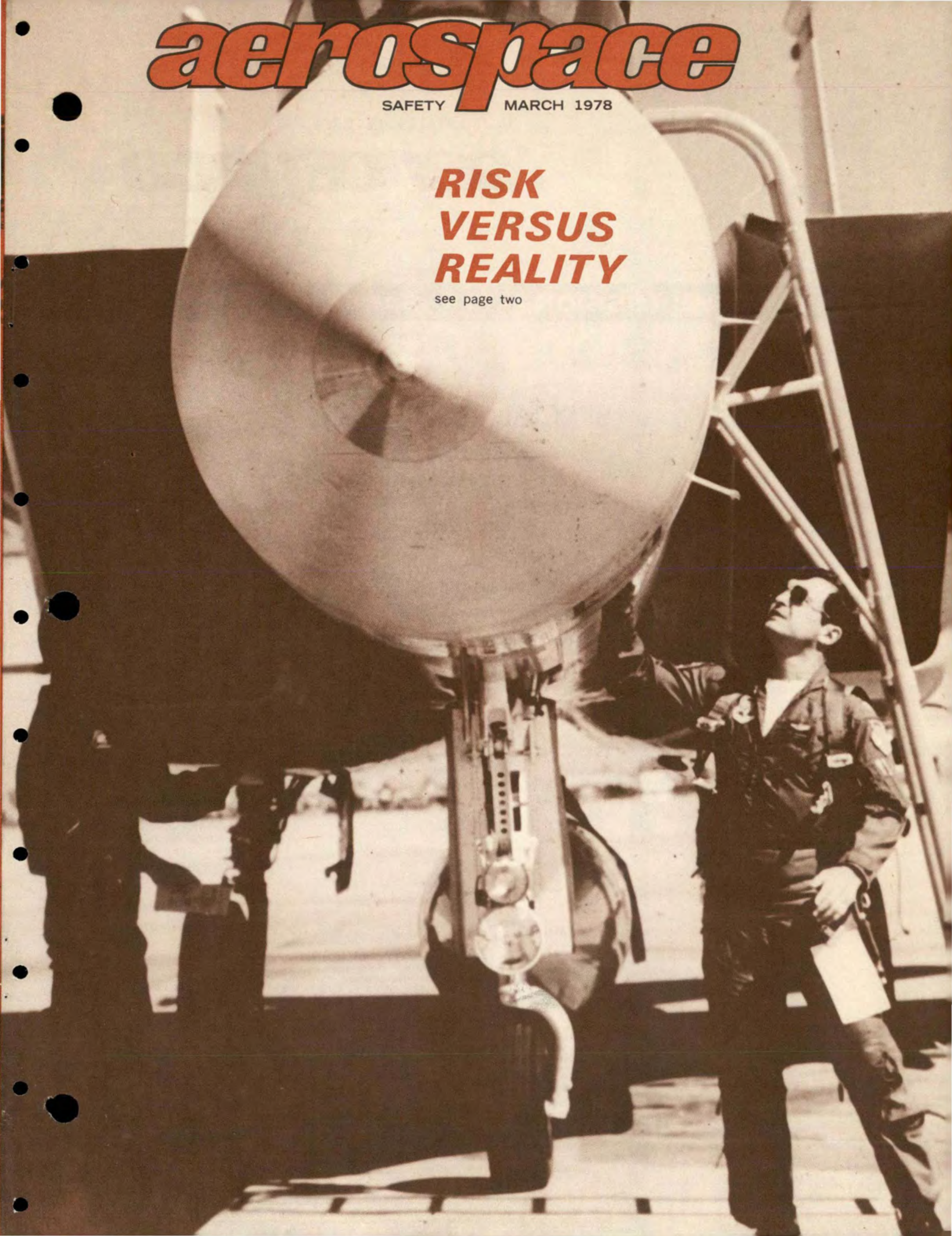

aerospace SAFETY MARCH 1978

RISK VERSUS REALITY

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MARCH 1978

UNITED STATES AIR FORCE

aerospace SAFETY

THE MISSION - - - - - - SAFELY!

SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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MARCH 1978 AFRP 127-2 VOLUME 35 NUMBER 3

NEWS FOR CREWS

Information and tips to help your career from the folks at Air Force Military Personnel Center, Randolph AFB, TX.

CAPTAIN CARL L. McPHERSON • Air Force Military Personnel Center

RATED SUPPLEMENT DYNAMICS

The Rated Supplement is a part of the total Air Force requirement for pilots and navigators. It provides the necessary augmentation for increased crew and rated staff positions during contingency operations.

The utilization of rated officers in non-rated duties is not a new concept by any means. In fact, in the early '60s over 18,000 rated officers were serving in what was then called "behind-the-lines" duties.

Today's Supplement is made up of approximately 6500 rated officers in the grade of lieutenant through lieutenant colonel who are currently serving in support career fields at all levels throughout the Air Force. It also includes rated officers assigned to AFIT and Professional Military Education (PME) programs.

In addition to meeting Air Force needs for wartime augmentees, the Supplement provides an excellent opportunity for career broadening of rated officers in non-operational areas. This has been extremely important in providing the management experience and background needed by senior Air Force leaders. It is this fact that dictates that Supplement duty be preserved for those officers who clearly demonstrate the potential to assume such positions.

In December 1977, a board of senior Air Force officers established guidelines for the distribution of rated officers to all support career fields. The board determined that the preponderance of the future Supplement inventory should be assigned to the research and development, logistics, and instructor career areas, but that no non-rated career field would be excluded from the future assignment of Supplement officers. The guidelines established are flexible enough to be easily adjusted depending upon varying rated officer inventory sizes.

Several avenues are presently available for entry into the Supplement, including: (1) completion of an AFIT program resulting in a directed duty assignment (DDA) into a non-rated specialty related to the area of graduate study, (2) identification and nomination of an officer by a local commander or major command for a specific non-rated position, or (3) request by an officer through the CBPO for a duty AFSC change to a non-rated specialty. Additionally, all rated officers "on-the move" (returning from overseas or completing controlled tours) are reviewed monthly by a rated officer review board and are considered for entry into the Supplement. This board meets nine months prior to the officers' "availability," and also reviews those officers currently in the Supplement for possible extension. In an effort to provide the same selection opportunity to all rated officers, the review board has recently been expanded to include all rated officers who meet minimum time-on-station and first "gate" (72 months of operational flying credit) criteria.

Each of these entry routes requires the approval of AFMPC to ensure that control is maintained over the number of rated officers assigned to each non-rated career field. AFMPC is also responsible for ensuring that inputs possess the quality necessary to produce career broadened senior managers.

In order to maintain the viability of the Supplement—ensure that those officers can, in fact, respond to contingency requirements—as well as provide career broadening opportunities to as many rated officers as possible, a continuing "flow" of officers into and out of the Supplement must be maintained. For this reason, Supplement tour lengths are strictly controlled. The Supplement completion date of an officer assigned overseas or on a stabilized stateside tour normally coincides with the date the officer rotates from his overseas assignment or the date he completes his stabilized tour. The tour of all other Supplement officers is normally three years. While extended Supplement duty was not uncommon in the past, future Supplement tour extensions will be on an exception basis and only after a careful individual review.

The Supplement inventory is projected to decline until flying training production rates reach the level needed to maintain an inventory to meet overall rated requirements. Rated officers currently serving

continued on page 28

RISK VERSUS REALITY

MAJOR LAWRENCE E. WAGY
Directorate of Aerospace Safety

Is it better to train with maximum realism for any potential war situation and accept the inherent costs, or to conserve our resources at a lower level of proficiency with the idea that war itself will quickly provide the necessary training to combat readiness?

A question that will always raise a heated argument among a group of aviators is, "Should we train the way we fight—so that we can fight the way we train?" Lieutenant General John P. Flynn, AF/IG, surfaced the question again in a letter published in the *TIG Brief*. General Flynn observes: "We were not born with ability, it's a learned thing, as is courage. It follows that in training exercises, reckless abandon is the worst thing to practice and conservatism is a reasonable course . . ."

Let's review the basic schools of thought. The first I'll call the Group A approach. This approach believes that no peacetime loss of weapon system or aircrew is justified. This approach is particularly popular in post war years when defense budgets are being cut to the bone. A's argue that no single peacetime mission is worth the loss of an expensive weapons system.

With understandable logic, A's believe that our peacetime training must first of all conserve our resources for future combat. Training would be limited to very low risk mission profiles. Aircrew proficiency would involve only the basics of flight. Pilots would be very capable in the area of intermediate to high altitude navigation, straight-in instrument approaches and landings, and controlled range box patterns. When accidents do occur, training operations are restricted further.

The Group A theory is that while conserving our resources (both man and machine) in peacetime, we will develop, by need, the more aggressive skills in actual combat. They concede that we will be less mission capable in the early days of conflict and suffer heavier losses, but believe the resource losses can then be afforded. Aircraft and aircrews are, of course, easier to obtain during periods of hostility. It is difficult to argue with the concept that training under fire is very effective for those who survive.

At the opposite end of the spectrum is the Group B school that believes that we should show no restraint during peacetime training. Realism is their key to success. Their motto is "a few good men" with the obvious, though not conceded, corollary of "a few good weapon systems." The very believable axiom is that the nature of modern warfare demands that a force be honed to combat sharpness on "day 1" of conflict in order to gain and maintain the offensive and defensive advantage.

Obviously, I have overstated the case for each extreme. When I was younger I believed that all very senior people were of the Group A persuasion and that all the young people were Group B types. This idea was further substantiated by the fact that as I grew older my views became more conservative as well. This coincided with my early years as a safety officer. A safety officer's grade card used to be a reflection of his unit's accident experience. A safety goal of a zero accident rate was reflected in the safety attitude of zero accident potential.

In truth, I've found our senior officers aren't of the Group A philosophy at all. In a 1976 *TIG Brief* letter, USAF Chief of Staff General David C. Jones said, "Readiness must be the prime concern in all our actions . . . new and better ways to meet the readiness challenge are needed . . . ORI's need to be realistic and simulate wartime tasking as closely as possible." My exposure to several senior officers while working with the Air Force Readiness Initiatives Group (AFRIG) convinced me that our leaders are far from my previous impression of being of the Group A school.

Now I will give my opinion, which, as you may suspect, falls somewhere in the middle. As a mathematician I find this subject somewhat easier to see by charting the variables. Since I don't have the exact figures to place on the axis, I will ask that you only consider these charts as depicting a representative relationship between the variables. Refer to Chart 1.

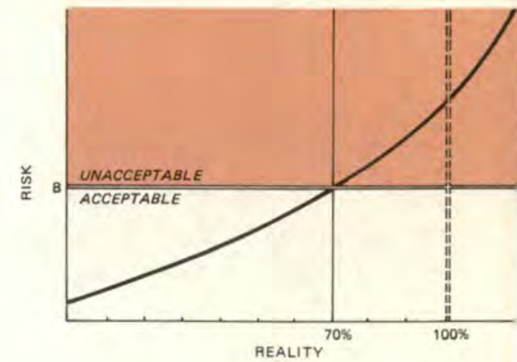


FIGURE 1.

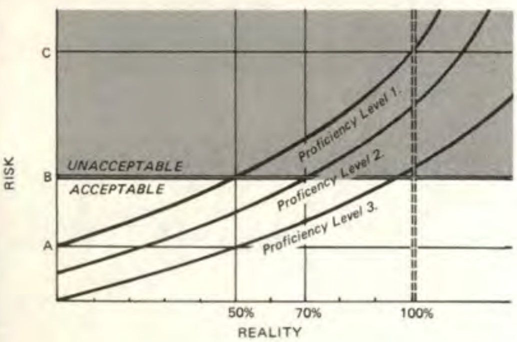
If we were to look at a single element of our combat-ready forces (e.g., TACTICAL FIGHTER FORCE) at their present proficiency profile, the relationship between reality and risk look something like this. The percent reality would depend on how close we are to "training the way we fight." Reality of 0 percent would mean our training would depict no element of the way we would fight. Reality of 100 percent would be exactly the way we would fight. I also assume that departing from reality is always to a more conservative mission. The chart would obviously be invalid if 0 percent reality was accomplished practicing spins at low altitude.

