flying

SAFETY | SEPTEMBER 1983

Some Physics of Turning

WHEN IS AN EMERGENCY A REAL EMERGENCY?

THERE I WAS

■ . . . enroute to the air-to-surface range to deliver some practice bombs. We were a 4-ship at 8,000 feet under IFR control.

Approach Control called out opposite direction traffic at 8,500 feet at 10 nautical miles (unverified altitude). Approach Control then called the same traffic 4 nautical miles at 8,000 feet.

Our flight lead then asked for avoidance vectors. By the time we were issued them, another flight member called "pull up."

We missed the light aircraft by 200 to 300 feet. Lessons learned:

- See and avoid is paramount.
- Unless both aircraft are under IFR control by the controlling agency, there is no requirement to issue avoidance vectors to the IFR aircraft.
- It is better to ask for avoidance vectors early and not need them, than wait until it's too late. ■

UNITED STATES AIR FORCE **flying** SAFETY MAGAZINE

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ABOUT THE COVER
You can make a dodecahedron (see drawing above). Simply photocopy this cover and cut on the outside black lines. PLEASE DO NOT CUT OUT THE COVER, as this magazine is intended for at least three readers. We hope you enjoy our first three dimensional cover.

Cover photos courtesy of Mr. Walt Weible USAF Recruiting Service.

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SPECIAL FEATURES

REGULAR FEATURES

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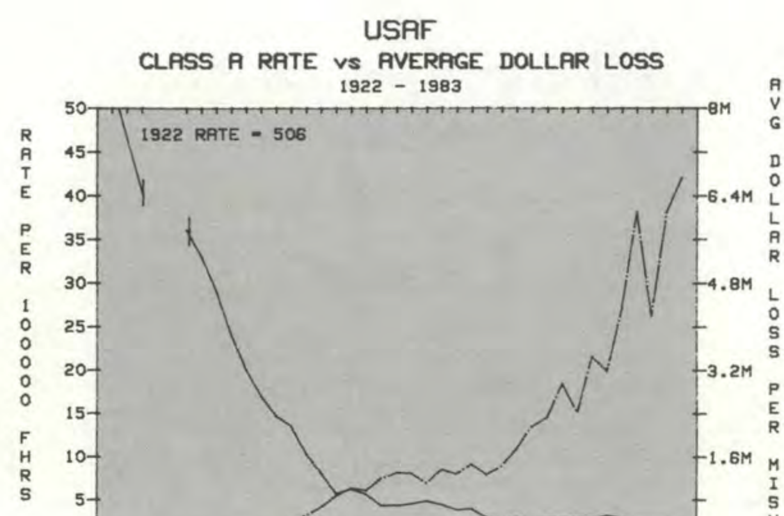
A SYSTEM FOR SAFETY

MAJOR JOHN E. RICHARDSON
Editor

■ The Air Force has a problem! Flying safety and preservation of resources has always been a concern of the Air Force. As a result of this concern, the USAF mishap rate has steadily come down to an all-time low of 2.33 Class A mishaps per 100,000 hours in 1982. Such an achievement is truly noteworthy, but at the same time this very achievement highlights the seriousness of the Air Force's problem (see figure below).



As you can see, although the rate of mishaps has fallen dramatically, the cost of mishaps has risen even more dramatically. The average cost of a destroyed aircraft has risen from $200,000 in 1947 to $6 million in 1982. And, as our aircraft become even more sophisticated, these costs will continue to climb. Clearly, we must do something, but what?

The foundations of a better way are found in a concept called system safety. This concept is to identify and evaluate hazards and risks and take action before the mishap occurs. In effect, what we are trying to do is take a before-the-fact approach to mishap prevention.

What is so revolutionary about this concept? Well, nothing, except that it is just the opposite of the traditional approach. Historically, aircraft design and safety analysis have been built on a ''fly-fix-fly'' approach to the problem.

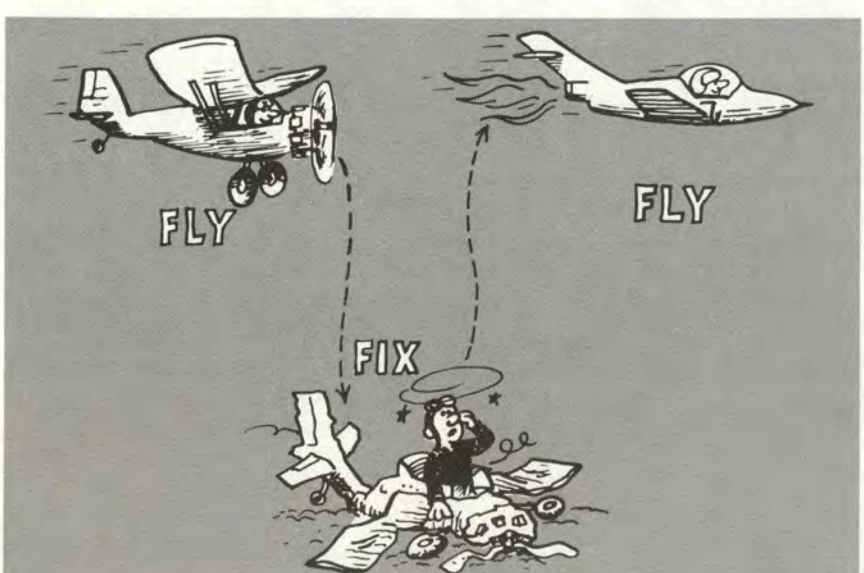
First, we build an airplane to meet an operational requirement. Then, when a mishap occurs, we investigate and feed the information on cause back into the system for modification. This somewhat informal approach to aircraft mishap prevention has

Photos courtesy of Mr. Walt Weible USAF Recruiting Service

been around since Lieutenant Tom Selfridge died in the first fatal military aircraft mishap. However, in today's highly sophisticated and costly aircraft operations such a reactive approach is wasteful and counterproductive.

The system safety approach is to identify potential problems and hazards, than analyze them for mishap probabilities and severities, and, finally, take steps to eliminate or control those hazards. All of this is done early in the design of a system before it is produced or deployed. This does not mean, of course, that every hazard is eliminated. Rather, it means that every known hazard is considered and actions taken are based on the risk of a mishap and the potential for damage or injury. When approached in this manner the problem of designing a safe, operational system can be solved in a disciplined, cost-effective way — concentrating on the most serious potential problems.

System safety in the Air Force is primarily concerned with design of new weapons systems. That does not mean that system safety concepts cannot or should not be applied to mature, operational systems. Quite the contrary — every Air Force system is considered. However, the biggest payoff obviously is in new systems development.



Although the system safety concept has been around since very early in Air Force history, it was not until the technical demands of the ballistic missile and space programs forced it that a formalized system safety program was implemented.

The basis for modern system safety program requirements within the Department of Defense is Mil-Std-882A. The foreword to this Standard states:

> "The principle objective of a system safety program within the Department of Defense is to ensure that safety, consistent with mission requirements, is designed into systems, subsystems, equipment, and facilities."

As mentioned before, the purpose of system safety is to identify the potential hazards in a system before the fact. This includes not only the factors of man, machine, and environment, but also the underlying management annd supervisory controls available. The system safety program is established to balance risk against controls. The factors to be considered include on one side the probability of occurrence of a mishap as a result of a hazard and the severity of the damage. These are compared with the costs and effectiveness of controls.

Sometimes, it is not practical to engineer a control for a hazard. The result of that hazard may be severe, but the probability of occurrence is so low that the control is not cost-effective.

On the other hand, a dynamic

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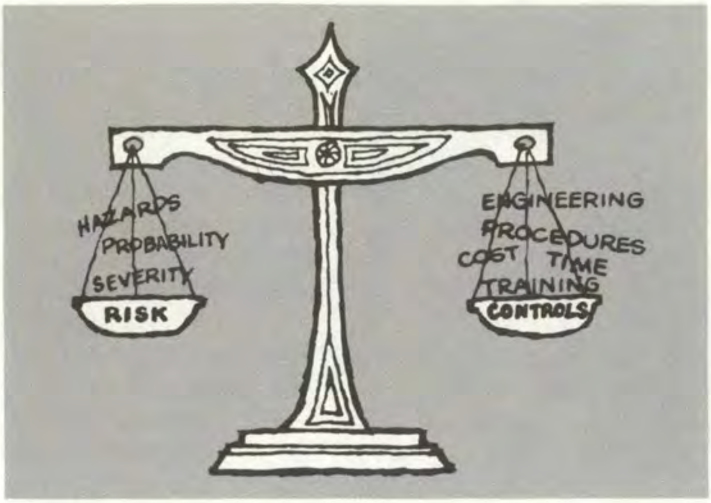

Hazard Severity

Category	Name	Characteristics
I	Catastrophic	Death Loss of system
II	Critical	Severe injury or morbidity Major damage to system
III	Marginal	Minor injury or morbidity Minor damage to system
IV	Negligible	No injury or morbidity No damage to system

Possible Hazard Qualitative Probability Ranking

		Occurrence Description	
Description	Class	Item[a]	Inventory[a]
Frequent	A	Likely to occur frequently	Continuously experienced
Reasonably Probable	B	Will occur several times in life of item	Will occur frequently
Occasional	C	Likely to occur during life of item	Will occur several times during use
Remote	D	So unlikely it can be assumed this event will not be experienced	Unlikely to occur but possible
Extremely Improbable	E	Probability occurrence cannot be distinguished from zero	So unlikely, it can be assumed the hazard will not be experienced
Impossible	F	Physically impossible to occur	Physically impossible to occur

[a] *Item* refers to a single component or system. *Inventory* refers to a large number of the items or systems.

system safety program will identify those hazards where the risk probability of a mishap and the severity of the resulting damage make controls essential.

This is all fine, you say, but how do we design a system to correct hazards we haven't seen yet? Well, the answer is that very often we *have* seen them. Feedback to the system safety program is a key to design of future systems. Analyses of mishap data by the Air Force Inspection and Safety Center, Air Force Logistics Command, and Air Force Systems Command are key sources of information through which improved systems are brought into the Air Force. An example of this kind of analysis is discussed in Major Dailey's article on GPWS on page 17 of this issue.

Engineers are not the only input to this system. Operational aircrews and commands can make their desires known through several channels. Those most familiar to aircrews include the Hazard Report and Material Deficiency Report systems. There are also the reports for changing T.O.'s (AFTO Form 22) and publications (AF Form 847). There is also the AFR 127-4 mishap reporting system, of course.

Another way to affect the design of a system is through inputs to the AFSC- or AFLC-sponsored system safety groups for the individual weapons systems. MAJCOMs have representatives to these groups for those systems about which they are concerned. In each of these cases the feedback from those who are actually using the system will affect design changes. But this feedback can only be effective if the data collection systems are used aggressively by the aircrews. If the designers don't know about a problem, they can't fix it. For more information talk to your flying safety officer. ■

JUST A SLIGHT SMELL OF BURNING RUBBER

CAPTAIN JAMES M. WRIGHT
60th Bombardment Squadron

■ . . . There I was cruising along just above a snowy white cloud deck with a beautiful blue Texas sky above and with friends I hadn't seen in a year waiting for my arrival. It was peaceful cruising there alone above the weather with the sun shining brightly; my mind was wandering, enjoying the view. Then it happened, nothing traumatic, but just a slight smell of burning rubber.

