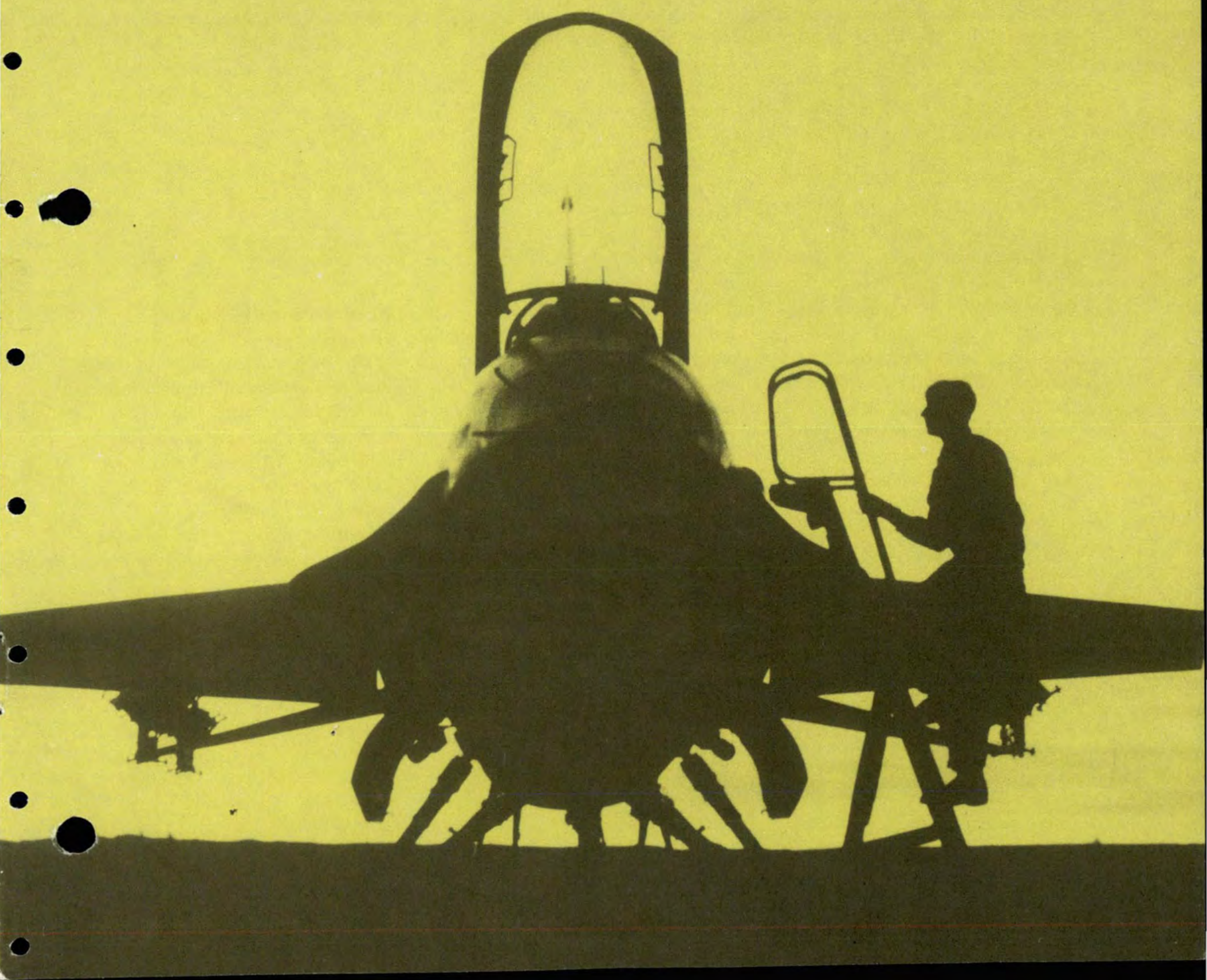
flying SAFETY

SEPTEMBER 1981



THERE I WAS . . .

■ . . . a T-38 student on a cross-country navigation flight to Buckley ANG Base in Denver. My flight commander was flying as instructor pilot in the front seat. It was CAVU weather, and we did some sight-seeing over the mountains on our way in. We were vectored through the busy Denver TCA to an instrument approach to Buckley. We were getting low on fuel and during the last stages of the approach we went minimum fuel. I mentioned it to my flight commander and he told me not to worry about it since we would be landing soon. He did not mention we had minimum fuel to ATC. I didn't anticipate any traffic delay, so I kept quiet.

He took the aircraft from me at minimums, since the regulations forbid student landings from the back seat. IP's were not known for their expertise at front seat landings, either. My instructor flew the aircraft smoothly over the threshold, and then flared the plane to what felt like five feet off the ground! With the wheels within 12 inches of the ground in a normal flare, this flare captured my attention in a hurry! I then thought to myself he probably had just flared high and knew it and that he would start easing the T-38 down to the runway. But no, he held us high while I watched the airspeed bleed off to below our computed landing speed.

With visions of one of our wings stalling and contacting the runway with a wing tip, I reached for the stick and throttles, while forming the words "I've got the aircraft." But then I hesitated for a couple of reasons: One being the fact we would be emergency fuel if we went around; two, because you don't take the aircraft away from your flight commander unless you are absolutely sure you're in the right. Well, my hesitation almost proved fatal because right then the left wing stalled. The left wheel hit the runway hard followed quickly by the right wheel. I'll never know how close that wing tip was to the runway but from that day on I vowed to *speak up* if I thought the other guy might be wrong, no matter who he is.

Thanks to the author for sharing the near tragedy. We all can learn from this one. A simple "we look a little high, better ease it down" could save a lot of grief. If your flight mate is any kind of man, he will thank you. If not, it doesn't matter! ■

Brig Gen Leland K. Lukens
Director of Aerospace Safety

UNITED STATES AIR FORCE

flying

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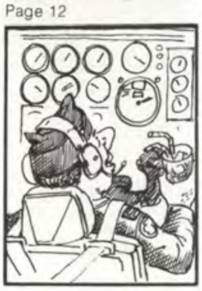
page 2

page 4

Page 12



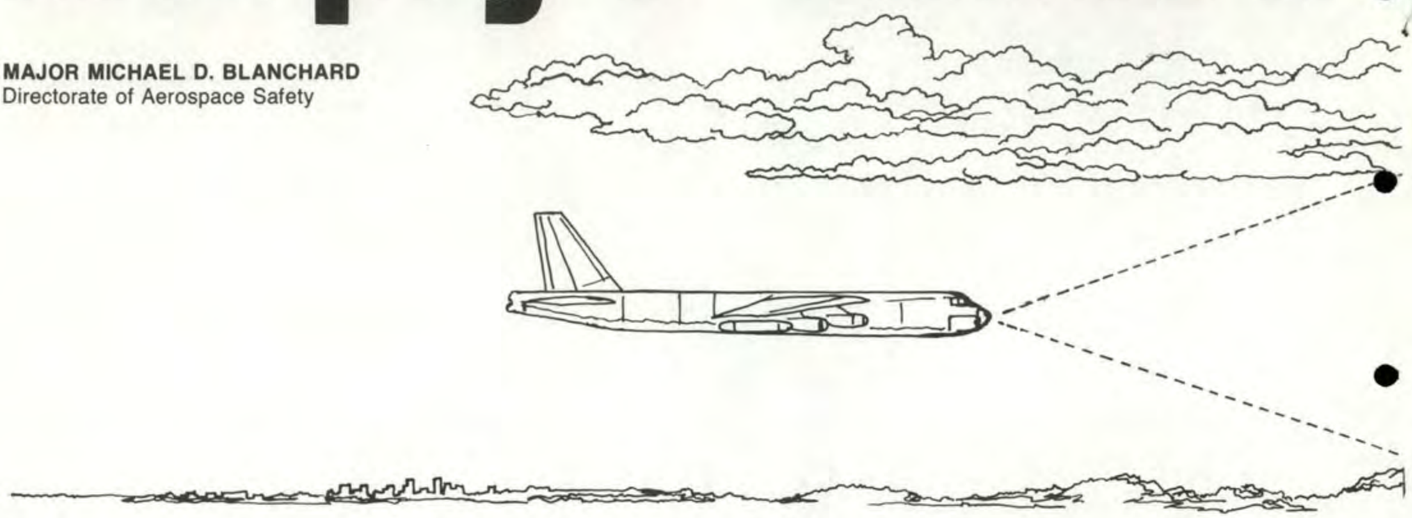
SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

Murphy's Shadow

MAJOR MICHAEL D. BLANCHARD
Directorate of Aerospace Safety



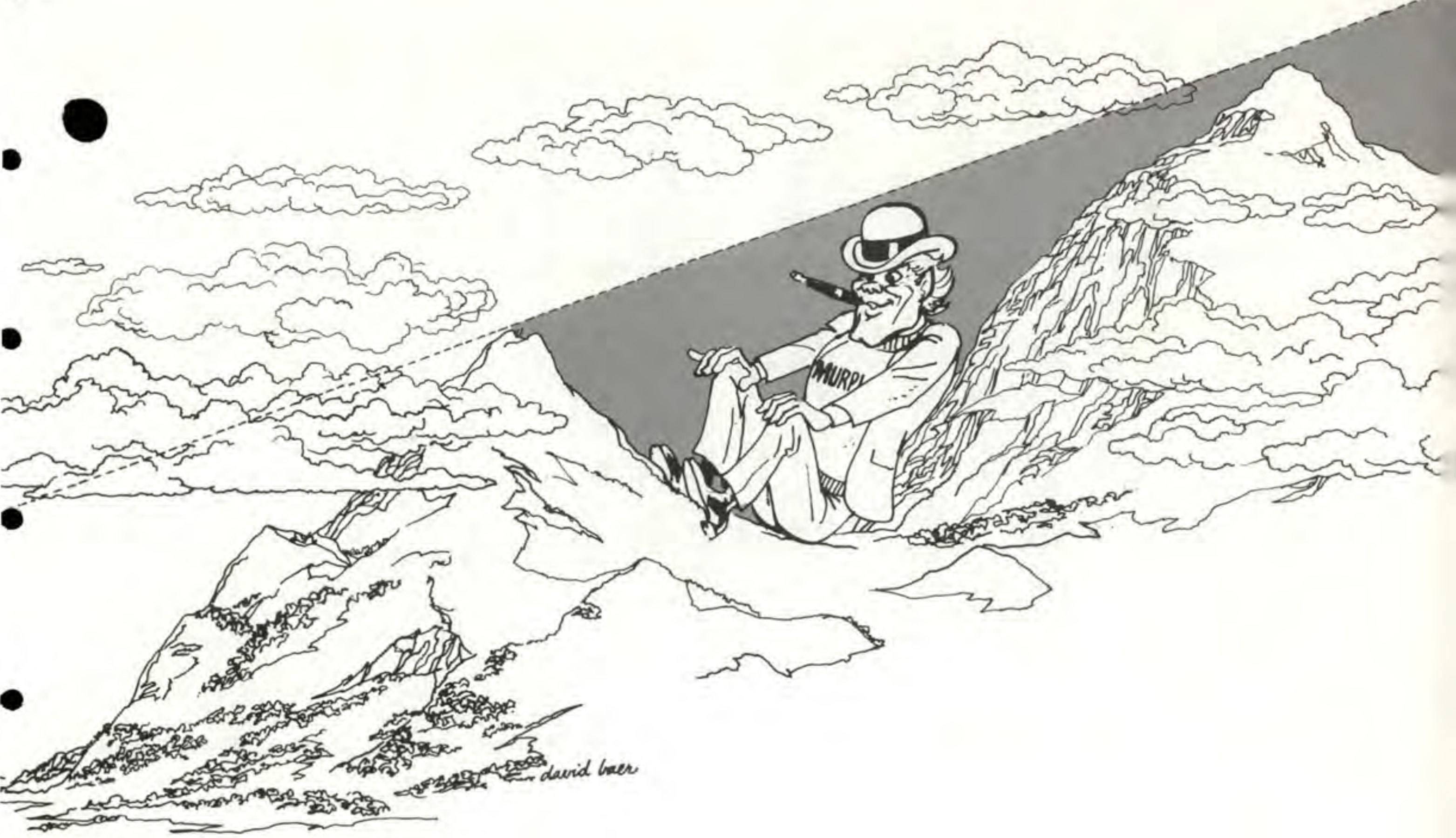
■ Everybody knows that Murphy's Law can throw a monkey wrench into the best laid plans. One of the best ways to counteract Murphy is thorough mission planning. In a multiplace aircraft this includes discussion of crew coordination.

