flying SAFETY

OCTOBER 1983

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Human Factors: FLIGHT SAFETY'S ACE

Share It Around

SQN LDR MARK A. LEWIS, RAAF
Directorate of Aerospace Safety

■ Have you noticed how many flying safety-related magazines appear in your crewroom each month? The total is quite impressive. Within these magazines are some articles that you will find very interesting. They have a message which is relevant to you.

You have read it, thought about it, and now you put the magazine back and forget about it. Please don't do that; share it around. The message contained in that article may have relevance for others, too. Some of those others will not be in the habit of reading these magazines. Some recent independent research at a local flying unit revealed that some FPs, CPs, ACs, and even an IP had not read any articles in a flying safety magazine during their current assignments. This is terrible! I don't believe that there was nothing of use for them in all of those magazines.

Well, what can you and I do about this? When you find an article that is worth reading, find someone who has not read it and show it to them; encourage them to read it. If each of you faithful readers do this, then we have immediately doubled our effective circulation. Good, but what else can we do? It may be appropriate to photocopy the article and put it on the crewroom notice board; that may help others to see it — to learn its lessons.

You safety folks, how about some active encouragement to read these magazines or at least some selected articles. They are written by we desk-bound mortals for your benefit. It is in the best interests of flight safety to encourage others to read them.

Let's generate an education program for the aircrew, by the aircrew. We need your support in this matter. Whatever it takes, please try to spread the word of flying safety. If each of you do a little, the total effect will be tremendous. ■

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SPECIAL FEATURES

REGULAR FEATURES

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Managing Your Risks

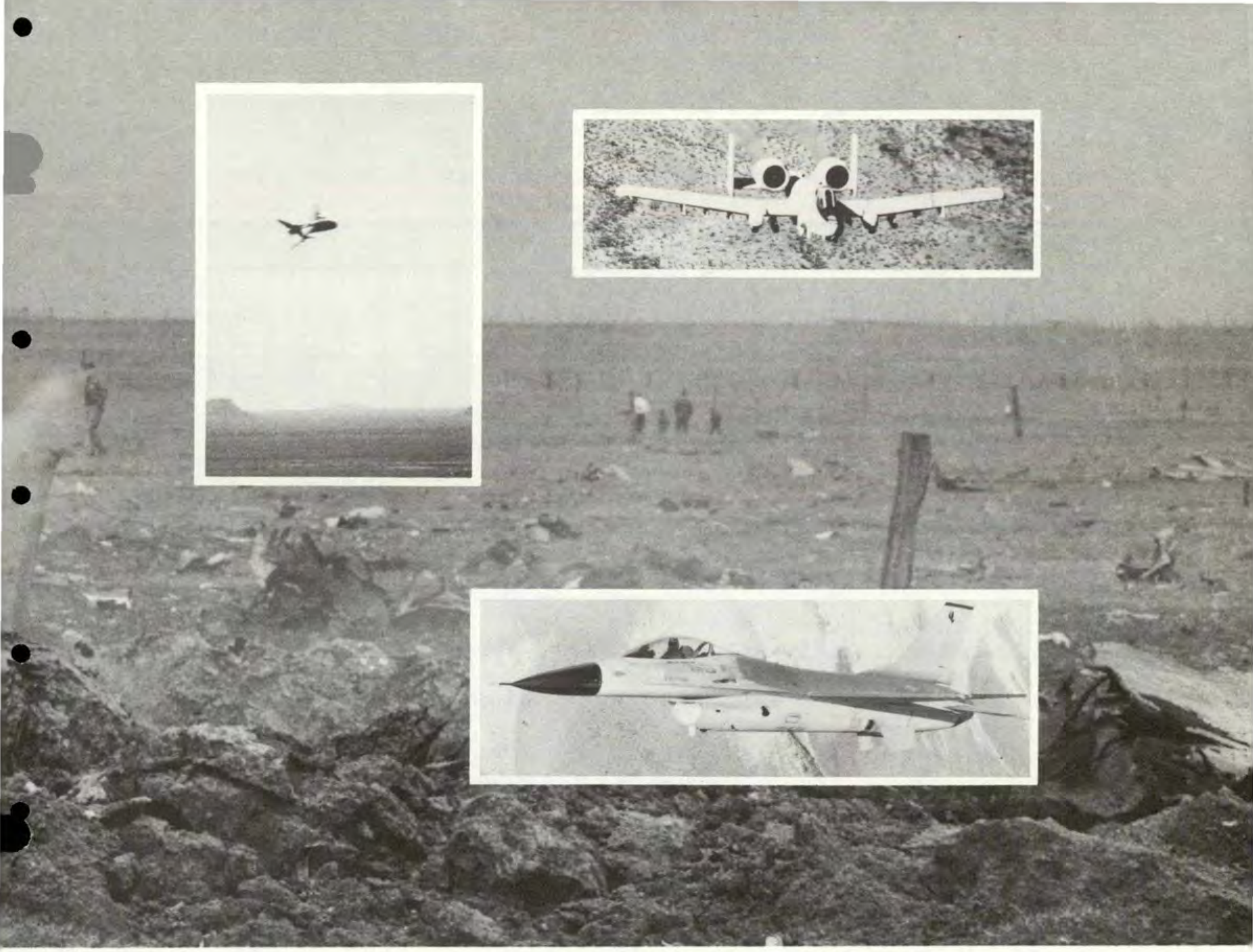
MAJOR JOHN E. RICHARDSON, Editor

■ It has been said that the only way to eliminate the chance of an aircraft mishap is to stop flying. While that may be true, it certainly does not contribute to mission accomplishment. So, if we are able to fly, we must accept the chance of a mishap. The other side of that problem, however, is that the cost of a mishap is prohibitive. (It averages over $6 million dollars per mishap in 1983.) But from an operations point of view, the dollar cost is secondary. Of much more concern is the loss of that resource, for without the aircraft we can't complete the mission.

So, the problem then becomes: how do we reduce the risk of accomplishing the mission to the lowest acceptable level? The answer to that question is what risk management is all about.

Traditionally, risk management has been limited to system safety engineering in the early acquisition phase of a system's life. There is no doubt that this aspect of risk management is vital to the system. But the same principles which govern that phase of system safety can also be applied to operational safety.

Before going much deeper let's establish some definitions: risk has been a rather ill defined term. We each have our own concept of risk. However, any comprehensive description must include the variables how likely, how bad, and how often. Therefore, our definition of risk is:



> Risk: An expression of possible loss in terms of mishap probability, mishap severity, and mission exposure.

The term hazard is another one which has been used rather loosely. For our purposes a hazard is:

> Hazard: Any condition that has the potential for causing a mishap.

This is obviously a very broad definition, and it is supposed to be. A hazard can be a chuckhole in the taxiway, or a poorly designed part, or a new low level route segment.

One of the most important but often overlooked area of hazards involves people. ''Human factors'' account for a majority of Air Force mishaps, so this is an area where attention is needed. What kind of hazards are we talking about? Consider such things as are crew rest requirements being met? Is the training schedule adequate to meet mission requirements? Has the mission pressure become excessive, overcoming logic and good judgment?

The list can go on and on but the point is that hazards exist and must be recognized and evaluated by commanders and supervisors.

Today, Air Force members are constantly bombarded with admonitions to perform safely. The best way to perform safely is to understand the mission and those components which constitute hazards. Once we have such understanding the risk can be measured.

How is risk measured? Remember our definition expressed risk in terms of expected loss over a period of time or activity. This loss can be measured in dollars, equipment, mission capability, or any other quantity. Risk is, of course, not always an absolute figure, but it can often be quantified in relation to the three factors: loss, frequency, and exposure. If we know the quantities for the three variables, the risk can be expressed in any measure we choose. For example,

Table

To determine the number of mishaps your unit will experience based on the mishap forecast use the following formula

$$\text{Number} = \frac{\text{Class A Potential X Unit Hours}}{100{,}000}$$

Once you have the number you can use the potentials by type mishap to determine the most likely area for a mishap. Some examples of this type of forecast are shown below.

AIRCRAFT		CONT LOSS	COLL GND	RNG	MID AIR	LDG (PLT)	T/O (PLT)	OPS OTH	FLT CONT	GEAR	FUEL	ENG	ENG FOD	HYD/PNEU	ELEC	STRUCT	BLD AIR	INST	LOG OTH	BIRD STRK	WX	UND MISC	TOTAL	FLYING HOURS
A-10	A POT	.56	1.32	.79	.28			.24	.51			.36		.37					.61				5.04	209,513
	DEST	1	2	2					1														6	
	CL A	1	2	2					1			1							1				8	
	CL B											2	1										3	
	B POT											1.04	.24										1.28	
F-16	A POT	3.34				.84	.64	5.28		.49		4.75			2.68							.56	18.6	103,979
	DEST	2				1		1		1		2			3							2	12	
	CL A	2				1		1		1		2			3							2	12	
	CL B									2													2	
C-141	A POT		.11				.12			.12													.34	294,667
	CL A									1													1	
	CL B					1				1													2	
	B POT		.11			.12				.34													.57	

Managing Your Risks

continued

using the mishap potentials forecast by AFISC we can establish a relatively firm risk equation for any given aircraft and mission.

Of course, the risk equation we get in this case is a generalized one.

If you want an equation specific to a unit you must convert the variables to unit numbers. There is an example in the Table.

But even with this mishap potential or risk equation we are not really addressing risk management because all this equation tells us is that for a given mission we have an overall risk of having a mishap of X. The equation does not identify the hazards which may lead to this risk. That is our job in managing risk.

The Air Force Inspection and Safety Center has developed a guide to assessing the risk involved in any mission. This procedure involves five steps: definition, identification, analysis, action, and feedback.