The engine instruments looked OK, but I turned off most of my electrical equipment to see what would happen. The smell went away and I turned my equipment back on piece by piece. I left the pitot heat off, thinking it was the culprit. As soon as that crisis was over I called for destination weather and learned it was zero-zero. Well, no use wasting the time flying down there since it had been zero-zero for the last 24 hours and the rest of the state wasn't in much better shape.

I requested an ILS approach for my alternate and was cleared down into the soup. I turned the pitot heat back on and waited for the smell of smoke. After a few minutes there was no smoke and I forgot all about that problem to concentrate on the problem at hand.

The lower I descended the darker it got outside, and the bumpier the ride became. Center vectored me all around the southwest and finally got me lined up with the ILS, instructing me to keep my speed up. So much for a leisurely approach! The weather was a mile with rain and fog and a 500 foot overcast; no problem, all I needed was half a mile and 200 feet.

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The bumpy ride and extra airspeed weren't helping the approach any when the radios decided to go intermittent. I couldn't get a good glide slope indication; the off flag would not make up its mind where it wanted to stay. I thought about shooting the localizer approach, but the minimums would be too high and I would still be in the clouds at the MDA.

I called outer marker inbound to tower and started down, however, the tower did not answer my calls. I called the tower several times with no answer. I could hear them talking to other aircraft and about me, but could not get them to talk to me. I thought about squawking emergency, but I was coming up on the MDA so I decided to look for the runway.

At this time I was getting intermittent off flags all over the place. Luckily I could see the ground, but only straight down. The ride was still pretty bumpy and although it was 38 degrees outside I was sweating like I had been in a steam bath for the last hour. Then tower came up telling me I was left of course, or was it turn left? Well, frijoles! Here I am at decision height with no radios, no runway in sight and with the last transmission from tower confusing the situation even more. I didn't think the visibility was a mile, more like half a mile but no matter, there was the runway *way* to the right.

I cranked the airplane over and landed long and fast. Not one of my better landings; tower flashed green lights at me so I taxied to final parking. I turned the aircraft off and tried the radios again. What do you know — they worked; the nav aids and everything came up with no off flags and tower read me loud and clear. Chalk it up to those aircraft gremlins.

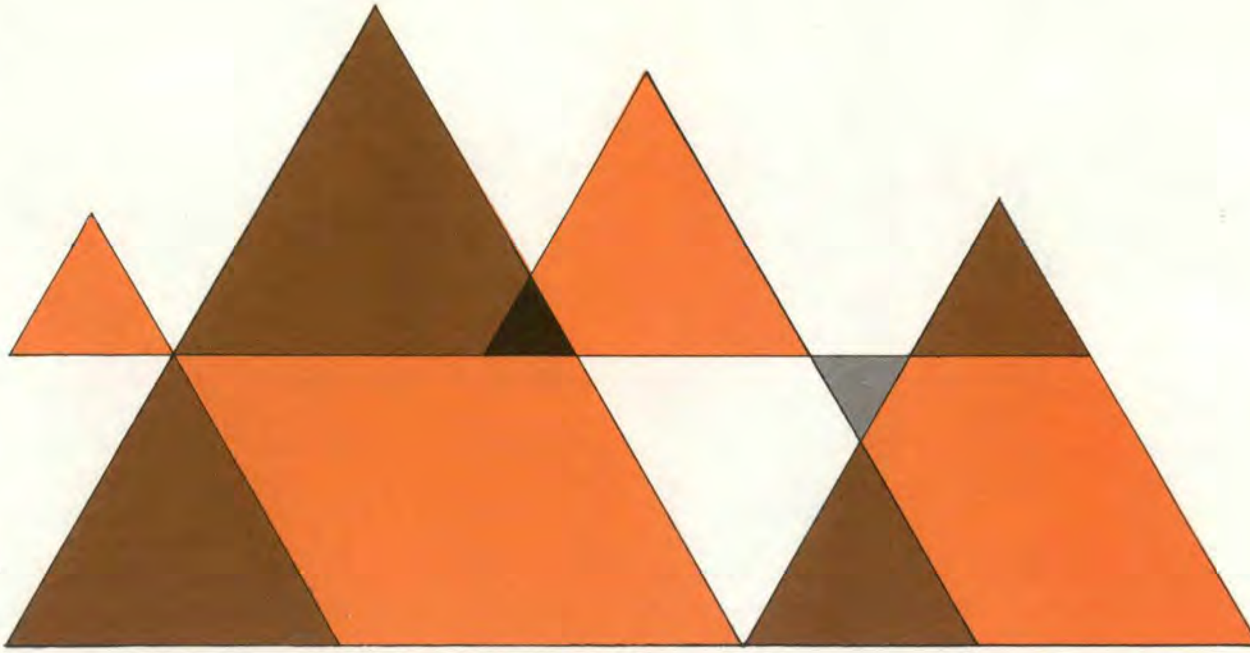
The next day I filed and preflighted, anxious to get going before my time ran out and I had to get back to work. The plane would not crank over and I wondered how I was going to get back to home station. I crawled out to take a closer look at the engine. I removed the cowling and discovered where the burning rubber smell had come from the day before. Apparently the alternator belt had broken and burnt. It would be no problem to replace and I could be on my way.

Maintenance arrived and noted that the belt had broken because the alternator had frozen up. Although I could receive ATIS that morning, the battery was basically dead.

Hmmm, that means yesterday in the weather, at decision height, barely below the clouds, with no runway in sight I had no electricity! Maybe that's why it was so dark and all the off flags kept popping in and out. If I had continued two more hours to my destination, I would have been lower on fuel with two hours flight time remaining and basically out of luck!

I learned my lesson. If you smell something burning, even for a second or two, land ASAP and take a close look at everything, not just the instruments that are now working OK on the ground.

"Get-home-itis" was the last step needed to make this home bound flight into a one way ticket to the pearly gates! Haste would have certainly made waste in this situation. Don't let "Get-home-itis" get you! ■



Critical Triangles Of Agreement

CAPTAIN JAMES D. PRICE
Vance AFB, OK

■ After a few tours on static display duty, you know exactly what the visitors are going to ask.

"Is that the gun?," referring to the pitot tube, and "Gee, look at all those instruments! How do you keep them all straight?"

I don't know about you, but at one time, that last question made me feel almost super human for a moment. When you think about it, the engineers who design our aircraft with "all those instruments" are pretty darn smart. There are back-up instruments to the back-up instruments in some aircraft, each driven by independent sources of information and various forms of power. You may not realize it, but all these instruments form corners of triangles, called critical triangles of agreement.

To emphasize my point, I will refer to some very unfortunate mishaps which could have been averted, if someone in the cockpit had applied the principle of the critical triangle of agreement. I'll also refer to some incidents which did not turn into mishaps because the critical triangle of agreement was employed.

Back in 1974, a Northwest Orient flight crew departed New York in a Boeing 727. They were on a charter flight . . . the first leg was to be flown deadhead to Buffalo, where they were to pick up a chartered group of passengers.

On the climbout, through rain and turbulent clouds, the flight was routine until after passing through the freezing level. The crew then began experiencing a problem with airspeed control. It was high. The rate of climb was also higher than normal. They were light, so they expected the aircraft to perform better than usual, but not this well. They thought they had gotten into some weird upward gust, so they eased back on the yoke.

The rate of climb went even higher, as one would expect, with back pressure and increasing pitch. However, the airspeed also increased mysteriously. They thought it was a phenomenal gust they were experiencing and pulled back on the yoke even farther. The airspeed increased still more. They fixated on the airspeed indicator and pulled harder on the yoke.

The crew violated the most basic premise of attitude flying by disregarding both the main and standby attitude indicators, and following one performance instrument.

Even through the buffet, the pilot increased pitch in an effort to reduce the airspeed. Why would anyone do something so ludicrous? As you know, the 727 is not exactly the SST, so in addition to the stall buffet which most aircrews experience in training, there is also mach buffet, which occurs when the 727 reaches .9 to .93 mach. Not many crews have experienced this buffet, since it is difficult to achieve.

The airspeed had "increased" so

continued

much, they were certain their aircraft was in mach buffet, so they increased the pitch more and even reduced power. When the aircraft entered a full stall, there were only seconds to spare and they had wasted valuable minutes concentrating on the airspeed indicator.

The principle behind critical triangles is nothing new. More than 200 years ago, a wise man observed, "If you desire to give a friend a clock, do not give him one, give him three so he will know the hour."

Think about that. With one clock, you only think you know what time it is. With two clocks that disagree, you may not discover which one is telling the correct time until it is too late. With three clocks you can be reasonably sure of the time if two agree. That is true in an aircraft as well, whether it is a Cessna 152, Boeing 727, or T-38.

A critical triangle of agreement must be predicated on three totally independent sources of information and it must derive the information from performance and control instruments, with agreement at all times. Sometimes, in addition to the three clocks, there is an alarm clock which brings us back to reality. Let's examine the clocks available to the 727 crew.

They had both the Main and Standby ADIs, climb power, and indicated airspeed available for the triangle. The one bad clock, the airspeed indicator, was confirmed bad by two other independent sources of information (control vs performance). Even if the climb power, which is set by engine pressure ratio (EPR), was incorrect, the critical triangle of agreement for power in the 727 would have allowed them to detect the bad power clock. That triangle is: Fan and turbine speed, (N_1 and N_2, known to most of us as rpm), EPR fuel flow, and EGT.

The crew looked only at the airspeed "clock" and disregarded the two correct clocks, pitch and power. This added to an already confusing situation. Also, they had an alarm clock to wake them up: Angle of attack. The buffet started, but they reacted like some of us react to an early launch time. They reached over and shut off the alarm, disregarding its life-saving message, and went back to sleep. They continued to be just as confused and frightened about the "increasing airspeed" and stalled. They entered a spin and crashed. That mishap held a lesson for all of us, including me. But I missed the part about the critical triangle of agreement.

I separated from the Air Force in 1976 and while training at TWA's facility in Kansas City, this mishap was part of the course material. We discussed the mishap board findings, and the instructor pointed out that checklist discipline had broken down. Not only did the first officer fail to turn on the pitot heat, but the second officer did not back him up! As the aircraft climbed through the freezing level at 16,000 feet, ice formed on both pitot tubes. Sometimes that will cause the airspeed to drop to zero, but ice in the pitot system can also seal certain passages and turn the airspeed indicator into an altimeter. That's what happened to the 727. The higher they went, the faster they thought they were flying.

Throughout my career as a second officer on both the 707 and 727, this mishap lingered in my mind as I backed up the captain and first officer while they played with their switches. If they missed something, I was on them like "white on rice," such an impression did that mishap leave with me. Another point that we discussed concerning the mishap was: It is extremely improbable to experience mach buffet in a climb.

When I was an AC on the KC-135, I learned that when something went wrong, the best thing to do was to check the applicable OFF-ON selectors in the "ON" position and command, "Check the circuit breakers." This usually solved the problem, but if it didn't, it gave me time to think of which checklist to call for. Had the 727 crew done that, the pitot heat switch would have been found off — problem solved.

