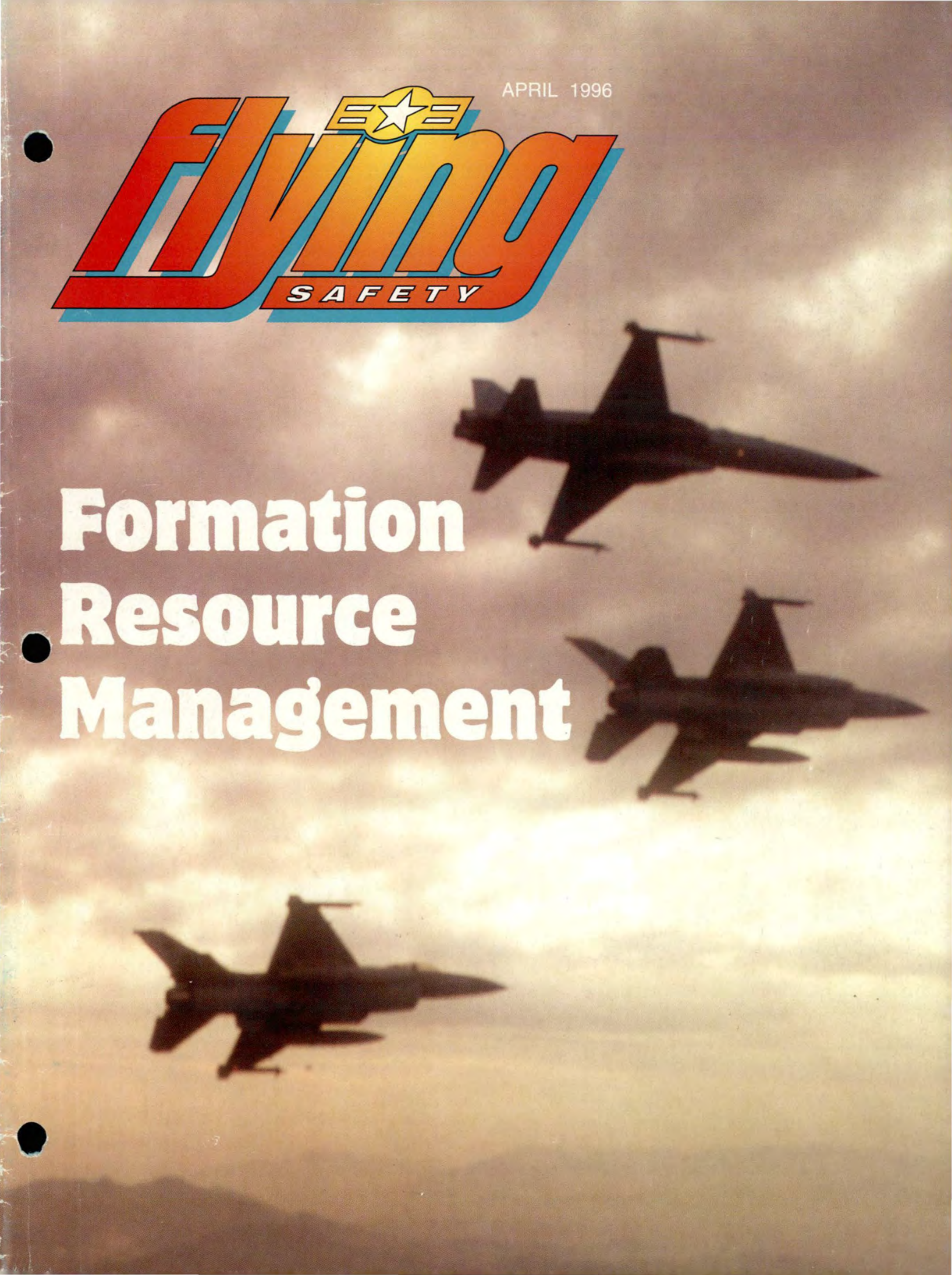
APRIL 1996

flying SAFETY

# Formation Resource Management



# RISK Management and Safety

During the last several years, Air Mobility Command, along with the rest of the Air Force, has undergone extensive downsizing and restructuring. At the same time, we have continued to operate at a very demanding ops tempo — and one that shows little sign of diminishing. Yet, for the past 2 years, the command has received the Secretary of the Air Force (Category I) Safety Award, symbolic of the Air Force's most effective overall safety program. How did we achieve this when our forces seem, at times, to be stretched so thin and worked so hard?

**GENERAL ROBERT L. RUTHERFORD**
Commander, Air Mobility Command

One tool we use is Risk Management (RM), a process that starts and ends with the commander. Thoughtful use of RM can help commanders at all levels make effective risk reduction decisions in a logical manner. RM is a problem-solving method for identifying the risk associated with an activity. By identifying the degree of that risk, the commander can weigh it against the operational need to complete the activity. By increasing the awareness of the risk involved in a required operation, safety awareness will also increase.

The first step in an RM process is to identify and list the hazards associated with the activity. The next step is to assess those hazards. What is the magnitude of the risk? What is the potential for a mishap?

Third, commanders must balance the risk against the mission. Is the mission essential? Is there another way to get the job done at less risk? What hazards can be minimized or eliminated? When these questions have been answered, commanders must decide on a course of action and lead the way in its implementation. They must then ensure consistent compliance to the standards set for safe mission accomplishment.

Known risks that are operationally unavoidable can be managed. Let me give you a very prominent example. In 1995, AMC aircraft received more damage from bird strikes than from hostile fire — over 600 incidents. Yet, through using RM tools, we are going to show a significant reduction this year. RM will help you assess the bird hazard when landing aircraft and, accordingly, will drive a change in operating procedures to truly minimize the hazard.

Commanders, supervisors, and individuals can also apply RM techniques to everyday situations. One significant area is off-duty vehicle mishaps, where we continue to lose our most cherished resource — our people. Also in 1995, AMC personnel were involved in 108 off-duty PMV mishaps, with 7 fatalities. Risk assessment can address such issues as seat belt usage, drinking and driving, "kamikaze" weekend trips, and other known hazards.

Risk management is an effective tool — but believe me — it works best when implemented by all of us — not just commanders and supervisors. We must use all available tools to operate safer, save resources, and meet the demands of the mission.

In conclusion, I'm not about to tell you that RM is a panacea, but when you combine it with good judgment and common sense, it may save lives. ✈

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Our cover photo courtesy
SrA Andrew N. Dunaway,II
1st Combat Camera Squadron

## 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.

# THERE I WAS

■ "Geez, how could anybody be that stupid?" I said to myself as I finished reading an article in a well-known civilian flying magazine. The article had been about a Federal Express crew that crashed shortly after takeoff, killing the three crewmembers. They were flying a night sortie as usual, but on this night, the soon-to-upgrade flight engineer was sitting in the first officer seat to make the takeoff.

In the mishap sequence of events, the flight engineer applied takeoff power, rotated, and could not maintain proper takeoff pitch attitude due to the nose-trim not being reset for takeoff. The flight engineer allowed the plane to stall, and the plane augured in, killing all aboard.

I had read this article as a young Air Force ROTC cadet sitting in the Cadet Lounge trying to soak up as much as I could about flying before heading off to Mather AFB, California, for Undergraduate Navigator Training. (It sure beat studying for my college classes!) I told myself I'd never be so stupid as to do something like that. Like most of us are prone to do, I assured myself that just by the mere act of reading this safety-related article, I could never be so dumb.

Several years later, as a student going through my second RTU and with my brandnew private pilot's certificate, I had the opportunity to log some coveted "Pilot in Command" (PIC) time. I would be sharing the fuel costs with a couple of friends of mine who were copilots in my RTU class. We were flying out of a small uncontrolled airfield, headed to a large controlled field near a metropolitan city. My copilot friend, sitting in the right seat, and my other friend, sitting in the back, were going to look at houses since they'd be permanently stationed there soon.

I had flown only Cessna 150s and 172s in the process of obtaining my private certificate and had logged a whopping 11.4 hours of PIC time in Piper Warriors, scrounging hours wherever and whenever I could. Like a lot of military aviators, I had a pretty smug and condescending view of civilian aviation. One "bugsmasher" is just like any other "bugsmasher," right?

The day of our flight, my friends and I arrived at the field to find the Cessna 172 we had reserved was broken, but an old Piper Cherokee 140 was available. No sweat. We were three experienced military aviators, and besides, one little white airplane is just like another. My "copilot" was in good with the old cranium FBO guy and convinced him I would do fine as PIC with himself in the right seat to back me up if I got in over my head. The crusty old guy finally gave in and wished us well.

As the mishap reports so often state, the preflight, ground ops, and taxi were uneventful. Mission planning was accomplished on a previous sortie to the same destination but in a different type airplane — no worries mate! I applied takeoff power, rotated, and like the doomed Fed Ex crew I had read about so many years before, had substantial trouble maintaining proper pitch attitude for our heavily laden Cherokee. I, too, had a nose-trim problem. In this case, I didn't know where the nose trim was!

There I was, fighting the yoke, trying to keep the airplane from falling out of the sky while my two friends were listening to their Walkmans' and my "co" was intently using our flight time to study real estate listings. I guess stupid pride kept me from saying, "Drew, where the hell is the nose trim?" Mr. Navigator didn't want to seem to his two military pilot friends that he was already in over his head.

My arms started getting REALLY tired from fighting the yoke. At the same time, of course, I was playing it cool, getting us on our initial heading, altitude, talking on the radio, and not letting my friends in on my little secret problem. I looked around the cockpit for the umpteenth time, trying to find the nose-trim wheel I was used to in the Cessnas and Pipers I had flown thus far. Finally, I noticed this funny-looking handcrank on the overhead center "console" of our mighty Cherokee. "That must be it!" I looked at it very closely and noticed some very faded writing and an arrow which said "nose down." Hallelujah!

Luckily for me, I had found the illusive pitch trim without repeating the whole scenario of the cargo crew I had read about. The pitch trim control looked entirely different and was located in a totally different place in that airplane than in any of the Cessnas, Pipers, or military aircraft in which I had managed to scrounge stick time. There are a number of things I COULD have done to prevent this situation from ever happening or from going on as long as it did. I think these are pretty obvious, but that's not the point.

The moral of this story is twofold. First, as military aviators, we must not "blow off" basic safety considerations when we become involved in civilian flying. We can find ourselves involved in flying "puddle jumpers" through Aero Clubs, Civil Air Patrol, airshows, FAA fly-ins, and scrounging flight time here and there, to name a few. If we are unavailable to fly our military aircraft because we killed or injured ourselves over the weekend in a Cessna, then we have adversely affected THE MISSION just as much as if we had done so in a T-38.

