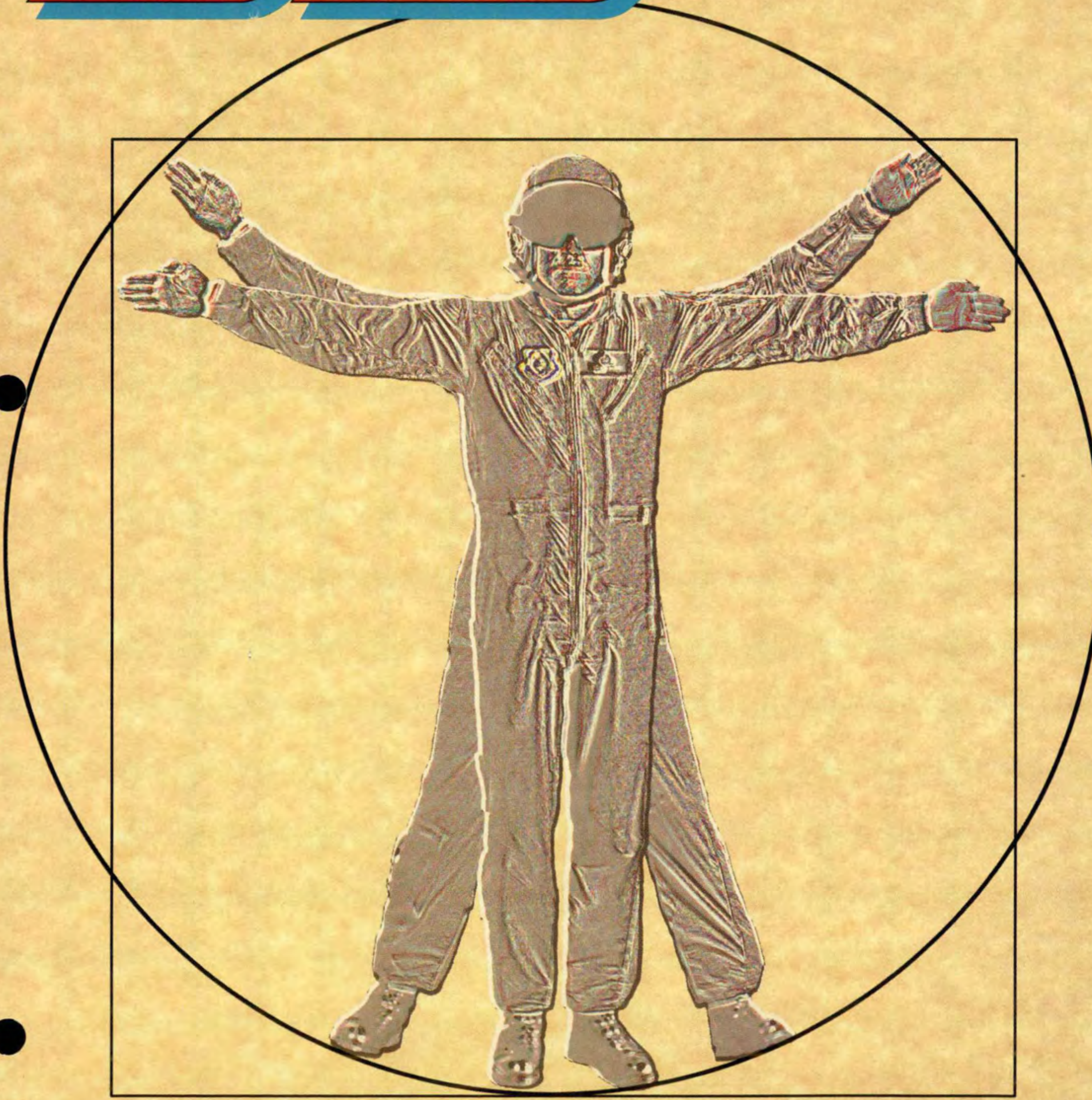
JULY 1997

flying SAFETY

The Issue:

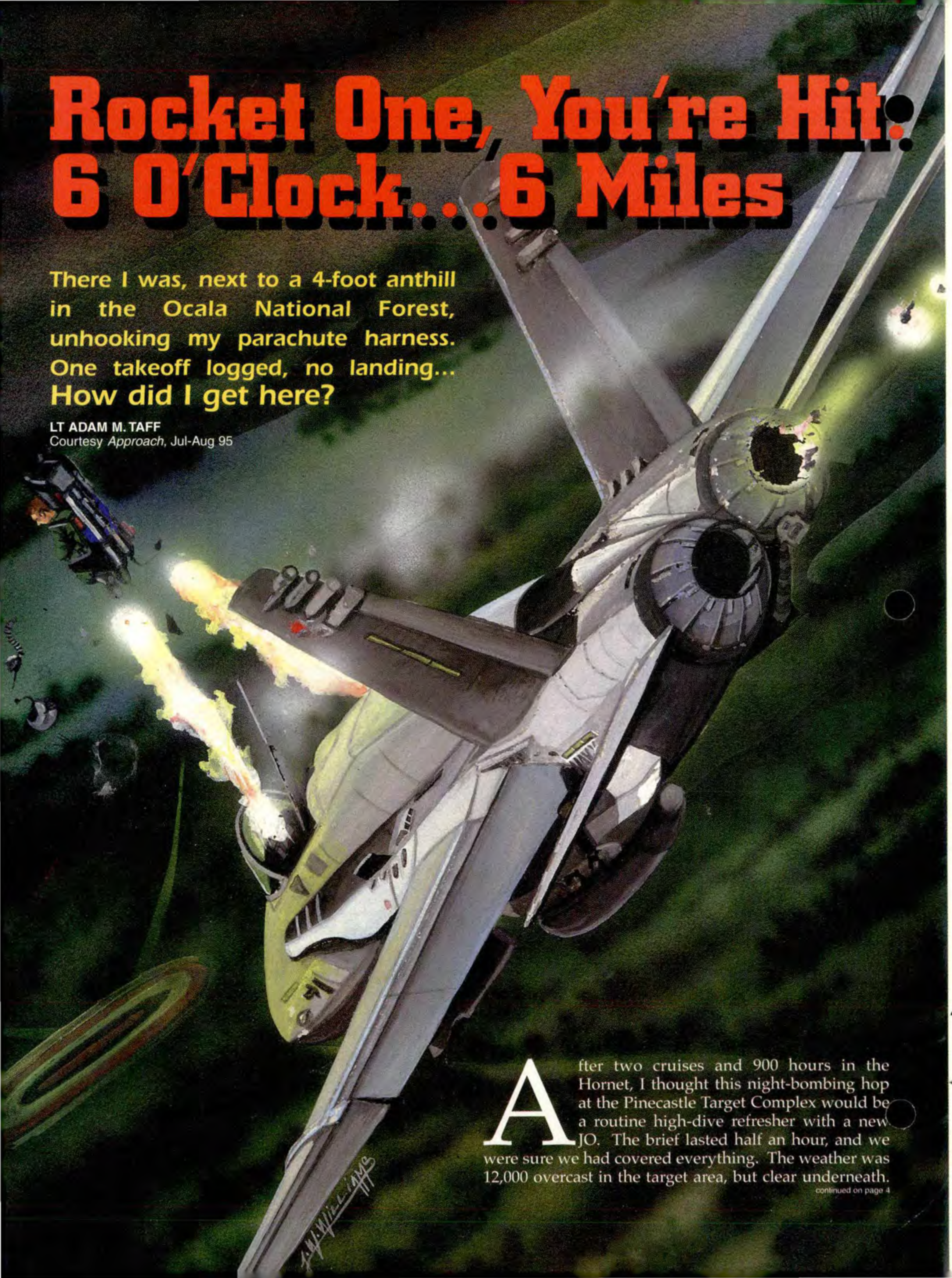


HUMAN FACTORS

Rocket One, You're Hit: 6 O'Clock...6 Miles

There I was, next to a 4-foot anthill in the Ocala National Forest, unhooking my parachute harness. One takeoff logged, no landing... How did I get here?

LT ADAM M. TAFF
Courtesy *Approach*, Jul-Aug 95



After two cruises and 900 hours in the Hornet, I thought this night-bombing hop at the Pinecastle Target Complex would be a routine high-dive refresher with a new JO. The brief lasted half an hour, and we were sure we had covered everything. The weather was 12,000 overcast in the target area, but clear underneath.

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Cover concept, photograph and electronic wizardry by MSgt Perry Heimer
Model: CMSgt Don Bennett

SPECIAL FEATURES

REGULAR FEATURES

CONTRIBUTIONS
Contributions are welcome as are comments and criticism. No payments can be made for manuscripts submitted for publication. Call the Editor at DSN 246-0936 or send correspondence to Editor, *Flying Safety* Magazine, HQ AFSC/PA, 9700 G Ave., S.E., Ste 282, Kirtland Air Force Base, New Mexico 87117-5670. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning.

Range time was 15 minutes after sunset. Because of the overcast layer, we expected our night vision would be mediocre as we adjusted to the darkness.

We launched on time and quickly reached 11,000 feet for the 10-minute trip to the target. After check-in with Pinecastle Control and Pinecastle Target, we were cleared onto the range for a cold ID pass. I descended from abeam the bull's-eye at 11,000 feet to an extended 2-mile run-in at 3,000 feet.

After a winds-aloft check and an "armstrong" call to my wingman, we passed the bull's-eye at 350 knots, heading 317 degrees. I could still barely make out the 50-, 100-, and 150-foot rings surrounding the target, and I could now see the 12 and 6 o'clock run-in lights.

"One's breaking," I said, and began a mil-powered climbing left turn to the briefed abeam altitude of 10,000 feet. Four seconds later, my wingman called, "Two's breaking."

Suddenly, a loud explosion violently shook my Hornet. I instinctively shallowed my climb attitude. Within a second of the explosion, I heard, "Engine right, engine right," sounding in my headset. A glance at my left DDI showed an R ENG STALL warning. I smoothly retarded my right throttle to idle and radioed to my wingman, "Stand by, Lucky, I'm having engine problems."

As I spoke, the right engine rolled back below flight idle. I raised the finger lift on the right throttle to shut off the engine, but the voice warning suddenly blurted out the three words 99.9 percent of Hornet pilots hear only in the simulators: "Engine fire right, engine fire right."

I quickly retarded the right throttle to OFF and pushed the right engine fire light.

"Lucky, I have a right engine fire light. I've shut down the engine and pushed the fire light. Come check me out."

Without hesitating, he replied, "You're still on fire!" For just an instant, I admonished myself for not instantly pushing the fire extinguisher ready light after pushing the fire light. Too many messages had addressed the fact that with any secondaries present, the ready light should be pressed, and I had secondaries! In reality, it was less than 10 seconds from "Engine fire right" to the time I pushed the ready light.

I didn't know my wingman was now emphatically calling for me to eject. It was 40 seconds since the explosion, and I floated for just a moment with an ejection handle tightly grasped in my left hand.

Later, I would discover that a titanium blade from the first stage of the high-pressure compressor had suddenly failed, most likely lodging among the other blades, resulting in incredible titanium-on-titanium friction. The result was a massive compressor stall and a 5,000-degree molten titanium fire that extended as far aft as the afterburner section of the engine. My wingman had seen a brilliant flame engulf the aft starboard section of the aircraft, extending twice the length of the Hornet.

Pushing the fire light and the extinguisher-ready light had killed the large flame. However, the heat from the titanium fire melted through the engine casing and firewall and into the critical area between the engines where the stabilator flight-control actuators and hydraulic lines were located.

I leveled off at 7,000 feet and 304 knots. At this point, I was convinced I would limp back to Cecil Field for a single-engine arrested landing. Continuing an easy left turn through south, I started to declare an emergency with Pinecastle Target.

"Pinecas..." was all I got out when the aircraft abruptly pitched down 10 degrees. I had never had a more unique and sobering feeling in an aircraft. For the first time during this ordeal, I felt real concern. I countered the pitch down with aft stick, and the aircraft appeared to stabilize, albeit nose down. I checked my airspeed to see if I had somehow lost SA and airspeed. I was still at 296 knots.

The aircraft dramatically pitched down to 40 degrees nose low, throwing me into the straps in a negative-G pushover. Once again, I instinctively pulled back on the stick. This time there was no response. I tried to trim the aircraft nose up with the stick-trim button, thinking that if the aircraft had transitioned to MECH (mechanical reversion), the nose would slowly right itself. I still thought I could save this airplane. But the aircraft again pushed over to approximately 60 degrees nose down, disregarding any of my inputs and throwing me more forcefully against the canopy. This was not good.

"Lucky, I'm out of control," I exclaimed as the aircraft accelerated toward the ground.

"Roger, you're passing 5,000 feet," he called.

That last statement flipped a circuit breaker inside me. I had to eject—now! Thirty-five seconds had passed since the explosion. I reached down between my legs to grasp the handle of my SJU-5 ejection seat. I couldn't reach it. I strained to get it with my left hand, then I took my right hand off the stick and reached with both hands. Still in a negative-G pushover, I was able to fish the handle up with my outstretched fingers. An instant later, I pulled the handle.

I didn't know my wingman was now emphatically calling for me to eject. It was 40 seconds since the explosion, and I floated for just a moment with an ejection handle tightly grasped in my left hand.

An ever-so-brief moment of wonder was erased by a brilliant red flash as the canopy jettisoned from the aircraft. As quickly as I could process the fact that the canopy had just blown, a freight train traveling 100 mph came roaring from below and thrust me into the muggy Florida sky. The fact that I continued to look down at the handle during ejection resulted in severe whiplash, though I wouldn't feel it for 2 hours. As quickly as I realized I was scorching through the sky in the rocket-propelled seat, I snapped to a violent halt as if on the end of a tether.