So, they missed that lesson in life. But, had they been aware of the critical triangle of agreement for pitch attitude or Chapter Two of AFM 51-37, the mishap would have been only an incident. There was, however, no indication on the cockpit voice recorder that anyone on the flight deck had cross-checked the ADI. In fact, the dialogue on the tapes was so unprofessional that Northwest Orient management did not want their crews to hear the tapes. Had the captain lowered the nose to level flight and set cruise power, safe flight would have been possible.

The lessons from this mishap went much deeper than the improbability of mach buffet, the importance of proper crew coordination, checking switches and circuit breakers, and good attitude flying. Critical triangles of agreement could have been discussed, but they weren't. If the mishap had happened after the crew had boarded their charter passengers, the Buffalo Bills, that would have sold newspapers, and a discussion of the critical triangle of agreement may have followed.

The critical triangle finally found me on May 15, 1981, when another IP and I were taking a T-38 to Fairchild AFB for a static display. Weather in Colorado and Utah was miserable, so the only way to fly from Vance to Spokane was through Mexico and California — Washington State the hard way. The first two legs through Albuquerque and March AFB were uneventful. I had flown both of these legs and was getting acquainted with the idiosyncracies of the "pod." The SID at March required that we fly south, about 45 miles out of our way, to Oceanside, then we could continue on to the north and our next stop, Beale AFB.

The climb was normal and as I leveled off at FL 390, I set cruise fuel flow for .9 mach and noted that the rpm and EGT agreed with the fuel flow. This was my cruise power triangle.

Right then, my partner commented that he had never seen Los Angeles. Just think, this was his first time over L.A., and I was the guy who had made it all possible. He seemed excited, so I threw back the "bag." I wanted to share in this memorable experience.

As we peered through the smog, looking for Disneyland and Farrah Fawcett's house, I noticed that the aircraft didn't feel right. It wanted to descend when the ADI was placed in the normal attitude. Level flight required two degrees nose-high on the ADI, which was the last used climb attitude. At first I thought it was just precession, but I felt a very light buffet when I applied the slightest amount of back pressure.

We wondered if the pod had something to do with the buffet. Could it have come undone or swiveled sideways? We were indicating .95 mach now. Could that be too fast for the pod, causing the buffet? Since this was our first trip with a pod and not much information had been written about it, all those questions were very rational in our minds. We checked the front speed brake switch — centered and up — and checked the pitot heat switch — on (although we had not flown through any visible moisture). We had checked the switches and the circuit breakers. What else could we do?

Both the main and standby ADI's agreed that we were indeed two degrees nose high. All the power instruments agreed that we had plenty of power. Then the alarm clock rang loud and clear. The AOA was reading .6 (approach). With 2,800 pounds of fuel and no-flaps, that equates to about 188 KIAS and .6 mach; not the 295 KIAS and .95 mach that the airspeed indicator was showing. We concluded that the AOA was right. The ADI's and the light buffet confirmed it in my mind.

My first instinct was to add power, and as I did, we heard two muffled pops, then nothing but wind rushing over the canopies. We began to pressure breathe oxygen and set up for a glide to 26,000 feet and the restart.

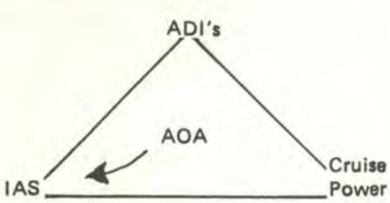
All during the glide I was mad at myself. How could I have taken so long to figure out such a simple problem? Now I had no engines and a suspect airspeed indicator, and I never did find

continued

CRITICAL TRIANGLES OF AGREEMENT continued

Farrah Fawcett's house. Then I began to feel thankful that I was VMC, for I had never done a needle ball and "wind rush" descent before. I hoped that I could approximate 270 KIAS for the airstart. Both engines restarted easily using 270 KIAS, and during the approach and landing at March AFB, the AOA agreed with the airspeed indicator. Why?

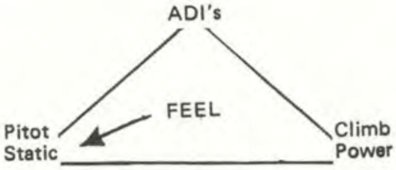
As we later learned, the AIM's computer static line had cracked. Since that line was in a pressurized portion of the jet, it told the computer that we were cruising at about 18,000 feet instead of 39,000. When both engines quit, the cabin depressurized and now the static line was reading the correct atmospheric pressure, providing the correct airspeed indication for the re-start. During the approach and landing at March, the cabin pressure agreed with the outside pressure, so the IAS agreed with the AOA and ADI's.



Neither my partner nor I had noticed anything unusual about the climb to FL 390 since all the pitch attitudes were normal and there wasn't the slightest hint of buffet.

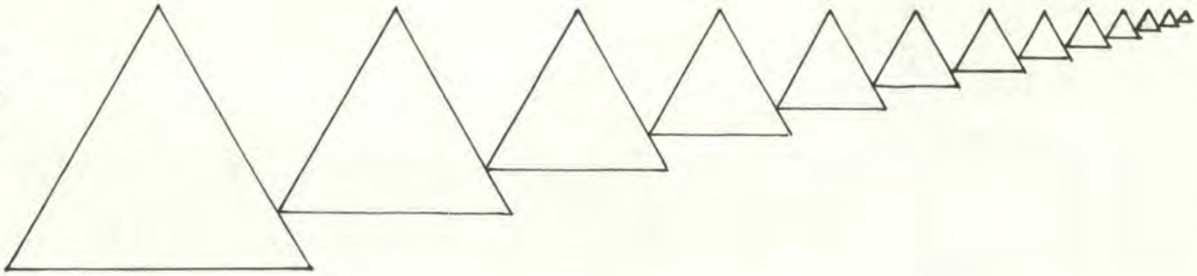
Inititally I had followed the same faulty reasoning that the Northwest Orient crew had, thinking about mach buffet. Then I realized that with my cruise power, it was ridiculous to suspect such a phenomenon especially with a pod. For a tie breaker, I used the AOA, but had the AOA not been working, I would only have had feel as my alarm clock.

Let me expand on the feel theory with another story. Years ago, a United DC-6 departed Chicago's Midway Airport into a low ceiling. After entering the weather, all the performance instruments began to read in reverse. The VVI, altimeter and airspeed all indicated a descent and stall. The captain, as you might imagine, had become quite familiar with the pitch and power requirements for a normal climb. The pitch and power that he saw were the same indications that he had always used, but his performance instruments were in complete disagreement with the control instruments.



The copilot's independently driven attitude indicator confirmed that the captain's pitch indications were correct. With no AOA installed in his aircraft, he depended on feel. The low airspeed indicated that he should be in a stall, but there was no buffet. Feel was his alarm clock, had he needed it. The captain held his usual pitch attitude and broke out of the weather at 6,000 feet. This flight crew handled themselves professionally, exercised the principles of good attitude flying, and used the triangle of agreement to turn a confusing situation into confident control. Critical triangles of agreement not only exist for climb, cruise and approach, but they also exist for takeoff.

Like me, two other pilots missed the critical triangle lesson of the Northwest Orient mishap. They were at the controls of an Air Florida Boeing 737 during take off from Washington National Airport on January 13, 1982. The mishap



which developed produced fatalities and heroes.

It was a terrible day, with snow and slush covering the runway, and it was snowing hard. The first officer was to make the takeoff. He set the target takeoff EPR of 2.04, and as they started the takeoff run, something seemed unnatural.

The engine anti-ice, which also heats the inlet EPR probe, was not on and the EPR probe in the engine inlet had iced over. (EPR uses an inlet and exhaust probe to find the pressure ratios). The probe in the exhaust has "natural de-icing," so the EPR gauges received lots of thrust pressure and very little inlet pressure information, causing a higher than actual EPR reading — this was like attempting a takeoff in a T-38, single-engine, at military power.

At 14 seconds into the takeoff run the first officer said to his captain, "That don't seem right, does it?"

Aside from the poor use of English, did you pick up anything from the first officer's statement? His feel was telling him that the critical triangle of agreement wasn't in agreement!

Of the several engine instruments available, only the EPR gauges looked right, and performance didn't confirm that. Had they looked at other engine instruments, such as N_1 and N_2 rpm's, EGT, and fuel flow, they would have discovered a low power setting.

Three seconds later he repeated, "Ah, that's not right." His captain replied, "Yes, it is; there's 80 (knots)."

Nine seconds later the first officer said, "Ah, maybe it is," believing that the EPR and the more experienced captain were correct. Then, only 4 seconds after that, "I don't know."

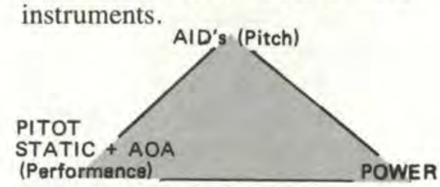
The 737 lifted off, but would not climb. It hit a bridge three-fourths of a mile off the end of the runway.

When the mishap reports were final, we learned many causes for the mishap: ice and snow on the wings, slush on the runway, improper de-icing procedures, and the engine anti-ice was not used, resulting in unreliable EPR indications. They relied on one control instrument, and disregarded the critical triangle of agreement for takeoff power, when so many independent sources of engine thrust information were readily available. If they had recognized the problem at any time prior to the impact and increased power, they would have flown out of the situation safely.

In the 737, as in the 727 and T-38, during takeoff, there are several independent control sources for the critical triangle of agreement and performance source. Graphically, the triangle would look like this:

The alarm clock in the center of the triangle rings when things don't feel right. When that happens, don't shut it off — your feelings are trying to save your life! Check the triangle!

Let's tie this all together with a general, all-purpose, triangle of agreement for all in-flight conditions. The three points of the triangle are: the pitot static instruments and AOA vs the power instruments vs the attitude instruments.



Sound familiar? It's also known as pitch, power and performance instrument flying (AFM 51-37).

Become intimate with the pitch, power and performance indications for a myriad of normal flight conditions, and do it now! If you don't know what to expect in normal situations, then it is difficult to complete the triangle when abnormal and confusing situations arise. Practice the principles of the critical triangles of agreement on each aircraft and simulator sortie. You'll avoid the mistakes that sometimes catch even the old pros.

I finally made it to the static display at Fairchild and some little old lady remarked, "Look at all those instruments!" I just smiled and humbly thought, "Yup, and I need every one of 'em." ■

— Some of the information for this article was taken from: "Critical Triangles of Agreement," by Archie Trammell, AOPA Air Safety Journal, March/April 1983.

X-COUNTRY NOTES

MAJOR WILLIAM R. REVELS
Directorate of Aerospace Safety

■ The Rex Riley Award has for many years been the standard for quality transient services, and for safety consciousness in routine transient flying operations. Therefore, it is appropriate here to discuss trends which threaten the record for transient services organizations. I'm referring to an increase in logistics-related incidents as cause factors in major aircraft mishaps.