The definition step involves describing the system, mission, procedures, environment, facilities support equipment, payload/armament, and personnel. To gather the necessary data, review the ops plan of this mission or other similar missions. There may be other sources of information which can provide the necessary information.

To be thorough in analyzing the hazards, it is essential that all the factors involved in the mission be defined.

Once the factors are defined we can move to the identification step and identify and list the hazards associated with each of the mission elements. This, too, should be a comprehensive list and include the inherent hazards like fire (system), explosion (armament), collision with ground (mission), etc. The analyst can also get into second level factors such as alertness or attention (personnel) or ambiguity (procedures). Interfaces between hazards should also be considered — an aircrew required to fly a second demanding mission of the duty period at night with minimum turnaround time (personnel, environment, procedures, system).

After the list of hazards is compiled, each one is evaluated in terms of potential effect on the mission. This evaluation is in terms of:

- What mishaps can result from these hazards?

We can accept, reduce, or eliminate the risk depending upon the mission, budget, and schedule constraints.

- How likely is it a mishap will occur?
- How severe would be the injury or damage?
- How many times could such a mishap occur during the planned operations or for what percentage of the time are we exposed to the hazards?

After those questions are answered, we have the basis for a quantitative or qualitative assessment of the risk involved for each hazard.

Now that we have a conclusion about the risk involved we can make decisions on actions to be taken. We can accept, reduce, or eliminate the risk depending upon mission, budget, and schedule constraints. Using the information from the analysis, the commander can identify those elements of the mission that are most critical and thereby concentrate on those areas.

But the task is not finished once we take action. We must make sure that the action was effective. This involves feedback or reevaluation of the mission and its hazards. This feedback phase also allows us to maintain a watch for new hazards unknown in the initial phase. If such a situation is uncovered then the whole process starts again.

Figure 1

DEFINITION OF MISSION REQUIREMENTS AND CHARACTERISTICS
(Primary Source: Operations Plan/Test Plan)

MISSION OBJECTIVES

MISSION PARAMETERS

- Altitude
- Speed
- Number of Sorties
- Number of Launches
- Launch Window
- Duration

AEROSPACE VEHICLE/SUBSYSTEMS

- Primary Aircraft
- Support Aircraft
- Tactical Missiles
- Strategic Missiles
- Communication Systems
- Radar
- Tracking Instrumentation
- ECM Systems
- Laser Designators

ORGANIZATION/PERSONNEL

- Primary Responsibility
- Higher HQ Involvement
- Other AF Organizations
- Army/Navy/Marine Corps Involvement
- Allied Military Services
- Operations & Maintenance Personnel
- Training Received and Required
- Qualification/Experience Level
- Experience with Similar Missions
- Familiarity with Range Routes
- Maintenance/Servicing Qualifications
- Special Training/ Requirements

PROCEDURES

- Tactics (Realistic Training)
- Special Procedures
- Test Methodology
- Emergencies/Contingencies

ENVIRONMENT

- Natural
- Induced

SUPPORT EQUIPMENT

- Maintenance
- Servicing
- Loading

PAYLOAD/ARMAMENT

- Unit/Range/Experience with Weapon
- Loading/Downloading Requirements
- Special Security Procedures/ Escort Protection

FACILITIES

- Building (Operational Base/Installed Equipment)
- Range Facilities (Targets, Fences, Buildings, etc)
- Runways/Runway Lighting
- Missile Launch Facilities/Control Center

Managing Your Risks

continued

This was a brief overview of the process of risk management. Obviously, it is much more complex than this, but the logic and sequence is relatively simple. To gain a better understanding of the process, let's look at some of the elements in more depth. Figure 1 is an outline of a typical set of mission requirements. From such a list, planners can develop the questions which need to be asked and then idenfity the mishap potentials.

One way to identify such potentials is to list all of the known hazards for each element. Obviously, this is difficult, but with some general guides for the elements such as those in Figures 2 and 3 the task becomes easier.

When it comes to risk assessment there are two approaches: quantitative and qualitative. The quantitative approach is that developed by system safety engineers for Mil Std 882A. This method establishes categories of severity, frequency, and exposure as shown in Figures 4, 5, and 6. The risk then becomes a number derived by multiplying the severity times the frequency times the exposure.

Sometimes the quantitative risk analysis is not effective because it does not really communicate the "threat" to the manager. Numbers like $1x10^{-5}$ or once in four million events do not always provide meaningful information. This becomes especially true in operational planning. There the qualitative approach is more fruitful. In this approach we identify the key problems and any unique concerns which affect the mission. Then we rank order these problems in terms of their effect on the mission and their likelihood of occurrence. Much of this kind of risk analysis is based on experience of the operators and often is far more productive than any mathematical assessment.

No matter what method is used, the real purpose of risk assessment is to provide a logical approach to

Figure 2

ITEMS TO BE ANALYZED
FOR DEVELOPMENT OF A PRELIMINARY HAZARD LIST

ELEMENT: PERSONNEL

HAZARD/MISHAP CAUSE	REQUIRES EVALUATION	NOT APPLICABLE
Supervisory Factors		
Acceptance of Responsibility		
Qualifications/Intelligence/ Experience		
Training (Including Emergencies)		
Team Coordination/Crew Discipline		
Morale		
Illness/Physical Disabilities		
Alertness		
Vertigo/Disorientation/Visual Illusions		
Responsiveness		
Perceptions/Human Factors		
Reactions		
Sight/Color Blindness		
Hearing		
Strength/Fatigue		
Stress (Physical, Psychological, Physiological)		
Buddy System Reliance		
Emotional Stability		
Communication/Language Difficulty		
Clothing/Protective Wear		
Boredom/Complacency/Fixation/ Hypnosis		
Efficiency		
Capability (Task Loading)		
Overconfidence		

Figure 3

ITEMS TO BE ANALYZED
FOR DEVELOPMENT OF A PRELIMINARY HAZARD LIST

ELEMENT: PROCEDURES

HAZARD/MISHAP CAUSE	REQUIRES EVALUATION	NOT APPLICABLE
Communications/Navigational Aids		
Supervisory Requirements		
Timing/Coordination Requirements		
Conciseness/Clarity/Ambiguity		
Emergencies/Blackout Procedures/ Buddy System		
Tech Data/Checklists/Safety Signs		
Requirement for Attentiveness		
IFR/VFR Conditions		
Procedure Reviews		
Lengthiness/Repeatability		
Comfortability		
Necessity		
Specialized Training		
Effects of Interruption		
Compatibility with Clothing		
Instructions for Anomalies/Hurried Judgments		
Specialized Protective Wear		
Specialized Environment Equipment		
Servicing		
Testing		
Maintenance/FOD Prevention Procedures		
Operations/Crew Discipline and Coordination		
Proximity of Instructions, Tables, Charts		
Checkout Procedures		
Criticality of Adjustments/Control Settings		
Criticality of Control Sequencing		

controlling those elements within a mission which could hamper our ability to successfully complete our tasks. Hazard identification is a real part of any operational planning task.

For combat, we continually assess "the threat." In peacetime, the threat is the chance of a mishap. It is essential that we consider that threat as a part of mission preparation. The approach described here is not the only way, but it is a method that provides some logical steps which can be applied to most operational situations. The problem is not how it is done but only that it is done for every mission. We cannot afford to do less. ■

Identification and thorough planning for the higher risk areas of your mission will always be your best assurance of completing your tasks and returning safely to base.

Figure 4

HAZARD SEVERITY CATEGORIES

I - Catastrophic
- Death
- Loss of System

II - Critical
- Severe Injury/Illness
- Major Damage to System, Equipment, or Property

III - Marginal
- Minor Injury/Illness
- Minor Damage to System, Equipment, or Property

IV - Negligible
- No Injury or Illness
- No Damage to System, Equipment, or Property

MEASURES OF SEVERITY
- Dollar Cost (Equipment Loss, Cargo, Litigation, Investigation, Repairs, etc.)
- Loss of Life/Personnel Injury
- Loss of Mission Capability

REFERENCE: MIL-STD-882A

Figure 5

FREQUENCY LEVEL	DESCRIPTIVE WORD
A	Frequent
B	Reasonably Probable
C	Occasional
D	Remote
E	Extremely Improbable
F	Impossible

REFERENCE: MIL-STD-882A

*The analyst may prefer to use actual mishap rate or frequency such as mishaps per flying hour instead of nondimensional values shown here.

Figure 6

Exposure to Mishap in Terms of:
- Unit of Time (Year, Month, Hours, etc.)
- Event (Launch, Takeoff, Landing, Penetration, Maintenance Operation, Engine Start, etc.)
- Population (Pilots, Maintenance Technicians, General Public)
- Item (Aircraft, Missile, Landing Gear, Engine, Bomb, Gun, Radar, Building, etc.)
- Activity (Miles Driven, Revolution, Cycles, etc.)

EXPOSURE LEVEL	DESCRIPTIVE WORD
A	Very Lengthy/Numerous
B	Above Average Duration/Numbers
C	Average Duration/Numbers
D	Below Average Duration/Numbers
E	Almost No Exposure
F	No Exposure

*Analyst may prefer to use actual exposure figures, such as flying hours or miles driven, instead of nondimensional values shown here.

A Target Of Opportunity

MAJOR JOHN E. RICHARDSON
Editor

■ The first rays of the morning sun shone down on the Spanish hillside as a shepherd watched his flock grazing contentedly in the morning light. From over the hill behind him sounded an increasing rumble, then with a roar, two fighters streaked over the hill near the village, turned, and ducked into a valley to the north. Neither the shepherd nor most of his flock paid attention to the aircraft because the area was under a tactical low level route and low flying fighters were a common occurrence.