The force of the opening canopy was transferred not to my rear as in a "traditional" ejection, but to my torso and chest because of my position. I ejected at approximately 4,000 feet, 375 knots, and 60 degrees nose low. The aircraft hit the ground moments later, 90 degrees nose low at approximately 525 knots.

At first my descent was uneventful. I felt no pain, although my helmet (oxygen mask tightly affixed) had been ripped from my head. Approaching 500 feet AGL, I abruptly realized I was falling toward the earth at a rapid rate. Although it was getting darker, I could make out the huge trees below. The fear of getting kabobbed on a tree branch or breaking a hip or leg on landing became very real. Fortunately, at 200 feet, I knew I would land in a small clearing of smaller trees and bushes.

I deployed my LPU and hit with a hard thump that knocked the wind out of me. But I knew instantly I wasn't hurt.

I sprang to my feet and confronted a huge anthill. I moved my chute and gear 20 feet away to a small clearing. Within 30 seconds, I was talking to my wingman on Guard. I switched us to 282.8 and began to arrange the rescue. Lucky was well ahead of me and had two helicopters en route before I landed. Moments later, I heard a voice yell from the woods. Someone else was out there in the middle of nowhere. "We're coming!" I heard, and I replied, "I'm over here."

Fifteen minutes later, four figures appeared from the darkness. A man, his wife, and their two children were packing up their dirt bikes when they witnessed the entire event. After I graciously refused several cigarettes, they led me to a clear opening 100 meters away where an Air Force combat SAR helo picked me up 1 hour after ejecting. Another hour and I arrived at the Naval Hospital, NAS Jacksonville, with whiplash and a bruised heart, but otherwise fine. I was back flying in 2 weeks. ✈

Flying SAFETY

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This article is not an analysis nor a rigorous scientific "paper" nor a learned article. Rather, it is a few musings on a topic rarely heard in safety circles: the role of emotion in the mishap chain.

EMOTION—(Webster's)—a complex, usually strong subjective response...a state of agitation or disturbance...the part of the consciousness that involves feeling or sensibility. "Emotions won out over good sense." Yes, indeed. That is, we think, the essence of the problem in many mishaps.

Remember that popular book of a few years ago, Emotional IQ? It showed that emotions are just as important as cognitive ability in determining the success or failure of a person. Aviators are selected on factors that are highly correlated with cognitive ability. Emotions are normally well controlled by the successful aviator. Controlled, but not eliminated. Yeah, feelings. Aviators got 'em whether they like it or not!

The Subjective State

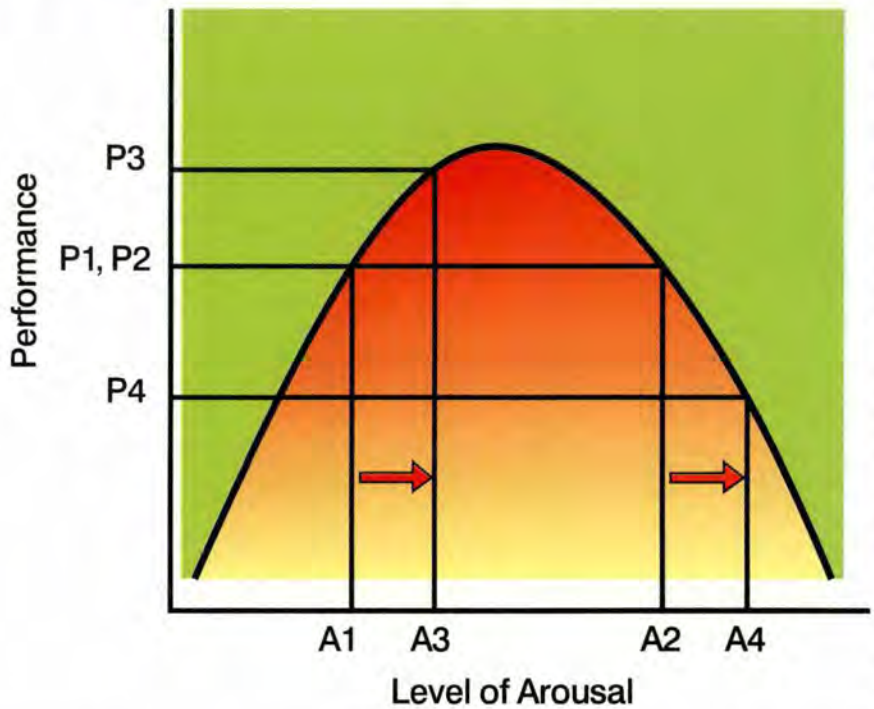
We believe that subjective states can materially contribute to mishap causation, compromise judgment during the mishap sequence, and affect survival, both positively and negatively. It is not easy to decipher the subjective states of the mishap participant. Yes, we think the aviator in trouble is rarely a passive spectator in his/her own demise. The workings, not only of the conscious, trained mind, but also of the subjective psyche, combine to determine the outcome of an emergency.

Much of mishap causation is attributed to suboptimal performance, to various categories of errors—loss of situational awareness, inappropriate action selected, lack of discipline, etc. The only emotional attribute usually cited is "overconfidence." A theoretical explanation for suboptimal performance does exist, however, derived early this century and generally accepted: the Yerkes-Dodson curve relating performance and arousal. (No, not that kind.) See the figure to the right.

Arousal is a state of alertness, a continuum from unconsciousness—through optimal focusing—to disabling panic. This theory supposes that performance is best at the pleasant top of the curve, in the middle. "Stress" is often inferred as a contributor to mishap causation, especially life stresses, be they subjectively negative (recent passover) or positive (birth of child). The theory is that stress increases distractibility, decreases attention, and generally reduces skilled performance. This curve points to the mechanism by which stress acts—by altering arousal. Further, it postulates that different personality types respond differently to a short-term workload stress. The relaxed extrovert climbs coolly up to the top when stressed, the anxious introvert slides dangerously down the far side. This is theoretically appealing, but not possible to prove. And in the USAF, we don't directly select aircrew by means of personality traits. Aviators, however, become experts at predicting what other aviators in their squadron will probably do in an emergency—whether the "pucker factor" or level-headed coping will prevail.

More importantly, this curve also offers insight into part of the contribution of complacency and overconfidence. The victim of complacency has allowed his/her talent and proficiency to reduce arousal to a suboptimal level. For instance, a senior instructor pilot who found himself sliding off the concrete. The student had blown a tire. Hours later, when asked why he had not steered or shut down the engine, he himself was mystified. He had, however, not been to the simulator in a year, and blown tire was not one of the usual emergencies practiced.

The level of arousal is not really an emotion. Rather, it is a psycho-physiological state that can alter, and be altered by, emotions. Whatever the personality structure, high proficiency may lead the best of us to a blissful state of blithe disregard. So is rapture, one of our sharpest subjective feelings, an accident facilitator? And what of its polar opposite, fear?



Fear and Anxiety

Fear is the stimulus for the "fight or flight" response to a life-threatening situation. It affects your place on the arousal curve instantaneously. In nature, fleeing danger is natural and highly recommended! But you are willing to cross the FEBA in combat and willing to stay with the jet in an emergency. Thus, fear is usually controllable. Remember, though, the origin of Red Flag: Aircrews were being lost at a very high rate during their first 10 missions in Viet Nam, then the loss rate dropped. Were they now on the optimal part of the above curve? Was fear no longer a detriment to their performance? Red Flag became the ultimate war simulator.

We believe fear alters the course of many peacetime mishap sequences. Most aviators have experienced some paralysis of cognition in an emergency. Overarousal does slow performance. Being afraid is not a sign of a coward. Rather, it's a rational response to an irrational situation.

Anxiety, on the other hand, is a response that is more intense than the situation warrants. Its extreme—phobia—is manifested by panicky avoidance of a situation which, cognitively, is not especially threatening. Aviating is inherently unnatural, inherently lethal. One highly regarded theory of adaptation to flying supposes that novice aviators develop a form of positive, adaptive denial to allow leaving the ground without experiencing fear. Aviators who develop a phobic "fear of flying" have lost some of this adaptive defense. And many aviators who have had a significant emergency, loss of a flying friend, or an ejection (up to 70 percent of ejectees in one analysis) must reconstruct the fear defense.

By the way, what about those bold aviators who seem to seek out dangerous situations, who seem to push the envelope? Well, they may actually be the most scared of all, engaging in dangerous behaviors to prove to themselves they aren't scared (we medical types call it "counterphobia"). We know of one guy who had to push his T-38 to 10 Gs. Turned out he did it to keep his mind off his almost irresistible urge to eject! As contrary to mission success as low motivation can be, overmotivation is just as detrimental. Ever know someone who just tried too hard?

And Many Other Emotions

If overconfident euphoria and abject dread are factors, what of other dimensions of feeling? Pride, that which goeth before a fall, also strikes often, mostly manifested as hesitation. We think the aviator's natural invulnerability leads to a form of instantaneous denial in an emergency. "This isn't happening to me. (I'm too good.) If I just exercise my usual superb skill and cunning, I can save this jet." Those thoughts ever flash through your mind? How about thinking that you own the sky and that others should look out for you, particularly those flying slower, inferior aircraft? Accident reconstructions invariably elicit disbelief in the investigators. Why didn't this talented crewmember act faster, act cooler, eject sooner? Pride, maybe masquerading as machismo, lurks not far from these mishaps. These are not just traits, by the way, of male aviators. Female aviators may also suffer from pride, maybe even more so, as it may be an extra burden to be first.

A cousin of pride and of anger, perhaps derived from the aviator's controlling personality type, is frustration. One workload research questionnaire actually uses this

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as a measured dimension. We have not seen it described as such by mishap boards, but a recent loss of a jet may illustrate. After the low fuel light came on, a seasoned pilot realized he hadn't checked his tanks after AAR. Much of the fuel on the gauge was unusable. Instead of swallowing his pride, declaring an emergency, and landing on the nearest suitable concrete, he spent at least some of his energy in remonstrating himself. Did his anger and frustration compromise his acutely needed capacity for clear thinking? We may never know for sure. How about the pilot who was so mad at himself for making the same "stupid mistake" again that he pounded his fists into the aircraft until his aircraft pounded into terra firma? He lived, and his emotional state afterward is unrecorded. Finally, how about the pilot who slammed his jet short of the runway after his estranged wife slammed the checkbook into the ground right before he flew?

One emotion worth considering, but not evident in USAF aviators, is the very absence of pride, fear, or anger—a sense of resignation. We have never read a report suggesting the accident participant willingly changed his/her role to victim as the emergency developed, but passivity is an expected personal emotion in other cultures. Too much automation may, in effect, make the aviator into a passenger who feels powerless to alter the course of events. Also, if it's done by a computer, who am I to second guess it? Well, guess what? We, as humans, are still smarter than any machine we build. Humans are able to maintain situational awareness, the big picture, while machines cannot. Those who fly highly automated aircraft still need to know what's going on, especially when something goes wrong. (Murphy lives.) Do you suppose we are now unconsciously selecting aircrew members who implicitly trust computers?

Never a cause of accidents, and more a kin to a phobia, is the feeling of extreme detachment known as the Breakaway Phenomenon. Some of you have probably experienced this unforgettable emotion yourselves or known of a victim. Typically occurring alone at high altitude, the flier senses profound loneliness and impending doom. Descending, or seeing the airfield, reassures and resolves it. Often, though, it sensitizes the victim and may recur.

In the extreme case, particularly after a mishap, aircrew members may develop genuine Post Traumatic Stress Disorder (PTSD) with nightmares, depression, drinking and abusive behavior, and phobic avoidance of flying. We marvel at the very low incidence in USAF aircrew of this ordinary emotional response to extraordinary trauma. The aviator may seem permanently disabled and overly susceptible to mishandling the next emergency. Neither supposition is true, and with intensive treatment, virtually all of these victims can return to well-adjusted flying.

Sadly, we must also mention another extreme human emotion—depression—with its risk of suicide. Usually well hidden in our aircrew population, its effects can be as devastating as other more obvious emotions. We cannot remember an active USAF aircrew suicide by means of aircraft, but one of us knows of a reliable account of a military airshow pilot's suicide—yes—during an airshow.

What Can We Do?

