flying

SAFETY

JULY 1981

HOW TO BREAK AN F-4

On Crashing and Burning

Finely Tuned Pilots

Getting Down (AF Style)

A Carbon Fiber Mishap

THERE I WAS

■ . . . on a touch and go, rolling down the runway at 100 miles per hour when Approach Control called up and asked "Did you hear Tower call you to go-around for vehicles on the runway?"

I shall leave our intrepid aviators on the runway for a few minutes while I retrace the events leading up to this moment. We were practicing multiple approaches and landings and were talking to Approach Control. Because of incessant chatter on GUARD during an approach, the IP turned it off, planning to turn it back on. However, he got wrapped up in other things and forgot, and I failed to notice it. We also planned this approach to be our last and to go to tower for VFR touch and gos. Therefore, on short final (about ½ mile from runway) Approach Control cleared us for the approach and landing and told us to contact Tower. Because we were in such a critical phase of flight, I wasn't about to play with the radios until later. Besides, if Tower needed to contact us, they could always call us on GUARD.

Well, let's return to our heroes. With the instinct of many years flying, and the pucker factor increasing at an alarming rate, the IP jammed the throttles forward to go around. I'm happy to report that we got off safely and were already well airborne when we passed over the vehicles. Oh, yes, one other thing. We were making a 100 percent flap landing, and on the go we couldn't figure out why the aircraft accelerated so slowly. Yes, you guessed it, the flaps were still at 100 percent instead of the normal 50 percent for takeoff. We had forgotten about the go-around procedures requiring resetting the flaps to 50 percent. Fortunately we were light-weight, and the extra drag didn't give us much problem in the C-130.

There are two kinds of pilots: Those who have done it and those who will do it. By relating this story, maybe we can prove this old axiom to be wrong. Remember, KEEP YOUR GUARD UP/ON.

Brig Gen Leland K. Lukens
Director of Aerospace Safety

CHARTS WILL GET YOU EVERYTIME!

We did not include all the information necessary in the first chart on page 19 in the May 1981 issue. Types of aircraft were not included on all entries. The corrected chart has been reprinted below:

TOTAL INSTALLED ENGINE FOD (except ice)
COMPARISON BY MAJCOM/AIRCRAFT*
1979 VS 1980

Increase				Decrease			
MAJCOM ACFT	1979	1980	Change	MAJCOM/ ACFT	1979	1980	Change
TAC A-10	10	14	+4	AFRES T-37	4	1	-3
AFRES C-130	1	4	+3	SAC FB-111	8	1	-7
ANG F-4	7	10	+3	AFRES C-123	3	0	-3
TAC F-4	42	45	+3	TAC C-130	3	0	-3
USAFE F-4	17	23	+5	SAC KC-135	10	5	-5
TAC F-15	19	24	+5	USAFE F-15	8	5	-3
TAC F-16	2	6	+4	ADCOM F-106	4	0	-4
ANG F-105	3	7	+4	TAC F-106	4	1	-3
MAC Test Cell	1	4	+3	AFLC F-111	5	2	-3
				USAFE F-111	10	5	-5
				MAC H-1	9	3	-6
				MAC H-3	4	0	-4
				AFSC T-38	3	0	-3
				ATC T-38	33	7	-26
				TAC T-38	9	4	-5

*Reflects only those MajCOM/ACFT combinations showing + or − changes of 3 or more.

OPS topics

CORRECTION

In the April issue of *Flying Safety* an Ops Topic, "IFR Landing Rule Change," explained a change incorporated into Par 91.116 of the FAR. The item, taken from the FAA *General Aviation News*, did not mention the exclusion contained in 91.116 excepting military aircraft of the US from the provisions of that rule. USAF aircraft are subject to AFR 60-16.

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SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

SUBSCRIPTION—FLYING SAFETY is published monthly to promote aircraft mishap prevention. It is available on subscription for $17.00 per year domestic; $21.25 foreign; $1.50 per copy, domestic; $1.90 per copy, foreign, through the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Changes in subscription mailings should be sent to the above address. No back copies of the magazine can be furnished. Use of funds for printing the publication has been approved by Headquarters, United States Air Force, Department of Defense, Washington, D.C. Facts, testimony and conclusions of aircraft mishaps printed herein may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payments can be made for manuscripts submitted for publication in the FLYING SAFETY Magazine. Contributions are welcome as are comments and criticism. Address all correspondence and, Postmaster: send address changes to Editor, FLYING SAFETY Magazine, Air Force Inspection and Safety Center, Norton Air Force Base, California 92409. The Editor reserves the right to make any editorial change in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Prior to reprinting by non-Air Force organizations, it is requested that the Editor be queried, advising the intended use of material. Such action will ensure complete accuracy of material amended in light of most recent developments. The contents of this magazine are non-directive and should not be construed as regulations, technical orders or directives unless so stated. Authority to publish this periodical automatically expires on 26 Jan 1982, unless its continuance is authorized by the approving authority prior to that date. Distribution: 1 copy for every 2.5 aircrew and aircrew support personnel.

How To BREAK An F-4

LT COL HORST GAEDE, GAF
Directorate of Aerospace Safety

■ Tuesday, April 14, 1981. Minutes ago the space shuttle "Columbia" made a flawless approach to Runway 23 at Edwards AFB and a perfect stop after a 2-mile landing roll. The shuttle was equipped with a Mark III antiskid system.

Thousands of miles away, an F-4D touched down at a European airbase. When the pilot noticed the brakes were inoperative, he depressed the paddle switch and again tried the brakes with no apparent effect. He then employed the emergency brake system, and the left tire blew. With 2,000 feet remaining, the hook was lowered, but too late to engage the cable. The aircraft stopped just short of the end of the runway. The F-4D was equipped with a Mark III antiskid system.

Watching the shuttle perform its flawless landing did not inspire me to write this article. What did it was the number of blown tire messages we have received over the past few months. A walk back to the computer room brought confirmation. The trend is up! In quite a few of our blown tire mishaps, we detect the aircrew at fault, using wrong techniques and procedures, or demonstrating what you might call poor judgment. So, if you have 10 minutes how about a little recap on brakes n'stuff?

By the way, let me apologize for misspelling the word "brake" in the headline. I just wanted to get your attention. There still is a connection between "break" and "brake," though.

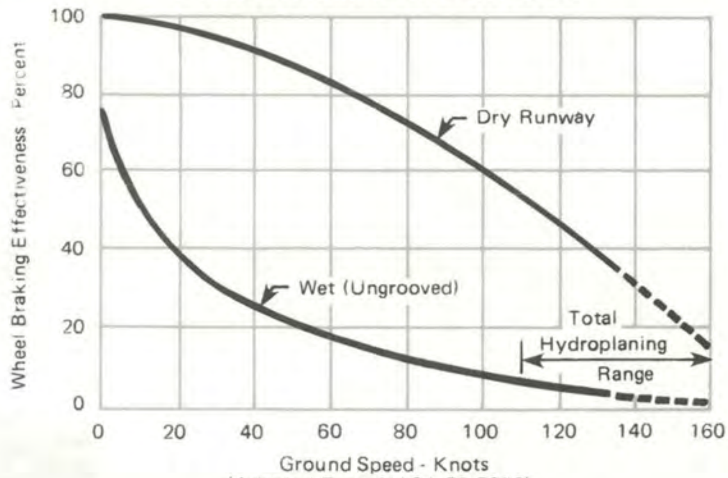
Don Stuck once said in one of his articles written for McDonnell Douglas *Product Support Digest*: "What makes airplanes go and stop is science and can be spelled out in black and white. What makes airplanes go and stop *well* is pilot ability and that is a mighty nebulous quality." Addressing science first, let's discuss some of the basics.

To stop an airplane on the runway, we try to get as much drag on the aircraft as possible. We use aerodynamic drag by means of flaps, dragchute, and nose-high attitude. Aerodynamic drag is a function of aircraft speed. The higher the speed, the higher the drag. That's exactly why your dragchute works best at high speeds. A nose-high attitude, unfortunately, is hard to achieve in the F-4 mainly because of gear locations and weight distribution. How we envy the Eagle drivers! However, holding the stick full aft and the stabilator nose-up transfers some extra weight back to the main gear, and that goes into the next equation.

One of the variables affecting wheel braking effectiveness is the airplane's weight. In essence, the total braking drag force is a product of the vertical tire load and the tire-runway friction coefficient. Again, speed is hiding in this formula. At high speeds, the aircraft's weight on the main gear is markedly lower than later in the game when you slow down. Think about it next time when you jump on the brakes at 145 knots or so and don't seem to get any deceleration. The law of physics may not have any more to offer at that point. Figure 1 should help explain the relationship between speed and brake effectiveness.

Figure 1

F-4 WHEEL BRAKING EFFECTIVENESS



(Adapted From NASA SP-5073)

Note also that vertical tire load varies from approximately 25,000 pounds for a high gross weight F-4 to about zero when going over runway bumps. The available friction coefficient varies with runway condition, of course.

A wet/icy runway would offer only a factor of 0.025 as opposed to 0.6 for a dry concrete landing strip. Hydroplaning comes into the picture, too. Whether dynamic, viscous or reverted-rubber (still know the difference?), what it does is create a layer between your aircraft tires and the runway, thereby reducing or eliminating vertical tire load, wheel rotation, and friction. After all, we need wheel rotation to make brakes work. A locked-up wheel is a wheel out-of-control, where braking is reduced and tire integrity is threatened.

Modern brake systems like the Mark III antiskid use a concept of wheel slip control in the area of 10 to 15 percent for most effective braking. Study figure 2.

Some more words about the Mark III antiskid system. Yes, because of several improvements, it gives you a smoother performance. This may occasionally lead pilots to believe the system is not functioning at high speeds or low friction coefficients. Pilots' misinterpretation at that point can result in a wrong course of action, possibly ruin the tires, the day, and more. The antiskid system provides high efficiency stops. If you want optimum braking, full pedal application is recommended. Theoretically, perhaps, it would be sufficient to maintain steady brake pressure at a level above the skid pressure. However, since this is a variable point and changes with speed, runway condition, etc., it is extremely difficult to obtain with any precision.

The system is further designed with "touch-down protection" that guarantees against locked brakes at touchdown. When the gear handle is moved to the DOWN position, a dump signal is retained until the last wheel exceeds 48 knots on spin-up or 3 seconds following weight-on-wheels switch activation, whichever happens first. If you touch down in a hydroplaning situation and the wheels don't spin up to above 48 knots, the system will revert to manual brakes 3 seconds after weight-on-wheel switch activation. The Mark III system analyzes, reports (inop light) and reverts to manual brakes during most antiskid malfunctions. However, it does not

continued

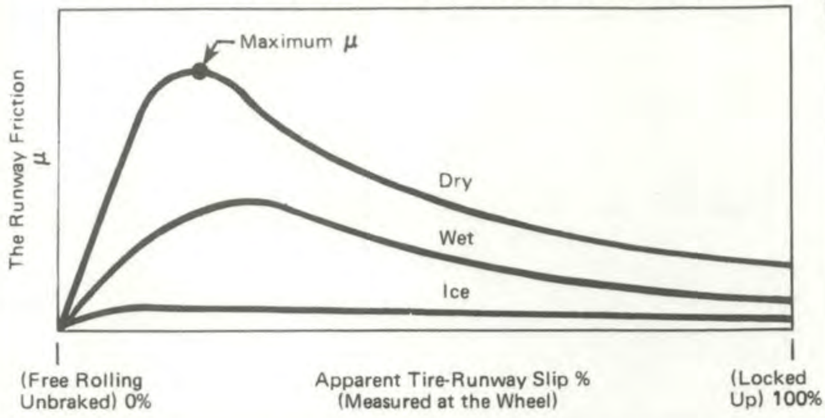
How To Break An F-4 continued

include 100 percent electrical failsafe provisions. When components in the failsafe circuitry fail, that circuit will no longer provide failsafe info to the system. So, whether you get the light or detect any abnormalities in the system when you use it, there is only one way to correct: get rid of the system. Turn it off!

Okay, now that I've discussed some of the basic information, let's feed this into a typical F-4 landing roll.

Figure 2

TYPICAL TIRE-RUNWAY FRICTION CHARACTERISTICS



The point I want to make right here is that a most important facet of the landing roll occurs even before the aircraft is on the ground—on final approach.

