited by time and his 'alert state' and is a relative constant. The machine may be pushing us closer to our maximum capability than ever before.

With the advent of ever more complex machinery and tasking, we in the military should perhaps pay some attention to a most important human factor limitation – fatigue. To our old "soldiers" – perhaps the days of dogmatic "can-do" should be laid to rest.

There is little doubt that a military objective would be best achieved by:

- Realistic tasking of a unit in relation to its capabilities;
- Ensuring a man/equipment ratio of trained and fit personnel to allow continuous progress toward such an objective.

LCol Kinghom joined the RCAF in 1962 and served as the Medical Officer and later the Senior Medical Officer at RCAF Stn Portage La Prairie. He was then appointed Regional Flight Surgeon at 1 Air Division Lahr. In 1970 he became the Senior Staff Officer Surgeon at ATCHQ in Trenton.



"About that altimeter setting, Smedley...."

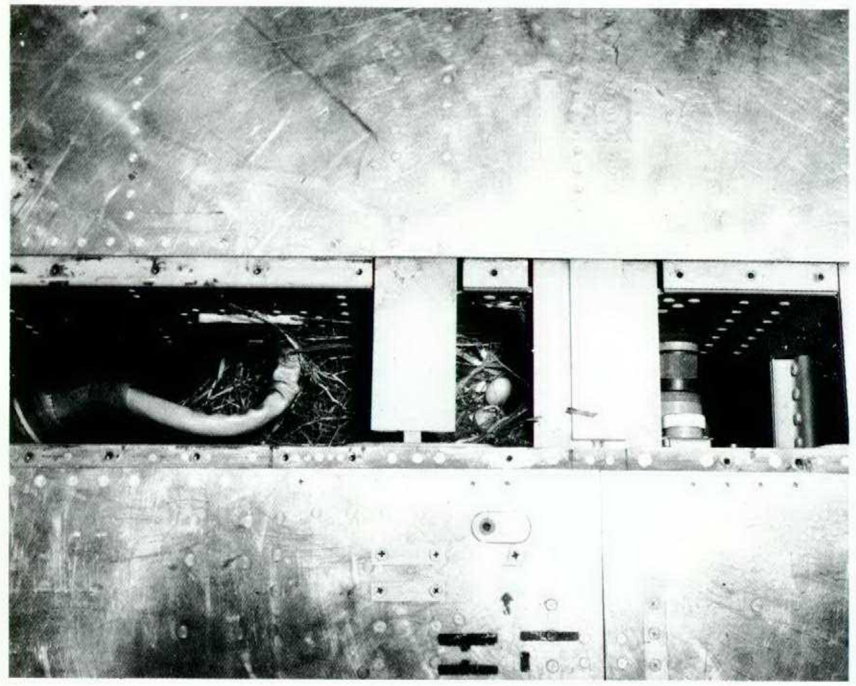
Bird Nests

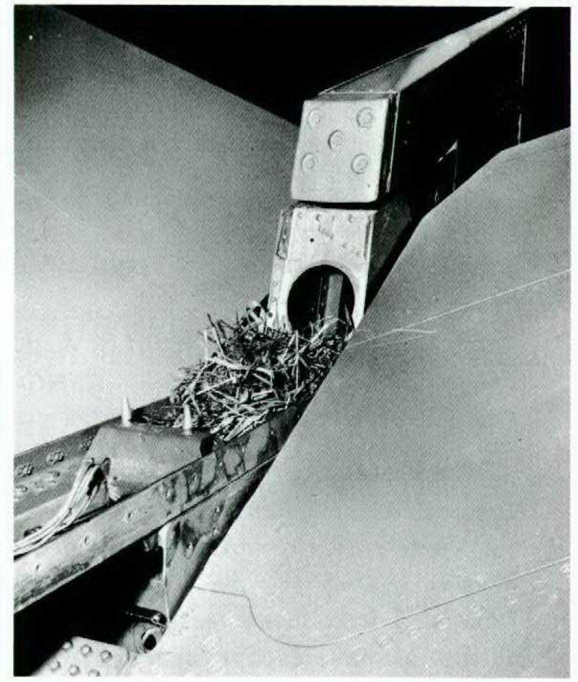
In the spring of the year birds like humans and bees get romantic inclinations. And judging by the number of times they pick such an unsuitable place as an aircraft in which to live they also have a housing problem.

Right now they seem to be particularly active at homemaking and several instances have been reported of nests being found in such places as carburettor intakes, jet intakes, and air ducts.

Birds can sometimes build their nests with amazing rapidity. A pair of particularly keen starlings have been known to build a nest in two hours. In another case a bird made a good start on a nest in the aileron hinge of a Dakota in forty-five minutes while the crew were flight planning.

This is the time of the year that extra precautions should be taken. Pilots should be particularly sharp-eyed while doing their external checks and remember, it doesn't require an aircraft to be left out all weekend before a couple of enterprising young birds can set up housekeeping.