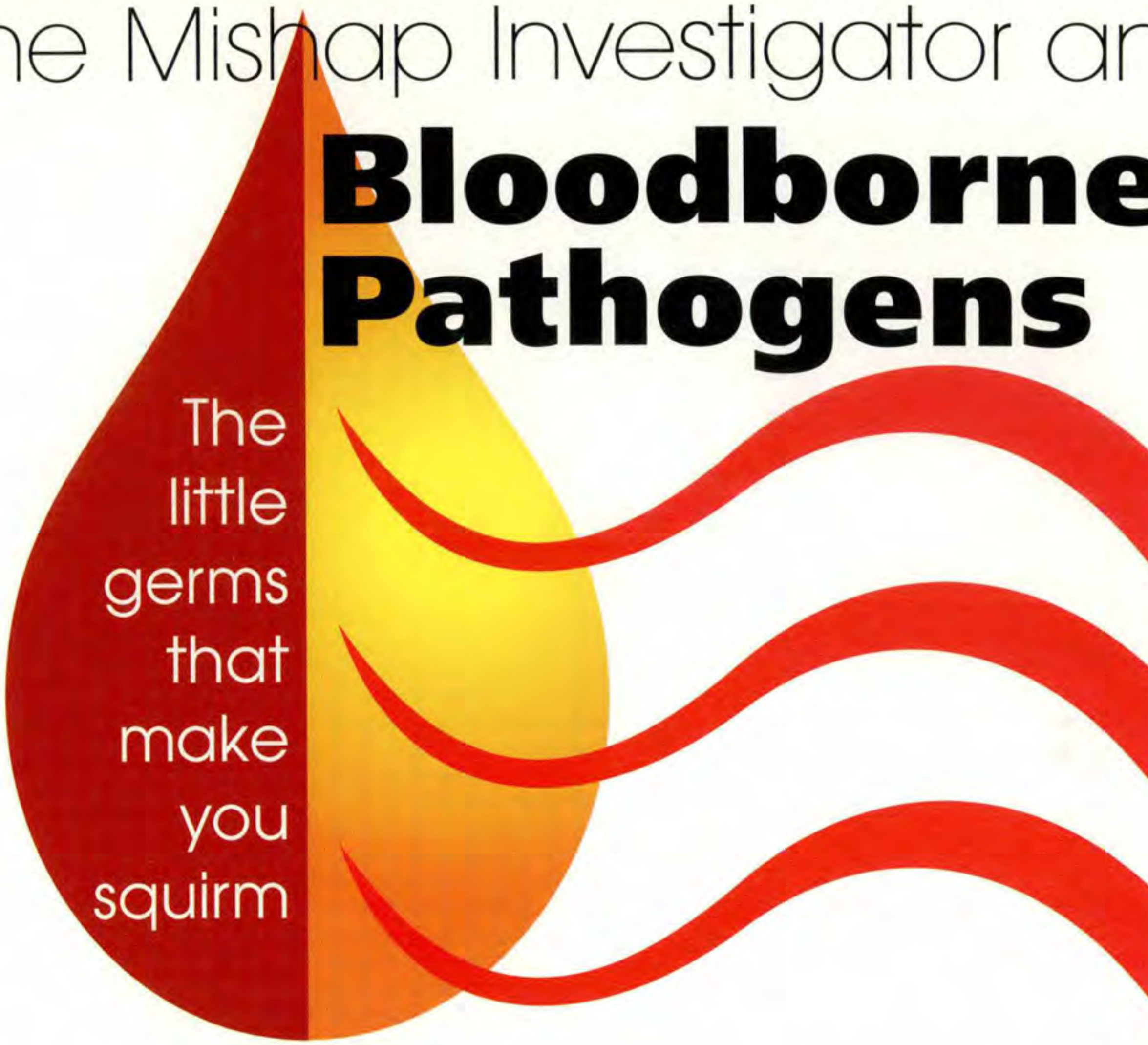
Is there a lesson in our musings? Can the effect of emotions be controlled during an emergency? Yes, with training. Much of the time, emotions in the air, as on the ground, are subject to some conscious overriding. It's always better to acknowledge emotions rather than trying to ignore or control them. Practice at dangerous situations in the simulator brings you back, to some extent, to the proper part of the arousal curve and optimizes performance. A life-threatening event, when successfully addressed in the nonthreatening simulator, alters the emotional response to the real emergency and reduces the chances of overarousal. In fact, we think simulator training itself is too predictable. You know the script before you strap in. Better to challenge you to the limits every time so that Bold Face Step Number One: Maintain Aircraft Control, is performed calmly in the face of impossible odds, with no interference from overarousal or fear or frustration.

Should aviators know themselves and their anticipated emotional responses? Aviators wouldn't think about operating in an environment they didn't understand yet remain ignorant about their own functioning. When are aviators emotionally vulnerable? During any transition period, positive or negative. Why not run one last checklist on your own ability to fly safely. What is your current emotional baseline? One of us received a call from a concerned flight surgeon about a pilot who "didn't want to fly." Questioning revealed his wife's pregnancy was overdue, as was his girlfriend's. Not flying during this stressful time showed excellent understanding of his emotional potential for disaster.

Between us we have perceived the unseen hand of human emotion in all mishaps we have studied. And yes, the complacent blown tire above was one of us—the senior author, a combat veteran. No normal person, no USAF aircrew member is unaffected by normal human subjective responses. Know your basic response style. Never forget where you are on the performance curve. Calmness counts. When an emergency inevitably happens, don't deny its reality. Act! Reframe fear into motivation to succeed. You won't experience most emotions—except frustration—in the sim, so you must mentally add them in to any emergency practice scenario. Acknowledge your own social stress risk. Analyze that of your crew or wingmen. And don't regard the victim of a breakaway experience or PTSD as a weaker aviator. They are normal—just like you! ✈

The Mishap Investigator and Bloodborne Pathogens

The little germs that make you squirm



Editor's Note: Individuals participating in mishap response, clean-up, or investigation should be aware of the hazards and take appropriate precautions based on the risk of exposure to blood and body fluids. The following article was taken from a training lecture given to Air Force Safety Center Safety investigation board representatives and consultants to Class A flight mishaps. Each base should take this information in consultation with their base Public Health to determine who falls under the requirements of 29 CFR 1910.1030, Occupational Exposure to Bloodborne Pathogens; Final Rule.

LT COL (DR.) JAY NEUBAUER
HQ AFSC/SEL

Anytime an aircraft mishap results in serious injury or fatality, there is the possibility of contact with human blood or body fluids. This puts you, the investigator, at potential risk for exposure to bloodborne pathogens. Although in most cases the risk is very small, knowledge is the key to protecting yourself. My intent is to provide basic information about the regulation on bloodborne pathogens, the risks, and ways you can mitigate these risks. More in-depth information can be obtained through your local Public Health Flight.

The Regulation

CFR 1910.1030, *Occupational Exposure to Bloodborne Pathogens, Final Rule.* CFR 1910.1030 is the Department of Labor regulation addressing contact with human blood and blood products as part of a worker's job. The standard was created in the late eighties and passed in 1991, largely to protect health care workers, but it has ramifications for many others including firefighters, security police, and those involved in mishap recovery and investigation.

Under the authority of the Occupational Safety and Health Act (OSHA), the regulation drafters classified blood as a hazardous material due to the potential for transmitting serious illnesses. In establishing the regulation, the drafters were guided by a standard similar to that used for hazardous chemicals in the work place. Specifically, the regulation outlines employer responsi-

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bilities and employee requirements for training and protection against the bloodborne pathogen hazard.

It's a good idea to review this regulation and be familiar with the safety practices and protective gear required if you are in any way involved in mishap response, recovery, or investigation. The Public Health people at your base hospital have a copy of it. Your base should also have an Exposure Control Plan outlining specific guidance on protection and what to do if you are exposed to blood or body fluids while performing your duties following a mishap. (See "Definitions" to help you better understand terms in these regulations.)

The Two Big Risks

The two big risks everyone is concerned about are HIV, the virus causing AIDS, and Hepatitis B, a virus that attacks the liver and can be life threatening.

HIV is typically passed from person to person through sexual contact with an infected person, the sharing of or contact with infected sharp objects such as needle, or, very rarely, through blood transfusions. HIV is epidemic in the United States right now. An estimated 1.5 million people are asymptomatic carriers of HIV. They may have an idea they are HIV positive but they are symptom-free. This 1.5 million figure doesn't include those who have full-blown AIDS.

Currently, there are about 10 new cases of HIV contracted by health care workers per year. To give you an idea of the risk involved, a study of 963 health care workers who sustained cuts or needle sticks which exposed them to HIV showed a 0.5 percent transmission rate (i.e., 1 in 200). Fortunately, HIV is not passed through the air, food, water, or casual contact. It survives for only about 1 day outside the body (e.g., on blood-contaminated aircraft parts).

Initially, infection from HIV can be very mild. Symptoms are usually nonspecific (they can't be tied specifically to HIV). In fact, the first symptoms may be as benign as a flu-like illness, with generalized weakness and swollen lymph nodes, appearing approximately 2 to 4 weeks after contact with the virus. The symptoms may clear up, and you may never know you have HIV unless you are tested. Unfortunately, the virus hangs around to develop into AIDS up to 10 years and longer after initial exposure.

As HIV progresses into AIDS, it attacks the body's immune system—the white blood cell system. As your immune system becomes weaker, your body becomes less able to fight "opportunistic infections." These are infections that come from "bugs" around us all the time—ones we usually fight off easily. But as the immune system takes a dive, "opportunistic infections" get the upper hand, and folks become sick and die.

Hepatitis B is the other major concern. Hepatitis B virus (HBV) is contracted the same way as HIV. The illness has a wide range of symptoms—from none (in fact, about 70 percent of those who contract Hepatitis B never have symptoms) to the more usual stomach pain, nausea, and vomiting. These symptoms usually occur 3 to 6 months after contracting the illness. Ninety percent of all those who contract Hepatitis B get over it—10 percent remain carriers. There are approximately 1 million asymptomatic carriers in the United States. An asymptomatic carrier is someone who continues to have the Hepatitis B virus in their blood system long after most people would have cleared the infection. Typically, carriers show no symptoms. Approximately 8,500 health care workers get the infection each year, and 200 cases end in death.

Hepatitis C, recently classified as a separate type of hepatitis, is also passed by blood. Although not specifically mentioned in the OSHA regulations, this virus is a potential risk, and like HIV and HBV, there is no cure.

Mitigating These Risks

Exposure Control Plan. Any organization or group with potential occupational exposure to these risks requires an exposure control plan. The exposure control plan should:

- Outline methods of compliance with OSHA standards.
- Define job classifications based on risk.
- Outline how to minimize employee exposure.
- Outline evaluation for individuals involved in an exposure incident.
- Outline training requirements.
- Outline maintenance of training and other necessary records.

Protective measures come in the form of engineering controls, work practices, personal protective equipment, and immunizations.

Engineering Controls. Any way we can remove a hazard or put a barrier between the hazard and the individual is an engineering control. Mishap site controls include:

- A cordon around the mishap site and limiting who comes into this area.
- An entry control point marked with a warning sign: "THIS IS A HAZARDOUS AREA—PERSONAL PROTECTIVE EQUIPMENT REQUIRED."

Work Practices (How we do business). In general, all blood and body fluids should be treated as infectious. This practice is called "universal precautions." It's effective in limited exposure in situations like aircraft mishaps where status is not immediately known (especially when civilians are somehow involved). Other work practices include:

• Putting any kind of blood-contaminated specimens (i.e., human tissue, equipment, pieces of aircraft, etc.) in leak-proof containers to prevent exposure outside the mishap site.

• Allowing no eating, drinking, smoking, or putting on lip balm, etc., while in the hazardous area at a mishap site or while in protective clothing.

• Special care should be taken not to contaminate unprotected areas of your body (e.g., don't scratch your eye or pick your teeth while wearing dirty gloves).

• Wash your hands each time you leave the mishap site.

• Since dehydration can be a problem, an area should be provided near the mishap site, for mishap personnel only, to get drinking water. Individuals should take off their gloves and wash their hands before getting a drink.

Personal Protective Equipment (PPE). The PPE you should be aware of include gloves, masks, goggles, gowns, and boot covers. ***The type of PPE should be based on RISK***, depending on what you will be contacting. If there are no fatalities or bodies, there is no reason for full protective gear.

Two very good work practices should be mentioned here concerning PPE:

• The removal of PPE is somewhat of an art. You want to avoid touching the contaminated outside of your protective gear. (If this sounds like removing chem gear, you're exactly right.) It's critical to peel back what you're taking off so only the inside contacts you—not the contaminated outside.

• Once you leave the mishap site, you should take off your PPE. This is why water for washing and drinking in close proximity to the mishap site is a good idea—you don't have to remove your gear so often. When you leave the site to eat lunch, it's a good idea to take off all PPE. And after removal, used PPE should be discarded and disposed of as hazardous waste through the base hospital or closest medical facility. Put on new or cleaned PPE items each time a used item is removed (e.g., if gloves are taken off to get a drink, they should be discarded and a new pair put on when reentering the mishap cordon).

Immunization. Hepatitis B vaccine, by OSHA requirement, must be offered to anyone who potentially may be exposed to blood and body fluids as part of the requirement of their job. It's a three-shot series given over a 6-month period. The vaccine is 90 to 95 percent efficacious, meaning it works in 90 to 95 of every 100 people who get the shots. If required, this series may be declined by civilians but not by military personnel.

If You Should Get Cut

Of course, there is still a chance you could be exposed to infected blood. This means contact with the nose, mouth, eyes, or broken skin (cuts, scrapes, rashes). If you get cut or stuck, there are some measures you should take. First of all, wash the area very well. If your skin is involved, wash with soap and water as soon as possible. If it involves your eyes, nose, or mouth, rinse with clean water. You will need to go to the nearest emergency room for treatment, preferably a DoD facility. Make sure you keep a copy of the evaluation and laboratory tests. Your base Public Health will need the information.

Public Health will put you in a follow-up program including counseling with a health care provider to discuss the exposure and your risk. At the time of exposure, no one will be able to determine exactly what you have been exposed to—Hepatitis B, C, or HIV. Periodic testing over the next 6 months will be completed to determine whether you have been infected.

To Keep You Safe

The intent of the OSHA Bloodborne Pathogen regulation is to protect you from some nasty diseases. Each base is responsible for determining who is at risk and to provide protection for those at risk. It's your job to be knowledgeable about those risks and to properly use appropriate protection. For more specifics, call your base Public Health office. ✈

DEFINITIONS

Blood. When blood is referred to, it is more than the "red stuff" that comes out of your arm when you are cut. Regulations also refer to components of blood which entail some vaccines and other things composed of blood products.

Bloodborne Pathogens. These are micro-organisms that float around in the blood and can cause human disease. Regulations don't have anything to do with animal blood or animal by-products.