- Fly ON-SPEED. Don't carry extra knots if you don't have to. More speed at touch-down means more lift, less vertical tire load, etc.
- Shoot for 700-800 fpm descent rate. This gives you 500-600 fpm on touch-down due to ground effect cushioning.
- Use firm touch-downs. Leave half an elephant back there. Don't "grease job." Those days are over.
- Force yourself to land in the touch-down zone every time. Don't give away runway you may need later by landing long.
- Throttle IDLE and chute DEPLOY immediately after touch-down.
- Hold the stick full aft. Help to put more weight on the runway.
- Use rudder/ailerons for directional control. That works well for most situations and is effective down to 70-90 knots. Differential braking at high speed for directional control is a very poor choice, particularly under bad runway conditions. Remember that you don't get optimum brake effect by using differential braking. That's how the system works!
- Let the aircraft slow down pretty well on its own to 100 knots or below (if possible) prior to braking at all. Remember as the aircraft slows down, the ability to feel the brakes and get better deceleration on the aircraft both improve. Should you have an antiskid malfunction and the system reverted to manual, like advertised, your brakes can take maximum system pressure now at 100 knots or less without skidding and blowing a tire. If, however, you find yourself with no brakes at that point, but did everything right before and know your procedures, there still should be enough room to stop the beast. Just remember, hook down is your first step now. Above 100 knots, it takes very little pedal displacement to lock a wheel with manual brakes. Under some conditions, as little as one-quarter inch may be enough! For the same reason, I personally don't advocate checking the brakes early in the game. It's hard to tell if they are working properly with a good system, and if they don't work, it could mean inviting trouble, particularly under bad runway conditions.
- If you have antiskid working for you and you are looking for optimum braking, apply brakes firmly and maintain constant pressure. Don't pump the brakes.
- Use nose gear steering as required. Under most situations that means from turning off the runway to the taxi back home, although I realize that high crosswinds, wet runways, etc., demand use of the system early in the game.
- Taxi slow. Cut down on sideloads to the tires. At a given radius, the loads go up as a square of the amount of speed increase. Greater mass means higher stress, and taxi out is more critical than taxi in. Most pilots taxi at twice the speed they think they do. Save that speed for after you get the gear up.
- One last consideration. Plan to use all the runway available for your landings.

You'll probably say now, that was all "old hat" you knew already. Maybe you did, maybe you didn't. Maybe you didn't realize how important it is to take your feet off the brakes when selecting manual or emergency brakes. And how about all the other extreme or emergency situations? Your flight manual covers it all and gives pretty good guidance. To stay on top of it, you have to study and know your brake systems like any other aircraft system.

STAY ON TOP OF IT! ■

When The Emergency Comes

CAPTAIN MYRON E. WILLIAMS
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Grissom AFB, IN

■ In an emergency, good crew coordination can save lives and aircraft. My crew has always emphasized this attribute, and last February it paid off.

We took off out of Hickam AB, Hawaii, nr three in a three-ship cell of KC-135s, ferrying Navy F-4s to California. We were flying at FL 280, under the composite route system between Hawaii and the mainland United States, when one of the three receivers assigned to us lost oil pressure in his starboard engine. Several minutes later he shut it down and informed us that he would not be able to maintain altitude. We quickly dispatched our other two F-4s to another tanker and accompanied the crippled F-4 down.

When the emergency began to develop, we each had a specific job to do, and the rest of the crew depended on him to do it well. The pilot maintained close visual position on the disabled F-4, allowing the F-4 crew to fully concentrate on their emergency procedures. The copilot called McClellan Airways on the HF radio, informing them that we were breaking off from the cell, descending to FL 190, and turning right ninety degrees to offset ourselves 25 miles from the composite track. He then consolidated the necessary information and transmitted a distress call for the F-4. I, the navigator, established a new track so there would be no airspace conflict with other aircraft. I then crosschecked the *IFR Supplement* to ensure that we were complying with the rules governing the track system while maintaining safe separation between our cell and other aircraft in the area. The boom operator assisted the pilot in maintaining visual contact with our two F-4s during the descent.

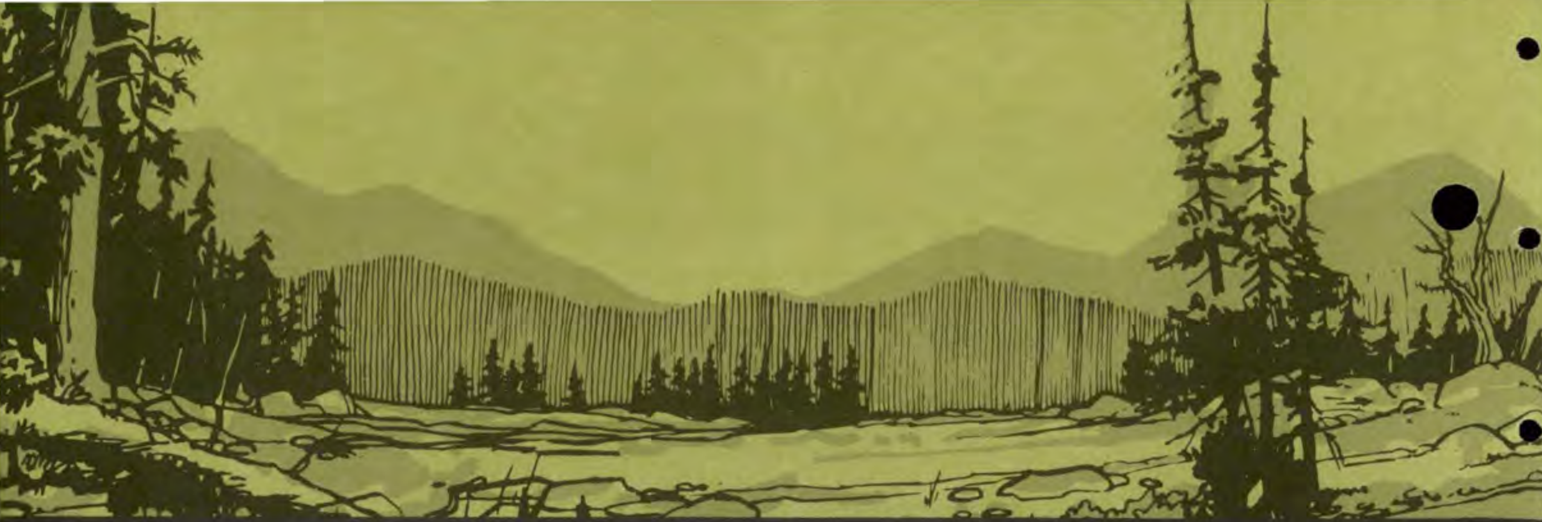
After leveling at FL 190 and after the F-4 pilot completed all of his emergency procedures, we discussed the situation and decided to fly with the F-4 in trail to Miramar Naval Air Station, 950 miles away. I put the coordinates in my computer, altered the aircraft heading and advised McClellan Airways of our intentions. Since the F-4 had only one engine, we also requested that a strip alert HC-130 stand by. Since my strip chart did not cover the area we would be flying over, I plotted the new track on one of the spare GNC charts we normally carry on over water missions.

Meanwhile, we attempted to refuel the disabled F-4. Since he did not have enough power with his one engine to make a contact and take on fuel we attempted to toboggan. Initial success made us hopeful, but he fell off as he gained fuel and became heavier. The toboggan refueling was finally terminated because the drogue flapped excessively during the maneuver.

We stopped our descent at 15,000 feet and tried a new technique. We started refueling at 274 KIAS. As we offloaded fuel we slowed to just under 250 KIAS, trying to time the deceleration to a five minute period. The technique worked, and the F-4 was able to stay in the basket. We used this technique for each of our subsequent refuelings.

Approximately 700 miles from the coast, the HC-130 aircraft came up on frequency. He requested our present position, altitude, and true track. We gave him the requested information and told him that our rendezvous equipment was set up for the refueling. We updated our information with him several times during the next hour. Approximately 375 miles from the coast, he appeared on our left wing to escort us and the F-4s. We gave the fighters one last onload 200 miles out. They assured us they had enough fuel to proceed with the HC-130. We obtained clearance to climb to a higher altitude and proceed with our mission.

When an emergency like that occurs, it requires quick, positive action from the crew. In that case, each crewmember had a specific job requiring total concentration. Our crew may have contributed significantly to saving the aircraft and its crew. I believe we must all strive for the goal of total professionalism in our every day flying because we never know when an emergency may arise requiring those attributes. ■



The Secret Of The Desert

SGT EDWARD SMITH · Det 2, 3636CCTW, Nellis AFB, NV

■ The misconceptions and folklore surrounding the hostility of desert environments have led many people to believe that it is impossible to survive in the arid stretches of the Sahara, the Gobi, or even the Great American deserts. True, there are documented accounts of people who have simply gone into the desert and vanished. Why? Was it misfortune, lack of knowledge, or a lack of preparation? Perhaps it was a combination of all plus a failure by the individual to maintain a strong will to survive. Whatever the reasons, the myths have always been a part of desert survival. Myths have contributed to the overall fear and apprehension attached to being stranded in an arid stretch of land we call a desert.

For the purpose of this article, a desert is a dry region rendered barren or partially barren by a lack of rainfall. The average annual rainfall in most deserts is 10 inches or less. Some receive little or no precipitation for several years then are deluged by heavy rains in a short period of time due to some freak change in climatic patterns.

Many people picture the desert as nothing but miles and miles of shifting sand dunes. That's not so. The largest desert in the world, the Sahara, is only 10 percent sand, while the Arabian Desert has only 20-25 percent, and the deserts in the southwestern United States contain even less.

Desert areas are noted for extremes in temperature and dryness and a general lack of vegetation. Yearly temperature variations will range from below 0°F during the winter months to a high in excess of 130°F in the summer. Daily temperature fluctuations between day and night may be as much as 45°F.

All these morsels of knowledge are fine, but it is more important to recognize the impact these factors will have upon you as a survivor in a desert climate. First, the temperature extremes will dictate protection from the sun's rays during the day and insulation from the penetrating cold at night. Second, the lack of water will be your most crucial concern. Without adequate water to replace normal body losses, your expected survival time is only a couple of days at best.

Water plays the most important role in your body's functions. With out this precious ingredient, the body will cease to operate. Under normal everyday conditions, you'll require a minimum of two quarts of water per day. Because of the stress induced by high desert temperatures, the daily requirement is doubled. With increased physical activity or extended exposure to the sun, the 4-quart per day water requirement may be doubled or even tripled; therefore, your survival time depends upon the temperature and the amount of water you have available. At 90°F, with only four quarts of water per day, you would be expected to live 10.5 days; however, at 120°F, your survival time is only 2.5 days!

Your body controls heat primarily through evaporation of secreted moisture (sweat) on the skin surface. When your body temperature increases six to eight degrees above normal for an extended period, death is likely. Therefore, you need a consistent intake of water to allow normal functions to occur and maintain normal or near-normal body temperature. If you lose 2½ percent of your body weight, or about 1½ quarts of body water, you'll suffer a 25 percent loss in efficiency. Also, by working in temperatures of 110°F, your efficiency is reduced by 25 percent. If the two events occur simultaneously, you are operating at 50 percent normal efficiency.

In addition to water losses incurred through evaporation, the body loses water through respiration, defecation, and urination. All of these losses have to be combatted in order to prevent dehydration and incapacitation. If you become dehydrated, the symptoms you can expect are dizziness, headaches, lack of salivation, slurred speech, nausea, flushed skin, and drowsiness.

This all sounds very bad, but there are several things you can do to prevent dehydration. First, drink plenty of water. You'll probably have a very limited supply on hand, but it is important to drink what you have, as you need it. This will maintain your body efficiency for a longer period of time. Your body needs water to create perspiration and to supply liquid for circulation. When the body dehydrates, the blood loses water, becomes thicker, and volume is reduced. The result is more work for the heart and less efficient circulation. These facts point out the fallacy in the old wives' tale which advocates rationing your water. Rationing water will only lower your body's water level to a dangerously low point! You merely lose efficiency quicker.

Your need for water can be controlled, to a certain extent, by rationing water *loss*. This can be done by three interrelated methods. First, keep your activity to a minimum! Work or travel is more desirable at night when the desert is cooler. Second, stay in the shade! The sun of some deserts can literally bake you. You must locate and remain in a shelter that will protect you from the sun and the wind, yet allow cooling breezes for ventilation. Third, keep your clothes on! Clothing will protect you from the sun's rays and absorb your perspiration. Sweat absorption extends evaporation time, and the cooling effect created within the clothing will retard water loss.

Although water is the critical factor in desert survival, food *may* become a problem, *if you have water*. You can live for weeks with no food, but only a few days without water.

Don't plan on living entirely off the native vegetation, although it is possible to supplement the concentrated foods in your survival kit with wild plant foods in many deserts. In the American southwest desert, edible plants are more abundant than in the Sahara, Gobi, or Arabian deserts. But keep in mind that it may take more energy to gather the food than you'll get by eating it.

Animal food is available in some deserts, but the benefits from your exertions could be counter-productive. When meat is digested, the liquid waste products must be eliminated from your body through the kidneys. That takes water. If your water supply is low, it may be wise to sun-dry any meat and save it until you have a more abundant water supply.

Desert insects are a good food source, but digesting them also requires water. If your water supply is low, you may want to forego insect food.

You may be able to get help from desert people. They'll recognize your sign language for, "I'm thirsty," even if they don't understand your words. Once contact has been made with natives in any desert, food and water are usually available. During normal times, desert people tend to be quite hospitable.