Risk is a value that reflects the probability of loss of aircraft and/or crew. Intuitively, I believe, the line gets steeper as we approach 100 percent reality both from a human factors and a material

RISK VERSUS REALITY
continued

standpoint. The more we demand from our people and aircraft the higher the failure rate will be.

Acceptable risk is the element we charge our commanders to establish. This should be relatively constant, based on maintaining resources to meet our combat mission commitments. (The concept of acceptable risk is very real as exemplified by the fact that we program and fund for replacement aircraft when a new weapon system is acquired.) By plotting this acceptable risk (b), we can then program our reality (on this hypothetical chart: 70 percent) to produce that risk.



The chart can be made three dimensional by modulating the proficiency profile. See Chart 2.

Experience has shown that risk is decreased inversely proportionate to proficiency. Therefore, the function of risk and reality should flatten as the proficiency profile of the aviators is increased. For a constant acceptable risk (b) training can be structured to appropriate levels of reality depending upon proficiency. The potential to increase reality past 100 percent could exist, although I see no need.

Let's look at a proficiency level 2, combat-ready element that is flying at the percent reality (70 percent) that produces an acceptable risk (b). This type of training should increase their proficiency profile. If it does not, acceptable risk is probably too low. This increased proficiency allows the unit to increase reality without increasing risk until the unit is as combat proficient as external factors will allow. (Excessive pilot turnover, for instance, could drive proficiency down.)

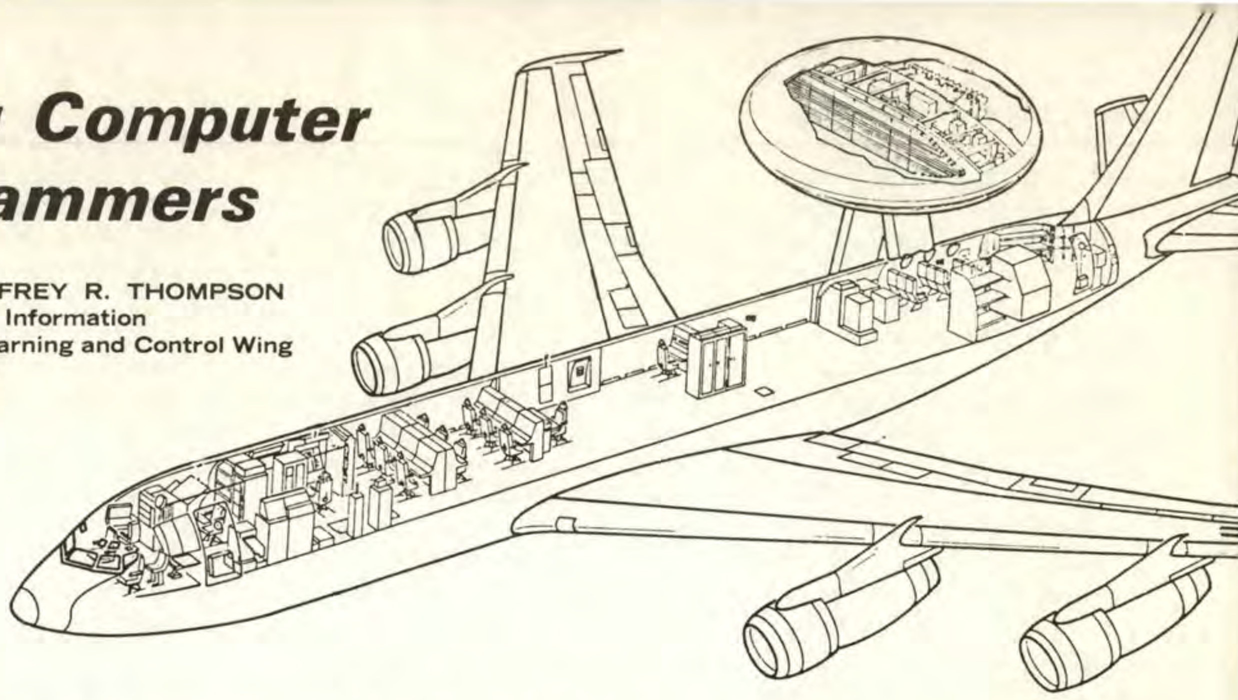
On the other hand, a proficiency level 3 unit that is flying at a reality (50 percent) to the left of their maximum reality is exercising the Group A approach. They are accepting a risk (a) which is approximately half of their maximum. The problem with this approach is that it tends to compound in the wrong way. This unit will probably see a decrease in proficiency and an increase in risk. When this results in a couple of operational accidents, the Group A approach will probably be reflected in further reality restrictions which will again reduce proficiency. Over a period of time this unit will drive itself farther and farther from reality and combat readiness.

The third consideration is the Group B approach. The annals are full of unsuccessful attempts to *force* an element to the right on the reality scale. An example is a proficiency level 1 unit attempting to train at 100 percent reality. Note that their risk (c) is twice that which is acceptable. A better approach would be to start at their maximum acceptable reality (50 percent) and as their proficiency increases, increased reality can follow.

Essentially I interpret General Jones' and General Flynn's messages to reflect this analysis. General Jones is saying that in order to meet our readiness challenge we must ensure we train as near reality as our acceptable risk will permit. General Flynn points out that to train with "reckless abandon" incurs an unacceptable risk.

Acceptable risk is a concept that used to float poorly around the safety community when zero loss rate was a goal. I believe this is no longer true. The goal of the safety community at all levels should be to assist the commander in attaining a readiness capability through training at the maximum level of reality that incurs an acceptable risk. ★

Flying Computer Programmers



CAPTAIN GEOFFREY R. THOMPSON
Chief, Office of Information
552d Airborne Warning and Control Wing
Tinker AFB OK

Programmers everywhere, drop your coding forms! Climb aboard the E-3A, the Air Force's newest, most sophisticated aircraft, and fly away with the mission crew of AWACS!

AWACS is an acronym for Airborne Warning and Control System, the descriptive title for the E-3A. The E-3A is a modified Boeing 707 airframe with a radar antenna mounted in a 30′ rotating radome. Its 17-man crew is trained to help defend friendly airspace anywhere in the world.

With all that computer hardware flying around (the E-3A carries several on-board computers, the largest being an IBM 4PI-CC1 central computer) it's only natural that programmers fly too. And that's exactly what happens at the 552d Airborne Warning and Control Wing at Tinker AFB, Oklahoma.

This whole new vista—flying—opened to the wing's traditionally ground-bound programmers in July 1977. And ever since that first flight, they've helped troubleshoot all phases of airborne computer operations, and after landing, written up software problems using firsthand knowledge.

On the ground, each programmer is a specialist in weapons, surveillance, battle staff, etc. But during an operational flight, he must advise the crew on many kinds of computer support problems. He must know both JOVIAL and assembler computer languages, and must be able to work with the airborne operational computer program (AOCP), data base generation and edit programs, and several stand alone utility programs.

AWACS programmers are excited about flying—it adds to their already challenging Air Force careers by bringing them closer to the operational crew they support.

"Before my first flight I thought in terms of a split between the ops guys and the support team," said Second Lieutenant Robert Hinsey, a Test and Evaluation team member for the wing. "Now all that's changed. The key word's not split, but interface."

Flying also broadens a young officer's experience early in his career. As Hinsey explained, "On my second flight I was the mission crew commander and directed a complete software test of the latest software version supplied by Boeing Aerospace Co. I had a private communications net to the aircraft commander, and each of my seven test team members sat at a console and conducted his own functional area testing, e.g., weapons or surveillance."

Staff Sergeant Robert Smith, a wing switch action programmer, added his own personal glimpse. "My first flight was everything I'd anticipated, and more. Unlike commercial aircraft, the E-3A has no windows, so to see out, you had to look forward, through the cockpit, not sideways past the wings. And all those things I'd heard about in-flight lunches weren't true. They were most edible!"

Staff Sergeant Jim Wishart, a weapons software expert, pointed out he was a little nervous before his first flight because the comm equipment was different from that he had used in the mission simulator (ground support facility). And aircrews strictly enforce proper comm procedures!

"The nervousness quickly disappeared when the test started, however," said Wishart. "In fact, I was so preoccupied I didn't realize the aircraft was performing hard turn maneuvers until the surveillance operator mentioned it over the intercom. When I did look up I felt the tug of gravity and watched the changing reflections of the sun glide across the ceiling as they flickered through a port mooring."

Flying helps both programmers

Flying Computer Programmers
continued

and mission crew. Programmers find the airborne system functions much as they expect, a tribute to Tinker's excellent software training facility.

"On the other hand, seeing the system in its operational environment held plenty of surprises," said Captain Joel Champion, a wing computer systems analyst. "Since the software is designed to support the crew, observing the software/man interface firsthand gave us ideas for further enhancements."

The best advantage of having in-flight programmers, is their ability to implement on-the-spot work-arounds. Even without extensive debug tools, software experts can often diagnose an internal problem by observing its external effects, then suggest a temporary problem avoidance procedure.

"Whatever computer problems we experience," said Champion, "must be put in perspective. Significant in-flight software glitches are rare due to thorough software testing before operational release. The system is also designed to automatically recover from most hardware problems, using system redundancy."

It might be interesting to relate two recent examples of in-flight assistance, where on-board programmers helped make successful missions out of possibly unsuccessful ones.

To explain the first case, you must first understand the Airborne Operational Computer Program (AOCP) will not work until it receives all real-time avionics inputs, such as navigation and position data, plus confirmation that all required hardware is turned on. So on one occasion the AOCP was missing at least one avionics input, and did not "come on." The condition was suspected by the crew as being a software malfunction, whereas the computer systems analyst diagnosed it correctly as a computer loop condition. The computer was branching (hanging up) around a set of start-up instructions, in effect saying, "I need that missing input!" over and over again. As soon as the missing avionics input was provided, the program functioned normally.

In the second case, as a result of a power fluctuation, the AOCP underwent a series of automatic restarts. The original diagnosis was a hardware malfunction, but the computer analyst discovered otherwise. The power fluctuation had caused bits of information on the memory drum not to be correctly updated, thus preventing a successful restart. The confusion was caused by the error analysis software, which provides maintenance advisories, calling the problem a computer arithmetic unit (CAU)* failure. So the in-flight analyst simply reloaded the memory drum with a fresh copy of AOCP from tape, and the mission continued smoothly.

These cases show how in-flight programmers serve as "answer men" when software problems arise. It also means they've learned to talk to crew members using correct terms, to get to the point faster. But programmers still have a long way to go to be completely conversant with the mission crew. The system is terribly complex, and each analyst is an expert only in one or two functional areas. So they'll continue to rely heavily on the crew's operational expertise. And, since not every flight

*The CAU is the E-3A 4PI processor sub-unit which performs all arithmetic and logical operations specified by the AOCP software.

Listening to the 4PI computer maintenance technician, MSgt John "Ad" Whattam (left), explain a suspected software deviation, is Capt Joel Champion, airborne software analyst. Direct conversations between maintenance technicians and software programmers, during flight, speed up troubleshooting since problems are observed live. Sgt Whattam is seated at the computer display maintenance operator position, where he receives maintenance advisories from the computer.

Working with an E-3A airborne surveillance technician, SSgt George C. Lewis (left), is Capt Rick Roger, airborne computer programmer. Capt Roger was called to a surveillance console to observe a degraded scope display, since he can often diagnose a possible software problem by observing its external effects. Earlier in the mission, Capt Roger sat at a weapons director console and tested earlier software changes.

carries a programmer, on more than one occasion programmers have been summoned to the wing command post, placed in radio contact with the aircraft, and helped resolve problems.