Contaminated. An object, a piece of material, or a surface is contaminated if it has blood or body fluids on it.

Exposure Incident vs. an Occupational Exposure. An exposure incident is a *specific* eye, mucous membrane (eye, ear, nose), non-intact skin (rash or a cut), or a parenteral (i.e., through the skin with some sort of sharp object) contact with blood or other infectious material in the course of one's job. An occupational exposure is the reasonable expectation you may come in contact with blood or body fluids.

Personal Protective Equipment (PPE). This is all the "stuff" you wear to try to mitigate the risk of contact with bloodborne pathogens, i.e., the suits, gloves, boot covers, masks, goggles, hair covers, etc.

Regulated Waste. Regulated waste has to be handled differently—separately—from regular trash. This is usually not a concern at the mishap site because there are some very explicit definitions of regulated waste. Regulated waste has to be saturated to the point of dripping or be caked with dried blood.

Universal Precautions. Under this concept, we treat everything as potentially infectious. So, if "Joe Schmoe" off the street comes in with a cut on his arm, we treat him and his blood as if it were infected with HIV, Hepatitis B, or some other nasty, ugly thing we don't want to get.

ASPARTAM

Is There Really a Problem?

Editorial Note: In May 1992, *Flying Safety* magazine published "Aspartame Alert," an article extracted from Navy Physiology which was published to shed some light on the artificial sweetener, aspartame. Since then, there have continued to be articles, letters, and reports written on the subject. The following information is adapted from a recent review entitled "Aspartame Alert: Is there really a problem?" researched and written by Jay A. Clemens, Lt Col, USAF, MC, FS, a flight surgeon attending specialty training in Aerospace Medicine.

Several recent articles by watchdog groups such as Mission Possible Aviation Division and the Aspartame Consumer Network stress the potential toxic effects of the popular sweetener, aspartame (NutraSweet™ or Equal™—the little blue packets). Some of these effects— seizures and cognitive performance impairment—are of potential concern to the aviation community.

Aspartame, originally discovered in 1965, was approved by the Food and Drug Administration (FDA) in 1974 for use in dry food products. The approval was suspended soon after for further research. The substitute sweetener was reapproved in 1981, but not without controversy as the FDA authorized its use over the objections of an expert panel concerned about the possible effects of aspartame on the brain and nervous system. The commissioner based approval on testing which showed ***no significant*** risk versus ***zero*** risk. In 1983, aspartame was further approved for use in soft drinks and has since been consumed by over 100 million Americans.

Since approval, there have been thousands of anecdotal reports (individual case stories) of abnormalities and problems linked to the consumption of aspartame. Unfortunately, individual stories rarely prove a connection (just suggest one). It is extremely difficult to draw causal connections unless controlled studies are done or there are a large number of very similar cases under similar circumstances. With the huge amount of aspartame used by the general public, it is hard to differentiate problems potentially associated with the use of the sweetener from background noise associated with just living and breathing.

E ALERT:

At the time aspartame was approved, a system for reporting adverse reactions was developed. The system was a voluntary reporting system directly to the FDA. In 1983, the FDA received 356 complaints which prompted evaluation by the Centers for Disease Control and Prevention (CDC). They looked at 517 complaints and found no common set of problems associated with aspartame use. Most of the complaints were of mild symptoms common in the general public (two-thirds of complaints included headaches, dizziness, mood alterations, and similar symptoms, one-quarter centered on the gastrointestinal system, and 15 percent were allergic or skin complaints). Some possible causes suggested were coincidence, suggestibility (an individual heard about someone else's problems then noticed the same or similar problems), and individual sensitivity to aspartame in commonly consumed amounts.

In November 1987, the U.S. Senate Committee on Labor and Human Resources held hearings to further examine the health and safety concerns associated with aspartame. The FDA commissioner stood behind his agency's decision to approve aspartame at an Acceptable Daily Intake of 50 mg/kg/day (this equates to almost 22 8-ounce glasses of Kool-aid™ or 14 cans of diet soda per day for a 60-kg/133-pound person). He further estimated that 90 percent of consumers ate or drank only 2 to 4 mg/kg/day (a single can of diet soda has about 200 mg of aspartame). The major concerns addressed were use of aspartame during pregnancy (fear of the effects on young and developing brains) and use in individuals with Phenylketonuria (PKU), a genetic disease where one of the components of aspartame, phenylalanine is not metabolized properly (thus the warning labels that now appear on products with aspartame).

There have been a limited number of scientific studies done to evaluate people who complained of aspartame-caused problems. One study looked at children with behavioral changes attributed to aspartame, another looked at adults with complaints of headaches. None of the studies provided evidence that aspartame was a problem. A 1991 study of a group of pilots looked at results of a complex series of aviation-related information processing tasks immediately after taking aspartame. A similar study in 1994 looked at the same testing after prolonged use of aspartame. Neither study showed any effect of aspartame on pilot function.

The Surgeons General of both the Air Force and the Navy have researched and reviewed the scientific evidence, and both support the position that there is no justification for prohibiting use of aspartame.

Aspartame has become the most studied food additive in U.S. history. It is consumed daily by millions of people around the world. While there have been a number of individual complaints about the adverse effects of aspartame, the number is extremely small compared to the overall number of consumers. If there were truly toxic effects from consumption of aspartame, one would expect consistent trends over the past 10 to 15 years. As with most food and drink, the key to minimizing the likelihood of individual reaction is to consume in moderation. ✈

STRAPLESS OVER THE DESERT SOUTHWEST

USAF Photo by SSgt Andrew N. Dunaway,

CAPT MIKE MARGOLIS, USAFR

You know the scenario…

The field's closing in 10 minutes and won't open again for 2 days. The jet has got to be back tonight—or else! You've been hopping around the West Coast—solo. Got a late start on the day because the previous night just wouldn't end, and so on. In other words, you've worked yourself into a hole and are frantically struggling to dig yourself out.

After a rough logistical morning, things began flowing very smoothly. They finally showed up with the start cart. They do, in fact, have your IFR clearance in the system. And the crew chief finally found his hearing protection.

Having flown through the before-start checklist (it's okay to fly through it—you've accomplished the check at least 1,500 times over the last 5 years—that's what habit patterns are for, right?), you light the fires and make the takeoff with 1 minute to spare. Of course, you meant to do that.

About 300 miles down range, over pretty much nothing but desert, you get that *I-know-I-forgot-something* feeling. Kind of like realizing you forgot to close the garage door before you left the state on 2 weeks of leave.

You look around, check the switches, check the knobs, check the gauges, and yes, the 781 is nicely stowed. Oh well, ops normal.

After another 200 miles, you shift in the seat like you always do after sitting for over an hour and notice you're not as ***un***comfortable as you usually are. That's good…no, that's bad!

Upon glancing down to check the status of the egress equipment, you discover with a bit of shock (and swear you can hear the background sound effects from the shower scene in *Psycho*) that the crotch straps to your trusty parachute are dangling loose behind the stick where you left them yesterday afternoon when you unstrapped.

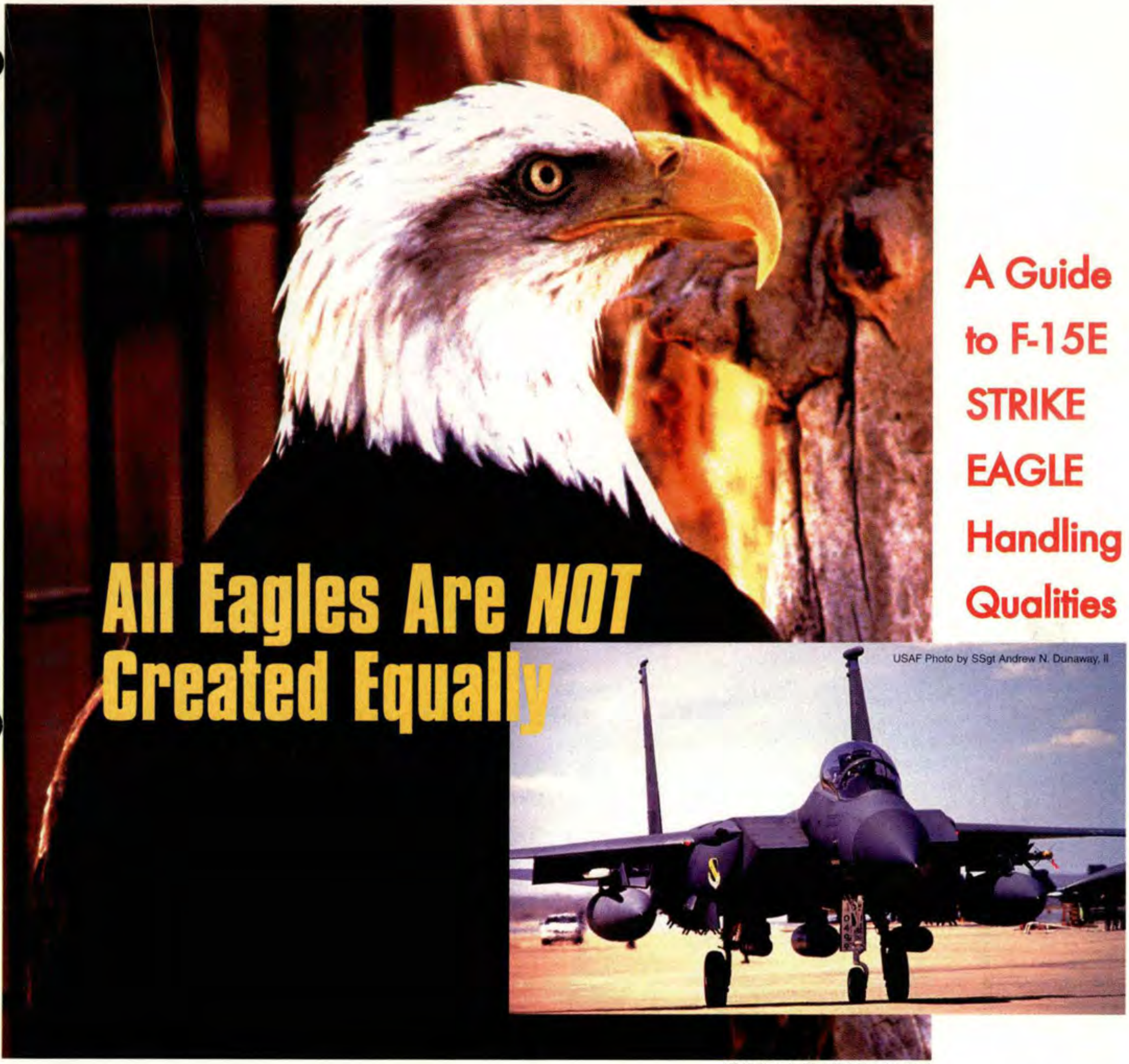
After completing the before-start checklist at 37,000 feet, you've got a few minutes to reflect. The first thing that comes to mind is the Safety Investigation Board's report that might have been written.

The mishap aircraft was heroically steered away from populated areas while Captain Whoosh expertly tried every technique known to man to solve the multiple systems failures. With no hope left to recover the crippled machine, Captain Whoosh ejected from the ill-fated and doomed aircraft. The ejection system functioned flawlessly. However, dang if we can figure this out—Captain Whoosh simply Swooshed right out of his chute. Bet that was some opening shock.

Mishaps occur as the culmination of a chain of events. Look always for those events or links in the chain before they connect and lead straight to a mishap. ✈

All Eagles Are *NOT* Created Equally

A Guide to F-15E STRIKE EAGLE Handling Qualities



USAF Photo by TSgt (Ret) Marv Lynchard

USAF Photo by SSgt Andrew N. Dunaway, II

MAJ MILES "COWBOY" CROWELL
USAFE/SEFF
MAJ GREG "MOOSE" BARLOW
USAFE/DOTW

Departures seem to have become a recurring event in the Eagle community. As a result, various articles have been written on Eagle departures and flying the jet smart. The article in the February 1997 issue of Flying Safety, "Shape Up and Fly Right—A Pilot's Guide to Eagle Departures," was an excellent review of "light gray" Eagle performance characteristics. However, the information was NOT correct for the F-15E community. A good number of Eagle drivers—Strike Eagle drivers, to be exact—perused the article thinking that the words just didn't add up. While the "Shape Up" article accurately described the handling characteristics of the F-15A-D fleet, it overlooked the tremendous differences in F-15E handling qualities. In the interest of spreading the word throughout the entire F-15A-E community, this article sets the record straight on F-15E STRIKE EAGLE handling qualities and departure characteristics.

Eagles Are Eagles, Right? WRONG!

While the family of Eagles looks alike in many respects, the F-15E is a completely different animal than the F-15A-D series from a handling qualities perspective. When the Strike Eagle entered service in 1989, it did so without the benefit of having "run the gauntlet" of a complete handling qualities/spin test evaluation. The original F-15E Dash One guidance on departures, recov-

continued on next page

ery procedures, and low/high angle of attack (AOA) handling qualities was copied word for word from the F-15A Dash One. Some unrecoverable departures in the early nineties preceded the USAF's reexamination of F-15E handling qualities. Thus began the first formal break from the belief that all Eagles fly alike—a distinction that is still not fully appreciated throughout the Eagle community.

Through a program known as KEEP EAGLE, the USAF pursued a complete evaluation of F-15E handling qualities to include departure and spin testing in both air-to-air and air-to-ground representative combat and training configurations. KEEP EAGLE resulted in retrofitted flight controls software, hardware, and perhaps most importantly, a complete rewrite of the F-15E Dash One handling qualities and departure guidance in both chapters 3 and 6. Bottom line: There are some major differences between the handling qualities of the F-15E when compared to the F-15A-D family, and those differences might be surprising to many readers.