Your survival in the desert may depend upon the knowledge you are willing to accumulate about the desert and the skills you develop to combat the forces working against you.

Living in desert conditions isn't easy, but it is possible. Confidence is gained through the positive perceptions you have about yourself and your own abilities. — Reprinted from *Aerospace Safety*. ■

No Walking at all

Max. Daily Shade Temp° F.	Available Water per Man, U.S. Quarts					
	0	1	2	4	10	20
	Days of Expected Survival					
120°	2	2	2	2.5	3	4.5
110°	3	3	3.5	4	5	7
100°	5	5.5	6	7	9.5	13.5
90°	7	8	9	10.5	15	23
80°	9	10	11	13	19	29
70°	10	11	12	14	20.5	32
60°	10	11	12	14	21	32
50°	10	11	12	14.5	21	32

Walking at night until exhausted and resting thereafter.

Max. Daily Shade Temp° F.	Available Water per Man, U.S. Quarts					
	0	1	2	4	10	20
	Days of Expected Survival					
120°	1	2	2	2.5	3	
110°	2	2	2.5	3	3.5	
100°	3	3.5	3.5	4.5	5.5	
90°	5	5.5	5.5	6.5	8	
80°	7	7.5	8	9.5	11.5	
70°	7.5	8	9	10.5	13.5	
60°	8	8.5	9	11	14	
50°	8	8.5	9	11	14	

This is Table 17B, p. 279, in **Physiology of Man in the Desert**, by E. F. Adolph and Associates, New York Interscience Publishers, 1947. Note that survival time is not appreciably increased until available water is about 4 quarts, the amount necessary to maintain water balance for 1 day at high temperatures. Utilization of shade or saving a few degrees of temperature is as effective and as important in increasing survival time as water.

■ With today's sophisticated ejection seats and extremely reliable aircraft, there remains little talk of the once common topic of crashing and burning. One might hear an infrequent reference to the subject in conversations between aircrewmen, but it is clear that crashing and burning does not receive the attention that it once did.

The fact that aircraft crashes and their subsequent fires are not everyday topics does not mean that these events have ceased to exist. Aircraft crews still practice the emergency procedures designed to combat the risk of emergency egress; in many aircraft that briefing is a required part of each mission brief. Most crewmen would agree that it is good judgment to have a predetermined plan of action ready for such emergencies, but it is not always clear how much critical thought has been given to these plans. Perhaps it would be beneficial to review the hazards associated with aircraft crashes and fires before continuing this discussion.

Aircraft Crashes

Every pilot has a vision of a stereotype aircraft crash, and most flyers have seen posters explaining the hazards of flight illustrated with pictures of early aircraft in interesting but unplanned attitudes. Every crew member has also participated in the monthly safety meetings which discuss and show the results of aircraft crashes. However, it is not always true that these same flyers have examined all the forces that affect an object striking the ground.

Studies have shown that an aircraft crash is not an instantaneous smoking hole but instead is the result of a sequence of events that lead to that hole. The injuries associated with aircraft crashes can also be attributed to several factors.

In a study of aircraft injuries it was found that 54 percent of the fatalities were caused by head injuries; 68 percent of the survivors also had injuries to the skull.

Clearly, one potential cause of injury is the deceleration of the occupants upon striking the ground. But, one must also consider the injuries resulting from the collapse of the aircraft structure, the impact of objects hurtled through the crew compartment, and the potential for the unrestrained or inadequately restrained passenger to also fly about the cockpit (1).

The aircraft flown today have been designed to counter many of these potential hazards, but these forces cannot be eliminated. The crewmember protected by his helmet and secured to his ejection seat must still dissipate the energy of a crash. If that energy is great enough or his equipment fails, the crewmember is no longer as well protected, and he may be injured. If this equipment is improperly worn or adjusted, the flyer is again subjected to unnecessary risks. In a study of aircraft injuries, (1) it was found that 54 percent of the fatalities were caused by head injuries; 68 percent of the survivors also had injuries to the skull. The potential for injury, whether protected or not, is always present in an aircraft crash. Even if there are no injuries, we should still expect the aircraft to be damaged, making egress from the wreck all the more difficult. Besides the usual damaged canopy system or the jammed hatch, one of the most common hazards is the post-crash fire.

Aircraft Fires

After an aircraft impacts any object, one would expect damage to the plane. In aircraft impacts with the ground, 87 percent have caught fire (2). These fires may be caused by ruptured fuel tanks or electrical faults or other causes, but the crew on board must still combat the fire if they are to escape. Not only must the crew counter the fire, they must also contend with the gases produced by the fire. In many cases, this combination of heat and fumes allows those on board the aircraft mere seconds to escape (3). The high probability of a post-crash fire and the short time available to egress make it vitally important that all crewmembers understand the problems facing them during an emergency.

"FIRE" is usually the one word that no one ever speaks on an aircraft; it is a subject about which one does not ever jest. But there are

In aircraft impacts with the ground, 87 percent have caught fire.

DAVID M. EIBAND and A. MARTIN EIBAND

On Crashing And Burning

certain characteristics of aircraft fires that are extremely important for the crewmember to know. Many

The stunned or injured airman may have only seconds in which to accomplish his emergency egress.

people would argue that fire related injuries are caused primarily by heat; some would more astutely answer that the most important fire related problem is not heat but smoke inhalation. In aircraft fires the most critical factor is the toxic nature of the burning structure's fumes. These fumes and the potential for intense fuel fires, make quick egress a necessity.

All crewmembers are aware of the fire protection afforded by their Nomex gear; it will not burn or melt as easily as the old cotton or nylon suits. Nomex will eventually burn, but more importantly, the flyer will have lost the flight suit's thermal protection long before the suit burns. This equipment was not designed to allow flyers to stay in aircraft fires for a long period of time. The purpose of protective clothing is to offer protection from flash fires while the crewman quickly makes his escape. While it may be an unwritten requirement for flyers to wear their flight suits disheveled to project the proper image, this practice in-flight only increases the possible injuries in a fire. Protective equipment is of little use if it is not used properly.

Crashing and Burning

The pilot who lands short of the runway, or fails to counter an excessive sink rate in the final turn, or departs the prepared surface is subjecting himself to a potentially hazardous situation. The potential for structural damage, excessive deceleratory forces, and flying objects are all very real threats. We would expect the average crewmember to be at least taken aback by all this and possibly stunned if not seriously injured. The situation can be infinitely worsened by the high probability of a post-crash fire, and the stunned or injured airman may have only seconds in which to accomplish his emergency egress. It is those few seconds which will determine if a survivable crash just became unsurvivable.

There are times when no amount of good looks, or flying skill, or even blind luck are going to get a flyer out of a bad situation. There are not many of us who have not been faced with an on-board fire, or brake or hydraulic failure. Likewise there are few instructors who have not sat through their student's learning to judge sink rate in the final turn. With this in mind, it might be wise to consider some improved protection. Wearing shoulder harnesses even when not required in your crew position is a good idea. It is also smart to roll down your flight suit sleeves and to carry two pairs of flight gloves—one for the dirty, greasy preflight and another clean pair for flight. Or one might consider wearing thermal underwear, which will provide additional thermal protection and help dissipate the heat of a fire.

Every aircraft Dash 1 recommends that aircrews not place loose items

Considering the hazards of an aircraft crash and the very few seconds a flyer may have to escape a probable post-crash fire, every precaution taken beforehand becomes an aid to survival.

on the glareshield or leave such items lying anywhere around the aircraft. Those objects can become lethal projectiles during a crash. There are a great many other protective measures which could be taken, but they, too, are often overlooked. When one is considering the hazards of an aircraft crash and the very few seconds a flyer may have to escape probable post-crash fire, every precaution taken beforehand becomes an aid to survival. Combined with a well thought out egress plan, those precautions could be the factor that makes a crash survivable. ■

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BULLDOZERS

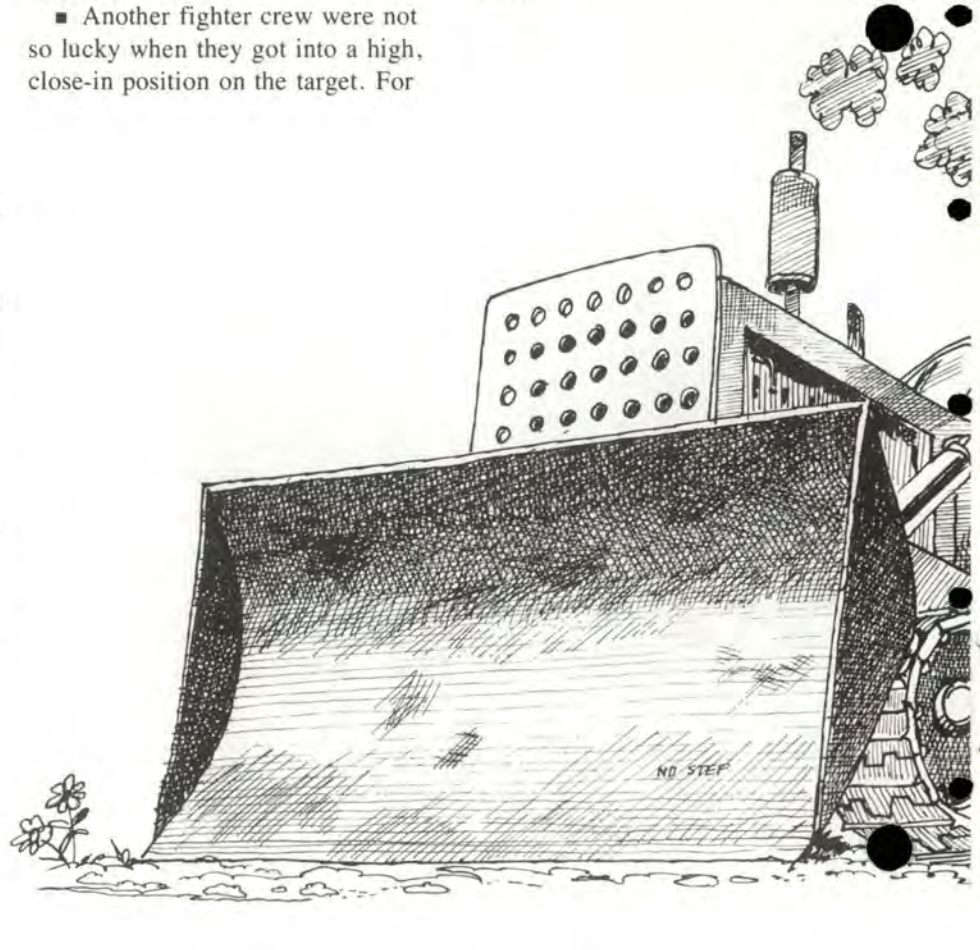
ROBERT W. HARRISON
Editor

■ When a pilot flies an airplane into the ground, it is usually a terminal act for both the crew and the machine. Last year, Air Force pilots did it eleven times (three on range and eight off). Fortunately some of the crewmembers escaped, although the aircraft were all destroyed. Here we're just going to talk about the off range mishaps.

All but one were fighter/attack aircraft, the other a transport. One pilot ejected safely, but the other crews were killed.

In every case, the aircraft was operating near the ground, which afforded very little room for a mistake and minimum time for recovery. A brief description of each mishap will illustrate why.

- A fighter was nr 4 in a 4-ship on takeoff in radar trail, weather 800 ft. overcast. The pilot couldn't get contact with the preceding aircraft on radar and broke off the SID to gain a radar trail position. In so doing he got into a diving right turn at low altitude. He attempted to recover but couldn't in time to avoid hitting the ground.
- A fighter, nr 3 in a 3-ship. The flight was holding in radar trail for entrance to the range and the crew, for whatever reason, flew beyond protected airspace in IMC. Strong wind at holding pattern altitude took the aircraft into an area of high terrain and it flew into a mountain.
- The mishap aircraft, a fighter, was nr 2, 5,000 feet out from lead, slightly aft of line abreast. Approaching a 9,000 foot mountain, the flight made turns which led the pilot to misjudge terrain clearance. The aircraft struck the ridge and subsequently was destroyed. It must have been the pilot's lucky day, because he ejected after the first impact and made it.
- Another fighter crew were not so lucky when they got into a high, close-in position on the target. For some reason—an illusion, target fixation, lack of awareness of their true situation—the pilot did not use proper recovery technique and the aircraft hit the ground, killing both crewmembers.
- Another fighter crew apparently lost excessive altitude on the inside of a formation turn. A recovery attempt was begun too late and the crew didn't make it.
- During a low altitude mission an A-10 crashed from a low orbit. There was no attempt to eject, the aircraft was destroyed and the pilot killed.



DON'T FLY

■ Another A-10 was lost when nr 1 on a low altitude tactical navigation mission got into an 85° bank turn with a high sink rate from which collision with the ground was unavoidable. A pilot and an aircraft were lost.

■ The transport crashed during a circling approach on a moonless night. The aircraft entered a nose low, steep bank attitude from which recovery was begun too late and the aircraft was destroyed on ground impact.