The young captain tweaked the radar in his F-16 as he streaked over the sparse vegetation of the Spanish countryside. This was his second MR mission in the squadron, and he was determined to do well. As he scanned the air, he thought of the part of the briefing that covered unbriefed intercepts. It was almost like combat. You had to be alert all the time because any aircraft could be "hostile." But then that's what it's all about: "training like we will fight."

Just then, the flight lead's voice crackled in his headset advising that he was turning in for the next intercept. As he bent the F-16 around to start the intercept, the sharp-eyed young pilot spotted two dots on the horizon. A second quick look confirmed a flight of what looked like two Navy F-14s heading his way.

Several thoughts flashed through his mind as he instinctively reversed his turn to meet the threat. Now with the two fighters off his nose, the F-16 pilot thought this was the perfect opportunity for a "Lima" shot as Lead had briefed. So, he maneuvered to put the unidentified aircraft in the HUD and achieve AIM-9 parameters.

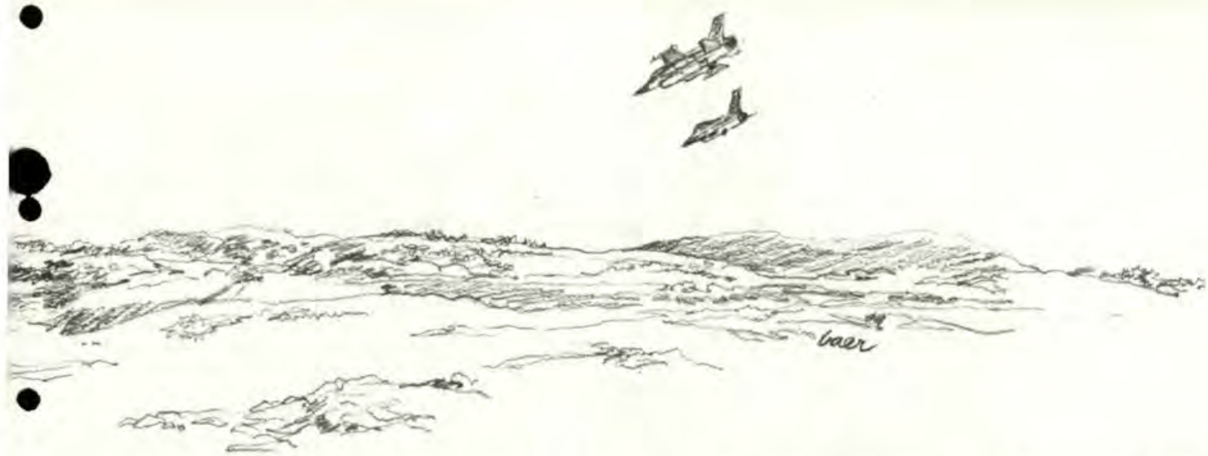
Having achieved the missile shot, the pilot realized that he was going to overshoot in front of the two Tomcats. Obviously, he thought, I have to maintain visual contact and safe separation. To do this, the pilot rolled into a steep left turn and pulled the throttle back to slow down. As he rolled out of the turn, the pilot looked back over his right shoulder to acquire the F-14s.

The F-14s started a turn to the right and now presented no threat. The F-16 pilot, in a hurry to get back to the original intercept, selected AB and started a hard left turn. As he shifted his eyes forward he had about two seconds to see the ridgeline.

The noise of this airplane was different. For one thing, it was much louder, so the shepherd looked up.

Then, up over the hill roared a fighter in a steep bank. The shepherd could see the vapor trails off the wings and the streak of fire out of the tail as the F-16 strained to turn and climb.

It was almost like a slow motion movie as he watched. At first, it



appeared that the plane would clear the ridge to the south, then the left wing struck the very top of the ridge and the aircraft began to cartwheel and break up.

About a week later, the flight lead of that flight and a few of his friends were sitting on the patio behind his house. As usually happens when pilots get together, the conversation turned to flying and inevitably to a discussion of the mishap. As the pilots debated the various aspects of the mishap, their attention became centered on the ROE for defensive reactions and Lima shots on targets of opportunity. The discussion continued into the early hours of the morning with many opinions expressed, but no solutions.

The Monday after, when our flight lead arrived at the squadron, one of the first things he did was get out the books. In the discussions Saturday he realized that even he was a bit hazy on the definitions and interpretations of the manuals.

As he read, he reviewed the ROE for defenders from MCM 55-200.

- Defensive maneuvering will not exceed a 180-degree turn level or nose high with one turn reversal to resume course.
- Defenders will cease maneuvering at 180 degrees or sooner if the attack is broken off/terminated and roll wings level, then proceed on course.
- Defenders will not maneuver for offensive position.
- All defensive turns will be no more than a hard turn, not a break or maximum performance turn.

That still did not really answer his question. So looking further, he found the discussion of the target of opportunity program. Here again, the rules and restrictions were clear. A little later one of his friends from wing stan eval stopped by. The two men got into another discussion of the concept of low level threat reaction training. Both agreed that such training is essential to combat effectiveness. The problem is that we are losing aircrews in this regime.

"We have to get a handle on this problem," said the stan eval pilot. "We can't afford to continue to lose pilots and airplanes like we have been."

"Yeah, but I hope we don't just stop the training. That's worse than the losses."

"You're right on that. But there is a way to do it. You know, in problem solving they always tell you to be sure to define the problem first. I think that the fact that we are losing airplanes is not the problem but the condition. Let's look at what they were doing when the mishap occurred."

"That doesn't help. We are right back to banning low level flying."

"No, we aren't. I did some checking. A lot of our mishaps in the low level regime in the past couple of years have occurred when the pilot was turning and looking some place besides where the airplane was going. You know, yourself, down that low you have to be aware of the aircraft vector all the time. If you're not, you're really in trouble."

"Yeah, I guess you're right. A friend of mind said that's what happened to that F-15 jock last year. He was turning back for a reattack looking over his opposite shoulder for lead. He didn't notice the descent and just pulled right into the ground. But what can we do about that?

The stan eval pilot leaned back and took another swallow of coffee.

"I don't have all the answers. I think the regs are pretty clear, so we don't need more regs. What we need, I think, is a better understanding of what's going on down there in the weeds and a better awareness of our flight vectors."

"You know, I read a couple of articles about that. I think there was one in the September *Flying Safety* magazine called 'Some Physics of Turning — Critical at Low Level.' Maybe a better understanding of what the airplane is doing down low and the times involved can help keep us from making that critical mistake."

"I think you're right; but now I've got to get back to the paperwork."

After he left, the flight lead sat for a minute or two. Then he opened his briefing guide and made a note to brief low altitude turns in his next briefing. ■

COLONEL GRANT B. McNAUGHTON, MC
Directorate of Aerospace Safety

HYPOXIA,

■ Some recent episodes highlight the fact that not all "crewmembers" of high flying aircraft have adequate familiarity with O_2 (oxygen) equipment or its use.

One episode involved rapid decompression in a C-130 flying at 22,000' at night. The two crew chiefs on board were not dedicated crew chiefs and therefore had not been issued oxygen equipment. The primary crew was unaware that the crew chiefs lacked their own 0_2 masks. One crew chief attempted to don a smoke mask but had difficulty getting it on properly. Also, this smoke mask was not initially attached to an 0_2 source. Eventually, he hooked up to a walk-around bottle but selected the emergency setting and rapidly depleted the 0_2. During this period he became dizzy and uncoordinated and required assistance hooking up to an 0_2 regulator.

The other crew chief was asleep in the crew bunk at the time of RD. Awakening, he mistook the mist for smoke and went to the cargo compartment to put out the fire. Shortly thereafter he realized what had happened and tried to find another smoke mask. By the time he reached one, he, too, was dizzy, uncoordinated, and unable to hook up to a walk-around bottle until provided assistance. Both recovered rapidly once on oxygen.

Another instance involved an air passenger steward. During

When carrying non crewmembers be sure to brief them thoroughly on oxygen procedures. You should also brief regular crewmembers to be especially alert in the event of an emergency. The passengers may need special help.

HYPOXIA, HYPOXIA

climbout, the cabin altitude of a modified C-135 rapidly increased to 33,000'. The pilot went to 100 percent 0_2 and directed the crew to do the same as he initiated a descent. One crewmember, the air pax steward, exhibited hypoxia and required assistance from other crew members. During preflight, this steward had tested his 0_2 mask on a yellow walk-around bottle. At the time of the incident, however, he had attempted to reach his helmet and mask rather than use the emergency oxygen pax kit he was carrying. Then, after he donned his mask, his symptoms did not improve. Unfortunately, the walk-around 0_2 bottle had been depleted, probably because of malposition of the regulator knob after preflight.

It is well to remember that walk-around bottles have a limited 0_2 supply and that hypoxia should reverse rapidly upon resumption of breathing 0_2. Failure of it to do so indicates either an empty bottle, or possibly one that was never filled with 0_2 in the first place. Depleted 0_2 bottles are purged with dry N_2 (nitrogen) prior to refilling. If the technician's procedure is interrupted, it's just possible that the bottle might not be filled with 0_2. The gauge would still indicate a full bottle, and a preflight check of 2-3 breaths would reveal no difference, since 100 percent 0_2 and 100 percent N_2 are indistinguishable by odor.

Such an incident did occur during a flight test of a prototype cargo aircraft. The victim happened to be the exchange officer from an allied air force. Anticipating a rapid climb to 15,000', this officer had dutifully hooked up his mask to one of eight walk-around bottles in the cargo bay and taken a couple of breaths to ensure flow. He had then climbed up on to the flight deck for take off. After take off, he returned to the cargo bay to perform a procedure related to the flight test. He had undergone refresher physiological training during the preceding 2 weeks and was acutely familiar with his own hypoxia symptoms. It so happened that his personal symptom included a headache early on, as well as confusion, tunnel vision and nausea; now, in order to avoid the hypoxia headache, he decided to go right for his mask.