What's Unique About F-15E Handling Qualities?

CFTs, LANTIRN pods, and airframe structural differences aside, KEEP EAGLE resulted in some significant F-15E changes. KEEP EAGLE hardware and software modifications fixed deficiencies in the early F-15E flight control's system and provided enhanced handling qualities, decreased departure/spin susceptibility, and good spin recovery capability throughout the range of authorized flight manual configurations and maneuver limits. KEEP EAGLE found that the F-15E now exhibits "excellent flying qualities above 30 AOA...better than the F-15A/B/C/D at high AOA." In fact, during KEEP EAGLE testing, not a single unintentional departure/spin was encountered at high AOA.

The bottom line for Strike Eagle drivers is that the F-15E is more departure/spin resistant than the F-15A-D at high AOA. Also, if departure/spin occurs, the Strike Eagle will exhibit good spin recovery characteristics in both air-to-air and air-to-ground configurations—even when asymmetrically configured with asymmetries in excess of 8,000 foot-pounds. The F-15E still shares some low angle of attack departure characteristics with the F-15A-D family.

Departures, It'll Never Happen to Me, Right?

Armed with the knowledge that the Strike Eagle isn't likely to depart controlled flight at high AOA, one might be led to believe that departures can't occur. Well, not so fast. The F-15E definition of a departure is the same as that for the F-15A-D: "...characterized by a large, uncommanded flightpath change such as an abrupt nose slice, an abrupt roll away from lateral stick, or excessive yaw rate." The F-15E Dash One describes the three causes of Strike Eagle departures as "lateral asymmetry, inappropriate low AOA control inputs, and asymmetric thrust."

Unlike the F-15A-D, the F-15E does NOT experience "...a region of reduced directional stability around 37-44 CPU..." Therein lies an important distinction in the departure characteristics of the F-15E from those of the F-15A-D. In fact, the Dash One further intones that the F-15E is "...much less susceptible to departures by unintentionally defeating the washout and ARI schedules when applying lateral stick while the aircraft is at high angles of attack." Yes, you can depart a Strike Eagle, but it's most likely to occur in the event of asymmetric thrust, flying with lateral asymmetries, or inappropriate maneuvering at low AOA.

Asymmetric Thrust Departure Prevention

Asymmetric thrust is a potential problem only for F-15Es configured with PW F100-229 engines. In the event of an ATDPS failure above 500 KCAS or 1.1 Mach, the jet is subject to departure. Likewise, intentional

Photo by Randy Jolly

attack (below 30 AOA). As with the F-15A-D, the Strike Eagle is subject to low AOA departures resulting from improper stick and rudder inputs.

The Dash One emphasizes the fact that the aircraft is capable of generating very high pitch and roll rates at low AOA. Inertial and kinematic coupling during high pitch and roll rates can lead to both high yaw rates and large AOA and sideslip angle excursions. Laterally asymmetric loads, centerline fuel tank, and LANTIRN pods can aggravate such excursions. And if these factors alone aren't sufficient to make Strike Eagle drivers take notice, higher airspeeds can aggravate the situation even further.

According to the Dash One, "Low AOA maneuvers which are particularly departure prone include abrupt lateral stick or full rudder pedal inputs below 25 CPU or abrupt or full cross-control inputs below 30 CPU. At any AOA, abrupt longitudinal stick inputs should be avoided while the aircraft is already rolling rapidly." Furthermore, rolling or slicing departures may be encountered even in level flight if attempting "...high sideslip maneuvers with extensive cross-control inputs (lateral stick opposite rudder) ...and such departures are more likely to be encountered with external fuel tanks and/or LANTIRN pods installed."

asymmetric throttle inputs in this flight regime can also lead to departure.

To prevent departures due to asymmetric thrust, don't make asymmetric throttle inputs above 500 KCAS/1.1 Mach. In the event of an ATDPS failure, remain below this speed regime. For those flying Strike Eagles configured with PW F-100-220 engines, the problems won't be encountered throughout the flight envelope.

Lateral Asymmetry Departure Prevention

While it may be intuitively obvious that an asymmetrically loaded F-15E would be more susceptible to departure, Strike Eagle crews may find themselves going to combat with just such a configuration. Mission tasking, multiple targets, and mixed loads may occasionally result in asymmetric aircraft configurations.

Nevertheless, application of Dash One procedures should prevent these departures. Limit maneuvering to below 30 AOA when asymmetrically configured, and avoid inappropriate low AOA control inputs. Keeping the AOA below 30 units under these circumstances is easy to do. However, the issue of inappropriate low AOA control inputs requires further examination.

Inappropriate Control Inputs at Low AOA

The most likely cause of F-15E departures is the misapplication of flight control inputs at low angles of

So, how do Strike Eagle drivers prevent such departures? There's an easy answer—follow the Dash One guidance. When maneuvering the jet at lower AOA (below 30 CPU), abrupt lateral stick/full rudder inputs and abrupt cross-control inputs are not effective means of flying the Strike Eagle, and these inputs can easily lead to low AOA departures. If this sounds like a lecture on basic flying skills, it's meant to be. As stated earlier, the most common cause of Strike Eagle departures is the misappropriate application of stick and rudder at low AOA, and adherence to Dash One handling procedures is the best way to prevent such problems.

What About Auto-Rolls?

No article on F-15E departure prevention would be complete without a discussion of auto-rolls. While an auto-roll will surely get your attention if it happens to you, the fact is, auto-rolls are not departures. Per the Dash One, auto-rolls fall into the category of "unintentional rolls" and are known flight characteristics of the jet. It is relatively easy to auto-roll the F-15E through the misapplication of flight controls. They frequently result when AOA is reduced while rolling the jet at high rates.

continued on next page

The F-15E Dash One is the Strike Eagle drivers' bible on handling qualities. If you haven't read chapter 6 in the last year or so, you may be surprised at the changes.

The Dash One states that "Typical auto-roll entry conditions are 200 to 350 KCAS and 20 to 35 CPU AOA."

For example, one of the "classic" auto-roll entries occurs when executing a loaded roll with rudder in the direction of roll, then easing off on the back stick pressure (reducing AOA) before neutralizing the rudder. Note that auto-rolls can occur outside of the Dash One typical entry conditions and can be particularly eye-watering at higher airspeeds.


USAF Photo by SSgt Andrew N. Dunaway, II

An auto-roll is a rolling motion coupled with yaw. The jet still has flying airspeed, typically above 175 KIAS, and the auto-roll is somewhat similar in feel to an uncoordinated, unplanned loaded rudder roll. During positive "g" auto-rolls, yaw and roll are in the same direction, and simply neutralizing the controls may slowly lead to recovery. However, the Dash One recovery procedure dictates gentle application of rudder opposite the roll to generate a rapid recovery.

As the aircraft recovers from an auto-roll, the yaw and roll motions inertially couple into pitch and will result in a temporary negative "g" pitchover which should be countered by aft stick. The severity of this pitchover is proportional to the airspeed and the abruptness of the recovery. Therefore, it is crucial to use only as much opposite rudder as necessary to smoothly stop the roll—abrupt full rudder will likely result in a severe negative "g" pitchover. In any case, be prepared to counter the pitchover with aft stick pressure per Dash One procedures and you'll quickly recover.

While an auto-roll is not a departure, there is the possibility that misapplication of controls during attempted recovery may lead to an aircraft departure. If lateral stick is applied vice opposite rudder (e.g., trying to stop a left-rolling auto-roll with right aileron) during attempted auto-roll recovery, it is possible to induce a spin which is indeed a departure.

How About Spins?

While the Strike Eagle is extremely spin resistant, misapplication of controls during auto-roll recovery may lead to a spin. The Dash One provides an excellent discussion of all possible manner of spin characteristics, and some basic tenets are worthy of discussion. Spins are indeed departures. Unlike unintentional rolls such as the auto-roll, spins are characterized primarily by a yawing motion. In addition, unlike auto-rolls, airspeed will be less than 175 KCAS in a spin.

If you do find yourself in a spin, all is not lost. KEEP EAGLE demonstrated that the Strike Eagle has very robust spin recovery capability. Application of Dash One spin recovery procedures, augmented by the aircraft spin recovery display aid, will lead to aircraft recovery. The key is to recognize that a spin has developed and then timely application of the appropriate Dash One recovery procedures.

Now, Go Out and Fly Right!

Hopefully, you've gained some insight into the handling characteristics unique to the F-15E. While the Strike Eagle exhibits some better handling qualities at high AOA than the F-15A-D, it still shares some of the low AOA departure characteristics with the rest of the Eagle family. F-15E drivers need to be cognizant of these similarities as well as the Strike Eagle-exclusive challenges of potential asymmetric load configurations and PW F-100-229 engine qualities.

The F-15E Dash One is the Strike Eagle drivers' bible on handling qualities. If you haven't read chapter 6 in the last year or so, you may be surprised at the changes. While the KEEP EAGLE program led to greatly enhanced handling qualities and departure resistance, it's up to the aircrews in the field to master these capabilities. Practice makes perfect, so study your Dash One, shape up, and fly right! ✈

Hazard:

The "Moth Effect"

CORNELIUS (NEIL) COSENTINO
Major, USAF, Ret.

It was a late winter night in the Eifel mountains of Germany. A thick, black fog silenced every sound, and you could barely see the glasses on your nose. It was the right weather for night air defense alert duty at Bitburg AB. After all, who in the Ramstein command post would be crazy enough to approve a scramble into this kind of weather? The weather was so bad that my guess was the nearest alternate was somewhere in Africa or Nova Scotia. So it was time to settle down for a night of popcorn and movies.

I don't remember hearing the Klaxon™ or anything else until I woke up to a 25-degree deck angle. My Phantom was climbing through 20,000 feet. Who was the idiot who did this to us? Then I began to settle down. I leveled off and was given a vector toward East Germany. My focus was on the instruments and the intercept, but my thoughts were on fuel, alternates, and getting home that night. The only rationale for a launch in that kind of weather was "Bluff," a generals' game of Friday night air power. And we were the dynamic part of their cold war game.

It was a routine mission except for the weather. There was just enough fuel for an approach at Bitburg and a weather divert to Solingen. Bitburg weather was variable, reported one-quarter of a mile or less in the thickest, blackest fog I can remember. The GCA controller was steady, calm, and professional, and that helped. We all were going to earn our beer money that night.

The controller kept me on course and glidepath all the way to minimums. I flew final as slow as I could to have the precious moments I would need to see the approach lights. I looked over the right side just before minimums. It was still there, the blackest night of my life. I could see nothing—not even the wing lights.

A moment later at minimums, I looked over the left side and saw one faint green runway threshold light. That one light was all I needed. I continued the descent which took us into a zero-zero fog bank. It seemed a lifetime until the moment we touched down in that zero-zero fog. And it was a moment later the dim runway lights started to appear off the left wingtip. Everything after was routine except we had landed with the left landing gear close to the edge of the runway. It was different to see the dim runway lights passing so close to the left wingtip.

My backseater was happy to be back on the ground and eager to break the silence and tension. He nonchalantly observed that we somehow landed on the left side of the runway instead of the centerline. And I was pleased with the overall outcome of the mission and with my response. I replied with a casual observation about the reasons they make runways so wide.

I had no other answer for him or anyone else about why we landed to the left side of the runway. The question stayed with me for many years. Why were we on centerline at minimums and a few moments later touched down on the left side of the runway? Everything happened so fast, spotting the one green threshold light at minimums, entering the zero-zero fog bank a moment later, and touching down on the left side of the runway.

Going back into the fog after minimums could easily be explained because of a small valley just off the end of the approach runway. Could the GCA radar centerline have been a little off to the left? I did not question my judgment or my skills. We were in the hands of Mother Nature and our faith. I remembered the fog during taxi and takeoff during our RTB and descent back to Bitburg. I was glad the F-4E had such a short takeoff roll during that near zero-zero takeoff roll and going solid IFR at liftoff. All I could do was my best on the approaches and then make the right decision about where to run out of fuel and eject, at Bitburg or at the alternate. All Europe that night was variable, a quarter of a mile or less in fog.

But why did we land on the left side of the runway? It was years later I made a connection between the "moth effect" and that one green runway threshold light on the left side of the runway. Humans, like moths, will steer toward a light source. I suspect it was the only thing I saw outside the cockpit, and so I must have steered toward the light. Would I have resisted that tendency to steer left toward the light had I known about this type of hazard? I think yes. Knowledge and being aware of all aspects of flight prepares a pilot for all situations, especially those that come once in a lifetime of flying.

We called their bluff that night! And we have a rich history of examples such as this one, when added altogether, are a part of how and why we won the cold war. But I came about 20 feet from a different outcome. It could have resulted in an aircraft mishap. We could have landed off the left side of the runway. If that had been the consequence, it would have been because one small but essential bit of information was missing from my formal training as a pilot, i.e., what are all the hazards associated with the "moth effect" and especially those associated with low visibility approach and landing at night in dense fog? ✈

Don't Just Sit There

MAJ JEFF THOMAS
HQ AFSC/SEF
Courtesy *Torch* Magazine, Sep 95

The following article by Maj Jeff Thomas offers us some good information about crew resource management—CRM. At the time this article was written, Maj Thomas was assigned to HQ AETC, Randolph AFB, Texas. He is now the CRM Point of Contact at the Air Force Safety Center.

—Ed.