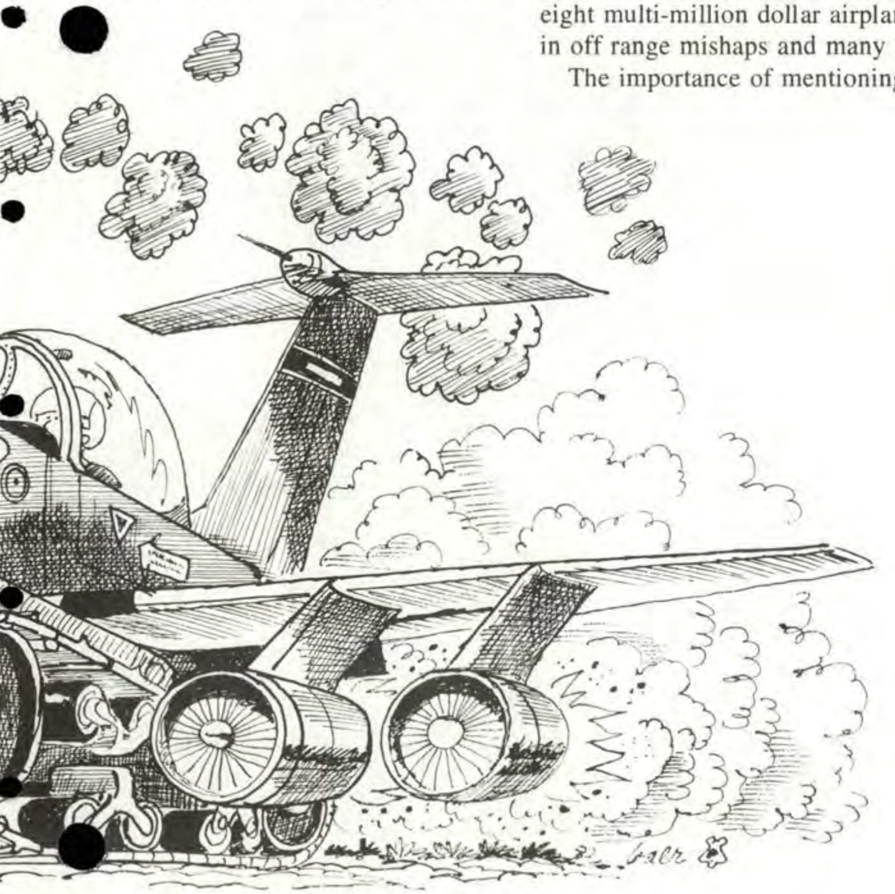
As you read those paragraphs did you find yourself thinking "could happen — but not to me." Would any of those crews have thought differently? I doubt it.

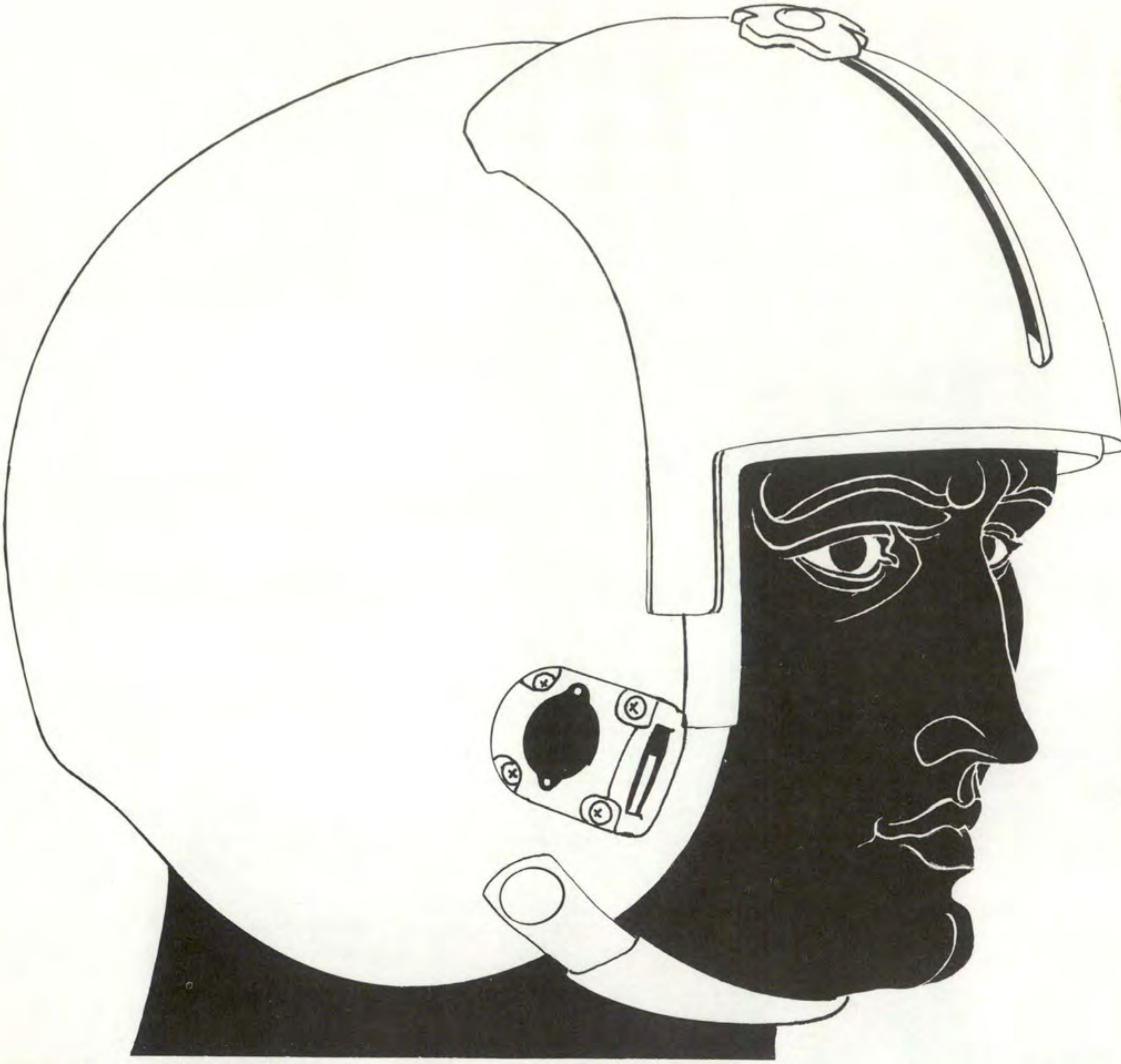
The picture for 1980 was much better than that of 1979 when there were 19 Class A mishaps of the collision with the ground type off-range and six on range. 1979 was a particularly bad year, in nearly every category, but from the dismal record of that year we must have learned something — or put some muscle into what we already knew. So last year we cut the collision/ground in half. Good, good. But before we pat our backs too hard, remember we lost eight multi-million dollar airplanes in off range mishaps and many lives.

The importance of mentioning these mishaps here is to give all our aviators a chance to see the broader picture. The common thread that appears to run through this whole skein of mishaps is that the pilot didn't realize how deep in he was until it was too late. A pilot saved his life by ejecting in time. He lucked out *after* the aircraft hit the ground and made it. The rest paid the big ticket.

Although 1980's record was much better than the previous year, we're not following through. Through May this year there were five collision with the ground Class A mishaps. Surely the trend can be reversed. This is one type of mishap that should be easy to avoid with some heads up flying. If we can reverse this trend the payoff in people, planes and mission capability will be worth any effort.

Airplanes are for flying, bulldozers dig holes in the ground. Let's make a deal: The bulldozers won't fly and airplanes won't dig holes. Agreed? ■





Finely Tuned Pilots

■ Under absolutely ideal conditions, a pilot is as finely tuned as a violin. The trouble is, a pilot is human just like everybody else and humans get out of tune. And it doesn't take a broken leg or a heart attack to put a person out of whack.

A pilot gone slightly sour needs a tune-up immediately. If he doesn't get one, he may land somewhere besides the strip he was aiming for, or plunge three counties into complete darkness by dragging down several miles of high-tension wire.

When such events take place, many people converge on the scene to launch an investigation. The aircraft is pieced back together, witnesses are questioned, and weather charts are consulted. If he happens to be available, the pilot has his brains thoroughly picked. Every stone for miles around is turned at least once. And all too often the investigators can only pack up their statistics and move on, dolefully muttering "pilot error."

Pilot error? There is more here than meets the eye. The investigators know that as well as anyone else. The term is a large one and covers certain mysteries of human behavior.

Is simple ignorance pilot error? An error can be committed only by a person trained to know better. Experts sometimes refer to this kind of error as the "human factor" behind mishaps; EVERYTHING the pilot did or failed to do that led to the crash. And WHY. The WHY is often the mysterious part. Many times the pilot can't say WHY himself. If he could, he wouldn't have crashed in the first place. But here is the cold truth. A person who has performed a simple action the right way hundreds of times suddenly does it exactly backwards. Why?

One answer is that mishaps involving the human factor occur when the human machine at the controls is not functioning the way it should. It's out of tune, running a little rough, developing a ping. Nothing really wrong and nothing that can't be easily fixed; but ripe for the conditions investigators have to label "pilot error."

The flight surgeon, the commander, the instructor, the other pilots in the outfit can easily spot a person in the clutches of Asian flu, whooping cough or the 7-year itch. No trouble at all. Pilots with such ailments are kept on the ground until cured. But spotting the person just slightly out of whack, ready for one of those sudden reversals of form that confuse everybody, is not quite so simple. He may be out of tune physically, emotionally, or both, and the naked eye sees nothing. He may act cheerful as a chipmunk and yet be gnawed on by marital problems or the state of a sick child. Or be ready to blow his top because the in-laws are running him into the ground and still look as serene as a poker player with four aces.

The human being is a complicated critter and some emotional disturbances are brought on by causes so deep a pilot doesn't even know they're there. All of us are constructed out of such a mess of instincts, fears, anxieties, resentments, frustrations, reactions, and desires that it's a wonder we operate at all; or have sense enough to roll over. But we do and we usually make out all right. Still, if one of these inner anxieties gets out of hand, maybe without our even being conscious of the same, we can be in for trouble.

All of us have days when it just doesn't pay to get up. What to do on those days? Sit tight, take a couple of deep breaths, and face the fact that this is not going to be your day. Apply the brakes. Extra caution is strictly in order.

Since everybody is different from everybody else, there is no exact yardstick by which human beings can measure just how far off the mark they are. The person whose day started off badly can only check the way he feels now against the way he USUALLY feels and act accordingly. The point is to stop and take a long look at the situation.

Complacency or inattention, whether caused by weal or woe, can lurk behind the error that lies behind the mishap. Nobody can put his finger on precisely how many crackups are caused by letting high spirits cloud the judgment, but it is a safe guess that some of them are. Everybody admires the person who whistles while he works. The trick is not to let the whistle take up more attention than the job at hand.

What pilots eat, or fail to eat, is another factor behind pilot error mishaps. The carelessness of some folks, young and old, never ceases to amaze the doctors. What a person takes in, of course, is directly related to his efficiency as a human being.

The human body is a machine that works on the energy manufactured from the food it consumes. A body needs fuel just as an aircraft does and it has to be the right octane too. Some people who laugh at that idea don't give much thought to what kind of fuel they consume themselves. They either eat too much, too little, or improperly.

The human body works on the glycogen stored in the liver and produced by glucose, a first cousin of lactose, or blood sugar. Carried by the blood, glucose—or blood sugar—is a highly desirable item to have floating around in one's insides. In fact, if blood sugar level drops below a certain point, anybody is in trouble—ANYBODY.

The longer a person flies, the more emergencies will come along to test his abilities. Only a finely tuned, responsible person can cope with them all as they arise.—Adapted from *Flightfax*.■

X-COUNTRY NOTES

MAJOR DAVID V. FROEHLICH

COMMERCIAL MESSAGE

■ This is my final "Rex" column and I want to put in a plug for the program. We are gaining! During my past three years' evaluations of almost 100 installations, I've noticed a trend toward "caring" and that is the secret. Lots of folks do more with less and it's strictly a function of a "can do" or "desire-to-do" attitude. I feel pretty good about the calibre of the bases we have on the list. We've been able to visit all those bases except one within the past three years and, generally, I think they represent places where an aircrew can look for safe and professional service and treatment. There are a few more installations which probably belong on the list, and we'll get to them! As I mentioned, though, I feel the list is credible. Credibility is a function of currency of information, however, and we still welcome and solicit comments from aircrews, ops folks, commanders and all interested players. Current info is the lifeblood of the program.

AIRCREWS

We still receive letters and critiques from the airplane drivers which report a bad turn by Podunk AFB and wonder why they are on our list. Further investigation reveals that the folks dropped in unannounced with a four-ship or a many-motor full of PAX or . . . . My "no-sympathy" warning light illuminates if there was no phone call or even an attempt to call on PTD within 20-30 minutes of landing. Cooperation and communication are the keys. Can't say often enough – let people know early that you're coming in and what your requirements are! If it's an airborne divert, call on PTD or through the command post. Even a message passed to Base Ops through tower, ground or clearance delivery may help to ensure that TA, parking, POL or whatever services required are readied.

