# AEROSPACE

SAFETY • MAGAZINE FOR AIRCREWS SEPTEMBER 1980

Pressing Problems . . . see page 5

# Minding The Store

■ "A good cockpit manager is an alert problem anticipator, an informed risk evaluator; and an effective delegator of duties who keeps a suspicious eye upon his surroundings. . . ."

Some time ago, A B707 aircraft was making an approach in 200/½ weather. Ahead of him, an L1011 with a hydraulic problem had landed successfully. The B707 captain noticed that the localizer was erratic during the latter stages of the approach. He was able to average out the excursions, but his suspicions were aroused. He found the runway in good position to land, but he went around on his suspicions, discovering the L1011 parked on the runway as he went around!

In another incident, a DC8 approached a runway reporting a 500 foot ceiling with one mile visibility. The first officer, who was flying, looked up at 400′ and saw what appeared to be strobes identifying the runway end. However, he *looked* at what he *saw* and successfully avoided a collision with another aircraft with wingtip strobes flashing.

These pilots were minding the store, an expression which might well be phrased to expect the unexpected. Fortunately, incidents such as these are incidents instead of accidents because most pilots have learned the trick of keeping an eye on both the front and back door, never allowing an intruder in the form of emergency, distraction, or complacency to keep them without an exit. For those who have not yet cultivated the sense of awareness on good storekeeping, here are a few questions which you might ask yourself:

- Do you study the flight plan complete with NOTAMS, weather, etc., or do you just read it?
- When you check the Maintenance Log, do you go back far enough into previous pages to get a history of problems past which may become problems future?
- While preparing for takeoff in poor weather, are the departure airport approach plates handy for an unexpected quick return?
- On lining up for takeoff, are there any birds, ditches, ground vehicles, etc., in close proximity?
- During the initial pre-$V_1$ takeoff roll, are you thinking abort instead of go?
- During the takeoff, have you considered other problems beside engine failure?
- Throughout climb vectors (as well as descent) are you physically building fences with VOR radials, etc., or otherwise mentally keeping track of terrain or traffic hazards?
- If an emergency or other distracting problems arise, has one crewmember been positively identified as *the* pilot to fly the aircraft while the others solve the problem?
- In cruise, are your thoughts including the weather at your alternate as well as at your destination?
- When everything is going so right that you feel good inside, do you start instinctively looking around for what could go wrong?
- On approach, are you looking for those same runway hazards that you watched for on takeoff?
- During an instrument approach, will you be expected to follow the published missed approach or will you be vectored?

This could go on ad infinitum. The point to be made is that a good cockpit manager is an alert problem anticipator, an informed risk evaluator, and an effective delegator of duties who keeps a suspicious eye upon his surroundings with a positive confidence while minding the store. – *Western Airlines Memo to pilots*. ■

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## SPECIAL FEATURES



## REGULAR FEATURES



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# Something Is Wrong. what should I do?

By **MAJOR TERRELL J. OSBORN**
Directorate of Aerospace Safety

■ While performing some air work, the crew experienced an engine flameout. It was an emergency, all right, but not of the ''extreme pucker'' variety. Just advance the other throttle, pick up windmill speed and restart the dead engine. It seems simple enough. Just one problem. The pilot left out one of those steps. He didn't maintain the recommended restart speed. The pilot did not realize he was holding much too slow an airspeed. He finally gave up and ejected, only to have the aircraft pick up speed and perform its own airstart after he ejected. An isolated occurrence? Not exactly.

During a recent 12-month period, crewmembers experienced nine aircraft emergencies (three of these were simulated) which they did not analyze properly. In each case, the crew used the wrong procedure and bashed the bird. Here is a recap of eight of those mishaps:

- Throttle failure. Didn't do the checklist steps; ran off the end of the runway because of a failure to shut off the engine.
- Throttle failure. Didn't analyze the problem and used the wrong procedure, resulting in hydraulic failure and ejection.
- Compressor stall. Landed hot and ran off the end of the runway.
- Engine failure (two-engine aircraft). Didn't follow the checklist and used the wrong procedure. Lost control.
- Student pulled the gear up early on a touch-and-go landing. An afterburner go-around could have salvaged the situation, but the student didn't use afterburners.
- Simulated engine failure for landing (two-engine aircraft). Got slow and lost control.
- Simulated engine failure in flight (two-engine aircraft). Did not maintain control.
- Simulated engine failure on takeoff (four-engine aircraft). Lost control.

There are many thousands of emergencies experienced by our crews each year, and the vast majority cope successfully with the problem. However, this review indicates that emergencies (both real and simulated) are unforgiving of errors.

What about minor problems which don't really classify as emergencies? Well, here again, some of our crewmembers have turned little problems into mishaps by not analyzing the situation correctly and maintaining aircraft control. Here is a recap:

- While flying a low-level nav mission, the pilot aborted for weather. He ran into a mountain.
- While attempting to find a VFR route to base, the pilot encountered bad weather and ran into the ground.
- While flying a low-level nav mission, the pilot aborted for weather. He forgot to cross-check the instruments and lost control.


- The primary attitude reference failed while operating in the weather. Although two other references and another crewmember were readily available, the pilot lost control.
- The pilot allowed the airspeed to bleed off in the holding pattern. While attempting to gain some airspeed, the crew lost control.
- A crewmember experienced an intercom problem. While the crew was working the problem, the aircraft landed gear up.
- The pilot had to go lost wingman. He didn't transition to his instruments and lost control.
- During rejoin, the pilot lost sight of lead. He didn't take proper action and collided with lead.

Although the problems encountered by these crews were not exactly routine, they should have been readily able to cope with the situations. In each case, the crew had time to analyze the situation and take the proper action. But, something went wrong.

During this period, there were also eight crews that inadvertently placed the aircraft in a dangerous situation that required immediate action. These were of two types: stalls and unusual attitudes. However, in all eight cases the crews had sufficient altitude and time to make a recovery. And, in each case they used the wrong techniques and lost the aircraft.

Landing patterns should be fairly routine. Still, three pilots allowed excessive sink rates to occur, realized the errors, then took the wrong courses of action. Fortunately, they all walked away, but the aircraft were heavily damaged.

Thus far, the emphasis has been on the pilots. However, in two cases, another crewmember realized a problem existed, but failed to act where action was needed.

- A rear seat IP was making a landing but lined up left of the runway. The front seat student let him land short and left of the runway.
- During multiple fly-by's, the wingman realized lead was flying too low, but he didn't speak up. On the next pass, lead hit a building.

What can we learn from this summary? Obviously, in this one year period 30 crews experienced problems, realized they had problems, selected the wrong courses of action, and, consequently, experienced Class A/B mishaps. There are some additional points of interest in these data.

Five of these "failure to cope" mishaps involved weather operations. Weather complicates otherwise routine problems, sometimes with very little warning. Crews must be prepared for weather and ready to fly instruments. And, when operating at low altitude, they must have a plan firmly in mind for when weather causes a change of plan. A sudden encounter with weather is no time to begin to think about how to handle the weather problem.

Nearly all of these 30 mishaps involved situations that developed suddenly. The shock of the initial problem and the rapid buildup of ☞

# Something Is Wrong continued

stimuli surely tended to create task saturation and confusion. Very few of these situations are ''played out'' in simulators. There can be a big difference between practicing the out-of-control recovery procedure in the simulator and actually accomplishing it in the ''real world.'' The ''pucker factor'' just isn't the same in the simulator.

Approximately half of these mishap sequences started with an error by the crew. No matter what the error, whether it is a stall, an unusual attitude, or a sinking base turn, realizing an error has been made tends to be all-absorbing. A person has a tendency to dwell on his error instead of concentrating on handling the problem. When faced with a sudden, low altitude, diving, unusual attitude, is not the time to be thinking ''how did I get into this mess?'' It is time to be ''cool,'' and concentrate on taking the right course of action. There will be plenty of time later to sort out the error that caused the original problem.

Although approximately 80 percent of our non-FOD Class A/B mishaps involve fighter/attack/observation/trainer aircraft, 93 percent of the ''failure to cope'' mishaps involved these ''smaller'' aircraft. This doesn't imply that ''fighter pilots don't do it better.'' The exposure to the risk of many of these types of mishaps is higher for tactical and trainer crews.

The taskload per crewmember is relatively high in tactical scenarios, and situations involving unusual attitudes and loss-of-control are very unforgiving. Consequently, the margin for error is reduced to a minimum for tactical crews much of the time.

In two of these cases, there were crewmembers who could, and should, have interceded in the interest of safety, but they did not. There can be no excuse for realizing the other person isn't coping, yet doing nothing about it. The crewmember who is ''just along for the ride'' shouldn't be doing it in an Air Force aircraft.

There is no doubt that we need to reduce the number of times aircrews try, but fail, to cope with serious, unusual situations. Here are some thoughts on ways to improve the odds.

Be mentally prepared for problems, particularly those involving weather. Remember that aircraft control must come first.

Make more effective use of ''situation'' emergency training. Only one of the 30 mishaps involved a ''boldface'' emergency. The others involved situations requiring speedy, careful, analysis, not reflex response. Obviously, practicing the emergency procedures in the simulator is useful. However, that training is more realistic and interesting (and, therefore, remembered better) if it is situational. In addition, flight briefings, safety meetings, and ''bar talk'' sessions are excellent settings for discussing critical situations ahead of time and becoming mentally prepared. It is one thing to read about an F-4 out-of-control procedure in the Dash One. It is another thing to have an ''old head'' talk about the yaw sensation, violent rolling departures, the sudden unload/hang in the straps, confusing recovery rolls and the tough-to-make ejection decision.

''Don't worry about spilt milk.'' It requires a lot of mental discipline to not become preoccupied with why you lost control of the aircraft, but this discipline is absolutely necessary. To think about anything but the recovery procedure is probably to lose the aircraft— and yourself. Again, crews must condition themselves ahead of time for such situations.

Help your buddy. If the guy in the other seat or your formation mate is making a mistake, let him know. If he has a problem and is coping okay, just stand by and be ready. But when things go wrong and you know the better way, it's time to help. The alternative may be to attend the memorial service and wishing you hadn't been so shy. ■

# Pressing Problems

By MAJOR JIM STEWART
Directorate of Flight Safety, Canadian Forces

■ Two Hercules incidents which crossed my desk recently got me thinking (for which reason you could say they are noteworthy indeed).