In November 1977 a very different use of in-flight programmers occurred. Eight programmers climbed aboard a "P" sortie (training sortie for the flight crew) and took over the back end (mission crew positions) of the aircraft.

"We had three goals in this test flight," said Major Jack Griffith, Chief of the wing's Software Management Division. "We continued to train our people in airborne software test procedures; we took a final version of a computer program supplied by Boeing Aerospace Co. and checked it out in an operational environment; and we verified a special software package built for 'EUROTEST 77,' an E-3A follow on test and evaluation deployment to central Europe.*

The test flight went exactly as planned. The software package was verified at the macro (system) level, and programmers learned from the reality of the flight environment. Each programmer sat at the console of his own area of software responsibility, e.g., weapons or surveillance. He performed switch actions; talked with the on-board computer maintenance technician; and worked with the on-board radar maintenance technician just as a mission crew member would.

Lieutenant Colonel James Gregg, Chief of the wing's Systems Programming Division, explained how important the test flight was. "Our vocabulary is saturated with terminology. We must speak the radar-weapons-aircrew language in addition to our language as programmers, so we are at the apex of the information explosion!"

In a nutshell, flying the E-3A is essential since all software can't be exercised in the mission simulator. After all, if a software problem can't be isolated, it can't be solved. That's why there are 12 flying programmer positions in the 552d AWAC Wing's Mission Support Deputate—two in software management, eight in operational programming, and two in systems programming. All flying programmers complete physiological, life support and water survival training, just as do other aircrew members, and they must pass flight physicals. Six Boeing contractor service people are also flight qualified.

Flying programmers like their work, and they meet the people who must live by the accuracy of their programming. Said Captain Champion, "Suppose a weapons director is trying to get a fighter to commit on a target. If the wrong call sign has been loaded, it's an abort because of invalid data base. So the relationship can become personal. No one wants to be responsible for decreasing a fighter pilot's chances of downing the enemy!"

To conclude, flying programmers ensure the E-3A crew can make full use of software's greatest advantage—system flexibility, i.e., every computer action doesn't have to be hard wired. Software is cheaper and more powerful than "all hardware" configurations, but only if it works! So with a system as complex as AWACS, programmers will continue to debug and isolate problems; however, at the 552d they'll also do it in the air! ★

*Seven wing programmers actually accompanied the E-3A to Ramstein, Germany, to provide software support. Being on mobility status, to deploy on short notice anywhere in the world, is another difference between programmers at Tinker and those stationed elsewhere.

Readying a mobility kit for deployment to Europe are (l to r) TSgt Bruce Kaufman, verifying labels and tape content; Capt Dave Wiederhold, making individual tape requests; and Capt Norm White, checking tape requirements against tapes packed. Software experts deploy to support the E3A, just as do maintenance personnel. And they take them duplicate copies of critical tapes, e.g., the Airborne Operational Computer Program.

Picture this one. A 707 freighter, passing Las Vegas at the end of an all-night JFK-LAX nonstop, continues westbound at FL390, ignoring the repeated descent clearances issued by LA center. After considerable effort and anxiety, radio contact is established through Arinc when the aircraft is nearly 100 miles west of LAX. Fortunately, the SELCAL (Arinc selective callup) chimes are loud enough to awaken at least one of the three sleeping crewmembers, and there is enough fuel for a safe return to LAX. In another instance, a DC-6 crew spent half an hour circling Atlanta when they all fell asleep with the autopilot on and the turn knob out of the detent. Cockpit slumber parties are one of the more dramatic effects of severe fatigue. Some will say that such conduct is inexcusable. I wonder if that oversimplification serves to mask some very real physiological problems. Several things can contribute to those awful sinking spells, but some of these factors can be controlled.

Lack of sleep is the most obvious cause of pilot fatigue but sleep is a complex subject that scientists are only beginning to understand. Basically there are two significantly different types of sleep of interest to the aviator. Deep sleep predominates during the first half of a normal night's slumber and is characterized by very low electrical (EEG) activity in the brain. Rapid eye movement (REM) sleep begins after that initial three or four hours

SINKING SPELLS

and is a totally different kind of sleep. During REM sleep, EEG activity is similar to that found in the waking state, plus there are rapid eye movements and evidence of dreaming.

Considerable research has established a clear need for both types of sleep. During several days of irregular working conditions, you may be able to satisfy deep sleep requirements and even maintain good efficiency while awake by napping for short periods. At the end of that time, your REM account will be overdrawn and that balance will need to be restored with at least one very long sleep. If, however, you miss an entire night's rest, you may be able to recover good vitality with a normal night's sleep plus one hour for the REM deficiency and an afternoon nap to balance the deep sleep account. I have found that 10 to 15 minutes of calisthenics after a short night's sleep is an excellent temporary substitute for lack of rest.

Another factor to consider is hypoglycemia or low blood sugar, which can cause malaise, fatigue, disorientation, and even lapse of consciousness. It is controllable with some very simple dietary tricks, but it helps to understand the mechanisms involved.

When you awake in the morning, your blood glucose level will be low from the overnight fast. If you start with coffee and sweet rolls, or any other highly refined carbohydrates, you may induce reactive hypoglycemia.

It works like this. Your system converts refined sugars and starches into glucose so rapidly that your blood sugar level rises at an abnormal rate. When the hemeostatic system that balances glucose levels senses the sharp rate and rise, it signals the pancreas to release insulin proportionately. In this case, the rate is abrupt and can only be sustained over the very brief time it takes for your body to convert the refined carbohydrates to glucose. The end result is that too much insulin is triggered to the bloodstream so that your glucose volume is soon driven well below the original, fasting level.

Proteins from a more normal breakfast are processed by the body at a much more steady rate so that appropriate quantities of insulin are metered out to stabilize glucose levels at the optimum point. Protein reduction and conversion continues for several hours and eliminates the peaks and rebounds induced by pure carbohydrate intake. Four dietary practices will prevent reactive hypoglycemia:

- Avoid refined carbohydrates (sugar and all refined starches).
- Eat protein-rich meals every four hours, especially when on flight duty.
- Use fruit or protein snacks for pick-me-ups at odd duty times.
- Substitute low-fat milk or fruit juice for coffee and soft drinks.

And speaking of coffee, I used to fly with a guy who drank gallons of coffee and never could stay awake. Turned out that he suffered from caffeine toxicity, a not uncommon problem that can cause poor sleeping, nervousness, headaches, and lethargy.

Coffee, tea, and cola, in moderate amounts, promote quick energy and clear thinking through the stimulant effect of caffeine. Above a certain level, caffeine ceases to be beneficial and becomes a hindrance to normal functioning. One cup of coffee or tea contains about 100 mg of caffeine. Twelve ounces of cola contain about 50 mg. Some doctors feel that 500 mg per day is enough, 750 mg is questionable, and 1,000 mg addictive.

Check your caffeine intake and be sure to include all the possible sources. Coffee, tea, and cola are obvious contributors, but caffeine is also present in chocolate and in many of the nonprescription headache and cold medicines, and over-the-counter stimulants.

Now about those cigarettes. One smoke raises the carbon monoxide in the blood to a level that equates to a state of hypoxia at 7,000 feet. Two cigarettes smoked consecutively raise the level to 10,000 feet, and these levels are further aggravated by actual cabin altitude. Smoking is unquestionably a contributor to fatigue.

When you do get drowsy in flight, try a few exercises, eat some nuts, and try to recall the thrilling contents of this column. If that doesn't keep you awake, nothing will.—*Adapted from Crossfeed.* ★

Now, at last, all is exposed! For the first time ever we present the untold story you've been waiting to read. Here it is . . . the unvarnished truth printed as it was written!

Confessions of

The life of a military runway is not all glory, as you might suspect. But life could be worse. I could be a radar antenna, definitely an AC/DC existence, or even a taxiway light, being just one in a crowd. No, things could be a lot worse, yet there are some disadvantages to being a runway.

I remember when I first started out. That was a long way back; in fact, my surface then was mostly packed dirt. The aircraft at that time were slow and lightweight. No matter what happened, they couldn't hurt me or my surface very much. Accidents during landing were numerous, but the pilots often walked away from the crash, just as people in automobile accidents often escape injury today. My surface would be plowed over, packed down, and I was ready once again for business as usual.

I can still clearly recall my first reincarnation which occurred just prior to World War II. I returned that time as a concrete surface. They painted me with lines and subjected me to the pounding of tail-dragging fighters and lumbering transports. These so-called state-of-the-art weapon systems

a Military Runway

As told to CAPTAIN JAMES J. LAWRENCE
Directorate of Aerospace Safety

had the peculiar habit of occasionally ground looping or depositing various failed components on my landing surface. In those days, bailing out of the aircraft was a difficult chore for the pilot. For that reason, so many of them braved it home and deposited their debris from one end of me to the other. Patching me up was a bit more complicated than it was in my past life, but we suffered through it okay. During this concrete period of mine, things really changed fast. The aircraft started getting bigger, heavier and faster. The jet-age arrived and brought with it a new breed of problems and hazards to complement the age-old ones.

Well, here I am today—reborn, rebuilt again, and fortified, your twentieth century runway, complete with approach lights, strobes, a high friction surface, VASIs, overruns. I'm longer and wider than I've ever been before. Engineers have spent innumerable hours planning my every detail. Big dollars, mega-bucks, have been spent in my design, construction, modification, and remodification. Yet, despite so many technical advancements since my inception, way back when, 17 percent of all the accidents which occurred in 1976, occurred on my surface. That's why I am speaking out today, after all these years. It's time I defended myself against all the ongoing accusations. You see, it's not so much me as it is you who have created my reputation as the primary object in the most hazardous phase of flight. You pilots and your aircraft have created this devilish image for me.

Let's examine the pilots first. I provide you with easy to identify approach lights, sequential strobes, landing markers, VASIs to tell you how your glidepath is doing, even distance remaining markers. But what do you do with all these aids? You physically attack at my approach lights. You land on my overrun. You disregard my VASIs, and cross my threshold high and hot, wasting thousands of feet of my landing surface. Your tires deposit rubber all over my approach end. Then, you come back the next day, landing in the opposite direction, and refuse to brake sufficiently in the first three-fourths of my surface. Instead, you try to brake heavily on the rubber you left behind yesterday, then blame me for your failure to stop in time.

Sometimes you forget your airspeed or angle of attack indicator while on short final. Who has to pay the price in the form of hard landing? I and my landing surface do. I've even had pilots miss me completely, landing at an airfield close by, thinking it was me. Some dummies have gone so far as to land on the taxiway that runs parallel to my surface. And what do these pilots do? They blame me even though my markings are proper, my nav aids are flawless, and these hazards are listed in their own IFR Enroute Supplement.