BASE OPS FOLKS

A large portion of the dispatch time at a busy location is taken up answering questions. One base we visited recently has cut the number of inquiries at their counter with a one-page info sheet (folded into four parts). This sheet began with "filing info" (SID availability, hazards, peak local flying times, etc.). It then showed preferred departure routes, frequencies, phone numbers, times and a small base map. The info sheets were conspicuous on the dispatch counter with a sign that said "before you ask, take one. . . ." The sign went on to say "if you have further questions, we'll

Bases on the Rex list can be expected to provide good transient services. Comments from crews, ops and commanders help keep list current.

Air Force Inspection and
Safety Center (SEDA)
Norton AFB CA 92409

EDITOR
FLYING SAFETY MAGAZINE
AFISC/SEDA
NORTON AFB, CA 92409

NOTE:
RETURN THRU BASE
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READER SURVEY

Flying Safety is published for aircrews, their commanders and supervisors, and support personnel in such fields as operations, air traffic control and life support.

If you are assigned in one of these career fields, *Flying Safety* is for you. We would like for you to tell us how we are doing so that we can publish a magazine that best meets your needs. Please take a few minutes to complete the attached pre-addressed survey.

We also welcome letters and articles for publication. Please write to:

Editor, *Flying Safety* Magazine
AFISC/SEDA
Norton AFB CA 92409

In accordance with paragraph 30, AFR 12-35, Air Force Privacy Act Program, the following information about this survey is provided: (a) Authority: 10 USC 8012, Secy of the Air Force: Powers and duties; delegation by; (b) Principal Use: To collect a sampling of opinions on *Flying Safety* magazine; (c) Routine Use: To present resulting grouped data for use by decision makers in evaluating the effectiveness of the periodical; (d) Participation is voluntary, and no adverse action may be taken against nonrespondents, although honest responses are needed and appreciated.

Thank you for participating in this survey.

USAF SCN 81-56B
(Expires 31 Oct 81)

SURVEY QUESTIONS

1. How often do you see the monthly *Flying Safety* magazine?
   ( ) a. every issue ( ) d. have never seen it
   ( ) b. most issues ( ) e. have never heard of it
   ( ) c. some issues
2. When you see *Flying Safety* magazine, how much of it do you read?
   ( ) a. all of it ( ) c. some of it
   ( ) b. most of it ( ) d. never read it
3. Are the articles interesting to you?
   ( ) a. often ( ) c. seldom
   ( ) b. sometimes ( ) d. never
4. Are the articles of value to you?
   ( ) a. often ( ) c. seldom
   ( ) b. sometimes ( ) d. never
5. Are you currently an aircrew member? No ______
   Yes ______
   What position?
6. What is your rank? ______________________
7. What is your AFSC? ______________________
8. What type of subject matter do you prefer to see in this magazine? ______________________
9. Please tell us how you would improve *Flying Safety*.

____

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THE

REX RILEY
Transient Services Award

be glad to help!'' Saved a lot of time and confusion at the counter and gave the crews something with all the info that they could take along with them. Super application of a time-worn idea.

NEW ADDITION

KEESLER AFB – A super stop with folks that care! Lots of traffic in the area make this an ''eyes-open'' must for departure and arrival. Check those displaced thresholds so that first runway remaining marker doesn't water your eyes on landing.

REVISITS

MYRTLE BEACH AFB – Still a good stopover, but they still have somewhat limited ramp space so give them a warning.

MARCH AFB – Limited visibility and heavy traffic. Study the area if you're not familiar. An excellent turn provided but lately some shortages of TA personnel for the traffic count make prior notification extra important. Facilities and service outstanding.

HOLLOMAN AFB – Still one of the best; it's also still one of the hardest to get in and out of. Warning areas, multiple runways/approaches and arrivals can be confusing, so do your homework. Thrashing around in the pattern is no place to be reading the IFR Supp! TA and Base Ops some of the best we've seen.

ANDREWS AFB – They continue to work hard at good service for all! Strange ops and mind-boggling priorities require some aircrew empathy. Q's are always full – call ahead.

DYESS AFB – Turning out to be one of the best bets for east – west gas stops, the folks at Dyess are doin' good. Single runway operation and another USAF patch is a ways away. Save some gas!

EGLIN AFB – Best in the southeast. Watch arrivals and departures, but the ''Eglinites'' will give you excellent service. Best billets we've seen in the USAF.

WRIGHT-PATTERSON – Base Ops facelift is complete, and what a change. They've always had good service and now they have the facility to match.

NO CIGAR

BASE X – This overseas place doesn't care! The highlights of the visit were moldy vending machines, violations of ramp safety criteria and TA apathy. Nuff said!

BASE Y – Nice Base Ops building, but we couldn't find a dispatcher to save our. . . . Hourly NOTAM update 35 minutes old, and the new one had been in the WX det basket for 40 minutes. Galloping apathy!

BASE Z – Billeting alone keeps them off the list. Check in was OK, and the room adequate. Check out was a disaster – surly clerk, lost registration slip, incorrect charges, etc. A shame that an otherwise outstanding installation is dragged down the tubes!

We care! The Rex Riley program is alive, well and carrying a sword off into the sunset to make transient's stays and stops *safer* and more efficient. If you have some comments – call AUTOVON 876-2113 or write Rex Riley, AFISC/SEDAK, Norton AFB, CA 92409. Thanks for the support! ■

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
MATHER AFB	Sacramento, CA
LAJES FIELD	Azores
SHEPPARD AFB	Wichita Falls, TX
MARCH AFB	Riverside, CA
GRISSOM AFB	Peru, IN
CANNON AFB	Clovis, NM
RANDOLPH AFB	San Antonio, TX
ROBINS AFB	Warner Robins, GA
HILL AFB	Ogden, UT
YOKOTA AB	Japan
SEYMOUR JOHNSON AFB	Goldsboro, NC
KADENA AB	Okinawa
ELMENDORF AFB	Anchorage, AK
SHAW AFB	Sumter, SC
LITTLE ROCK AFB	Jacksonville, AR
OFFUTT AFB	Omaha, NE
BARKSDALE AFB	Shreveport, LA
KIRTLAND AFB	Albuquerque, NM
BUCKLEY ANG BASE	Aurora, CO
RAF MILDENHALL	UK
WRIGHT-PATTERSON AFB	Fairborn, OH
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
VANDENBERG AFB	Lompoc, CA
ANDREWS AFB	Camp Springs, MD
PLATTSBURGH AFB	Plattsburgh, NY
MACDILL AFB	Tampa, FL
COLUMBUS AFB	Columbus, MS
PATRICK AFB	Cocoa Beach, FL
ALTUS AFB	Altus, OK
WURTSMITH AFB	Oscoda, MI
WILLIAMS AFB	Chandler, AZ
WESTOVER AFB	Chicopee Falls, MA
McGUIRE AFB	Wrightstown, NJ
EGLIN AFB	Valpariso, FL
RAF BENTWATERS	UK
RAF UPPER HEYFORD	UK
ANDERSEN AFB	Guam
HOLLOMAN AFB	Alamogordo, NM
DYESS AFB	Abilene, TX
AVIANO AB	Italy
BITBURG AB	Germany
KEESLER AFB	Biloxi, MS

What Meets The The Eye...

Real Or Illusion?

"Human error" and "approach and landing" are phrases frequently used in describing causes of aircraft accidents. Statistics reveal that about 80 percent of aircraft accidents involve human error as a contributing factor. In addition, about 50 percent of all accidents occur during the approach and landing phase. (USAF experience, however, is different, with landing mishaps at 17 percent as of 1979—ed.)

Your primary role in the cockpit is making decisions. In order to do this you must sense and process information. Potential sources of error range from limitations in your senses and perceptual mechanisms to inadequacies in procedures and methods prescribed for the flight crew. This article will briefly present some characteristics related to sources of information processing error during the approach and landing.

Your senses receive physical stimuli and encode information; perception interprets information and attaches meaning to it. Most of the information which you receive comes to you through your eyes; some comes from instrument displays in the cockpit, but a large amount is obtained from outside the cockpit, often under conditions which may be far from ideal. Indeed, certain conditions may prevent the necessary information from even reaching the eye. More often a signal reaches the eye but the brain misinterprets and you "see" something else; in other words you experience a visual illusion. We will discuss only the illusion, or false perceptions, associated with direct vision.

Visual illusions are potentially common in flying and result from the incorrect interpretation of what you see. This may be due to there being too few visual cues so that you have to fill in the rest of the picture by drawing on your preconception of the situation, by "seeing" what you think you "ought" to see, or simply by guessing. It may also occur when cues presented to the normally master sense, vision, are weak and are in conflict with relatively strong responses by other senses, particularly those of balance and orientation, which have sensors in the inner ears.

The purpose of this article is to draw your attention to some of the circumstances in which visual illusions may be experienced and to the hazards which the illusions may introduce on the approach to land. Increased awareness of these factors will enable you to recognize and compensate for most visual illusions and so reduce the risk of an accident.

Visual illusions during the landing approach may be caused by one or any combination of the following features:

- Sloping approach terrain
- Sloping runways
- Runway width
- Rain on the windscreen
- Featureless approach terrain
- Runway lighting intensity
- Shallow fog
- Rain showers
- Darkness
- Black hole effect

Sloping Approach Terrain

Normally, when a pilot makes a visual approach he subconsciously judges the approach path from a combination of the apparent distance of the aircraft from the runway and its apparent height above the approach terrain. If the ground under the aircraft slopes upwards towards the threshold an illusion may be created, particularly during the early stages of the approach, that the aircraft is too high (see Figure 1). Conversely, ground which slopes downwards towards the threshold gives the impression that the approach path is too flat (see Figure 2).

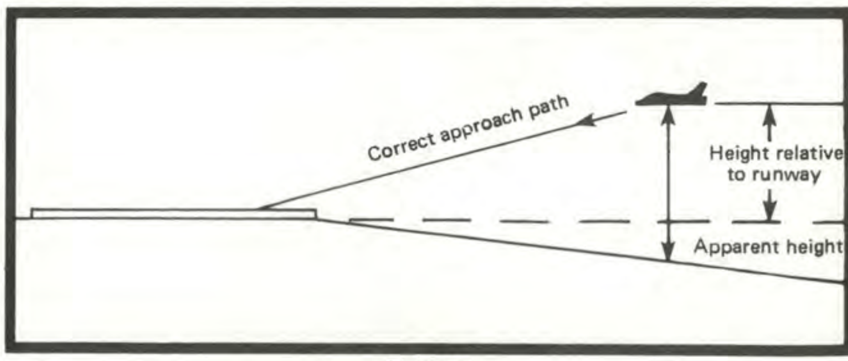


Figure 1

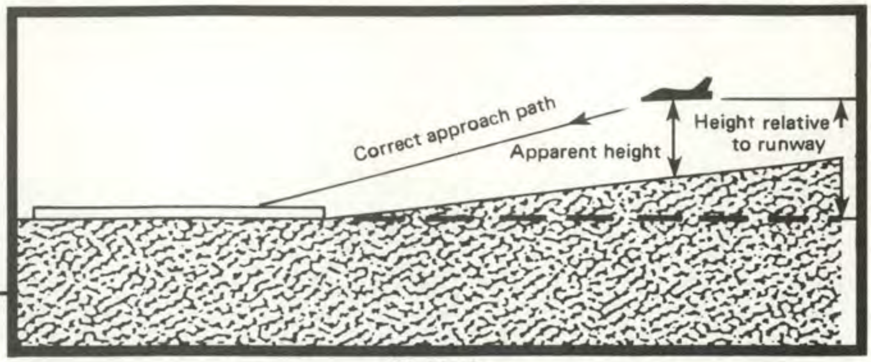


Figure 2

Sloping Runways

Through the regular use of ILS glide paths and VASIs, with three degree glide slopes, pilots become accustomed to the complementary angle of 177 degrees between the runway and the approach path (see Figure 3). Additionally, from experience, pilots come to know with considerable accuracy the amount of power required to maintain the correct approach path to the point of touchdown. If, however, the runway slopes upwards from the landing threshold and the 177 degree relative angle is maintained, a visual approach will be lower than it should be, by about the same amount as the runway upslope, and the "usual" power setting will be inadequate to meet the requirements of the flatter approach. If the runway has a downslope, the converse applies, so that by maintaining the 177 degree angle relative to the down-sloping runway, the approach to the touchdown point will be steeper and the "usual" power setting in excess of that required.