For the first time in recent history, logistics (materiel and maintenance) has exceeded operations as cause for major aircraft mishaps. In 1982, logistics-related mishaps accounted for 41 out of 78 Class A mishaps. This logistics figure is not isolated and is part of an upward trend in the last 4 years. In 1979, a total of 26 logistics mishaps produced a rate of .8 per 100,000 flying hours, and this rose to 1.2 in 1982. This trend is opposite to the overall Air Force rate which dropped from 2.9 to 2.3 during the same period.

Transient Alert is, of course, a part of the logistics area, as well as a member of the transient services community, and is potentially susceptible to this trend toward unsafe practices. Many of the errors which are driving up maintenance-related mishaps are basic, and stem from low skill levels, lack of experience, and mission pressure. In Transient Alert operations, these factors are further complicated by multiple aircraft types, and infrequent exposure to some types of aircraft. For example, a new Transient Alert technician may well be faced with serving a T-38, a CT-39, and an F-16 during a work shift, then not encounter one or more of these aircraft for several weeks.

Better training, better supervision, and better management are key elements to solving the problems associated with handling aircraft. These are large concepts, though, and are more easily said than done.

Recently, an airman was assigned to an aircraft where opening the canopy was necessary to accomplish his job. He was unsure how to open the canopy and asked for help from a senior airman nearby. The senior airman explained the canopy opening process, but did not stay to supervise the actual work. The airman then attempted to open the canopy, but did not fully understand all the steps and could not open it. He then saw the emergency canopy instructions, but did not understand the word "jettison" and thought it was meant as an alternate method for routine canopy opening. He jettisoned the canopy, and did signficant damage to the aircraft.

The point of the story is that you can't train, supervise, or manage to prevent all of the errors all of the time. It is simple to blame the airman, the senior airman, the commander, or the Air Force in general for the breakdown which caused this mishap, but there will always be similar incidents when people fail to recognize potential hazards.

Because of the complexities involved, a Transient Alert organization must be especially sensitive to this problem; Transient Alert people must adopt an attitude for safety awareness which transcends routine preoccupation with the job at hand. In the words of The Gambler, "You have to know when to hold, and you have to know when to fold." The airman from the example showed signs of this awareness attitude when he asked for additional supervision, but for some reason, perhaps pride, fear, or peer pressure, he did not persist. The germ of awareness can begin in a training program, it can be fostered by supervisors, and it can be renewed by observant managers, but it cannot survive without generous and complete reinforcement from all the players.

In the final analysis, leadership at all levels is the key to

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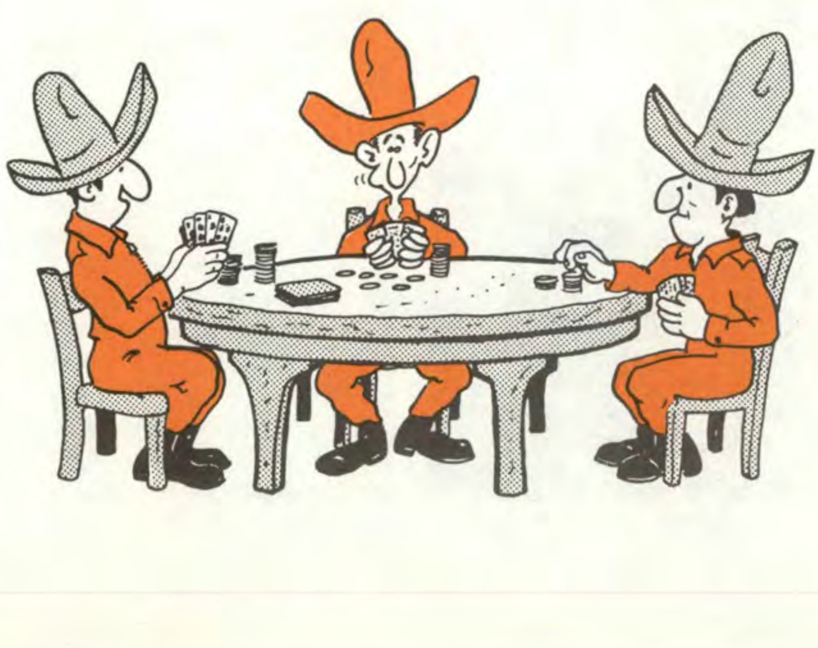


REX RILEY
Transient Services Award

LORING AFB	Limestone, ME
McCLELLAN AFB	Sacramento, CA
MAXWELL AFB	Montgomery, AL
SCOTT AFB	Belleville, IL
McCHORD AFB	Tacoma, WA
MYRTLE BEACH AFB	Myrtle Beach, SC
MATHER AFB	Sacramento, CA
LAJES FIELD	Azores
SHEPPARD AFB	Wichita Falls, TX
MARCH AFB	Riverside, CA
GRISSOM AFB	Peru, IN
CANNON AFB	Clovis, NM
RANDOLPH AFB	San Antonio, TX
ROBINS AFB	Warner Robins, GA
HILL AFB	Ogden, UT
YOKOTA AB	Japan
SEYMOUR JOHNSON AFB	Goldsboro, NC
KADENA AB	Okinawa
ELMENDORF AFB	Anchorage, AK
SHAW AFB	Sumter, SC
LITTLE ROCK AFB	Jacksonville, AR
OFFUTT AFB	Omaha, NE
KIRTLAND AFB	Albuquerque, NM
BUCKLEY ANG BASE	Aurora, CO
RAF MILDENHALL	UK
WRIGHT-PATTERSON AFB	Fairborn, OH
POPE AFB	Fayetteville, NC
TINKER AFB	Oklahoma City, OK
DOVER AFB	Dover, DE
GRIFFISS AFB	Rome, NY
KI SAWYER AFB	Gwinn, MI
REESE AFB	Lubbock, TX
VANCE AFB	Enid, OK
LAUGHLIN AFB	Del Rio, TX
FAIRCHILD AFB	Spokane, WA
MINOT AFB	Minot, ND
VANDENBERG AFB	Lompoc, CA
ANDREWS AFB	Camp Springs, MD
PLATTSBURGH AFB	Plattsburgh, NY
MACDILL AFB	Tampa, FL
COLUMBUS AFB	Columbus, MS
PATRICK AFB	Cocoa Beach, FL
WURTSMITH AFB	Oscoda, MI
WILLIAMS AFB	Chandler, AZ
WESTOVER AFB	Chicopee Falls, MA
ELGIN AFB	Valparaiso, FL
RAF BENTWATERS	UK
RAF UPPER HEYFORD	UK
ANDERSON AFB	Guam
HOLLOMAN AFB	Alamogordo, NM
DYESS AFB	Abilene, TX
AVIANO AB	Italy
BITBURG AB	Germany
KEESLER AFB	Biloxi, MS
HOWARD AFB	Panama
GEORGE AFB	Victorville, CA
PETERSON AFB	Colorado Springs, CO
CLARK AB	Philippines
MOODY AFB	Valdosta, GA
RHEIN-MAIN AB	Germany
RAF LAKENHEATH	UK
ZARAGOZA AB	Spain
TORREJON AB	Spain

developing an attitude for safety awareness. A critical element of this leadership chain falls to the lowest level, the technicians and supervisors in the local Transient Alert unit. The airman who asked for help was using personal leadership, the senior airman exerted leadership when he explained the procedure, but both stopped short of completing the effort. The local Transient Alert unit is small and usually close knit. Supervisors have an opportunity to demonstrate and reinforce attitudes which generate a mind set that will stop short of the unsafe act.

Integrating safety awareness into routine duties requires a continuing effort, with personal attention to the daily tasks. How is the level of safety awareness in your unit? Are routine tasks performed with only superficial attention? Do checklists assist and remind personnel, or are they simply "in view" for inspection purposes? Do personnel receive regular reminders about potential hazard subjects which are peculiar to your unit? How do your people react to mission pressure — do they skip steps or bear down for greater efficiency? The mishap rates are climbing, and Transient Alert is a player in the high threat area. The time is right to review local procedures and persevere to reduce flight line errors.

Letters To Rex

The following letter from Major General Stanley F. H. Newman, ANG Assistant to CINCMAC, to Major General James E. Light, Jr., Commander, Oklahoma City Air Logistics Center, sums up nicely the fine services available at Tinker AFB. As many of you know, the high quality services at Tinker provide excellent support for everyone.

"Just a short note to express my appreciation for the fine service and courteous treatment afforded me on 13 March 1983. My CT-39 'broke' at your base and thanks to your passenger service people, motor pool and Base Operations dispatchers, I was able to arrange for alternate airlift to Travis AFB and was expeditiously transported to Tinker. Upon arrival and throughout my 'No-Notice VIP' stay, I received outstanding treatment by all concerned — particularly by your passenger service and operations personnel.

"I was most impressed with your VIP waiting room. The thoughtful availability of refreshments provided by the Tinker Credit Union, Tinker Management Club and Tinker Officers Wives Club was an unusually 'nice touch' and greatly appreciated.

"Thanks for the great hospitality and efficient courteous support."

The following letter from Colonel John J. Closner, III, Commander, 917 TFG (AFRES) to 354 TFW/CC speaks highly of the outstanding Transient Alert unit at Myrtle Beach AFB.

"I would like to express my sincere appreciation to the Myrtle Beach AFB Transient Alert staff for their exceptional efforts in the support of 917TFG aircraft. Twelve of our A-10's returning from a Checkered Flag deployment landed at Myrtle Beach AFB within a 20-minute period. The Transient Alert crew promptly began postflight and servicing operations, displaying a high level of efficiency. This outstanding performance was repeated the following morning as our aircraft were launched in minimum time.

"Our pilots were unanimous in their praise of the courtesy and professionalism displayed by the Transient Alert personnel. They particularly appreciated the warm reception and prompt service after their long flight. Please convey our thanks and a sincere 'well done' to TSgt Dwight Roberts, SSgt Michael Williams, SrA John Owens, A1C Boyd Nelson, A1C Gregory Lichy, A1C Brook Pence, A1C Robert Colvin, and Amn Bryan Dillon."

Trip Reports

The trip reports included below are from recent Rex travels in Europe. A 3-week tour of European bases requires a lot of coordination and a great deal of support from organizations in the CONUS, as well as overseas — too many, unfortunately, to thank all of them for their support. Suffice to say that cooperation by all the players was exceptional, with a special word of thanks to the 702d MAS (AFRES), McGuire AFB, DE. Lieutenant Colonel Czech and crew, from the 702d, provided support for the first phase of the trip and did an excellent job. They were also a pretty entertaining group to fly with.

Services in Europe tend to be good in general. In most cases, the "can do" attitude is clearly apparent, and is mostly accountable for the success stories. This is true because facilities are aging in most locations, with remodeling and replacement funds riding low on the priority list. Self-help projects are underway in many locations and make a significant difference in the speed for gaining needed repairs.

Crew complaints vary widely, with the most frequent ones dealing with coordination problems; parts are late arriving at the aircraft, clearance delivery is slow, passengers or cargo have not been loaded. Both fighter and transport crews feel the problems are of the irritation variety, rather than major discrepancies at particular locations. These fragmented reports tell a story, though, and the services community should keep an eye on crew reports of the irritant variety.