The first involved a departure from a newly constructed airfield in the Arctic. The aircraft sustained damage to the tailskid during takeoff. The runway was bumpy and at about 80 kts the nose wheel bounced off the runway. Rather than risk putting the nose down into the bumps again, the pilot elected to continue the takeoff run slightly nose up. Subsequent bumping during the takeoff roll most likely accounts for the damage to the tail skid.

The second incident (just the next day) could have had more serious consequences. During takeoff from an uncontrolled airfield in Quebec the port wing tip contacted a shrub and received minor damage. The runway was covered in mud.

Before we go any further let me make one thing clear! I am not pointing the finger at these two pilots. They are both very experienced and competent. I, in fact, hold the personal belief that it was this experience and competence which may have prevented these two incidents from being of a more serious nature. In both cases, the crews were faced with the challenge of operating large aircraft into short, unmaintained airfields. So – how does all of this relate to Flight Safety?

Well – let's suppose that the pilot in control did not have the experience of these two individuals. What would be the result if the nose wheel were lowered to the runway, hit a large bump and collapsed? What would be the result if the wing tip had contacted the mud instead of a shrub? What if, in fact, the pilots were brand new aircraft commanders who had little experience in operations into airfields that are not maintained and for which little or no information is available?

There is no point saying it can't happen, it can! It can happen to you and it can happen to me. In fact, it has happened to me! And that, readers, is what this story is all about.

I was a brand new Hercules aircraft commander and one of my first duties was in the Search and Rescue role. This role entails some ☞

of the toughest flying one will ever do in a Hercules. Low ceilings, poor visibility and there you are cranking around a 130,000 lb airplane at low level.

My first SAR launch was a search in Quebec, north of Bagotville. We filed our flight plan and boarded the aircraft. During startup Base Ops advised that we were to deliver the searchmaster and his team to Chibougamau where they would establish search headquarters. We boarded the party and rushed to make our takeoff time within the allotted two hours after callout.

During taxi the searchmaster asked on intercom if, in fact, 3,500 feet of runway was acceptable for landing a Hercules. Sounded all right to me so we launched off into the low cloud and rain which covered our transit to Chibougamau as well as our search area.

Enroute we began to get a little more professional. We consulted the letdown book and the charts and realized that Chibougamau had a runway length of 3,800 feet. Our ground roll was about 2,400 feet, so we needed 2,900 feet to do a maximum landing. No sweat – we had lots of runway! An added bonus was the fact that the runway surface was gravel. This would help to eliminate the problems associated with landing on a wet runway.

About this point the eagle-eyed flight engineer mentioned that we would be at maximum recommended landing weight and would have over 6,600 lbs of fuel in the outer wing tanks.

(Technical break – the Hercules aircraft is restricted, on landing, to a sink rate of 540 fpm. If, however, you have over 6,600 lbs of fuel in the outer wing tanks this figure is reduced to 300 fpm. Further to this, almost all Hercules fires on landing are caused by hard landings which break the wings and release fuel from the tanks. Got the picture?)

We effectively solved the wing fuel problem by remembering to brief a 300 fpm sink rate on landing. Piece of cake – right?

We also received a weather report for Chibougamau and it was not encouraging. It was 700 overcast with rain and haze and the wind was 90 degrees off the runway at 20 gusting to 25 knots. We flew an NDB approach, broke out at about 700 feet AGL and transitioned to a maximum performance visual approach. (Time for a break.)

Our blueprint for disaster is coming along nicely. Let's just review the box we were building and see what we did not have going for ourselves:

- 3,800 feet of gravel runway with a raised portion in the center area at the 2,000 foot mark,
- wing fuel such that sink rate at touchdown must be below 300 fpm,
- wind 90 degrees off at 20 kts with a 5 kt gust,
- ceiling at circling limits and on limits for the maximum performance landing,
- reduced visibility in rain and haze,
- no information on runway condition,
- transitioning in minimum weather for a maximum performance landing without the benefit of an orientation pass.

As we broke out we saw that the final approach path was crossed by a high power line. Past the power line was a downslope for about half a mile and then an upslope to the runway. This necessitated a dive down to the runway after passing the power line with the subsequent hazard of misjudging the upslope to the runway environment. The aircraft was flared just over the end of the gravel surface.

Unfortunately, as so often happens, the mind was so busy collecting and compensating for the marginal conditions that an important visual cue was not registered.

The end of the gravel was not, in fact, the end of the runway. The gravel had been pushed over the end of the runway and was very effectively masking a hazardous lip on the runway threshold.

The aircraft touched down in the center of the runway with wind correction applied, 20 feet short of the actual threshold. We contacted the lip of the runway in what can only be described as a controlled crash. After a thorough walkaround by the flight engineer, we flew back to Trenton, entered a heavy landing in the MRS and requested a thorough heavy landing check.

Not a super day by any standards but we were extremely lucky! Deciding to press on regardless of the marginal conditions could have resulted in a flaming wreckage at the end of the runway.

Since arriving at DFS I have

noticed that this was not an isolated incident. There are many pilots out there who press on with the assumption that they can handle all conditions. General aviation still lists, as the major cause of accidents, pilots flying into weather they cannot handle.

Anyhow, you say, what's the point of all this? If we don't want to have accidents, we put them in the barn and leave them there – right? WRONG! We have a job to do. The idea is to do the job in the safest way possible. Flying entails risk. There is no way around this. The question is – what risks can we accept and still safely accomplish the mission? There are no easy answers.

I know, in my case, after Chibougamau, when I was forced to operate without any factor on limits, I spent considerably more time evaluating just how my aircraft's performance would be affected. If I had two factors on limits I knew I was going to have to be alert to the combined effects of the conditions. If I had more than two factors on limits I reevaluated the importance of my mission and weighed the options available. These options could be as simple as a hold until conditions improved, landing on another runway or as demanding as a diversion to another airfield. In any event, the purpose was to set a priority on the mission at the operator level.

You may think that some commanders at this point are saying – WHOA, ENOUGH! We'll never get the job accomplished if every pilot refuses to fly to the limits of his aircraft. Well, commanders are also interested in safeguarding their resources, and their biggest resource is personnel – YOU!

Besides, I am not suggesting a reduction in what are proven safe limits of aircraft operation. What I am suggesting is that mentally and physically we may be able to cope with one or two marginal conditions but if we continue to accept additional marginal conditions we may overload ourselves. We then begin to miss important information and have set the stage for disaster. Each of us must set limits on our own performance capabilities. If we don't understand our limits there exists the chance of unknowingly exceeding them.

One of my first pilot instructors made an interesting observation. When he became a pilot instructor he realized that he had to establish limits of performance for himself. For six months he allowed his students to fly to his limits with the

"The aircraft touched down in the center of the runway . . . in what can be described as a controlled crash."

confidence that he could recover. During one mission when the student lost control close to the instructor's limits, the instructor realized that he had left himself no margin for error. He then had to back off the allowable student limits to ensure that his own personal limits were not exceeded by the time he physically took control of the aircraft. A basic concept, you say, but it is a concept that is, at times, neglected in the effort to accomplish the mission. – Courtesy No 1 1980, *Flight Comment*. ■

# Tell it LIKE it is

■ Today was a special day for John, his first official act as an instructor pilot. The mission: a recurrency ride for one of the line pilots. Frank, the line pilot was in the front seat. John, sitting in the back seat was closely monitoring the engine start and was thinking: Boy, I hope things go good today. The boss is really getting up tight about late takeoffs and crew screw-ups. If we can get off on time and the ride goes well, it might look like things are turning around a bit. Better quit daydreaming and get to my own checklists.

Both engines were running now. John and Frank were preparing the aircraft for taxi. The crew chief had removed the chocks and was positioning himself for the aircraft to taxi when the trouble started. Frank was attempting to set his ADI when he realized the knob was loose.

"John, I've got a problem. I can't set my ADI. I think the set screw or something must be loose."

John began thinking, Oh, No! Ten minutes to take off and this has to happen.

"Can you get it to move at all, Frank?"

"I don't think so," replied Frank. "I'll get ground to take a look at it."

Frank unlocked his canopy in preparation for the crew chief, but his attention was still on the ADI. He thought to himself, maybe if I apply a little side pressure while rotating the knob . . . Hey! It works! "Got it, John! I've found a way to set the knob. No need for ground, let's press on. If you're ready, power is coming up!"

**By MAJOR ROGER JACKS**
Directorate of Aerospace Safety

"Ready, Frank," answered John. "That's great. I think we can make the on-time takeoff."

"Roger that!" adds Frank.

They taxied to the active, got a once over from mobile, received their takeoff clearance, and moved into position on the runway.

"Okay, Frank, the takeoff is all yours. Make sure you're all set before we roll. I'm ready now. Looks like we've got an on-time takeoff in the bag."

Last minute checks were performed, and the aircraft began rolling down the runway. Engine instruments looked good as the nose rotated into the air. Suddenly, the front canopy began rising into the wind stream. Shortly thereafter it violently ripped off the aircraft. John quickly told Frank, "I've got the aircraft." Control was transferred and John set the nose wheel back onto the runway. Brakes were applied and the aircraft stopped just short of the overrun.

"Frank, are you okay?" asked John. The question fell on deaf ears as Frank was engulfed in embarrassment. Damn it. Boy, did I blow it! How could I forget to lock the canopy! What do I do now? If I own up to it, the boss is going to go through the roof. My chance of ever becoming an IP will be slim or none if I admit to this one. I'll never live this one down . . . if I don't admit anything and just act puzzled it might be pretty tough to prove anything.

"Hey, Frank! Are you okay?" repeated John.

"Uh? Oh, yeah, I'm okay. Wow! That was some ride. I don't know how that happened. Canopy looked good to me before we took the active."

It wasn't long before the safety officer was on the scene and the investigation began. During discussions with the pilots, both crewmembers confirmed their cockpit canopies were down and locked. Neither one remembered seeing a canopy unsafe light. Maintenance investigations did not produce any defective parts or maintenance malpractices. Both operation and maintenance staffs began to worry about the possibility of an unknown deficiency in the canopy locking system. All base aircraft of that type were grounded for a one-time inspection. A message was sent to the Air Logistics Center describing the problem. They, in turn, grounded all USAF aircraft of that type for a one-time inspection. The canopy locking mechanism of the mishap aircraft was shipped to the factory for analysis. AFISC, MAJCOMs, and the numbered Air Forces assigned action officers to monitor the progress of the mishap investigation. Air Force engineering experts reviewed factory design specifications of the canopy locking mechanism in hopes of finding a reason for the failure.