When was the last time you reviewed the oxygen system in your Dash 1?

He donned his mask and took a few breaths, then noted the rapid evolution of his hypoxia symptoms. He recalled thinking that the aircraft must be climbing a lot faster than he realized — just before he passed out. When he was found shortly thereafter, he had vomited in his mask and was blue. Another crewmember ripped of his mask, wiped out his mouth and administered rescue breathing. The victim remained confused and nauseated and had a headache that lasted 18 hours. (It was later discovered that two of the eight walk-arounds, including his, contained only nitrogen.)

Finally, after 40 minutes of flight at 19,000' MSL, a T-37 student pilot began to feel dizzy and disoriented. His IP noted he was abnormally slow to react. During a check of the student's life support equipment, the O_2 regulator switch was found to be off.

Oxygen procedures are in your Dash 1. When was the last time you refreshed your memory on the oxygen system? For those of you flying passenger and cargo aircraft, be especially alert when carrying non-crewmembers. They probably don't know the procedures well enough to react quickly and correctly in an emergency. Here is where the "buddy system" with a regular crewmember is a good idea. ■

Medicines And The Pilot

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Understanding the actions of drugs on your body, their side effects and the special effects which result from the flight environment requires the knowledge and training of a flight surgeon. That is why the risks in self medication are so great for aircrew members.

■ The 1981 fatal crash of a U.S. Marine Corps pilot attempting a landing on the aircraft carrier Nimitz highlights the potential hazards of drugs to flying. Investigators found that the pilot was taking the drug brompheniramine and that significant amounts were in his blood at the time of the accident.

This drug is commonly used to relieve the symptoms of a head cold. The drug, however, can produce serious "side effects" from the standpoint of safe piloting. These include diminished coordination and retarded alertness. Accident investigators attributed the accident to derogated pilot performance resulting from the effects of the drug. Other examples of drug-influenced accidents in all categories of flying occur each year.

Medicines that are commonly used from time to time in daily life may have a devastating effect upon pilots in the flight environment. All pilots should be aware of this potential safety hazard.

U.S. Federal Aviation Regulation 91.11 prohibits pilots from performing their duties while under the influence of a drug that would impair their ability to fly safely. Until recently, guidance material in regard to the above has been scanty, out of date or, in many cases, unavailable. The International Civil Aviation Organization has warned of medication hazards.

This article gives an overview of this increasingly important subject and provides information concerning authoritative sources for guidance in regard to specific drugs.

What Is A Drug?

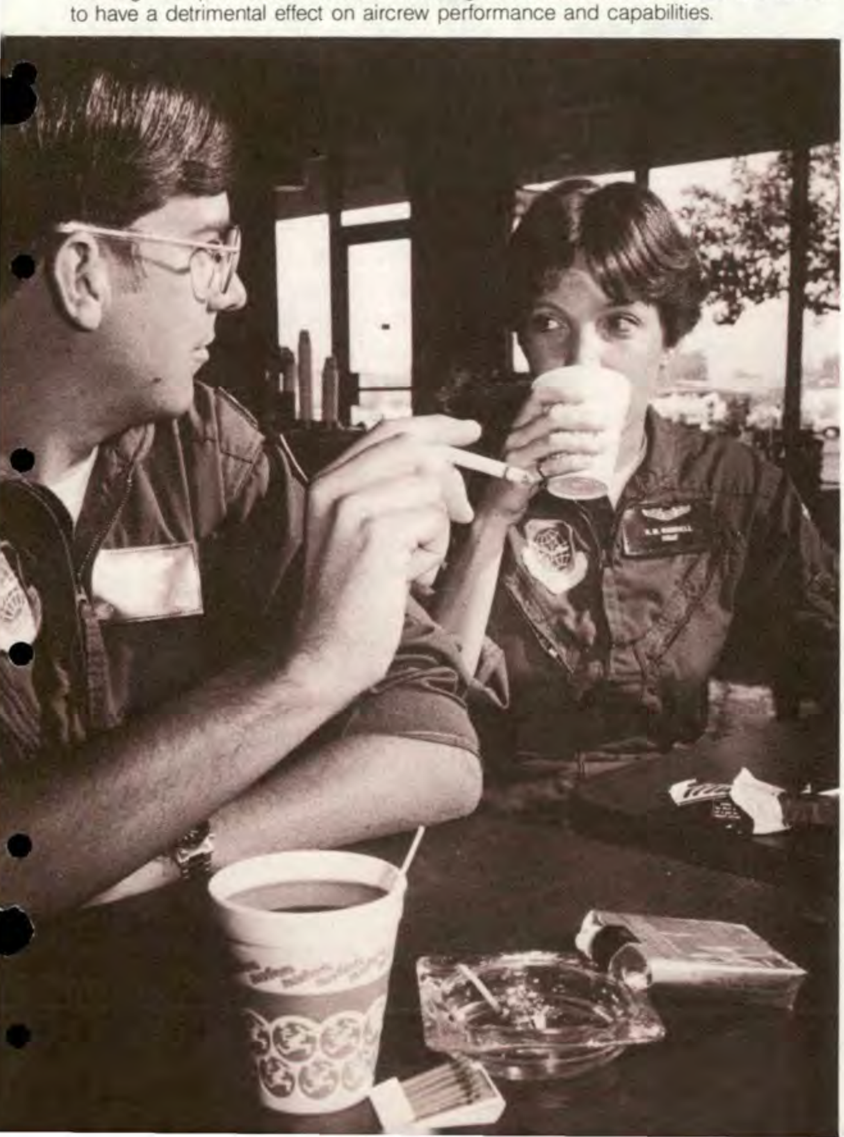
Drugs are substances taken to bring about a specific result, substances other than those taken for daily nutrition. Daily nutrition normally consists of solid foods, water, milk, fruit juices and/or other traditional nutrients. Alcohol, the most ancient and the most common drug, must be avoided by pilots during the eight-hour period prior to flight, a provision of U.S. Federal Aviation Regulation 91.11.*

Caffeine and nicotine are additional common drugs. However, the U.S. federal aviation medical regulations in Part 67 specifically except these two substances from the prohibition stating that pilots may not be dependent upon addicting substances. The medical regulations also are silent in regard to commonly used birth control medications. These have not been associated with air safety hazards, and, accordingly, the U.S. Federal Aviation Administration (FAA) has made no issue of their use.

*A new Air Force policy on alcohol is currently in coordination. Under this policy, no alcohol should be consumed by aircrews 12 hours prior to duty and minimal alcohol 24 hours prior to duty.

Certain potent drugs in the United States and other countries can be obtained through the prescription of a physician or a dentist. These drugs are those that the U.S. Food and Drug Administration and similar agencies in other countries have found to be effective for their intended purpose and relatively safe when used properly under guidance. There are more than 1,300 of these basic drugs in the U.S. alone, each known by its "generic" name, the one assigned to it by the American Medical Association and the pharmaceutical industry. These generic drugs often have brand names (trade names or proprietary names). There are more than 7,000 of these brand name prescription drugs. Many are the same generic drug but with different names, as mentioned, with others comprised of combinations of generic drugs.

In addition to the above drugs, there are in excess of 300,000 drug names available as "over-the-counter" drugs, which may be purchased without prescriptions. Through long tradition (or, in some cases, through various studies), it has been shown that these are reasonably safe under certain circumstances. There is no guarantee to date, however, that these drugs are effective for the purposes for which they are advertised. As with the prescription brand name drugs, many of the same basic drugs sold over the counter are given different names by different companies. Similar mixtures of drugs also are sold under a variety of names.



Although not prohibited, the common drugs nicotine and caffeine are well known to have a detrimental effect on aircrew performance and capabilities.

How Drugs Act

Drugs may be swallowed, injected, rubbed on the skin or taken through a number of other routes. They may be in the form of tablets, powder, syrup or other preparation. They may act by attaching at the molecular level to specific receptor sites in various tissues of the body, by directly attaching to an infecting organism, by modifying a cell membrane or through other mechanisms.

Drugs may act at the site of application or at a distant site. They may need to pass through the liver and be modified to have their ultimate effect. The body rids itself of drugs through excretion in the urine, modification by the liver or other route or mechanism of elimination. A given drug may have actions at more than one tissue site in the body and on more than one kind of tissue.

Drug actions that are not desired when a specific drug is taken for a specific purpose are known as side effects. Side effects such as drowsiness, altered thinking, dizziness or nausea can make a drug particularly hazardous for pilots.

An additional consideration is that two different drugs taken at the same time may interact and have multiplied side effects constituting a severe hazard for pilots. In some cases, the drugs may neutralize one another, eliminating the reason for which they were taken.

What's the real risk of an over-the-counter cold remedy? After a recent military mishap, investigators found significant amounts of a drug commonly used as a cold remedy in the pilot's bloodstream. This drug's side effects include diminished coordination and alertness The investigators attributed the mishap to the reduction in pilot capabilities from the drug.

Medicines And The Pilot continued

Half Life and Effect

Following absorption of a drug through the stomach, intestines, skin or other part of the body (for example, a muscle following an injection), further distribution usually takes place through the blood plasma. After distribution, generally a fairly rapid process, the drug is progressively eliminated from the body or inactivated by the liver and the inactivation products steadily eliminated. Often final elimination of a drug or its breakdown products takes place in the urine or feces.

The concentration of a drug following peak absorption progressively decreases in the blood plasma. As the concentration decreases, the drug effect generally begins to diminish.