The coordination of actions within a crew is of prime importance to ensure the optimum degree of mission success and safety during all phases of operation. This coordination is not necessarily limited to actions alone. Complete familiarity with one's crew position, the responsibilities thereof, and a working knowledge of the other crewmembers' duties will contribute immeasurably toward crew coordination. Each crewmember will be constantly on the alert and should notify the responsible crewmember of any deviation or discrepancy which will affect successful accomplishment of the mission. Liaison between individuals concerned will be established prior to initiating any action or procedure which will alter aircraft configuration or require correlation of activities between crewmembers. Prior to flight, the pilot will ensure that all crewmembers are thoroughly familiar with all aspects of the assigned mission as pertains to their crew specialty.

All you B-52 types should hear a familiar ring from the preceding paragraph. If you didn't, I suggest you review section 8 of your dash one because that is where the information is located. If you can struggle through that much dash one reading without falling asleep, I will relate a story which strongly emphasizes and supports the concept of crew coordination.

Crew S-02 from Base X was mission planning for a routine training mission the next night. It was to be a 2200 take off which included cell take off and departure, in-flight refueling, celestial navigation, low level terrain avoidance (TA) flight in a mountainous route and ending with some crash and goes at 0600 in the morning.

You might think that S-02 has no problem with crew coordination; they are standboard troops. S-02, however, does not fly all that much together as an integral crew due to other requirements. Because of this and the demanding mission, the pilot and crew believed in complete and thorough mission planning. Of special concern was the night TA because they would be flying at 500 feet AGL. They carefully studied the low-level terrain, towers, obstacles, turn points, headings, IFR altitudes, bombing procedures, etc. Flying over and through canyons, valleys, ridgelines, and mountains at 500 feet at night is no time to make an error. Everybody has to do the job right the first time.



At 1900 the next day the crew arrives at the squadron to catch the crew bus for Base Ops. Everybody is well rested; that is, as well as you can be when you have tried to nap through crying babies, phone calls, doorbells, slamming doors, etc. Nobody really enjoys this all night flying, but this crew, like most, is determined to do their best.

At Base Ops, weather briefing is OK, but low-level is forecast to be overcast at 2,500 feet, visibility 3 miles. This means they can still fly TA, but it is tough to see anything on the ground.

Take off, air refueling, and the celestial nav leg are uneventful. The crew is tired, but all they have left is the low level and then home.

Low-level entry goes smoothly with interphone chatter at a minimum and crew coordination optimum. The TA calibration is accomplished with a final value of 300′ on the clearance plane setting computed to give the aircraft 500 feet ground clearance.

Next comes final descent to TA altitude, the adrenalin flows a little more freely, and everybody is mentally and physically alert. Just after the third turn point the radar says "Hey, pilot, what's it look like up there? I'm picking up a lot of shadows."

The pilot first confirms the terrain trace on the HRL, looks over to the radar altimeter and sees 300 feet. He immediately climbs to IFR altitude to try and figure out what is happening. After leveling at IFR altitude, the copilot says "Who reset the clearance plane to 100 feet?" Both the pilot and safety observer said they hadn't touched the switch. The pilot then resets the CP to 300′, and they watch it as it slowly drives toward zero.

The TA warning light had not illuminated when the CP went through 200 feet because that function had been disconnected to allow for an additional 200 feet of bias error compensation.

An alert, well-prepared crew caught a rather insidious error that could have had catastrophic consequences if not noticed. This is what crew coordination is all about. What one guy might miss, someone else can catch.

All you expert BUF types out there will recognize some necessary editorial license in this article, however, the malfunction of uncommanded clearance plane movement during night TA did occur and changed 200 feet before the crew noticed it.

Present TA requirements dictate that all crewmembers be extremely diligent in performance of their duties. Let's not lose a crew because somebody didn't notice an anomaly in time. ■

BLACK HOLE APPROACH

COLONEL GRANT B. McNAUGHTON, MC
Directorate of Aerospace Safety

■ After a 4.5 hour night cross country, the pilot was cleared to descend his large transport from an enroute altitude of 37,000 feet to his destination base located in a remote desert area. Though unfamiliar with that base, the pilot elected to fly a VFR approach. Descent clearance was delayed, and the aircraft arrived over the field at about 2,000 feet AGL, too high for a straight-in. Continuing his descent, the pilot flew to about midfield, then commenced a left descending turn into what appeared to be a 360° overhead pattern. One minute later the aircraft impacted, having completed just over 100° of left turn, at a 9,000 feet per minute rate of descent and 275 KCAS, killing all aboard.

Flight data recordings during the final minute indicated that that accident was primarily due to a failure to control attitude (as well as altitude). At 24 seconds before impact, the pilot had slightly overbanked the aircraft left to 37°. The bank angle was then reduced to 33° at 17 seconds before impact. This was followed by an increase in left bank to about 70° with only 11 seconds remaining. At this point, the aircraft was descending through 1,000 feet AGL at 3,000 feet per minute. Attitude was 17° nose down and airspeed 227 KCAS. A roll to the right was initiated; however, the roll averaged only 5° per second whereas 18° per second was available; and the rate of descent, instead of slowing, rapidly increased, as did airspeed, right up to impact.

How did the pilot allow this unusual attitude to develop? One reason is simply that he had no outside horizon. When he turned the aircraft left away from the runway, he was confronted with a lightless black hole. It was after midnight locally, and the moon had already set. Though the night was clear, there was a haze layer that, when viewed horizontally, obscured the real horizon and blended black sky with black desert. At this point, the pilot was a set-up for several of the vestibular illusions and should have gone immediately to his gauges.

Two characteristics of vestibular (balance) organs are important regarding illusions. First, they do not detect velocity but rather changes in velocity (accelerations). Once velocity is stable, vestibular cues cease. And second, they do not detect accelerations below a certain threshold. For example, a roll rate of less than 2-4° per second may go undetected. Fifteen seconds of such a subthreshold roll to the left could result in a left 30-60° bank. If this initial bank fails to register in the balance mechanism and then the pilot rolls back to the right faster than 4° per second, he now perceives himself to be in a right bank. This all-too-common illusion would tend to cause him to bank back to the left. It is known as the somatogyral illusion or "leans" and is operative in such phenomena as the "graveyard spiral" or "graveyard spin."

Also in this mishap, the prolonged constant-velocity descent from altitude could have habituated the senses and been perceived as level flight, following which a level-off would be perceived as a climb. The pilot's tendency would be to keep forward pressure on the yoke and

continue the descent. Turning toward the black hole with absence of both horizon and ground references, a subthreshold roll would explain the initial left overbank, and the "leans" the subsequent left overbank. Various combinations of bank angle and descent rate would produce the same feeling as a 30° banked level turn. The forward acceleration of the descent would create the sensation of climb. Again, the pilot's reaction would be to push forward on the yoke.

There was another factor out in that black hole that could have created confusing and distracting illusions. Several miles beyond and to the left of the landing runway, at roughly the pilot's 10 o'clock position as he reached midfield in his overhead, stood a 298 foot tower with nonstandard lighting. Lighting consisted of a steady red light on top and two white lights farther down. With no visible horizon, on a black night with no other visual cues, the lights on the tower could have been mistaken for an approaching aircraft. Had the pilot perceived the "aircraft" to be conflicting traffic, he might well have initiated evasive maneuvers consisting of more left roll and more descent. The copilot would quite likely be monitoring this "traffic" instead of minding the attitude and altimeter. Fixation on these lights for perhaps 10 seconds is all the time needed to set up this accident.

At the 10-11 second before impact point, the pilot initiated an unusual attitude recovery from the 70° left bank by rolling right, but since the aircraft was accelerating, he sensed a climb and countered by holding the nose down. A ground proximity warning at 8 seconds may only have distracted the crew and may have partially blinded them. It apparently went unheeded. At 3.6 seconds, after the minimum descent altitude light illuminated, the pilot added power and began a pullout, albeit too late. The last reliable external visual cue seen by the crew since the pitch-out was most likely the rapidly rising desert floor illuminated by their landing lights.

There were some other human factors in this mishap, too. Lack of recent pilot experience (two night landings in the previous 60 days; few 360° overhead approaches; primary duty as simulator IP). Circadian phase-shift fatigue (multiple recent time zone changes in a west to east transmeridian direction); acute fatigue (the pilot had slept only 4 hours the preceding night and had remarked at breakfast that morning that his body was still on the time of home base). Also, the pilot had been awake for approximately 16 hours at the time of the mishap. These factors undoubtedly degraded the pilot's ability to recognize and properly manage the emergency situation created by the sudden loss of an outside horizon.

Loss of an outside horizon, regardless of cause, whether it be weather, dust storm, snowstorm, heavy rain, smog, haze, fog, or a black hole, is an emergency. The treatment: Get on the gauges—primarily the attitude indicator—immediately! ■

Thanks to Major Stan R. Santilli, USAF School of Aerospace Medicine, for his assistance in the preparation of this article.

A Look At Brake Cooling

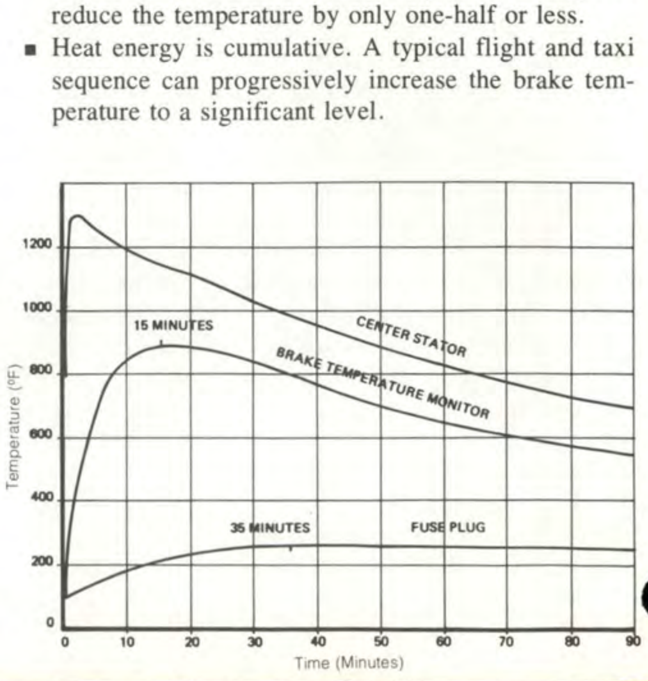
■ Consider the following scenario: An aircraft makes a normal landing following a routine flight. After taxiing two miles to the ramp, it is parked for an hour and a half, in preparation for the next leg. The airplane is then taxied several more miles to the active runway and the takeoff roll is begun. At approximately 110 knots, the pilot rejects the takeoff (RTO) and the airplane is taxied off the runway. After checking the problem that caused the RTO and deciding to continue the flight, the crew determines from the brake cooling chart that the brake energy from the RTO is below the "caution" range. They therefore taxi back and proceed to take off. Several tires fail during the takeoff and the thrown pieces of tread cause considerable damage to the airplane; more damage is incurred during the subsequent landing. The airplane is grounded two weeks for repairs.

Fiction? Not at all . . . although it was an unusual combination of circumstances, it did happen, and there have been a number of similar incidents. Most of them were avoidable.

The Cause

The underlying cause of these incidents is a lack of awareness of the essential facts concerning airplane brakes :

- The kinetic energy which is absorbed in stopping the airplane is converted through friction into heat energy.
- The brakes dissipate this heat very slowly. Depending on many variables, an hour of ground cooling will reduce the temperature by only one-half or less.
- Heat energy is cumulative. A typical flight and taxi sequence can progressively increase the brake temperature to a significant level.



WALT BLAKE • The Boeing Company

- Even a moderate kinetic energy absorption by a brake which is already hot can cause the wheels to reach a temperature high enough to melt the protective fuse plugs. This will result in tire deflation.
- Depending on the energy absorbed, tire deflation can occur at a time ranging from only a few minutes to almost one hour after the energy has been absorbed.
- Failure of a tire is, for all practical purposes, the same as failure of a brake; tire failure during an RTO or a landing will thus increase the distance required to stop the airplane. It will also increase the amount of energy which the remaining operational brakes must absorb and therefore will increase the possibility of melted fuse plugs in those wheels.

In the above incident, the brakes were still hot, but within limits, at the time of the RTO. The RTO energy absorption was enough to raise the brake/wheel temperatures to a point which resulted in tire deflation. The deflation, which probably occurred during the taxi back to the takeoff point, was not detected. The takeoff on the flat tires caused their failure and the ensuing airplane damage.

The Prevention

- Use good pilot technique during landings and taxiing to minimize kinetic energy inputs to the brakes. Prompt extension of the speed brakes, proper use of reverse thrust, and judicious application of the brakes are important. Careful control of the touchdown speed and touchdown point are essential.
- Any landing at a weight exceeding the certified maximum "quick turnaround" weight, or any rejected takeoff, is cause to stay on the ground long enough to ensure that the tires will not deflate.
- Use of in-flight gear-down brake cooling can reduce residual heat energy very rapidly and is recommended particularly for short-haul operators to whom cumulative heat energy can be a serious problem. It is also valuable on training flights making full stop or stop-and-go landings. The gear-down cooling can be accomplished either by delayed gear retraction after takeoff, performance permitting, or by early extension on approach.