Hundreds of people from numerous organizations were actively seeking an answer to the unexplained departure of the aircraft canopy.

Only one person knew it was a wild goose chase. Frank was not a bad officer. In fact, he was extremely capable and had accumulated an outstanding performance record. He was a good pilot and well thought of in the squadron. A combination of circumstances put Frank into a perceived corner of no escape. All the choices were poor, but in light of recent happenings in the unit an unexplainable cause looked the best. After all, the aircraft is sound, no one is going to be put in danger by not telling the truth. Maybe what he didn't realize was the enormous amount of people, equipment, money and time the Air Force would use tracking down a ghost.

Integrity has always been the cornerstone to an effective military organization. It's not my intention to get into a lengthy discussion on integrity but, rather, to illustrate the resources that are needlessly tied up or consumed when the facts of a mishap are deliberately hidden. Austere budgets, manpower problems and hard-to-get aircraft parts give added emphasis to the importance of integrity. ■

# A Form In Your Future

By MAJOR DION W. JOHNSON
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■ How sharp are you on the AFTO 781? A recent mishap involving a double compressor stall on takeoff could have been avoided if a Vari-ramp write-up had been put on a red X rather than a red diagonal. Technical Order 00-20-5 describes who writes up what in the AFTO 781. Here's a little refresher course.

### General Information

Symbols will be entered in the SYM block of the AFTO 781A to reflect the seriousness, in the opinion of the individual making the entry, of the particular discrepancy.

Ground abort discrepancies will be documented on the AFTO Form 781A by aircraft personnel only. The first discrepancy in such cases will be preceded by the notation "No Flight-Ground Abort." No entry is required in Block 10, FLIGHT CONDITION DATA of the AFTO Form 781H when a ground abort occurs.

The pilot or aircrew member will enter all defects noted before, during, and after each flight. They will not, under any circumstances, enter more than one defect in each block. However, they may use as many discrepancy blocks as necessary to completely describe a single discrepancy.

Prior to each flight, the pilot will review all discrepancies listed on the AFTO Form 781A and 781K. The pilot will not include in the remarks any discrepancy previously listed, unless the discrepancy is considered more serious than represented.

The pilot or aircrew member will enter their signature and grade in the DISCOVERED BY block for each discrepancy recorded.

When remarks are entered in the discrepancy block to denote specific attention to an item or situation, the remarks will be entered as follows: "NOTE – Do not operate hydraulic system, accumulator removed." The remarks may be underlined in red. The word "Note" will never be entered in the symbol block. When required, only the applicable red symbol will be entered in the symbol block to denote the seriousness of the entry.

When an aerospace vehicle has:

- made a barrier arrestment attempt/engagement,
- been involved in a ground or air incident,
- encountered severe turbulence during flight,
- made contact with a foreign object,
- been damaged in an accident,
- has exceeded the airspeed or G load limitations,
- made an extremely hard landing,
- used excessive braking action due to aborted takeoffs, long or fast landings, or long taxi runs at high speed,
- flown a sustained flight below 3,000 feet over salt water, a brief entry will be made in the discrepancy block. If known, the cause of the discrepancy and the extent of damage will be included when determined. Responsiblity for making this type of entry will rest with the individual having initial knowledge of the occurrence. These entries are required to assure that adequate inspections of affected systems or components are made to prevent or reduce the possibility of future accidents. The entries will be made upon occurrence of any of the conditions enumerated above regardless of the apparent condition of the aircraft.

Repeat discrepancies will be identified by entering in red "REPEAT" in the discrepancy block.

### Symbology

RED X. A red X indicates that the weapon system or support system is considered unsafe or unfit for flight and that the weapon system will not be flown until the unsatisfactory condition is corrected. No one will authorize or direct an aircraft to be flown until the red X is properly cleared. When the red X has been applied, inspection of the work performed to correct the discrepancy and the accomplishment of an audit of all related entries involved for completeness and accuracy are required by maintenance personnel authorized to clear a red X condition. This means to aircrews that two maintenance signatures are needed to sign off a red X.

CIRCLED RED X. A red X inside a red circle will be used to indicate that an aircraft is grounded pending compliance with an urgent action TCTO.

RED DASH. The red dash indicates that a required maintenance action, scheduled inspection, special inspection, time change item replacement, oil sample, operational

There's a form in your future. And your future might well depend on how well you take care of that form. Also, your attention to the form can influence someone else's future. That form is the Maintenance Deficiency/Work Record, better known as the AFTO 781A. If you do a good job filling in the right information, maintenance will have a better shot at giving you a good airplane.

check or functional check flight (FCF) which is due has not been completed.

▪ This symbol is used to indicate that the condition of the equipment is unknown and a more serious condition may exist. The red dash condition will be corrected as soon as possible by performing the required inspection, time change item replacement, operational check, FCF or necessary maintenance.

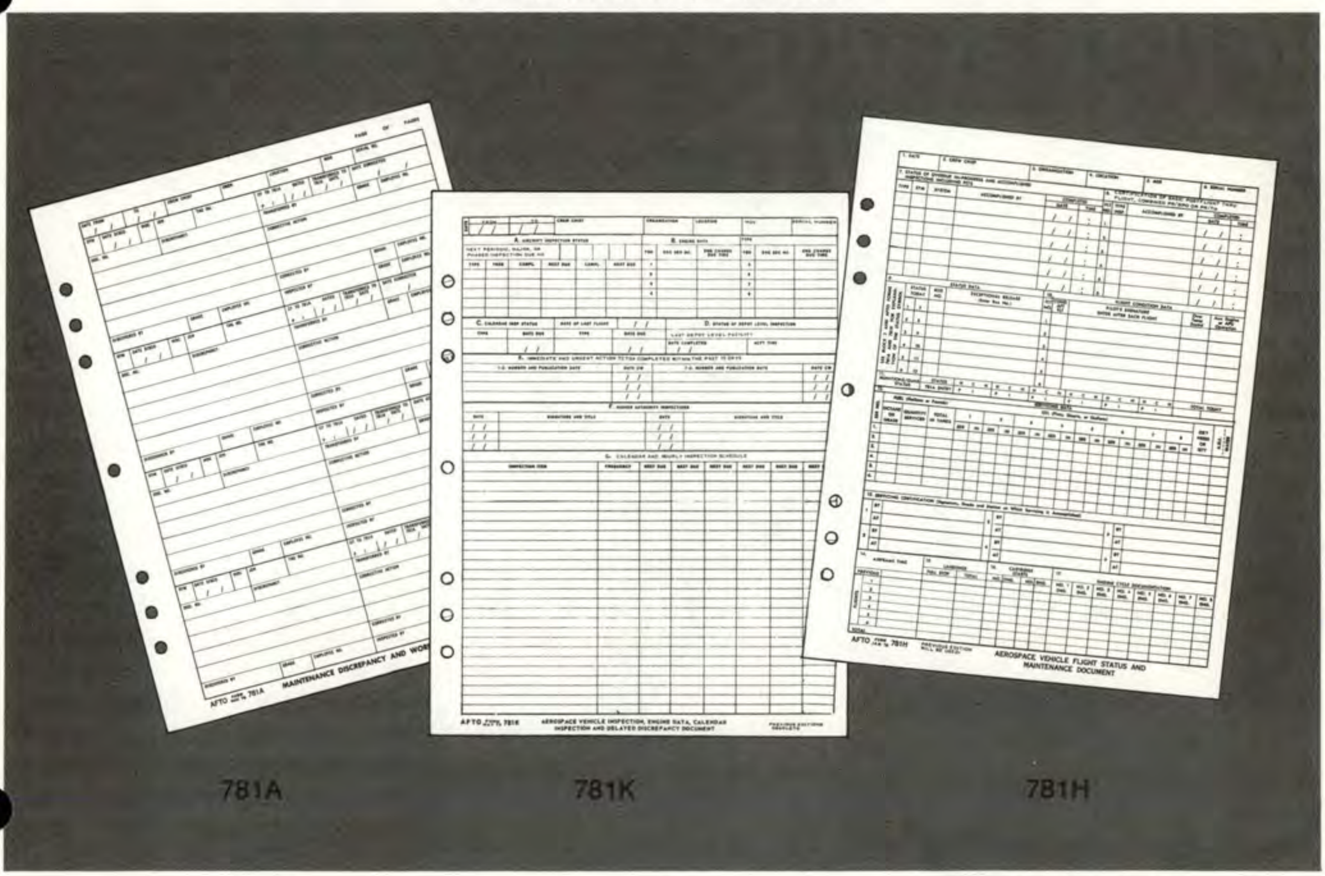
▪ Time change items, other than life sustaining items, continued in use beyond their scheduled replacement will be carried on a red dash until upgraded to a red X. Use of the red dash symbol will begin at the hourly postflight, minor, phase, periodic or major inspection nearest to the replacement due time.

RED DIAGONAL. The red diagonal indicates that an unsatisfactory condition exists on the aircraft or equipment; but, is not sufficiently urgent or dangerous to warrant grounding of the aircraft or discontinuing use of the equipment.

CIRCLED RED N, CIRCLED RED B, and CIRCLED RED C. The red letters N (Nuclear), B (Biological), or C (Chemical) inside a red circle indicate that an aircraft has been or is suspected to have been contaminated with a nuclear, biological, or chemical contaminant.

Hip pocket write-ups don't really do anyone any good. Get them down on the 781A. *Don't forget to transfer red X's in the log at the back of the forms. The history of red X's is for you, the aircrew. Since you fly the aircraft, you have the right to know what's been wrong with it. You also have the responsiblity to pass along this info to the next crew. ■

*Test program at Seymour Johnson AFB, NC.