New Awards

TORREJON, AB, SPAIN The folks at Torrejon take extra care to insure aircrews get the service they deserve. Renovation is underway in Base Operations which includes a new crew lounge for those making a short stopover. There is a PPR in effect which is not designed to limit transients but helps to schedule parking space and maintenance support. Be sure to arrange flight planning to allow for filing at least 1 hour prior to departure. Automated filing equipment is not in use with Spanish Air Traffic Control and a delay in filing can mean a takeoff delay. Give the Torrejon services folks cooperation and they will keep you well cared for.

ZARAGOZA AB, SPAIN Zaragoza provides excellent facilities with people who are willing to work for aircrews. You'll find excellent BOQs, transportation, and messing facilities as well as first-class Transient Alert and Base Ops facilities. Remember to file a flight plan early as the Air Traffic Control system can develop slowdowns. Also, there are numerous bird sanctuaries to the north which generate king size, kamikaze prone, feathered friends. Heads up!

RHEIN MAIN AB, GE Rhein Main provides quality services in Germany's central region. All service areas go the extra mile to insure aircrews can do their jobs with minimum problems. During the next few months remodeling will be underway in the base hotel cafeteria; however, other dining facilities will take up the slack. Watch the taxiing at night. The ramp is quite dark, and there is construction on I and H parking rows. Use your head and give the marshallers a chance to do their stuff.

ZWEIBRUCKEN AB, GE The attitudes and services at Zweibrucken are oriented to quality support of transient aircrews. Aircrew critiques are monitored and deficiencies are acted upon. Billeting, Base Ops, and Transient Alert personnel are dedicated to insuring that aircrew needs are acted upon. Improvements in the Base Ops facility are planned to better serve aircrews. The future includes a new building to house Base Ops, safety, and a weather station. Zweibrucken has an aggressive services program, and they will strive to make your stay a good one.

RAF LAKENHEATH, UK Lakenheath offers fine facilities and helpful personnel. There is a renovation in progress at the VOQ's and you'll see new carpet and fixtures in the near future. Remember to call ahead for weekend arrivals. Give the Lakenheath services people cooperation and they'll give you a quick turn or a pleasant RON.

continued

X-COUNTRY NOTES

continued

Reevaluations

LAJES FIELD, AZORES Services at Lajes are well planned and well executed. The 1605th Military Airlift Support Squadron does an excellent job overseeing the needs of aircrews transiting this island location. You can count on a fast turn with minimum hassle. This visit to Lajes was the first in a long time for Rex, and it was good to find the folks there continue to produce fine results.

DOVER AFB, DE Dover provides excellent services for transient aircrews. The base has completed renovation in the VOQ's and boasts one of the largest Transient Alert organizations in the states. Base Ops is also staffed to handle all your needs. Dover clearly makes good use of facilities on hand and has an ingenuity and enthusiasm to make aircrew stopovers simple and painless.

MILDENHALL AB, UK Mildenhall is currently undergoing a large remodeling operation in the VOQ's. Until the work is completed, you can expect to stay off base. Transportation is pitching in to minimize inconveniences to transients by providing very responsive bus and taxi service. The folks at Mildenhall are working hard to improve facilities for transients. You can help with your patience while the work is in progress.

No Award

BASE X Billeting was the primary cause for this base's elimination from the Rex Riley list. The problem is in base support. The VOQ parking lot is totally dark, requiring great dexterity to simply find one's assigned building. Upon entering the building, aircrews are greeted by a dim hallway covered with torn and dirty carpet. The building is cold. Base civil engineers consider temperatures above 50 degrees as warm enough to terminate winter heating of crew quarters. In other words, this base does not support the concept that transient aircrews require and deserve quality services while away from home station.

BASE Y The billeting organization at this unit was overwhelming with its creative apathy. A regular stopping place for MAC sorties, reservations are routinely ignored with no alternatives or transportation offered. Rooms are dirty and noisy, with poor ventilation and little sympathy or assistance from staff members. This unit is either unaware or unconcerned that aircrews have to sleep in order to fly.

BASE Z Found numerous maps and flight planning materials out-of-date and on open display for aircrew use. Discussed out-of-date material with duty personnel, but there was no attempt to remove and replace outdated material. The general attitude was that currency in the flight planning room was not too important. It's true that charts and maps may not always change significantly with each new issue, but the issue which is not changed on schedule could lead an unwary or rushed aircrew into a compromising situation. Let's keep the pubs up to date.

Questions or comments about the Rex Riley Transient Awards program should be directed to HQ AFISC/SEDJ, Norton AFB CA 92409, AUTOVON: 876-2113. ■

GROUND PROXIMITY WARNING SYSTEMS
FOR TACTICAL AIRCRAFT

MAJOR DENNIS D. DAILEY
Directorate of Aerospace Safety

■ The value of ground proximity warning systems (GPWS) in large air carrier and cargo aircraft has been proven beyond a doubt since installation first became an FAA requirement in 1974. Prior to that time, there had been an average of 12 controlled-flight-into-terrain (CFIT) mishaps per year worldwide since 1946. Subsequently, in the 4,100 GPWS-equipped worldwide aircraft fleet, there were 4 CFIT mishaps in 1975, 3 in 1976, 2 in 1977, and 1 in 1978. This compares to 20, 15, 16, and 15, respectively, during those same years in the 2,000 aircraft not equipped with GPWS equipment.

As impressive as these statistics are, it is still commonly believed in some circles that this equipment is suitable for large aircraft only.

continued

That is true to a point, for up to now there really hasn't been equipment developed which is applicable to the broader hazard spectrum of fighters. But, there is no doubt about the large potential for improvement in fighter/attack CFIT mishap rates. This fact has been recognized in a Tactical Air Forces statement of operational need (SON) recently validated by the Air Staff. This SON details the number of fighter/attack CFIT mishaps to show the need for GPWS equipment.

The need was further justified by an Air Force Inspection and Safety Center independent review of CFIT mishaps. Our analysis was accomplished by reviewing 86 range and nonrange, fighter/attack, CFIT mishaps during 1977 to 1982. Fifteen of these would likely have occurred regardless of the sophistication of a GPWS. Another three would have required specialized forward-looking sensors to warn of imminent contact with manmade obstacles. The remaining 68 mishaps clearly show the potential effectiveness of a GPWS in providing a collision warning. Using the minimum essential warning envelope of 45 degrees of pitch and 60 degrees of bank as described in the SON, warning would have been provided in 71 percent of the mishaps. When the bank envelope alone was increased to the desired 135 degrees, an incremental improvement of 23 percent was realized. Thus, an adequate warning would have occurred in 94 percent of the cases. This is a hypothetical saving of 64 aircraft over the 6-year period.

Obviously, the units presently in use on air carrier and some Air Force cargo aircraft are not directly adaptable for use on fighters. The first and most critical shortcoming is the limitations of present radar altimeters. Even the recently developed combined altitude radar altimeter provides accurate radar altitude to only 30 degrees of pitch and 60 degrees of roll. Present commercial units do not provide a flight path predictive capability at the speeds and vertical velocities prevalent in some fighter tactics.

The logic used to predict a potential CFIT situation must be such that it will provide the pilot with enough time to react and correct the situation. At the same time, it must not give unnecessary warnings which would eventually lead to loss of confidence in the system. Developing this logic will be a challenging task which will probably take several iterations to accomplish.

For those of you who are skeptical about the practical use of this equipment on fighters, it should be noted that the work in this area is not completely theoretical. The Aeronautical Systems Division at Wright-Patterson AFB has contracted for a flight test of GPWS equipment adapted for fighter use. The first stage of the program was accomplished using a T-33 and was quite successful. Brigadier General Gordon E. Williams, the Director of Aerospace Safety, flew in the aircraft for a demonstration and was impressed with its capability at this point in development. The next stage of the program will be to test the equipment on an A-10 starting this fall.

Although the flight test is only considered a proof of concept test, it looks like we are headed in the right direction in proving the practicality of GPWS equipment for tactical aircraft. Hopefully, GPWS-equipped aircraft will become a reality in the not too distant future. ■

A night penetration through low ceilings, crosswinds and rains is rough enough even without added fireworks displays.

Flashbulb in the cockpit!!

■ The mission was set up to rotate aircrews from the States to England. I had flown C-141s from McChord for two years but this would be my first opportunity to fly to Europe since I had left SAC three years ago.

The challenge of flying into different areas and unfamiliar bases is always very real for the MAC pilot. I thought back to my previous duty in Europe. I remembered the low ceilings and poor visibility common to England, but also about the good radar coverage that was available. Yes, I could remember quite a number of things about flying in Europe that I would add to the information in the enroute supplements and letdown charts. I certainly could not see any unusual problems, and it would be a desired change from the Pacific missions our unit normally flies.

Our itinerary called for pickups at Travis, Kelly and Dover. We would crew rest at Dover prior to proceeding to our destination — Mildenhall.

Saturday morning was a beautiful day at McChord. As we took off, the sun was coming over the crest of Mt. Rainier. Everyone on the crew was in good spirits and looking forward to seeing Europe.

The first day out was really enjoyable, and it was obvious that I was flying with a crew of professionals. All problems encountered were quickly resolved and we arrived at Dover ahead of schedule. After coordinating with Mildenhall ACP we decided to take two extra hours of crew rest. This would give us a better take off time in the morning and a better arrival time at Mildenhall.

We were alerted on time, and after a thorough study of the European procedures and letdown plates, we received our weather briefing. The forecast was for good weather enroute with an 800-foot ceiling and one mile visibility upon our arrival at Mildenhall. Greenham Common, our alternate, had a 2,000-foot ceiling with three miles visibility. This was even better than I had expected.

This happy state began to sour

continued

Flashbulb in the cockpit!! continued

slightly when we were about one hour past ETP (equal time point). Mildenhall ACP called and requested we change our alternate to Prestwick because Greenham Common weather had just gone below minimums.

For the next few minutes we were busy. I had the navigator compute the fuel with Prestwick as an alternate. He said we would have a thousand pounds to spare. Good! Then I had the copilot call Mildenhall to OK the change of alternates and get another forecast for Mildenhall. I called Oceanic Control for a clearance to flight level three seven zero and received same.

About five minutes later we received a new Mildenhall forecast, which called for rapidly deteriorating weather due to a fast moving low pressure area. The winds were forecast from the west at 20 knots with gusts to 25. The ceiling was 1,000 feet overcast and visibility three miles in heavy rainshowers. The engineer checked the crosswinds — 21 knots, the limit for a wet runway.

The stars were visible above us, but clouds obscured the lights below as we crossed the English coastline. I decided to continue to Mildenhall. The weather was not good and the winds were at crosswind limits, but we had enough fuel for one approach before proceeding to our alternate.

After accomplishing the approach briefing, with special emphasis on keeping track of the crosswind conditions, we completed the descent checklist and called radar control for an enroute descent beginning 125 miles out of destination. However, we received clearance to descend from 60 miles out. I knew we were on a dogleg to the runway and expected to get down in time with a maximum rate of descent.

During descent we rechecked the winds and found that they were as forecast and the runway was wet. Then I noticed a light out in front of the aircraft — static electricity was building up on the radar dome. I had encountered buildups on the dome before. It beacons out in front of the aircraft like a searchlight and peels off over the canopy with a loud snap.