You're on the wing, being led down the ILS glidepath by one of the most experienced flight leads in the squadron to the home drome where the weather has been reported as 500/1 1/2...right at mins for a formation approach. You're approaching decision height; looking ahead reveals no sign of the runway, just more of the soupy white mass that has encased your jet since the beginning of the descent. You've just passed decision height. You check your position on the wing, then glance out the windscreen—no runway in sight.

Decision time...what will you do? Let the situation go unchallenged and hope everything turns out okay, assuming an experienced pilot like your flight lead couldn't possibly knowingly violate minimums (you must have misread the altimeter)? Ask flight lead to confirm passing decision height? Initiate a single-ship go-around?

Sound farfetched? Several years ago, a large Air Force transport-type aircraft was destroyed during landing under vaguely similar circumstances. During the descent, the aircrew updated the weather and noted the active runway had a slight tailwind. The crew, not wanting to land with the tailwind, smartly requested a circling approach to land opposite direction and figured their landing distance based on such. The circling request was denied, and the crew was informed the runway was wet.

The highly experienced aircraft commander, unchallenged by his relatively inexperienced copilot, committed the crew to landing with the reassuring comment, "We can handle that," and continued the approach to touchdown without taking the necessary time to recompute landing data for the tailwind/wet runway conditions. End result: Runway required exceeded runway available, and the aircraft terminated the sortie in several pieces after the concrete ran out. (Nobody was injured.)

What is similar about these situations? Although one involves fighters and one involves heavies, both involve a CRM concept known as *group dynamics*. Due to the failings of "groups" as the cause of many aircraft mishaps, one of the main focuses of CRM research has revolved around the topic of group dynamics.

According to the Air Force CRM AFI, 36-2243, group dynamics factors include command authority, assertiveness, conflict resolution, legitimate avenues of dissent, etc. Another name applied to the concept in academic circles is authority dynamics.

Interestingly, authority dynamics was put to the test in the early 1970s in an airline simulator study when the captain, unbeknownst to the first officer, feigned incapacitation during a low visibility instrument approach. Approximately 25 percent of these simulated flights hit the ground when the first officer failed to assume control from the disabled captain.

The conclusions drawn from this research indicate the authority dynamics surrounding a captain (a.k.a. IP, aircraft commander, check pilot, flight lead, senior staff pilot) are extremely powerful! Many aviators, as evidenced by this study, have difficulty questioning the decisions or actions of pilots with more authority, whether that authority resides in or out of the cockpit environment.

Think this is a problem only in large, transport-type aircraft? Look back at the opening paragraph to see that you don't have to be sitting side by side to face similar authority dynamics problems.

The military mission has some unique authority dynamics problems. Consider rank reversal. Occasionally, a crew or flight may be headed by someone junior in rank to other members of the crew/flight. A navigator or WSO who outranks the aircraft commander comes to mind. Or a DV with flight experience may be listed on the manifest for you OSA types. However, regardless of the rank reversal involved, there should be no question that the aircraft commander or flight lead is in charge during the flight or any related ground activity.

Authority confusion results when two chiefs try to lead. If you are the designated pilot in command or flight lead on the flight orders, DO IT! The FARs state "the Pilot in Command of an aircraft is directly responsible for, and is the final authority as to, the operation of the aircraft."

However, there is a "Catch-22." The above statement does not state or imply inputs from other members of the crew or flight are to be ignored just because "I'm in charge here!" Remember, someone else may have the bigger picture. If you were leading the fictional formation in the opening paragraph, but developed an undetected altimeter malfunction on short final, you'd better hope your wingman speaks up.

At the other end of the spectrum, if you are a junior crewmember, don't withhold information or concerns with a mission or maneuver. This trap is known as excessive professional courtesy...and it has killed more than one aviator. In our "too little runway available" example, the copilot was accustomed to flying with senior aircraft commanders and had come to trust their judgment in all matters. The "he must know what he's doing" mindset has cost us too many aircrew and aircraft.

Having said all of the above, let's look at several guidelines that can be applied in the aircraft to leaders or followers when faced with situations similar to those above. (Thanks to a major air carrier's CRM program for these insights.)

- Don't delay airing your uncertainties or anxieties because you are afraid of looking foolish or weak. Just prior to ground impact is probably too late. Other crewmembers or flight members may well be feeling the same.
- When your opinions or ideas are given or sought, give your point of view fully and clearly. The key word is clearly. The statement "We might want to think about going around" meekly states your position, while "We're below decision height and need to go around" clearly states the problem and begs a response/solution.
- Don't become "ego involved" with your own point of view and simply try to get your own way; deal in evidence and not prejudice. If a group decision has been made, accept it unless you feel that it contains some hazard not appreciated by other members of the group. Focus on ***"What's right,"*** not ***"Who's right."***
- Don't let others progress down wrong paths of actions and get themselves into trouble just to make yourself look good later. You might think this wouldn't be a problem for professional aviators, but several years ago a DC-10 landed on a closed runway and was destroyed (with significant loss of life) when the copilot, due to a personality conflict with the captain, withheld information that the captain was shooting the approach to (and ultimately landed on) a closed runway.

These few guidelines are just the "tip of the iceberg" when dealing with the complex subject of group/authority dynamics. Don't be misled into thinking that, armed with these tips, you are fully prepared to tackle every flight/group problem you'll encounter. But they do represent a starting point from which many issues can be resolved.

Now, proceed back to the opening paragraph. Apply what we've discussed, and see if you can find a solution to the scenario presented. ✈

COMMUNICATION:

Live by the Word, Die by the Word

CW4 TOM CLARKE
PA ARNG
Courtesy *Flightfax*, Mar 97

We all know that military aviation is an inherently dangerous business. Having been in the "business" for a little over 18 years, I've witnessed many of those dangers. During my career in aviation, I've noticed that many mishaps have a common thread that not only links the results, but could have prevented the mishaps in the first place.

Of course, that link is communication. If you think of all the situations leading up to a mishap, you can pinpoint a breakdown (at some point) in communication. A breakdown in communication is usually the first hazard that creates a chain of events, a chain that ultimately leads to a mishap.

I'm reminded of my experiences as a junior aviator and what I've learned from many close calls while flying attack helicopters. Recently, I was going through some pictures of fellow aviators I once flew with. One of those pictures was of a brand-new pilot assigned to our unit just before we deployed for a 30-day field exercise at Fort Irwin, California.

As one of the unit's new trainers, I was assigned the new guy as a copilot. He was not only young but seemed to be somewhat of an introvert (unusual for the attack-helicopter community). Every day we flew together, I wanted to teach him something new and valuable that would make him not only good, but safe! We spent our battle drills working on crew-coordination techniques, tactics, and other tools to improve our proficiency. That one aspect of his personality, shyness, never seemed to surface during our flights. My assumption was that he left that on the flightline when he climbed in the aircraft. This assumption was the beginning of a breakdown in communication that nearly cost us our lives and the lives of another aircrew.

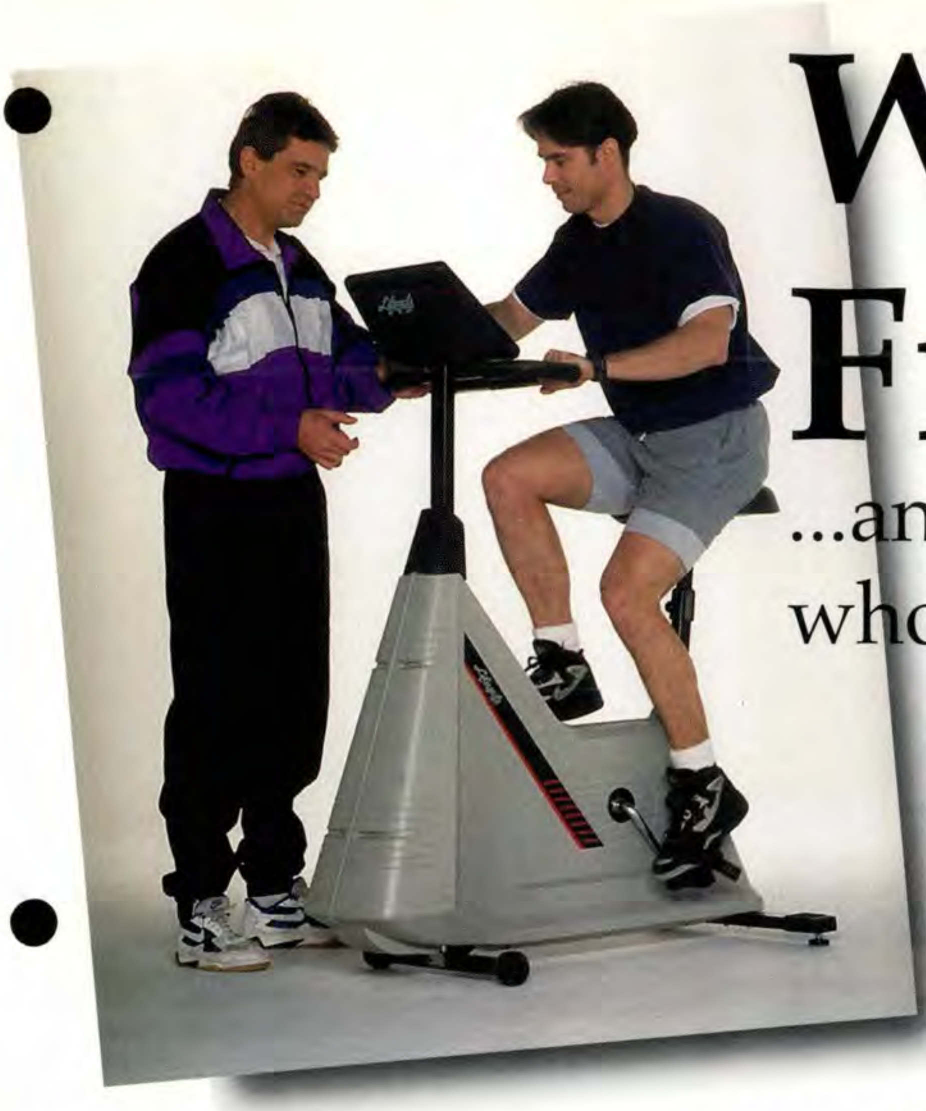
We were flying a Combined Arms Team battle drill. Our mission was to fly to a battle position (BP) with three other AH-1s. We had two Scout helicopters with us that provided oversight, command and control, and other routine services. As we entered the BP, we had maneuver room and set about getting the best observation position for unmasking and locating the armor targets we knew would be entering the "kill zone." As we maneuvered, I was unaware that one of our Scout helicopters had landed (to our 5 o'clock) and was waiting for commo from another battle captain. My new guy (in the front seat) saw the Scout land, and he assumed that I had seen it as well. Unfortunately, my eyes were trained in the direction the enemy was expected to come from, and my scan was limited to that side of the aircraft (opposite the Scout).

As we slowly hovered at 10 feet AGL, something didn't feel right, and I increased power to gain about 10 additional feet. As I did, something caught my peripheral vision. The two pilots from the Scout were looking up at us as they ran away from their aircraft, ***which I now saw below our own landing skids.*** Our skids cleared their main rotors by no more than 5 feet as we flew directly over them! The Scout pilots knew it was too late to get our attention with a radio call, so they bailed. As I cleared their main rotor with our aircraft, my terror was replaced by sheer anger at my copilot, who seemed to be enjoying the whole ordeal. My first words to him were, "Did you see that aircraft?" He said he had and didn't say anything to me because he thought I saw it too. I was livid.

We landed and shut down our aircraft. I quickly approached the Scout pilots and apologized, explaining the problem. They were just happy I had my "psychic friends" along that day when I decided a 20-foot hover felt safer (just prior to impacting their aircraft). My new guy and I had a long talk about never assuming anything while in the cockpit. I told him that our breakdown in communication for just that single 30- to 40-second period nearly killed us and the Scout crew and nearly destroyed two aircraft.

I learned a valuable lesson that day, not only about crew coordination and communication between crewmembers, but also that personality plays a significant role in determining the thoroughness of a crew briefing. Knowing my copilot's introverted nature outside the cockpit should have sent me a signal. I should have stressed to my new guy that shy behavior and precise cockpit communication is an oxymoron. We can never assume anything about the other crewmember while flying. When we aren't as precise as possible in communicating thoughts, ideas, and directions, there is a degradation of safety and a sharp increase in potential risk.

In Army aviation, as well as in every aspect of today's society, there seems to be a decline in understanding between individuals caused by a simple lack of or breakdown in communication. The only way to improve our skills in this area is to practice constantly. Mission prebriefs and postbriefs are ways to identify and correct deficiencies in communication. ✈



Who's Fit?

...and for those who are not

FREDERICK V. MALMSTROM, Ph.D.
Certified Professional Ergonomist

Nobody denies physical fitness is good for you. The only discussion is how we should get there. Some years ago, a reporter from the Air Force Times told me few articles generate as many letters to their editor than ones on the Air Force's physical fitness program(s). Alas, the topic of today's Air Force Bicycle Ergometer Fitness Test is a sure-fire way to spark arguments and food fights amongst otherwise genteel Air Force ladies and gentlemen.

The Air Force has been in search of the ideal physical fitness measure. During my career, I could recall the Air Force evolving through many measures, beginning with the (Army) Physical Fitness Test {1957}; (RCAF) 5BX Test {1963}; (Cooper) 1½ Mile Run {1969}; 3-Mile Walk {1984}; and the Bicycle Test {1993}. Which one of these measures is best? Well, the answer is one of those "It depends" things. I do, however, have some facts which I'd like to share with you.