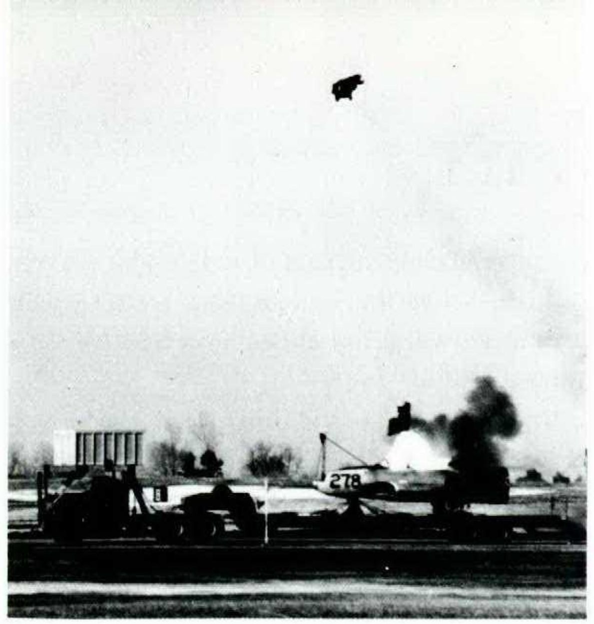


PREVENTION IS BETTER THAN CURE

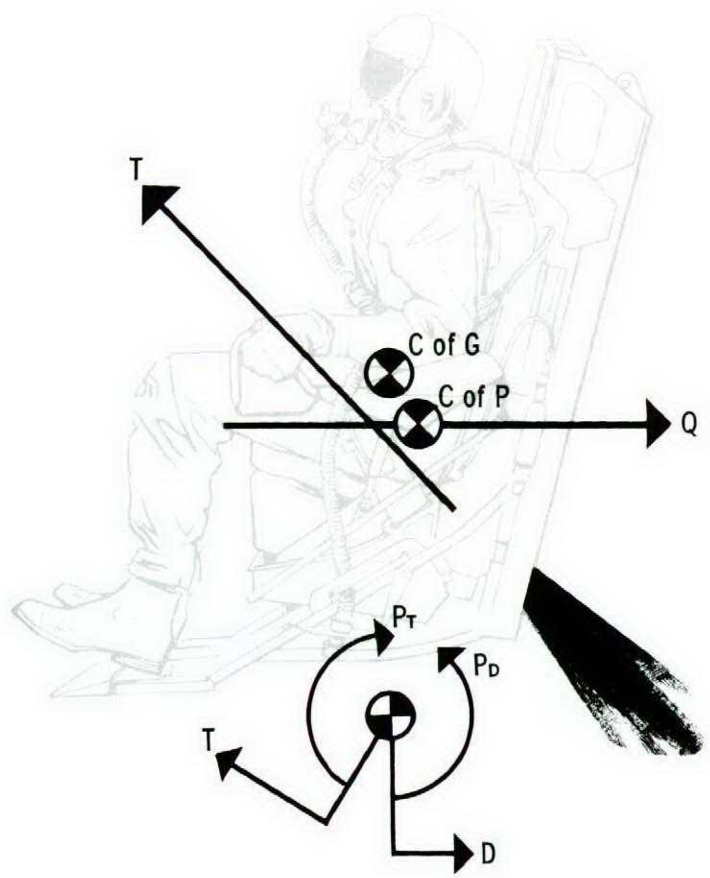
Excessive battery overcharging, or internal starts of turbine engines at frequent intervals, can lead to overheating of nickel-cadmium batteries and eventual thermal runaway.

Specific measures have been instituted to minimize this possibility e.g. limiting internal starts to emergency situations, and reducing the d.c. bus charging voltage in the summer in installations which require it.

However, *careful maintenance* is also an important preventive measure, particularly the proper torquing of cell terminals and close inspection of cell condition during periodical shop checks. On high-rate batteries it is important that the security of intercell connectors be checked at adequate intervals on the aircraft. A warning block on page 3-2-3 of EO 40-5EA-2 stresses this point.



The new T33 escape system



by Capt R. A. Jordan
CFHQ/DAE

"Modernization of the T33 escape system has been a recognized requirement for years. Test and evaluation of a prototype improved escape system for the T33 was begun in 1965, and from these tests – plus the availability of new escape systems hardware – come even more extensive changes than had been originally foreseen. Finally, after tests at AETE had evaluated the new system's capabilities throughout the aircraft speed range, we knew we had a much improved escape system with a greater life saving potential than was earlier aimed for."

This statement was from an article written by Major D.S. Poole in the Nov-Dec '69 Flight Comment. At that time it was planned to commence rocket modification in the summer of 1970. Now here we are, two years later, and the only T33 with a rocket ejection seat in the CF is T33 505 which is a test bed at AETE. I feel that it is necessary to reprint and update Major Poole's article and also to inform everyone concerned of the reasons for the delay in modification and the proposed modification date.