That's not all. Pilots consistently blow their tires all over me. Some forget to engage the antiskid brake systems. Others don't have antiskid brakes, but these pilots come equipped with big, heavy hams connected to their ankles. They stomp the brakes, even when crossing paint stripes, rubber deposits, or the cables that have been laid across me. When the tire can't stand the heat and it explodes, the pilots shamefully deplane and curse me,

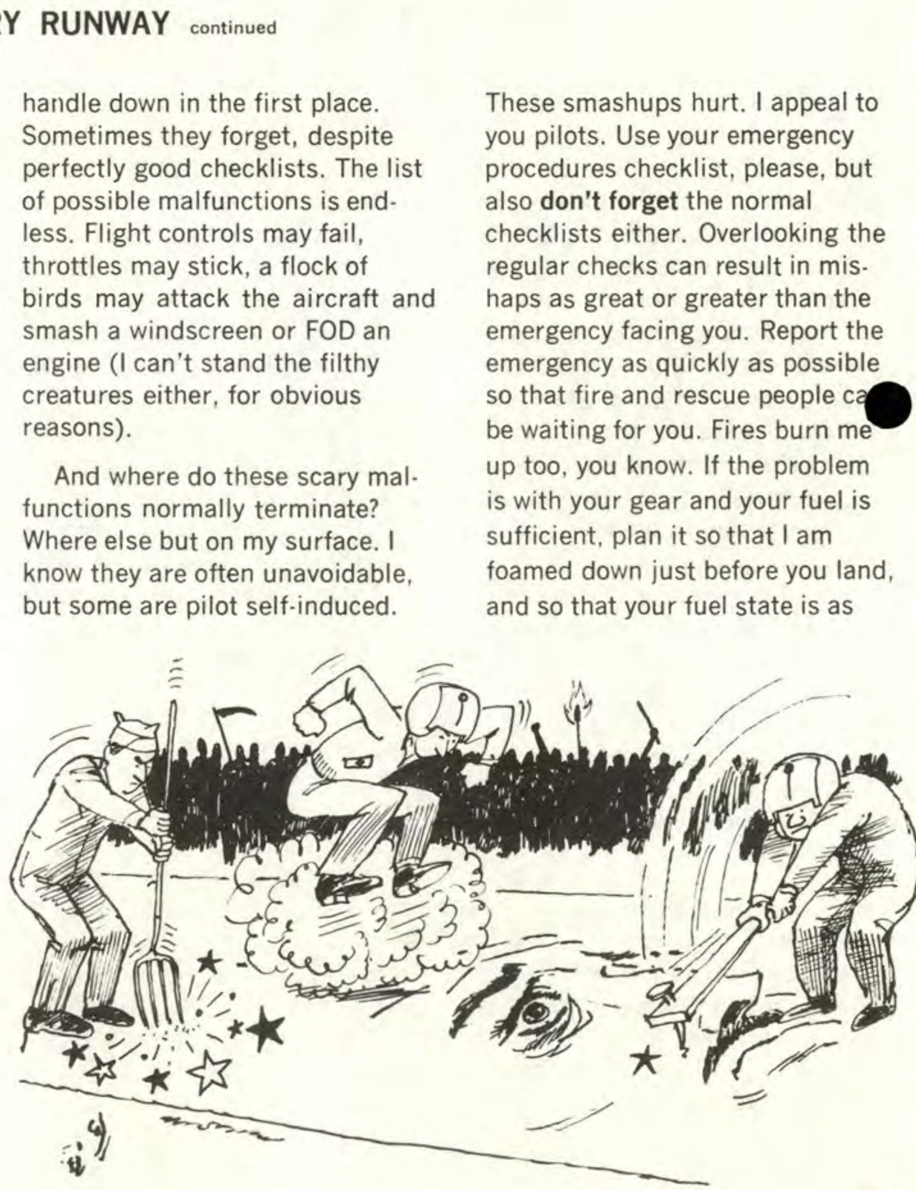
CONFESSIONS OF A MILITARY RUNWAY continued

abusing my surface with kicks and derogatory comments.

Yes, Mr. Pilot, it had to come out. My evil reputation, fostered at stag bars and hangar flying sessions, is there because you created it yourself. Something like a modern version of the Frankenstein monster, you play the doctor that started it all, and I play the blameless monster. Of course, people only remember the monster, not the guy who really deserves the infamy. It's not bad enough that pilots have so much trouble on my runway surface, but they have to turn around and make airplanes that decide to malfunction during this critical portion of your flight.

Modern aircraft are fast and heavy. They come whizzing in over my overrun and touch down. Then, they proceed to do terrible things like collapse gears or cock the nose wheel to full travel in one direction. The aircraft gets wracked up, the crew or passengers may be hurt, and my surface is marred and torn apart. Sometimes a plane will land on me without gear, because that aircraft simply refuses to let its gear come down; that's assuming the pilot remembered to put the gear handle down in the first place. Sometimes they forget, despite perfectly good checklists. The list of possible malfunctions is endless. Flight controls may fail, throttles may stick, a flock of birds may attack the aircraft and smash a windscreen or FOD an engine (I can't stand the filthy creatures either, for obvious reasons).

And where do these scary malfunctions normally terminate? Where else but on my surface. I know they are often unavoidable, but some are pilot self-induced. These smashups hurt. I appeal to you pilots. Use your emergency procedures checklist, please, but also **don't forget** the normal checklists either. Overlooking the regular checks can result in mishaps as great or greater than the emergency facing you. Report the emergency as quickly as possible so that fire and rescue people can be waiting for you. Fires burn me up too, you know. If the problem is with your gear and your fuel is sufficient, plan it so that I am foamed down just before you land, and so that your fuel state is as



low as you can safely land with. And, of course, don't be afraid or ashamed to call in and ask for help from a supervisor, a stan/eval rep, or a safety type from your squadron. I've seen a lot of accidents and, believe me, when the adrenalin is pumping, it's easy to forget or overlook otherwise obvious things. A calm head on the ground, with the tech order open, may just find the solution to your problem, and thus you may spare me another wreck.

My last topic for discussion is the subject of some natural hazards that all too often result in bent airplanes and pilots. Rain is a prime example. When dry, I'm a rather easygoing entity—docile and pleasant. But when it rains, I must admit, some inner evil takes over. I become enraged. I just hate water, and what else can I take it out on but an aircraft? And take it out I do. My favorite target is an aircraft with little tread on its tires, which flies final faster than its computed approach speed. What I do is let the water pool right around the zone it is landing in. The standing water keeps the wheels from making contact with my runway surface. I believe you call the result dynamic hydroplaning. The aircraft wheels either never spin up or if they do, I slow them down to a near standstill. The result is a zero coefficient of friction between the tire and my surface. Normal braking is useless, and directional control can be pretty tricky.

The wet runway situation is compounded when a healthy crosswind is blowing across me. Several sharp pilots have discovered that normally when landing in a crosswind, the best bet is to touch down on the upwind side. Well, when I'm wet and a crosswind is blowing, rain drainoff is inhibited on this upwind side. In fact, that may well be the wettest portion of my surface. The aircraft touches down in that slop, hydroplanes, and the crosswind takes care of it in a hurry. The aircraft is quickly deposited in the boondocks. Of course, hydroplaning can work equally as well with ice or snow on my surface. These substances often aggravate me even more than rain, and I can become especially treacherous.

My greatest annoyance, however, is those smart aleck pilots that think they know it all. You know the type. They check and double-check landing data versus runway length. They call base operations for the latest RCRs and query Ops on when and how these latest readings were taken. They fly their approaches on speed or slower, if their tech order recommends it. They pick an aim point and land on it, but stay away from puddles by clearing visually and checking with Ops or tower for areas of standing water. They use all speed reduction devices available and are careful with their braking technique. You never find this type with bald tires. They ruin all my kicks.

Well, there you have my confessions as a military runway. Landing may represent one of the more hazardous phases of the flight profile, but let's face facts. You guys have created the reputation, not me. Oh, I may get ornery once in a while when I'm wet, but your mistakes most commonly cause the accidents, not mine. If you fear landings, then respect them. If you respect them, then you will avoid complacency and stay prepared for all contingencies. Use your government issue, one-each, brain, but don't be afraid to call for some help or expertise. And then, perhaps, you will cease littering up my handsome surface with dismembered aircraft and related parts. ★

DIFFERENT VERSE

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Directorate of Aerospace Safety

His ears were ringing, and his head whirled slightly as he squinted his eyes into the high altitude sunlight. The sight was familiar to the young fighter pilot, but somehow strangely different. No longer was he surrounded by plexiglass, dull black metal, dials and gauges; a stick in one hand, the throttle in the other. Instead, he stood alone on the clouds, suspended high above muted greens, browns, and blues of the earth.

As an old man walked down the clouds toward him, he forced his mind back, remembering the feel of his 'craft as he tried to bring it back under control. He remembered trying to coax a little more out of the 'craft, close to the ground, he was good . . . the best! But somehow the wings no longer responded to his commands. The nose sliced and the green earth filled the windscreen. And now he was here in this strange but familiar place.

"Hello, my friend," the old man said, snapping the young pilot's thoughts back to the present. "My name is Otto. Please come this way, and we will get you checked in and squared away." The old man led the way up the clouds toward a great gate in the sky. As they made their way toward the final destination, Otto explained that he had been an aviator in a much earlier time. It had been many years since he had handled a stick and throttle, and he was anxious to learn more of the wonderous advances that had been made in the field of aviation since he left it more than half a century ago . . . at the close of the Great War. As they walked, he produced a scrapbook. The pictures were somewhat faded and worn, but lines still sharp and clear. The pages of the book were filled with pictures of bi-winged, tail-dragging machines from a time when aviation was still in its infancy. Many of the pictures were of crashes, and as they continued, Otto provided a short story on each picture.

"This is what remained after my second solo. It was the sixth Albatross our class destroyed. We could have been considered aces,

German Albatross III trainer destroyed on student's second solo.

Another Albatross III. Pilot Walked away uninjured.

for the allies, of course. This Albatross CIII had a maximum speed of less than 90 mph, and a service ceiling of just over 11,000 ft. I understand that training aircraft have changed somewhat."

"Yes, I should say so," chuckled the young pilot." Even the T-41s they're starting in today can do better than that. And an ATC wing commander wouldn't last two shakes if he lost six machines. By the way, what happened on that second solo? Stall it?"

"That's what some people said, but I always thought it was the wind. We had a little storm off the field, and I was in a hurry to get down. About 5 meters above the grass on short final I came down all right. One second we were flying and the next *crunch!* I thought I would lose my eye-teeth. But those machines were strong, and I wasn't even scratched."

"Sounds like windshear may have gotten you. Even today we are still learning about it. Some folks think that quite a few pilot factor accidents were actually windshear."

"Otto nodded slowly, "Perhaps so, but so many other times the pilots just blew it. Here is another Albatross CIII. Lieutenant Ernst stalled this one while making a turn at low altitude. "Would you believe he walked away with no injuries?"

The young pilot's mind flashed back to his own crash, only . . . how long ago? He knew now he was dead, but somehow the idea was still foreign and not acceptable. He, too, had "lost it" at low altitude, but the results had been much different. "Did you have many fatalities in those days?" he asked, turning to the old man.

"Yes," the old man's expression was sad as he nodded "All too many, and although some were due to mechanical failures, many were so foolish . . . avoidable. Here is a Pfalz DIII that flew into the top of a hill at night. And this is what is left of an LVG CII that spun in. In those days we didn't carry parachutes, so there was no choice but to ride it in. But today I see so many newcomers who could have delayed their arrival if they had decided to go over the side . . . er . . . up the rail sooner. Why do they wait?"

This Pfalz DIII flew into hillside at night.

LVG CII that spun in.

Pfalz CIDS flown by German pilot P. Ernst crashed from 4,000 feet.

1Lt Heintz "went west" when he allowed this Albatross CIII to stall from 10 meters. He'd forgotten to fasten his shoulder harness.

SAME SONG continued

"I don't know . . . pride . . . fear of repercussions. A classmate of mine fought an F-4 all the way down after he departed. He delayed punching until it was too late."

As the old man turned another page he said, "Here are two more that stalled and spun in. We were not very good pilots then—very litle training, not much flying time, and such young pilots.

The young man looked down between a break in the clouds and thought a moment. "Sounds like a song I've recently heard down there. The crews are getting younger and younger, less and less experience, flying time harder and harder to come by. And everytime we have an accident . . . er . . . mishap . . . the board recommends restrictions on training."

As they approached the gates, Otto had time to turn one more page. "Ah, yes, this was airman Heintz's last ride. His engine was acting up, nothing really serious, but he came back to make an emergency landing. He had to land into the sun because of the wind. The squadron commander and wing commanders were out here to supervise the whole thing, ambulances and trucks all over the place. I ran into Heintz just after I got up here. He said he got so distracted by all the confusion on the ground he forgot about flying the aircraft. He ran out of speed and fell in from about 10 meters. He should have lived, but he had forgotten to fasten his harness."