# SURVIVAL: May Be A Snare

By SSgt. JAMES E. MARISCH • Arctic Survival Training • Det 1, 3636 CCTW (ATC) • Eielson AFB, AK

■ The thought of ripping the entrails from a rat or field mouse, plunging him in boiling water, and calling it supper or breakfast, does not appeal to many people. When our survival may depend on wild animal flesh we would like to simply walk up to a deer, elk, or moose, bash its skull with an axe and drag the carcass back to camp for filet mignon, and prime rib dinners. However, not many of God's creatures are going to stand still while the survivor strolls up and tries to terminate their existence. Granted, there are a few unfortunate creatures who possess little or no intelligence, but they are few and far between.

Whether you are running through waist deep snow in 40 below temperatures chasing snowshoe hares, or sprinting along in ankle deep sand in 120 degree heat chasing kangaroo rats, the survivor, as he is lying on the ground gasping for breath, will soon realize there must be an easier way to catch animals. The easier way is guns. But seldom does a survivor have a good weapon. What the survivor does have are traps and snares which work 24 hours a day, thereby making it much easier to obtain animals.

The first requirement for a trap or snare is simplicity. The more working parts or functions, the greater the chance of failure. One of the simplest snares is a simple loop snare, a loop made of small wire, string, rope, or any flexible material (Figure 1).

Tie a very small loop in the end of your material, then pass the other end of the material through the loop and you have constructed a simple loop snare. The size of the loop and strength of the material should match the head size and strength of the animal (Figure 2).

Most survivors should concentrate their efforts on small game, birds, rabbits, squirrels, marmots, etc.

**Figure 1**

**Figure 2**

Larger animals, such as deer, elk, moose, and caribou can be taken, but extreme caution should be used. Large predators, such as bears and members of the cat family, should be left alone. Large predators can cause severe trauma to the survivor and are very adept at killing. No survivor needs to spend long hours suturing shredded flesh or splinting broken bones. Dangerous animals should be avoided.

Once you've determined what animal you wish to catch, locate an area with an abundance of signs, i.e., droppings, and tracks. Look for areas of high use or trails which have the highest concentration of

## A majority of people take eating for granted

tracks and droppings. One set of tracks out across the lone prairie is not a good trail. Trails tend to meander through dense areas of vegetation. Find a spot where the trail is the narrowest.

Tie your snare so it hangs in the middle of the trail. Adjust the height from the ground so the bottom of the snare will hit the animal's legs just above the knees, i.e., rabbit 1½″ to 2″, squirrel 1″, deer 1½′ to 2′, coyote 10″, etc. (Figure 3). Adjust the loop so it's slightly larger than the animal's head. Outline with small twigs or pieces of vegetation to help conceal the snare, and place small branches on the sides of the snare to keep animals from going around it (Figure 4). When you are finished with the snare, step back and look at it, and make sure the area looks reasonably undisturbed. If so, good; if not, fix it. There is not a great abundance of suicidal animals in the wild, so your snare should look natural or your efforts may be futile.

Set out as many snares as possible and check them daily. The more you set out, the better your chances of procuring an animal. If, upon checking your snare, you find that you have outwitted some creature and caught it, this should prove that the snare was set effectively.

Once creatures are captured, they must be collected quickly to avoid possible loss to a predator. If the animal is dead, simply remove and reset your snare. If the animal is alive, kill it. This is best accomplished by placing a fairly stout piece of wood very vigorously between the eyes of the creature. This results in a very quick and humane death.

A majority of people take eating for granted. They just run to the chow hall, stores, or restaurants whenever they get hungry. However, when you are in a survival situation and see a lizard run by, or find rabbit and deer tracks everywhere, you'll soon realize that those animals are your breakfast, lunch, and dinner. You can't run them down and they are not going to surrender, so your only hope of eating may be a simple loop snare which can be extremely effective tool for your survival. ■

Figure 3

Figure 4

# MSAW--Pilot's Friend

By SMSgt MARSHALL E. HOLMAN
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■ Federal Aviation Regulations place responsibility for safe altitude management on the pilot. However, there is a function of the Federal Aviation Administration's (FAA) programmable automated radar terminal system (ARTS III) that assists air traffic controllers in detecting aircraft that are within or are approaching unsafe proximity to terrain or obstacles. This function is called Minimum Safe Altitude Warning (MSAW).

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Those pilots who are not familiar with this program may ask, "How do I participate?" Very easily, indeed! Aircraft on an IFR flight plan that are equipped with an operating altitude encoding transponder, participate by asking the controller. Example: "Los Angeles Center, (call sign) request MSAW." However, it must be remembered, participating in the MSAW program does not relieve the pilot of the responsibility for safe altitude management.

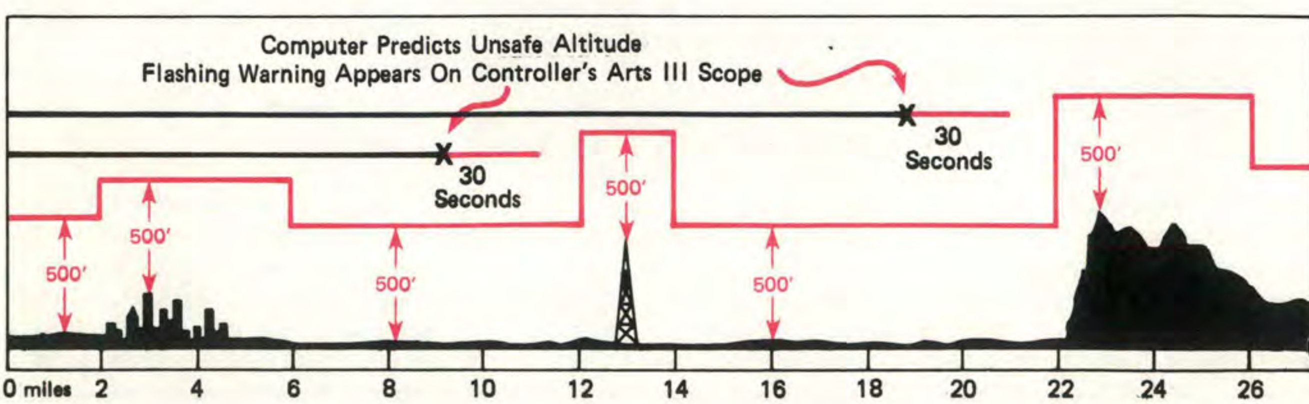
Here is a brief functional description of how MSAW works. For general terrain altitude monitoring, MSAW maintains a computerized grid map of the terminal area. The grid map is comprised of 2-mile squares. The highest known obstacle in each grid or bin determines the minimum safe altitude for that location. The minimum safe altitude is 500 feet above the highest terrain/obstacle in each bin. The ARTS computer compares the current Mode C altitude of an aircraft against the minimum safe altitude. It then looks ahead 30 seconds to see if the aircraft will enter a bin below the minimum safe altitude if it continues its present heading, altitude or rate of climb/descent. Then, the program assumes a 5-degree climb and computes to see if the aircraft will remain above the minimum safe altitude if it were to start climbing immediately. For the look ahead, a buffer of 300 feet, instead of 500 feet, above the highest obstacle is used.

MSAW monitors the final approach course from the final approach fix to a point approximately 2 miles from the landing threshold. It first checks 100 feet below the minimum descent altitude (MDA)/step-down fix altitude. Then it looks ahead down final using the computer established descent rate to determine if the aircraft will be 200 feet below the MDA/stepdown fix altitude in 15 seconds.

The computer alerts the controller if an aircraft is, or is predicted to be, below a minimum safe altitude by displaying "LA" in the aircraft's data tag on the radar scope. Also, an aural alarm is sounded to attract the controller's attention. The controller will then evaluate the situation and, if appropriate, issue a radar safety advisory; e.g., "LOW ALTITUDE ALERT, CHECK YOUR ALTITUDE IMMEDIATELY."

There are situations, however, under which the controller will not receive an MSAW alert; therefore, he may not be aware of the condition. Situations include:

- ATC radar beacon interrogator not operating.
- The ARTS III computer with the MSAW program not operating.
- The aircraft not being tracked by the ARTS III.
- The aircraft's Mode A or Mode



C transponder sending garbled, weak or erroneous signals. (Both Mode A and Mode C signals are required for MSAW processing.)

■ The aircraft not within radar coverage because it is below line of sight or too far away from the radar site.

■ A departing aircraft within 3 miles of the airport, or an arrival on final approach to an instrument runway and within 2 miles of the airport or between the stepdown fix and the airport. (Because of the various types of activity in an airport traffic area it is not currently practical to continue MSAW processing within these areas.)

■ The aircraft has been inhibited from computer processing for low altitude alerts. (Aircraft are sometimes purposely operated at low altitudes. MSAW processing of these flights will be inhibited because the controller would receive continuous alerts [false alarms] causing the intentionally low flying VFR pilot to be unnecessarily advised to check his altitude.)

Due to radar antenna rotation time, the computer needs about 10 seconds to establish a definite course and/or altitude change. Consequently, there are two conditions that may result in low altitude alerts being issued too late to permit the pilot to take corrective action. These are:

**An aircraft's projected track is clear of any known obstacle and an abrupt turn is made toward one.**

**An aircraft operating at an altitude just above the programmed MSAW makes an abrupt descent.**

Remember, when a pilot receives a low altitude alert advisory from a controller, it is the pilot's responsibility to evaluate the situation and determine what action may be necessary. Also, the pilot is expected to inform the controller immediately should any action be taken after receiving the radar safety advisory. ■


# Request Avoidance Vectors


**By SMSgt MARSHALL E. HOLMAN**
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**■ A recent near midair collision between a flight of four F-105's and a Bonanza near Tinker AFB emphasizes the need for all pilots to fully understand the availability of "additional" air traffic control services.**

**The flight of F-105s, climbing on a SID from Tinker AFB, was issued traffic at "11 to 12 o'clock, 10 miles, altitude unknown." As the flight was climbing through 5,500 feet MSL, a Bonanza was sighted, and the flight lead directed the aircraft on his left to stay low. A collision was narrowly avoided as the Bonanza passed slightly above and about 30-40 feet to the left. The Bonanza, which was not in contact with air traffic control, was observed to lose some altitude as it encountered the jet wash.**

**This near miss possibly could have been avoided if the flight had asked for and received avoidance vectors from the controller when the traffic was not immediately sighted.**

**The primary purpose of the air traffic control system is to prevent a collision between aircraft *operating in the system*. In this case, the Bonanza was not a participant in the system. Thus, according to air traffic control procedures, the F-105 pilot would have to request the avoidance vectors. When received by the controller, the request would have been treated as an additional service (third priority duty) and factors such as limitations of the radar, volume of traffic, frequency congestion, and controller workload would have determined the controller's ability to handle the request. However, it is highly likely that the request would have been honored.**

**Missing another aircraft by 30-40 feet, at 350 KIAS, while in formation flight, should be enough incentive for any pilot to request any air traffic control service the next time. Fortunately, for these crews, there will be a next time. ■**

# Residual Effects Of Alcohol On Aircrew Performance

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■ Many of the immediate effects of alcohol ingestion are well known and well documented. Hundreds of studies have been done over the years which point to specific negative effects on such things as reaction/response time, vestibular functioning, coordination, judgment, memory, decision-making, risk taking, and a host of others.