This buildup was much brighter than any I had ever seen, and I thought about turning up the cockpit light intensity but didn't want to ruin my night vision. We were now passing through 10,000 feet and I anticipated seeing the runway or lights below when we broke out of the clouds.

Then, crack! Like the snap of a bullwhip, the static electricity peeled off the radar dome. The cockpit lit up as if a flashbulb had just gone off in front of my eyes. I couldn't see the instruments. I asked the copilot if he could see, but he was worse off than I. He had been looking out of the windshield when the static electricity peeled off.

I remembered descending through 9,000 feet at about 3,000 feet per minute. I knew I had to break that rate of descent, so I started pulling back on the control column. I could make out the instrument panel but couldn't focus my eyes sufficiently to read the instruments. I heard approach control calling for a turn, but I couldn't see what heading I was on. I blinked hard, trying to get rid of the spots in front of my eyes.

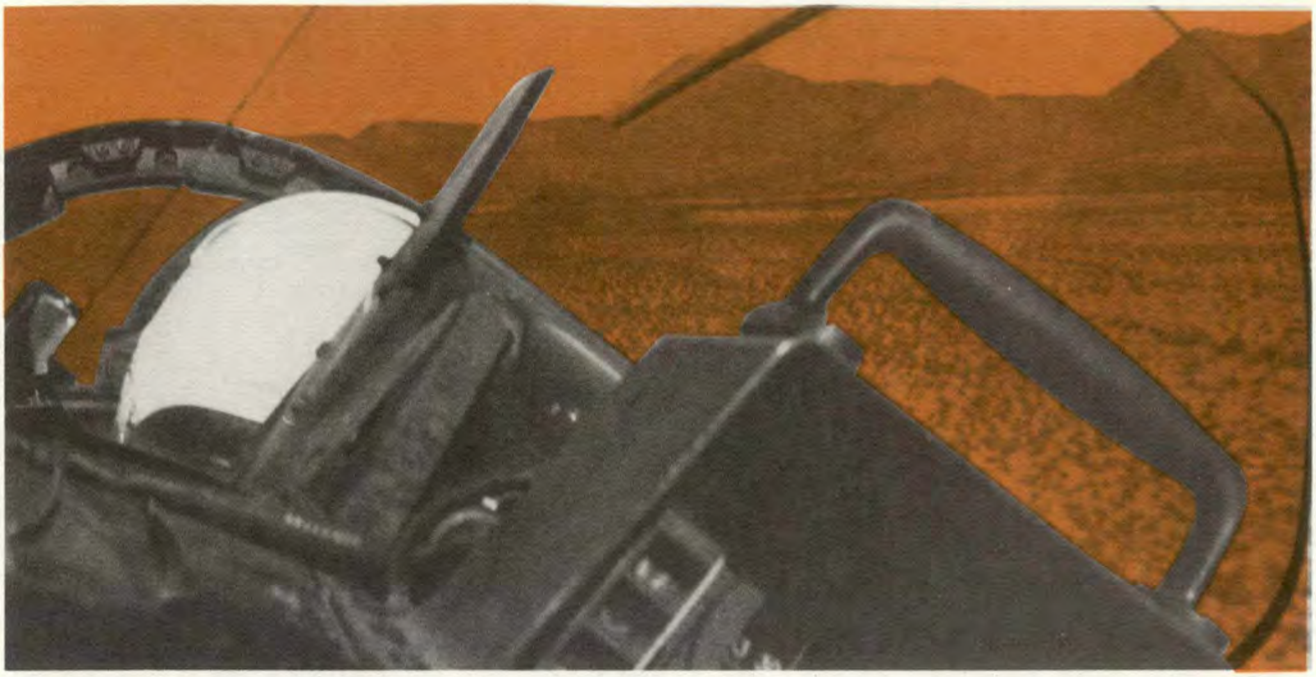
As the instruments started coming back into focus, I leveled off at 2,000 feet and turned as directed by the controller. As the aircraft slowed to 180 knots, we started preparing for landing.

As we passed through 1,000 feet the copilot called "Runway in sight at two o'clock." The rain was now striking the windshield like shotgun pellets; I called for rain removal. Now I could see the runway. We were on glide scope at a 45-degree angle to the runway. The surface wind was still at limits and seemed much stronger. As we passed over the approach lights I was just about to add power for a go-around when the wind seemed to die off. I straightend the aircraft to the runway and touched down, called for spoilers and applied pressure to the brakes. As we turned off the runway I could feel my knees shaking.

A mission that seemed to be going so well had progressively turned into a near disaster. Should I have left the autopilot on? Or turned up the cockpit light intensity? Was my weather information lacking? Perhaps you can think of some other questions. I know that since that day I always keep an extremely close watch on rapidly changing weather conditions. ■

There are a lot of tales
Pilots can tell,
Of heavenly delights
And a bit of hell.
Too bad they're usually
Spent at the bar;
Sharing with all is more
Valuable by far.

— Reprinted from *Aerospace Safety*, April 1969.



SOME PHYSICS OF TURNING - - CRITICAL AT LOW LEVEL

CAPT MILT MILLER
162d TFG, Tucson, Arizona
COL GRANT B. McNAUGHTON, MC
Directorate of Aerospace Safety

■ Every year, we see a number of collision with ground (CWG) mishaps which lead us to believe that there may be an inadequate understanding of some basic physics of turning. A common pattern in many of our CWG mishaps combines *turning and looking* — turning at a high bank angle, and simultaneously looking at something other than the nose track relative to the horizontal. The closer you operate to the ground, the more important it is to bear the following points in mind.

■ To start a level turn, the nose track needs to be visually cross-checked to ensure the nose doesn't drop.

■ To maintain a level coordinated turn, the number of Gs must equal

$$\frac{1}{\text{cosine bank angle}}$$

as shown in Figure 1. (This is based strictly on lift generated by the wing; no allowance is made for lift generated by fuselage and tail at higher bank angles.) For example, a level 60-degree banked turn requires 2 Gs, 70 degrees about 3 Gs, 75 degrees

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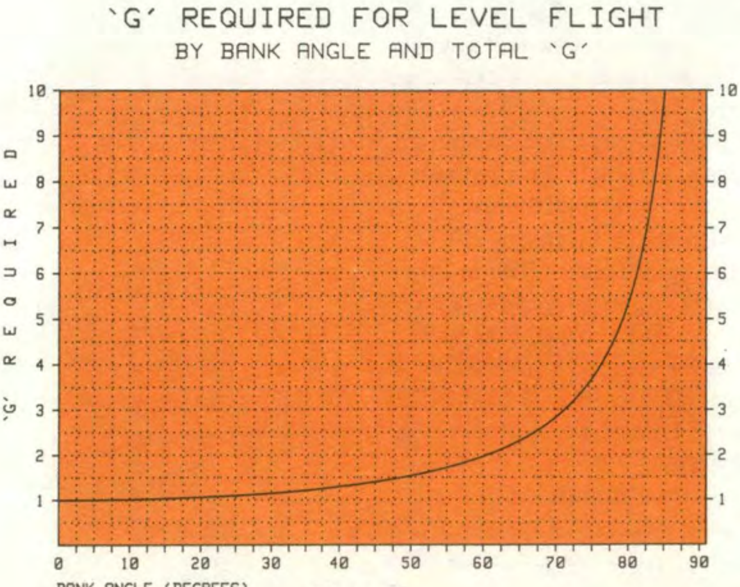

Figure 1

continued

about 4 Gs, and 80 degrees about 6 Gs. Note also that at 85 degrees, over 11 Gs is required, and that at 90 degrees, the number is theoretically infinite.

■ If the G is insufficient to maintain a level turn, the pull of gravity will cause the aircraft to fly a descending path. The formula for the altitude lost, or distance (d) is:

d = 16.1 (G multiplied by the cosine bank angle minus 1) t^2, where G = G on aircraft, and t = time in seconds. Figures 2, 3, and 4 are based strictly on this formula; they make no allowance for changes in velocity vector.

■ If a turn is unmonitored, it is very easy to overbank. Whereas 2 Gs will hold a level 60-degree bank, if you inadvertently overbank to 70 degrees while holding only 2 Gs, Figure 2 shows you will lose 200' in less than 6.3 seconds. If you inadvertently overbanked to 80 degrees while holding 4 Gs (sufficient to hold only 75 degrees) you'd lose 200' in under 6.4 seconds.

Figure 3 shows what happens when Gs are held constant (in this case 2), but bank angles exceed 60 degrees.

Figure 4 shows the effect of a constant bank angle (in this case 80 degrees) with insufficient G.

■ Note in the foregoing the importance of time: Altitude lost is a function of *time squared.* By the end of the 3rd second, you will have lost 9 times the altitude as at one second; by the end of the 5th second, 25 times the altitude as at one second.

■ Whereas altitude AGL provides some safety margin while wings level, the margin evaporates

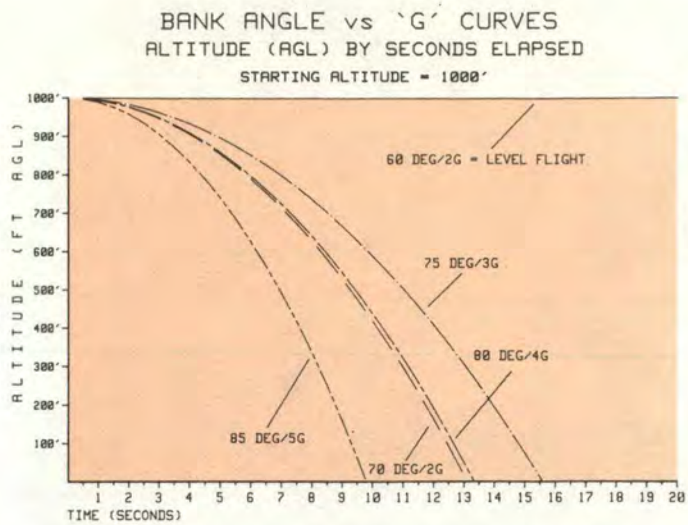

Figure 2

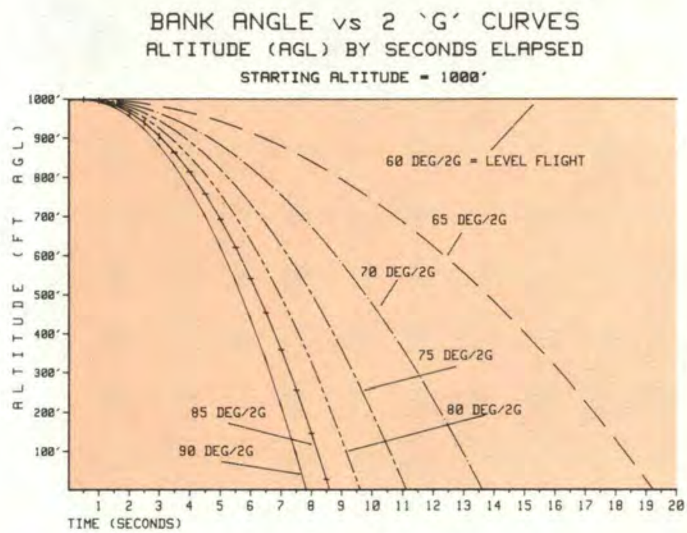

Figure 3

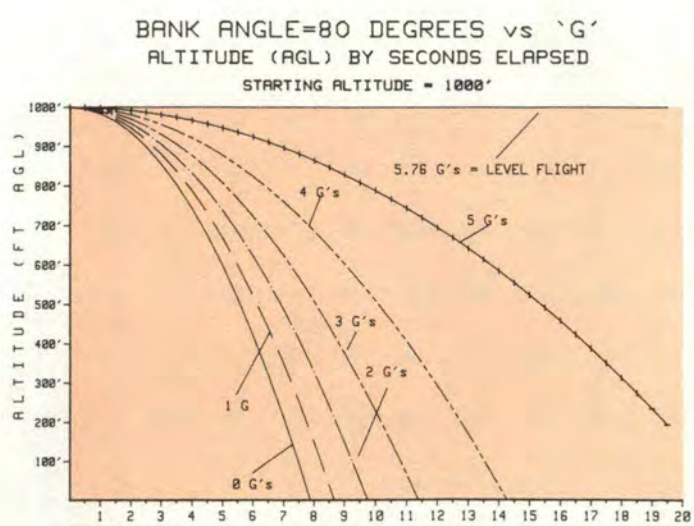

Figure 4

when turning. See Figure 5 to compare times to impact (TTI) from our common "Step Down" altitudes with a 1 degree wings level descent versus steep overbanked turns. Doubling air speed halves the TTI in the wings level descent but airspeed has a negligible effect on TTI from overbanked turns, until you bank significantly past the vertical and continue pulling + Gs.