"Unnecessary cockpit distractions are still a problem. It seems that whenever you have a problem, the whole world wants to get into the act and help. I understand that the multi-engine drivers even have big brother looking over their shoulder during routine missions, and it seems that routine procedures sequenced into critical time phases of the mission have figured into more than one crash."

The old man turned and extended his hand to the young pilot. "This is where we part for now. The gent behind the desk will help you fill out the necessary forms and issue you a new set of wings. I hope we can continue our discussion later.

"Although you have developed new and faster aircraft you still seem to be crashing for the same old reasons. We will have lots of time to talk about it, all the time in the world." ★

Albatross BII damaged during emergency landing at Genershein.

OPS TOPICS

MIJI

Meaconing-Intrusion-Jamming and Interference (MIJI) is any interference that blocks your ability to transmit or receive on an assigned radio frequency. Recently, an Air Traffic Control frequency was effectively blocked by loud, persistent music sounds. When the aircrew changed to a backup frequency, the center requested a radio check on the blocked frequency and almost immediately upon the aircrew's return to the original frequency and transmission, the unidentified music began again.

A thorough investigation revealed no clues as to the source of the culprit. But, the investigators recommended, "In future cases of such interference, the exact time should be noted. This will enable commercial broadcasters to identify exactly the equipment and frequencies that are in use and may be intermittently malfunctioning."

A quick in-flight or post flight review of MIJI procedures in the IFR Enroute Supplement will reveal the exact data required for a report. If you note your position and time at the beginning, the end, and most effective point of interference, you should be able to fill in all of the other required information on mission termination.—Capt Ted M. Thompson, Directorate of Aerospace Safety.

WHY PLAN? WHY BRIEF?

An Army helicopter conducting a low level flight during field training exercises struck powerlines approximately 50 feet above ground level, severing the tail boom. The aircraft, of course, immediately ceased aviating. During the crash, one passenger was thrown clear of the wreckage and sustained fatal injuries. A second passenger received major injuries, and the crew escaped with minor injuries. The investigation revealed some alarming facts:

1. The pilot performed low terrain flight following without a thorough map reconnaissance of the intended flight route.

2. There wasn't a tactical map or a hazards map at the field site to guide unit aviators in safe mission accomplishment.

3. The pilot slept only 3½ hours during the 24 hour period before flight.

4. The copilot, flying during the mishap, was required to wear prescription lenses to correct a nearsighted condition (objects beyond 20 feet were difficult to distinguish). He wasn't wearing them at the time of the incident.

5. Inadequate passenger briefing on the use of safety belts and shoulder harnesses resulted in the fatally injured passenger's failure to have his shoulder harness secured. A proper briefing may have prevented his death. —Courtesy *Flightfax*.

Is this only an Army helicopter problem? No! Since November, two Air Force fixed wing aircraft on low level routes have hit electrical wires, causing substantial aircraft damage. Crew rest violations were factors in three recent mishaps. And lastly, when was your last comprehensive and effective passenger briefing? ★

USAF IFC APPROACH

MICROWAVE LANDING SYSTEM

Most pilots will agree that landing an aircraft is the trickiest, if not the most challenging part of flying. When you add low ceilings, poor visibility, night, and/or rain to the approach and landing, the challenge increases rapidly. For many years pilots have relied upon two basic types of precision approaches, the Precision Approach Radar (PAR) and the Instrument Landing System (ILS). Both these systems have their individual strengths and weaknesses; however, the narrow band of course guidance in both systems severely restricts their potential to meet the requirements of future aviation growth.

In 1967, the Radio Technical Commission on Aeronautics (RTCA) formed a special committee to research and recommend an alternative approach aid that would expand the capabilities of the ILS and PAR. The committee recommended the development of a full-performance Microwave Landing System (MLS), capable of meeting all user needs, and having the ability to be tailored to specific aircraft and operational requirements.

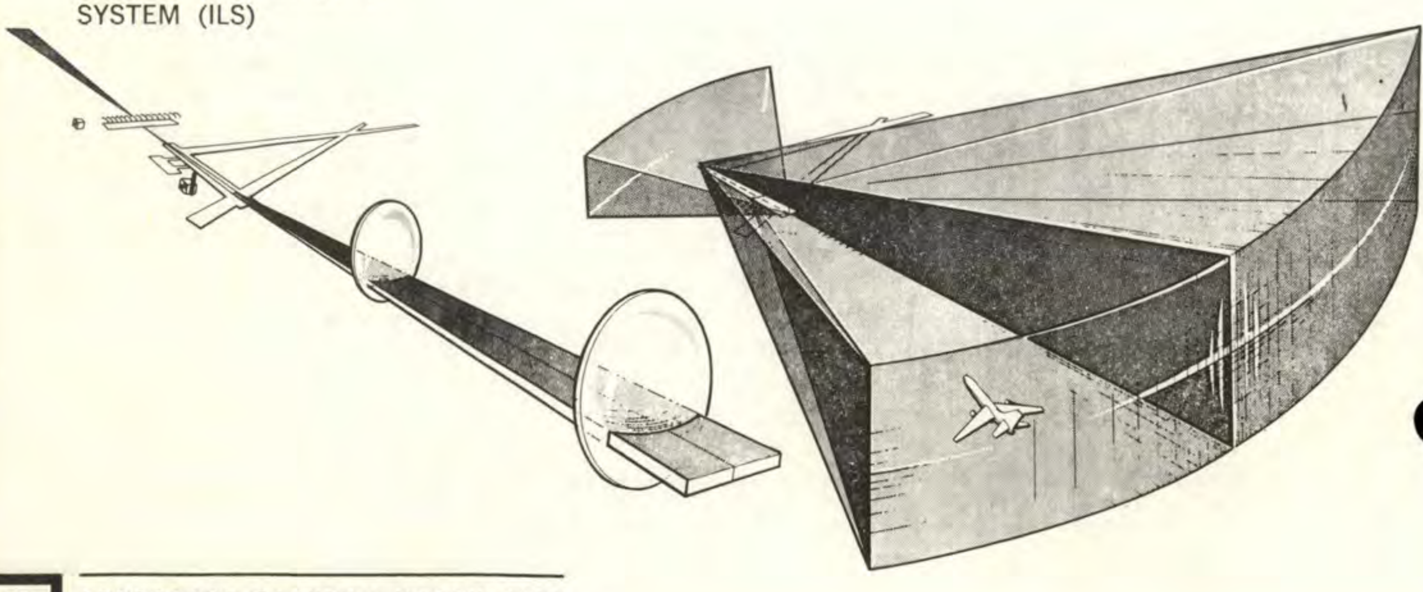
Prompted by the RTCA committee recommendations, the US formed a joint planning group, consisting of the Federal Aviation Administration, the Department of Defense, and the National Aeronautics and Space Administration, for the joint development and testing of a common civil/military MLS. Similar efforts were also initiated by other countries. The International Civil Aviation Organization (ICAO) is presently coordinating these independent programs, and will select the international standard in the near future.

There are two basic types of MLS systems in the research and development stage, the Time Reference Scanning Beam system and the Doppler system. The Time Reference Scanning Beam system sweeps two narrow beams across the sky, one from side to side, the other up and down. The aircraft's MLS equipment measures the elapsed time between successive passes by both the horizontal and vertical beams to determine the aircraft's angular position with respect to the runway centerline and its position in relation to the selected glideslope. In the Doppler system, the aircraft uses the difference between the received frequency and a reference frequency to determine its position. In either system the aircraft's airborne MLS equipment interprets the signal data and presents the information for pilot action. Both systems contain integrated precision Distance Measur-

Figure 1

MICROWAVE LANDING SYSTEM (MLS)

INSTRUMENT LANDING SYSTEM (ILS)



ing Equipment (DME). Regardless of the MLS system selected as the standard, we can look forward to radical changes and increased flexibility in approach design.

The most unique characteristic of MLS is its capability to provide a vastly expanded signal coverage area. Figure 1 graphically illustrates a direct comparison between ILS and an MLS with only ±40 degrees of azimuth coverage.

In comparing the two, ILS course guidance provides directional azimuth coverage horizontally through about 6 degrees with course information valid to approximately 18 NM. In contrast, MLS could provide 80 to 120 degrees of coverage with valid signal coverage out to 25 miles (approximately 436 square miles precision maneuvering airspace is provided with the 80 degree azimuth and 654 square miles with the 120 degree). Vertical ILS coverage provides approximately 1½-degrees of glideslope width with between a 2 to 3 degree descent gradient. MLS, on the other hand, provides a selectable descent gradient from the glideslope transmitter site of 0 to 20 degrees, so that any desired glideslope, or even segmented glideslopes can be flown. With the extremely accurate integrated DME, the MLS also provides for infinite flexibility in designing and flying any number of three dimensional precision approach paths to the landing runway. The MLS also incorporates limited precision missed approach guidance. Because it is compact and light weight, the MLS will also provide vast improvements in portable tactical precision approach systems. Using MLS, it will be possible to set up a precision instrument approach at a forward operating location in a matter of minutes.

With the implementation of MLS and the advanced technology associated with the system, the complexity, originality and utility of precision approach profiles will depend upon the level of sophistication of airborne equipment, airframe limitations, and imagination of the approach designer. MLS will solve most of the ILS and PAR deficiencies with more approach channels available, improved signal integrity, integral precision DME, and unlimited approach path flexibility. Initial implementation is expected early in the 1980's with MLS co-existing with ILS and PAR. MLS should be fully implemented as the single standard precision approach and landing aid by the year 2000. Although you won't see MLS procedures in AFM 51-37 for a while yet, it is the system of the future and many of you reading this article can expect to be using it before your flying days are over.

Q: I am being radar vectored to a final approach course. When the radar controller clears me for the approach, am I required to maintain my last assigned heading until intercepting the course?

A: The controller expects you to maintain your last assigned heading until intercepting the final approach course. However, if the assigned heading is detrimental to course interception (because of such factors as adverse winds or intercept angle) then the pilot should employ good judgment and common sense and change his heading to a more appropriate one.

As most of you probably already know, the Instrument Flight Center is in the process of being closed down. Some of you are probably wondering who you can call to confirm that you've won the case of beer you bet on that instrument related question you were arguing about the other day. Don't worry, you can still win your bet (or lose it as the case may be). The Flight Standards Division of the USAFIFC will be open until 30 June of 1978, and most of your questions can be answered there. For TERPs, call AUTOVON 487-4274. For pilot procedures/directives, call AUTOVON 487-4276. For questions on FLIP, call AUTOVON 487-4884. At the end of June FSP and FSF (the sections which look after TERPs and FLIP respectively) are tentatively scheduled to move to Scott AFB. FSD, the section which looks after pilot procedures/directives and interpretation of manuals has already been partially relocated at HQ ATC. The section there is responsible for AFM 51-37, AFR 60-16 and AFP 60-19 and can be contacted at AUTOVON 487-5835. As more information becomes available on the disposition of the various functions of the Instrument Flight Center, we will inform you through future "IFC Approach" articles. If you have questions on instrument related matters, please do not hesitate to call any of the numbers listed above. ★

Takeoffs And Judgment

There is an old adage among pilots that anyone can make a takeoff; it's the landing that's tough. Statistics support the belief that there are many more landing than takeoff accidents.

But takeoff accidents do occur, and all too often they are the result of judgment errors. Errors in common tasks which are routinely performed before every flight. Errors which cause other pilots to shake their heads and say, "I can't understand how he could have made that mistake." Perhaps because tasks like performance data computation or pretakeoff checklists are so common, we tend to pay less attention to them than they deserve. As a result, special circumstances may be glossed over and no compensation made. The result, all too often, is a mishap.

A DC-8 on a cargo flight struck the ILS antenna and approach lights during takeoff from an airport in New York. The National Transportation Safety Board (NTSB) investigation found that the crew accepted a clearance for a runway which was too short for the aircraft takeoff performance capability under existing gross weight and weather conditions.