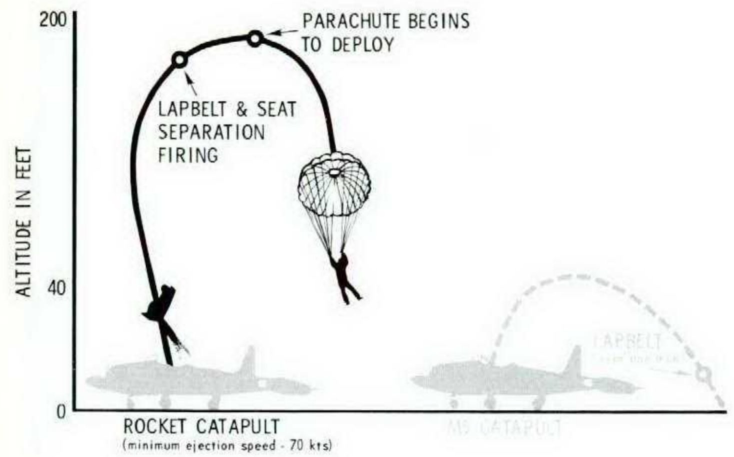
USAF statistics indicate that 90% of all ejections take place below 1000 feet. With the M5 catapult system, the record show 100% fatality below 100 feet (unless you land in a swamp as a pilot did at Thunder Bay in 1968). Below 500 feet things aren't much more encouraging – nearly 60% chance of not making it. It is therefore obvious that our greatest need for escape system improvement lies in the regions of low altitude and low speed, and in a descent. In retrospect, the escape systems team at AETE Uplands was able to satisfy the hoped-for improvements in the T33 ejection systems.

A number of components have been changed and others added. The new system consists of:

(a) a rocket catapult (ROCAT) capable of propelling a seated pilot to a height adequate for ground level ejection (70 knots – no sink rate);
(b) a seat/man separator in the form of a ballistically operated rotary actuator;
(c) a new lap belt which ensures a greater reliability for automatic opening;
(d) a new global rigid seat survival kit;
(e) a ballistic inertia reel (BIR) to ensure both forward and aft seat occupants are prepositioned in a good posture for ejection;
(f) a single motion ejection control;
(g) a sequencing system to ensure that both occupants are safely ejected from the aircraft in minimum time.

ROCKET CATAPULT

The new rocket catapult is a two stage device with the rocket motor encased by the catapult. The catapult is fired by a cartridge which is activated by pressure from an initiator. As the rocket motor separates from the catapult cylinder (almost at seat tip-off from the rails), the rocket is ignited. The catapult portion of the operation takes place in 0.15 seconds and accelerates the seat to approximately 45 feet per second. The rocket motor burns for 0.25 seconds with a maximum thrust of 6000 pounds giving an 18G acceleration. This rocket catapult is basically identical to that used in the Tutor aircraft; only the rocket thrust angle is different. The rocket thrust direction was selected to provide maximum stability for the full range of pilot "configurations" throughout the aircraft speed range. However, some tumbling can be expected in most ejections especially after rocket burnout. The forward component of rocket thrust provides a more comfortable deceleration during high-speed bailout. The vertical component ensures adequate tail clearance at high speed. The greatest advantage of the rocket seat is the added time it provides in trajectory; time is the critical factor in a low altitude ejection.



RIGID SEAT SURVIVAL KIT

This new survival seat pack developed by CFIEM offers greater comfort and stability during normal flight as well as ensuring better ejection posture with less slump and "submarining" under the lap belt. Less maintenance will be required. The global survival kit contains a more versatile life support package.

SINGLE-MOTION EJECTION CONTROL

For the pilot, the only difference from the present system is that the trigger has been eliminated. Raising the right hand armrest now initiates the entire firing sequence. The reason for the change is that aircrew in stress and disorientation have had difficulty in finding and actuating the trigger. For instance, during one year 35 surviving USAF pilots reported difficulty in locating the trigger due to disorientation or panic. How many non surviving pilots suffered the same problems? Obviously, they were not as successful as the survivors. Other pilots squeezed the handgrips before realizing they had missed the trigger, or, they pulled the survival kit release instead of the armrests.

BALLISTIC INERTIA REEL

Adding a ballistic inertia reel to the T33 ejection seat ensures correct positioning of both occupants prior to ejection regardless of who initiates the ejection. Controlled haul-back of the shoulder harness through the BIR (essentially a gas powered wind-up reel similar to the seat/man separator) cinches up the upper body thus imparting good ejection posture and providing adequate restraint. The same type of BIR is installed in CF5 and CF104 aircraft and has operated successfully on previous ejections. However, aircrew must ensure that lap belts are tightened properly; the BIR could increase the possibility of "submarining" if the lap belt is loose.

RPI AUTOMATIC LAP BELT

The addition of the RPI gas operated lap belt offers some new safety features to the T33 ejection system. The new belt has greater reliability for automatic opening, positive arming of the parachute during opening, and a "no lock" restriction unless the parachute arming cable tab has been correctly inserted. The belt is operated by a one-second delay initiator which is activated when the seat starts up the rails. The positive lock modification which was developed by AETE and on which aircrew were briefed by a CFHQ team during Feb–Mar 71 will be included on the belt. Disadvantages such as weight and difficulty of strap-in are known complaints but when the decision to purchase was made, there was no alternative on the market. The RPI belts are now standard on all our high performance aircraft; they have worked flawlessly on more than 30 ejections.

SEAT/MAN SEPARATOR

One second after the seat begins to move up the rails a gas initiator ballistically operates the seat/man separator or rotary actuator. The actuator, which is basically identical to those used on other CF ejection seats, coils up a "y" strap webbing which is normally stowed beneath the survival kit and attached to the seat bucket lip. This forcibly separates the man and seat. Seat/man separation is essential to prevent seat interference with the man or parachute. The rotary actuator device does provide adequate seat separation.