From the above, note what happens on a level break turn using 90 degrees bank from 100' AGL: one-potato, two-potato, three po — crash! From 5 times that altitude AGL, the time to impact is only slightly over twice as long. What happened to all that safety margin?

Any time you initiate a steeply banked turn at low AGL, snap your eyes forward out the front of the aircraft to immediately detect any nose drop to the inside of that turn. If you are only 100' AGL, you will have to catch that nose drop within the first second to prevent impact by the 3rd. The most critical control input to prevent impact is to immediately decrease bank. Then increase G.

Time To Impact (TTI) In Seconds

Wings Level Descent: -1°			Overbanked Turn		
AGL	240KIAS	480 KIAS	85°/4G	90°/ANY G	95°/5G
100'	14	7	3.0	2.5	2.1
300'	42	21	5.2	4.3	3.6
500'	70	35	6.8	5.6	4.5

Figure 5

Some additional points regarding these graphs are:

- If the altitude lost represents time to impact, you should realize that the point at which recovery is no longer possible is reached considerably sooner. There are multiple factors affecting this point of no return; among them are velocity vector; angle of attack; roll rate; G available; airspeed; aircraft weight, CG, and symmetry; density altitude; changes in terrain elevation; and pilot reactions.

- At 90 degrees of bank, you fall like a rock, regardless of Gs. Past 90 degrees, with positive G, you are directing your lift vector towards the surface; you'll get there ahead of the rock.

- Note that airspeed is not a player in how fast you fall with insufficient G for your bank angle until you roll past the vertical. It does, however, affect the impact point, as well as such factors as G available and turn/pull-out radius: Faster movers go farther while falling, and though they may have more G available, use up more room turning or pulling out.

To recap, turning and looking at something other than your nose track can get your nose started down, and can lead to overbanking. Overbanking (turning at high bank angles with insufficient G) loses altitude. The amount of altitude lost is a function of the square of the time at that high bank angle. Time is therefore critical.

Unfortunately for us humans, our sense of time is not particularly accurate nor even constant. Sometimes it runs a little fast, sometimes a little slow. As a rule, when we are concentrating on something, distracted either inside or outside the cockpit, excited, stressed, preoccupied or otherwise having a good time, it's safer to assume that time flies. Like one of Murphy's Laws, things always take longer than you think. Judging from many of our CWG mishaps, pilots sometimes do allow themselves to become inattentive to their flight path for excessive periods of time.

While turning at low altitude, you may have only a second or so to prevent CWG. **Turning and looking at low level is a death act.** There simply is no margin for that kind of error. ■

When Is An Emergency A Real Emergency?

MAJOR JOHN N. KOMICH
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■ I can vividly remember an incident that occurred early in my career when I was hovering a helicopter on a taxiway at a Navy base. An F-4 was shooting touch and go's and on one, just as he lifted off, his drag chute inadvertently deployed. I was alerted to this by the young female controller in the tower advising him of this in a rather excited and anxious voice. He replied, "Roger, I'll jettison it" but it didn't jettison, and I initiated a takeoff in his direction to assist in what I felt to be an inevitable disaster. The controller must have felt similarly because her voice became even more excited when she advised him that the chute did not jettison.

I'll never forget his casual reply of "How about that?" spoken in a mannner that Steve Canyon, Smilin' Jack, or even Pappy Boyington would have envied; and he proceeded to fly a normal closed pattern with the chute deployed. At the time, I thought he was the coolest head alive, and I vowed to always keep my cool. I hoped that if a similar situation ever arose, I could sound (and be) as confident and undisturbed as he did.

However, a recent incident of a fellow aviator has led me to believe that this concept deserves some additional analysis. My cohort was just departing in IMC from an Air Force base where large four-engine transports are stationed when he lost all the oil in the main transmission. This necessitated his getting on the ground immediately, since a seized gear box results in a helicopter with the glide ratio of a boulder. He declared an emergency with departure control who vectored him for a GCA. This was done in conjunction with vectoring several of the local transports who were also in the instrument pattern on training missions.

When it was all over and he was safely on the ground, he contacted the controller. He felt that while he had received priority, he wasn't sure if it was adequate since the frequency was cluttered which hindered his communication and he would have preferred a 180 downwind approach instead of the long vectors for the active runway. When asked, the controller explained that he didn't realize the severity of the problem. This incident has prompted me to bring up the following discussion.

In the first instance, we had a controller who thought the situation was much worse than it actually was (the F-4 transient) and in the second we had someone who thought the situation was much less severe than it was. In thinking this over I realized that when a four-engine airplane shuts one of the engines down, it is an emergency, but I also know that it can fly indefinitely on three engines or even two in many cases. So even though it is an emergency, it's not as critical as the loss of main gear box oil. In both instances, the aircraft was transient and the controllers were unfamiliar with its characteristics.

I began to do some research on the subject and visited both military and civilian towers to see what their procedures were in handling emergencies, and I learned the following: Air Traffic Control provides services to aircraft on a "first come, first served" basis with a few exceptions. One of these exceptions is an emergency, which is defined in one of the Air Traffic Control handbooks as a "distress or urgency condition." Because of the infinite variety of possible emergency situations, specific procedures are not outlined for the controller.

The controller must select and pursue a course of action which appears to be most appropriate under the circumstances. A decision on what type of assistance is needed is based on the information the controller receives from the pilot. The initial information a controller must request, if he doesn't already have it, is the aircraft identification and type, the nature of the emergency, and the *pilot's desires.* It would be extremely difficult for a controller to handle an emergency aircraft safely without this information. Additionally, other pertinent information is requested, as needed (e.g., fuel, altitude, airspeed). Should there be more than one emergency aircraft, they are handled according to the urgency of each individual situation. A complete understanding between the air traffic controller and the pilot is always needed, particularly in an emergency situation. The critical point for the pilot is to be sure you communicate your situation and requirements clearly.

Another incident comes to mind here, and that is the two-engine civil airliner that lost both engines because of heavy rain and crash landed. In the tape transcript in the NTSB report the copilot radioed "We've lost number one engine" shortly followed by "We've lost number two engine." The controller replied "Roger," and I remember wondering when I read it whether the controller was ultra cool or was he unaware that it was a DC-9 and they were in a dead stick configuration due to the coolness of the pilot's transmission. I wish to emphasize at this time that I am not criticizing any of the above pilot's actions. Rather, I'm attempting to see if anything can be learned for future judgment from a little Monday morning quarterbacking.

I have flown with an Air Force aircraft commander who declared an emergency for the loss of a navaid, and I've flown with an airline captain who would *not* declare an emergency with a gear malfunction, but he did ask the tower to "just advise the crash crews." His personality precluded me asking him if that request meant for the crash crews to sit in the fire trucks in the firehouse but not start the engines. The point here is that it doesn't cost a thing (except maybe a letter) to declare an emergency, and that's what the crash crews are there for.

On the other hand, one could get into a "cry wolf" situation where the circumstances require full attention, i.e., optimum traffic priority and clearing the frequency of extraneous transmissions (remember the famous radio call in Vietnam: "Aircraft calling Mayday — standby, you're interrupting a comm check on guard!). However, if the controller can't differentiate between this and a "precautionary emergency" our disabled aviator might not get all he needs. Remember, both the civil and military have lots of new controllers since the strike, and the experience level is reduced.

To compensate for this, I'd like to suggest a system of emergency priorities with different levels. They all are still emergencies, but some are more critical than others. For example, Level 1 would be a four-engine plane with one engine out, Level 2 would be an intentional gear-up landing, and Level 3 would be a dead stick landing. However, I realize that to incorporate such a program would be unfeasible, so as an alternative, let's overcome the tendency to be Mr. Cool and communicate to the controlling agency exactly what you *have* and more important, exactly what you *need.* You might get a little razzing at the bar that night but at least you'll be at the bar. ■

About The Author

Major Komich flew C-133s, HH-53s, and UH-1s on active duty. He is presently flying HH-3s with the Air National Guard. He has flown commercial helicopters and is now a DC-9 First Officer with an airline.

OPS

Runway Incursion

■ A KC-135 was about one mile on final approach when Approach Control directed a go around. A front end loader had entered the runway without clearance. When the driver approached the active he requested, but did not receive, clearance to cross. Despite this, he proceeded across the runway intending to be clear of the active before the aircraft arrived.

The unit involved has established a training program for those with flight line driving privileges.

Air Force to Build, Test New Flight Data Recorder

The Air Force plans to develop, build and test a new, solid state flight data recorder with improved reliability and reduced size and weight for use in fighter, attack, and trainer aircraft.

Aeronautical Systems Division has initiated the effort by writing a tri-service specification for a standard flight data recorder. The F-16 Fighting Falcon "C" and "D" versions will probably be first to be outfitted with the new recorders.

The first phase of this two-phase program will be to develop, build, and test the solid state data recording system, including a crash-hardened memory unit specifically fitted to the F-16. The recorder system will include a signal acquisition unit and an auxiliary bulk memory unit for storing structural and engine monitoring data for later retrieval.

Phase two will involve Air Force aircraft other than the F-16 as well as Navy and Army aircraft identified for this type of recorder. ASD's Deputy for Aeronautical Equipment will have management responsibility in phase two. — SSgt Bob Mathews, ASD, Wright-Patterson AFB, OH.

Dead Bug!

Shortly after liftoff in an F-4E the crew began losing all pilot static indications. They were able to continue the climb to a safe altitude using angle of attack. Then another F-4 joined to lead the mishap bird to an uneventful wing landing.

Maintenance investigators found that during take off roll a bug hit the pitot tube, and the bug remains plugged the system causing loss of indications.