In that mishap the crew was very familiar with the airdrome. The company had a procedure which called for the station agent to prepare weight and balance and takeoff data for the flight. While taxiing out for takeoff, however, the crew elected to take a shorter runway due to reduced RVR on the preplanned runway. Normally, such a change would not be significant but, in this case, the crew neglected to check the aircraft performance and gross weight restrictions for the shorter runway.

The first officer, at the captain's request, did check the runway facilities chart and determined that the runway was "adequate" for use. However, these facility charts do not contain limitation information and, consequently, the crew was not aware of their over-gross condition. In fact, the aircraft was more than 33,000 pounds overweight for the conditions existing at the time of departure. The takeoff performance was such that the aircraft struck objects 1 foot above runway elevation, 250 feet beyond the departure threshold and 4½ feet above runway elevation, 850 feet beyond the end of the runway. This crew should have realized they were exceeding the performance limitations of their aircraft. They should have, but they didn't. So, why did they commit themselves to this marginal situation? There is no simple explanation. A combination of factors all contributed: familiarity with the routine, the last minute change in runways, reliance on an outside party for planning. Things can and will change, sometimes

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with little or no time for recomputations. But this is exactly the time when we, as aircrews, must be most alert.

Sometimes a combination of events is set in motion by the crew. Lack of attention or hurried planning can build into a situation where a mishap becomes inevitable.

A flight of two fighters was on a navigation training mission. At an enroute stop, the weather briefing indicated that, on departure the flight would encounter light icing. The flight leader did not evaluate this information and decided to take off with engine inlet screens up. Shortly after the formation entered the clouds, both aircraft experienced compressor stalls and flameouts due to ice accumulation on these inlet screens. Neither crew could get restarts, and they both were forced to eject.

Sometimes there are factors other than the crew which set the stage for a mishap. In one case, lack of adequate planning led to a situation where the crew's capabilities were overextended, and they committed several errors resulting in a fatal crash. In another case, a flight lead overestimated the proficiency of his wingman. The flight took off in marginal weather without adequate briefing on lost wingman procedures. Shortly after takeoff, lead made a fairly abrupt turn. Number two was not able to keep up, lost sight of lead, then became disoriented and crashed.

Yes, takeoffs are normally easy. And because they are, we tend to overlook the potential for mishap. Such an attitude leads to the kinds of errors we've talked about. Aircrews are the ones who can do most to prevent takeoff mishaps.

Knowledge is the key. Know what each situation entails and be sure that all the pertinent factors are considered. Then takeoffs will continue to be easy. ★

THE

REX RILEY
Transient Services Awa

LORING AFB	Limestone, ME
McCLELLAN AFB	Sacramento, CA
MAXWELL AFB	Montgomery, AL
SCOTT AFB	Belleville, IL
McCHORD AFB	Tacoma, WA
MYRTLE BEACH AFB	Myrtle Beach, SC
EGLIN AFB	Valparaiso, FL
MATHER AFB	Sacramento, CA
LAJES FIELD	Azores
SHEPPARD AFB	Wichita Falls, TX
MARCH AFB	Riverside, CA
GRISSOM AFB	Peru, IN
CANNON AFB	Clovis, NM
LUKE AFB	Phoenix, AZ
RANDOLPH AFB	San Antonio, TX
ROBINS AFB	Warner Robins, GA
HILL AFB	Ogden, UT
YOKOTA AB	Japan
SEYMOUR JOHNSON AFB	Goldsboro, NC
ENGLAND AFB	Alexandria, LA
KADENA AB	Okinawa
ELMENDORF AFB	Anchorage, AL
PETERSON AFB	Colorado Springs, C
RAMSTEIN AB	Germany
SHAW AFB	Sumter, SC
LITTLE ROCK AFB	Jacksonville, AR
TORREJON AB	Spain
TYNDALL AFB	Panama City, FL
OFFUTT AFB	Omaha, NE
McCONNELL AFB	Wichita, KS
NORTON AFB	San Bernardino, CA
BARKSDALE AFB	Shreveport, LA
KIRTLAND AFB	Albuquerque, NM
BUCKLEY ANG BASE	Aurora, CO
RICHARDS-GEBAUR AFB	Grandview, MO
RAF MILDENHALL	UK
WRIGHT-PATTERSON AFB	Fairborn, OH
CARSWELL AFB	Ft. Worth, TX
HOMESTEAD AFB	Homestead, FL
POPE AFB	Fayetteville, NC
TINKER AFB	Oklahoma City, OK
DOVER AFB	Dover, DE
GRIFFISS AFB	Rome, NY
KI SAWYER AFB	Gwinn, MI
REESE AFB	Lubbock, TX
VANCE AFB	Enid, OK
LAUGHLIN AFB	Del Rio, TX
FAIRCHILD AFB	Spokane, WA
MINOT AFB	Minot, ND

EFFECTS OF RUNWAY GROOVING

Since their introduction, jet aircraft with their higher landing and takeoff speeds and high pressure tires have had problems with incidents/accidents resulting from loss of traction between the aircraft tire and the pavement surface. Aircraft systems, as well as pavement surface characteristics, have been modified to reduce the probability of loss of control resulting from lower traction.

Aircraft systems such as antiskid and modified nose wheel steering are two of the manufacturers' approaches to maintaining aircraft ground directional control. The remainder of the solution falls to pavement engineers to provide the best possible surface and to flight crews to use proper care when operating on wet, flooded, snow and slush, or ice covered runways.

This article will deal with one method of improving traction between the aircraft tire and pavement surface. Most of you are familiar with a type of grooving as it is used on highways. These grooves are normally longitudinal, i.e., cut parallel to the traffic direction, and are relatively narrow and shallow. In contrast, the grooving used on runways is approximately ¼ x ¼ inch and placed perpendicular to traffic flow. The primary purposes of these grooves are to serve as routes for the water to be expelled from under the tires and, in the case of transverse runway grooving, to help remove bulk water from pavement surfaces.

The British first used grooving to improve traction on their roads in the early 1960's. Since that time, grooving has been used on all types of pavement to help improve available traction. In the US considerable research has been and is being conducted to determine the best groove pattern (see Figure 1 for examples of patterns now in use). Most authorities now agree that a ¼" x ¼" groove on 1" to 1¼" centers is the best pattern when considering only traction. However, when cost is considered, this type of groove pattern may be more than is actually required under most conditions.

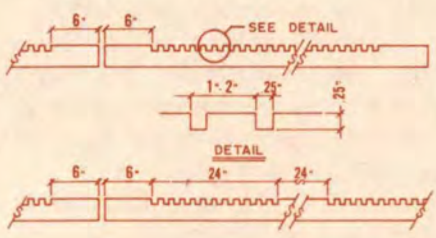


Figure 1
Typical Grooving Patterns

The FAA is continuing limited work to determine the best compromise between cost of construction and traction requirements. The patterns in Figure 1 have all been evaluated by the AF Standard Skid Resistance Evaluation System and found to have good traction characteristics. Figure 3 shows some before and after results which indicate the effectiveness of grooving. From a civil engineering aspect, grooving is probably the easiest method of improving traction on runways. However, there are two USAF limitations of which operators should be aware. First, a HQ USAF policy letter (25 Sep 75) and AF Manual 91-23 limit grooving to beyond 1500 feet from the threshold and to a maximum width of 140 feet. Secondly, it is AF policy not to groove asphaltic concrete (AC) surfaces.

The Air Force policy letter was written as the result of many complaints about the reduced tire life

CAPTAIN DANNIE O. BURK • Air Force Civil Engineering Center, Tyndall AFB FL

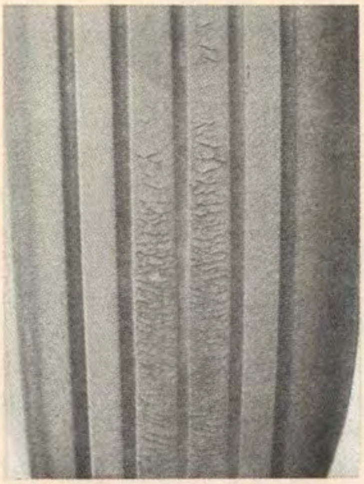


Figure 2

Chevron cuts showing wear as tire wears—not deepening or spreading to other ribs. B-52G tire after 19 landings on .25 x .25 x 1" grooved runway. (Photo from Pavement Grooving and Traction Studies, **NASA SP-5073, PP. 176.)**

caused by chevron cutting (see Figure 2) which is a product of forces generated at touchdown on a grooved surface. The tire industry along with the USAF and airline companies studied this problem and new rubber compositions are now in use which reduce tire susceptibility to chevron cuts. However, the new compositions did not eliminate completely the chevron cutting problem, and the policy restricting the grooving to the non-touchdown areas of the runway was initiated. For a discusion of the potential problems which result from this restriction see the Nov 76 *Aerospace Safety*.

Although the 140 ft (42.7 m) maximum width is primarily a result of economic considerations, it is wide enough for any aircraft to land and maintain track. On wide runways the ungrooved width is primarily for outriggers which do not require high traction surfaces. Still, skid resistance does differ at the juncture of the grooved and non-grooved pavement surfaces. This condition is not inherently unsafe as long as standard operating procedures are used. If non-standard procedures are implemented during an emergency landing or takeoff, then it is of utmost importance that aircrews know the locations of differing skid resistance surfaces.

The policy of not grooving AC surfaces stems from the probability that surface grooves would be susceptible to flowing back together or shearing of the lands (area between the grooves) during sharp turns by taxiing aircraft. While the AF does not groove AC as a standard practice, the civil airports in the US and several AF runways have had their AC surfaces succesfully grooved. The wear life of the grooving and the AC engineering characteristics prior to grooving are not generally known.

There are two primary methods of grooving runways. The first and most prevalent is sawing the grooves in existing pavement with diamond saw blades. This method is used on older pavements in need of corrective action to improve skid resistance. The second method, which is used in new Portland Cement Concrete Pavements, is forming the grooves during construction while the concrete is still plastic. This type of groove drains somewhat slower than sawed grooves because of the rougher drainage channels. However, this slower drainage is not considered to be a significant problem for AF aircraft operations.

Effects of Runway Grooving continued

EFFECTS ON AIRCRAFT TRACTION

It may seem at this point, that a great many words have been expended that apply only to the civil engineer, but operators must also look at the benefits as well as the potential problems of any surface treatment. The aim is to gain an insight into the factors which govern their particular situation. With the general engineering view behind us, let's look at the characteristic advantages and disadvantages of grooving from the viewpoint of the aircrew. As mentioned earlier, the primary reasons for grooving a runway are: (1) to get the bulk water away from the runway as fast as possible and, (2) to provide alternative methods for water to be expelled from beneath the tire as the aircraft transverses the runway. Grooving provides bulk drainage by providing the shortest path off the runway and in most cases the path of least resistance, when wind and surfaces texture are considered. When the rainfall rates are too great for the drainage capabilities and the water depth exceeds the tops of the pavement aggregates, grooves function exceptionally well as an added path for the water to escape from beneath the tire. This reduces the dynamic water pressures under the tire which could cause *dynamic* hydroplaning.

While the probabilities of *dynamic* hydroplaning have been essentially eliminated, assuming grooves are clear and in good shape, the potential for *viscous type* hydroplaning or reduced surface traction resulting from partial *dynamic* hydroplaning still exists. Loss of traction on a grooved runway resulting from *partial* and/or *viscous* hydroplaning is considerably less than that expected on an ungrooved runway. *Viscous* hydroplaning results from poor surface microtexture caused by a polished aggregate and/or rubber build-ups. Figure 3 provides comparisons between some typical grooved and ungrooved runways. As the figure shows, there are dramatic improvements in the results obtained after grooving.