Runway Width

The ability to use the apparent convergence — due to perspective — of two parallel lines to estimate their length is well known. Increasing or decreasing the distance between the lines, however, can create the illusion of shortening or lengthening them. On the approach, a pilot bases part of his judgment on a mental comparison of the runway before him with the "normal" view of the runway to which he is accustomed. Variations in the runway width, therefore, can be misleading. For example, the wider the runway, the shorter it appears; moreover, the width can also have an effect upon the apparent height of the aircraft in relation to the runway, a wider runway making an aircraft appear lower than it is.

Rain

Heavy rain can affect the pilot's perception of distance from the approach or runway lights by diffusing the glow of the lights and causing them to appear less intense. This may lead him to suppose that the lights are farther away than in fact they are. On the other hand, only a little scattering due to water on the windscreen can cause runway lights to bloom and double their apparent size, with the result that the pilot believes that he is closer to the runway than he actually is, leading possibly to a premature descent. Similarly, rain on the windscreen can cause illusions as a result of light ray refraction. For instance, even though an aircraft is correctly aligned on the approach path it can appear to the pilot to be above or

continued

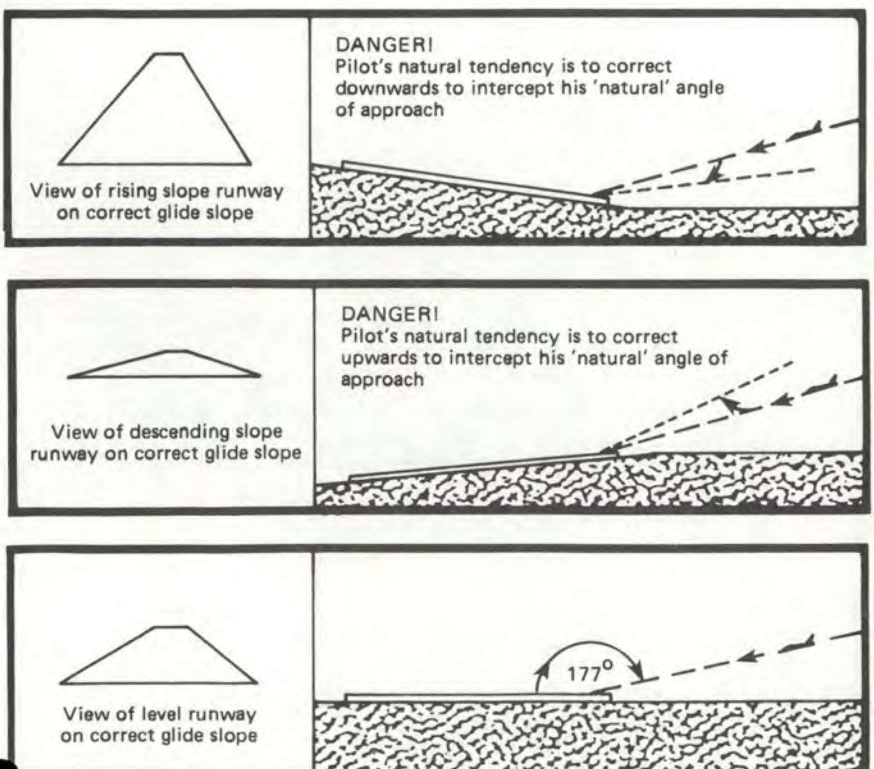


Figure 3

What Meets The The Eye . . . Real or Illusion? continued

below the correct glide slope, or left or right of the runway center line, depending upon the slope of the windscreen and other circumstances. The apparent error might be as much as 200 feet at a distance of one mile from the runway threshold.

Featureless Terrain

Visual descents over calm seas, deserts or snow, or over unlit terrain at night, can be hazardous even in good visibility. The absence of external vertical references makes judgment of height difficult and the pilot may have the illusion of being at a greater height than is actually the case, leading to a premature or too rapid descent. Height above the runway is also made more difficult to judge if, because of snow for example, there is no contrast between the runway surface and surrounding terrain. The problem is compounded if the descent is made into the sun or in any conditions which reduce forward visibility.

Runway Lighting Intensity

Because bright lights appear closer to the observer and dimmer lights farther away, the intensity of the approach and runway lighting can create illusions. Thus, on a clear night, the runway lights may appear closer than they actually are, particularly when there are no lights in the surrounding area.

Shallow Fog, Haze

In shallow fog or hazy conditions, especially at night, the whole of the approach and/or runway lighting may be visible from a considerable distance on the approach even though Runway Visual Range or meteorological reports indicate the presence of fog. On descent into such a fog or haze layer, the visual reference available is likely to diminish rapidly, in extreme cases reducing from the full length of the approach lights to a very small segment. This is likely to cause an illusion that the aircraft has pitched nose up, which may induce a pilot to make a corrective movement in the opposite direction. The risk of striking the ground with a high rate of descent as a result of this erroneous correction is very real.

Rain Showers

A weather feature which may reinforce a pilot's visual indications that he need not apply power to reach the runway or to arrest a high rate of descent is an isolated rain shower. A heavy rainstorm moving towards an aircraft can cause a shortening of the pilot's visual segment — that distance along the surface visible to the pilot over the nose of the aircraft. This can produce the illusion that the horizon is moving lower and, as a result, is often misinterpreted as an aircraft pitch change in the nose up direction. A natural response by a pilot would be to lower the nose or to decrease, not increase, power.

Darkness

The greatest confusion potential exists at night. Darkness provides excellent camouflage and the eye loses much of its efficiency. Normally used cues such as shadows, color and detail are not available. Lights must compensate for this loss, but lights usually lack sufficient definition to provide more than an outline, an incomplete stimulus to which the pilot may or may not react correctly. At the other end of the scale we have a profusion of lights. Large airfield complexes have so many lights that frequently there is considerable difficulty experienced in just finding the runway.

Black Hole Effect

This illusion can occur on a clear night with no visible horizon. The aircraft approaches the runway over the sea or other featureless, unlit terrain towards an aerodrome with bright city lights behind it. Visibility is so good that there is little need to rely on the instruments except to check the airspeed. The straight-in approach is totally uneventful until the aircraft lands short of the runway, possibly by several miles. What could have gone wrong?

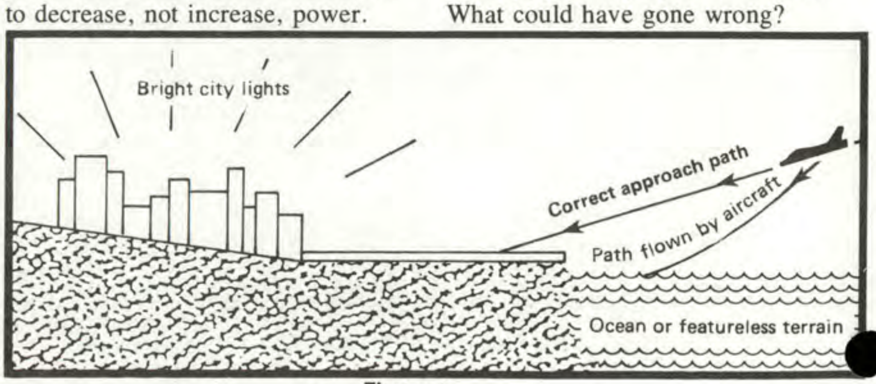
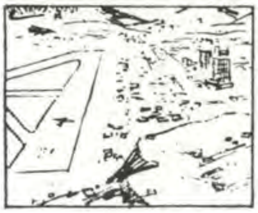


Figure 4

Tests have shown that under these circumstances a pilot relying on a visual approach will tend to fly along the arc of a circle centered above the pattern of city lights with its circumference contacting the terrain. Such a path results from maintaining a constant visual angle subtended at the eye by the nearest and farthest city lights. When deceptive conditions are present, such as up-sloping city terrain, this kind of approach path can go to critically low altitudes. The lack of foreground lighting results in the pilot being denied important closure information without his awareness and consequently the aircraft lands short.

NIGHT REFERENCES
Is this a 10,000 ft runway seen from 1,000 ft agl at 3 miles, or an 8,000 ft runway from 700 ft agl at 2½ miles? Is the dark area at the lower right a sparsely populated section or an unlighted obstacle such as a hill?



Avoiding The Problem

Be aware of the circumstances in which visual illusions may occur and be prepared to take corrective or alternative action. Learn to recognize impending situations which may place the safety of the aircraft and its occupants in jeopardy.

Study aerodrome charts, maps and other applicable reference material to determine runway slope, the slope of terrain around the aerodrome, the relative position of the aerodrome and surrounding features, the aerodrome approach and runway lighting in use, etc., etc.

Anticipate the need for rain repellant on the windscreen and use as appropriate, before departure.

Wherever available use ILS or VASI to monitor the glide slope. If a DME is located at the aerodrome use the "rule-of-thumb" 300 feet per nautical mile for your descent profile, but remember to take into account the relationship of the DME beacon to the threshold of the runway in use.

If the nominated runway has no precision approach aids, consider the need to request an alternative runway with precision aids. When no precision aids are available fly a full circuit, never a straight-in approach. The aircraft can be more accurately positioned at 600 feet on a two mile final having flown a full circuit than on a straight-in approach without aids. It may also be possible to position the aircraft at a known point, such as over a locator, at the correct altitude and approach configuration. The pilot should then obtain a visual image of the runway and maintain this image throughout the approach. If none of the foregoing procedures are possible, consideration should be given to diverting to a more suitable aerodrome.

On two-pilot operations use the monitored approach technique. One pilot flies the instrument approach while the pilot who is to land the aircraft monitors the approach and gains "experience" of the ambient conditions before taking over control.

During single-pilot, IFR operations the pilot should use the autopilot as the pilot flying the approach. While flying a coupled approach, the "real" pilot should try to gain experience of the conditions. The autopilot should remain engaged as long as possible until the pilot has obtained a good visual picture, and a safe landing is assured.

On all operations, avoid landing expectancy; be prepared to go around or carry out a missed approach if there is any doubt about the safety of the landing.

Wherever possible, pilots should receive training flights to aerodromes where it is known that conditions can be conducive to visual illusions.

In conclusion, remember that illusions must be expected in flying. Also that it is human nature to want to believe our own senses rather than instrument indications. Knowledge of illusory sensations will help because our responses are determined more by the meaning we attach to stimuli than by the stimuli themselves. It is ultimately on the basis of knowledge and self discipline that we make decisions and select our responses.

How sharp are your eyes? Did they catch *the the* title? – Courtesy Department of Transport Australia, *Aviation Safety Digest* 111/1980. ■

GETTING DOWN (AF Style)

MAJOR JOHN E. RICHARDSON · Directorate of Aerospace Safety

■ There is no doubt that the biggest aircraft mishap problems are in the two areas of control loss and collision with the ground. This has been discussed time-and-again in Blue 4 News, *Flying Safety* and MAJCOM safety magazines, and even in *TIG Brief*. However, most people think of these mishaps in terms of low level or combat maneuvering flight. There is a large number of mishaps in these demanding flight regimes, but another phase of flight has accounted for 33 mishaps in a recent 18-month period. Ever since Lt. George Kelly crashed, landing at Fort Sam Houston, Texas in May 1911, aircrews have been having trouble during landings.

No one thing is overwhelmingly responsible for mishaps in and around the traffic pattern. There are, though, some categories which appear with monotonous regularity. None are really new, but we just don't seem to be able to learn from our mistakes. So, one more review is in order.

Birdstrikes

Birdstrikes in the traffic pattern are not usually as catastrophic as those at 300+ knots on a low level route. Nonetheless, during the 18-month period we reviewed, five birdstrikes caused Class B damage. Even if costs for all five were set at the minimum for Class Bs ($50,000), something which is very unlikely, the total cost would still be $250,000. A couple of the pilots in those birdstrikes never saw the birds. But in two cases, the crews elected to continue the approach into large flocks of birds and in the fifth, the crew was set up for the mishap by inadequate procedures. (We will talk more about supervision later.) Birds will always be around. But there are some things you can do to reduce your exposure.

- Use your landing lights—birds don't really have a death wish. If they see you, they are likely to get out of your way.
- Try not to make approaches when bird activity is heaviest.
- If you see large groups of birds while on approach, go around if there appears to be a conflict.

Fatigue

Three separate mishap investigations pointed out crew fatigue as a critical factor in the chain of events leading to the mishap. Fatigue has many effects on the body, most of them especially detrimental to flying. These effects include channelized attention, short term memory loss and lengthened reaction times. Adequate crew rest is hard to get sometimes, but the consequences of fatigue are too serious to ignore.

Procedures and Techniques

Fourteen of the mishaps in our survey involved incorrect procedures or control inputs by the aircrew. Some stemmed from lack of knowledge about the aircraft. For example, one aircrew misidentified the malfunction, and the resulting action caused the aircraft to depart controlled flight and crash during the approach. The misidentification was attributed to lack of systems knowledge on the part of the aircrew. In other cases, the crew just failed to follow normal procedures and either selected an incorrect flap setting, failed to maintain minimum airspeed, or attempted to continue an approach that was unsalvageable. The facts in each case speak for themselves. Our job as crewmembers is to know the airplane as well as we possibly can. Not knowing and/or not following emergency procedures has proven fatal.