Aerobics Are Scientific

For centuries, athletes have known there were at least two kinds of physical fitness, power versus endurance. However, only in this century two scientists, A. V. Hill (1922) and Sir Hans Krebs (1953), received well-deserved Nobel Prizes for their discoveries of the body's anaerobic (power) and aerobic (endurance) energy conversion pathways. Despite the Hollywood ballyhoo attributed to aerobics, I present these factoids to stress that aerobic fitness is not a fad, it is scientifically respectable.

For the unenlightened, aerobic fitness is measured by the maximum ability of the body to burn oxygen efficiently, expressed in milliliters 02/kilogram body weight/minute (i.e., ml/kg/min), aka VO_2 max. VO_2 max can be achieved only by pushing the body's cardiovascular system to its limit over a long period (5 minutes or longer) of exercise. Long-distance running is, of course, an excellent aerobic conditioner.

So, in 1969, Maj Kenneth L. Cooper, M.D., then an Air Force physician, published a landmark research paper in the Journal of the American Medical Association on aerobic fitness among Air Force personnel. Following suit, the Air Force declared the Cooper 1½-mile run as THE physical fitness standard; anaerobic fitness was declared

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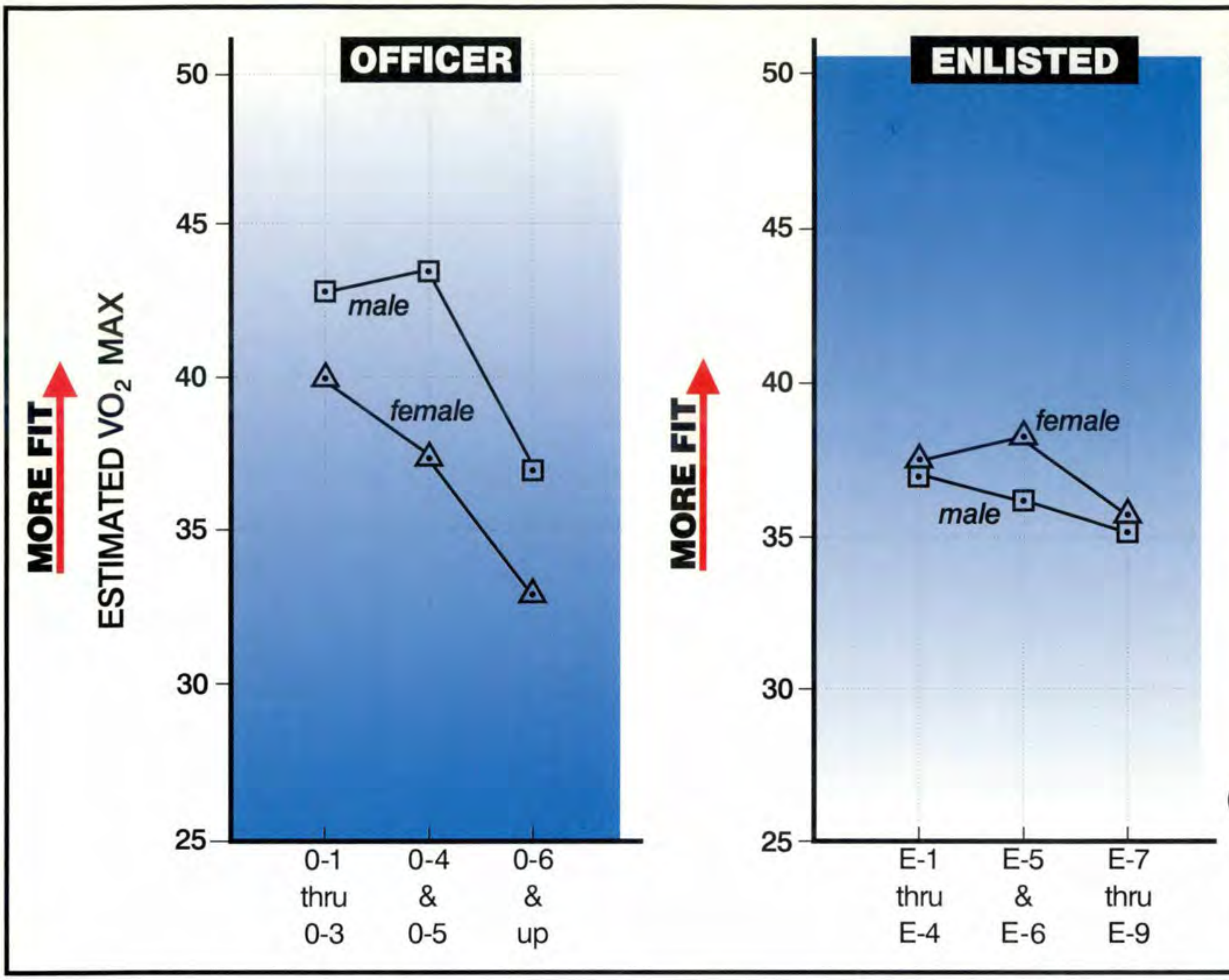

optional. Aircrews were to maintain rigidly higher aerobic fitness standards than nonrated personnel. Air Force personnel with a VO_2 max greater than 33.7 ml/kg/min were declared "fit." That is, to pass the test, you had to run at least 1.25 miles in 12 minutes; 1.5 miles in 12 minutes was the average.

There are at least five ways to measure physical fitness, each measure with its own good news and bad news. The most accurate yardstick is a 100 percent theoretically valid concept known as Physical Work Capacity (PWC) which can, unfortunately, be known only by unethically working a person to utter physical exhaustion. The second best measure, VO_2 max (about 90 percent theoretical validity), absolute aerobic capacity, can be estimated only by hooking up subjects to an oxygen-measuring device during prolonged physical exertion. The third best measure, maximal steady state cardiac output (about 85 percent theoretical validity), requires direct measurement of heart rate. The fourth best measure, prolonged, sustained maximal running speed (about 81 percent theoretical validity) is easily measured. The fifth best measure, prolonged submaximal steady state heart rate (about 60 percent theoretical validity) is presently used by the Air Force in the modified Astrand Bicycle Ergometer Test.

For the unenlightened, aerobic fitness is measured by the maximum ability of the body to burn oxygen efficiently, expressed in milliliters 02/kilogram body weight/minute (i.e., ml/kg/min), aka VO_2 max. VO_2 max can be achieved only by pushing the body's cardiovascular system to its limit over a long period (5 minutes or longer) of exercise.

What the Air Force Is Doing

Why has the Air Force switched to a different type of fitness test? The short answer is that Air Force physical fitness programs are largely individual. Whereas other services typically schedule daily and weekly mass physical fitness training for all personnel, the individual air-

crew is usually expected to provide his or her own exercise program, and, therefore, the motivation. Motivation, or the lack of it, is the key. If Joe Flyer remains an unmotivated sofa slug all year and suddenly runs a 1 1/2-mile sprint, he has an invitation to a heart attack. So, in 1993, the Air Force adopted the submaximal bicycle test. Definitely less accurate but definitely safer and is still a decent test.

I routinely hear complaints from aircrews who say they jog regularly and then flunk their annual bicycle test. Likewise, they tell me of Maj Overweight Smoker who breezes through the bicycle test every year. The answer to their righteous complaint is that no test is perfect. Science is riddled with false alarms and misses. Medics call them false positives and false negatives. Furthermore, if you want to perform well on a running test, practice running. If you want to perform well on a bicycle test, practice bicycling.

In 1991, one of my Air Force graduate students pulled the physical fitness records of 100 randomly selected 18- to 50-year-old Wright-Patterson AFB officers and NCOs, both male and female. We compared their times to complete the 1 1/2-mile run. The results showed officers were more physically fit than NCOs, and males had better aerobic fitness than females. (Because VO_2 max is a measure of total body mass, not just lean muscle mass, females always, by definition, pay a penalty in measures of aerobic fitness. Likewise, 18-year-olds have a natural aerobic advantage over 50-year-olds.) However, against all expectations, the sample of eighteen 30- to 40-year-old officers, most of them rated, showed their aerobic fitness superior to all other groups!

In 1995, Capt Gregory A. Esses and I decided to repeat the study. We randomly pulled the fitness records of 225 Air Force Materiel Command officers, NCOs, and airmen. (By this time, the bicycle test had replaced the 1 1/2-mile run, so we had to convert heart rate to estimated VO_2 max.) The results, shown in the figure, were consistent with our 1991 study.

There were, as expected, significant differences between officers and enlisted, and there were the significant differences between fitness levels of males and females. However, the differences applied only for officers. Enlisted males and females scored about the same levels of fitness.

It is truly mind-blowing, however, to consider our male O-4s and O-5s (the majority of them rated) actually consistently score higher on physical fitness than their O-1, O-2, and O-3 contemporaries. It's as if we have a group of 35-year-old men in 25-year-old bodies. It is quite obvious most field grade aircrewmen take their physical fitness quite seriously. Here is a group of middle-aged men worthy of further study.

Some Valuable Fitness Tips

Here are some valuable lessons learned from rated majors and lieutenant colonels. I'll give you three guaranteed tips, putting the most important one first.

1. Quit smoking. You will live longer. The average nonsmoker lives about 7 years longer than the smoker. Rated personnel smoke less than nonrated. My latest statistics also showed fewer than 2 percent of Air Force Academy cadets now smoke cigarettes.

2. Lose weight. Being overweight puts unnecessary strain on your cardiovascular system. Shed fat and, by definition, you'll improve your VO_2 max. Persons with weight below norms live many years longer than persons with weight above norms.

3. Start an aerobic fitness program. Check with your flight surgeon first, and then begin an aerobic fitness program. Any Air Force gymnasium has personnel who will offer professional tips and instruction on how to begin a program. Also, most commercial home exercise equipment developed during the past 15 years are fine, technological improvements, and they're getting cheaper all the time. I encourage anyone to invest in aerobic home exercise equipment—check the classified for good second-hand deals. It's a fact that persons with cardiovascular fitness enjoy a higher quality of life and have greater resistance against stress, fatigue, and disease.

Follow these tips for a better chance at staying fit!

PHC Johnny R. Wilson USN

MISTER TOAD'S WILD RIDE

LCDR RICK DOLAN
LT EUGENE CHAN
Courtesy *Approach*, Sep-Oct 95

A quick approach and we can call it a day. Current ATIS: 1735L, wind 020 at 10, ceiling 800 feet overcast, visibility 1,500 meters with rain showers, runway 01 in use, altimeter 30.03. I'm in the left seat, but tonight is a good night for the "old guy" to log an approach. I set the cockpit up for the NAF ILS. After takeoff, we remain VFR over the harbor. I contact Approach for an IFR pick-up to a PAR full-stop.

Approach clears us, "Squawk 5211, climb and maintain 4,000 on present heading."

We comply and enter the clouds at 700 feet, heading 340. It's thick, dark, cold, and raining moderately. I include the OAT in one scan. It won't be a problem. We level at 4,000 feet, and without delay, Approach turns me left to 240 and hands me off to NAF GCA. I call for landing checks. My copilot, backed up by our crew chief, does the checks. Then GCA turns me right to 300 for sequencing and clears me to 1,500 feet.

I report leaving 4,000 feet and start my turn. Descending through 3,500 feet, the aircraft lurches, and a bright light illuminates the cockpit, followed by electrical arcing and smoke. We have an electrical fire.

The automatic stabilization equipment (ASE) has failed, and my attitude gyro is laying on its side with the OFF-flag showing. My copilot's gyro is the same. The rest of my last normal scan on this leg reveals that I have lost my gyro compass. All my panel lights are flashing. My copilot has his flashlight out, but it's flickering at best. The crew chief has the fire extinguisher ready, but we can't isolate the fire. The circuit breakers pop and isolate the fire for us. It's all compressed into one fateful moment, and now we're on a circus ride.

I call Approach and declare our emergency. I'm assessing as I report the status of our equipment. I think, "Ball is out. Keep it centered. Maintain 70 knots. Keep the needle straight." Controller tapes later indicate it has been approximately 11 seconds since things started going wrong. Our NAF controller offers a partial-panel GCA and I accept, feeling that I should be able to do it if I can just fly level long enough to get my bearing. After all, I have a needle, ball, airspeed, torque, and VSI, right? My training forces me to believe the gauges. Yet, I feel the attitude excursions are getting larger and larger.

The turn needle is straight up. It isn't moving. Everything else is. The crew chief in his gunners belt is alternately pinned against opposite sides of the aircraft. My copilot's head bobs fore and aft. He later reports seeing me pulled out of my seat to the limits of my harness.

I try making small, deliberate control inputs as I scan the gauges I have left. The turn needle is dead. Without it, we have no way of knowing our attitude. I set 55 percent torque and try to stay in that range.

It's black outside the cockpit. I feel lateral accelerations or uncoordinated rolls in my seat. I try to center the ball. It comes in, but not to center. It's diverging. I know it. Another cycle, then Approach asks me to maintain present heading. I ask them to stand by. The instruments show we're at 1,900 feet and 70 knots, with a centered ball. It's transient. The airspeed needle is racing toward VNE. The aircraft is over on it's side, but which side? The VSI shows a 4,500-plus fpm descent rate. I think, "This won't last much longer."

A dim light penetrates the darkness outside the cockpit. My aircrewman calls it out. It is a small hole at best, a layer between clouds. I see a line of distant lights that extend from top left in my windscreen down to the wet compass on the center glareshield. If the lights are on the ground, then we are near 45 degrees left-wing down. If not, oh, well. I'm out of options. I push the stick right. The airspeed was already slowing from my last correction.