PARACHUTE

The back style standard 24 foot diameter flat circular canopy parachute with the MK10A timer and emergency oxygen bottle attached, is a good parachute system and has remained basically unchanged. The time delay setting in the timer has been reduced from 3 seconds to 1 second making it identical to the back style parachutes in our other escape systems. The parachute tab that attaches the arming cable to the RPI lap belt, has been slightly modified. The seat pack type parachute can no longer be used as it allows an unacceptable shift in centre of gravity during ejection with a rocket catapult.

SEQUENCING SYSTEM

Sequencing at the ejection became necessary when rocket seats were introduced in single canopy tandem aircraft. The rear occupant must be ejected first so that he will not be exposed to the forward seat's rocket blast. Regardless of who initiates the ejection, the rear seat is always ejected first. The instructor will now ask: What about the student being able to eject me without my consent? Read on, and keep in mind the reasons for the T33 sequencing system. First, it is mandatory (as already stated); hence, the only alternative is to leave the existing catapult system in service. Second, the student on the T-bird is of necessity not totally inexperienced; he should react to a situation with some competence and predictability. Of course, all aircrew will be thoroughly briefed on how the system works, and its advantages. For example, the addition of the haul-back inertia reel will ensure that even if the ejection sequence is initiated without warning from the forward cockpit, the rear occupant will be pre-positioned for ejection. With the new ejection system either or both occupants can go for the ejection handle if the situation seems to warrant ejection.

What about the command selector system? Both the USN and USAF have tried or are using a command selector system to ensure that the instructor is not inadvertently ejected by the student. Both systems ensure that the rear occupant always leaves the aircraft first.

USN

The USN command system has a selector handle in each cockpit. They are inter-connected and operate as one unit. Either pilot can assume command by moving the control to the "both eject" position in his cockpit:

(a) If the selector is so positioned in the front cockpit, the rear selector position is "rear only". In this configuration, the front cockpit occupant can eject both seats, or the rear cockpit occupant can eject himself independently.

(b) If the selector is so positioned in the rear cockpit, the front selector position is "no eject". In this configuration the rear cockpit occupant can eject both seats, but the front cockpit occupant cannot eject without first moving the selector back to the "both eject" position in his cockpit.

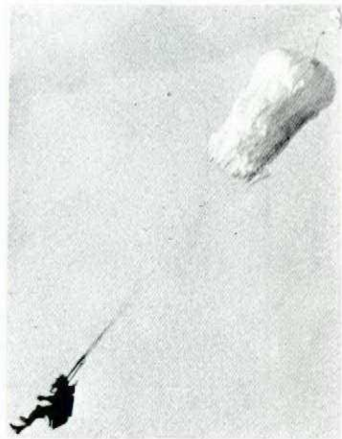
Should the front occupant try to eject when his selector is in "no eject" position, the initiators can be fired and the BIR retracted, but the seat will not eject. He then must first reposition the control to "both eject" then employ the opposite ejection method – either the face curtain or "D" ring. This system could add time to the ejection sequence depending on control position and flight circumstances.

USAF

In one USAF command system, if the control is positioned for rear cockpit command, the front armrest ejection control cannot be raised. When the rear seat occupant ejects, the front cockpit handle is automatically unlocked allowing the front occupant to eject. When the control is positioned for the front cockpit control, the front/rear linkage is disengaged allowing both occupants to be ejected from the aircraft in the proper sequence. This system also complicates the ejection procedure and could cause delays or even trap the front seat occupant were the other occupant to become incapacitated. The USAF no longer employs this system.

CANADIAN FORCES

A delay cannot be tolerated; the new T33 ejection system ensures that either or both pilots can eject in the



minimum time with a maximum possibility of survival. To achieve this, there is no command system; it is possible for the front seat occupant to eject the rear seat occupant without his knowledge although the probability of this happening is remote. Again, this points to a thorough education program preceding use of the system.

EJECTION PROCEDURE

To eject, the front seat pilot raises the seat armrests. Both armrests should be raised simultaneously even though only the right handle initiates the ballistic system. The ejection handles offer some restraint and protection during ejection. The sequences are then automatic;

(a) The canopy ejects, and both ballistic inertia reels fire simultaneously;

(b) the rear seat ejects one second after initiation (the one-second delay ensures adequate canopy clearance at low speed);

(c) the front seat ejects one half second after the rear seat – a total of 1-1/2 seconds after initiation.

This sequence is the same whether the rear seat is occupied or not; in fact, the rear seat will eject even with the safety pins installed as for solo flights.

The rear seat occupant can also initiate his own ejection at any time independent of the front seat occupant's action. The armrests function in the same manner except that the front occupant will not be ejected; he must initiate his own sequence. The ejection sequence is the same for both seats; after the rocket catapult fire the sequences are:

(a) As the seat travels up the rails it mechanically fires a one second delay initiator which opens the lap belt and operates the seat/man separator (rotary actuator).

(b) The parachute is armed either by the momentum of the automatically opening lap belt segments or by the seat/man separation motion. Parachute deployment is unchanged except that the arming delay is now one second instead of three seconds.

(c) The parachute will be fully inflated approximately 2 to 3 seconds after seat/man separation depending on ejection velocity. This means the rear occupant should be under a full canopy approximately 6 seconds after raising the armrests. The front seat occupant's sequence is completed 1/2 second later.