Second, it is not enough to just read these safety articles. We need to internalize them and make them a part of how we approach this business of flying we are in. Safety needs to become a basic part of your character as a flier. When I sat in that cadet lounge so many years ago and wondered how the crew of that 727 could be so stupid, little did I know I would have a smaller version of the same problem years later, but bigger in the stupid department. How many of you, reading safety articles in this and other aviation magazines, have said, "Geez, how could anybody be that stupid?" Or, translated, "That could never happen to me." Trust me, it can happen to you. It's happened to a lot of your buds — some living, some not.

I'm lucky. This situation taught me a valuable lesson with a highly experienced and skilled pilot sitting right next to me, and I was probably never in any real danger. But what if he hadn't been there, or what if I hadn't had as much brute strength as I did that day? Somebody, somewhere would be reading about my untimely death, saying, "Geez, how could anybody be so stupid?" all the while convinced it could never happen to them.

"Stupid is as stupid does." ✈


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# FORMATION RESOURCE MANAGEMENT

USAF Archival Photo

**CAPT BILL KOUKOURIKOS**
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Recent Air Force decisions are making crew resource management (CRM) more than just some class to sit through. Each mission will soon be developing their own aircraft-specific CRM program. Even the fighter/trainer community will need to study what was commonly considered a big jet requirement. However, just as the crewmembers of a big jet work together for the success of a mission, so do the members of a formation. After all, the only reason we fly formation is for mutual support, right? Then how about using a new term, Formation Resource Management (FRM), and applying it to the same concepts as CRM — but adapted to the fighter/trainer community.

As a former B-52 aircraft commander, and now as a T-38 instructor, I've seen both sides of the story. Amazingly, the same items that caused inefficient crew coordination in the B-52 cause inefficient formation leadership in the T-38. Even looking at formation mishap reports in various flying safety magazines, the same items keep coming up. What are those items? In just about every incident, the lack of situation awareness (SA), coupled with lack of proper communication, led to the demise of an aircraft or a pilot.

Unlike the aircraft commander, the formation leader is physically separated from his flightmates in the other aircraft. The only way to relay information is to key the mike. Due to this physical separation, verbal communications need to be clear and concise since they are almost exclusively the only way to communicate complicated information. Visual communication is limited in daylight and almost nonexistent at night. So what's a formation leader to do when he needs all the information possible in order to safely recover a wingman in distress?

The solution to the communication problem starts during the formation brief. If the formation leader carefully briefs which situations require a "knock it off" or "terminate" call, if he carefully briefs what actions will be taken during emergency situations, and if he clearly depicts the mission profile and objectives, the wingmen will have a clear picture of what is expected of them. With clear guidelines, a wingman can easily tell if a formation mission is going according to plan or if he needs to speak up when the plan is falling apart. If the formation brief is quick and nondescriptive, then the wingman will not have a clear picture of the mission. This is a classic setup for the "I thought you were going to do this" debrief — or worse yet — mishap investigation.

The second solution to the communication problem occurs in the air. Making intentions clear during a nonstandard situation or aircraft emergency will go a long way in helping everyone in the formation define their role. We are all taught in UPT to come up with "the plan" during a morning standup. "The plan" would clearly describe, in one sentence, what actions were to be taken to recover the aircraft. The details would be filled in as the situation developed.

This method of relaying important information is clearly shown in a recent F-16 engine failure that resulted in a successful SFO landing. The wingman experienced an engine failure and quickly relayed the information to lead. After turning to the field and setting up the glide, the wingman let lead know how he planned to execute the SFO. Lead agreed with the plan, and with a clear picture of the events to come, lead was able to coordinate with the SOF and tower, leaving his wingman free to concentrate on the emergency and the SFO glide.

In yet another incident, a wingman of a four-ship experienced engine problems. Each member of the flight was directed to help their crippled buddy land safely, much like the aircraft commander of a big jet directs tasks to the crew during an emergency. Bottom line: If the troops know what the goal is, they'll do everything to achieve it. If there is no defined goal, failure is close behind.

It should be apparent that in both situations, the formation leader played a pivotal role in the successful recovery of the crippled jets. This was not by accident. Both leaders were open to suggestions from their wingmen and allowed a free flow of information. In FRM terms, this is called Group Dynamics. This is a very important point. A wingman, especially a new one in the squadron, can be intimidated by the formation leader.

A highly experienced F-15 instructor was flying low-level tactics with a trainee on his wing. As the instructor was setting up for the next maneuver, he let a slight descent occur. The wingman allowed lead to violate command and squadron guidance for low-altitude training and did not make a radio call to save his instructor's life, watching the aircraft impact the ground. A formation leader should make it clear to the wingmen they are to speak up when things are not going well. This is especially important if the formation leader is a senior officer in the squadron and the wingmen are relatively new.

Professional courtesy is part of formation flying, but letting it go too far has caused several mishaps. As the formation leader, you may want to involve your wingmen in the briefing. You may have them brief special subjects, making them feel more a part of the mission and more confident with you. If you, as the leader, make yourself more approachable, then your wingmen will be more confident in communicating their concerns, in the air or on the ground. The days of the wingman saying "2" and "Lead, you're on fire" are quickly drawing to an end. The overbearing aircraft commander teamed up with a diminutive copilot has played the role in many big jet mishaps. Don't let it happen to you in a


USAF Photo by SrA Andrew N. Dunaway,II

continued on next page

USAF Photo by SrA Jeffery Allen

fighter formation.

All this great communication information is very helpful, but it isn't worth a darn if formation members lose SA. What is SA? How do you get it? How do you lose it? How do you get it back? Pretty tough questions to answer since every pilot may have an opinion on the subject.

Maj Tony Kern wrote an excellent article for the AETC publication The Human Factor in the Spring 1994 edition. The article is called "Situational Awareness: What You Don't Know Can Kill." In the article, 173 small jet pilots were interviewed on what they considered as components of good SA. They are listed below.

1. Building a 3-D image of the entire situation. Think of "the plan" again. To better help our flightmates build an image of the situation, we must provide them with as much information as possible. Relaying the recovery plan in an emergency situation helps the wingmen build SA.

A four-ship of fighters were en route to a destination where the weather was quickly deteriorating. All four lost the "big picture" and made multiple attempts to land at a field that was weathered in. A suitable alternate was 15 minutes away and VFR. The end result was one jet out of fuel and in a farmer's field. There were many other factors in this incident, but every pilot in this formation lost the 3-D picture of the situation.

2. Assimilating information from multiple sources. During emergencies, everybody and their grandmother may be on the phone trying to talk to you or the aircraft in distress. Being able to cut through the extraneous calls will aid in building SA for the formation, especially for the pilot that's fighting a crippled aircraft. Even in a normal flight situation, being able to take in all the information from Metro, the SOF, your wingmen, your fuel gauges, the looks of the weather outside, the NOTAMs that SIGMET Center just broadcast, and a Center-directed change of flight routing are monumental tasks. Being aware that information overload is occurring is the first step. Delegating some of the chores to the wingmen is the second step to recovering SA.

3. Knowing spatial position and geometric relationships. This is closely related to No. 1 above. Understanding how fast, and in what direction your 3-D image is changing will help you as lead in aiding your crippled wingy and help you decide if the plan is working or needs to be changed.

4. Periodically update the current situation. Draw a moving 3-D image of the situation, updating it as the speed of events dictates. Where am I currently in this situation? Can I accomplish my goals from my current position? Most of us ask ourselves these questions without knowing it. The more experienced pilots are constantly asking these questions, where the young pilots may be task-saturated just trying to attain weapons parameters or formation training maneuvers.

Since the formation leader is usually the more-experienced flier in the group, it's his responsibility to monitor not only his own, but the wingman's situation as well. How many times have you seen a lead land, but the wingman go around for some reason. If fuel is low, the weather bad, and a good alternate nearby, make sure the young wingman is aware. All it takes is to key the mike.

5. Prioritizing information and action. Do what's top priority now, like flying the jet. Let other items wait. A formation leader can accomplish this during the brief. Clear objectives and a concise emergency-procedures portion of the brief lets the wingmen know what you consider priority. In the air, being directive with the wingmen lets them know again what you consider priority. The four-ship with a crippled jet is an excellent example of the flight lead announcing the priorities.

6. Making quality decisions. This is the essence of good SA and flight leadership. The troops need a goal to achieve. By making a timely decision, you aim them in the direction, and they will do the work required. Think of it as the wingmen providing the thrust, while the formation leader provides the vector. All that was needed in the fuel starvation incident was a decision to divert to the alternate.

Making all these components work together is no easy task, especially during formation emergencies. Experience seems to be the method of making all these components work together harmoniously. A flight lead is chosen for an experience level of some sort, but it's important to realize the wingmen may not have the same talent. If the leader is losing SA at any time in the mission, think of what the wingmen are doing.

A classic case of lost SA and lack of communication was evident during a Navy night refueling operation. A fighter missed the wire and headed for the A-6 tanker to refuel. The fighter ended up too far in front of the A-6, so he started to slow down to get behind the tanker. The A-6 slowed to rejoin on the fighter first, then swap leads and continue refueling. Both aircraft inadvertently slowed to buffet airspeed without saying a word to each other. They finally recovered at 300 feet over the water. A quick radio call was all that was required for both pilots to regain SA and avoid a dangerous incident. If in doubt, and things are getting worse, key the mike, and ask the question.