It has been found, as a general statement, that each absorbed drug diminishes in a given person at a relatively constant rate. For example, a given drug taken at 1345 hours may achieve a peak blood concentration at 1400. Three hours later, the blood concentration is half that found at 1400. Another three hours later (2000), half of the 1700 level exists, and at 2300 the 2000 concentration is found to have been halved. This drug would be said to have a half life of three hours.

Four half lives from an original drug peak dose will see 94% of it eliminated. For many drugs, the concentration after four half lives is sufficiently low that the drug effects are no longer manifest. The half life of a drug is the major determinant of frequency of repeat dosage.

Some drugs have a half life of a few minutes, while others may extend to two or three days. It is very important to have access to drug half-life data, because this will give information concerning the potential duration of drug effect. A book is now available to all pilots that describes currently available drugs and gives the half life of each drug where necessary. In addition, adverse side effects of each drug are provided.

Any time a question arises concerning a specific drug and its possible adverse effects on safe flight, the pilot should consult his or her aviation medical examiner, a flight surgeon, government aviation regulatory authority physicians or an authoritative source who can correlate the drug with its effects on flying. A reference is available, as indicated above, that provides specific data on the question. A summary of the approach used follows in the Guidelines for Pilots.

There are drugs "disapproved" by the U.S. Food and Drug Administration; there are illicit drugs, and there are, from time to time, "new" drugs appearing on the market. Pilots should not take disapproved or illicit drugs. In regard to the "new" drugs, the advice of the aviation medical examiner, a flight surgeon or a government regulatory authority doctor should be sought. ■

MEDICINES AND THE PILOT

Some Guidelines

Drugs may be categorized in six major areas in regard to effects on pilots. Category I contains those drugs that normally are safe to take while flying.

Category II consists of those drugs that a pilot may use and fly if approved in the individual case by a flight surgeon, an aviation medical examiner or a government regulatory authority physician.

Category III contains those drugs that the FAA has approved in individual circumstances when all of the medical information is available.

Category IV contains drugs that have adverse effects on the pilot. Flight duties are not permissible so long as the drugs are in the body at concentrations of more than that which would remain after three half lives have passed.

Category V contains drugs that prohibit the pilot from flying while using them, because the condition for which they are prescribed precludes safe flight.

Category VI contains extremely potent drugs. At least five half lives should pass prior to undertaking pilot duties.

CATEGORY I

Flight Duties Are Normally O.K.

GENERIC	TRADE
acetaminophen	Tylenol
acetylaslicylic acid	Aspirin
calcium carbonate	Lactocal F
candicidin	Vanobid
ephedrine	Efed
propylhexadrine	Benzedrax
tetrahydrozoline	Visine
undecylenic acid	Cruex, Desenex

CATEGORY II

Flight Duties O.K. for an Individual With Aviation Medical Examiner Approval

GENERIC	TRADE
amoxicillin	Polymox
betamethasone	Uticort
carbenicillin	Geocillin
chloroquine	Aralen
iodoquinol	Panaquin
methyltestosterone	Android
nystatin	Nilstat
para-aminobenzoate	Potaba
tolmetin	Tolectin

CATEGORY III

Flight Duties O.K. for an Individual With FAA Approval

GENERIC	TRADE
acetazolamide	Diamox
allopurinol	Zyloprim
benzthiazide	Diuride
chlorthiazide	Diuril
cimetidine	Tagemet
clofibrate	Atromid-S
cromolyn	Intal
griseofulvin	Fulvicin
probenecid	Benemid
propranolol	Inderal
thyroglobulin	Proloid

CATEGORY IV

Flight Duties Not Permissible Until Drug Discontinuation for 3 Times the Half Life

GENERIC	TRADE	½ LIFE
allobarbital	Dialog	42 h
aminophylline	Aminodur	4 h
codeine	Varies	4 h
dimenhydrinate	Dramamine	8 h
flurazepam	Dalmane	12 h
phenobarbital	Eskabarb	6 days
prednisolone	Delcort	8 h
secobarbital	Seconal	12 h

CATEGORY V

The Condition Requiring the Drug Precludes Safe Flight Duties

GENERIC	TRADE
acenocoumarol	Sintrom
acetrophenazine	Tindal
biperiden	Akineton
caffeine-ergotamine	Ercat
carbamazepine	Tegretol
chlorpromazine	Thorazine
deslanoside	Cedilanid

CATEGORY VI

Flight Duties Not Permissible Until Drug Discontinuation for 5 Times the Half Life (4 times the ½ Life eliminates 94% of the drug)

GENERIC	TRADE	½ LIFE
acetohexamide	Dymelor	8 h
amphetamine	Robese	8 h
carisoprodal	Soma	2 h
chlordiazepoxide	Librium	24 h
diazepam	Valium	48 h
ibuprofen	Motrin	6 h
indomethacin	Indocin	2 h
methaqualone	Soper	12 h

— adapted from FSF *Human Factors Bulletin*, May/June 1983.

SAR EFFORTS

YOU CAN HELP, TOO!

LT COL WILLIAM E. CLARK
Deputy Director, Inland SAR
Aerospace Rescue and Recovery Service
Scott AFB, IL

■ You probably skimmed the SARSAT-COSPAS article in the July 1983 issue of *Flying Safety* with casual interest. Nice to know what other blue suiters are up to, but not particularly germane to a ''good stick.'' After all, your preflight is meticulous, you're under radar observation most of the time, and you're on flight plan all the time. The accident is always going to happen to the other guy.

Wrong O!!!

We wish the accidents wouldn't happen — but they do. And when it is the other guy, you can still be of assistance. The SARSAT-COSPAS system is only an aid to search and rescue (SAR), as TACAN is an aid to navigation. The SARSAT-COSPAS system makes SAR easier and quicker, but it still needs a lot of human involvement to make rescue successful.

You can be a big help to the SAR system. First, don't assume the distress signal you hear is being worked by anyone else. It may be, but that's a weak assumption. Even if it is, the fact that you hear it tells you it hasn't been found and fixed. Report what you can about it, through air traffic control with a request for relay to the Air Force Rescue Coordination Center. All ATC facilities should know to pass all reports to the Air Route Traffic Control Centers (ARTCCs) who are the prime point of contract with the AFRCC.

Your information (bearing, fix, position report, etc.) will amplify the SAR communities' data, if not initiate the incident with them. Another comm line to the AFRCC is through the USAF Aeronautical Airways Stations for relay via AUTOVON to the AFRCC (at AUTOVON 638-4815). The better the data you can provide, the better situation that crew down there in the mud and weeds will be in.

You say there are too many beeper signals on 121.5 and 243.0? The SARSAT confirms your observations. The false alarm problem on both frequencies is horrendous. The SARSAT system reports approximately 100 signal hits per day to the AFRCC from its 18 daily passes over the lower 48 states. Roughly a dozen of these are solely on 243.0. Of these 100 hits per day, the averages show three are caused by G forces or other means as the device was designed. Two of these will be hard landings or forced landings or non-class A type accidents. Only one will be an actual crash. But the system can't tell which one is real, and needs SAR. The 97% of false alarms are caused by a wide variety of members of the Murphy family.

Unfortunately, too many cases have shown that a false alarm from a strong but non-distress source in the airfield environment may mask a weaker signal from a real distress in the mud and weeds. Please note, a prompt response to silence the signal is important. AFRCC stats show that an on-base non-distress signal will transmit for an average of 27 hours before being found and silenced.

Another frustration which degrades the SARSAT system performance is on the voice transmission on "guard." Your voice transmission on "guard" is from a stronger transmitter, so it overrides the distress signal. The SARSAT must be locked on to the distress signal for four minutes to be able to compute the signal source fix. By design, this four minute lock-on is intended to eliminate the short duration transmissions from testing of the distress beacon. The good news is the average voice transmission doesn't key the mike for four minutes. The bad news is the voice transmission does interrupt the distress signal processing, which degrades the accuracy of the SARSAT fix produced. Also, the U.S. Mission Control Center equipment can monitor the voice call, so when you use your call sign on guard, we know who you are. Please keep voice on guard to bonafide emergencies.

The two Soviet COSPAS satellites are only capable on 121.5 VHF and the new experimental 406 MHz. Our American satellite added in 243.0 capability on 5 July 1983. The last satellite in the planned constellation of four will be the second American one, tentatively scheduled for launch in March 1984. It will not add new capability, but it will increase the frequency of orbital coverage.

And what if you do unfortunately become a SAR customer? The beeper or survival radio becomes essential if you need or want rescue. With the satellites we recommend you transmit on beeper continuously because you won't know when an orbital pass is looking at you. And with the high false alarm rate, consecutive orbital hits are essential to define the search parameters. Combine a SARSAT beeper hit with an overdue on your flight plan, or a declared in-flight emergency, and a rescue chopper will very soon be in your neighborhood. When you hear the aircraft in your area, then you can cut beeper and come up voice. Be advised though, only in combat do we bring champagne.

The objective to the SARSAT program is to minimize the time and effort spent in search, while expediting the rescue phase. Even with the false alarm problem, the SARSAT-COSPAS system is proving effective towards this objective. continued

The biggest problem with the new SARSAT system is false alarms. Ninety-seven percent of the alarms registered each day by SARSAT are false. Unfortunately, every one must be investigated because it just might be for real. There is no one cause which can be pinpointed, but good maintenance and proper use of your ELT is the best preventive action. Check the mounting of your ELT — it must be mounted on a structural member, not the fuselage skin. Also, make sure that the G switch is properly oriented. If the ELT is improperly mounted, a reasonably normal landing could activate it.

SAR EFFORTS
YOU CAN HELP, TOO!

continued

A large proportion, perhaps a majority, of false ELT signals could be quickly corrected if pilots would tune the radio to 121.5 briefly while performing the start and shutdown checklists. Then if an ELT is operating in the area (including yours), it will be easy to isolate and turn off.