During the design phases of this project the suggestions that another set of initiators be installed as a backup to the canopy release system was explored. It was not adopted because:

(a) we have no reported canopy initiator failures;

(b) the additional movements would consume valuable time;

(c) a major redesign of the system would be required.

USAF experience since 1972 points to 29 through-the-canopy ejections with three fatalities. Although not conclusive, the evidence suggests that in two of the three fatalities the seats were not equipped with a canopy breaker, which we have in our T33s.

IMPLEMENTATION

I am sure you must be asking why the modification program has not yet started. Basically the delay has been caused by the failure of one type of initiator to meet MIL SPEC limits of time delay during lot sampling tests. The culprit was the newly developed M10 gas fired two-second delay initiator which is used in the backup system for the front seat. Results of two groups of lot sample tests indicated that this initiator was 0.1 to 0.4 seconds over the delay limits when tested at temperatures of -65°F and +70°F. No qualified substitutes for this initiator could be found. The question then arose whether to delay the modification for an undetermined period while the manufacturer solved the initiator problem or whether we accepted sufficient M10s to carry out the modification even though they did not conform to MIL SPEC.

Reliability studies indicated that the total reliability of the initiator system (primary plus backup) for the rear seat was 99.6 and the reliability of the primary system for the front seat was 99.2. Because of the high reliability of the front seat primary initiator system and the significant advantages of the rocat over the present system the decision was made to accept the M10 initiators and go ahead with the modification. In the meantime a solution would be sought to the initiator problem so that these initiators could be replaced as soon as possible.

A further problem has arisen lately which was not evident until a quantity of ejection seats were modified by the contractor. It was found that there was not enough clearance to install the ballistic inertia reel complete with bracket in the headrest; differences in dimensions and tolerances between individual seats caused nuts protruding from the BIR bracket to jam up against the seat actuator electrical box in many seats. The problem was solved by countersinking the bracket and reversing the bolts; however subsequent testing with the modified bracket at AETE resulted in failure as two reels failed to retract the strap. This was due to the modified bracket causing misalignment in the reel. The manufacturer has now developed a new bracket which will be fastened to the reel in a jig to assure proper alignment. After testing by AETE, action will be taken to modify all T33 BIR brackets. This will be done as quickly as possible and should not cause further delay.

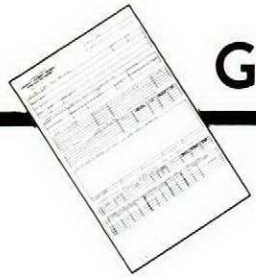
The rocket catapult mod became dormant during the period of initiator problems. Logistics slowed down and personnel changed. Action is now underway to reactivate this project and it is hoped to commence installation during the summer of 1972.

THE OTHER INGREDIENT – THE PILOT

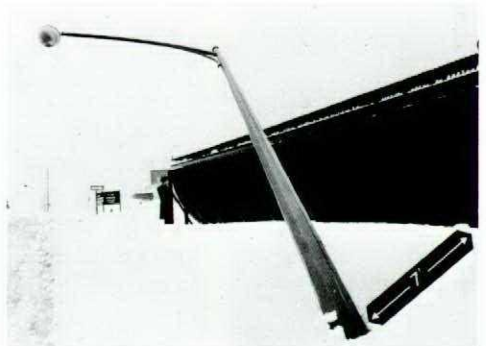
The new T33 emergency escape system obviously provides a much improved low-level escape capability. Having said that, pilots should avoid pushing this system into the region of its new capabilities. We have enjoyed two successive fatality free years, a tremendous feat when compared with the ejection records of other armed forces. This is attributable to highly reliable equipment and the pilots learning not to wait too long.

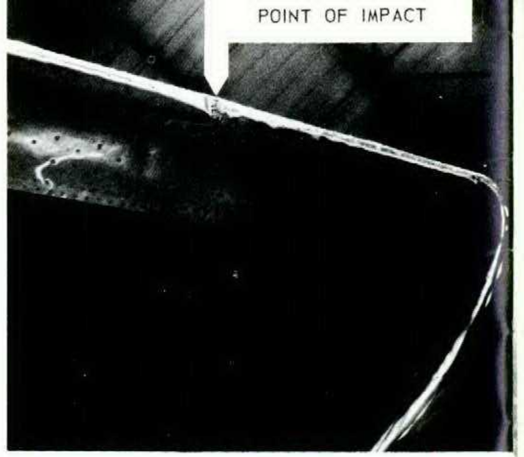
As Major Poole said previously, "We believe the T33 system is a major improvement; the rest is up to the pilot. Remember, ejection is well within the state of the art – resurrection is not!"

Captain Jordan joined the RCAF under the ROTP plan in 1961. After graduating from the University of Western Ontario with a Bachelor of Engineering Science degree he lectured at the Engineering Centre at Centralia. Between 1966 and 1970 he was project engineer in the escape systems section at AETE, where he conducted the sled trials for the Tutor rocket escape system held at Holloman AFB, New Mexico. At AETE he was also involved modifying and testing the escape system for the CF5, T33, CF101 and CF104. He also looked after the physiological and pressure suit aspects of the Centennial Project involving the CF104 which flew to 100,100 feet. Since 1970 he has been technical design authority for escape systems at CFHQ/DAE. Captain Jordan is a qualified parachutist.