Our descent stops almost immediately. I call Approach and fly to the lights. Ground radar provides obstacle clearance. We maintain VMC and clean up the cockpit with the checklist en route. Two minutes and 25 seconds after it started, our wild ride is over, but we are still flying. We won't get any of our equipment back. The failure was permanent. The lights are on the beach 10 miles south of NAF.

We make our way west over the beach, occasionally as low as 150 feet AGL to avoid clouds. I follow the route of VFR course rules into the field. We discuss the possibility of landing short of our destination, but I am familiar with the terrain, wires, and obstacles, and the route doesn't overfly any residential areas. I fly cautiously at 40 knots, with the searchlight on as the entire crew keeps a sharp eye out for obstacles. We pass over the highest wires with an uncomfortable margin due to the ceiling. Approach is giving us our position from the field and track. I pick up the approach lights inside a mile, make an uneventful landing, and shut down.

Water accumulating in our ASE-channel monitor panel probably caused the electrical fire. Power surges opened fuses in the ASE amplifier, turn-rate gyro system, yaw-rate amplitude demodulator, and popped the No. 2 lighting circuit breaker. The main cannon plug for the ASE-channel monitor panel was missing three pins, and the heat from the arcing had damaged the remaining pins. Maintenance confirmed there was nothing we could have done in flight to regain use of any of those systems.

We regularly check the components mounted under the pilot and copilot windows for water. Did we use all of our options during this emergency? Perhaps not. But we can analyze our conduct in the comfort of the ready room trying to identify what else we might have done.

Look closely at redundant systems that share common components and beware. Everyone has practiced ASE-OFF partial panel back in the training command and thought, "This will never really happen." ✈

IT WAS A NORMAL DAY FOR OUR VH-3H VIP DET. WE FLY PASSENGERS FROM THE SHIP TO THE HELO PAD AT THE NAVAL STATION, DROP THEM OFF, THEN HEAD FOR HOME. WE ARE ONLY 14 MILES NORTHWEST OF THE FIELD......

Silent Boom

It's hard to fathom such a fatuous, yet so preventable, ground incident could ever happen on an aircraft maintenance flight-line—especially on a United States Air Force flightline!

CMSGT DON A. BENNETT
Technical Editor

Prelude

These kinds of careless, senseless mishaps might have happened long ago, but after decades of improvements, our Air Force Mishap Prevention Program is now one of the world's best. In this case, surprisingly, it seems most of the "new and improved" aircraft maintenance activity processes (training, quality assurance, vehicle upkeep, supervision, management, and individual as well as organizational discipline) were seriously broken. Despite this, our Air Force mishap rates reflect constant improvement. So how could this highly preventable ground mishap occur—and so blatantly? What went wrong?

Well, what went wrong was there were multiple levels of complacency combined with an unhealthy dose of apathy—therefore, inaction. Many people and agencies up and down the mishap prevention chain of command were responsible for bringing this regrettable mishap to its full fruition. Nobody in the mishap chain stood up in their area of responsibility to stop the mishap's forward momentum. All it would've taken was just one. That's what went wrong.

Silent Boom Signals

The incident involved a USAF 7.5-ton crane being used to lift a 3-ton-plus load during an aircraft maintenance activity, and it fell over on its side. Besides damage to the crane, the aircraft was extensively damaged as well. Thankfully, no maintainers were killed or injured. Still, the mishap was an embarrassing, costly event.

The toppling crane probably made a loud noise to signal the instant of the mishap. However, in hindsight, the most thunderous signals imaginable that a high potential existed for a mishap of this magnitude were loud, clear, and continuous long before the mishap, yet they either weren't heard or went unheeded.

Luckily, you might say though this incredible unresponsiveness or inaction (silence) on the part of us human beings when there's a known safety hazard represents only a "silent minority" in our Air Force mishap prevention efforts. However, regretfully, it takes only a small fraction of our total annual aircraft maintenance events—Air Force-wide—to result in some form of mishap, yet they cause us major grief. And remember, an even smaller fraction of all mishaps results in major death and destruction events.

Unfortunately, it's these fractions which cost the Air Force big time in scarce resources and mission readiness. So let's agree here and now there's always an urgent need to bring even these silent minority folks into the folds of responsible, responsive maintenance management and mishap prevention. Let's also agree there's never any room for individual or organizational apathy in the aircraft maintenance business—too many lives and valuable resources are at stake.

For the sake of this discussion, it really doesn't matter the make or model of the incident crane, type of aircraft, or maintenance activity. That's not what's really important here. The mishap could've involved any aircraft, any piece of equipment, any vehicle, at any place. Besides it's reasonable to assume all the parties responsible for the crane's safe operating procedures—its maintainability—its serviceability—have **now** heeded the distress signals emitted from this costly incident and have taken the appropriate actions.

Although the maintenance team members employing the crane were supposedly trained to perform their respective tasks, the crane training course was discov-

In this particular tipover incident, the mishap load was over 2,200 pounds *more* than the crane's boom angle and boom radius allowed by tech data. The difference in what the tech data called for and the mishap crane's actual boom angles and boom radii at the time of the mishap were 19° and 9 feet, respectively.

ered to be faulty and inadequate for the safe, effective training of prospective crane operators. Why was the course found defective? The crane's been around quite some time. The incident operator was a "seasoned" crane operator. The incident base had successfully performed this task many times before. So how did a defective course lend itself to his mishap?

The Boom Angle, Radius, Weight Factor

Any crane under load has some critical operating factors that have to be considered to ensure the whole outfit doesn't become unbalanced and tip over. These factors are boom angle, boom radius, and the weight of the intended load. If the weight of the load is a constant, then the only possible variables are the boom's angle and radius. However, changing any one of these two variables will not only affect the other, but could also cause the weight of a properly calculated safe load to change to an extremely unsafe load.

For instance, if the boom angle is decreased and the boom's radius increased, the maximum weight of the load has to be reduced. If the load weight is not reduced, a tipover is very likely. So, naturally, it's imperative the crane operator pay keen attention to this "weight/angle/radius" formula *before* the operation is started and especially during an actual lifting operation.

In this particular tipover incident, the mishap load was over 2,200 pounds *more* than the crane's boom angle and boom radius allowed by tech data. The difference in what the tech data called for and the mishap crane's actual boom angles and boom radii at the time of the mishap were 19° and 9 feet, respectively. Big differences, ?

Supposedly, the criticality of this weight/angle/radius formula wasn't stressed or emphasized during the crane operator training course. The course lesson plan didn't even have an instructor's note to do so. So is it any wonder the base crane operators might not pay very close attention to this important factor during lifting operations?

It probably didn't help any that the mishap lift activity supervisor wasn't crane operator-qualified or knowledgeable enough of the tech data requirements to even perform duties as a lift operation supervisor. After all, as a lift activity supervisor, how would you know if the crane operation is being conducted safely if you don't know what constitutes a safe or unsafe condition?

Publications

Plain and simple, the crane's tech data didn't have any additional warnings or emphasis concerning the weight/angle/radius factor. So, between the inadequacies in the tech data and the crane operator training course, all future crane operators were sent out to the field *without* enough critical operating information to ensure the success of the lift operation or their own safety.

The applicable weapon systems tech data covering the intended maintenance operation interjected even more confusion. The tech data incorrectly listed the aircraft component to be lifted as over 1,300 pounds *less* than the actual weight of the incident component! The listed component weight was that of a previous model, but nobody (that means the applicable depot, MAJCOMs, wing/base, and any squadron Air Force-wide employing this particular crane) had expended the efforts necessary to detect or correct this misleading data—data absolutely critical for safe lifting operations.

In addition, the crane's tech data also had an incorrect weight for the hoist block. This publication error equated to a difference of 107 pounds *more* actual pounds lifted than prescribed by the tech data! Add this erroneous

continued on next page

Better to rise up for the occasion than to sit back, do nothing, and listen for another "silent boom." Who knows? It may be *your* last opportunity to do so.

weight to the incorrect component weight and you have a high potential for a tipover every time this operation is carried out. That's Air Force-wide, folks!

In the science of "weight and balance" activities, it doesn't take much to tip the scales one way or the other. Yet, in this incident, it took over 2,200 pounds to finally topple the crane with the vehicle outriggers (stabilizers) deployed! That equates to a lot of "margin of safety" that was used up to eventually tip the crane over.

The Crane Itself

Apparently a design oversight or inadequate vehicle maintenance upkeep of the crane might have also added a significant ingredient to the mishap scenario.

The crane has a boom angle indicator located on the boom itself which is in full view of the crane operator. This safety device allows the operator to verify the correct boom angle before, and especially during, the actual lifting operation. Unfortunately, the boom angle increments on the incident boom angle indicator didn't agree with the manufacturer's recommended boom angles (with relation to the radius).

This obvious confusion has led all unit crane operators to estimate the required boom angles which, remember, also affects the boom radius and the load weight. Since the correct boom angle relates to the correct radius, and the correct boom angle and radius both directly relate to a safe lift capacity, we can clearly realize the safety ramifications of misreading or miscalculating with this boom angle indicator.

Silent Apathy

After the mishap, a lot of folks (including the participants) had something to say about their past safety concerns on this lifting operation. However, nobody—not one—saw fit to channel their well-founded safety concerns to those above them. Somewhere, somebody could've fixed all the above inadequacies in short order, i.e., when extremely unsafe conditions existed. But all the knowledge in the world about unsafe conditions is useless if it isn't passed on to those who can eliminate the hazards.

It goes without saying that when people learn to tolerate or continually work around known safety hazards, it's just a matter of time until a mishap strikes. Apparently, some of our Air Force maintainers haven't totally embraced or internalized this hard-fought safety credence in their day-to-day routines. They choose, instead, to remain silent until one day they put not only their fellow maintainers at high risk for injury or death, but themselves as well.

Epilogue

Many players unwittingly orchestrated this loud and clear "silent boom" into a flightline incident. This ground mishap just laid in wait for a long time before striking. It smacks of a reaction mode in mishap prevention instead of a proactive mode. It also, as well as other past highly visible ground and flight mishaps, represents a serious breach in our defenses against flight, ground, and industrial mishaps. It should never have happened.

In fact, the majority of our ground and flight mishaps should not have happened. They're mostly human-caused in some form or other—apathy being an excellent consideration. These are mishaps we all can lend a hand in preventing in the future if we only take the appropriate actions at the appropriate time when we see something is wrong. Whether we are responsible for identifying, initiating, or implementing the corrective action of a known hazardous condition doesn't matter either. We're all on the same United States Air Force Mishap Prevention Program team. ✈

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There I Was

Official USAF Photo

Oy! Who's on First?

ANONYMOUS

There I was...an experienced control tower watch supervisor getting a little time in local control. We weren't real busy, but enough was going on to make it fun. I had two Eagles in the pattern with more gas left than most other fighters can carry. A transient Viper was inbound on an instrument approach, and that was all the traffic I had.

I told you it wasn't very busy. As Eagle No. 1 was in the break, I sequenced him inside of the F-16 5-mile final. Eagle No. 2 was sequenced behind Eagle No. 1 as he turned initial. Eagle No. 1 configured, and once he got a visual on the F-16 said he would rather not turn in front of the Viper and was breaking out to reenter. (He was in no hurry, and besides, he had enough gas to power a school bus until the year 2043.)

I told Eagle No. 1 to report the VFR entry point, checked the wind, and scanned the runway lest our fearless Viper drivers collide with one of our fearless rabbits. Eagle No. 2 called base. Wind check, low approach clearance, we were cooking with gas.

After bringing my binoculars from the runway/rabbit scan, a quick check to make sure our Electric jet driver had put down his hydraulic landing gear was in order. Unfortunately, what I saw as I turned to look up the final approach course to visually acquire the F-16 was not what I expected. Eagle No. 2 was rejoining on the Viper on a 1.5-mile final!

The next three things happened simultaneously. The Viper started a turn away from final and the Eagle (thank you, sir, whoever you are). I asked the Eagle if he had the F-16 in sight (I didn't think he was ever aware there was an F-16 within a million miles of him—I never told him), and the PAR controller started asking (yelling) "WHO'S NUMBER ONE?!?" Boy, things were happening fast now!

Eagle No. 2 quit thinking about aim-point, airspeed, and all that other pilot stuff and tightened the turn to stay on his side of final, turned out of traffic at midfield, and reentered. In the space of a few seconds, I had created my own little air show. The only difference was I was not enjoying this unscheduled aerial demonstration one little bit.

Eagle No. 2 and the Viper parted company without swapping any paint as Eagle No. 1 reported reentering. The Viper left, I got someone else in position, started breathing again, and tried to figure out what happened.

When Eagle No. 1 said he was reentering because the Viper was too close, I made what I thought at the time was a common-sense assumption. I figured if Eagle No. 1 was too close to turn inside, then Eagle No. 2 would turn behind the Viper and all would be right with the world. The only problem—I never told Eagle No. 2 that I had a new plan. The Viper driver was looking for an Eagle to turn inside him, not IN to him and was probably the one action that broke the chain of a potential catastrophe. The accident board might have blamed the Eagle pilot for not clearing his flightpath, but would have certainly pointed the fickle finger of fate squarely at me. ✈

FRANKLY SPEAKING...

A note written by a young girl passenger and handed to the pilot on a commercial flight.

Dear Captain,
My name is Nicola.
I'm 8 years old.
This is my first flight
and I'm not scared. I
like to watch the
clouds go by. My
Mum says the crew
is nice. I think your
plane is good. Thanks
for a nice flight. Please
don't bugger up the landing.

Our thanks to the fine folks at *FLYING FEEDBACK*
Australian Defense Force
Directorate of Flying Safety - Air Force
Calligraphy by Miss Jennifer Moreland