Supervision

Not all of those fourteen mishaps attributed to aircrew procedural errors were solely the crew's failure. In a distressing number of cases, the aircrew was set up for the mishap by supervisors. In one case, the supervisors neglected to brief diverting aircraft about the barrier status at the divert field. There was also a breakdown in communications concerning deteriorating weather. Finally, the pilot with an aircraft emergency, deteriorating weather and low fuel was painted into a corner and a mishap resulted. In the birdstrike mishap mentioned earlier, flight operations personnel were not aware of the increased seasonal bird activity at a satellite airfield. Therefore, flying operations at the field were not curtailed.

Flying is a difficult enough business for aircrews without compounding the problem by supervisory error. As crews, we often complain about "micromanagement" of the crew force. While that is frustrating, mismanagement is often disastrous. If you have the responsibility for supervising, be sure you are not guilty of hindering rather than helping mission accomplishment.

There is nothing new in this analysis. Approach and landing phase mishaps are still a major problem in the Air Force. But they can be reduced. We fly at least one approach and landing each flight. The problem is that because we do it so often we tend to become complacent or we get so wrapped up in the extraneous details that the basics of flying the airplane get away from us.

Mishap on approach is no way to terminate a flight. ■

OPS topics

Preflight

■ When the pilot of a C-12A lost all pitot static indications, he quickly decided to land. Airspeed indications were erroneous and the altimeter still indicated field elevation. This minor mishap resulted as more serious ones do from a progressive series of events: (1) The pitot tubes and static ports were taped for aircraft washing, (2) No entry was made in the forms, (3) Tape was not immediately removed because of anticipated maintenance requiring water on the aircraft surface, (4) When tape was removed from the pitots, it was not removed from the static ports, (5) Both maintenance and flight crew preflights missed the taped static ports.

Control Obstruction

On preflight, prior to an FCF, the pilot secured the back seat of the T-38 but did not remove the seat survival kit. Instead, he secured it by tying the survival restraint straps to the seat belt. The flight was uneventful until the pilot attempted inverted flight. At minus 3 - 4 G and 300 knots, the pilot heard a bang. Rolling right to upright he found stick travel severely limited to the left and aft. The pilot was forced to make a no-flap landing at 210 knots (the lowest controllable airspeed). The rear seat kit had come loose and wedged against the rear cockpit stick (see picture).

Egress Mishap

An Air Force member's wife and two sons came to visit him at work. While there, the two boys went into a hangar where some aircraft were parked. Shortly thereafter, the maintenance crew on duty heard a loud explosion in the hangar. When they investigated, they found that the canopy of an aircraft had been jettisoned. One of the boys admitted "playing" with the jettison handle.

This mishap only cost $3,000 and some embarrasment. Not all such occurrences turn out so well. In the past two years accidental egress system activations have killed people totally unfamiliar with the aircraft and who were also completely unsupervised. Hangars and ramps are no place for the uninformed. The risk increases even more with static displays. People love to pull levers, push buttons and flip switches. If you are shepherding some visitors around your airplane or ramp, please be sure they follow pilot's golden rule nr 3 and don't fool with red guarded switches (or egress handles).

A Minor Adjustment

Everything was going well on the wing landing until the pilot in nr 2 deployed the drag chute and selected idle. Then the F-106 began to yaw left. The pilot was able to stay on the runway by use of nose wheel steering. After things calmed down, the investigators found that the pilot liked to fly with the rudder pedals closer than usual for his height. Such a pedal position made it easy for the pilot to inadvertently apply brake pressure when making a rudder input as would be done during a wing landing. This is true even with the pilot's heels on the floor. This is not the guaranteed cause of the blown tire in this case. But, it is something worth considering when you get in and set up the cockpit. A blown tire on landing is not necessarily a fun thing.

Check Complete?

After an hour and a half of flight, the evaluator in the back seat of an F-4 began to experience hypoxia. At first, he found no switches out of position but could get no oxygen flow when 100 percent was selected. The evaluator then activated the emergency oxygen cylinder and shortly began to feel better. Another check of the regulator was made and the on/off switch was found off. Neither cockpit regulator on/off switch was safety wired. The front cockpit pilot noticed this and the fact that the switch was off on preflight. Apparently, the SEFE did not. The regulator on/off switch is one of those items on the checklist that is easy to overlook. How is your checklist discipline?

"What You Thought You Heard Is Not . . ."

A T-37 was approaching home base when the crew spotted a C-141 at one to one-thirty. Shortly thereafter, approach control called traffic at ten o'clock, five miles. Both pilots in the T-37 were sure the controller gave the azimuth as one o'clock (the position of the C-141). Based on this, they called tally ho. Twelve seconds later the T-37 pilots saw a general aviation aircraft at twelve o'clock slightly high—converging. When the RAPCON tapes were reviewed, it was clear that the traffic advisory azimuth was ten o'clock. But, since the pilots had seen traffic at one o'clock they were predisposed to assume that that was what the advisory referred to.

Hard Landing

It looked like a good no-flap landing for the T-38 student. The IP was satisfied that the glide path, AOA, and aim point were all satisfactory. Then as the aircraft approached the overrun, the student relaxed the back pressure he had been holding on the stick. The nose of the aircraft dropped suddenly, the IP took control and started a max power go around, rotating the aircraft to approximately 15° nose high. After a successful stop, maintenance discovered damage to the engine ejectors from dragging on the overrun surface and also to the horizontal stab from gravel thrown up by the tires when the aircraft touched down in the overrun.

Murphy Strikes Again

A C-141 loadmaster and an air cargo specialist were unloading a C-141 engine and trailer from the aircraft. The winch cable was attached to the trailer (4100 series) tow bar for braking and after an integrity check by pulling on the tow bar and putting tension on the cable, the trailer was rolled slowly down the ramp. About halfway down, the telescoping shaft of the tow bar pulled out of the fixed shaft. The engine and trailer freewheeled down the ramp and rolled about 25 feet before skidding sideways to a stop. The pin which secures the telescoping shaft to the fixed shaft was not properly installed. The pin was inserted through the aft holes of the shaft, but the telescoping portion was butted against the pin rather than being secured. The telescoping shaft was slightly bent and could not be inserted far enough to align the pin holes. The bend also caused the binding which was confused with a proper security check. This common piece of equipment has no warning marks for proper alignment.

It Is Legal

A B-52 crew filed a HATR concerning a near miss between their aircraft and a Bonanza on a published low level route. As the FAA emphasized during the investigation, any aircraft, VFR below 3,000′ AGL, may proceed at any altitude or on any route. Even if a pilot knows a certain published route is hot, nothing prevents the pilot from crossing the route. The only protection is a set of roving eyeballs.

Trash Deployment

The HC-130 was performing practice deployments of MA-1 kits. On climb-out from the first delivery, the trash bin in the cargo compartment departed the aircraft narrowly missing the loadmaster standing on the ramp. The latch pin which held the trash bin in place failed or vibrated loose in the flight. ■

A Carbon Fiber Mishap,

MAJOR ROGER L. JACKS • Directorate of Aerospace Safety

■ In flight circles, for the last five years we have been praising and cussing the unique properties of carbon fiber materials. Praising because they give us increased strength and rigidity at a significant weight savings, and cussing because of the possible electrical hazard they represent when accidentally released during an aircraft mishap. Risk assessments as to what effect the liberated fibers would have on the Air Force mission have been controversial to say the least. Early laboratory experiments verified that the hazard did exist and in some circles created concern that we might have a major catastrophe just looking for a place to happen. In actuality, little research had been done on burning composite materials at that point and no one was really sure what the full scope of the problem entailed.

In the mid-70's the Joint Logistics Commanders founded a tri-service organization called the Joint Technical Coordinating Group (JTCG-HAVE NAME) and tasked them to assess and define the carbon fiber hazard. In addition, NASA was brought into the program to look at the risks in nonmilitary composites application. Electrical Systems Division (ESD), as the principal Air Force Agency awarded contracts to companies such as TRW, MITRE, A. D. Little, and O.R.I., to assist the JTCG. In January 1978, Rome Air Development Center (RADC) became the program office for the Air Force. Because of the number of variables in the assessment it was soon realized the problem would take years to properly analyze. AFISC, RADC, and several air staff agencies agreed that in the meantime the problem had to be briefed to the Air Force at large and some type of protective measures had to be instituted. From contractors, data was compiled and used to publish a preliminary carbon fiber protection guide in May of 1978. In addition, the word "Corker" was put into being to alert carbon fiber response agencies that an aircraft had crashed with carbon/graphite or boron materials on board. AFISC developed a carbon fiber briefing for MAJCOM staffs, put articles in the *TIG Brief* and distributed the preliminary carbon fiber protection guide to MAJCOM safety offices.

After publicizing the potential hazard, a coordinated effort was pursued to develop a Corker Annex (Annex E) to the base disaster preparedness plan. The May 1978 carbon fiber guide was used as the primary source document. At this point, the general consensus among decision makers was to plan for a worse case situation. Early briefings and recommended procedures reflected this philosophy. In an effort to ensure a timely response to a carbon fiber mishap, a system was designed to track aircraft containing carbon fibers. Air Logistics Centers (ALC's) and system managers provided AFISC with aircraft tail numbers. In addition, contacts were made with the Navy, Army, and commercial manufacturers to produce a composite list of aircraft flying in the US that had carbon fiber materials aboard. A grand idea, but the rapidly growing use of the materials made the lists next to impossible to keep current; not to mention the additional cost and man-hours the task required. Undaunted, management pressed on and tried to keep the list up while hoping the research community would quickly assess the risk. The plan was to maintain the status quo until a more definitive hazard analysis was available.

By 1979, most bases in the Air Force were in the "Corker" business. Base disaster plans included "Corker" annexes; practice exercises were taking place; and IG teams were including "Corker" as an inspection item. Official positions still differed on the magnitude of the carbon fiber hazard. Some people criticized the Air Force program as being overzealous. Some thought the risk was being overstated; others, that it was being understated.

Through all of this, research continued and progress was being made. Boron materials were deleted from the electrical hazard lists. It was determined that the voltage they required to become conductors was substantial enough to rule out causing problems with numerous types of electronic equipment. Also, boron fibers are much heavier than carbon fibers. The weight of the boron fibers lessened the chance of secondary effects since liberated fibers were found to remain close to their release point. Practical

BIG DEAL OR LITTLE DEAL?

experience gained while investigating F-15 mishaps painfully pointed out, however, that boron fibers are sharp, stiff, barbed-like splinters, and can easily penetrate clothing, light gloves, and human skin. In one case, an airman was bending down to inspect a piece of wreckage and got a pierced ear job free of charge. Other than the physical discomforts of skin penetration and its associated implications there are no other known health hazards from boron or carbon fibers. However, research is continuing on composite materials in order to quantify the health factors associated with fibers released from a fire or explosion.

By the end of 1979, NASA had concluded their civil sector risk assessment. They stated that in commercial aviation the secondary effects of carbon fiber mishaps would be negligible if proper clean-up and disposal of fiber residue took place. NASA gave manufacturers the go-ahead to use composite materials in their production processes. The Joint Technical Coordinating Group (JTCG) provided support to NASA throughout their program, and concurred in their assessment. However, the JTCG knew that the military risk factors differed significantly from the civil sector. Carbon/graphite usage in military aircraft differed from that of commercial aircraft. Mishaps involving fire and explosion occur with greater frequency for the military. The research objectives were different; NASA was looking at the risk of dollar loss, and the military was looking at the risk to mission accomplishment.

The JTCG completed their on-going studies within six months of NASA. On 5 June 1980 the Joint Technical Coordinating Groups final report was briefed to members of the DOD, military contractors, and NASA. The risk to the Air Force was determined to be negligible when carbon fiber debris are properly contained, cleaned up and disposed of following a mishap. With this assessment came the need to realign our Air Force carbon fiber mishap procedures. RADC, AFISC, and JTCG believed the best method was to rewrite the carbon fiber protection guide and to produce a video tape that concentrated on how to contain, clean up and dispose of liberated carbon fibers. Once source material was available, base disaster plans could be updated using the revised procedures. The video tape, "Mishaps Involving Carbon Fibers, TS 1495" was produced and released in April of this year. The revised carbon fiber protection guide is completed and is in the distribution process.

A meeting was held in March of 1981 to bring key players together and discuss the steps remaining to implement a carbon fiber mishap plan that reflects the recent research findings. The group decided to delete the word "Corker" when referring to carbon fiber mishaps. Rationale included the belief that the word was too strongly associated with a severe problem when that probably will not be the case. The aircraft Corker list was dismissed as being inaccurate, too difficult to maintain, costly and unnecessary. Long term medical research will be necessary to assess health risks associated with carbon fibers. In the meantime, precautions outlined in the protection guide and the referenced video tape should be followed. Avenues were established to "get the word out" via safety channels and disaster preparedness channels.