Emergency Locator Transmitter (ELT) false alarms are a problem for general aviation pilots as well as military aircrews. Since many Air Force members own or operate general aviation aircraft either through Aero Clubs or private airports, the following information has been adapted from the FAA *General Aviation News.*

The only effective way currently to reduce false alarms from ELTs is through voluntary action by pilots and owners.

A very large proportion — perhaps a majority — of false alarms could be prevented at the cost of only a few seconds of time and — in most cases — without the expenditure of a single penny for equipment. If each pilot simply adds to his shutdown and startup checklist an item for tuning the radio to 121.5 briefly, he will be alerted to the presence of any ELT signal over the entire airport, as well as from his own aircraft. The life you are protecting by this simple action could certainly be your own. Many ELTs have been activated by a hard landing which did not really seem that hard to the crew, or by turbulence in flight. If the ELT is activated and not turned off, not only will search and rescue personnel be needlessly loaded with work but the next time that aircraft flies, the ELT battery may be dead.

Checking the 121.5 MHz frequency in your panel radio *before* startup is also recommended, since other persons may have flown the airplane in your absence, or moved it in a manner that started it "whupping" silently. Even if the aircraft was kept in a locked hangar during disuse, it is possible that a wiring short, as a result of corrosion, could activate the transmitter.

The enormous pile-up of false alarms that hamstrings the search and rescue program could be largely dissipated if enough pilots would make these simple, voluntary additions to their operating checklists. What is needed is a change in attitude toward the ELT, as an integral and highly sensitive component of the aircraft. If you use a portable ELT and normally store it elsewhere than in the cabin (car trunk, garage, attic, etc.) make it your business to monitor it with a simple, inexpensive portable VHF radio.

Avoid using your aircraft ELT for any purpose other than that for which it was designed and licensed, such as boating or back-packing in the wilderness, or for non-emergency communications. Non-licensed usage is illegal and could jeopardize the safety of others in distress. Use equipment especially designed for these other purposes. Get into the habit of assuming that any ELT which has been handled, moved or untested for a period of time is *likely to be transmitting, unless proven otherwise.* ■

Some Causes of False Alarms

1. Oversensitive G Switches
Activated by landing impact, inflight vibrations.

2. Corrosion.
Short circuits activate unit.

3. Improper Mounting.
Mounted on fuselage skin instead of structural member; or direction of G switch improperly oriented.

4. Improper Disposal.
Old ELTs should not be trashed. They have sounded alerts years after being discarded. Give to a mechanic for dismantling.

5. Improper Testing.
Test only within first five minutes of hour, and only for three cycles.

6. Improper Shipment.
Improperly packed units have sounded alert while in the mail. Moving signals are hard to track.

ACES II EJECTION SEAT UPDATE

H. ENGEL, JR.
VICTOR P. SANTI
Aeronautical Systems Division
Wright-Patterson AFB, OH

■ The ACES II ejection seat has continued to maintain its excellent record of performance. Since first being introduced into the Air Force inventory in August 1978, nearly 3,000 ACES II seats have been installed in A-10, B-1, F-15, and F-16 aircraft. Current plans also call for ACES II installations in the new Air Force trainer.

Through 31 July 1983, the USAF had experienced 52 ejections with ACES II. The injury rate continued to be impressive with mostly minor, minimal or no injuries being reported. The statistics are shown below. Four of the fatalities were due to ejections out of the envelope and the fifth resulted from a drowning following an ejection over a cold, windy sea.

Even with these impressive statistics, work is continuing to upgrade the seat with open contracts on a single point release system and an advanced system for limb restraint. Future developmental possibilities call for sequencer refinements that will further expand the envelope for safe escape. ■

USAF ACES II EXPERIENCE
8 Aug 78 - 31 July 83
Injury Classification

Aircraft	None	Minimal	Minor	Major	Fatal	Total
A-10	0	9	0	2	3	14
F-15	0	5	1	2	1	9
F-16	8	13	6	1	1	29
Totals	8	27	7	5	5	52

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

Human Factors: FLIGHT SAFETY'S ACE

CECILIA PREBLE, Assistant Editor

For 30 years Dr. Anchard F. Zeller has been the resident psychologist at the Air Force Inspection and Safety Center. During his career he has watched the number of Class A aircraft mishaps per year drop from 2,500 to 80. Dr. Zeller's work in Human Factors has contributed to this improvement.

The author of the first human reliability regulation, Dr. Zeller, through his knowledge and experience in human factors, has helped solve the problems which cause the majority of Air Force mishaps — people problems. "Human Factors: Flight Safety's Ace" is the first in a series of interviews with Dr. Zeller in which we will examine various aspects of human factors as they relate to flying safety.

■ **In a recent interview published in the April issue of *Flying Safety*, General Gordon E. Williams, Director of Aerospace Safety, stated that the human factors area will be getting increased attention. What do you see as the most pressing needs in this area?**

The most pressing need in the human factors area is probably organization. We have a lot of people needing to know a lot of things, but not a very good system for providing them all the information we have. In conjunction with this, we need to organize the material we have and then define new research in terms of gaps highlighted. We must develop an information system which is easily accessible and understandable to the user. This means we need human factors translators who can reduce scientific information into a form applicable for managers who have to make real time decisions on equipment and people programs.

We also have a need for decisions. If there are difficult or unpleasant choices to be made with unpleasant political or social overtones, there's a tendency to relegate the problem to additional study and avoid coming to grips with it.

Our main source of information on mishaps comes from the safety investigation. Who on the safety investigation board is responsible for collecting human factors data?

By regulation, the flight surgeon. He has the option of getting assistance, but the responsibility is his. One of the problems with the flight surgeon having this responsibility is that many of the kinds of problems most frequently surfaced in mishaps are not the kinds of problems that he or she by temperament, education, and choice wants to deal with. These are frequently related to the normal human in a normal setting and involve areas like attention, adequacy and timing of perception, the decision making process, skill and some psychodynamics of personal idiosynchrasies or psychosocial pressures. All these may affect the individual's actions in a given instance and the analysis of mishaps suggests that these kinds of variables are involved more frequently than the more orthodox medical problems of incapacitation.

What sort of human factors information needs to be documented by the safety investigation board?

The items just mentioned as variables associated with mishaps are the things the SIB should examine. History shows that if they're not the cause, they're at least associated with mishap occurrences. There's been a very conscientious effort to broaden the scope to include more of this kind of behavioral information. For the past several years the School of Aerospace Medicine has had psychological specialists available for selected mishaps. This agency is currently developing a field checklist for use by the flight surgeons and investigators in considering these areas. It will include an extensive and elaborate breakdown of the factors just discussed.

Should there be any changes in the human factors forms in Tab Y of the report?

Yes. A revision is in process. These forms were developed some 20 years ago in conjunction with the other services. The other services have changed their forms already. We decided to wait to see what success they had from their modified forms and compile ours using the best sources. This has not proved a particularly profitable approach so we are instituting a major revision dictated by our changing needs and circumstances. The revision will update some obvious items that have become obsolete with time. It will incorporate a more elaborate human factors section and will provide for greater analysis of the possible contribution of other than primary crewmembers to the mishap. It will incorporate provisions for the study of the psychodynamics of these individuals as well. Also the old legal size format will vanish and the new forms will be in the 8½"x 11" configuration.

In the aircraft safety investigation course for board presidents, there is a suggested outline for the human factors report. Why do we need all those different inputs?

The approach to the investigation of human factors is in a state of transition. The problem is clear, the solution is not as readily apparent. There are a variety of approaches, all with basically the same elements. With time, these will undoubtedly be consolidated.

Are there any experts in Human Factors available to assist a safety investigation board?

There are many experts available. However, the number of people with a background in the total spectrum of the human factors discipline who can be used in the mishap investigation is very limited.

Given that we develop a method to collect human factors information for safety investigation, what does AFISC do with the information?

There are two uses of mishap investigations. The first is to use the information to correct immediately apparent deficiencies. Some problems in supervision, TO content, and training, when the recommended corrections are very specific, fall into this category. The second approach is to analyze many mishaps collectively so even where the causes are not obvious in one, they become apparent when the mishaps are considered together.

The Broad Look study identified problems in training, experience, and rated force management. What do you see as the Human Factors contributions to these problems?

Selection of people involves concepts of skill and talent. Training involves modification of skill. All of these are basically Human Factors considerations. Within the Air Force, Human Factors is used to describe the total human in an operational environment from the point of interface between the human and the machine through the perception-decision-action sequence. Included are physical, physiological, psychological, psychosocial and pathological considerations.

We are hearing a good deal about second-level causes of mishaps: over-motivation, stress, task saturation, etc. Can we really assign such causes with any degree of confidence? If so, what mishap prevention options are available?

There are some. One option is increased attention to the selection of people. We should evaluate their characteristics and skills more carefully, differentiating them, for example, on the ability to divide attention and the ability to make decisions. We could either select for these characteristics or train for them after people are selected. Training methods vary greatly. The Air Force is considering a program where individuals are specifically trained for one type of aircraft. Another area with Human Factors promise is improved supervision. Another is in design of equipment so it is more compatible with human abilities and deficiencies. In all these areas, perfection is probably impossible, but we can sure do a lot better.

System safety engineering has made rapid progress in solving the purely mechanical and material causes of aircraft mishaps. Can we do as well in Human Factors engineering in the future?

System safety, if optimally used, incorporates human factors. It frequently hasn't. I don't know if we can go as far as system safety has, or further, but I know we can do a lot better than we are doing now — and any improvement is progress. ■

AUTOMATION OF THE AIRPLANE?