Our laboratory, among others, has periodically undertaken studies to examine some of these factors in an aviation environment. The findings not only substantiate these obvious alcohol effects but also have brought out the increased significance of such effects on a highly complex high risk task like flying a high performance vehicle in a hostile environment (1, 2, 8, 9, 15).

It is well known that drinking and driving a car is dangerous. Flying after drinking magnifies this danger potential. A comparison of automobile driving with flying may help to make this clear.

It is not uncommon to overhear an instructor pilot say to a prospective student, "Flying is as easy as driving a car." This is just not true! Controllable car motion does not have as many degrees of freedom as an airplane. The automobile driver controls left and right movement (yaw) only. An airplane pilot, on the other hand, not only uses a control for yaw but for pitch and roll as well. In addition, a pilot frequently, if not usually, controls all three of these axes at the same time in an attempt at well coordinated movement.

The speed of automobiles on the open road is presumed to be somewhere around the legal limit, 55 mph. Airplane pilots normally cruise at three figure airspeeds or more so that closing distances as a function of time happen much faster than in a car.

If the driver in a car drops a cigarette, loses his map, or spills a beverage, he can, if he chooses, pull over to the side of the road and retrieve the object or clean up the mess. If he is tired or a bit too relaxed because of the couple of drinks he had toasting the bride and groom at a wedding reception, he can pull over and rest. A solo pilot does not have that option. Once airborn, he must fly on until he reaches his destination. In sum, an airplane is more complicated than a car and flying is more demanding than driving.

A few years ago we conducted an experiment to see what effects alcohol might have on the general responses involved in a simple flying task (13). We gave college students, who had been practiced in a jet instrument trainer (Figure 1), enough vodka and gingerale to be the equivalent of approximately a .08% blood alcohol level. This was significantly below the limit established by the State of Ohio for legal driving (.10%). Thirty minutes later we asked them to fly a very simple profile. They were instructed to begin with the preflight checklist, continue through the run-up, taxi to the active runway, take off, climb to 5,000 feet and level off. They were to maintain this altitude until notified otherwise. Some of the behaviors exhibited during the study included: incorrect wing flap settings for takeoff and landing, accidental fuel dumping by selecting the incorrect switch, dropping the landing gear well in excess of placarded speeds, attempts to land by instruments at 10,000 feet above ground level (misreading the altimeter by 10,000 feet), forgetting checklist items or performing them out of sync, and in one case literally falling into the cockpit! And all of this while legally sober. That is, sober enough to legally drive a car!

Since most people who drink socially do so in the evening, we followed this study with a night-flight version (Figure 2). We found not only that our subjects (Ss) committed the same types of mistakes but were much more likely to act as though their visual apparatus had been constricted to a kind of tunnel vision with thinking to match. They were also unable to handle routine emergencies in an appropriate and timely fashion (14). We replicated these studies with some variations and found that data to be in general agreement in both cases.

The old World War II image of the hot-shot pilot included flying the hairy mission, making it safely to home base, and then repairing to the local bar to hoist a few and


Figure 1. Subject in single engine jet simulator.

Figure 2. Subject dark adapting while waiting for alcohol to become fully effective.

swap lies. It was part of the macho image of the day. That image has still not altogether disappeared. Many pilots, like non-pilots, do drink socially and a few drink more than they should. On more than one occasion prior to takeoff a pilot has been observed taking a few whiffs of 100% oxygen to clear out the cobwebs. This suggests that although it had been some time since the last drink, he was suffering from what is commonly known as a hangover – a condition we prefer to call residual or delayed alcohol effects.

A review of the literature on the lasting effects of alcohol ingestion discloses residual effects of alcohol that include changes in epinephrine/norepinephrine secretions (3), plasma testosterone levels (18), metabolic acidosis (19), plasma renin activity and plasma aldosterone levels (10), blood glucose, blood lactate, free fatty acids, and ketone concentrations (20), and, lasting from 14 to 21 hours after drinking. In addition, some studies have reported long lasting residual detrimental effects on such important functions to the pilot as Coriolis stimulation and positional nystagmus (6, 11) – functions important in maintaining equilibrium and correct orientation.

According to FAA regulations, Part 91 (7), only an 8-hour elapsed time is required between drinking and flying. This regulation assumes that detrimental alcohol effects have been effectively dissipated within the 8-hour period.

Because of the discrepancy between this FAA regulation and the reports of residual physiological effects in the literature, we set out to determine what, if any, residual behavioral effects could be observed when alcohol ingestion was combined with a fairly simple flight related task – a preflight checklist situation. More specifically, we were interested in comparing a no-alcohol condition with a 30 minute post-alcohol condition with a 14 hour post-ingestion condition. In this study, reported elsewhere (16), oversight errors were used as a measure of alcohol effects. For example, before each S entered the simulator cockpit, the experimenter preset the following errors.

The landing gear handle was placed in the UP position. If a pilot takes off in this condition and in this particular simulated aircraft, as soon as a significant amount of weight has been removed from the wheels, they retract automatically. Result? A good chance that the plane would settle back down on the runway and onto its belly.

The dive flap or speed brake switch was placed in the DOWN or extended position. This means that as soon as hydraulic pressure reaches the proper level they will extend and remain extended. Takeoff would have been extremely difficult, if not impossible.

Wing flaps were set at the 50% position. This would create excess drag and cause some difficulty on takeoff.

The fuel selector switch was a three-pole, double-throw, center-off switch by which the pilot could select

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TIP TANKS, OFF, or MAIN TANKS. For the experiment, the fuel selector switch was placed on tip tanks. This meant that after lift-off if the pilot tried to change the fuel switch by moving it one click (detent) in the proper direction, he would actually place it in the OFF position. Obviously, this would result in premature fuel starvation, probably on climbout.

The parking brakes were left off. If the pilot overlooked this, the aircraft would begin to move shortly after the throttle was placed in the IDLE position and the engine spooled-up. This action might easily bring about contact with other aircraft or support vehicles parked nearby at the very least resulting in "ding-damage."

Finally, the altimeter was misset by 1,000 feet. If not caught prior to attempting an instrument landing, the pilot, without realizing it, would actually be trying to put the aircraft 1,000 feet below the surface of the runway!

The results were very enlightening. In spite of the fact that all traces of alcohol were probably gone from the blood 14 hours after drinking, our results indicated a definite detrimental effect on the preflight task.

It is obvious that these misset errors hold considerable danger for the unsuspecting pilot. However, in this study if the Ss had carefully followed the checklist, they would have caught each and every one of them. This, unfortunately, was not the case. Fourteen hours after drinking, approximately 68% of all Ss missed at least one preset error as compared with 10% for the no-alcohol condition and 89% for the 30 minute post-alcohol condition. In fact, responses after 14 hours were much more like those 30 minutes after drinking than they were like those under the no-alcohol condition. The Ss did not anticipate errors, so they found none.

The results appear to speak for themselves. The residual effects of alcohol produced a significant number of oversight errors. How to explain this is another matter.

We can assume that all traces of alcohol were absent from the blood by the time the Ss were tested in the 14 hour post-ingestion condition. Therefore, it had to be something other than a direct alcohol effect. Alcohol produces significant changes in the body systems, as was pointed out earlier. These changes appear to remain long after the alcohol itself has been metabolized and may produce, in some as yet unknown way, alterations in behavior. Perhaps with time, the body readjusts, eventually returning to something resembling its normal state.

### Conclusions

What conclusions may we legitimately draw from all of this? Obviously, we cannot discount the residual effects found in the study described above. Further, this suggests that the same phenomenon may be occurring in other related conditions, e.g., military, air carrier, and general aviation flying but because of the less obvious, more subtle nature of residual effects, is not readily overtly observable. Beyond this we must be careful not to generalize too far afield. However, based on our findings it is suggested that the same thing may well be happening in many, if not most, industrial settings wherever man and machine are mated. In support of this thinking, one study (17) has reported detrimental effects on such industrial type tasks as eye/hand coordination and positioning for up to 18 hours after drinking. This is especially relevant to so-called high risk tasks where a slight error of judgment or miscalculation might be catastrophic for the individual worker and very costly to the industry itself.

Unfortunately at this point in time, we really don't know what proportion of industrial accidents or airplane crashes are caused partly or fully by this residual effect of alcohol because of its latent nature.

On the positive side, however, the FAA (4, 5, 12) has already begun a series of studies reevaluationg their 8-hour rule. More are anticipated. Notwithstanding that effort, thorough studies, particularly in realistic settings, are strongly urged on air carriers and military air arms, and, it is essential that such an important factor as residual alcohol effects be intensively studied in a wide variety of industrial man-machine situations and systems. ■

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# letter to rex

■ Here at Downsouth AFB one of our special interest items concerns the coveted Rex Riley Transient Service Award. We want it badly and intend to win it. I won't go into the details of our efforts toward this goal, but believe me, we're expending a lot of time and energy to provide the tops in transient support.

However, the object of this letter, Rex, is not to promote our efforts. We need your assistance in solving a problem which is plaguing not only us, but most likely other bases as well.

Rex, imagine this scenario: An Army C-12 with a general aboard lands and taxis to the parking area. A few minutes later a crew bus— a bus, Rex,— arrives and picks up the general and crew. Shortly afterward, the pilot walks up to Base Ops counter and announces to the shock and dismay of Base Ops personnel that the general has arrived! Not much of a welcome, right? It happened here and unfortunately, the story doesn't end in Base Ops. Not only had the pilot not bothered to ensure word was passed of the general's estimated arrival, he also apparently failed to read the "Welcome" brochure— in which local procedures are outlined— which Base Ops personnel provide transient crews. So, shortly before departure, instead of paying for coffee and flight lunches at our "One Stop" area in Base Ops, he walked to the flight kitchen, paid the bill and decided to walk back to his aircraft. Had he read the brochure he also would have learned that you don't enter the flight line at just any point on the ramp. There are clearly defined entry points and roped off restricted areas. As you might guess, the pilot walked into one of the restricted areas. That's when Security Police came into the picture. The pilot was quickly apprehended in what was rapidly becoming an embarrassing situation for pilot and general alike.