Sources of Kinetic Energy

There are two airplane maneuvers which may require the brakes to absorb large quantities of kinetic energy; Landings and rejected takeoffs.

Rejected takeoffs from high weights and speeds, which fortunately are rare, represent the most extreme use of the brakes, since an RTO is typically at a higher weight than a landing, and available stopping distances may be significantly shorter than during a landing. The RTO speeds may be as high as, and in some cases higher than, the landing speeds. A maximum-energy RTO will require replacement of the wheels, tires, and brakes.

Even at the same weight and brakes-on speed, an RTO requires the brakes to absorb more energy than a landing because:

- The airplane during an RTO has less aerodynamic drag, due to the smaller flap setting.
- An RTO is initiated while the engines are producing takeoff thrust, compared to a landing in which the brakes are applied with the engines already at idle thrust.

A significant source of energy which must be absorbed by the brakes, largely overlooked but nevertheless very important, is taxiing. Depending on engine thrust and airplane weight, it is often necessary to use the brakes simply to keep the airplane from accelerating to an unacceptable taxi speed. In addition, taxiing requires full stops at times.

Energy Accumulation

It is essential to understand that heat energies are cumulative. Examine a conceivable flight sequence beginning with the landing: The landing by itself requires a moderate amount of kinetic energy to be absorbed by the brakes. When the landing is followed by taxiing, more heat energy is added to the already heated brakes. Parking the airplane for normal turnaround times does not fully cool the brakes since the heat is dissipated quite slowly. Taxiing out for the subsequent takeoff adds still more heat energy. In the event of even a moderate RTO, then, the brake/

continued

A Look At Brake Cooling

continued

wheel temperatures may be raised above the point at which the fuse plugs will melt.

Let's look at an example of brake energy accumulation in a representative airline operation. A 737 leaves Seattle for its first flight of the day to Portland, San Francisco and Los Angeles. The brakes are cool before the landing at Portland, but the 95,000-pound landing, plus the taxi-in, requires the absorption of approximately nine million foot-pounds of energy per brake. About three million of these will be dissipated during the half-hour ground time, but the taxi out will add a million.

As the airplane leaves Portland, then, each brake contains seven million foot-pounds of residual energy, only about two million of which will be dissipated during the one-hour flight to San Francisco. Landing there at 90,000 pounds plus taxiing, leaves each brake with about eight million foot-pounds at the time of takeoff. Obviously then, an RTO of moderate to high energy will put the brakes well over the fuse plug melt energy of 20 million foot-pounds. Even without an RTO, the short flight to Los Angeles means that the landing there will be made with some seven million foot-pounds, remaining in each brake.

Temperature Time History

We have been talking about the slow dissipation of heat energy. To illustrate this, let's look at a chart of temperature versus time for a hot brake. Figure 1 shows the time-temperature history of a 747 brake following a 30-million foot-pound energy input—a moderate RTO.

Notice that the center stator, the hottest portion of the brake, almost immediately reaches its peak temperature of 1300°F and then begins the long slow process of dissipating its heat. Even after 90 minutes, the center stator is in excess of 650°F, ABOUT ONE HALF OF THE INITIAL HEAT ENERGY IS STILL IN THE BRAKE.

Notice also that the fuse plug does not reach its peak temperature until 35 minutes after brake application. This lag is due to the relatively slow flow of heat from the brakes outward into the wheels. The time lag between the brake and fuse plug temperatures depends on the energy absorbed—in the extreme high-energy case, the fuse plugs will melt within a few minutes.

A brake temperature sensor is installed on most 747's. The sensing element is located in the backing plate at the extreme end of the brake stack which is the only member of the brake heat sink which is static and therefore available for installation of a probe. This location, at the end of the brake stack, is not the hottest part of the brake immediately after a stop. The backing plate temperature continues to rise, and the center stator temperature drops, until the entire heat sink is at the same temperature. As a result, there is an appreciable time lag to the temperature indication, again due to the relatively slow flow of heat from the brakes outward. The lag will be as much as 15 minutes.

Brake Cooling Methods

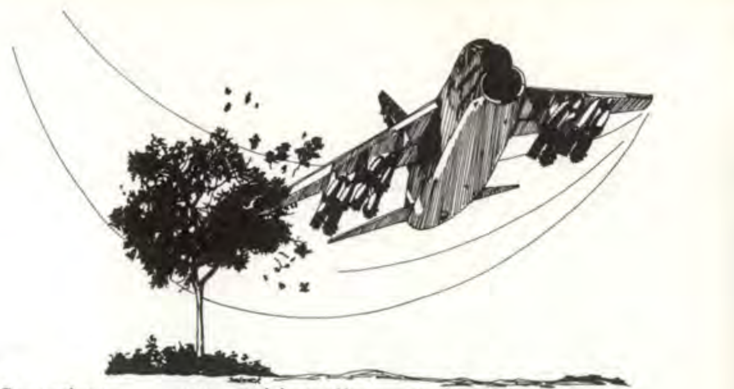
In-flight cooling with the landing gear extended is by far the most efficient method of brake cooling and is especially useful for those training flights used to practice takeoffs and landings. Some airlines utilize gear-down inflight cooling after takeoff following a short turnaround, especially when the upcoming flight segment is brief, in order to ensure landing with reasonably cool brakes. When feasible, it is also effective to extend the landing gear somewhat early during the landing approach following a short segment.

Brake cooling when the airplane is parked is only fractionally as effective as in-flight gear-down cooling. Several hours may be required to cool the brakes to ambient temperature after a typical landing. Some airlines have adopted the practice of using large electric fans with airflow directed over the wheels and brakes to speed brake cooling when parked. The 747 has an optional brake cooling fan mounted within the wheel which has proven to be very effective.

Slowest of all is brake cooling with the landing gear retracted in flight, which is less than one-third as effective as on-ground parked cooling. To improve gear-up cooling, some airplanes have airscoops which direct cooling air through the wheel well in flight. — Adapted from a longer article in the *Boeing Airliner,* July 1979. ■

—Reprinted from *Aerospace Safety* Magazine.

A Close One



■ The mission for the two A-7s had gone very well. They had successfully completed medium altitude DACT with some A-4s and had also performed the defensive maneuvering to defeat a low altitude attack by an F-4.

The F-4 broke off just prior to the A-7's turn for the final target run-in. In the turn, the IP flying wing saw lead descending and called for an immediate pull-up. But before the pilot could climb, the right wing struck the desert brush at about 8′ AGL.

How could this happen? First, the terrain was relatively flat with small 8 - 10′ brush but no distinguishing features, the classic environment for a visual illusion. The pilot had just completed some very demanding defensive maneuvering—now all he had to do was make an easy 45° turn and set up for the target run. He could relax for a minute.

Turns at low altitude require skill but, for the experienced pilot, this is not as demanding a task when compared to defensive maneuvering at low altitude. But they are often complicated by the factors discussed above.

The pilot judges height above the ground visually by comparing relative size of objects on the ground. If the terrain is flat and relatively featureless (desert, snow, dry lake bed, or open water), the aircraft can get dangerously low without giving the pilot any visual clue, other than instruments in the cockpit (Figure 1).

The problem of the visual illusion is complicated by the other factor—relaxation. It is, of course, true that some parts of a flight are much less demanding, and during that time we, as pilots, tend to relax. Sometimes, as in this case, when the transition is abrupt and the reduction in demand large, the pilot relaxes too much—complacency contributes to lack of attention, and the pilot fails to notice the deviation in altitude.

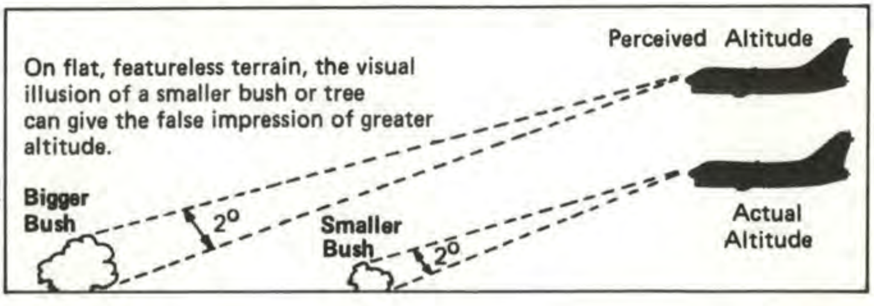
In 1977 Captain John Jumper wrote an article for *USAF Fighter Weapons Review* on low altitude flying. In that article he gave some techniques for low altitude turns which are worth repeating.

"1 ROLL-IN. When the turn is signalled or called, check for a visual reference 90° to the flight path. This will preclude the distraction of checking the compass, and the reference can be used for any delayed or in-place turn. The roll-in should be a rapid, unloaded roll to a bank angle which will allow the nose to track a straight line along the horizon. Obviously, we don't know what that bank angle is until we are established in the turn and can identify trends in nose position.

"2 ESTABLISHING THE TURN. In order to monitor trends in nose position, the eyes should be focused on the ground at left ten o'clock (for a left turn), so that peripheral vision includes the nose of the aircraft at one extreme and a view of the terrain being turned into on the other. As the turn progresses, this eye position allows constant cross-check of proximity to the ground vs any tendency the nose has to rise or fall. *This is especially important in aircraft with a stubby nose, such as the A-10, in which subtle yaw or pitch changes may go undetected. Ed.* Corrections should be made by adjusting bank angle. Use of rudders is not recommended once the turn is established since your inputs will disturb your interpretation of nose position. Once a smooth nose track is established, we can briefly afford to check the progress of the turn, position of lead, and area of lookout responsibility.

"3 ROLL-OUT. Just prior to roll-out, make a final check of the nose position. If it's still good or slightly rising, roll unloaded to wings level. If slightly below the level reference, roll-out with a slight back stick pressure to break the descent. During roll-out, the eyes should shift to focus attention directly over the nose. This will allow immediate correction of any tendency to climb or descend."

Low altitude is where we must operate to defeat "the threat." But down there we must also defeat the other threats. The pilot in the A-7 came uncomfortably close to becoming another statistic in the Safety Center computer. It only takes a second or two. ■



YOUR WAY OUT

SSGT ROBERT J. PAETZ
3612 Combat Crew Training Squadron
Fairchild AFB, WA

■ You have just been tossed out of your cozy warm cockpit and find yourself tumbling into a survival situation. That's a brand new mission. Could you hack such a mission, not knowing what it entails? Unfortunately, a lot of aircrew members have forgotten that they have an assigned mission even after they leave their aircraft. Let's look at what Uncle Sam says that mission is, and why.

The moment you depart your aircraft, Sam states you're to "return to friendly control without giving aid or comfort to the enemy, to return early and in good physical and mental condition." On first impressions, "friendly control" seems to relate to a combat situation. However, even in peacetime your environment may be quite hostile. Imagine parachuting into the Arctic when it's -40°F. Would you consider this friendly? I doubt it. If you are forced to crash land in the desert where temperatures may soar past 120°F, would this be agreeable? Hardly. The list is endless. Almost any place you might bail out, you can

be confronted with situations difficult to endure. You want to "return to friendly control."

The second segment of the mission, "without giving aid or comfort to the enemy," is of course related to a combat environment. This part of your mission may be most effectively fulfilled by following our moral guide, the Code of Conduct. Remember, however, that it should be followed at all times and in all places. It *does* apply to the peacetime situation.

The final phase of the mission "to return early and in good physical and mental condition," will probably be the most strenuous requirement to accomplish. The most important criterion for successul completion of that part of the mission will be your WILL TO SURVIVE. Although this "will" is inherent in all of us, some will find it difficult to activate. Surely you've read stories or know of incidents where people have eaten their belts for nourishment, boiled water in their boots to drink as broth, or have eaten human flesh — though this certainly wasn't their cultural instinct.

One incident where the will to survive was the deciding factor between life and death involved a man stranded in the Arizona desert for eight days without food or water. He traveled more than 150 miles during searing daylight temperatures, losing 25% of his body weight due to the lack of water. (Usually a 10% loss is considered fatal.) His blood became so thick that the lacerations he acquired could not bleed until he'd been rescued and had received a large amount of water. When he had started on that journey, something must have clicked in the back of his mind telling him to live, regardless of any obstacle which might confront him. And live he did!—on guts or will alone.

Let's flip the coin and check the other side of "will." Our location is the Canadian wilderness. A pilot ran into engine trouble, and chose to deadstick his plane onto a frozen lake rather than punch out. He did a beautiful job and slid to a stop in the middle of the lake. He left the aircraft and examined it for damage. After surveying the area, he noticed a wooded shoreline only 200 yards away where he could find warmth, food and shelter; he decided to go there. Approximately half way there, he changed his mind and returned to the cockpit of his aircraft where he smoked a cigar, took out his pistol and blew his brains out. Less than 24 hours later, a rescue team found him. Why did he give up? Why was he unable to survive? Why did he kill himself? Why do other people eat their belts or drink broth from their boots or take a bite out of George? No one really knows, but it's all related to the WILL TO SURVIVE.