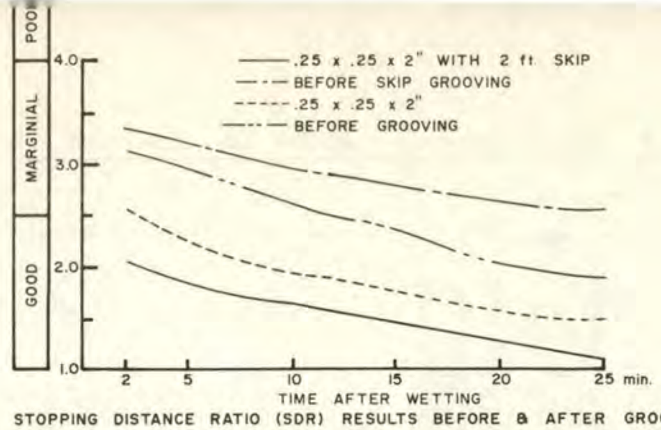


Figure 3

Having shown the differences that grooving can make in skid resistance, I will review some NASA test data which also substantiates the effectiveness of grooving. These tests included both a Convair 990 and an F-4D aircraft (data came from *Pavement Grooving and Traction Studies*, NASA SP-5073, Nov 68).

Figure 4 is a pair of graphs showing ground speed, expressed as a percentage of the theoretical dynamic hydroplaning speed, vs cornering force as a percentage of the dry cornering force. Figure 5 is a series of graphs showing a plot of ground speed vs braking friction coefficient during maximum braking efforts by the aircraft. Figures 4 and 5 both show the improved traction that can be expected as a result of grooving a runway. This improvement easily justifies the cost required for cutting grooves to enhance safety.

Review of these figures also shows one additional item of importance—the difference between dry grooved friction and wet grooved friction. While this difference is not as great as when the pavement is not grooved, it is of sufficient magnitude that under certain aircraft and weather conditions, loss of aircraft control resulting from partial hydroplaning is a possibility.

Combinations, such as bald tires, high crosswinds and a wet grooved runway, are not likely to be common occurrences. However, if these circumstances begin to combine, the crew should plan accordingly. Figure 7 is included primarily for information, to show the effect that smooth tires can have on surface traction during wet runway conditions. Having discussed wet runway conditions, I will now briefly discuss the effects grooving has on other runway surface conditions.

Slush covered runways are not too common, but when they do occur

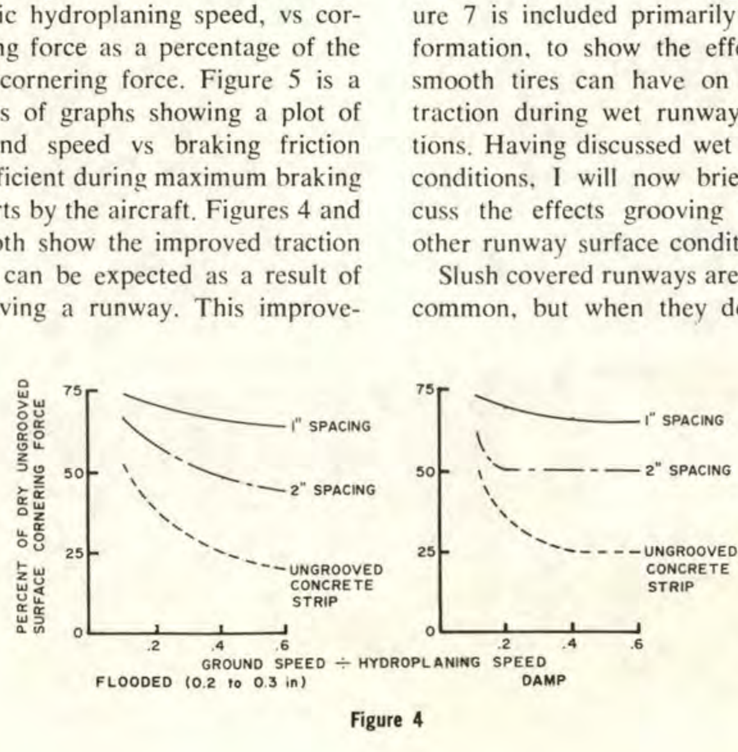
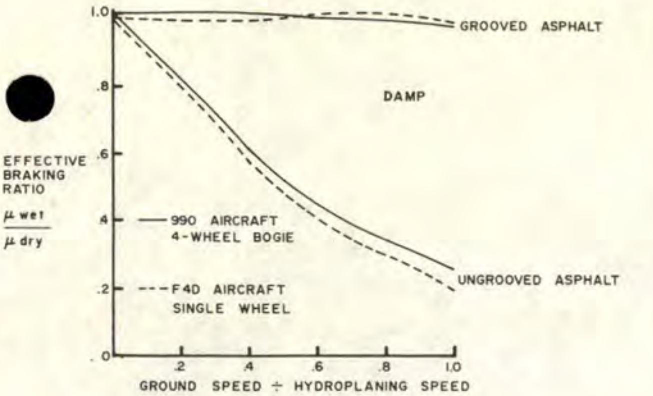


Figure 4



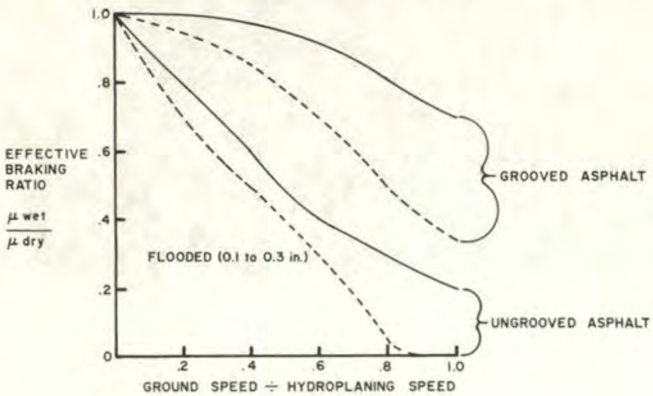


Figure 5

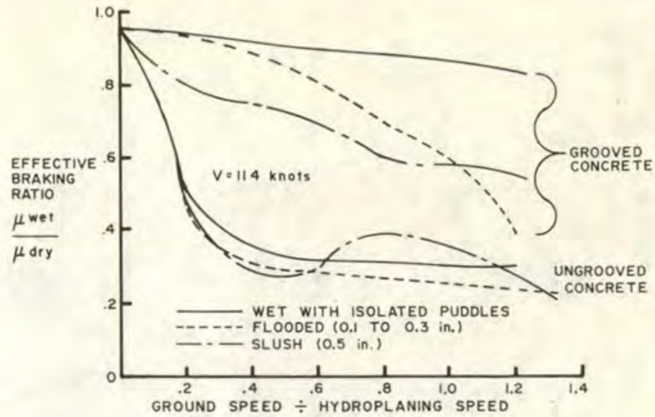


Figure 6

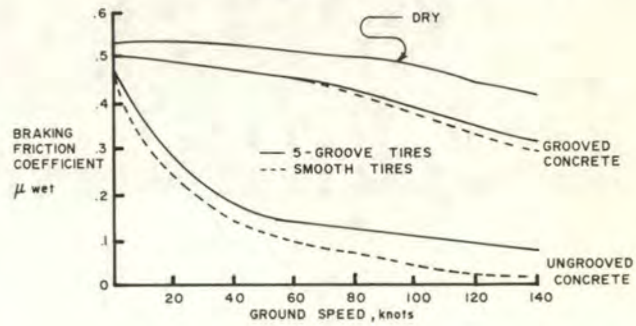


Figure 7

grooving improves the movement of the slush from beneath the tires just as it does with water. Figure 6 shows the loss of braking effectiveness that results from a slush covering and compares the results with water. The reduced drag resulting from slush provides an added safety factor. However, since groove patterns vary, the exact drag reduction cannot be specifically stated.

When the Runway Surface Condition (RSC) is ice or snow, traction is not really enhanced by grooving. However, ice that accumulates on grooved pavement when the temperature is near freezing (−5°C to 0°C) will normally breakup faster with traffic than on an ungrooved runway surface. Additionally, some airport managers claim benefits such as faster melting and clearing of runways when grooving is used. This is probable, but as yet has not been documented.

Evidence collected to date indicates that grooving provides a safer surface during wet, flooded, or other runway surface conditions*. The potential disadvantages of this type of surface are minimal to both aircrews and pavement maintenance crews. But, as with any safety system, it can be negated by non-standard or careless operations. ★

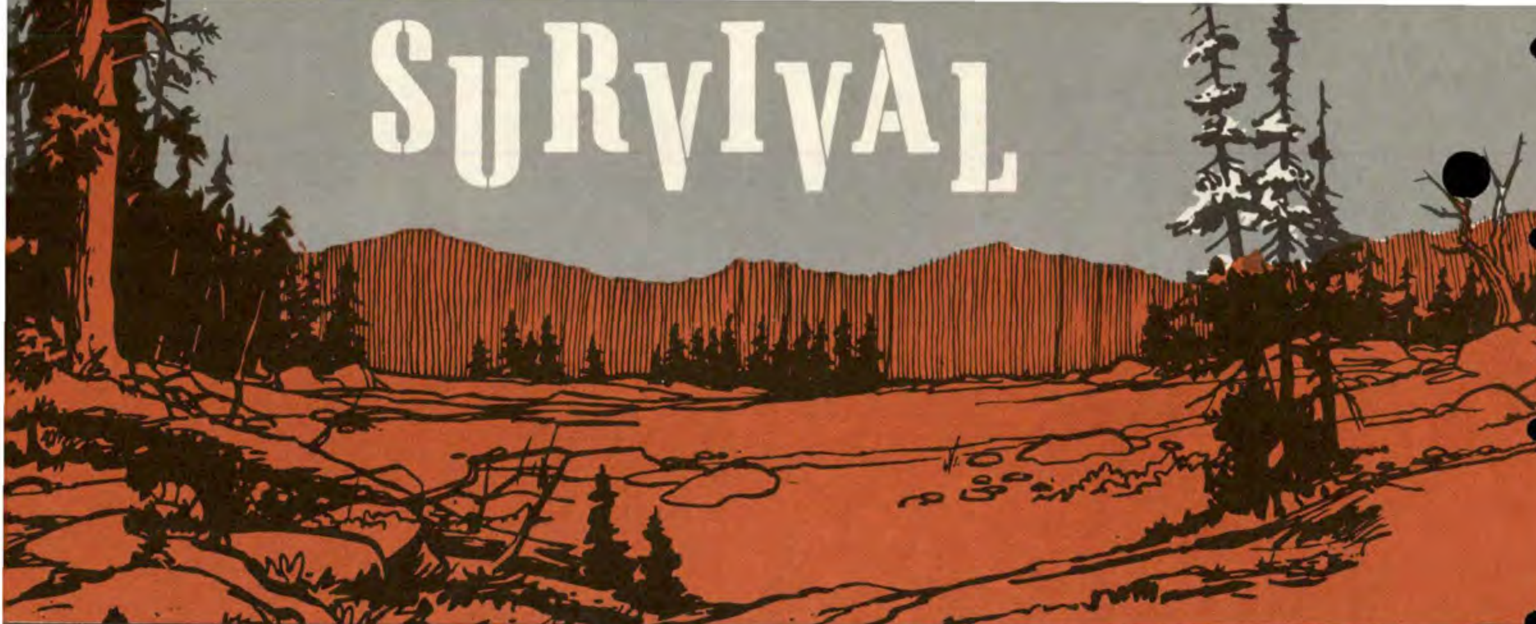
**We must, as aircrew members, maintain as a part of our memory, a general knowledge of: (1) the types of surfaces a runway may have, (2) the kind of traction that each surface affords and, (3) the runway environmental weather conditions immediately prior to landing (within 2 minutes of landing). The first two items are a part of the standard format of each skid resistance evaluation report and should reflect capabilities of the runway if the report has been accomplished wtihin five years and the pavement has not been resurfaced. Beyond five years, the wear and deformation of the runway may have completely changed the traction characteristics. The last item, runway environmental condition immediately prior to landing, should come from tower advisories or the RAPCON.*

DEFINITIONS

Macrotexture—The large scale surface texture which allows drainage of water from under a tire.