By the time the general's trip to Downsouth AFB was completed, he had, to say the least, become somewhat frustrated at the series of events which had occurred. And rightly so!

The bottom line to this, Rex, is that bases need some degree of cooperation from aircrews in order to provide good transient service. Granted, in the case just mentioned, the flight service station should have forwarded the DV information contained in the remarks section of the flight plan; but we all know— or should— that this doesn't always occur. There are additional methods to pass along such information— and receive acknowledgement of receipt. For example, a radio call to the Base Ops dispatcher or command post prior to landing— or even to ground control after landing if all else fails. Of course, when calls are made to other than Base Ops, pilots should request that the information be passed to Base Ops. Frankly, if I were flying a DV around, I'd probably use all of the above methods. After all, who wants to fly back home with an upset general?

You know, Rex, facility commanders can do everything in their power to provide excellent transient service but their efforts may fall as flat as last Saturday night's beer unless aircrews also make an effort to help themselves and their passengers. And when this occurs, the base often looks bad even though that may not be where the fault lies.

Well, Rex, thanks for listening and providing the opportunity to pass this info on to the aircrews. By the way, if you should find yourself on the road, you're welcome to drop in. Our troops here are friendly and professional and you'll find this a beautiful part of our country, especially during the spring months. We look forward to your next visit.

Hope to see you soon.

Chairman,
Rex Riley Award Committee

*Dear Chairman*

*We couldn't have said it better! Transient crews have no gripe coming if they don't make an effort to let the destination know about special requirements–be they VIP, fuel, cargo, parking, drag chute, etc. About the ramp security/entry problem–we've kind of passed the word to TA folks to remind crews of access points as they deplane. That can save a lot of delay and embarrassment. Thanks for the story. We'll stop by!* ■

# Safety First...Last...and Always

Not too far back in the history of the working man — about 90-odd years ago — the words "safety" and "work" just didn't get along together. Safety, during the brawling clangor of world industrialization, connoted a prim and elegant concept better suited to pale young men chatting in tearooms than to buckos sweating in the mines, the mills, firing the furnaces that made the wheels go 'round.

In those days the only safety a man could get was what his sinews and skills — and luck — could give him. And when these played out, laddie, that was the way of it.

Yet strangely enough, out of ego, ignorance or both, many of that era's workers developed a sort of arrogant pride in their ability to do a good job under perilous conditions — an attitude, incidentally, applauded by owners who considered anything less as disloyal, unpatriotic or, even worse, costly.

Turn-of-the-century Welsh miners, for example, regarded askance one enlightened owner's attempt to better their lot by equipping them with a "safe-labour helmet" — the prototype of today's hardhat that, ironically, has become the symbol of workman machismo.

A local gazette reported the miners' reaction: "... many of the colliers forthrightly eschewed the headpiece, one pit-fellow even likening it to a chamberpot better put to other ends."

But safety procedures weren't always considered an affectation. Not by a millenia. In fact, safety engineering can trace its conceptual roots to Greek antiquity: to Daedalus who not only invented man's first wings but who also originated the safety specs in how to use them properly.

The wings were made of feathers and wax, materials that more or less limited flight to a safe zone — the "middle air" between sun and sea. Too high and the wax would melt in the sun; too low and spray-soaked feathers would drag the craft into the sea. Daedalus, as the design engineer, knew the limitation of his construction; as history's first flight safety analyst, he developed a plan that would circumvent the flight's hazards — a procedure he stipulated to son Icarus, the soon-to-be mourned flyer. ☞

Everyone knows the story's end. Icarus violated the flight plan and flew too high; his fall from grace gave birth to the venerable Greek maxim: "Next time listen to your poppa!" Daedalus' admonitions were perhaps the first application of a discipline we mortals now call system safety engineering — a case history that reveals why industry now recognizes that the functions of the design engineer and the safety engineer are inseparable.

The importance of safety engineering is no myth. It's as real as the "eject" button on a fighter's display panel. The aerospace industry, in particular, has cocked an increasingly attentive ear to safety engineering in the last twenty years — due in large part to the increasing insistence of the military services.

Safety experts agree that this increasing awareness is due to the abandonment of the belief that people were to blame for most accidents. In the '30s, it was thought that 85 per cent of all accidents were caused by careless actions, as opposed to unsafe conditions. More recent studies have shown the percentage of accidents attributable to carelessness is closer to 25 per cent.

Ironically, it was the advent of unmanned systems, such as missiles, that helped cause this shift in philosophy. With accidents involving aircraft, the tendency was to blame the pilot. But when missiles became part of the flight inventory, their malfunctions could no longer be blamed on the pilot; defects in design or manufacturing gradually assumed the villain's role. Armed with this data, the defense agencies started requiring contractors to include programs for system safety as an integral part of hardware design.

Safety engineering received another boost from an unexpected quarter: the courts. Judicial opinion began finding for the plaintiff in cases involving death or injury caused by faulty products, a trend sending shudders through all of industry.

Enter system safety engineering, a discipline that applies innovative analytical and engineering methods to ensure safety in systems design.

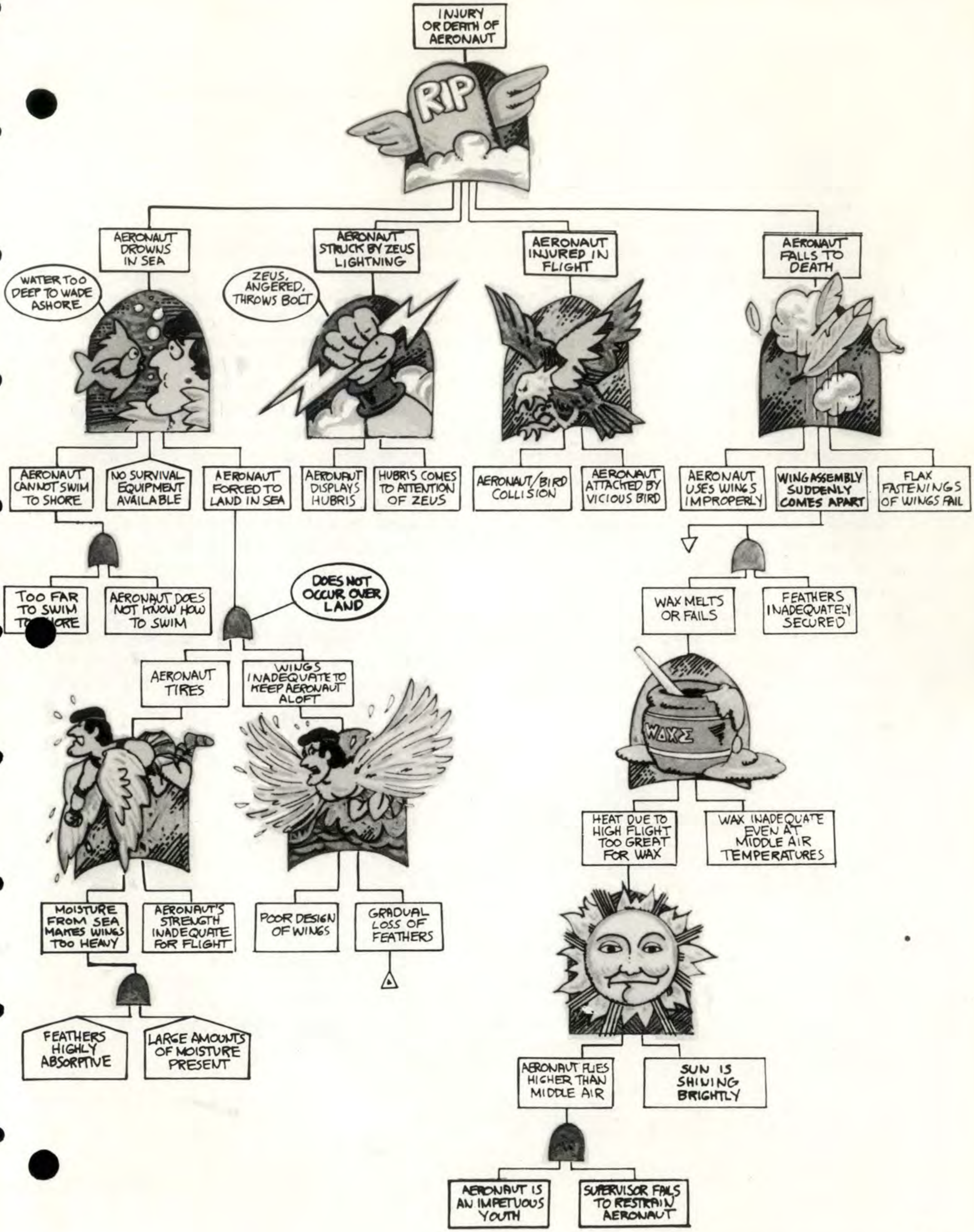
Central to the discipline is the concept that accident prevention must begin as soon as the idea for a new product or system is conceived. The earlier in the design process that potential hazards are recognized and controlled, the greater will be the manufacturer's savings in terms of modifying a system — or the avoidance of a liability settlement in a negligence case.

At the heart of system safety engineering is a precise analytical technique called Fault Tree Analysis. Developed by Bell Laboratories for an Air Force missile safety program, Fault Tree Analysis uses Boolean Algebra techniques in a manner strikingly similar to the way electrical engineers use digital logic to design computers.

Like the input/output gates of a computer, each potentially hazardous situation or event leading up to an accident (such as a valve failing to close) exists in one of two states: present or absent. When two or more such situations occurring simultaneously lead to another, more precarious situation, they are said to be connected by an AND condition. If, on the other hand, any one of the two or more lower level events can by itself bring on the more dangerous situation, an OR condition exists.