Like a lot of other things in this world, your will may be improved upon. Let's take a look at some ways. In an emergency outside the cockpit you may have a tendency to panic or fly off the handle. That can usually be handled by sitting down, calming down and analyzing the situation rationally.

After your thoughts are collected and you're thinking clearly, the next step is making decisions. In all walks of life, some people always avoid making decisions by letting others do their planning for them. But in a survival situation that won't work. You're on your own, and every decision may mean life or death. When you make critical decisions, like how and where to build a shelter, how to signal and where to find water and food, you've got to be flexible and plan ahead. Flexibility is essential because circumstances may not always go according to that plan. For example, you may have started to construct a shelter and hear an aircraft in your vicinity. You would probably want to postpone the shelter and attempt to get out a signal. I don't mean to be as flexible as jelly, but maybe like jam.

If you get in a pinch and find yourself without an item you feel is critical,

use a little "Yankee ingenuity"—improvise. Today you might walk outside and see a tree and wonder how tall it is or what good shade it could provide. But in a survival situation, you have to look at that same tree in a totally different light. It may supply you with shelter, food, signalling, warmth and medicine.

Tolerance is the next topic of concern. You will have to deal with many physical and psychological discomforts, such as creepy crawlers, flying insects, loneliness, and maybe even "Sasquatch." Just by being in the military you've had a chance to learn to tolerate uncomfortable situations. Fine. Apply that to your new environment. You'll probably find it's not so bad.

Facing and overcoming childhood fears is another threshold you may have to cross. Realistically speaking, everyone has acquired childhood fears. For instance, why do you usually turn on the bedroom light when it's dark even though you've been there hundreds of times before and already know where every stick of furniture and every knick-knack is located? Is it a habit, or a reflex? Or could it be that when you were very young someone jokingly scared you in the dark? Maybe as a small child someone told you not to leave the yard because wild animals in the nearby woods might get you. And now you may find yourself in a strange dark woods which is the playground of these wild and ferocious animals. Old fears can be detrimental to your survival unless you learn to overcome them.

Perhaps one of the most important psychological factors to remember is optimism. With today's modern technology, it's likely someone already knows you are missing and a rescue team is being organized to find you. Like the old saying goes, "Keep the Faith, Baby!"

As you can see, the survival mission Uncle Sam has assigned you is not an easy one. This is just a peek at some of the ways you can succeed in that mission if you're ever "fraged" for it. If you find yourself in this predicament, I hope you'll remember that your WILL TO SURVIVE is Your Way Out. ■

—Reprinted from *Aerospace Safety* magazine.

TV and Cartoons In The Cockpit

MAJOR JOHN E. RICHARDSON · Directorate of Aerospace Safety

■ Today a pilot must assimilate data at an astounding rate. The speed, complexity, and operating environment of modern aircraft have severely challenged many of the current methods of presenting data. So Air Force engineers are searching for new, more efficient ways to give the aircrew the information needed.

The answer may just be in the realm of new electronic display technology now becoming available. The Flight Dynamics Laboratory at Wright-Patterson Air Force Base is working on several programs which could give pilots advanced pictorial displays of flight information, mission status, and subsystem checklists.

The Flight Dynamics Laboratory's program manager, Dr. John M. Reising, says pictures on cathode ray tubes (CRT's) could simplify information presentation in cockpits now crowded with gauges, dials, and CRT's, all competing for the pilot's attention in a confusing mixture of letters and numbers (alphanumerics).

"The pilot has many tasks to do under stress, so his workload needs to be lightened, not made more complex," Dr. Reising said. "Because a person is able to interpret information from pictures more easily than alphanumerics we'd like to get away from the letters and numbers as much as possible and give the pilot pictures to fly by."

Color coding would make the pictures even more meaningful. For example, enemy threats could be one color, friendly forces, another. Similarly, munitions carried, their readiness for release, and release could be depicted with different sized and colored drawings (Figure 1).

One specialized adaptation of the fly by picture concept is an electronic terrain map. The map display—updated continuously from a digital memory of terrain data, would give airborne pilots perspective views of terrain with both natural and man-made features added. In effect, the map would permit pilots to see what's ahead and below despite weather darkness and electronic jamming.

The System Avionics Division of the Wright Aeronautical Labs is testing the concept to establish which map features pilots like and would use if the map were operational. According to engineers, there have been enthusiastic comments from pilots who have seen a computer simulation of the terrain map. However, they add that the new model now being tested has many refinements and much more closely resembles what could be built in production quantities.

During the test program various map tests, including human engineering studies, will be conducted. For these tests and in operational use, the map will be coupled to an aircraft navigation computer which calculates the aircraft's "state vector" (heading, altitude, latitude, longitude). Thus, a pilot glancing at the map display would see a combination of flight data and terrain information (Figure 2).

Ultimately, production models of the map could be "tailored" to display the navigational check points that a pilot prefers—one pilot may want to see roads whereas another may prefer natural terrain features. Since the map's electronics would be "programmable," engineers believe such tailoring feasible.

The prototype map will depict terrain drawn from a digitized data bank containing a quarter of a million square miles and use more than 1,500 bits per square mile to encode both terrain and limited cultural data. Small size and portability are among the distinguishing design features which necessitate a customized design which processes data more than 100 times faster than conventional mini/micro computers.

Air Force engineers are confident that eventually the map could be coupled with existing aircraft subsystems to provide terrain data enhancing operation of these subsystems. The map could be integrated into low level terrain following/avoidance and weapons delivery systems to give higher reliability in terrain following and greater safety and confidence in weapons delivery (Figure 3).

While most of the test models for graphic displays are based on CRT's, the technology is adaptable to other methods. One of the most promising is the so called "flat panel" display (Figure 4). A solid state matrix of light emitting diodes, the flat panel can be programmed to present many varieties of information. The biggest advantage of the flat panel is its potential reliability in comparison to the tube display. Air Force program managers estimate that the mean time between failure of a flat panel display is 10,000 hours, while that of an average tube display is only about 500 hours. And while a tube display can suddenly and completely burn out, the flat panel remains readable even if several hundred of the thousands of light emitting diodes go out.

The biggest obstacle facing developers of these new displays is designing the computer software necessary to produce the quality images desired. The displays call for speed and complexity in computer programs far beyond what is currently used.

While the programs for these displays are in the initial stages of research, if the problems can be solved before too many years, Air Force pilots will be seeing TV screens and pictures in their cockpits. ■

Figure 1

This kind of picture could become the primary cockpit display for Air Force fighter aircraft of the future. Color-coded pictures let the pilot see at a glance important information about the battle scenario. Part of the information is conveyed by colors—green for friendlies, red for threats, etc.

Figure 2

This is a look-down view of terrain as depicted on the computer simulation of the color electronic terrain map. The new map would display scenes of the ground reconstructed from data in a massive digital memory of terrain features. Aircraft heading, altitude, latitude and longitude readings are superimposed over the map.

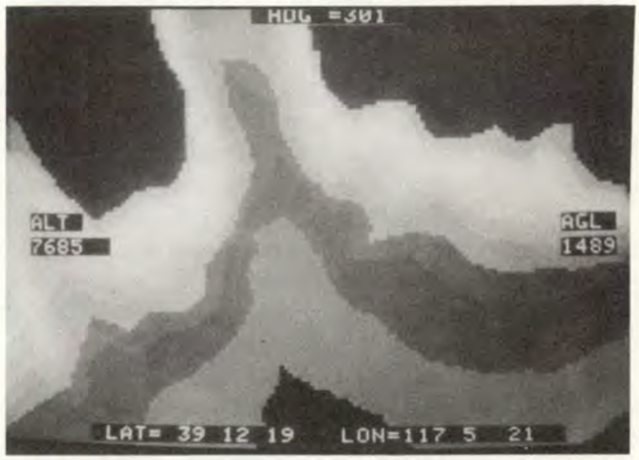


Figure 3

This is the airborne approach to a mountain range as depicted on an engineering model of the color electronic terrain map. When the aircraft altitude and heading change, the picture is continually updated automatically many times per second to give perspective views of ground features.

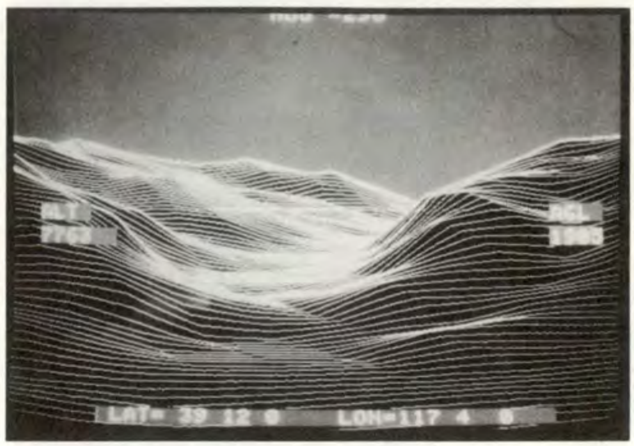


Figure 4

This flat-panel display only three inches deep, uses tiny light emitting diodes to depict the symbology, letters and numbers on the screen. This new display could replace mechanical dials and CRTs in future aircraft.

Birdstrike Report

MAJOR JOHN E. RICHARDSON
Directorate of Aerospace Safety

■ The Air Force has been concerned about aircraft birdstrikes for some time. During the Seventies, the rising cost damage from birdstrikes plus some losses of aircraft and crews prompted the establishing of a formal birdstrike hazard reduction program.

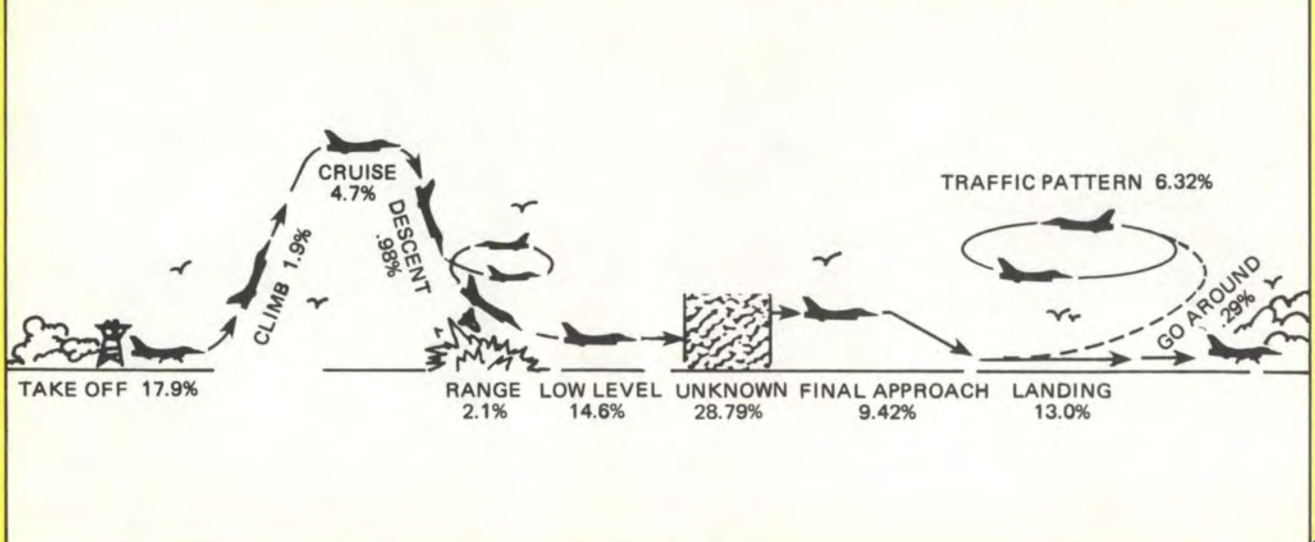
Part of the program was to establish a data base from which the Air Force could identify the magnitude of the problem and then provide the justification for positive steps to reduce the birdstrike hazards. To do this, the Air Force needed to collect information on birdstrikes. So for a two year period every birdstrike, regardless of damage, was reported. The results of that data collection were published last year and form the basis for this article.

During the study period, there were 3,258 birdstrikes to USAF aircraft reported. Damage costs from these strikes amounted to over $5¾ million. However, fortunately there were no aircraft destroyed nor major injury or death from birdstrikes during the two-year study.

Birdstrike studies in 1971 and 1972 stated that windshield/canopy penetrations posed the greatest hazards to aircrews. Since that time, more stringent specifications have been enforced for bird resistant windscreens during new aircraft programs. There have also been retrofit programs to upgrade current operational aircraft windshields. The success of these efforts is borne out in the study which found that, although over 20 percent of all birdstrikes occurred on the windshield/canopy, only 7 percent of these resulted in shattered transparencies.