At the present, work is being done to replace the carbon fiber lists with a more reliable, simpler, and more manageable method of identifying a carbon fiber mishap. AFR 127-4 and AFR 355-1 are being evaluated to ensure they reflect the new posture. And, a coordinated effort is being made to provide the field with some general guidelines on what should be included in a carbon fiber mishap plan as an appendix to the base disaster preparedness plan.

So, the question is, "Is it a big deal or a little deal?" The answer: It will most likely be a little deal. There is a remote chance that an accidental release of carbon fibers could cause secondary electrical problems. But, we can reduce that possibility and keep a little deal a little deal by following post accident guidelines and properly containing, cleaning up, and disposing of liberated carbon fibers. ■

A special thanks to the Rome Air Development Center (RADC) and Mr. C.E. Gallaher of the Naval Surface Weapons Center for their technical assistance.

MID-AIR COLLISION AVOIDANCE

MAJOR JOHN E. RICHARDSON
Directorate of Aerospace Safety

■ The following is an edited, translated article from the French Air Force *Air Safety Bulletin* examining reasons for midair collisions in the French Air Force.

1980 Midair Collisions

- January—Two "wingmen" of the "Patrouille De France" collided with each other.
- April—Two T-33's collided with each other, the second one having lost sight of its leader.
- July—Two Mirage III E's that could see each other collided at a very high speed, one of the pilots having misinterpreted the direction of the other's turn.
- August—The leader of a two-ship Mirage flight lost sight of his teammate flying just a few seconds ahead of him and collided with him.
- September—Nr 4 aircraft of a Mystere IV-A flight announced: "2 . . . I am passing by," gave the wrong call sign, and collided with aircraft nr 3.
- September again—A "fighter" on a night very low altitude interception mission thought that he saw a drone ahead of him. He pursued it and collided with it.

It's a long, long list. So, once more, we ask ourselves the question that everybody would like to see answered: What is the cause of all these collisions?

The files of all the accidents which have occurred since 1965 were studied. All of them were scrutinized then we tried to reassemble them in every way possible in order to find any connection whatsoever between them. However, we were forced to admit that there were no two identical cases. In a way, it was rather reassuring because it proved at least that training methods are good, even if they still could be improved. However, this verification is neither satisfactory nor sufficient.

The Figures

Thirty-two collisions have taken place since 1965. Among them, 25 took place within the same flight. This figure is enormous. Out of these 25 collisions, 21 were found to have the same cause: A poor visualization by one of the pilots in the flight.

These 21 collisions may be divided as follows:

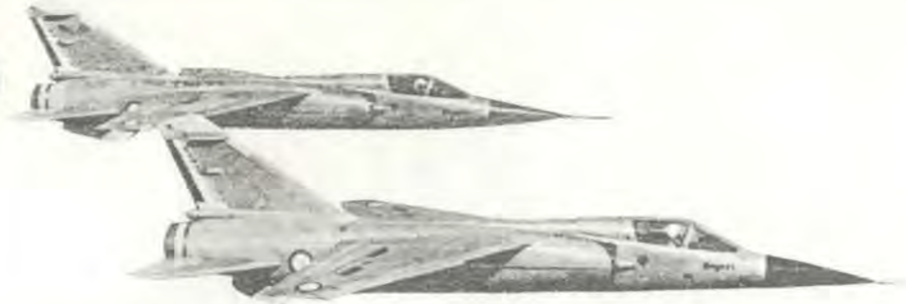
- One took place upon takeoff.
- Nine took place during demonstrations.
- Eight were due to the fact that the leader was no longer seen.
- Three were due to the fact that the drone was no longer seen.

It would be useless to investigate the matter more thoroughly. We are therefore facing a problem of . . . poor visualization. Pilots aren't visualizing well. Does this mean that they are visually clearing the airspace around them less carefully? It seems that the answer to this question is yes. Then why?

The Reasons

The first reason seems to be the presence of ground radars. This is paradoxical . . . and yet through their vigilance, their aid (the controllers are so efficient), the danger becomes vague in the mind of the pilot. In fact, the radars guide, observe, warn and often seek out the team leader for the fighter who has lost visual contact. In short, the ground radars give an impression of security, and this impression usurps the pilot's responsibility to such a point that he loses the basic reflex of the constant visual search.

The second reason for this phenomenon is very likely the development of aircraft. Indeed there is little in common between a Mystere IVA or even a super-Mystere where the piloting is chiefly "sensorial" and a Mirage IIIE or a Mirage F-1 in which the pilot has everything necessary in the cockpit



and is less inclined to look outside for the information he needs. Because of this, he is much more compelled to look constantly at his instrument panel and thus loses, little by little, the vital reflex of looking around.

A reason essentially connected with the nature of man should be added to the two technical reasons. It is a question of the pilot's "dislike" to announce that he has lost visual contact. He remains silent out of vanity, thinking that he will soon find again the aircraft which he doesn't see any more. Also out of vanity, he doesn't dare to admit the error . . . another mistake. This is commonly called the inability to be humble.

What Can Be Done?

No longer use ground radar resources? Who would dare envisage such a solution? Change the aircraft? Nonsense. On the other hand, there is one thing that can be altered: The pilot should first look outside again. However, this implies several behaviors.

- Consider that the means placed at his disposal: GCI, airborne and radar instruments, as sophisticated as they may be, are at his service and not he at theirs. In other words: Don't become totally reliant on their capabilities.
- Taking this into consideration, he should constantly check his environment in order to see everything with his own eyes. Should the need arise, he should be humble enough to announce immediately that he has lost visual contact . . . or has made an "unforeseen" maneuver.

This attitude will have two consequences:

1. The pilot's vigilance will be constantly on the alert, because he will have recovered this basic reflex: The first thing is to see.
2. The others' vigilance will also be on the alert, because they will be aware, as soon as they hear the announcement of the loss of sight, that they must redouble their attention in order to locate the one who has lost visual contact.

Conclusion

My intention was not to provide "tricks" in order to avoid collisions. I just intended to have the reader reflect on the "unquestionable" risks of a flight collision. How to avoid it? Look outside to be the first one to see. It is a golden rule.

The USAF Story

The USAF experience is not much different from that of the French. In 1980 we had ten midair collisions.

All but one of these involved aircraft in the *same* formation. Six occurred during turning, maneuvering, tactical formation. In every case, the wingman lost sight of lead or failed to correct an excessive closure rate. The other three occurred during take off or landing when the wingman failed to maintain adequate separation.

Like in the French study, visualization is our problem, too. But radar could not have helped in nine out of ten cases. In 1980 our collisions did not occur in the "heat of battle" during DACT or a mixed force ground attack mission. Every one of the nine was in a less demanding regime where flying formation was the main task for the pilot. True, there were distractions like low altitude, weather, or poor lead technique, but in no case did these distractions make it impossible for the pilots of the mishap aircraft to avoid the collision. So we are led back to the problem of visual contact or loss of it.

The French study mentioned a pilot's "dislike" for announcing that he has lost sight of lead while in formation. It hurts our pride to admit we goofed. It is so much easier to press on for a few more seconds or minutes and hope to reacquire the other aircraft. Three times in 1980 the "press" led right into a collision with lead.

So, the answer is relatively simple. In fact, it is the one we learned in pilot training—keep lead in sight, and if you lose sight make sure you have safe separation.

One other point—the fault does not lie totally with poor old "2" hanging out there on the wing. Lead can certainly make things very difficult and in effect set "2" up for a real problem. Such things as turns without informing the flight or checking wing positions and nonstandard, unbriefed maneuvers made the perfect environment for a midair.

The problem is there, and it is real. There have already been three more midairs in 1981. Let's look out and not let formation get too close. ■

DECISIONS

MAJOR JAMES L. GILLESPIE, CF
Directorate of Aerospace Safety

■ Decisions are something we all make several times a day. We should be very good at it; after all, practice makes perfect, right? Well, maybe. Life is one continual process of decision making. Some good—some bad, some successful—some not so successful. Some are made on instinct, others on fact. Some are made over an extended period of time, others instantly. Some are made under calm circumstances, others in the heat of the moment. And then, there are those that are not made at all.

If we attempt to classify decisions as to importance, then surely those associated with aviation have to be near the top. Consider for a moment the decisions made regarding an aircraft which the pilot accepts for flight. They are numerous, complex and have been made by several different people. Before that particular craft is returned to its parking spot, the pilot will make many more. Hopefully, all of them will be the right ones. We all know that this may not necessarily be true. Some decisions are mistakes and could lead to an accident. Some are forgiving, but many are not. Flight safety files are replete with sterling examples of decisions both good and bad. Consider the following examples:

■ An interceptor pilot was tasked to complete an out-and-back for the purpose of delivering an item. Prior to his arrival, he was aware of the wet runway conditions and slight tailwind at the recovery airfield. He decided to execute a no-chute landing. Looking back on the situation from his vantage point off the right side of the runway with a damaged airplane, it probably occurred to the pilot that he had made a bad decision.

■ A close support aircraft was participating in a low-level, tactical offensive air support training mission in hilly terrain. During defensive maneuvering to avoid an attacker, the pilot found himself in a steep descent approaching a ridge. With his aircraft already at max performance and the ridge rapidly filling his windscreen, the pilot decided to eject. The aircraft cleared the ridge and crashed 3NM beyond. Enough said.

■ An interdiction aircraft was participating in a six ship low-level exercise strike mission. During target ingress, the formation leader called for a bad weather abort and climb. The leader pulled into clouds followed by his wingman who maneuvered his aircraft aggressively into an extreme nose high attitude. He became disoriented and ran out of airspeed and ideas (except for one) at the same time. He decided to eject, which probably was wise, all things considered.

■ In some cases, Lady Luck is a player. A single place aircraft proceeded to the takeoff position for a live weapons drop training sortie. During engine runup to full mil, the pilot noted that the brakes would not hold. He diagnosed the problem as worn brake pucks which probably would not have precluded a successful recovery, but the pilot decided to abort the mission anyway. The crew chief, doing routine maintenance following engine shutdown discovered the high pressure afterburner fuel line had become disconnected and would have resulted in a certain fire and/or explosion had the takeoff been performed. Hindsight is a great pacifier.

And, on and on it goes. We all know that for every bad decision, several good ones are made. The good ones are expected of us and, as such, get little or no publicity. Our objective should be to eliminate the bad ones.

The point is that we are each faced with making numerous decisions every day. Some people are better at it than others. There is no formula we can use to ensure success, but playing with a full deck helps. Some people have their own theory of how and when to make a decision. Experience tells us that premeditated ones based on full and complete knowledge stand the best chance of success.

There are times on the flight deck when we, as pilots, do not have the luxury of time. Instinct backed by experience is the alternate choice, sometimes referred to as a knee-jerk reaction motivated by a rapidly deteriorating situation. Because we rarely think about the decision-making process, a moment of introspection is recommended to assess our capability. Very little advice can be offered on this subject other than like the motto of a well known youth group "Be Prepared." ■

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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.

MAJOR
Rowland H. Worrell

CAPTAIN
John A. Osborn

27th Tactical Fighter Wing
Cannon Air Force Base, New Mexico

■ On 28 August 1980 Major Worrell and Captain Osborn were flying a night student instructor pilot upgrade sortie in an F-111D. During climb, between 9,000 and 10,000 feet MSL, both crewmembers heard an explosion and saw a bright glow in the left rear area of the aircraft followed by severe aircraft vibrations that made it difficult to accurately read the flight instruments. They checked the engine instruments and noted the left engine rpm was decreasing, so the left throttle was immediately retarded to idle and then to the cut-off position. After the engine was shut down, the left engine fire push button was depressed to isolate all fuel and hydraulic lines to the malfunctioning engine. As the fire push button was depressed, the left engine fire warning light illuminated for approximately five seconds, then went out and the external glow dimmed and disappeared. The climb was continued and the crew confirmed there were no indications of a continuing fire. Major Worrell declared an emergency while Captain Osborn completed all necessary checklist items and a single engine recovery to Colorado Springs Municipal Airport was begun. The aircrew increased the airspeed to 310 KIAS, but encountered an excessive left yaw causing full right ball deflection in the turn and slip indicator. Full right rudder was applied and the wing sweep changed to 16 degrees with no affect on the yaw or the vibration. The crew elected to configure for a single engine landing at a safe altitude planning a long, straight-in approach. Once configured, the vibration intensity began decreasing and ceased at 180 KIAS. A flawless single engine landing was made. Subsequent investigation revealed severe internal engine damage. The left engine had completely separated from its afterburner. Numerous lines and accessories associated with the engine had been broken or damaged and shrapnel from the engine had ruptured the aft fuel tank and saddle tank. Sparks from the shrapnel ignited the fuel vapor in the aft tank, causing the fuel vent tank in the vertical stabilizer to explode. The explosion in the vent tank tore away one-third of the vertical stabilizer from the aircraft. The prompt, decisive actions and coordination of Major Worrell and Captain Osborn averted possible injury or loss of life and held aircraft damage to a minimum. WELL DONE! ■

Keep Your Nose Out Of

TROUBLE