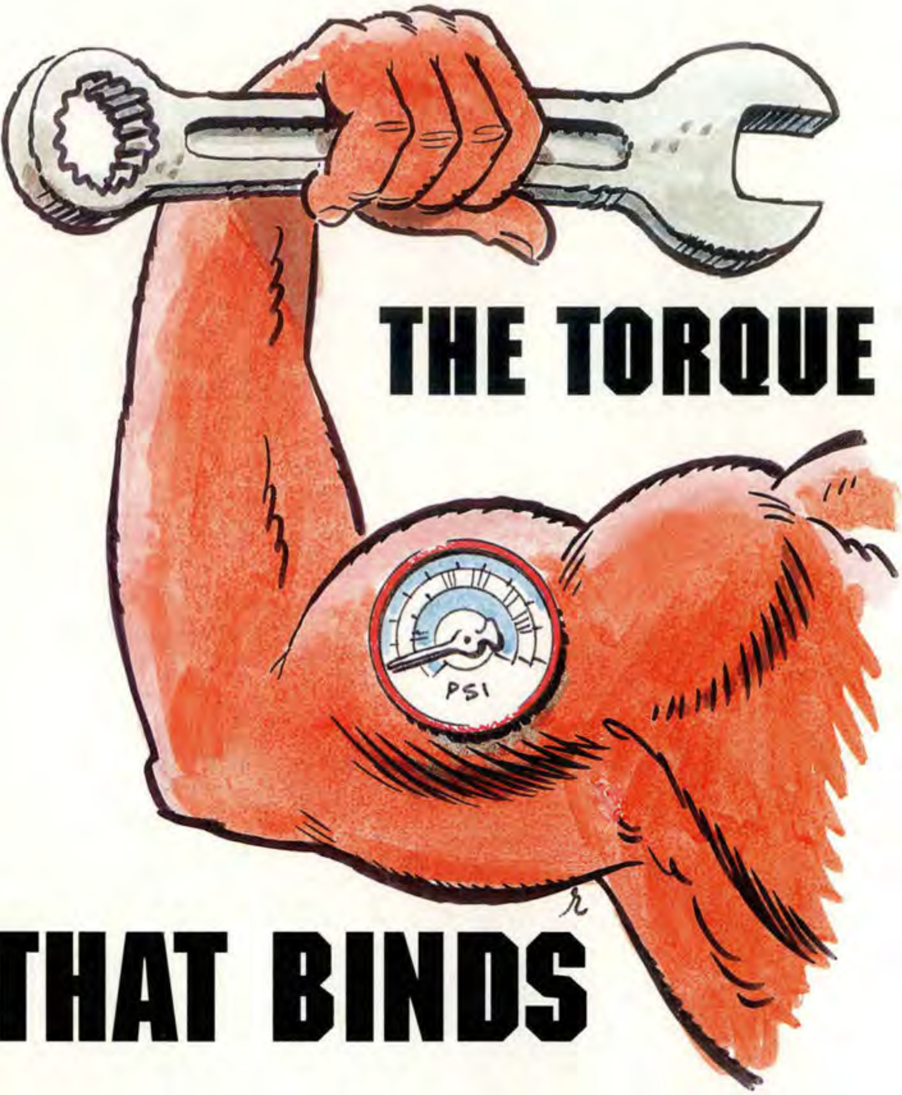
Another classic setup is losing sight during a rejoin and delaying the radio call. Obviously, the one who's lost sight has also lost SA. How many times have you found yourself in this predicament? You may have said, "I'll regain visual quickly." Meanwhile, your jets are closing in at US highway speeds. Loss of sight and subsequent collision are major causes of formation mishaps. All it takes is to key the mike, give all formation members the "heads up" to build their SA and yours, and safely rejoin when proper SA is regained.

Although there are many other factors in FRM that lead to a successful and safe mission, SA and proper, clear communications are the cornerstones. It's a full-time effort to stay on top of a mission with several fast jets around you. Being aware of the pitfalls that cause you to lose SA and fail to communicate is the first step in using FRM effectively.

FLY SAFE! ✈

Unlike the aircraft commander, the formation leader is physically separated from his flightmates in the other aircraft. The only way to relay information is to key the mike. Due to this physical separation, verbal communications need to be clear and concise since they are almost exclusively the only way to communicate complicated information.

USAF Photo by TSgt David S. Nolan courtesy Torch Magazine




# THE TORQUE THAT BINDS

**CMSGT DON A. BENNETT**
Technical Editor

■ For you wrenchbenders: Even if the tech data doesn't specify any torque values, use some common sense before cranking that nut or bolt down to eternity! Your profession demands it. The lives of others deserve it. Your honor and integrity scream for it!

A trainer aircraft crew (two qualified instructor pilots) had to cut short their functional check flight (FCF) when they encountered an unsafe nose gear situation during an operational check of the alternate gear extension system. Both mains were in the "Green," but not so the nose gear. After verifying the applicable checklist aircraft configurations were correct, they tried unsuccessfully to get the nose gear "down and locked" light to come on by performing some in-flight maneuvering techniques. Later, a chase aircraft verified all three gears did appear down, yet the mishap crew still didn't know if the nose gear was locked down. Next, they reset the gear circuit breakers, and the nose gear indicator finally lit up. There were no further complications on the return trip home.

It seems an overzealous mechanic had overtorqued the nose strut assembly's lower drag link bolt which eventually caused the nose gear to bind during the FCF alternate gear extension procedure. However, it was further determined it wouldn't have been too hard for the mechanic to take the "extra measures" in torquing the mishap bolt — the aircraft's tech data didn't even provide the mechanic with any specified torque value in the first place! Apparently, someone along the many procurement, validation, and acceptance inroads to introducing this trainer aircraft to the operational world failed to discover this critical torque value omission.

Yet, despite the missing torque value in the tech data, isn't the installation maintainer responsible for exercising a little mechanical savvy and common sense during any wrench-turning task? Obviously, too much (or too little) of anything can sometimes cause further complications than were originally corrected. For instance, there have been many mishaps caused by aircraft environmental or hydraulic systems discrepancies where over- (and under-) torqued nuts, connectors, or bolts have caused bigger leaks than the original, pre-mishap repair actions tried to stop. And, in correcting these "insult to injury"-type discrepancies, there were cases of faulty hardware installations, such as rolled, stripped, or crossed threads, cracked fittings, flanges, or tubing, damaged seals, and more.

Others have even identified free-wheeling components or parts, such as fan blades, rollers, bearings, and the like, that were found to be binding, stuck, or damaged because of overtorquing.

Should it have taken tech data to direct the installation mechanics not to keep cranking down on the hardware so the component won't turn or bind up? I hope not! Especially if the unit mechanics are properly trained, supervised, disciplined (if required), and followed up on. And certainly not if there's a well-established, professional, uncompromising organizational mindset that will prompt (better yet, challenge) every maintainer to question even unit maintenance practices as well as tech data procedures that aren't clear or defy our mechanical, commonsense logic.

Such was the case in the omission of the mishap link bolt's torque value. Should we have left it up to each installing mechanic's natural muscle strength to determine the applied torque, e.g., for a component that depends on rotating or pivotable forces to perform its function properly?

Most disturbing: This mishap aircraft had flown a number of sorties since the "link bolt" work — without incident — so the binding action wasn't discovered until after this particular mishap FCF flight.

This observation prompts some interesting questions. Why wasn't the binding condition discovered during an operational "gear swing" after the gear work was completed? Aren't landing gear retractions still required after certain critical gear components are replaced or adjusted — to certify the gear retraction or extension sequencing hasn't been altered? And, as in this case, the nose strut lower drag link had been replaced, so wouldn't an operational gear swing be called for on this critical gear sequencing component? Lastly, on a relatively brand-new aircraft ('93 model), what would cause the lower drag link to be replaced so soon? Is there something else missing in the gear system's tech data, engineering design, or aircraft specifications that would warrant further inquiry and research?

As aircraft mechanics, we often feel confident our "finished product" won't fall apart if we really crank those nuts and bolts down during reassembly, e.g., when there are no specified torque values listed in the tech data. Right? You've been there, too. That nut or bolt is about as tight as you can get it without "bustin' a knuckle," but you still give it one more grunt turn just to be sure. There's nothing wrong with being confident about your repair work — just don't get overzealous in gaining that confidence.

Be safe out there, and for Pete's sake, if there are any problems with any tech data, fix 'em! ✈

# THE INTERIM SAF

COL JOHN J. MITCHELL
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It was 0645, and I had just returned from my morning jog. My wife called to say the command post was on the line. Nothing terribly unusual about that, given the wing commander was away. However, my sensors quickly went on alert when the duty controller said there was an Air Mobility Command general officer requesting a phone patch with me.

The patch took seconds to complete. The message took a bit longer to digest. "The commander wants you to proceed to Boondocks AFB to investigate an airlift aircraft mishap. How soon can you get there?"

My commander was off station. I was in charge. Surely there must be someone else available, especially since my boss was away and, thus, incur a dual absence. My comments were noted, but again I was asked how soon I could be to Boondocks AFB. After asking some questions of the transportation management office, I informed the general the earliest I could be there would be the next morning. That was not good enough. I was told a C-21 would be waiting for me in 2 hours. I would proceed to Boondocks AFB via Scott AFB for further instructions so as to be in place by midnight.

My reason for relating this anecdote is to establish the extreme importance our leadership places on establishing a safety investigation board as expeditiously as possible. Some boards are formed with less speed, but in all cases, while that activity is going on, others are involved with capturing and initially cataloguing the environment of an aircraft mishap. I will focus on the responsibilities of the interim safety board.

Every wing commander's nightmare is a major aircraft accident occurring on or near his installation. The successful management of a tragedy of this type is the true test of a wing commander's leadership. He brings to bear every element of his command. He will soon learn whether he has a mature team. His disaster control teams and on-scene commander should know what

# ETY BOARD

## A Safety Investigation Board President's Perspective

their jobs are. His exercise/inspections and safety offices must have prepared all personnel through meaningful, demanding preparatory exercises. Every person must know how to perform the essential elements of their responsibilities to mitigate and contain the disaster while, at the same time, they must protect the environment so investigators who follow will have sufficient evidence to determine the mishap cause. The mishap has brought damage and destruction to lives and property. The chore now is to ensure a mishap of this type never happens again.

The purpose of an interim safety investigation board is described in AFI 91-204, paragraph 1.2.5.2, which states its job is "to protect and preserve vital evidence pending the arrival of the formal safety investigation board (SIB), to include generic requirements for photographs, collecting of fluids and gases, obtaining witness statements, TOX testing, physiological testing." Its mission is critical. Should evidence be lost, corrupted, or otherwise compromised, the root cause(s) of the mishap may never be found — with the worrisome possibilities of a similar accident occurring which might have been avoided.

The pressures on the interim board president can vary, depending on personal experience and the preparation of his team to deal with tragedy. Murphy's and Schwartz's Laws will have their way. (For those who do not know, Schwartz said that Murphy was an optimist.)

It cannot be overstated that the success of an interim board will be directly proportional to the right combination of trained people available. It would be a mistake to have trained only one or two key people for critical leadership positions. Invariably, the people trained will be on leave or TDY, and the duty of managing the chaotic mishap environment will fall to a neophyte. Even if you are lucky enough to have the people you trained available, the system relies on a dynamic environment almost any part of which can unravel and foil the best effort.

Returning to my anecdote, I arrived at Boondocks AFB at approximately 1800 that night and

continued on next page

Official USAF Photo

was met by the interim board president who spent several hours assuring me I had nothing to worry about. All that could be done had been done. He even knew exactly what happened. All I had to do was gather the supporting details. Being a freshman in the safety business, I was reassured by his confidence and slept well that night.

My board assembled throughout the next day. As we picked up momentum, we learned, as Paul Harvey would say, "the rest of the story." It became clear that if I had been complacent last night, I would not be for the next 29.

After the mishap aircraft cleared the runway, the interim board felt compelled to do a quick assessment of material on the runway. Its base aircraft were expected to return in the next few hours. Pressures do abound, tugging one way and then the other.

The interim board president was caught in a classic dilemma. He could have arranged for the diversion of his homebound aircraft. Instead, he chose to expedite the gathering and "preservation" of evidence by ordering still pictures taken of the mishap sites and aircraft. Shortly thereafter, the larger pieces of material from the mishap aircraft (covering the approach end of the runway) were collected and placed in a storage shelter. The smaller pieces were removed by mechanical sweepers and disposed of in the local landfill. The mishap aircraft, which had cleared the runway on its own and sat securely on a taxiway, was towed to a "more appropriate" spot. Did I hear a gasp? Be assured this sort of mishandling of evidence is not unique to this anecdote.