Engine damage from birdstrikes caused a disproportionate share of the dollar value loss. Engines received 19.8 percent of the strikes, but the damage was almost 40 percent of the total, or over $2½ million. The costs ranged from $33 to over $116,000. The relatively high dollar value of engine damage is partially related to today's cost of high technology for engines like those of the F-15 and F-16 and the costs to repair those for the C-5 and

Figure 1 Birdstrikes by Phase of Flight



The majority of birdstrikes occurred within 10 miles of the airfield. Range birdstrike experience is remarkably low. Low-level flight accounted for 14.6% of the strikes.

Photo by AAVS

C-141. Flight at or near the airfield accounted for a majority of the birdstrikes to engines. Although the relatively slow speeds in this area, especially take off and landing, make the risk of airframe damage low, the high rpm of engines make them susceptible to a much higher degree of damage from bird ingestion.

The study brought out an encouraging trend in the number of birdstrikes near airfields. Previous studies indicated that 51 percent of birdstrikes occurred during take off, final approach, go-around, traffic pattern, and landing. In the latest study, this percentage was reduced to less than 47 percent. An increased awareness of the problem by airfield managers appears to have produced this favorable result.

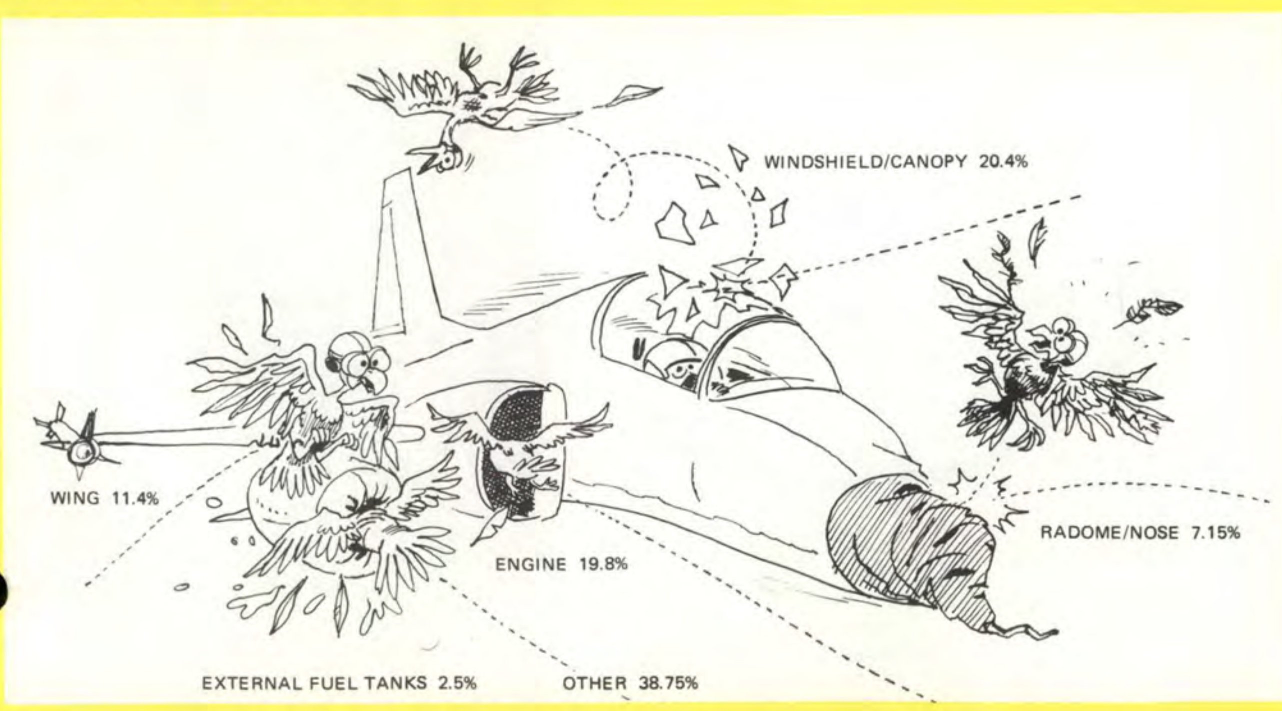
The main areas of birdstrikes are shown in Figure 2. In addition, there were strikes on landing gear, vertical and horizontal stabilizers, flaps, fuselage, and even ordnance. The damage included such things as shattered windshields, smashed radomes and even a 3-foot tear in the aircraft skin. The aircraft damage is directly related to the weight of the bird and speed of the aircraft. The force generated quadruples each time the speed is doubled. Impact forces of 200,000 foot pounds are not uncommon.

Although the majority of birdstrikes occurred during bright daylight, the only real significance of this is that the majority of military flying and most intense bird activity occur then. The chance of incurring a birdstrike is about the same for either day or night. The first 500 feet of altitude is where the greatest hazard of birdstrike exists.

During the period of the study, the highest reported birdstrike was 14,000 feet, and the lowest was a Blackbird which hit an F-4 holding nr one for take off. The chance of hitting a bird dramatically increases

continued

Figure 2 Impact Point on Aircraft



Birdstrike Report continued

below 300 feet AGL and just as dramatically decreases above 3,000 feet AGL.

Fighter and attack aircraft had the lion's share of birdstrikes (Figure 3). This is primarily due to the fighter mission and to the larger number of fighter aircraft. In the large aircraft category C-135s had more strikes than any other type. Once a birdstrike occurs, there is a one in six chance that the strike will cause damage. In addition to staying above 300 feet AGL, the study also showed that aircraft with operating strobe lights were most successful at avoiding collisions with birds. This was also supported by a similar British study.

October is the most hazardous month for birdstrikes in the Continental U.S. This is the month of heaviest migratory activity. Therefore, a little extra care regarding flight operations and bird activity during this period can pay some real dividends.

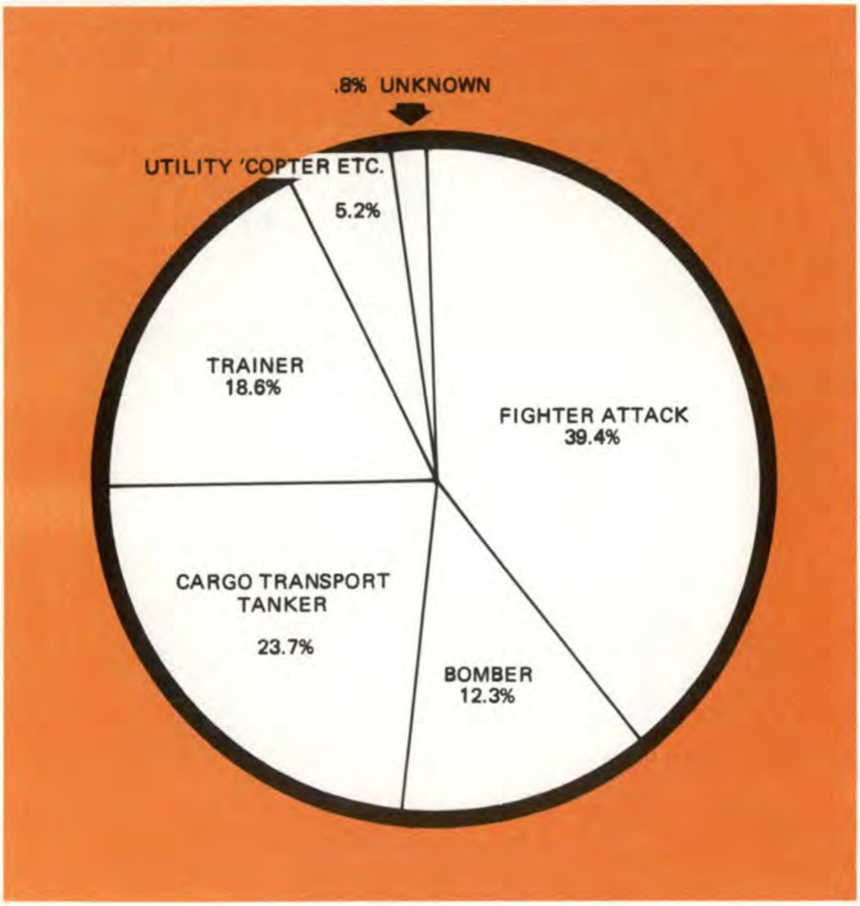


Figure 3
Birdstrikes by Aircraft Group

Although some improvements in birdstrike avoidance have been achieved and there have also been reductions in the damage categories of birdstrikes, bird/aircraft collisions continue to be a problem. So far, the best way for aircrews to reduce the birdstrike hazard is to be aware of what the problem is and where it is.

The Engineering and Services Center at Tyndall AFB is developing a new computer model for bird avoidance to help the pilot be aware. This program will specifically cover low level routes and ranges, something not adequately considered in most bird hazard avoidance programs. Although still in initial development, the model will include all DOD low level routes and ranges CONUS wide. This information will be meshed with known bird migratory concentrations and movements, aircraft mission types, and flight profiles. The result is a relative birdstrike risk measurement for a given aircraft profile time and route. This can be used for planning and scheduling missions. The first test program will be instituted at Tyndall later in 1981 or early 1982.

The test will not be as flexible as the future application because the data will be available only through the Engineering and Services Center. Once operational, the plan should allow aircrews to gain access to bird hazard information for their proposed routes, much in the way they now can get weather and NOTAM information. ■

CAT 1 MDRs

COL JOHN J. GRIFFIN, JR.
Directorate of Aerospace Safety

■ There's been a change to TO 00-35D-54 that can help us in the Directorate of Aerospace Safety help you. At first glance, it appears that we're asking you to do more work. Perhaps we are, and you deserve some explanation, so here goes the "word."

TOPS 101, specifically page 3-10.1, amends paragraph 3-4b to *eliminate the old provision for downgrading or discontinuing* CAT I or CAT II MDRs once the condition is known or action is under way to resolve the deficiency. This practice may have saved time and some paper, but it totally destroys the true mishap data base and masks the picture of what's happening in our fleets.

Think about it. Once the depot acknowledges a problem and you stop submitting MDRs or start sending CAT IIs to cover CAT I situations, the management folks no longer get the urgency indicators they used to get. On our trend charts, the problem has gone away. It used to be there, but after a certain date (the time you were told or felt you no longer had to submit MDRs) no more MDRs; the failure trend is gone, and your fleet must be OK, right? Wrong!

As you know all too well, fixing hardware takes time, and lead time on big modifications can be quite lengthy. If the original decision to fix something by replacing it by attrition is made on the basis of a few MDRs and then reporting is cut off, how does the management structure learn that you're now having a failure a week instead of one a month? Maybe he needs to change his fix schedule. By cutting off or downgrading, you hide that new data from the decisionmakers.

We in AFISC also have a vested interest in accurate reporting of CAT I failures. Given the size of the USAF fleet and the thousands of things that go wrong every day, our people and computer cannot handle everything. We can, should, and do handle the critical items—those that, regardless of when discovered, could clearly result in an Air Force mishap, or that result in a requirement to use prescribed emergency procedures or other extraordinary means to avert damage or personnel injury. Does that sound like a definition? You bet it is, straight out of TO 00-35D-54, and it's the criterion you should use to decide on sending in a CAT I MDR! And, when you do that, we can help you.

We combine those with mishap reports submitted by the safety folks under AFR 127-4 and use our automated computer trending to identify unfavorable failure trends right down to the work unit code level. We can do it on a daily basis, and, when the computer spits out a bad trend, we notify both the command maintenance and safety folks as well as the system manager.

This trending capability is a big step toward mishap prevention rather than mishap reaction. But, as with all of our safety programs, it depends on you. You must report *all* CAT I conditions, regardless of when discovered, and regardless of who else has reported it or when. You give us the right information and we'll give you a factual, clear picture when something is coming uncaged. ■

WIND SHEAR

Part II

MAJOR JOHN E. RICHARDSON
Directorate of Aerospace Safety

■ In the first part of this series we discussed the types of wind shear and where they came from. As a quick reminder: Wind shear is an abrupt change in direction and/or velocity of wind; the shear can be horizontal or vertical and is associated with frontal activity, thunderstorms, temperature inversions or surface obstructions.

An aircraft is affected by the change in wind direction/velocity because the aircraft motion relative to the ground is also changed by the wind. At high altitude this is usually not a problem, except for the turbulence associated with a shear plane. There is usually enough altitude and airspeed to compensate for the changes. When the aircraft is at low altitude the situation changes; the safety margin is very thin. It is possible for the wind shear to exceed the pilot's capabilities or performance of the aircraft.

We can discuss performance capabilities in terms of available energy. Changes in energy cause changes in aircraft speed and position. In unaccelerated flight, an aircraft maintains a certain energy level, balanced against the surrounding atmosphere. If this balance is disturbed, by a wind shear, for example, some compensation must be made. Events in an aircraft are dynamic, and the aircrew is continually reacting to the changing flight conditions.