No Heat

An F-16 pilot was advised of reported icing conditions during recovery, so he turned on the probe heaters. About 1-1/2 minutes after entering the clouds on a night PAR final approach, numerous caution lights came on, the AOA began cycling, and the aircraft went through three climb

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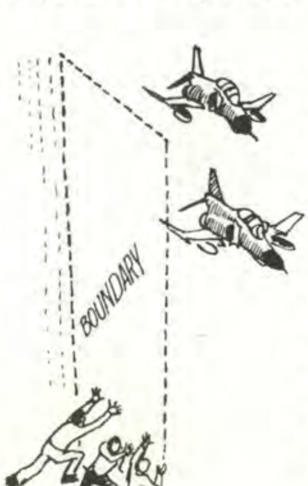
pitch-over cycles which were fortunately mild enough for the pilot to control. Aircraft control response returned to normal after the aircraft broke out of the clouds (about 1,000 feet AGL).

After landing, ice was found on both AOA probes. The right and left AOA probe heat, air data, total temp, and pitot tube heat circuit breakers were all found open.

This was the second sortie for the aircraft since it had been on jacks for maintenance. In accordance with tech order guidance, the five circuit breakers had been pulled. However, the panel covering them was reinstalled without the circuit breakers being reset.

On the first flight, which was entirely in VMC, the pilot remembered turning on the probe heat after landing for the ops check but did not recall the crew chief accomplishing the check. (Checks are not made after engine start because of the proximity of the probes to the intake.)

Proposed Air Space Boundary Changes



The Air Force and Federal Aviation Administration have proposed a change in air space boundaries of the Utah Test and Training Range west of the Great Salt Lake.

The proposed action will redesignate special use or restricted air space boundaries of the UTTR. This action will widen the corridor between the existing north and south restricted areas and will allow better lateral separation for commercial air traffic using Salt Lake City Airport.

Simultaneously, the air space reserved for Air Force pilot training and weapons systems testing will be widened to the west of both the north and south areas near Wendover.

The additions to the special use areas are already designated as Military Operating Areas intended for joint civilian and military use. The proposed action will reduce the chance of conflict between civilian and military aircraft by increasing the amount of air traffic control; however, civilian aircraft using the space in the future will find it more difficult to obtain access to the air space, particularly below 11,000 feet.

Loss of Consciousness

In another service, an F-4 was engaged in a DACT mission. As the pilot initiated a 4 G turn at about 14,000 feet, he lost consciousness. The aircraft continued through 80 degrees of turn losing 2,000 feet. The pilot partially recovered consciousness and initiated a rapid high G pull up. At the onset of Gs the pilot promptly lapsed into unconsciousness again. The aircraft departed controlled flight and the backseater initiated successful dual ejections at about 8,000 feet.

Investigators found that the pilot had failed to connect his G suit and then did not perform a proper M-1 maneuver. This led to loss of consciousness and subsequent departure from controlled flight. ■

Time Pressures

■ It seems that as aircrews we are always trying to catch up, but there is never enough time. We military pilots are not alone in this feeling nor are we the sole sufferers of the consequences of time pressure, as the following excerpts from the ASRS *Callback,* indicate.

The taxiing flightcrew was distracted, missed a hold short instruction, and crossed a runway without clearance.

. . . The cause of the improper crossing was related to the crew and ground controller having a conversation about the takeoff time and extra delay being incurred because of the long line for takeoff, which in turn broke the chain of thought and concentration of the crew members. This thereby reaffirms the idea that the radio is no place for excess and nonessential communications.

Time — or more precisely, lack of time — figures more prominently, in a different sense, in many ASRS reports. Two flightcrews illustrate an oft told tale. To paraphrase Cecil Rhodes — "So much to do, so little time to do it."

. . . cleared to taxi after a short turn-around on a through flight. During the short stop the aircraft was deplaned of perhaps five passengers and added three. During that time the captain and I went through the "after landing" and "parking" checklists. We reviewed the weight and balance forms with the agent and received and reviewed new weather and clearance. We proceeded to the "before start" list and started No. 2 engine. To save time we called for taxi instructions and started No. 1 engine while taxiing. With Nos. 1 and 2 started we made "after start" and "before takeoff" checklists while simultaneously switching to Tower frequency and making a P.A. announcement. The "before takeoff" checklist was completed on the runway and we began takeoff roll. Shortly after takeoff Tower said "Cleared for takeoff, change to departure." No takeoff clearance had been received . . .

An ASRS analyst thinks it fortunate that they did get both engines started before taking off and wonders if they could possibly have had time to look for other traffic. The next story involves another short turn around, starting engines on the run, and a few other things:

. . . We pushed back from the gate; brakes were set, No. 2 engine was started, and the tow bar was removed. As I prepared to taxi from the ramp, the tug driver signaled for a stop and to set brakes. He then disappeared under the nose of the aircraft. When he reappeared he had the nose gear pin in his hand. The groundcrew had forgotten to remove it . . . he again signaled that we were clear to taxi. At that point I asked the first officer for our runway assignment. His response was "9 Left." Enroute to 9L we started engines No. 1 and 3 and completed the "after start" and "taxi" checklists . . .

We now hear from the first officer:

. . . Captain then asked which runway we should use. As if I could hear the controller say it in my head, I replied "9 Left." Prior to crossing Runway 13 . . . the captain asked me if we were cleared to cross and I, still hearing the "voice" in my head, said we were cleared to the runway. As we approached the runway I switched the radio to Tower frequency and at this time I noticed the volume control on the radio turned full down. I said, "Oh my . . . I think I forgot to call for taxi."

Well, you get the drift. Taxiing without clearance; crossing an active runway without clearance. Several reasons for these happenings; several lessons learned. ■

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UNITED STATES AIR FORCE

Well Done Award

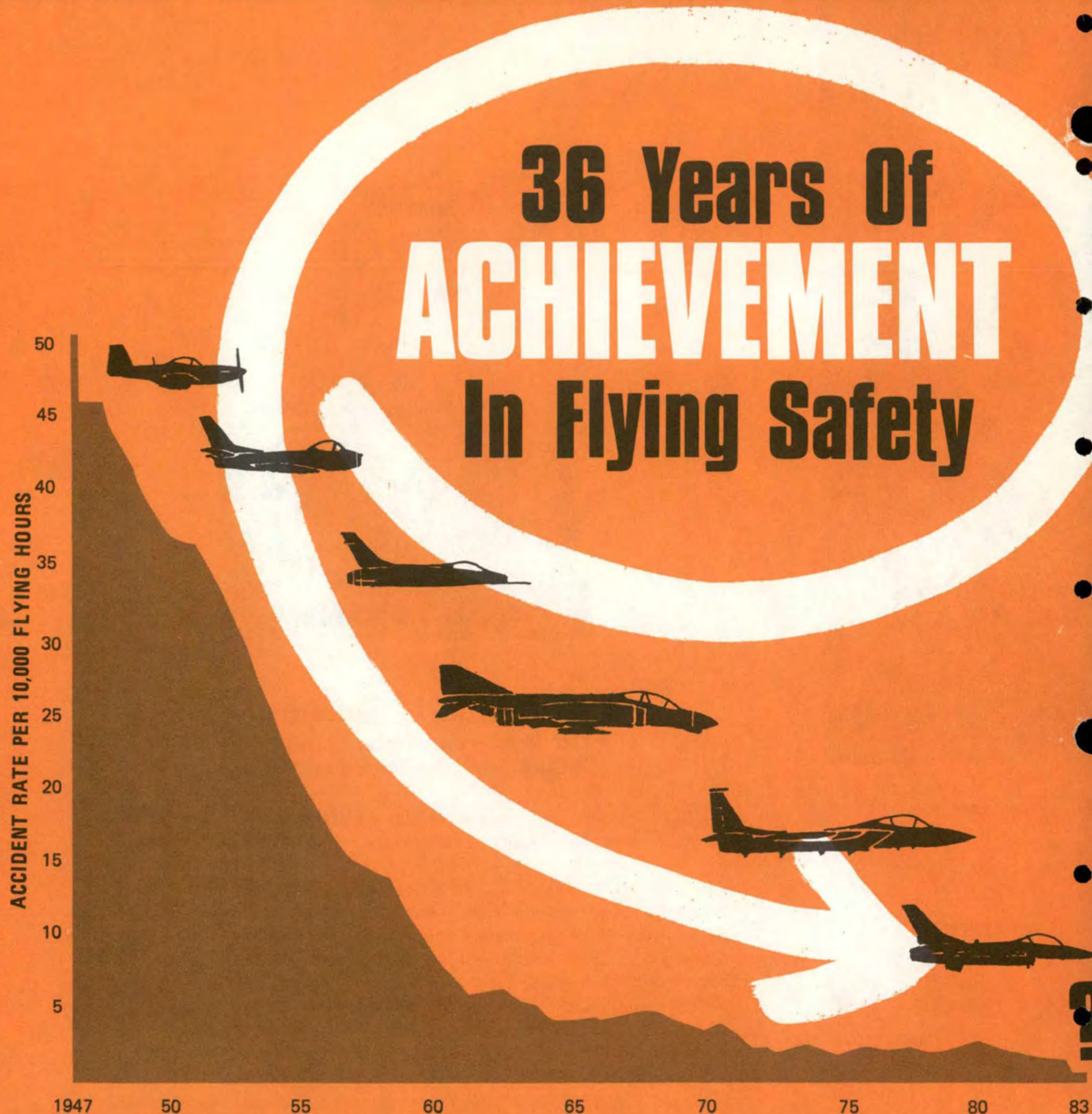
Presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Accident Prevention Program.

CAPTAIN

Thomas L. Darner

49th Fighter Interceptor Squadron
Griffiss Air Force Base, New York

■ On 25 October 1982, Captain Darner was flying an F-106B on a cross-country mission. Shortly after departure and while level at 15,000 feet, an airframe vibration was felt, but there were no abnormal cockpit indications. Approximately 18 miles from the base, Captain Darner decided to return because of the persistent vibration. During the turn back to the base, the Master Caution and Oil Pressure Low lights illuminated, and Captain Darner declared an emergency. Thirty seconds later, the engine flamed out because of oil system failure and the subsequent failure of the engine accessory unit. Captain Darner believed that a restart of the engine was not possible with this type of failure and concentrated on planning a straight-in flameout approach, opposite direction traffic. Flying only on hydraulic pressure supplied by the ram air turbine, Captain Darner briefed his passenger on the approach and the possibility of ejection, emergency extended the landing gear, and planned the approach. The approach was complicated by a B-52 that was being towed down the active runway. The B-52 cleared the runway as Captain Darner flew across the threshold, 500 feet in the air at 250 knots. He touched down with 7,000 feet of runway remaining, then deployed the drag chute, dropped the tailhook, and jettisoned the external fuel tanks. The BAK-12 cable was successfully engaged, and the crew egressed without injuries. Captain Darner's timely decision to return to base, along with his skillful handling of the aircraft during this emergency, probably prevented the loss of a valuable aircraft with possible injury or loss of life. WELL DONE! ■



LET'S KEEP THE MOMENTUM GOING!