Investigators spent hours sifting through the landfill for evidence. But as luck would have it, the "golden BB" was not found in either the landfill or the storage shed. It was found as a result of scores of men and women scouring the area adjacent to and either side of the first half of the runway. I tell you this just to complete the story.

The interim safety board failed to preserve the scene. It succumbed to pressures within its purview to control. Had the critical part been among the material swept up, it is likely it would have been damaged or rendered unusable as evidence due to scrapes and abrasions resulting from sweeper operations.

There were many other issues associated with the conduct of the interim board, but I will deal with one other directly, and that is the requirement for toxicology testing. The rules are very specific, but Murphy and Schwartz again intervened. The gathering and packaging of material were done properly, but the technician finally responsible for packaging the material failed to release it. In fact, a week into the investigation, the SIB found it still in the possession of the clinic. As if that was not enough, once gathered again, another technician failed to send it to the correct lab for study. Needless to say, the material was now valueless.

To be fair, the burdens of the interim safety board are many. They have to make sense out of the first few hours of catastrophe. They have to organize chaos. Mistakes will be made. The questions are: How significant will these mistakes be, and what will be their impact on the resolution of causal findings?

The business of aviation is filled with potential hazards and is made safe only by vigilance of people who take their jobs seriously — every minute of every day. Given a constantly changing environment, they continually examine their processes for possible flaws or improvements. In that context, an effective interim safety investigation board follows from concerted preparation. Preparation equates to time, and time, as the song goes, is what we have too little of.

Yet I contend the mistakes, or the lack thereof, will be in direct relationship with preparation. So the burden of persuading wing leadership to invest the time belongs to the wing chief of safety. In most cases, the task will be relatively simple. People chosen to be wing commanders intuitively recognize the necessity of preparing for a major aircraft mishap at their installations. They are vulnerable every day of the week.

Can the effects of this dynamic environment be mitigated? In my judgment, this will occur only when the wing safety office is clearly recognized as the process owner and is prepared to perform as such. Planning, advice, and followup are critical contributions to the wing commander and his interim safety investigation board. Wing leadership must "walk the talk." When exercises are planned and executed — participate! The standard is set at this time.

Remember, the wing commander's worst nightmare can occur at any time. High tempo and unusual activity are not the sole sources of mishaps. The mishap aircraft of my anecdote was from another base, engaged in what some might consider low-threat transition training.

In closing, I offer the following checklist for your consideration. It is not all inclusive. Use it profitably.

Duration of Interim Safety Investigation Board: 12 to 72 hours or until relieved by the formal board.

I. Assume control of mishap scene from disaster response team.

II. Prepare for formal board arrival.

A. Put mishap plan in place.

(1) Agencies responsible for records collection should be clearly identified and should deliver

records to interim board versus board members collecting them individually.

(2) Immediate action to secure cockpit voice recorder (CVR), flight data recorder (FDR), maintenance data recorder, and any other electronic or magnetic data. Remember, tapes keep running if power is on the aircraft. Tapes are looped and generally limited to only 30 minutes total duration.

(a) Determine if there are any other recording devices operating.

(b) Flightline security at many bases is augmented with video equipment. A mishap in the runway/ramp vicinity may be recorded.

(c) Have a plan to prevent the loss of that information.

(3) Coordinate with home station, departure base, or en route stops to secure perishable records.

(4) Obtain copies of initial OPREP reporting and coordinate on the 1-hour public affairs news release.

B. Conduct recorded interview with surviving aircrew ASAP.

(1) Conduct while information is fresh.

(2) One on one in private.

(3) Keep individuals separated to prevent a group consensus from obscuring individual observations.

(4) Formal meeting at 4 to 7 hour point.

III. Special considerations:

A. Impact on survivors and rescuers can be traumatic.

B. Preserve perishable evidence — quickly and completely.

(1) Measure

(2) Photograph (before any movement of evidence) as found. Video tape if possible, but photograph before you move. Package and mark parts for identification.

(3) Capture fluids in sample bottles.

(4) Beware of explosives and other dangerous material in wreckage (prevent secondary mishap).

(a) Tires and other pressurized vessels.

(b) Life raft pyrotechnics.

(c) Fire extinguisher squibs.

(5) Management of deceased.

C. Focus

(1) Cockpit (switches, etc.).

(2) Structure.

(3) Abnormalities.

(4) Medical authorities-Human Remains.

D. Civilian aircraft involved: NTSB takes lead, but generally not quick to arrive (36 hours).

E. Off-base Class A (loss of life). Local coroner in charge, even with military aircraft involved. Check with mortuary officer and refer to local memorandum of understanding.

F. Eight-hour report.

(1) Factual, fully releasable.

(2) Should match PA 1-hour report.

(3) Mishap classification (initial).

(4) Do not directly contact AFMC or contractors.

IV. Prepare facilities for formal board arrival (huge dedication of resources).

V. Contact the Air Force Safety Center. Provide a detailed description of the mishap. The Safety Center will alert tech assistance personnel, place them on standby, and select a Safety Center representative to participate in the investigation.

VI. In-brief formal board. ✈

## WE'D LIKE TO PUBLISH YOUR STORY!!

We know there are some great experiences out there just waiting to be told, so how about jotting them down. We'd like to hear from you — how you are accomplishing your mission **safely**, or some first-person lessons learned, or some new technological advances, or anything you think will interest the *Flying Safety* magazine audience. Your articles can help us "get the word out" about what's happening in the Air Force.

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We look forward to hearing from you and reading your story!!!

**CAPT PHIL WARD**
97 OG/OGV
Chief C-5 Standardization and Evaluation Pilot
Altus AFB, Oklahoma

# Lightning

■ Recently, while on an air refueling training mission, I received some first-hand experience with lightning strikes. Here's the story.

I was flying an initial qualification air refueling student sortie. We were to refuel on track 024 N with a cell of tankers, call signs Raid 12 and 13. After becoming airborne from Altus, we called the command post to do a final check on the status of our tanker and discovered they were still on the ground due to high crosswinds. In an attempt to complete my student training, we coordinated with Air Traffic Control to fly to the north end of track 024 and wait for our tankers closer to their departure base.

En route to the northern ARIP, we were required to deviate off track at the south end of the AR track to avoid an area of thunderstorms at the southern exit point. Continuing up track, we were above a fairly solid cumulus cloud in which we could expect to be refueling when we joined up and flew this track back to the south. We informed the tankers the track was covered with clouds and the south end also had an area of thunderstorms near the exit. They were airborne at this time, and we asked them to coordinate for another refueling area.

At the north end of the track, however, the weather was clear enough to accomplish the rendezvous. But almost immediately after the rendezvous, we entered the weather, and visibility decreased to around 100 feet. I asked the lead tanker if they had an alternate refueling location coordinated because I had students on their first AR ride, and these conditions were very tasking. I again reminded them to watch the weather at the south end of the track.

Approximately 20 minutes after the rendezvous, my student in the jump seat stated we were 100 miles from the exit point. About this time, I started hearing an increase in static in my headset and told my crew this was not a good sign because it often indicates lightning in the area.

I took control of the aircraft and started backing up to aft of the precontact position. We heard the cell lead directing a left 180-degree turn for weather as we entered into an

area of rain. Hearing this, I directed the student to turn on our weather radar so we could scan the area for hazards.

As the student switched on the weather radar, a lightning bolt hit the No. 2 tanker which we were behind, followed his boom down, and jumped across to also strike our C-5. I initiated a breakaway, and my students stated we were in a solid area of red on our weather radar and to continue the left turn to a heading that would clear the storm. During this turn, our aircraft took two more lightning strikes before clearing the storm. Needless to say, we were awake at that point.

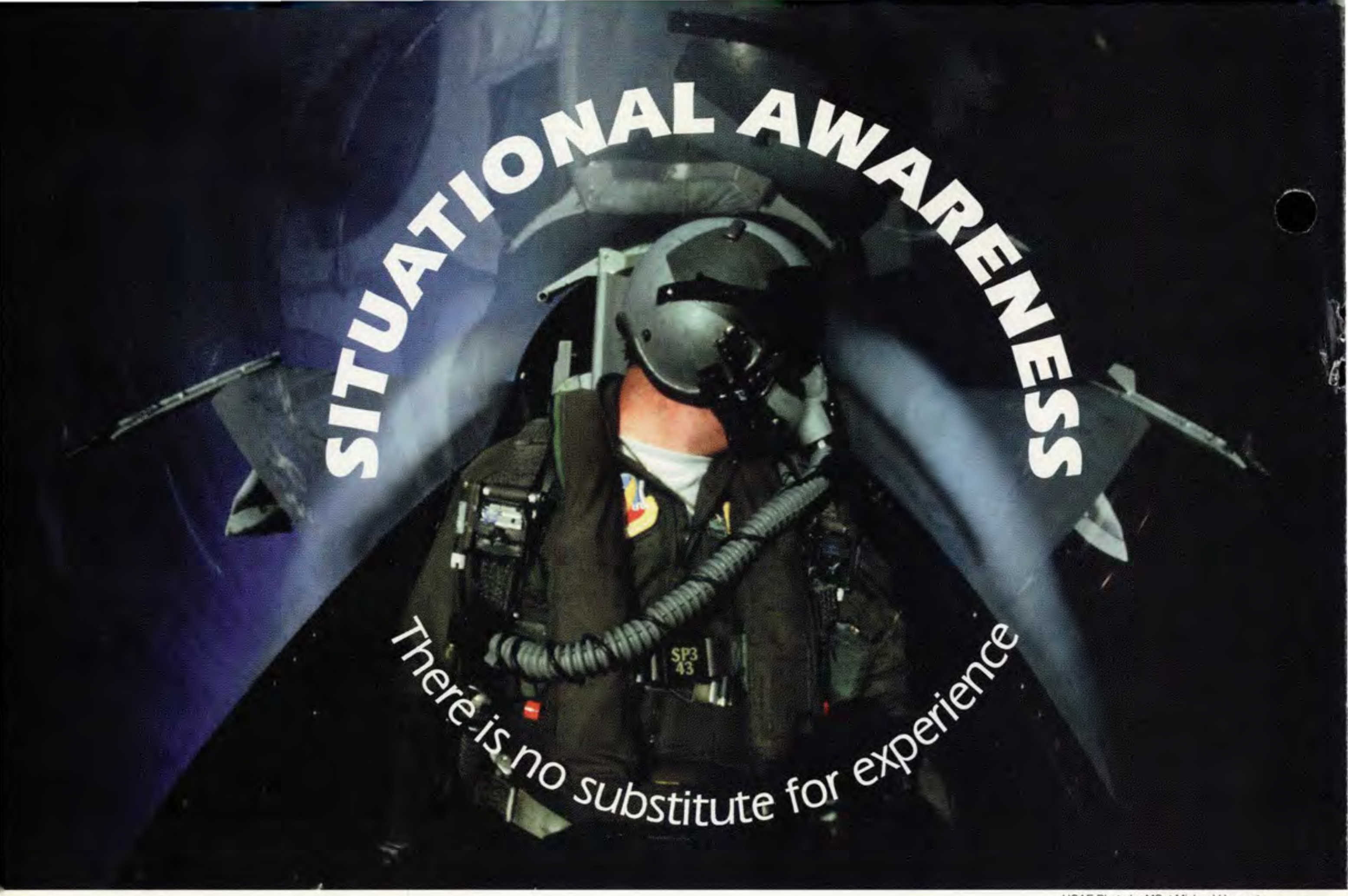
This incident brings attention to the importance of recognizing areas of probable lightning strikes. Aircrews must increase vigilance and have an avoidance plan should these conditions be encountered in flight. According to AFM 51-12, Volume 1, lightning strikes are most common in the following conditions:

- Temperatures within 8 degrees C of the freezing level,
- Within about 5,000 feet of the freezing level,
- In light precipitation (including snow), and
- In clouds, in light or negligible turbulence.