Using these basic elements, a safety engineer can analyze the causes of accidents by starting with the most disastrous, top-level event, and tracing his way down the fault tree. And he can also calculate the probabilities of mishaps by using computer techniques.

Here's how Daedalus might have used Fault Tree Analysis in a safety program for his invention (see diagram). The ultimate catastrophe, "Injury or Death of Aeronaut," can be seen to arise from an OR condition involving "Aeronaut Drowns in Sea" and "Aeronaut Falls to Death." These events, in turn, arise from combinations of other, less obvious hazardous situations, and so on down to the lowest branches. In this way, even the most seemingly trivial danger is spelled out in relation to the overall safety of the system.



INJURY OR DEATH OF AERONAUT
RIP
AERONAUT DROWNS IN SEA
AERONAUT STRUCK BY ZEUS LIGHTNING
AERONAUT INJURED IN FLIGHT
AERONAUT FALLS TO DEATH
WATER TOO DEEP TO WADE ASHORE
ZEUS, ANGERED, THROWS BOLT
AERONAUT CANNOT SWIM TO SHORE
NO SURVIVAL EQUIPMENT AVAILABLE
AERONAUT FORCED TO LAND IN SEA
AERONAUT DISPLAYS HUBRIS
HUBRIS COMES TO ATTENTION OF ZEUS
AERONAUT/BIRD COLLISION
AERONAUT ATTACKED BY VICIOUS BIRD
AERONAUT USES WINGS IMPROPERLY
WING ASSEMBLY SUDDENLY COMES APART
FLAX FASTENINGS OF WINGS FAIL
TOO FAR TO SWIM
AERONAUT DOES NOT KNOW HOW TO SWIM
DOES NOT OCCUR OVER LAND
WAX MELTS OR FAILS
FEATHERS INADEQUATELY SECURED
AERONAUT TIRES
WINGS INADEQUATE TO KEEP AERONAUT ALOFT
WAXΣ
HEAT DUE TO HIGH FLIGHT TOO GREAT FOR WAX
WAX INADEQUATE EVEN AT MIDDLE AIR TEMPERATURES
MOISTURE FROM SEA MAKES WINGS TOO HEAVY
AERONAUT'S STRENGTH INADEQUATE FOR FLIGHT
POOR DESIGN OF WINGS
GRADUAL LOSS OF FEATHERS
FEATHERS HIGHLY ABSORPTIVE
LARGE AMOUNTS OF MOISTURE PRESENT
AERONAUT FLIES HIGHER THAN MIDDLE AIR
SUN IS SHINING BRIGHTLY
AERONAUT IS AN IMPETUOUS YOUTH
SUPERVISOR FAILS TO RESTRAIN AERONAUT

Other, less mathematical methods also contribute to a sound system safety program: Failure Modes and Effects Analysis, which scrutinizes the effects of hardware failures; Contingency Analysis, which provides emergency measures to cope with any hazard that cannot be eliminated; and Procedures Analysis, which examines the effects of human errors.

This last category is vitally important since the performance of the human operator of any system is the most unpredictable element. Often, accidents attributed to human error were in part caused by the designers' failure to adequately consider human factors involved in the operation of the system.

For instance, safety officials investigating an airliner crash determined the probable cause of the accident was the pilot's failure to accurately monitor his fuel supply. However, the examiners noted that the design of the fuel gauges — which required the pilot to multiply by one of two different scale factors — may have contributed to the confusion that led to the ultimate error.

At Hughes Aircraft Company, every system under development includes system safety as an important element of overall logistics support.

The Maintainability and System Safety organization of Hughes shoulders most of the responsibility for not only implementing system safety programs but ensuring that the personnel are properly trained as well.

Just as Daedalus alerted Icarus to important safety considerations in operating his wings of feathers and beeswax, Hughes safety engineers meet with design engineers involved with all phases of development of systems — including flight control systems for the U.S. Navy and Air Force.

Far more complex than feathers, today's flight systems pose potential safety problems Daedalus could never have envisioned. High voltages, torrid temperatures, intense pressures, lethal lasers — all of these, singly and in combination, are meticulously analyzed by safety engineers working in concert with designers at every stage of system development.

Fortunately, the significant safety hazards inherent in each system have been automatically eliminated by a series of interlocks built into the system, designed to prevent dangers from cropping up in the first place. Still, the need for instructing the services' modern-day Icaruses in safety measures cannot be sold short. It's just one more aspect of a safety program that starts before the system is designed and continues throughout its lifetime.

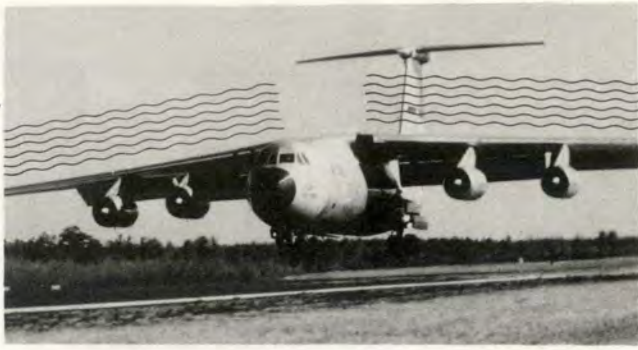
A safe system and an operator schooled in its safe operation have finally brought the words "safety" and "work" where they belong — together. And if there are any "safety-eschewing" miners around who doubt it, let them remember what happened to Icarus. ❖

**Courtesy *Vectors* magazine, Vol XXII, Spring 1980 Hughes Aircraft Co., Culver City, California**

# OPS topics

## Wake Turbulence

■ Wake turbulence still rears its ugly head from time-to-time. An F-106B crew discovered this when they landed about two minutes after a KC-135 had made a low approach. In the flare the '106 developed a high sink rate and power was advanced for go around. But the aircraft touched down hard 500 feet down the runway. Control was maintained and the aircraft stopped; however, there was considerable damage to the aft fuselage, engine shroud and the tail hook release mechanism. The wind pattern was such that the KC's vortices would hold on the runway which led to speculation that the mishap was caused by wake turbulence. A few days earlier a B-52 encountered wake turbulence during a MITO. The left tip gear and tank struck the runway. Pilots should always be aware of potential wake turbulence and be prepared to take necessary counter action.



## Vibrating Nose Gear

At 20 - 40 kts on takeoff roll, a C-141 began lateral vibrations that became so severe the pilots could not keep their feet on the rudder pedals and were unable to use the brakes. The aircraft was stopped with reverse thrust. The problem was a disconnected scissors assembly. The aircraft had been towed by maintenance which disconnected the scissors. When the crew arrived at the aircraft the 781 indicated the scissors was reconnected and signed off. The assembly stayed attached through four turns but apparently disconnected during takeoff roll.

## Controls Binding

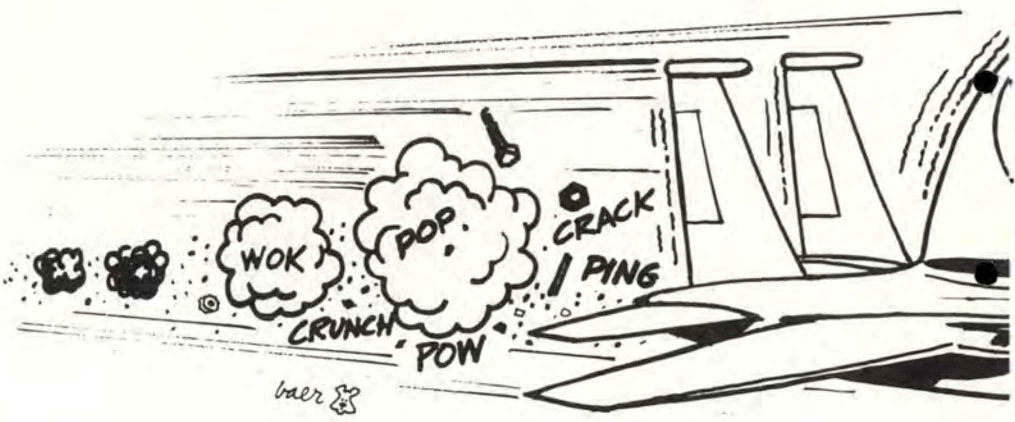
An F-4D crew had their hands full when the stick bound and could not be moved forward. The flight was an FCF after extensive lateral control system maintenance. In a climb, as airspeed decreased through 250 kts, the pilot attempted to unload, but the stick wouldn't go forward. Both crewmembers pushed to no avail. Recovery from their 30 degrees nose high was by rudder. During RTB, repeated attempts to overcome the problem failed. The decision was to land at 200 kts with no flaps. After touchdown, as the aircraft crossed the BAK-13, the stick broke loose. Preliminary investigation indicated an aero 7A umbilical dust cover had lodged on the stabilator bellcrank. If that turns out to be the case, it won't be a first. Same thing has happened before.

## Wrong Field

What do you do if you are a tower controller and see a light twin aircraft approach the field at about 500 AGL, fly through the pattern, cross the field outbound on final approach to 4 DME, then turn inbound on final to the runway? After other attempts to contact the aircraft failed, an alert controller at Williams AFB got the pilot on a nearby civilian field frequency and instructed him to depart the airport traffic area. The aircraft was on a cross country, and the pilot simply mistook Williams for nearby Falcon Field. A similar event occurred within days at MacDill AFB when a light plane was on final for Rwy 36 at MacDill and thought it was Tampa. These don't happen every day, but they are frequent enough to remind us that despite the many nav aids we have, some people don't, or won't, use them. So stay alert—both controllers and aircrews. ■

# Don't Crash Engage Your JFS.

**By GALEN STANLEY**
Senior Systems Safety Engineer
McDonnell Aircraft Company




■ **". . . During first engine start, the JFS engaged normally, accelerated through 50%, disengaged, and returned to idle. The engine stagnated and the pilot noticed the FTIT climbing through 600 degrees as the rpm decayed through 45%. He immediately raised the fingerlift and pulled the throttle to off. As he did, the JFS accelerated and the CGB re-engaged the decelerating engine. The rpm and FTIT drooped to zero while the JFS continued to run at 100%. The JFS switch was placed in the 'off' position, and the aircraft ground aborted. Investigation revealed the CGB stub shaft had failed at its designed shear section. . . ."**

As you read the above excerpt from a recent report, how many of you asked yourselves if this could also happen during an attempted *inflight* JFS-assisted *restart*? Well unfortunately it can, so let's see why this potential problem exists.