Microtexture—The smaller irregularities on individual surface aggregates which provide the major portion of the friction between the tire and pavement surface.

SDR (Stopping Distance Ratio)—A measure of the traction on a pavement surface. Wet stopping distance divided by a standard dry stopping distance of 300 feet. Distances are measured by a diagonally braked vehicle which initiates stopping at 60 mph (96.6 kmph).



I Can Survive(!)(?) *(CHOOSE ONE)*

**SSgt ALAN E. ERICKSON • Operations and Requirements Branch
3636th Combat Crew Training Wing (ATC)—Fairchild AFB WA**

There seems to be a consensus among aircrew graduates of the USAF's Basic Survival School: "Thank God it's over," and "I'm sure glad that it's a once-in-a-lifetime course."

Those of you who are now smiling and nodding in agreement or shouting "Amen!" please do a little **honest** self-evaluation. What if our nation went to war tomorrow? If you should find yourself on the ground, could you effectively put to use the skills and knowledge that would be necessary for evading unfriendly forces and staying alive for an extended period of time?

Right now some of you just mumbled something about guaranteed rescue within 72 hours of getting on the ground. Not necessarily so! With recent developments in surface-to-air missiles (both vehicle-mounted and hand-held) slow moving rescue aircraft could have a very difficult time getting to you. So you might have to move a long distance to find a better position for recovery.

For those of you who think that you will be dead or captured if you're not rescued quickly, there is not much that can be said because you have already given up. You need a strong will to make it back.

Some will die. Some will be captured. Some will be rescued. What category will you be in? That can be greatly influenced by your attitude and prior preparation.

Survival schools introduce you to what you need to know, to better your chances.

Continuation training and intelligence briefings refresh your memory and keep you informed of new developments. The immunization program, yearly physicals and the aerobics program try to ensure that you are healthy enough to undergo the rigors of survival living.

What you get the least exposure to is field practice of survival skills. Remember the "once in a lifetime course" gave you only four to six fast and furious days of application of the skills which may determine which one of the previously mentioned categories you will fall into.

Do you attempt to run the aerobics test each year without any prior preparation? Some of you do. Frequently some fail or are miserably sore for the next week. "So what if I don't make it. My friend the timekeeper will pad the time, or, at worst, I'll have to retest or attend a reconditioning program." In the combat survival environment there is no padding or retest. Any test of skills is for keeps.

I'm not proposing attending survival school again. I am proposing that you practice the skills taught to you at basic survival school. If you hike, hunt, camp, fish, ski, or go on picnics you have perfect opportunities to practice some of those skills. For example, instead of starting your next barbecue or fireplace fire with half pint of lighter fluid and two pounds of paper, try finding natural burnable materials in your yard or a vacant lot or a nearby forest. Then prepare to ignite them with only one match or a flint-like sparking device (non-zippo) that you can get at the local sporting goods store. If it is raining when you gather materials, so much the better, because in an evasion situation that would be one of the better times to have a fire. Small amounts of diffused smoke would blend with the fog and mist. At such times you may need the heat and drying effect of the fire.

If you think you'd never have a fire during evasion, forget the warm climate of SEA and imagine a northern latitude in the late fall, winter, or early spring. If you're soaked with rain or wet snow you'll need a fire to survive. Hypothermia can kill you almost as fast as the enemy. A hidden "Dakota hole" fire (see illustration) might be the only thing between you and death. If faced with that situation, you'll fare much better if you had practiced recently. Remember, no padding or retest.

You may have heard that a person can survive for 30 days without food. This may be true in a warm climate if the survivor is doing absolutely no work. Not so for an evader in a cold climate. Food means calories, which equals body heat, energy, and life. The general purpose ration that the USAF puts in survival kits today contains approximately 900 calories per can. If you have a seat survival kit, you may have one or two cans. POWs in North Korea existed on a diet containing approximately 1600 calories per day, while in confinement. Most had extreme weight loss.

Evading is hard work and much more so if it occurs in a cold climate. The active evader needs all of the food that he can get. The question of food procurement could be extremely important. Check with the local game department to see if it is legal to take pest animals, such as gophers and ground squirrels, by snaring. If so, get some thin, flexible wire, nylon string or fibrous bark that can be made into simple snare loops. Next ask some local farmer if you can catch some of his varmints. If you explain your reason and show him that your snares are harmless to his livestock, you may make a good friend and find a place to practice and picnic at the same time.

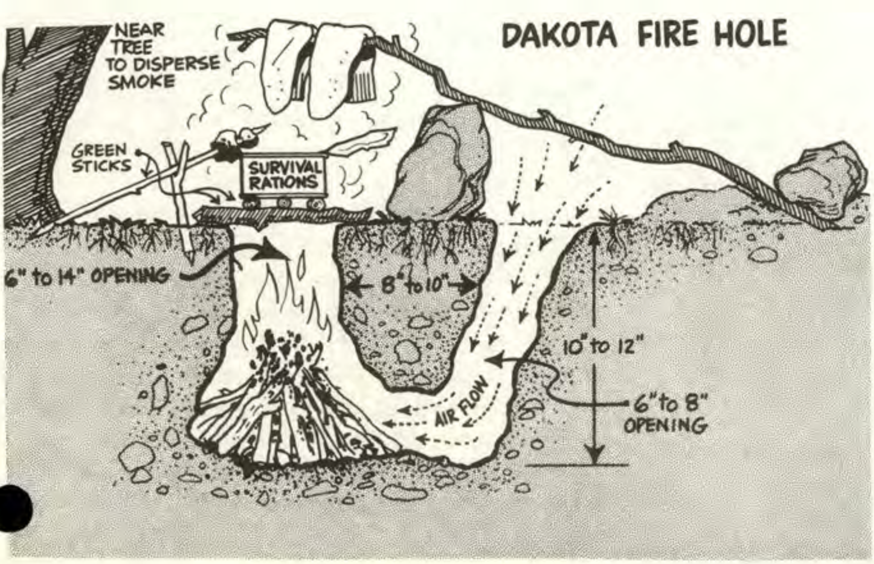
You might try getting vegetables out of "your own" garden at night without leaving evidence of your activity. Check the next morning.

You might find some excellent plant food books or identification cards at your local sporting goods or book store. When hiking or fishing, take them along and try some easily identified plants like dandelion or cattail. If you're not absolutely sure what a plant is, discard it or go through the edibility test procedures.

Instead of walking down the trail to your favorite fishing spot, try creeping quietly through the brush. In this way you can practice evasion movement and good fishing techniques at the same time. It might get you the biggest fish in the hole.

The next time that you go hunting or hiking would also be a good time to practice evasion techniques. If you hunt by stalking, or walking, try to do it quietly and without leaving many tracks. Stop, look, and listen often. Turn around and check your route of travel to see how you did. You should have selected a route that was not obvious, walked in the shadows, and been quiet. If you did well, chances are you ran into game because that's how the animals avoid/evade you. Additionally, avoid leaving tracks in the open, walking in soft soil, breaking branches, turning over rocks, matting down grass, or dropping any manmade objects.

If you sit still to hunt, select a secluded area. Approach it very carefully so you don't leave any evidence of your passing. Gently part the brush and slide through it. Do not "bull" your way through,



Survival! I can survive (!) (?)
continued

bending and breaking leaves and branches as you go. Position yourself so that you have rocks, logs, brush and/or branches to conceal you as well as protect you from the elements. If you have to use manmade materials for protection, make sure that they are not visible from above or outside of your shelter. Rearrange the natural materials so that your protection is increased and so that you can observe the approaches to your position. The shelter should look like everything else in the area, not like a brush heap. This probably means that it will have to be quite small, low, and irregular in shape in order to blend with the surrounding terrain.

If you get cold, you might try building a small, smokeless evasion fire in a Dakota hole. Use dead hardwood of little finger size or smaller. Be careful not to start a forest or grass fire.

Just prior to your next mission, look into a mirror and ask yourself a few questions: What is bright and shiny on my uniform? Is my clothing sufficient for the environment I'm flying over? Do I have a personal survival kit on my person? Being prepared means more than having the most current knowledge. No one should expect to functionally use skills learned in a "one time only" training situation and then expect to recall his proficiency after three years or more of no physical practice. You can't be at a desk job for several years and then jump back in the aircraft and expect to fly without practice!

Survival under evasion conditions makes severe demands on survivors. The basics of firecraft, food and water procurement, shelter, and the like can be put off for some time because of enemy activity. Eventually these needs will have to be met.

Don't over saturate yourself by trying too much practice all at once. This could turn you sour on the whole idea. A little bit at a time, as the situation comes up, should help maintain some proficiency.

Your family might enjoy participating and learning valuable skills at the same time. Children make relentless aggressors at a game of "hide and seek" while on a picnic. Your wife or girlfriend may not mind your slowness in starting the fireplace or campfire when you explain to her your reason and the need for the meticulous steps in firebuilding. The amount of practice you get is up to you.

Are you physically and psychologically prepared to cope with such harsh and demanding conditions? Remember there is no padding, retesting, or reconditioning program in combat. Get your own insurance—practice what the basic survival school preached.

Any questions or comments about this article should be referred to SSgt Erickson, 3636 CCTW/DOTO, Fairchild AFB WA 99011, AUTOVON 352-5470. ★

NEWS FOR CREWS

continued from page 1

in non-rated career areas should anticipate returning to rated duties at the completion of their current Supplement tour. The controlled return to rated duties has several advantages, including: (1) ensuring a young, responsive supplement resource which is truly capable of augmenting contingency forces, (2) protecting the rated credentials and viability of the individual Supplement officer, regardless of total "gate" credit, and (3) providing the opportunity for duty in support career fields to as many rated officers as possible.

With the Supplement of the future reduced to approximately one-third of its current size, competition for duty in support career fields will be keen. If a Supplement tour is in your personal career plans, communicate your desires via the AF Form 90 to your resource manager at AFMPC.

ABOUT THE AUTHOR

Captain Carl L. McPherson, Chief, Rated Supplement Section, has been assigned to the Military Personnel Center as an action officer of the PALACE SCOPE management team and Rated Supplement Section since September 1974. After graduation from the Air Force Academy, Captain McPherson flew C-130Es from CCK AB, Taiwan and Dyess AFB, Texas prior to a tour as an air weapons controller in Korea. ★

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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.

First Lieutenant David A. Deptula

555th Tactical Fighter Training Squadron
58th Tactical Training Wing
Luke Air Force Base, Arizona

On 29 June 1977, Lieutenant Deptula was nr two in a flight of two F-15s flying a syllabus training mission. He had 18 hours in the F-15 and was just completing the conversion phase of training. Three minutes after takeoff, climbing through 6,000 feet MSL, he heard a bang followed by the illumination of the left engine fire light. Lieutenant Deptula initiated the in-flight fire emergency procedure, including engine shutdown and fire extinguisher discharge, and called for his flight lead to join up for support. The flight lead visually confirmed the aircraft was still on fire and appeared to have some damage around the left aft section. Lieutenant Deptula turned towards Luke AFB, dumped fuel, and made a controllability check to determine that he could land the aircraft. To avoid any danger to personnel and to keep property damage at a minimum in the event an immediate ejection was necessary, he requested a landing on a runway which had a relatively clear approach. Eight miles on final, the right engine overheat light and the left bleed air light illuminated simultaneously, further complicating his situation. Lieutenant Deptula was now down to two options—eject or continue the approach. He elected a single engine straight-in approach which was flown to a successful landing. Crash recovery personnel prevented further fire damage by quickly extinguishing a residual fuel fire as Lieutenant Deptula ground egressed from the aircraft. Lieutenant Deptula, although relatively inexperienced in the F-15, safely returned the aircraft after experiencing in-flight fire and aircraft damage. His superior airmanship, prompt reaction to a grave in-flight emergency, and professional competence resulted in saving a valuable aircraft and averted possible injury or loss of life. WELL DONE! ★


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