Changes in wind velocity or direction are part of these dynamic conditions. The crew perceives the need for a change in aircraft energy levels through the instruments and makes changes. The applied corrections are not, however, instantaneous and, as a result, the reaction of the crew or aircraft may not be sufficient.

To illustrate the effects of these dynamic changes, let's trace some hypothetical wind shear encounters. Suppose the aircraft is stabilized on an ILS approach and encounters a shear which results from a decreasing head wind. In such a case, there is transient loss of airspeed and lift causing the aircraft to descend. The pilot must compensate for this loss of lift. The critical factor is whether there is sufficient altitude to complete a recovery. In Figure 1 the shear occurs at an altitude high enough for the pilot to complete the recovery (just past the final approach fix, for example).

As the aircraft passes through the shear level, airspeed and lift are lost. The aircraft starts to sink and drops below the glide path. The pilot sees this as a deviation and corrects with increased pitch and power. Very often the correction is too large, and the aircraft overshoots the desired airspeed and glide path. However, since there is sufficient altitude to correct, the pilot is able to land safely.

Figure 2 illustrates the situation where the shear encounter is farther down the glide path. Reaction time is more critical. Again, the initial reaction of the aircraft to the shear and the pilot's correction are the same. But, in this case, if the pilot overcorrects and the aircraft goes above the glide slope and airspeed increases sufficiently, there is insufficient altitude to recover, and the aircraft may land long and hot.

The case in Figure 3 is the most serious. When the altitude of the encounter is too low to effect a recovery or the shear itself is sufficiently strong to overcome the aircraft performance, the aircraft lands short.

A decreasing tail wind has the opposite effect. When the aircraft crosses the shear plane and loses the tail wind, lift increases and the aircraft climbs above the glide path. As in the head wind case, the pilot's reaction can mean an overcorrection. The worst case here is the one similar to Figure 2. There the overcorrection leads to a transition to below glide path, but without enough altitude to correct. This is the classic high sink rate, hard landing.

The most hazardous form of wind shear is that encountered in thunderstorms. The severe, sudden wind changes can exceed the performance capabilities of even such sophisticated aircraft as the F-16. There have been numerous documented cases of aircraft mishaps directly related to encounters with thunderstorm wind shear.

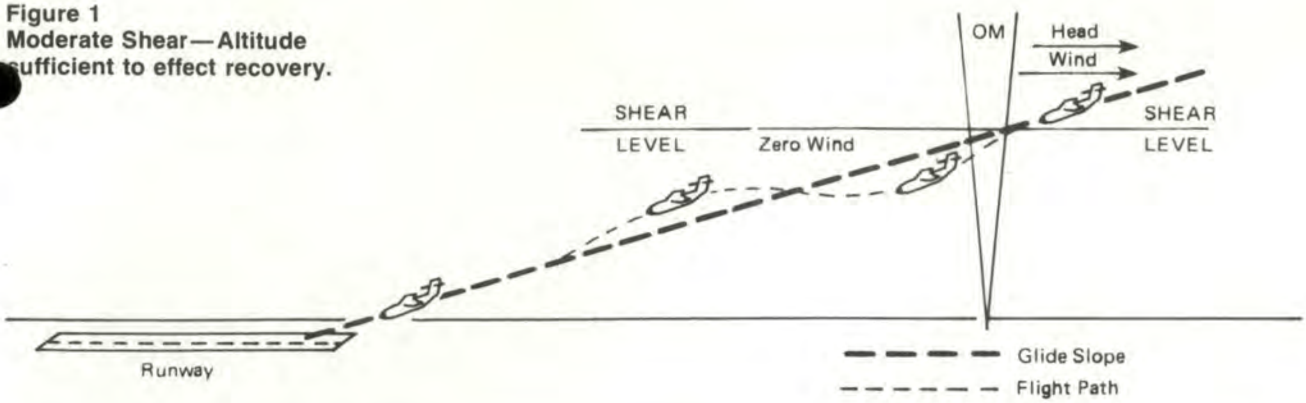
Wind shear is one of the "occupational hazards" in flying. The best way a pilot can cope with a shear is to:

a. Know it is there.

b. Know the magnitude of the change.

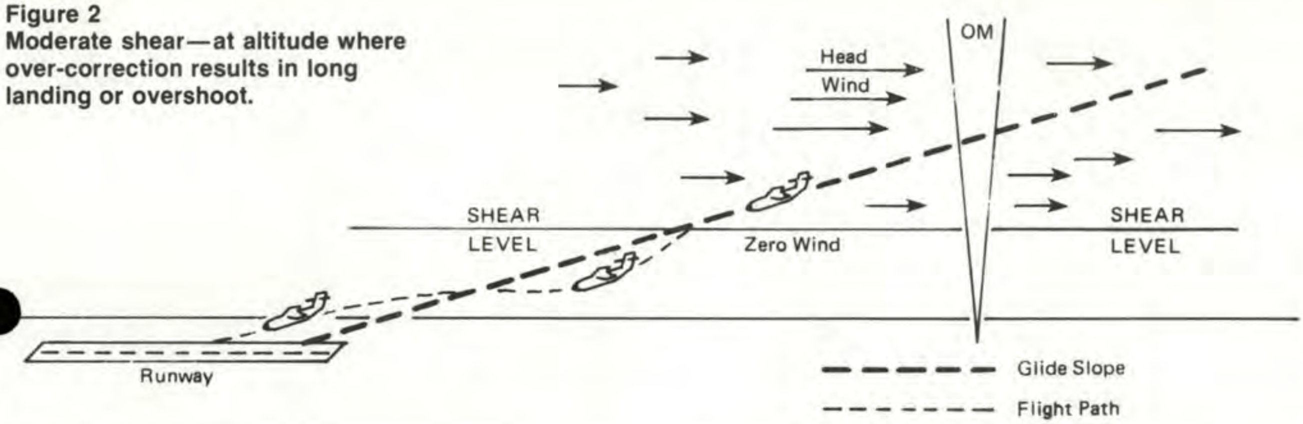
c. Be prepared to correct or go around.

Figure 1
Moderate Shear—Altitude sufficient to effect recovery.



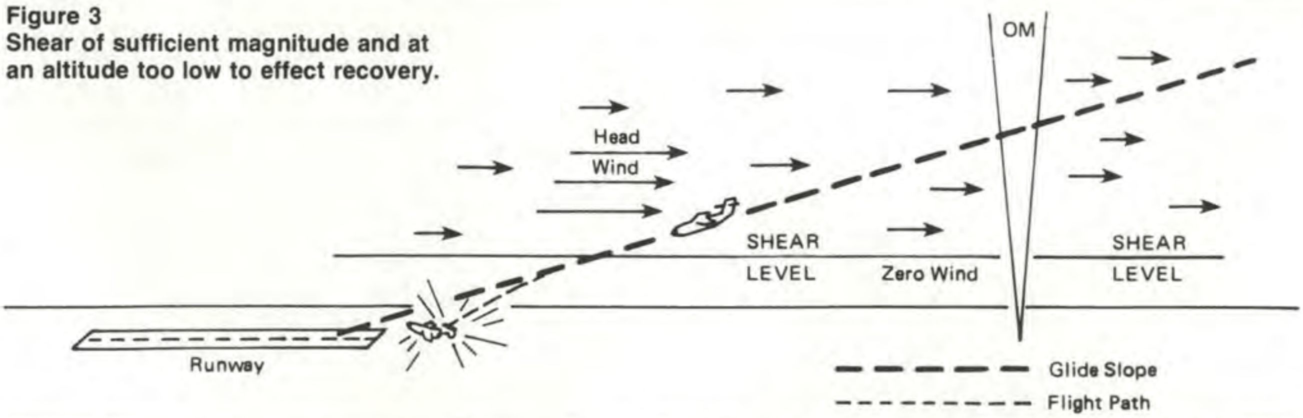
- Loss of indicated air speed is equivalent to shear value.
- Lift is lost, aircraft pitches down, drops below glide slope.
- Pilot applies power to regain speed, pulls the nose up and climbs back to the glide slope.
- Probably overshoots the glide slope and target air speed but recovers and lands without difficulty.

Figure 2
Moderate shear—at altitude where over-correction results in long landing or overshoot.

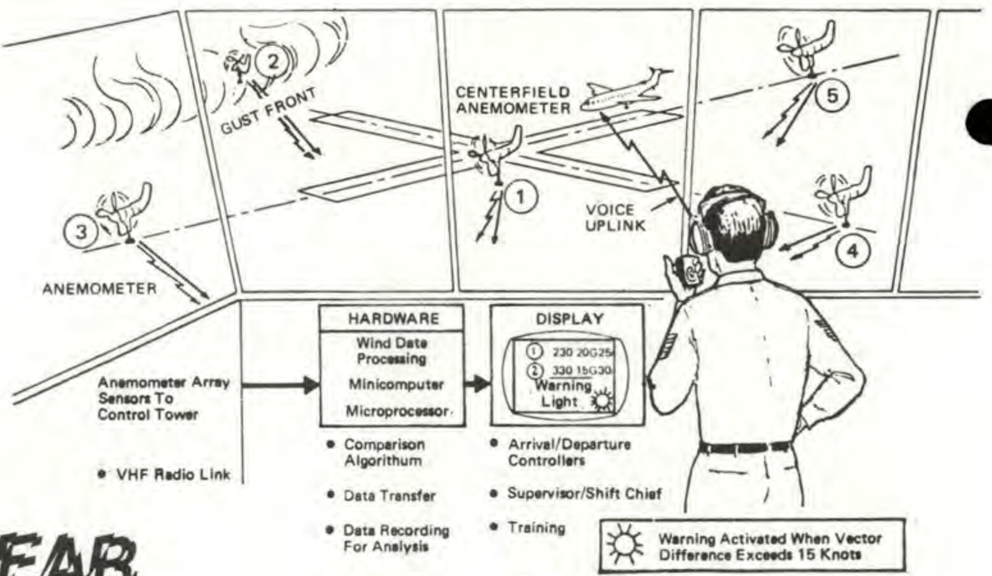


- Loss of indicated air speed is equivalent to shear value.
- Lift is lost, aircraft pitches down, drops below glide slope.
- Pilot applies the power to regain speed, pulls the nose up to climb back to the glide slope. Nose up trim may have been used.
- When airspeed is regained, thrust required is less than required for the previously existing head wind.
- Thrust is not reduced as quickly as required, nose-up trim compounds the problem, airplane is climbed back above glide slope.
- Airplane lands long and fast.

Figure 3
Shear of sufficient magnitude and at an altitude too low to effect recovery.



- Loss of airspeed is equivalent to shear value.
- Lift is lost, aircraft pitches down, drops below glide slope.
- Pilot applies the power to regain airspeed, pulls nose up to climb back to glide slope, engine spool-up requires time.
- Aircraft is in high drag configuration, altitude critical, increase in angle of attack produces only a slight or momentary increase in lift accompanied by a tremendous increase in drag as the maximum value of the lift/drag ratio is exceeded. The result is a momentary arrest of the descent with decreasing air speed followed by a large increase in an already high descent rate.
- Pilot's only hope is to pull on the yoke and push on the throttles.
- Pilot action is too late, aircraft crashes short of the runway.



WIND SHEAR

Part II continued

Figure 4 **Low Level Wind Shear Alert System concept.**

The key is information. The more information the pilot has, the better chance a timely decision can be made. The FAA is working hard to develop a better system to alert pilots to the presence of wind shear.

One such program is the Low Level Wind Shear Alert System. This system is currently being installed at commercial airports around the country. Figure 4 shows a sample installation. The remotely located anemometers (typically 5) send wind direction and speed information to the central computer. The computer compares the inputs for each remote location with that of the centerfield anemometer (no. 1 in Figure 4). If the vector difference exceeds a certain value, the system triggers a warning light in the tower and displays the wind information for the tower controller. The threshold is currently set at 15 knots, but can be changed for individual airports. Once the warning is displayed, the controller can advise the pilot of the differing information.

There are some limitations to the system. It cannot detect vertical shear. Further, it merely reports variations in wind heading and direction. The pilot must decide whether the data presented represent a hazard to the aircraft and what action to take (continue the approach, go around, etc.).

Finally, this system is currently installed only at civilian airports. However, as the system is further tested, and if it proves to be truly effective, those of us in military aviation may see some benefit as well.

Wind shear is a common problem for aircrews. We cannot avoid it, but with knowledge and forewarning we can cope with it when it occurs. ■

How To Become An OLD PILOT

■ Brian Trubshaw gave some advice when asked how to become an old pilot. His answers may give you some clues on how to finish every sector smelling of roses:

Be suspicious: Don't take anything on trust. Ask.

Be prepared: Know your emergency procedures. Assume you *will* lose an engine at a critical phase of flight; know in advance what you can do. Assume your destination weather *will* be below minima; know what you will do and where you will go.

Be professional: No one ever flies as well as they ought to all the time. You can always do better. Stick to your standard operating procedures. If you deviate, know why and what you are doing. If you are not happy with the approach, carry out a missed approach procedure.