Gen from Two-Ten





COSMO, TOWED INTO STREET LIGHT As the towing crew were manoeuvring the aircraft into position in front of the passenger terminal, the left wing of the aircraft struck an unlit lamp post located just beyond an adjacent blast fence. The impact damaged the leading edge de-icing duct.

The flight engineer in the cockpit saw the impending collision and tried to brake the aircraft; his warning calls to the driver could not be heard above the tractor noise.

As a result of the occurrence all aircraft will in future be backed into position and more emphasis has been placed on keeping towing vehicle mufflers in good condition. The offending lamp post has been permanently removed.

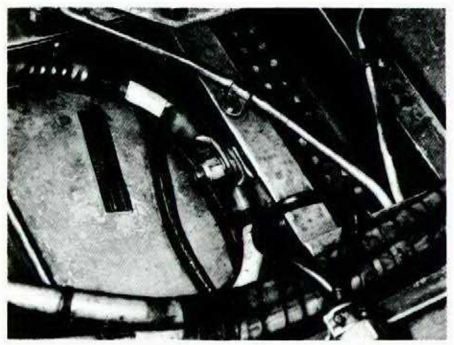
VOODOO, STRAY SCREWDRIVER During an armament loading exercise, the pilot had accepted the aircraft and lowered the canopy manually to a position just above the ladder. A monitor then decided to close the canopy. He removed the ladder and lowered the canopy further by the external canopy switch, however, about an inch from the fully closed position the canopy suddenly sprang up to about five inches above the rail. A large screwdriver was found lying on the canopy rail.

Investigation revealed that the aircraft had been put u/s three days previously, the repairs completed, and the aircraft signed out serviceable near midnight the same day. Subsequent work was carried out by various trades the following day and again the aircraft was declared serviceable. A DI and a SAC were performed before the aircraft was towed to the flight line.

Although various checks were made, a tool check was apparently not one of them, and a damaged canopy crankshaft assembly resulted.

T33, "LOST" SIDE CUTTERS The aft section had been removed during trouble-shooting for a fire warning light. While checking for indications of fire, a technician spotted a pair of side cutters firmly lodged between the skin of the aircraft and some grounding wires. Marks on the skin indicated the side cutters had been "lost" for some time – in spite of the fact that this particular aft section had been removed several times because a series of fire warning lights and to make repairs to JATO hooks.

This incident – one of several similar events in recent months – is symptomatic of a lack of appreciation among some technicians of the requirement for tool checks. It was fortunate that the side cutters lodged among grounding wires.



T33, ABANDONED INVERTER When the pilot checked the alternate inverter on his pre-taxi check, cockpit indications showed the inverter to be inoperative. After the same results on a subsequent check, the pilot put the aircraft unserviceable.

When the nose compartment was opened, technicians found that there was good reason for the inoperative signals received by the pilot – the inverter was lying loose and unconnected in the luggage area of the nose section. The aircraft had been signed out ready for flight.

Following the previous flight the aircraft had been written up for an unserviceable main inverter. While an instrument technician was replacing the defective equipment, a telecom technician was working in the area, so the IE tech left the inverter in the nose section and attended to other duties, while waiting for the telecom repairs to be completed.

When the telecom techs completed their job and ground checked the aircraft, they closed the nose compartment and signed the necessary entries on the repair card. Later, the instrument technician, without having returned to the aircraft, also cleared the entries against the aircraft and signed as having installed a main and standby inverter. Another NCO instrument tech signed the same CF349s in the "inspected" and "passed" columns. These were later certified serviceable by a senior NCO, a DI was carried out and the aircraft cleared for flight.

The cause factors assigned to this incident summarize the chain of omissions:

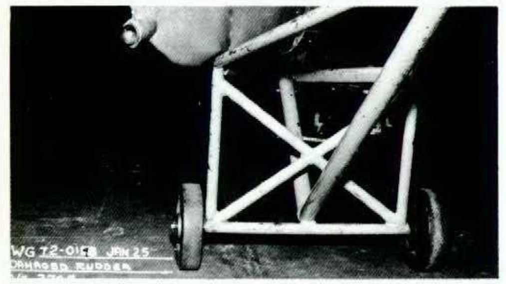
- The IE tech failed to install the standby inverter and signed the CF349 as having done so;
- The telecom tech did not check the adjacent area (AMO 00-15-2) for loose objects on completion of his rectification;
- The telecom junior NCO who inspected and passed the telecom repairs, failed to inspect the adjacent area;
- The senior NCO in charge of the snag allied trade section, failed to co-ordinate the workload between the trades in order to complete all rectifications orderly and efficiently.

BUFFALO, MURPHIED HOSES When the engines were shut down after a cross-country flight, a large quantity of oil could be seen seeping from the right engine. The source of the oil was found to be a scavenge line connected to the fuel-heater. A new line was subsequently delivered and installed and the flight continued.

Back at base it was discovered that similar malfunctions had occurred on this aircraft within a short period of time. The investigation revealed that the fuel-heater inlet and outlet oil hoses had been interchanged, probably during engine installation.

What was uncovered on further investigation reads like a page out of Murphy's EOs:

". . . Prior to implementation of EO ________ it was practically impossible to interchange the fuel-heater oil inlet and outlet hose assemblies, due to the length of the hoses. Following the modification, it became physically possible to interchange the hose assemblies . . ."