Air refueling directives state that after the rendezvous, the tanker is responsible for weather avoidance. However, both the C-141 and C-5 have a better weather radar than the KC-135 and, when encountering the threat of thunderstorms, aircraft commanders should use these weather radars to aid in weather avoidance to the maximum extent possible without creating a hazard to the crewmembers of the other aircraft. (C-5 and C-141 radars can be safely operated while maintaining as little as 50 feet separation between receiver aircraft and the boom.)

All aircrews should make every attempt to avoid the above conditions in order to minimize the possibility of a lightning strike. We were lucky our C-5 received no damage from this incident. Others have not been as fortunate.

The bottom line: Whether single ship, formation, or air refueling, aircrews must exercise extreme caution when operating in conditions conducive to lightning strikes. ✈




USAF Photo by MSgt Michael Haggerty

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Pilot situational awareness (SA) has been a hot research topic in the USAF over the past few years. Shortly after the end of the Gulf War, then Air Force Chief of Staff General Merrill McPeak directed Air Force research laboratories to study how pilots gain and maintain SA. In a handwritten memo to his staff, Gen McPeak posed the questions:

"Just what do we mean by 'situation awareness'? (I know it when I see it.)"

"Can it be measured objectively?"

"Can it be learned?" and

"If it can be measured, when in the flying training process should we take measurements? (Can we select for it?)"

The Armstrong Laboratory's Situation Awareness Integration Team (SAINT) responded to the general's concerns.

An Air Staff working group answered the first question by defining SA as:

A pilot's continuous perception of self and aircraft in relation to the dynamic environment of flight, threats, and mission, and the ability to forecast, then execute tasks based on that perception.

This definition, adopted by the SAINT team, clearly describes SA as a complex construct involving perception, processing and interpreting data, forecasting, decision making, and action. Failure in any one of these functions results in poor SA and less-than-optimal performance. Objectively measuring a pilot's perceptions and thought processes in flight is impractical, if not impossible.

Fortunately, like Gen McPeak, many pilots know SA when they see it and can provide reasonable assessments of their squadron mates' SA. These assessments are an important yardstick for validating measurable fundamental skills, abilities, and characteristics as predictors of situational awareness.

Several researchers[1,2,3] have identified three factors that are valid predictors of job performance for almost all tasks, including pilot performance. These predictors are general cognitive ability (intelligence), psychomotor skill ("good hands"), and a combination of personality traits collectively known as "conscientiousness."

To objectively measure these predictors, Armstrong Lab's SAINT team developed a battery of 24 computer-based tests. The hardware used for the tests, a PC with a hefty control stick, throttle, and rudder pedals, was a refinement of the lab's Basic Attributes Test (BAT) stations used for screening pilot candidates. Tests covered a broad range of abilities, including attentional control, verbal and spatial working memory, velocity estimation, control precision, multi-limb coordination, and reaction time. The team selected a computer-based self-assessment inventory to measure personality traits.

To investigate SA in the demanding air-to-air mission, the SAINT team targeted F-15 AC pilots as test participants. There were 171 active duty F-15 AC pilots from Eglin, Elmendorf, Kadena, and Langley who took part in the team's study. Participants ranged in rank from first lieutenant to lieutenant colonel and ranged in experience from 88 to 2,007 F-15 flying hours. Participants were tested on the computer-based battery at their operational bases. Supervisor and peer ratings of SA were collected independently.

Rating scales used for supervisor ratings of SA had been developed in a previous study by experienced F-15 pilots who served as subject matter experts (SME). These SMEs identified tasks essential to air combat success and required for SA. Supervisor rating scales included 31 specific items measuring general traits, communication, information interpretation, systems operation, tactical game plan, and tactical employment. Standardized definitions for each item were provided to every rater to ensure consistency. Each of the 31 items was rated on a 6-point scale from 1 — "Acceptable" to 6 — "Outstanding." Supervisors also rated pilots on SA and overall fighter ability using the same 6-point scale.

For peer ratings, pilots rated other pilots in their squadron with whom they had flown on SA and overall fighter ability. Pilots also rank-ordered their peers from 1 — "The best I've flown with" to N (number of peers rated), indicating their judged standing on the trait of SA.

Between peer and supervisor ratings, each pilot in the study was rated by several other pilots. Analysis of the multiple SA ratings revealed remarkably strong agreement between peer and supervisor ratings of SA. Apparently, those who claim to "know good SA when they see it" are all looking at the same thing. For purposes of the study, peer and supervisor ratings were weighted equally to create a baseline SA rating for each pilot.

The pilots in this study varied greatly in their level of flying experience. Not surprising, peer and supervisor ratings of SA were strongly related to F-15 flying experience. Generally, peers and supervisors regarded highly experienced F-15 pilots as having better SA than low-time pilots.

In order to get a clearer understanding of the relationship between ability (as measured by the computer-based SAINT test battery) and actual flying performance (as determined by peer and supervisor ratings), F-15 flying experience was treated as a control variable in further analyses. Six tests of the 24-test battery proved to be significantly related to SA. Relevant cognitive tests included measures of spatial reasoning, divided attention, and information integration. Significant psychomotor tests included measures of aiming, attention, reaction time, and rate control.

**SA can be defined as a pilot's continuous perception of self and aircraft in relation to the dynamic environment of flight, threats, and mission, and the ability to forecast, then execute tasks based on that perception.**

Investigators performed a series of analyses to determine the relative value of cognitive, psychomotor, and personality ("conscientiousness") measures and flying experience for predicting SA. Statistical tests showed that F-15 flying experience was the most predictive variable. Only the measure of cognitive ability provided incremental validity beyond F-15 flying experience.

Psychomotor skills and conscientiousness did not predict SA. Although fighter pilots will always argue about who's got the "best hands," among the pilots tested, all scored within a tight range of high scores on psychomotor skills tests. Differences between individual pilots were extremely small. It is likely that constant training and the myriad levels of screening endured to become an F-15 pilot served to reduce — to almost nothing — individual differences in psychomotor ability. Among the pilots tested, individual differences in conscientiousness were also small, negating

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the utility of this measure as a predictor of SA.

Flying experience, the opportunity to accumulate job knowledge, was the most predictive variable of SA. Cognitive ability, the ability to accumulate job knowledge, was also predictive. The result for cognitive ability is consistent with recent Air Force studies[4,5] involving cognitive ability and pilot performance in Undergraduate Pilot Training (UPT).

The implications of the SAINT team's study are straightforward. The first implication is that flying experience builds situational awareness. Although the study focused on F-15 pilots, this implication can be expected to hold true for pilots of all aircraft.

**Psychomotor skills and conscientiousness did not predict SA. Although fighter pilots will always argue about who's got the "best hands," among the pilots tested, all scored within a tight range of high scores on psychomotor skills tests. Differences between individual pilots were extremely small.**

The second implication is related to pilot selection. Current USAF pilot candidate selection methods such as the AFOQT and BAT rely heavily on measures of the construct found to be predictive of situational awareness: cognitive ability. Future pilot selection instruments should retain measures of cognitive ability.

In answer to Gen McPeak's questions: Can SA be measured objectively? Not exactly — yet. Peer and supervisor ratings used in this study were reliable with excellent agreement across a large number of raters, but the ratings are largely subjective. Objective measures of pilot experience and intelligence can only roughly predict SA. Can SA be learned? Absolutely, and experience is the best teacher. When in the flying training process should we take measurements? As soon as possible in the pilot selection process. UPT applicants obviously cannot be evaluated on the basis of jet flying experience because few of them will have flown a jet prior to entering UPT. However, applicants can be screened on the factors that have been shown to be related to success in training: intelligence, hand-eye coordination, and flying experience. ✈

This article describes just one aspect of an in-depth investigation of situational awareness by the SAINT Team. Follow-on research is focused on activities to transition the experimental SA measures used by the SAINT Team to an advanced development phase and eventually produce a version suitable for operational use. In regard to the computer-based tests, studies are planned to examine their reliability, validity against training performance criteria, and gender/ethnic group differences in test performance. Eventually, these or similar measures can be incorporated into USAF pilot selection procedures. For more information on Armstrong Lab's SA studies or aircrew selection research, write to the authors at AL/HRMA, 7909 Lindbergh Drive, Brooks AFB, Texas 78235-5352, or call DSN 240-3922.

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**DOROTHY SCHUL**
Editorial Assistant

# Sniffles and Flying Don't Mix

■ "It's only the sniffles, so why shouldn't I fly?"

The simple answer is because it's dangerous! The everyday head cold has been, and could be again, the cause of aviation mishaps and incidents. Flying is a demanding job, physically and mentally. Anything which adds stress adversely affects performance. In a matter of hours, sniffles have a way of turning into full-blown head colds, causing a real problem on long, as well as short flights.

The average adult, during the course of a year, will get two or three colds, and if there are children in the home, perhaps up to six. As wonderful as our modern science is, at present there are no antibiotics or vaccines against the common cold. Your own body's defenses must do the job. And since a cold is such an ordinary and mild illness, it's easy to assume it isn't serious enough to keep an aviator from flying.

Today's crewmember should pay attention to the potentially adverse effects of upper respiratory infections and have in mind a possible plan of action should one inevitably occur. Of course, the best solution would be to swallow your pride and stay down when your nose is a little stuffy. But physiological incidents can creep up and surprise us all.

A cold decreases G tolerance, tolerance to fatigue, tolerance to hypoxia, tolerance to cold stress, and increases susceptibility to decompression sickness. A cold can lead to sinus block, pressure vertigo, symptoms from self-medication, or extremely painful ear block. Singly or combined, any of these problems could lead to total incapacitation.

Ear blocks should not be taken lightly. They can be worse than uncomfortable — even fatal. Once in a while, one ear can block resulting in severe vertigo. Vertigo has been implicated in the loss of several single-pilot aircraft.