Don't be over-confident: The day you have all the answers, either retire or start worrying. Nobody has all the answers, we all have something to learn.

Don't be afraid to admit an error: No one is perfect. If you think you have made a mistake, report it. You may be helping someone else avoid the same error. ■

– Courtesy *Flight Safety Focus.*

SPECIAL HANDLING

■ Have you done any VFR flying lately — —perhaps to the range or on a local training flight? If you did, and ATC assigned you a special VFR code, you may have thought that you were receiving special handling by ATC. Or worse, you forget that you are VFR and don't maintain VFR cloud clearance criteria. Here is what can happen in such a case:

After a VFR takeoff, we obtained an IFR clearance, and began our climb to Flight Level 370 bound for points north.

During the climbout, we entered a layer of fairweather cumulus clouds which appeared to be about three or four thousand feet thick. At the instant we broke out of the north side of the clouds we were face-to-face with about 25 passenger windows that were attached to a commercial jet. In my 14,000 hours of flight time, I've never come closer.

The air traffic controller working our flight told us that the commercial jet was on a training flight and was squawking a VFR code that could not be interrogated and displayed on the controller's scope.

It seems that when you're operating VFR, but talking to ATC, and are assigned a special transponder code instead of the normal 1200 that we associate with VFR operations, you are not getting special handling. Yes, when you are told to "squawk 0450" it may seem that you've been issued a clearance, but that is not what is happening.

What ATC has accomplished, in this case, is to set your transponder up to be interrogated should ATC desire to do so. In high traffic areas, a controller's block of airspace may be well filled with only the IFR "targets" which are his responsibility; thus VFR "targets" are deselected on his radar to prevent saturating his scope with data blocks and obscuring his primary responsibility, IFR traffic. Thus, when you plow through a block of controlled airspace with your transponder set to its special VFR code, you may be invisible to ATC; a controller will only "see" you if he or she decides to select VFR targets in addition to the IFR targets.

In this case, it may seem that you can lounge back (mentally) and attend to those detailed conversations typical of training flights. You cannot. You are on your own, and no one is looking after you. You are not special; you're just one of the crowd. ■

—Adapted from FSF *Accident Prevention Bulletin*.

YOUR MASK

MAJOR ROGER W. PAGE
Asst Chief of Aerospace Physiology
HQ Air Force Medical Service Center
Brooks AFB, TX

We often blame complacency when accidents occur, but once in awhile the cause is lack of knowledge or perhaps the inability to retrieve a small piece of information, which, if available, would have changed some action. Like how many clicks on the bayonet fitting is enough?

■ There are few of us who enjoy the feel of an oxygen mask, but intellect, regulations, and, in some cases, experience, all combine to remind us of its value. Some of us even wear the mask properly—that is, snug to the degree that it won't leak under pressure. There are those who wear it just snug enough so it won't slide down during high G to mash the soft cartilage at the end of the nose. Then again, perhaps some feel that it isn't expected to seal properly until there is a really good sheen of oily sweat on the face.

If you feel that the snug fit of the O_2 mask isn't really important, if you're confident that the mask, valve, connectors, regulators and O_2 storage/supply apparatus will work without much attention, and if you think hypoxia symptoms will always be clearly evident to you, the value of your oxygen mask is becoming questionable.

Our physiological makeup is such that our bodies expect a certain amount of oxygen to be available. When we exceed or receive less than the appropriate amount, our bodies are likely to make inappropriate responses. The oxygen regulator is engineered to provide the proper amount of oxygen, dependent on altitude, but if the mask isn't worn properly, the crewmember will not receive the appropriate amount.

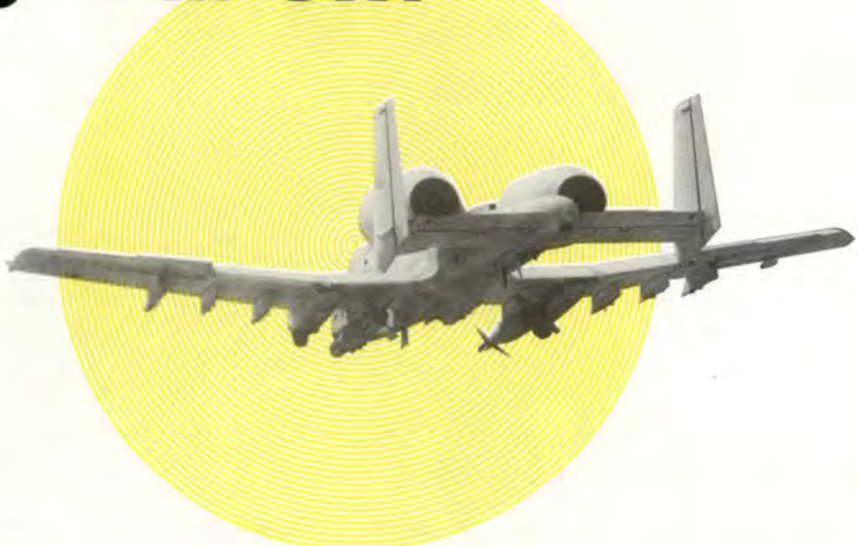
Studies by Lt Col Paul Sheffield at the USAF School of Aerospace Medicine, USAFSAM/HM, have shown that a proper mask fit will result in as much as 50 percent greater tissue oxygen levels than a poor fit when breathing 100 percent O_2. This makes the integrity of the mask and mask fit a very critical link in your oxygen system.

Because of the insidious nature of many hypoxia symptoms, the individual may not be aware of reduced effectiveness. You may recall from your last Aerospace Physiology refresher course that some of your symptoms in the altitude chamber were subtle and that visual ability is the first area affected. The following characteristics occur with lower than normal O_2 levels before most individuals approach the limit of the time of useful consciousness:

- Slow mental processes.
- Sluggish response to visual and aural stimuli.
- Impairment of night vision.
- Heterotropia may occur (one eye deviates while the other fixates).
- Accommodation (ability of the eye to adjust to see at various distances) powers decrease.
- Increased rate of breathing.
- Judgmental errors occur.

The mask fit is one of the critical areas that will affect your ability to perform. Make sure this isn't a critical link in a series of problems that could lead to an accident. Ensure that your mask fits properly. NOTE: If you have a terribly uncomfortable mask, you may request that a custom mask be constructed at the Wright-Patterson Aerospace Physiology Unit. Check with your life support shop to see if you qualify. ■

I'm OK?



MAJOR JOHN E. RICHARDSON
Directorate of Aerospace Safety

■ The A-10 mission was to be a combination range/air refueling mission with an SEFE as chase to complete a couple of instrument approaches for the pilot's annual instrument check. Things did not start out very well.

The first aircraft had to be aborted for a malfunction. Then, after making the second take off, the flight made an instrument approach to another base and then headed for the range.

The A-10 pilot had no trouble with the PAR, but enroute to the range he felt that his aircraft control was "a little rough," and he had some spatial disorientation when he entered IMC.

The SEFE was forced to go lost wingman in heavy clouds. After this, the lead pilot missed several radio calls. The range was unworkable, so the flight rejoined VMC and exited the range. During the exit, the lead pilot continued to have difficulty. He found it "hard to think" of what to say or do. Instrument flying required all his energy, and he tended to fixate on a single instrument.

The pilot's performance continued to deteriorate, and when he would not respond correctly to the SEFE, the evaluator declared an emergency and began directing the pilot. Even after going to 100 percent oxygen, the pilot still had difficulty. Flight control required maximum concentration.

After landing, the pilot stated that during flight *he did not recognize that he was having a physiological incident*. Even when being directed to landing by the SEFE, the full seriousness of the situation didn't sink in. He felt satisfied, detached, and not at all worried.

Like so many physiological episodes, an exact cause could not be determined, but either contamination from an unknown source or a form of hypoxia are the most likely candidates.

The important point in this occurrence is the subtlety of the symptoms. The pilot failed to recognize his symptoms and so was unaware of the problem. Fortunately, the wingman was alert and prevented a much more serious mishap.

How long has it been since you reviewed your physiological symptoms? Would you be able to recognize a problem? ■

Good Grief

■ The active runway was 19. My former flight instructor was sitting in the back seat and my almost new instructor was in the right front seat. Both instructors are real kidders and practical jokers. During an ILS Runway 1 approach jokes were told and we were talking back and forth pretty freely (me under the hood). I started a Non-Directional Beacon Runway 1 approach; at the Outer Marker I was about ¼ mile east of course. Tower then said (I thought), "Turn right at Missed Approach Point for a circle to land on 19," as we had requested. While trying to get back on course, both instructors were talking about my being off course, my descent to MDA, heading, etc. Anyway, afterward I talked to the controller and both instructors and this is what the tower said, about one mile north of the Outer Marker: "Turn right." I did not acknowledge the transmission from the tower; I was just too worked up by the instructors and with getting back on course, and I guess I just didn't hear the controller say, "Turn right, traffic departing 19. Turn right NOW!!"

At this time the instructor in the back seat said, *"Push the nose down; we're going to hit that airplane."* The instructor in the right seat then pushed the control yoke full forward and most everything in the airplane hit the ceiling. We passed about 180 feet under the airplane, who never saw us. We then circled left to land. ■

—Courtesy NASA *Callback*.

OPS topics

Late Go

■ The pilot didn't have much time in the Cessna 172. But it wasn't too bad a day, so he decided to take two friends on a trip. The proposed landing field was a grass strip a bit over 2,000 feet long. There had recently been a rain storm over the field and the runway was wet. The pilot planned a short field landing but landed long and bounced twice. The aircraft finally stayed on the ground about halfway down the runway. The pilot began raising the flaps but as he got them to about 25-30 degrees, he decided that he was going too fast to stop. So with about 600 feet to go at 40 knots the pilot added power, but failed to set the flaps. The aircraft came off the ground about 10 feet from the end of the runway, flew across a ditch at the end of the field, but failed to clear the 3-foot high embankment on the other side. The nose gear separated on impact, but the pilot was able to recover and keep the airplane flying. The aircraft returned to home base and landed without further damage.

Are *You* Prepared?

As the aircraft started to fall behind during a wing take off, the F-15 pilot confirmed that the left AB was not lit. He then continued a single ship take off but, shortly after lift off, the right engine stalled and stagnated.

Forced to shut down the right engine for an overheat after the stall, the pilot was then faced with a thrust limited situation. But after jettisoning the centerline tank, he was able to make a successful landing.

The pilot stated that he was not mentally prepared to handle an emergency as serious as this on take off. He felt that engine failure on take off was not a big problem in the F-15. He had not practiced emergencies of this nature during simulator or cockpit trainer missions.

Sometimes a little thought about "what would I do if?" and some simulator practice can slow the development of gray hair in young pilots (until they become old pilots).

Monofilament Aileron Roll

How would you like to be on final for a straight in approach and have the aircraft roll upside down? It happened to a T-38 pilot recently, and it was caused by his clipboard. It seems the pilot had attached the clip so the monofilament that attaches the clip to the board formed a loop. While the pilot was moving his leg, the loop went over the top of the stick and hung up on the trim button. Next time he moved his leg away from the stick, the loop pulled the stick and trim button to the side. The aircraft rolled, the pilot recovered. He discovered the hazard and told the flying safety officer. The flying safety officer began to tell other people and found out a number of them knew of the problem or had a similar experience in their background. The solution is to put the clip on the other way so the monofilament does not form a loop.— Adapted from ATC *Approach to Safety*.

Ricochet

As the F-4D started a right climbing turn to rejoin after a strafe pass, the crew heard a loud bang and felt severe vibrations from the left engine. The investigation discovered FOD, caused by a metal object which closely resembled a 20mm projectile. The flight was well within the prescribed limits and should have been "safe" from ricochet damage.

Flameout

On a routine mission, the CT-39 was level at FL 390 and trying to avoid thunderstorms over West Texas. The aircraft encountered moderate turbulence and the airspeed decayed to around 170 knots. At this point, the right engine compressor stalled and flamed out. The crew returned to the departure base and made a safe landing. A combination of high angle of attack, turbulent airflow, and high power settings set up the conditions for a flameout.

Canopy Away!

Several times during the past year, passengers in fighters have blown it—literally. Most recently, an AFA cadet was a pax in an F-4 for an orientation ride. Upon their return, the IP started the after landing checklist, the cadet responding for the back seat. The cadet was a bit unsure of himself and the IP was directing him as to the location of various switches and handles. Apparently there was a communication gap because there was a bang and away went the canopy.

There were two things about this mishap that provide good lesson material. For one, the cadet had received egress training 12 days earlier and general cockpit orientation 4 days before the flight. It's too much to expect that the cadet could remember the location of every switch and handle. Second, it was the cadet's recollection that the IP, in directing him to the canopy actuator switch, referred to it as a *handle*. That's what the cadet pulled that sent the canopy on its way. Better to learn from this mishap than have one of your own.

Not His Day?