AFTI/F-16 FLIGHTS SHOWING THE WAY

■ The AFTI/F-16 testbed aircraft has completed the first phase of flight testing with its return to Carswell AFB, Texas.

The flight originated from Edwards AFB, California, where AFTI/F-16 has flown a variety of new technologies which seek improvements and greater automation for future fighters, including digital flight controls, voice command, and multipurpose cockpit displays.

AFTI/F-16, an acronym for Advanced Fighter Technology Integration, is jointly sponsored by the U.S. Air Force, the Navy and the National Aeronautics and Space Administration. Program management is the responsibility of Aeronautical Systems Division's Flight Dynamics Laboratory.

The fighter's flight to Texas on July 30, 1983, was its 118th since it flew for the first time July 10, 1982, after extensive modifications by Air Force contractor General Dynamics Corporation, Fort Worth, for conversion to the testbed configuration. During the past year it has logged a total of 176 flight hours by seven different test pilots.

Program test and evaluation director Robert A. Gill of Flight Dynamics Laboratory described AFTI/F-16 testing as "highly successful" with accomplishments in many of the systems under scrutiny.

"We looked at AFTI/F-16's flying qualities and flight control system in great detail and made 12 modifications to the flight control software. After intensive testing of the flight control system we identified three flying modes which seemed most mature: standard normal, decoupled air-to-air gun and decoupled air-to-surface bombing. (Pilots next will concentrate on them in Phase II testing.)

"The pilots' evaluations of AFTI/F-16's handling qualities also were extensive. In their opinion it's a better landing aircraft than standard fighters because it's more stable and holds the angle of attack while in the landing approach.

"They also found AFTI/F-16 to be a better handling aircraft for tracking aerial targets since there was more control for fine tracking. For air-to-surface maneuvers, pilots found you could place the pipper (the gun target indicator) onto the target faster, especially while in a 'flat turn,' one of AFTI/F-16's unconventional, or decoupled, flight maneuvers."

Gill said that AFTI/F-16's digital flight control computer worked extremely well with no hardware failures in flight associated with the system.

"We never had to revert to the analog Independent Backup Unit (IBU) in the system. In fact, the aircraft was flown by the IBU only when the pilot intentionally engaged it for test."

"In voice command testing," he continued, "we were looking for very basic data: for example, the effects of Gs and noise in the cockpit on words spoken into the voice command system. We did no voice 'utility testing' — determining how useful it would be for tasks — but focused instead on the more monotonous though tedious testing.

"Five pilots used voice command," Gill added, "and two of them have taken the voice system through its entire range of baseline tests."

The AFTI/F-16 wide-field-of-view Head Up Display (HUD) worked very well, according to Gill, and was used primarily for flight instrumentation and air-to-air tracking. "We had no problems with it, and during Phase II it will be tested much more thoroughly, especially for displaying 'predictive symbology,' which tells the pilot what the aircraft will be doing as much as 10 seconds in advance during air-to-surface weapon delivery," Gill said.

Partially because of the HUD's good record in the AFTI/F-16 program, its optics have been selected for the F-16C/D models.

The two multipurpose displays (cathode ray tubes surrounded by pushbuttons) proved to be very useful — especially because of the amount of information that could be displayed on them, Gill continued.

Pilots said they were easy to read — even in bright sunlight — and used the buttons rather intuitively for switching information on the displays.

Also included was evaluation of the maneuvering controllers in the AFTI/F-16 cockpit which command the aircraft's unusual ways to fly: a right hand controller identical to ones in standard F-16 cockpits; a modified throttle to the pilot's left side for controlling the aircraft's direct lift, pitch, and vertical translation; and foot pedals to "point" the aircraft and command flat turns.

While discussion continues about the better side stick mechanisms, i.e., right versus left controllers, Gill said pilots generally prefer controlling the unconventional maneuvers with the left side stick. However, the foot pedals were used hundreds of times to put the aircraft into strange attitudes for evaluation of handling qualities; and they are accepted as appropriate, Gill said.

While AFTI/F-16's helmet mounted sight isn't scheduled for testing until Phase II, electronics for it were installed, and it was flight qualified — passing safety tests and checks for electromagnetic interference. While it was not used as a display mechanism, the helmet was worn in flight so that some measurements could be made for the pilot's line of eye sight.

The AFTI/F-16 aircraft will now go through spring 1984 retrofit with cockpit avionics identical to those in the F-16's Multi-Stage Improvement Program and a cathode ray tube on its "pedestal" along the center floor of the cockpit. That CRT will be dedicated to testing two kinds of moving map displays: a film type projection map and a digital data base map.

AFTI/F-16's flight control system also will be modified, and its fuselage will receive structural stiffening and a cooling system to accommodate a sensor/tracking pod, built into the right strake (where the wing attaches to the fuselage). A dummy pod for counterbalance will be built into the left strake.

All planned 156 flights for AFTI/F-16 Phase II testing will originate from NASA Dryden Flight Research Facility at Edwards AFB with 35 missions flown over the bombing ranges at Nellis AFB near Las Vegas, Nevada, for checkout of weapon delivery effectiveness and tactics using the unconventional AFTI/F-16 flight modes. ■

Friendly (?) Fire

The RSO was preparing to close down the RSU. He removed the flare pistol with a flare still installed. He then dropped the flare pistol, causing it to discharge.

The flare ricocheted around the RSU approximately three times and came to rest beneath the microphone and telephone. The Fire Department responded and was able to put out the fire without much difficulty.

Good Grief — No. 15

While monitoring a trainee on radar we became aware of a Mayday squawk in the area and found a target squawking code 7700 about 15 miles west and heading toward the airport. Numerous calls were initiated from various operating positions but no communication could be established. The aircraft proceeded to the airport and landed opposite to traffic on Runway 25R. The advertised runways were 7R and 7L.

I was later informed that the aircraft was a training flight and that the instructor aboard shut off the radios and had the student do no-radio procedures for practice.

— Courtesy ASRS *Callback*, July 1983.

A Hairy Tale

An F-4 had just become airborne when the right fire light came on. The crew accomplished the check list items and the fire light went out when the throttle was placed in idle. There were no other indications of a fire.

The aircraft entered the weather and almost immediately both primary and backup heading systems failed. The pilot requested a no gyro approach and was vectored to final.

Thunderstorm activity on final approach limited PAR capability, so when the aircraft broke out at about 2 miles it was a mile left of course.

The pilot had to use AB on the good engine to maintain airspeed during the maneuvers to align the aircraft with the runway. Once aligned, the pilot made a successful landing.

Changes in Procedures for Weather Briefings

Pilots will now be able to receive preflight weather briefings tailored to their individual flight needs by taking advantage of procedural changes in the weather briefing format. As of August 4, 1983 any one of three types of briefings may be requested: standard, abbreviated, and outlook.

The *standard briefing* should be requested when the pilot has not received any prerecorded or mass media weather information

TOPICS

(e.g., PATWAS, TWEB, A.M. Weather, etc.). After giving the briefer his type of flight (VFR or IFR), aircraft number, aircraft type, departure airport, route, destination, altitude, ETE, and ETD, the pilot will automatically receive the following:

- Adverse conditions
- Whether VFR flight is not recommended
- Synopsis of prevailing weather systems
- Current conditions
- En route forecast
- Destination forecast
- Winds aloft
- NOTAMs
- Any expected delays
- Any additional information the pilot requested

Previously, pilots received much of this information whether needed or not.

An *abbreviated briefing* should be requested if the pilot has used pre-recorded or mass media weather information to make a go/no-go decision. The FSS briefer, who is aware of what information has been included in these weather broadcasts, will then "fill the gaps" with only the information the pilot has not received (such as forecasts). Again, the pilot should provide the pertinent information about aircraft type, route, etc., tell the briefer just what source he has listened to, and ask for the abbreviated briefing.

For long-range flight planning, the pilot can ask for an *outlook briefing,* conditions expected six or more hours ahead. Of course, an abbreviated or standard briefing should also be obtained prior to departure. Inflight weather briefings will follow the same format.

Changes to the briefing procedures are explained in detail in the August 4, 1983 edition of the *Airman's Information Manual* (purchased on subscription from Superintendent of Documents, Government Printing Office, Washington, DC, 20402). Flight Service Station specialists are also prepared to answer any pilot query about the new procedures.

— Courtesy FAA *General Aviation News*/July-August 1983.

(An) Interrupted Descent

The pilot of the mishap aircraft was flying a night TFR low level mission. As a result of malfunctions, the aircraft failed to level at the correct altitude from which recovery was not possible.

The crew was not monitoring the descent and failed to note the malfunctions. As a result, the aircraft struck the ground and was destroyed. No ejections were attempted.

One Way Traffic Only

A KC-135 was completing a normal training mission to a northern base. The weather was an indefinite ceiling one-half mile in rain and fog with an RVR of 33.

The pilot successfully completed an ILS and touched down at about 1,200 feet down the runway. He had retarded the throttles to idle and was just reaching for the speed brake handle when the copilot saw two snowplows and an automobile on the runway about the 4,500 foot point. The copilot directed a go-round and selected 30 percent flaps. The pilot rotated about 1,000 feet from the vehicles and cleared them by about 50 feet.

After things quieted down, the investigation determined that the snow removal team had requested clearance onto the runway. The ground controller granted clearance, but before he could coordinate with the local Tower controller he was distracted. So when the KC-135 requested a landing, the Tower granted clearance, unaware of the vehicles on the runway.

Proposed Chart Changes Previewed

Major changes in the format of VFR charts (sectionals, terminal area, and world aeronautical charts) have been proposed and were displayed last summer for public comment. Beginning last August, prototypes of the new design were shown at flight service stations, for comparison with the existing charts. On

Proposed Chart Changes Previewed

continued

August 4 and 5 FAA cartographic experts were on hand at the EAA Fly-in at Oshkosh, WI (and at the AOPA Convention at Albuquerque, NM in October) to brief visiting pilots in detail and accept pilot comments.