Several years ago an aircrew member was on the schedule for a 10-hour operational flight. He awoke with a case of sniffles, but since he could still clear his ears, he decided to press on. The mission promised to be exciting.

However, during the mission, the virus causing the sniffles multiplied and strengthened its hold. At some point, while at altitude, the tiny Eustachian tubes leading from the pilot's throat to his middle ears became blocked due to inflammation and secretions. It was painless, he was busy with his in-flight duties, and he didn't notice what was happening.

During descent, the crewman began to notice a sensation in his ears. First there was mild pressure, which got gradually stronger, then painful. He desperately tried to force higher density air into his middle ears with the valsalva maneuver, but he couldn't. His Eustachian tubes were shut tight.

The correct procedure is to immediately notify the pilot of the problem. The cabin altitude can then be increased (by climbing or adjusting the pressurization) back to the original altitude, equalizing the pressure on both sides of the eardrums, thus relieving the pain. And hopefully, using a slower descent and frequent, forceful valsalvas, equal pressure can be maintained. This usually works — unless the Eustachian tubes are completely

continued on next page

Fortunately, this crewmember decided to stop by the flight surgeon prior to going to the debrief, the club, and to bed. Upon examination, his eardrums were seen to be stretched very tightly over the small bones of the ear.

blocked.

In this case, the descent was slowed, but cabin altitude was never regained. The pain was not unbearable. The aircrew member landed with the outside of his eardrums at sea level and the inside at cruise cabin pressure of around 8,000 feet AGL.

Mother Nature likes to fill vacuums. One possible way is for the eardrum to rupture and let the higher pressure in. Since the eardrum is only several cells thick, it's surprising this doesn't happen more often.

The usual way the ear equalizes pressure is to dump fluid, particularly blood, into the middle ear. The space fills until the remaining air is at atmospheric pressure. The pain eases as the tension on the eardrum is relieved. Hearing becomes drastically impaired, however, and the fluid takes at least 2 weeks to be absorbed. Sometimes the blood causes permanent scarring on the tiny bones in the middle ear. Throughout this time valsalva is impossible, and grounding is required.

Fortunately, this airman decided to stop by the flight surgeon prior to going to the debrief, the club, and to bed. Upon examination, his eardrums were seen to be stretched very tightly over the small bones of the ear. He was given some nose drops to help dilate the Eustachian tubes. Following this, a burst of high-pressure air was introduced into his nose, forcing pressurized air through the obstructed tubes and into the middle ears, relieving the negative pressure.

Once neutral or positive pressure is restored to the middle ears, the danger of them becoming filled with fluid is past. The airman had to be grounded for only his cold symptoms rather than waiting the several weeks necessary for the fluid to be absorbed. If he hadn't decided to be seen immediately after the ear block occurred, his down time would have been 5 to 10 times as long as it was. His Eustachian tubes opened within several days, valsalva became possible, and he went back "up."

According to Dr. Richard A. Levy, Chief, Life Sciences Branch, here at the Air Force Safety Center, this same problem can happen on the tail end of a cold — major symptoms have resolved but Eustachian tubes are still inflamed with resultant ear block on descent. This can cause pain, hemorrhage into the eardrum, and 10 days DNIF if the aircrew manages to get down without catastrophe.

The airman's wise words: "I'll never again go flying with a cold coming on." ✈

## THE SINUS BLOCK

If you've never had a sinus block, it's easy to underestimate how painful it can be. Anyone who has suffered pressure-induced sinus pain will assure you it is extreme and quite incapacitating. The cause of sinus pain is very much like that of ear pain, and it occurs on descent if there is blockage due to inflammation.

People often think if there's a mild amount of pressure at 4,000 feet, surely it will not be so bad at ground level. Wrong!

In those few seconds of final approach, the pressure change is so much it can cause excruciating pain. The head feels like it is about to explode. Vision can become blurred or double. Blood vessels inside the sinus sometimes burst, filling the sinus cavity with blood.

A KC-135 navigator began to feel a mild fullness in his cheekbones, just below his eyes. He tried to clear his ears and pressed on his nose, but the sensation was not relieved. The pain only got worse as the aircraft descended.

The pilot offered to abort the approach and go around, but the nav felt he would be all right. An ambulance met them at the ramp and took the nav to the hospital for treatment.

He told the doctors he had only slight stuffiness that morning. However, the x-rays showed sinusitis, and he was grounded for several weeks.

If you have the sniffles, see your flight surgeon. Don't take a chance on being incapacitated at a critical time during your next flight.

# USAF SAFETY AWARDS

***The Secretary of the Air Force Safety Award***

*— The highest safety award for the best all-around mishap prevention program.*

***Category I —***

MAJCOMs that fly 2 percent or more of the total USAF hours.

**Air Mobility Command**

***Category II —***

MAJCOMs/FOAs/DRUs that fly less than 2 percent of the total USAF hours or have no flying mission.

**Air Force Materiel Command**

**Major General Benjamin D. Foulois Memorial Award —**

The best aviation mishap prevention program

*Air Force Materiel Command*

**Colombian Trophy —**

The best aviation safety program in a fighter, attack, or reconnaissance organization.

*48th Fighter Wing (USAFE)*
*RAF Lakenheath, United Kingdom*

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*Captain Bart D. Klein*
*55th Air Refueling Squadron (AETC)*
*Altus AFB, Oklahoma*

**System of Cooperation Among the Air Forces of the Americas (SICOFAA) Flight Safety Award —**

The best aviation mishap prevention program in an organization with other than a fighter, attack, or reconnaissance mission.

*436th Airlift Wing (AMC)*
*Dover AFB, Delaware*


# THE INSTRUMENT QUIZ

**CAPT KEVIN JONES**
AFFSA/XOFD

■ After getting you to several different locations, we're going to work backwards and let you try to depart one. You are on one of those training weekends and decided to land at Lake Tahoe for some high altitude landing practice. Now, after a relaxing crew rest, it's time to flight plan for your next leg.

**QUESTIONS:**

1. Where can you find the SID for South Lake Tahoe?

a. Look around the FBO. They are required to furnish SIDs.

b. Lake Tahoe's SID is found in FLIP's Western Civil SID book.

c. Don't worry about it — military pilots are not required to fly SIDs.

d. You are required to fly a radar departure anyway and don't need one.

2. What is the minimum climb gradient you must achieve when flying the Shole One?

a. 200 feet/NM to the MEA.

b. 300 feet/NM up to 9,000 feet MSL.

c. 400 feet/NM up to 8,300 feet MSL.

d. 700 feet/NM up to 9,800 feet MSL.

3. Are there any obstacles associated with the Shole One departure?

a. No, the climb gradient is an ATC restriction only.

b. Yes, but they don't penetrate the required gradient, so they are not depicted.

c. Yes, but civil SIDs do not depict obstacles.

d. No, all those mountains you flew by on the way in have miraculously become molehills.

4. What about the ▼ symbol? Does it mean anything to USAF pilots?

a. No, it's a notation for civil pilots informing them of nonstandard takeoff minimums.

b. Yes — it tells us to look in the front of the book for ATC climb gradients.

c. Yes — the ▼ notifies us that the field has a published IFR departure procedure.

5. Which of the following statements are TRUE regarding civil SIDs with a published climb gradient?

a. If there is a ▼ symbol, check the front of the book in case there are ATC climb gradients published.

b. The published climb gradient is because of an actual obstacle.

c. Check the front of the book for higher climb gradients associated with an IFR departure procedure.

d. The controlling obstacle which makes the gradient necessary will be indicated on the SID.

BONUS: Now that most of you know something about the "trouble T," go back to question 2. Why do we have to fly at 300 feet/NM instead of 400 feet/NM as called for in the takeoff minimums section.

a. I have no clue. I got No. 2 wrong also.

b. You should be climbing at 300 feet/NM — AFFSA got it wrong again.

c. The SID depiction takes precedence over the ▼.

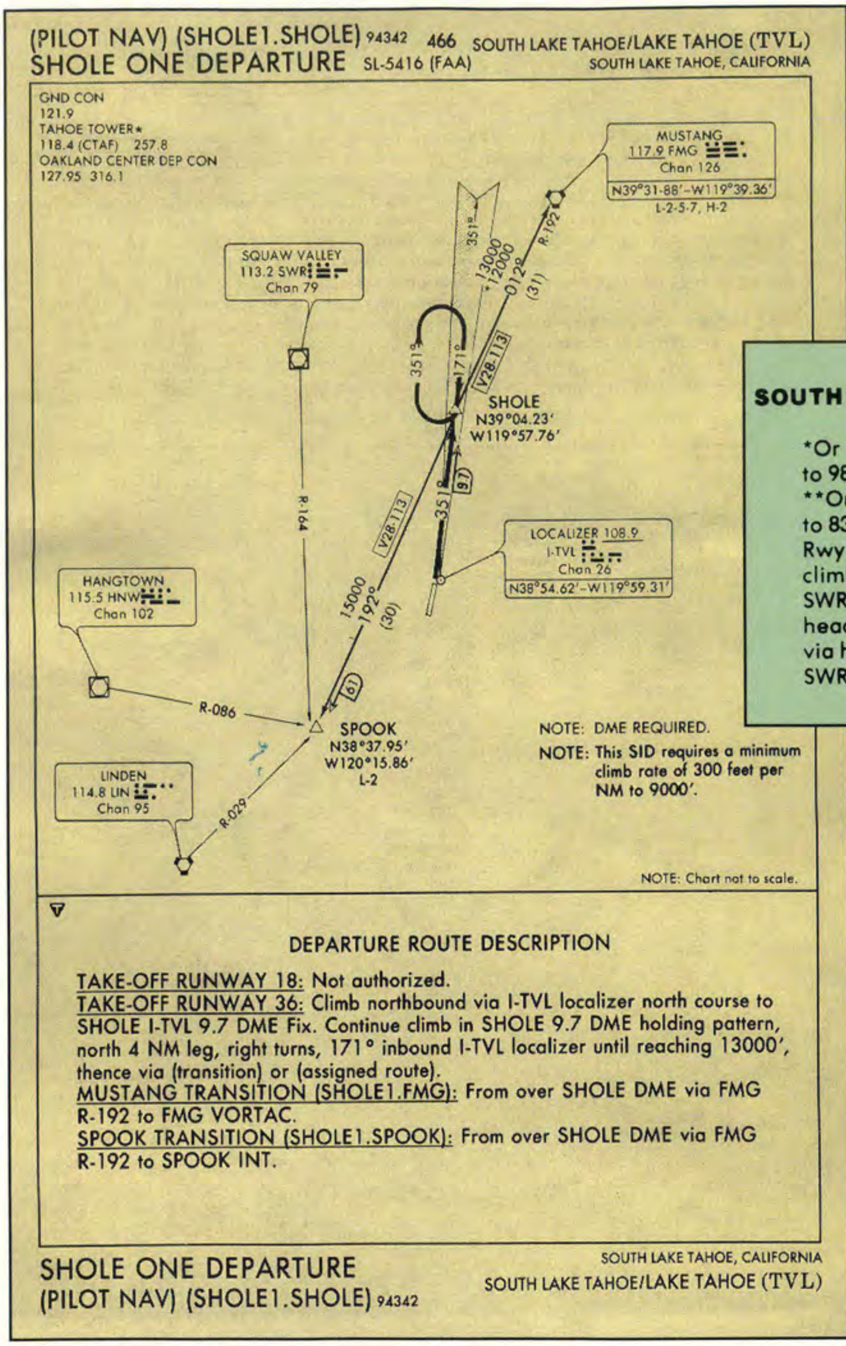
d. The 300 feet/NM is for the military, the 400 feet/NM is for civil aircraft.