Sometimes it seems that someone up there has it in for you. No doubt the pilot in the following narrative felt that way. Flying an A-37, he attempted a TACAN approach but had to make a missed approach due to rain and heavy turbulence. Then while he was being vectored to a PAR approach, lightning knocked out the PAR. RAPCON then sent him to a holding fix, but lightning shut down the TACAN.

This aircraft was one of a flight of three that separated for individual approaches. Now RAPCON confused the call sign and positions. Our pilot declared minimum fuel, but RAPCON vectored him off final for spacing. He then requested clearance to an international airport, but was told to stand by. At that point, he was down to 600 lbs of fuel. Then he flew into the clear, spotted a small airport with 3,200 feet of blacktop and no overruns. He could see a wall of thunderstorms between him and home, so he decided to land.

Because of electrical disturbances, he couldn't get the SOF. The approach was over 30 - 40 foot trees, light rain, and a direct crosswind. He didn't quite get off scot-free.

The runway was short and wet, and the approach was a little high because of the trees. He ended up 200 feet off the end with only minimal damage to the aircraft. It was his day, after all.

Dead End

One of the worst traps a light plane can get into is a box canyon with rising terrain. An unsuspecting pilot flies into the canyon at low AGL, climbs to stay above the ground (trees, rocks, etc.), loses airspeed, can't climb out, tries to turn—splat!

An Aero Club pilot recently played out that scenario. He was lucky; he got only a broken leg, and his passengers were not injured. What he didn't know when he flew into the canyon at about 50 feet above the trees was that many of his predecessors, including both Aero Clubbers and Air Force official flights, have ended in destruction of the aircraft and the death of pilots and passengers.

The next safety meeting would not be too soon to give Aero Club members a few minutes on the hazards of mountain flying, especially the danger of entering any canyon. Above the rim is better.

continued

Over G

When the F-15 came back after an air-to-air mission, maintenance discovered some damage, including wrinkled skin, buckled spar caps, and a cracked rear spar. The pilot was positive that he had not exceeded 7 Gs.

Investigation by maintenance confirmed the maximum Gs at 7. Nonetheless, the damage to the aircraft was classical over G damage of the type which relates to approximately 140 - 150 percent of design load limit.

Although the pilot was correct in that he never exceeded 7 Gs, he did exceed the G limits. If, during the first engagement, the pilot pulled 7 Gs instead of 4 - 5 as he planned, the unsymmetrical G limit of 5.2 is exceeded by the amount necessary to do the damage discovered.

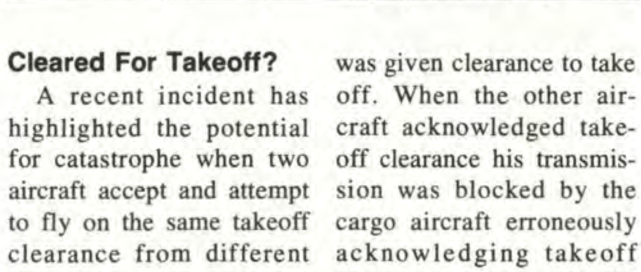
Test pilots testing the new overload warning system have discovered that it is very easy to overstress the F-15 without even realizing it.

Wrong Way Antenna

Every pilot knows that things can go wrong with his aircraft. An engine flames out, a gage goes crazy, the hydraulic system gets cranky. The list is almost endless. Okay, you expect those things. Now do you believe similar glitches happen in the other fellow's systems and that they could be hazardous to *your* health? Read on.

A KC was being vectored to intercept the localizer for an ILS. It soon became apparent that something was wrong. The controller's instructions did not put them where they should be. Fortunately, the weather was clear, and the crew could see the terrain. It was then established that the controller's scope indicated the aircraft was northeast of the outer marker while the crew could see ground references that showed they were northwest of the OM.

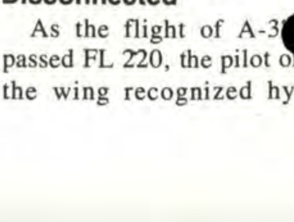
The radar equipment had malfunctioned, the azimuth shifting 90 degrees from its synchronized position. That meant all video returns were 90 degrees off. Be wary. The life you save may be your own.



Cleared For Takeoff?

A recent incident has highlighted the potential for catastrophe when two aircraft accept and attempt to fly on the same takeoff clearance from different runways.

A military cargo aircraft was cleared "into position and hold." Another aircraft with a like call sign was given clearance to take off. When the other aircraft acknowledged takeoff clearance his transmission was blocked by the cargo aircraft erroneously acknowledging takeoff clearance. The tower did not question the blocked transmission because they observed the other plane taking off. When the cargo aircraft was observed taking off from another runway, the tower questioned the cargo aircraft's movement/take off. The aircraft commander, recognizing confusion and a potential mishap, aborted the take off. He had exercised outstanding judgment by aborting the take off when the tower had questioned his take off roll. The possibility of a serious mishap was averted. — Courtesy 834 Airlift Division.



Disconnected

As the flight of A-3 passed FL 220, the pilot on the wing recognized hypoxia symptoms. He informed lead and started an emergency descent. When the pilot selected 100 percent and Emergency on the oxygen regulator, he felt no increased flow to the mask. Then, checking his connection, the pilot discovered that the oxygen mask hose was not connected to the CRU-60/P connector. After the hose was reconnected, the hypoxia symptoms rapidly disappeared.

Because the disconnect occurred at the bayonet fitting and not the quick release, the flow restriction feature of the CRU-60/P was not available to warn the pilot of the disconnect. During preflight, the pilot did not turn the bayonet connector far enough to positively lock it in the CRU-60/P.

Such a situation would pass a regulator check, but could become disconnected by normal body movements in flight. The suggested check is a twist and pull rather than a straight pull. ■

New SURFACE-TO-AIR Visual Signal Code For Survivors

■ The International Civil Aviation Organization (ICAO) and the Intergovernmental Maritime Consultative Organization (IMCO) have jointly adopted a new, and simplified, set of signals for use by survivors when signaling to aircraft. The new signals are only five in number, replacing a long standing group of eighteen signals. ICAO will incorporate the new code in Annex 12, Search and Rescue to the Convention on International Civil Aviation. IMCO will include them in the first amendment to the IMCO SAR Manual—the basic manual will be issued shortly.

The amendment to Annex 12 became effective on 15 April 1981 and the signals will become applicable for aeronautical use on 26 November 1981.

The following figure shows the old signals and the new. ■

—Courtesy *On Scene* The National Maritime SAR Review

No.	Message	Code Symbol
1	Require doctor - serious injuries	I
2	Require medical supplies	II
3	Unable to proceed	X
4	Require food and water	F
5	Require firearms and ammunition	V V
6	Require map and compass	□
7	Require signal lamp with battery and radio	I I
8	Indicate direction to proceed	K
9	Am proceeding in this direction	↑
10	Will attempt take-off	I>
11	Aircraft seriously damaged	L⌐·
12	Probably safe to land here	Δ
13	Require fuel and oil	L
14	All well	LL
15	No	N
16	Yes	Y
17	Not understood	JL
18	Require engineer	W

No.	Message	Code Symbol
1	Require Assistance	V
2	Require Medical Assistance	X
3	No or Negative	N
4	Yes or Affirmative	Y
5	Proceeding In This Direction	↑

☆U.S. Government Printing Office: 1981-214/11

UNITED STATES AIR FORCE

Well Done Award

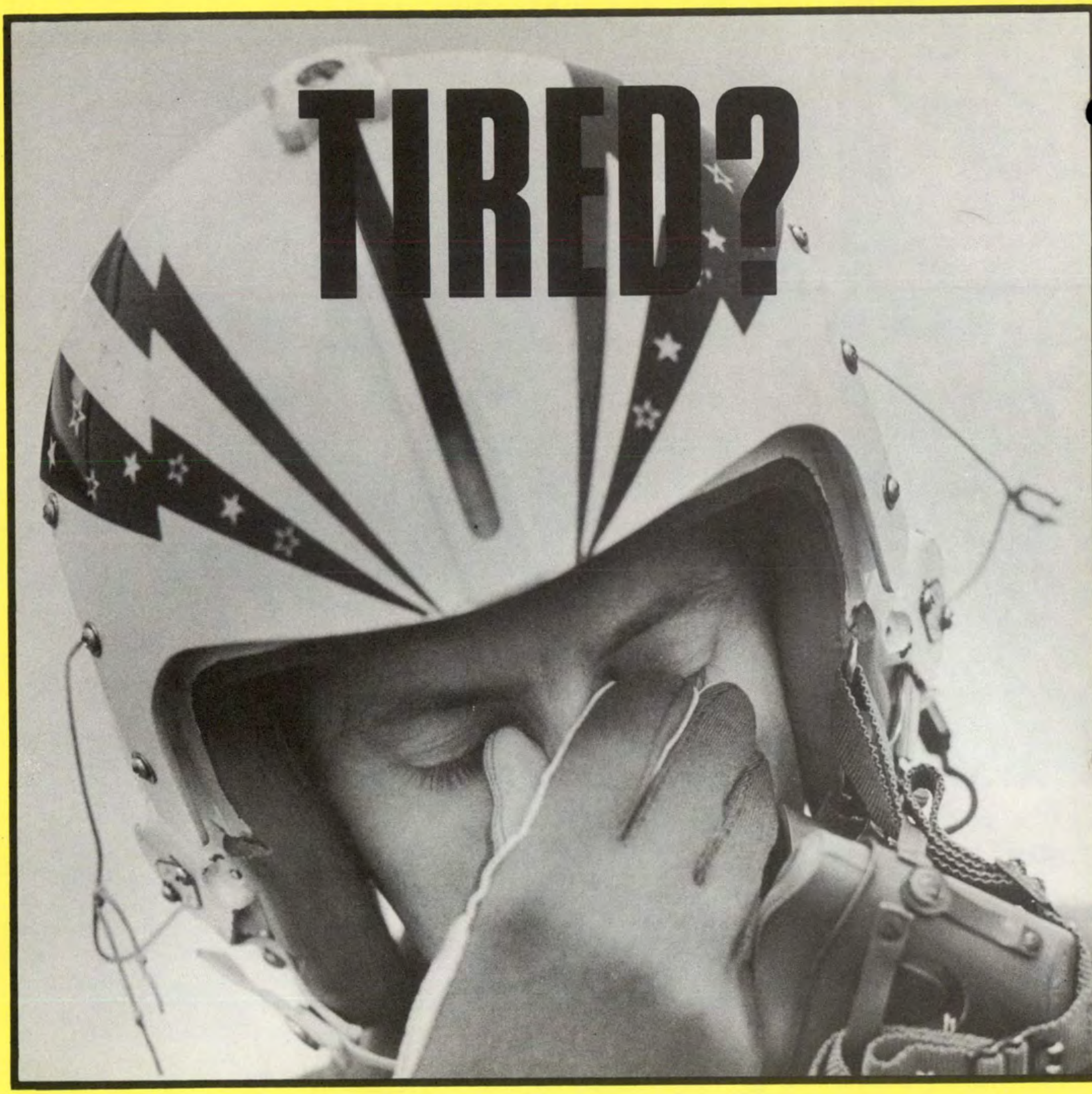
Presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Accident Prevention Program.

CAPTAIN

Gary L. Kopren

388th Tactical Fighter Wing
Hill Air Force Base, Utah

■ On 3 December 1980, Captain Kopren was leading a flight of two F-16As on a night air refueling and surface attack mission. Shortly after refueling, while enroute to the gunnery range in IMC conditions, Captain Kopren's aircraft developed a severe angle of attack sensing problem that resulted in a violent rolling pitch-up to an inverted out of control rotation which forced Captain Kopren against the canopy. While straight-and-level with his wingman in close formation, Captain Kopren's first indication of a malfunction was increased pitch control sensitivity combined with a dual flight control failure warning light. He quickly checked the caution light panel and advised his wingman of his indications. Almost immediately thereafter, his aircraft pitched up, rolled, and entered an inverted rotation. Captain Kopren's timely advisory call quite possibly prevented a midair collision with his wingman. Captain Kopren riding an out-of-control aircraft in an inverted rotation at night in IMC, analyzed his altitude and concluded that time was available for a recovery attempt prior to ejection. He checked throttle response to ensure proper engine operation and applied a flight control input which returned the aircraft to an erect attitude. Now in an upright rotation, Captain Kopren again assessed altitude and elected to pursue the recovery. He applied forward stick which stopped the rotation, lowered the nose, and permitted him to obtain flying airspeed. During this phase, he broke out of the weather and recognized he was descending into a valley bordered by mountain ranges. Captain Kopren carefully brought the aircraft to controlled flight and returned to Hill AFB for an uneventful landing. Captain Kopren quickly and accurately assessed a most difficult situation, and recovered his aircraft from an inverted, out of control condition in the weather at night. WELL DONE! ■



check for:

- **Short attention spa**
- **Visual illlusions**
- **Decreased perfomance standrds**