## It Works Like This

To fully understand how you can get into this fix, a brief description of the engine start circuitry on aircraft with Air-Operable JFS capability is needed. I'll only talk about the right engine circuit to avoid confusion, but the left engine circuit is the same as far as this situation is concerned.

When the right master switch is ON, power is provided to the right engine start switch (actuated by the fingerlift), whenever the rpm is below approximately 50%. Momentarily actuating the start switch (lifting and releasing the fingerlift) will energize the right AMAD select relay, designating the right AMAD/engine to be engaged by the JFS. By the way, the left and right select relays cannot both be energized at the same time; and once one of the relays is energized, it will remain energized until the rpm exceeds 50% or the master switch is cycled or turned completely off. To illustrate the point, if you were starting with external power, you could lift and release one of the fingerlifts before starting the JFS, and then during JFS start, the corresponding AMAD/engine would engage automatically once the JFS reached the proper operating speed and pressures.

## There I Was . . .

The Flight Manual emphasizes the importance of attempting/considering normal inflight restarts before attempting a JFS-assisted airstart during a dual engine out situation. Suppose you follow the book's advice, have no luck and decide to shut down and attempt a JFS-assisted airstart. The net result is that you have had two opportunities to inadvertently engage the start circuit while shutting down the engine. If during either shutdown, the fingerlift was held full up while moving to the full cut-off position you will get some kind of inadvertent or out-of-sequence engagement. Let's look at the possibilities.

If the engine start circuitry has previously been activated, the JFS, when started, will immediately engage and attempt to accelerate the engine. If the engine rpm is below 30%, the engagement should be normal and not result in any problem.

If the start circuit is already energized and the engine rpm is above 30% when you start the JFS, you stand a good chance of shearing the CGB stub shaft. This is also true

if you inadvertently actuate the start circuit while shutting down the engine with rpm above 30% and the JFS already running. In either case, if the shaft fails the JFS will accelerate to 100% and stay there. JFS restart capability for that engine has been lost.

The problem with this failure is that you will not know what has happened. What you will see is that neither engine is coming up to JFS motoring speed, no matter which fingerlift you raise; and inflight it will be almost impossible to tell that the JFS is at 100%. The only way out of this one is to de-energize the start circuit without affecting fuel flow to a running or stagnated engine.

### It's Up To YOU

Well, now that you know why the problem can exist, and how you can get yourself into it, let's see what can be done to prevent it. If you experience a dual engine stagnation, try a spooldown (throttle to idle at 25%) airstart as you attempt to establish a 350 knot dive into the JFS envelope. If the spooldown attempt is unsuccessful (for example, hot start) your best option is a JFS Assisted Restart. If you follow the book—

1. **Throttle (right engine)—OFF**
2. **Centerline stores and pylon—JETTISON**
3. **JFS switch—CHECK ON**
4. **JFS handle—PULL AND RELEASE**

the engine rpm should be at or near 30% before the JFS reaches the speed necessary to engage. Thus, the odds of damaging the CGB shaft are low.

The first step, throttle-off, is extremely important as it starts the rpm decreasing back below 30%, while the other steps set the JFS up to assist the restart attempt. If you can afford an additional few seconds, waiting until approximately 30% rpm before pulling the JFS handle will virtually eliminate the possibility of shearing the CGB shaft due to an inadvertent engagement during a JFS start.

If you are forced to start the JFS with engine rpm above 30% or if you shut down an engine between 30 and 50% with the JFS running, you could shear the CGB shaft and accelerate the JFS to 100%. This condition would be obvious on the ground but is extremely difficult to detect in flight. Therefore, if you attempt an inflight JFS engagement and do not get an rpm increase, quickly cycle both master switches and try again. If you still get no response, cycle the master switches again and try the opposite engine. NOTE: Rapid cycling of the engine master switch will de-energize the start circuit without affecting fuel flow to a running or stagnated engine.

### An Ounce of Prevention

The best way to avoid the problem described above is to avoid activating the start circuit during engine shutdown. At the present time only your careful movement of the throttles into cutoff without hitting the start switches will prevent start circuit activation but we don't want to have to rely on "technique" in a dual engine out situation. MCAIR is investigating ways to eliminate the problem completely; but in the meantime your throttle technique remains very important. If you want a chance to test your skill (without damaging hardware), try this drill when you go out to fly. After starting the JFS, place both throttles at idle. When ready to start the right engine, place the throttle in cut-off using your normal technique and see if the JFS engages. Before the second engine start, lift the left fingerlift and release it as soon as you start to move the throttle aft. The odds are good that you will get an inadvertent engagement on the right engine but you will be successful in avoiding it on the left.

**Editor's Note: An Interim Operational Supplement has been issued against the F-15 "Dash One" to add the following statement in Section III under Starting, Abnormal Engine Start, Engine Fails To Accelerate Normally, after Step 2; and under Inflight, JFS Assisted Restart, after Step 7:**

**CAUTION**

**"Exercise caution when shutting down an engine with the JFS running. Release the fingerlifts prior to reaching the cutoff position to prevent immediate JFS re-engagement above 30% rpm."**

TO IF-15A-1S-73 applies to A and B models, while 1F-15C-1S-10 pertains to C and D models.

Incidentally, MCAIR test pilots Pat Henry and Glen Larson recently had the opportunity to experiment with the F-15 simulator at Luke AFB, which has been modified to include Air Operable JFS. They report that with this added capability, the simulator is also a good place to practice your shutdown technique as well as Dual Stagnation and JFS-Assisted Restart procedures. Sounds like a good idea to us. —Courtesy Vol. 27 No. 2, 1980, *Product Support Digest,* McDonnell Aircraft Company. ■

| MAJOR | CAPTAIN | CAPTAIN | AIRMAN FIRST CLASS |
|---|---|---|---|
| **Harry L. Brodock** | **Thomas C. Blow, II** | **Clarence J. Fennell** | **Walter D. Pitts** |

**42d Bombardment Wing (H)**
**Loring Air Force Base, Maine**

■ Major Brodock and crew, temporarily assigned to the 306th Strategic Wing, were flying a night refueling mission in a KC-135 with 10 passengers aboard when Major Brodock learned through a Guard transmission that an F-111F, Trest 56, had experienced an explosion during a touch and go landing at neighboring RAF Lakenheath and that damage was unknown. Arrangements were made for the tanker to stand by for emergency refueling. Captain Blow took over the required radio communications and arranged refueling headings, altitudes and turn ranges. Honington Approach Control coordinated a rendezvous at 4,000 feet Mean Sea Level. During join up, the F-111F lost all utility hydraulic pressure and the left generator. Using Honington Radar vectors and air to air tacan for separation, the two aircraft established themselves within two miles of each other. The F-111F initiated refueling operations with only 15 minutes of fuel remaining. Airman Pitts' first expedient contact saved the F-111F crew from a flameout and ejection. Moderate turbulence seriously hampered refueling operations and, combined with reduced maneuverability of the receiver aircraft in the landing configuration caused several disconnects during the half hour ordeal. At the slow air speed, the boom was very sluggish and required considerable lead time in its operation. Airman Pitts skillfully maintained contact despite reaching full boom limits. Towards the end of refueling operations, he was forced to pressure refuel and maintained boom contact by touch only. A total of 11,000 pounds of fuel was transferred to the F-111F prior to the KC-135 experiencing a refueling boom malfunction. A visual inspection of the damaged aircraft revealed the left main wheel was missing. Major Brodock described the damage to the RAF Lakenheath maintenance personnel and crash network. The tanker's refueling boom malfunction was continuously pumping fuel overboard at a moderate rate. Due to the aft fuel system, the tanker developed an adverse center of gravity which became more pronounced and aggravated the longer the KC-135 remained airborne. Landing weather was 300 feet overcast, direct crosswind at 20 knots, and a wet runway. A perfect approach was flown in spite of the crosswind and aft center of gravity. The professional competence, aerial skill and superior crew coordination displayed by Major Brodock, Captain Fennell, Captain Blow and Airman Pitts directly contributed to the successful recovery of both aircraft. WELL DONE. ■

☆U.S. Government Printing Office: 1980-683-214/11

UNITED STATES AIR FORCE

# Well Done Award

*Presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Accident Prevention Program.*

CAPTAIN

## Patrick W. Chandonnet

CAPTAIN

## John G. Sletten

**430th Tactical Fighter Squadron**
**Nellis Air Force Base, Nevada**

■ On 1 February 1980 Captains Chandonnet and Sletten launched from Nellis AFB, NV as an airborne spare for an F-4D deployment. Following A/B termination, the crew felt a vibration coming from the left side and suspected a loose panel or problem with their travel pod. Upon slowing to 250KTS, their Right Generator Out light came on, and the generator would not reset. The crew declared an emergency with approach control. As they prepared to return to Nellis, the left utility hydraulic system failed, followed by multiple caution and warning lights. The crew suspected a bleed air duct failure, and as Captain Chandonnet maneuvered to avoid populated areas, Captain Sletten reviewed the multiple checklist items. Eight miles from the field, the Right Engine Fire light began flashing and Captain Chandonnet retarded the right throttle to idle. Being so close to the field, and because neither smoke nor other instruments confirmed a fire, the crew elected to leave the right engine in idle rather than risk landing single engine with total utility failure. The crew jettisoned the centerline and outboard tanks and turned toward Nellis. While setting up for final approach, their right utility system failed, followed rapidly by a steady Fire light on the right engine. They blew down the landing gear and flew a no-flap approach, using the left engine for power, with the right engine in idle. After engaging the approach end cable, their right engine auto accelerated and Nellis tower reported smoke coming from the engine. The crew shut down and ground egressed. Postflight maintenance inspection revealed severe damage to the hydraulic system and high potential for an in-flight fire had the mission lasted any longer. The aircraft system knowledge and crew coordination demonstrated by Captain Chandonnet and Captain Sletten resulted in the recovery of a seriously disabled aircraft. WELL DONE! ■

# F-16 Fighting Falcon


The first year of F-16 operations has been highlighted by flight deployments and evaluations and by aircraft deliveries to six air forces around the world. The F-16 has proven its capability during the first year of operation in three countries. Currently, over 100 F-16s are in service in the six air forces, with more than ten aircraft being produced each month.