**ANSWERS:**

1. b. Civil SIDs are found in FLIP's Civil SID/STAR publication. It's divided into two volumes — Eastern U.S. and Western U.S. Military SIDs are found in the appropriate FLIP approach book.

2. b. If a civil SID requires a climb gradient greater than 200 feet/NM, it will be printed on the SID. In this case, you must maintain 300 feet/NM until reaching 9,000 feet MSL, and then you must continue to climb at 200 feet/NM until reaching the MEA.

3. c. You'd better believe there are




obstacles! As most of you know, there are plenty of things to run into around Lake Tahoe. Unlike military SIDs, civil SIDs don't depict the obstacles for you — no matter how big they are! There are several "clues" on the SID though. First, if a civil SID has a climb gradient published, it is only because of an obstacle — they just don't tell you how high it is or where it is located. Another great source of obstacle information is the approach plate for the airport you are leaving — a good review of the obstacles depicted on the approach plate will help with knowing what obstacles you will encounter when you depart.

4. c. I call the ▼ symbol the "trouble T" because it can spell trouble for the uneducated. The T notifies us that the airport has a published IFR departure procedure, and it tells civilians the takeoff mins are nonstandard. USAF pilots must abide by the takeoff mins found in AFI 11-206, so we usually ignore the weather information. What we can't afford to ignore, however, are climb gradients. Many fields publish minimum climb gradients to be used in lieu of weather minimums. USAF aircraft are required to meet or exceed published minimum climb gradients.

5. b. Answer "a" is wrong because civil SIDs never publish ATC climb gradients — pilots are expected to figure those out for themselves. Answer "c" is not quite right either. If a climb gradient is published on the SID, that's the climb gradient you must fly. The climb gradients are published for a particular route. The SID climb gradient is used if you fly the SID route. The departure procedure climb gradient is used if you fly the IFR departure procedure's route. Answer "d" is wrong as well. Civil SIDs don't publish obstacle information like our military SIDs do. The correct answer is "b." If a climb gradient is published on a civil SID, then there is an obstacle out there. Civil SIDs establish only climb gradients for actual obstacles, not for ATC.

**SOUTH LAKE TAHOE, CA** . . . . . . Rwy 18, 4000-3*
Rwy 36, 2700-3**
*Or standard with minimum climb of 700′/NM to 9800.
**Or standard with minimum climb of 400′NM to 8300.
Rwy 18 climb rwy heading to 9800 then continue climbing right turn via heading 280 degrees and SWR R-152 to SWR VOR/DME. Rwy 36 climb rwy heading to 8300 then continue climbing left turn via heading 340 degrees and SWR R-102 to SWR VOR/DME. Then all acft proceed on course.

BONUS: c. AIM states "these minimums also apply to SIDs unless the SID specifies different minimums" which the Shole One to South Lake Tahoe does. The 400 feet/NM would be required if the SID did not have the 300 feet/NM restriction published.

Congratulations on getting out of Lake Tahoe. Call me at DSN 858-5418 if you have any questions or want to fight over any of the answers. ✈

USAF Photo and Special Effects by MSgt Perry Heimer

# REFLECTORIZING AIRFIELD PAVEMENT MARKINGS

**MICHAEL D. ATES**
HQ AFCESA/CESC
Tyndall AFB, Florida

### Synopsis

The Air Force has always used glass beads to reflectorize airfield pavement markings. Light entering the beads is bent to reflect the color of the underlying paint and is reflected back to the source of the light.

### Description

Beads are made from 1.5 or 1.9 indices of refraction (IOR) glass. The sketch shows the difference in reflection for the two types.

Glass with a higher IOR will more accurately focus the incoming light ray to the true center of the bead, reflecting light back on a path parallel to the incoming light ray. Therefore, the high-index beads appear brighter if viewed from an angle very close to the light source. However, they cannot be made from scrap glass (as the low-index beads are) and are very expensive to manufacture.

### High- Versus Low-Index Beads

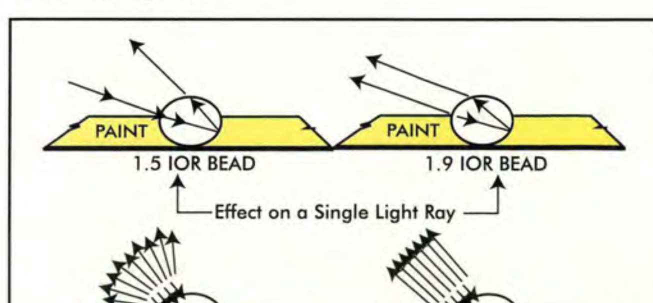
The use of high-index beads continued until recently with not much thought given to the location of landing lights in relation to the pilot's eyes (more precise reflection is only an advantage if the eyes are in close proximity to the light source). In response to requests for waivers to use the lower-cost, low-index beads, we initiated a formal study. We applied taxiway markings with both bead types, took reflective readings, and surveyed pilots.

Early in the evaluation, the pilots noticed almost no difference in the markings. But after 9 months of snow-removal operations, the high-index beaded markings had lost more than 70 percent of their retroreflective value. The low index lost only 11 percent.

We gained approval to use the low-index beads on taxiways and aprons and then began an evaluation on runways. One side of Tyndall AFB's runway 13L/31R was marked with low-index beads, and the other with high-index beads. For 15 months, we tracked the retroreflective value of the markings and surveyed pilots. Over 90 percent of the pilots indicated they could not tell a difference between the two materials.

We documented the results and coordinated with the safety and flying communities. All agreed the results were significant, and on 25 August 1995, HQ USAF/CEO signed out a letter advising the MAJCOMs they were authorized to begin using Federal Specification TT-B-1325, Type I (1.5 IOR) beads on all airfield markings.

This change will allow USAF to save approximately $2.8 million annually while improving the durability of our markings. ✈



# AIRCRAFT CANCER

**LARRY BELCHER**
Oklahoma City ALC Public Affairs
Courtesy *Leading Edge*, Sep 95

■ The corrosion effects on aircraft metal parts can be difficult to uncover, and in a worst-case scenario represent a hidden danger to flightcrew safety and mission success.

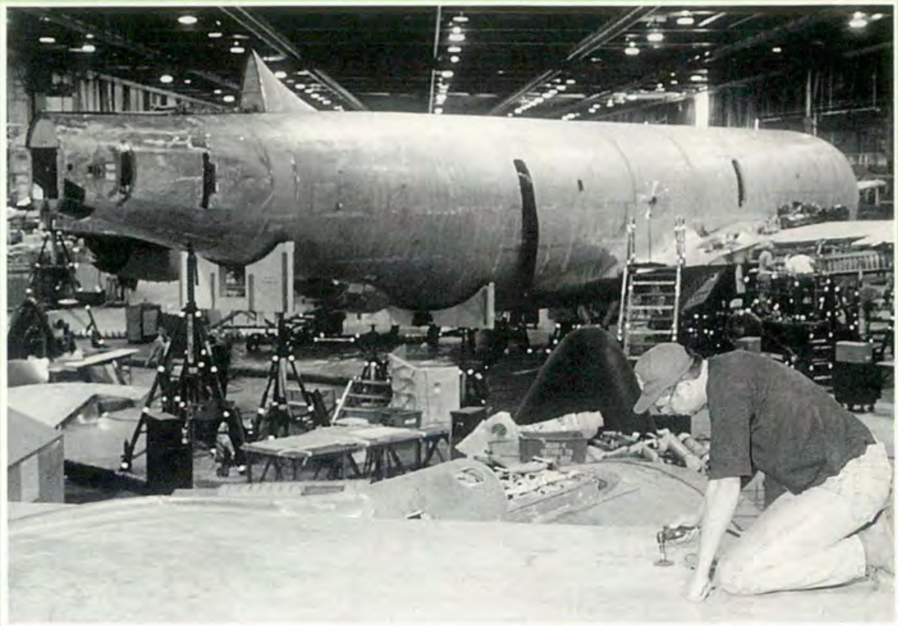
This was evident in 1988 when an Aloha Airlines 737 lost a large portion of the fuselage in flight. Corrosion between the fuselage lap joint layers was responsible for premature fatigue cracking and the subsequent catastrophic structural failure.

Technicians at Oklahoma City Air Logistics Center, Tinker AFB, Oklahoma, are cracking corrosion strongholds with a series of innovative procedures. The program, termed CORAL REACH, involves methods to uncover and repair corrosion during C/KC-135 depot overhauls.

Through a set of eight phases, CORAL REACH also identifies, quantifies, and predicts future corrosion problems. Those eight phases are:

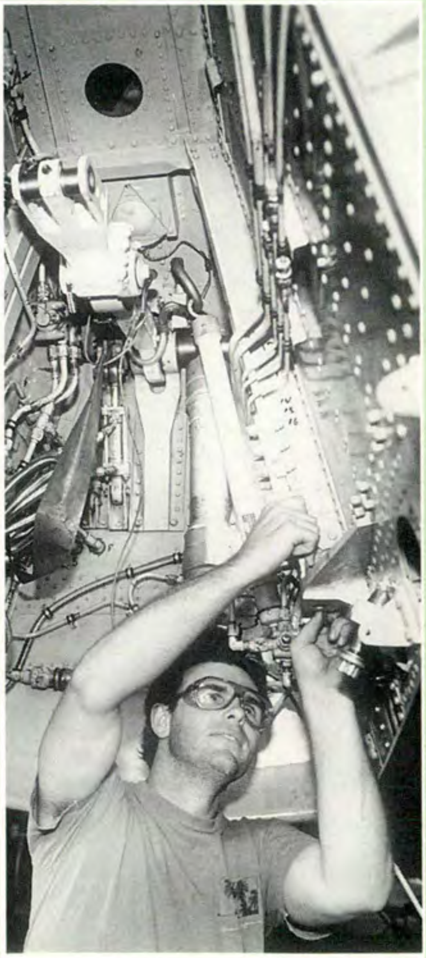
- Complete disassembly of a C/KC-135.
- Structural integrity testing.
- Corrosion data-collection system development.
- Non-Destructive Inspection (NDI).
- Corrosion growth-rate testing and analysis.
- Corrosion quantification.
- Corrosion modeling.
- Corrosion prevention.