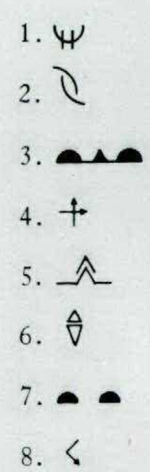


OTTER, BENT RUDDER The rudder was damaged when the towing crew lowered it onto the tail lifting-bar – the second such occurrence on the same aircraft within one week. After the first incident a UMI was promulgated but all personnel on the unit were not advised of it. The investigation revealed that an incorrect lifting technique had been employed again.

As frequently happens, the incident brought to light a lack of supervision. In this case the unit maintenance supervisor was not present during lifting operations – a requirement clearly stated in regulations.

How's your Wx?

Much valuable information may be obtained from symbols on a weather map or chart. Test your knowledge by matching the appropriate symbols with their meaning.



A. squall line
B. blowing snow
C. severe turbulence
D. tornado
E. moderate icing
F. frontogenesis (warm)
G. tropical revolving storm
H. frontolysis (warm)
I. hail showers
J. occlusion
K. lightning

Answers on page 24

Comments
to the editor

Hair Styling EO

In reference to your reply to the letter "Hair Nets?" in the Jan-Feb '72 issue, I would like to know when the 05-1 (Aircraft General series of Engineering Orders) became the authority for haircuts and styles.

When I read the article, I was intrigued that this regulation should be published in an Engineering Order, and upon looking up EO 05-1-2B, I discovered that this Order pertains to Self Luminous Aircraft Interior Markers, with no reference to haircuts, mustaches or hair styles. Are these markers hairy, or are the 05-1 series being rewritten ("given rise to the most recent amendment to Engineering Order 05-1-2B which now limits length of sideburns")? Perhaps you meant that when the Engineering Order is amended it will refer to CFAO 17-3.

Cpl C.W. Perry
434 Sqn Cold Lake

Actually, we meant to add an "E". The EO in question is 05-1-2BE.

434 Reunion

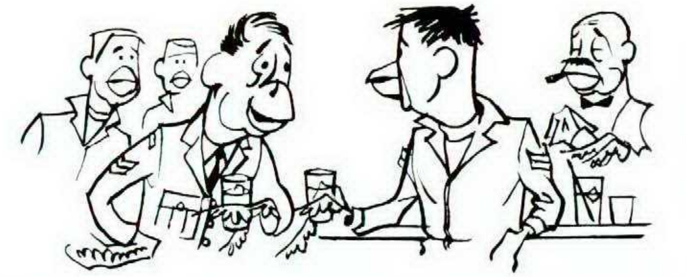
434 squadron is planning a reunion of all officers who have served on the squadron since its inception during World War II. It is to be held at CFB Cold Lake on the first or second weekend in November. Anyone knowing names and addresses of former squadron officers is asked to send the information to 434 Squadron, CFB Cold Lake, Medley Alberta. Former members will be sent further details.

LCol P.G. Howe
CO 434 Sqn.

Experience

We should be careful to get out of an experience only the wisdom that is in it. The cat that sits down on a hot stove lid will never sit down on a hot stove lid again and that is well; but also she will never sit down on a cold one any more.

Mark Twain



"What do you think of a fire hydrant marker 10' 2" high?"

"Great, can't miss it."

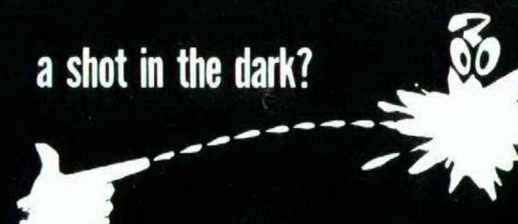
"We didn't."

FOD

While casually recovering from a power-on stall on a local check ride, a green 18-inch long, one-half inch in diameter snake slithered from the upper right airconditioning vent to avoid the cold and took up residence in the warmth of the instructor's lap. A complete survey of type and size of snake was accomplished in approximately .01 second. The instructor and student formed a committee of two to apprehend and confine the snake as it was in violation of current directives (not on flying status, not manifested, not medically cleared, no dog tags, and not enrolled in a formal training course). Subject snake was captured and confined to a sick sack for the remainder of the flight. Upon return to the flight room, subject snake was chastised for his willful violation of flying regulations and utter disregard for safety of flight. Damage to the aircraft was confined to minor seat cushion deformity. Ingenuity by pilots has changed many would-be accidents to good war stories. This story points out that ingenuity still exists and the opportunity to use it occasionally appears.

INTERCEPTOR

a shot in the dark?