According to project engineering manager Don Nieser, "We have completely disassembled one aircraft and mapped the corrosion. This is the first time corrosion has been quantified and numerically compared with predictions by NDI equipment." Nieser is assigned to the C/KC-135 directorate, which performs depot maintenance on more than 50 aircraft annually. He received Air Force Materiel Command's Career Achievement Award earlier this summer for his engineering contributions.



Air Force photos by Margo Wright

(above) Eric Guttery works on the wing of a disassembled KC-135. Disassembly of CORAL REACH project models is necessary to detect hidden corrosion on aging KC-135s.



(right) Sheet-metal mechanic Darren Kendrick removes corrosion from the landing-gear area of a KC-135.

"We believe our work is stimulating the aerospace and scientific communities to address the new technical problems brought about by extending the life of an aircraft three to four times the original design life," he added.

Nieser said he expects that in the future, the CORAL REACH program will have a significant impact on other military aircraft as well as the worldwide aviation community.

"We will be able to predict where corrosion will grow, how severe it will become, and how it will degrade the structural strength," he said. "Then, we'll be able to schedule structural component removal and replacement before a catastrophic structural failure occurs." ✈

Maintenance Matters

## Canopy Sling Failure

An F-15 canopy was accidentally dropped during installation to the tune of over $30,000. Yep, over $30,000 had to be spent for the mishap unit and the Air Force to find out a maintenance shop wasn't conforming to the high standards the flying community demands.

Luckily, nobody was injured when a canopy sling unexpectedly failed while maintainers tried to install the canopy strut. The canopy was being raised with the canopy sling when the sling failed at some strap stitch work. A metal D-ring pulled loose and shot into the windscreen — which destroyed it, too.


USAF Photo by SrA Andrew N. Dunaway,II

The canopy sling had been recently repaired twice by the local base survival equipment shop, and each time the mishap strap was replaced. But the shop didn't have the proper specifications for the strap's stitching patterns or the proper type of thread to use. Just imagine — a long-established survival shop not having the proper manuals and engineering drawings to accomplish work to Air Force standards and specifications! Could there be some more suspect work floating around their fleet of aircraft?

After each local repair was completed, the mishap unit should have performed a load test to verify the integrity of the canopy sling. The load test is required by tech data and AFOSH standards. However, no load tests were ever accomplished, so the integrity of the strap network wouldn't be verified until the sling was used operationally!

The mishap unit also didn't ensure the sling had an inspection tag or documentation verifying load tests, inspections, and repairs were accomplished on the sling which is also required by tech data and AFOSH standards!

We just keep reinventing the wheel, don't we?

## Design, Worn, or Complacency?

After a fighter aircraft returned from a mission, maintenance discovered the nose fairing and its locking pin were missing from an AIM 9 missile launcher. Of course, it was never determined "when and where" the fairing and lock pin departed the jet. That's unfortunate, because the mishap lock pin by itself would have been very helpful in identifying a precise, valid reason for this dropped-object incident, and especially invaluable in preventing recurrences.

The unit, however, did easily verify the serviceability of the locking pin's receptacle by installing another lock pin. The substitute pin could not be removed without depressing the pin's positive locking mechanism at the head of the lock pin, as designed! In addition, there wasn't any visible damage to the locking receptacle area to support a "forced" departure of the nose fairing. So that pretty much left only two possible reasons — the lock pin wasn't installed, or the lock pin was defective (design). The unit chose the material design (defective part) theory.

But consider this! Depending on how long the lock pin was installed on the jet and how many times the pin's locking feature had been used, isn't it safe to say the lock pin could have been just plain ol' "worn out"? Was the lock pin really installed, but its worn-out locking feature never really engaged properly, and the lock pin eventually backed out? This is highly possible, too. But this theory would suggest that a person didn't detect, write up, and replace the worn-out pin upon its last installation.

It just can't be a design problem if the lock pin performed up to its manufacturing specifications, but eventually wore out with constant use. Besides, if it was designed or manufactured wrong, wouldn't there be a nasty trend to point to? Have you heard of many of these AIM 9 missile launcher nose fairings falling out of the sky?


USAF Photo

Now for the lock pin not being properly installed or "not installed at all" theory — we all hope and pray this wasn't the true reason for the mishap because no less than the weapon load crew chief, post-load (7-level) inspector, weapon early crew inspector, dedicated crew chief, end-of-runway crew, and the mishap pilot ALL would have neglected to perform their checklist duties responsibly and failed to inspect the lock pin! This lack of organizational checklist discipline could never have developed at any level within today's Air Force, could it?

Anyway, if you ask me, it's highly probable a maintainer failed to write up and replace a safety pin that came to the end of its "service life." To suggest anything else would point to a bigger, more disturbing problem than a part's design — human factors. While we can't change the "design" of human beings, we sure can influence their habits, behavior, or actions through our leadership and supervisory efforts!

## $3,000 a Bolt — Times 10!


USAF Photo

After an aircraft returned from a sortie with problems with the radar system, it didn't take long for maintenance to troubleshoot and discover the cause. It seems some maintainer neglected to install 10 of the required 12 bolts that hold the radar assembly together! One of the two installed bolts apparently broke and allowed the radar antenna dish to fall forward and tear the dickens out of some other radar antenna parts, including the jet's nose radome.

Let's figure out the dollar impact here. About $30,000 in total damage, divided by 10, equals $3,000 a bolt! Pretty expensive hardware, isn't it!

The mishap sortie was only the second one since the aircraft returned from programmed depot maintenance (PDM). While there, a new radar assembly had been installed. The unit's acceptance inspection upon its arrival didn't turn up any problems with the radar assembly, plus no maintenance work had been accomplished on the radar assembly by local maintainers since the aircraft's return from PDM. So, it looks like the missing 10 bolts weren't installed in the first place during the replacement action at PDM.

Imagine! Only 12 bolts required— 2 installed, but 10 missing — at a depot facility — in today's quality Air Force?!?

C'mon now, tell us this all was a nightmare and it ain't true! ✈

# IT'S A PRIVILEGE

**COL KEVIN L. DAUGHERTY**
HQ AFSC JAG

■ As the new JAG at the Air Force Safety Center, this is my first opportunity to speak with you in this column. As I have been working issues which have come up because of recent developments in the area of safety privilege, I have been asked several questions by you in the field that I hope to answer here.

As we know, our basic rule (AFI 91-204) requires limited use safety information, better known as the "safety privilege," to be protected from unauthorized release. Recent developments emphasize the need to remain ever vigilant in protecting this information so we can fulfill our mission of preventing mishaps. One of the primary recommendations of the Blue Ribbon Panel was to continue to aggressively protect the safety privilege. The steps to do so must begin within the units.

**Can safety information be passed to the user via the Internet?** The short answer is "No." Our computer technical folks here at AFSC tell me that right now, given the current state of technology, putting something on the Internet is just like broadcasting in the clear, even though the information is addressed to a particular person. It's simply too easy for someone to get into the Internet and get the information, and the sender will never know it.

Since we can't control or limit access by "hackers," we must not risk the unauthorized release. The Secretary of the Air Force has published a memorandum which prohibits sending official business via the Internet. Because the lack of control has been recognized as too great a risk to send safety information, use direct messaging or DDN closed lines, or mail the information to the unit. E-Mail (over a direct line) may be used "within the fence" where a safety password is employed. But when safety information is sent out on the Internet, it is simply not protected.

**Who gets to see safety information?** Again, a short answer is those who have a need to know. This may be Air Force people within the maintenance community, the flying community, base civil engineers — whoever needs the particular information so they can prevent a mishap.

Often people who don't have a need to know, but who are curious, will ask someone in safety to see a copy of a report. Or a spouse will ask for a copy of a report because their husband or wife was injured or even killed in a mishap. As much as we would like to be accommodating, we must not release the information outside the safety community. The only release authorities for providing safety information outside the community are AF/SE or AFSC/CC. Don't get yourself in a bind simply because you wanted to be helpful.

**Are cockpit voice recorders privileged?** As of 15 July 1995, the transcript of intra-cockpit communications are factual matters which will be placed in Part I of a safety investigation report. (Air-to-ground communications have always been treated this way.) A recent federal court decision stemming from the Ramstein C-5 mishap said the CVR was factual data which would be releasable. The rationale was that the CVR was not generated in support of a mishap investigation but was part of routine flight operations. Hence, the transcripts were factual. The next update of AFI 91-204 should reflect this change.

However, there is a privacy interest covering the actual voice recordings. Under the case of New York Times v. NASA, the Air Force will assert a privacy interest to prevent the release of the actual tape, so there won't be a broadcast of the voices of a mishap crew on the evening news.

**When is toxicological testing ordered?** After a mishap, it is crucial that prompt action be taken to preserve evidence. Blood and urine testing is particularly time sensitive since the evidence is quickly purged from the body. This is why AFI 91-204, para 1.2.5.3, directs the commander of the base nearest the mishap to ensure toxicological testing for military members and civilian employees in accordance with AFPD 36-27. Civilian testing is limited to only those for whom there is evidence they may have caused the mishap. Flightcrews and other military individuals whose actions or inactions may have been factors in the mishap sequence should also be tested.

The real problem centers on contractor employees who may be involved in the mishap sequence. Here, you must look at the contract and see if toxicological testing is provided for in the contract provisions. If toxicological testing is agreed to, follow the same steps you would for Air Force personnel. If the contract sets out certain procedures, be sure to follow them. ✈



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WELL DONE AWARD
UNITED STATES AIR FORCE

# THE 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 Mishap Prevention Program.

## SSGT CHARLES B. SHEAVES

HQ 23d Wing
Pope AFB, North Carolina

■ Although it was not his regular jet, SSgt Sheaves was tasked with recovering an F-16. During a normal postflight inspection, SSgt Sheaves noticed a tiny deformation on the top of the forward rudder seal (actually attached to the vertical stabilizer). Even though this small flaw looked relatively harmless, he took the initiative to request stands and conducted a detailed inspection of the affected area.

Upon removal of the forward and aft rudder seal panels, the cause of the deformation was brought to light. Severe buckling of the rear rudder seal had occurred due to an improper rudder seal panel being installed. Further examination showed that the buckled rear seal had also caused a severe failure of the left nut plate channel on the rudder. This channel had cracked a distance of 10 inches. Had SSgt Sheaves not identified or pursued his discovery, it is very possible this crack could have led to a flight control failure or a departure of the control surface from the aircraft.

As a direct result of SSgt Sheaves' attention to detail and professionalism, a future catastrophic mishap was prevented.

WELL DONE! ✈

KNOCK IT OFF!

It's better to be chastised alive than to be ridiculed dead. Make the call...