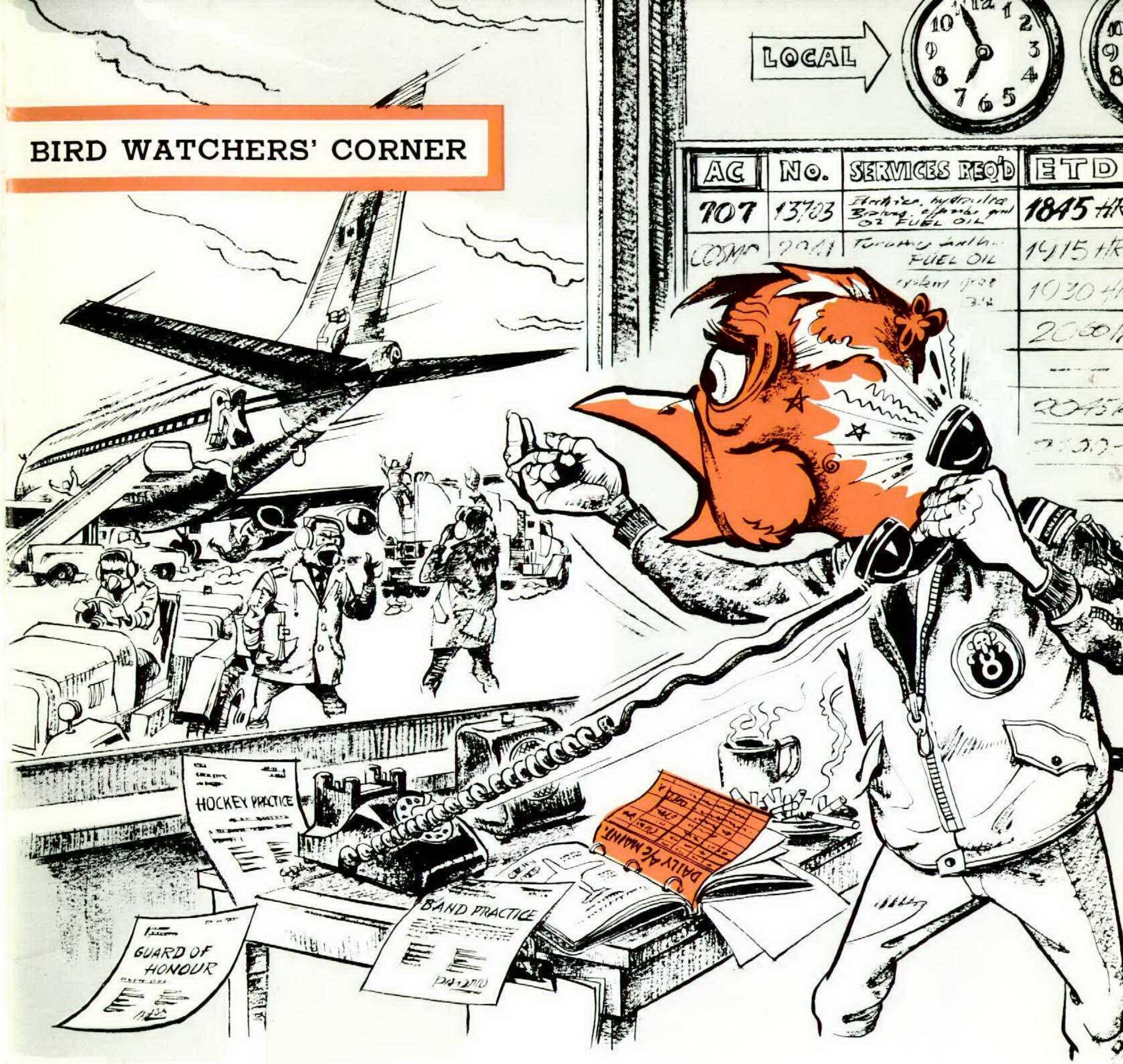
Crashes in the vicinity of an airfield usually provide a natural "magnet" for all aircraft traffic in the area, most of which imagines that it is trying to help. However, specifically-authorized search and rescue aircraft must receive priority over "rubber-neckers" or well-meaning but non-essential traffic.

Does the accident response of your base provide adequate control of aircraft in the crash area?

Answers to Wx Quiz

1-E	2-G	3-J	4-B	5-C	6-I	7-F	8-K

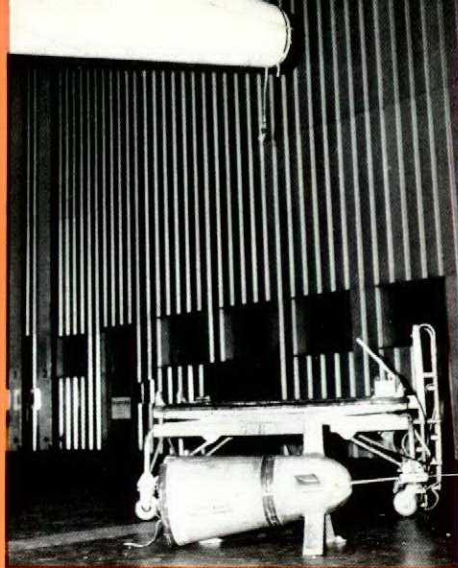
BIRD WATCHERS' CORNER



TURNAROUND SWIFT

Whenever aircraft are about to go flying, you can usually find this ornithological oddity in a flap, performing curious ritualistic gyrations to the accompaniment of raucous squawking and mad scurrying. Experienced birdwatchers attribute the behaviour to a frenzied environment created either by frantic supervisor birds, or by some species of the Swift itself, dedicated to advancing their own career. Departure time is king in this chaotic setting, thereby forcing technician birds to conduct repairs in whatever time remains before the scheduled takeoff — often not enough to do the job properly. Thus, like its near relative, the Walkaround Swift, this species is a hazard to upcoming flights. The call can occasionally be distinguished.

LAUNCHING-THE-PLANE IS-THE-NAME-OF-THE-GAME



Our Most Potent Enemy?