The intention of the agency is to reduce clutter — the inevitable pilot complaint — and improve the readability of important data. Changes have been proposed in four areas of presentation: aeronautical/airway information, data included on chart margins, topograhical features and man-made features.

Among the topographical changes are darkened contour lines and gradients, removal of three-dimensional and form shading, lightening of tints, discontinued use of green elevation tints (mistakenly assumed to represent vegetation), fewer elevation color brands, and removal of the dark blue shading around shorelines.

Changes to man-made features include a different shade of yellow to indicate urban areas (the new color is easier on the eyes in daylight and more visible at night), removal of the black outline around the urban areas, enhanced railroad and transmissionline symbols, toning down of secondary roads, and omission of small town names unless used for landmarks or located near airports.

Changes to aeronautical/airway information include removal of private airport symbols (except those suitable for emergency use or as landmarks); data blocks for airports limited to three lines; a new special use airspace symbol; lighter tones for transition areas and for the blue and magenta outlines of TCAs and TRSAs; pictorial display of obstructions; new format for NAVAID information boxes; and adding fix reference data now normally found only on instrument charts.

Information contained on chart margins, such as the chart legend and explanations of special use airspace, would be printed in a less harsh blue that is easier on the eyes and more readable.

A three-phase evaluation process over the next six months will include comments by pilots at large on specially prepared evaluation forms, flight testing of the proposed charts by military and FAA pilots only — prototypes are not intended for public use — and a panel review of the economic feasibility of making any or all of the changes.

Pilots may write to FAA Cartographic Standards Section, AAT-259, 800 Independence Ave., S.W., Washington, DC, 20591 for free copies of the charts and a self-mailer evaluation form. ■

— Courtesy FAA *General Aviation News*/July-August 1983.

Flight Delayed Or Cancelled?

SQN LDR MARK A. LEWIS, RAAF
Directorate of Aerospace Safety

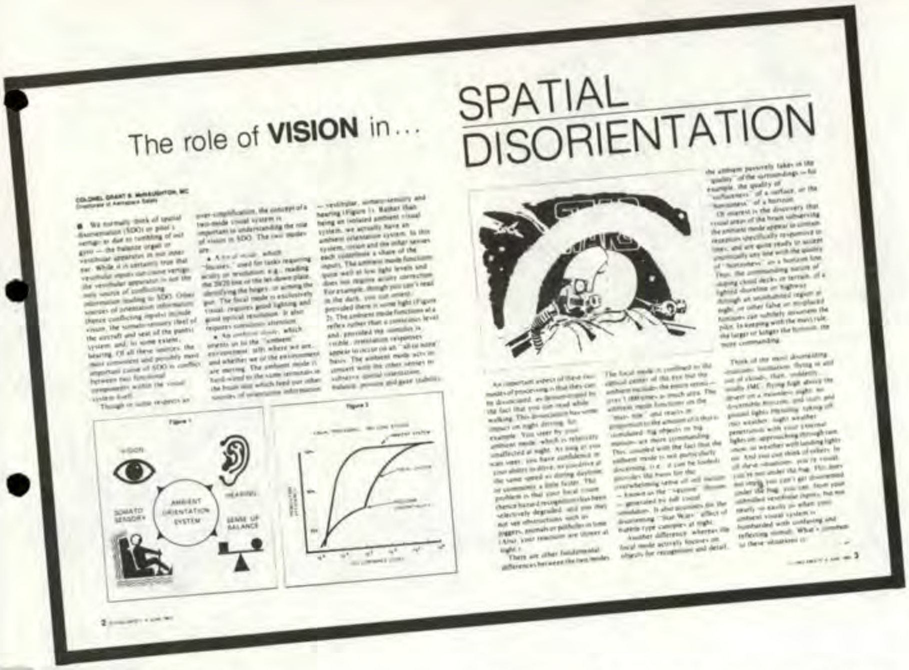
■ In today's Air Force there is a tremendous amount of pressure to complete missions on time. This is necessary when you consider the numbers of people and the quantities of equipment we work with. Keeping an aircraft on time is the responsibility of the aircraft commander. Another of his responsibilities is to delay his aircraft when there is reason for doing so.

Our mission in the Air Force must be to respond to our country's needs in time of war. To do this, we must preserve our resources for use whenever they are required. If the pressure to make a schedule causes an aircraft commander to launch and he damages or destroys an aircraft/crew, we have lost valuable resources. He has weakened his country's defense capability which directly affects you and me. After all, it's our country and our defense.

It is often difficult to assess the potential for damage in a particular set of circumstances. Delays may be justified for reasons such as weather, maintenance, crew duty, and many other variables which are often not apparent to you and me as passengers. The aircraft commander will not delay his mission without giving serious consideration to the pros and cons. If your flight is delayed, you may be assured that there is a very good reason for it.

The inconvenience caused by delays is obvious, but what of the inconvenience of the alternatives? Reflect on this when next you are delayed on an Air Force aircraft. ■

MAIL CALL


The role of **VISION** in... SPATIAL DISORIENTATION

Spatial Disorientation

I have just read the article "The Role of Vision in Spatial Disorientation," by G. B. McNaughton, in *Flying Safety*, June 1983. It is a very up-to-date and helpful article for pilots but it contains one piece of advice that could cause a catastrophe. To deal with a disoriented wing man in formation in *reduced visibility*, one of the suggestions is that the formation leader should consider transferring the lead to the wing man who is disoriented, in order to let that wing man give full attention to his instruments. That advice is disastrous, and if our flying bases still get this USAF journal I suggest that you inform them that the advice is erroneous and that a disoriented wing man should *never* be given the lead of a formation. A note to that effect should be attached to every copy of the article.

To give a disoriented wing man the lead of a formation does a disservice to both (a) the wing man individually and (b) the rest of the formation. Note that (a) it is harder to transition to instrument flying when disoriented than to continue flying formation, and it is quite likely that a successful transition would not be made. An attempted transition to instruments would only increase the hazard to the disoriented wing man. Also, (b), the disoriented maneuvering of the wing man-now-leader could easily disorient the rest of the formation too, and in fact, the whole formation could fly into the ground without suspecting that anything was wrong.

K. E. Money
Defense and Civil Institute of Environmental Medicine
Downsview, Ontario, Canada

Dr. Money's exception was taken to the following statement, which appeared on page 4, column 3, of that article: "Lead should also consider transferring lead to you — to let your get your ambient mode out of 'Star Wars' and devote the full attention of your focal mode to the necessary gauges. (This should all be briefed ahead of time.)"

Dr. McNaughton's intent was to provide another option to help an uncomfortable pilot before he becomes severely disoriented, provided it is briefed beforehand. This is in keeping with AFM 51-37 (C2) 15 Oct 1982, paragraph 7-5 d. (4) (i) which states: "If the above procedures are not effective, then lead should consider transferring the flight lead position to the wingman (while straight-and-level). NOTE: Once assuming lead, maintain straight-and-level flight for 60 seconds before initiating turns, climbs, or descents. The objective is for the disoriented pilot to reestablish visual dominance as quickly as possible. Again, a wingman who is severely disoriented should not elect or be directed to execute lost wingman procedures. A disoriented pilot may be unable to accomplish these procedures precisely or safely. At this point consideration should be given to terminating the mission and recovering the flight by the simplest and safest means possible."

Flying safety *would be interested in hearing from other pilots on this topic. Please let us know what you think. — Editor.*

We Don't Get Letters

Why don't you have a regular "Letters to the Editor" column?

Frustrated Letter Reader

We would, if people would write us letters. The address is:
Editor, Flying Safety *magazine*
AFISC/SEDF
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names reversed by contractor

FIRST LIEUTENANT
Mark L. Sime

CAPTAIN
William H. Cole

MASTER SERGEANT
George M. Richardson

67th Aerospace Rescue and Recovery Squadron

■ On 29 November 1982, Captain Cole, Lieutenant Sime, and Sergeant Richardson were flying a routine training mission in an HH-53C practicing simulated water search and rescue procedures. The mission profile consisted of a navigation leg ending at a point in the water training area where a simulated survivor was to be located and rescued. During the initial part of the sortie, a single point power check was conducted to ensure that the engines met the minimum acceptable power for operations over salt water. Both engines were good, and the search and rescue portion of the mission was begun. Lieutenant Sime, the copilot, took the controls approximately 8 minutes prior to the hover work. He arrived at the site of the simulated survivor, flew two patterns and made an approach to a 50-foot hover. The throttles were full forward and rotor rpm was 105 percent. After the hover was established, the engineer stood at the crew door giving hover instructions for the simulated hoist. During this time, the copilot allowed the hover altitude to decrease to 25 to 30 feet above the water. Captain Cole advised him of his altitude loss and that he should return to 50 feet. As Lieutenant Sime began to increase the collective and add power, a loud bang was heard, accompanied by a yaw kick. Captain Cole immediately assumed control of the helicopter and called out the bold face procedures. Lieutenant Sime began to accomplish the bold face procedures for engine failure and Sergeant Richardson, the engineer, quickly returned to the cockpit. The helicopter began to settle, and power was increased on the good engine via increased collective. There was no power assist from the number one engine. It froze almost immediately after failing. Captain Cole noticed the rotor droop to 95 percent rpm, and lowered the collective slightly to prevent the rpm from drooping any further. He then began to very slowly ease the cyclic forward to get flying speed. Sergeant Richardson began to dump fuel. As the aircraft passed through translational lift it was less than 25 feet above the water. It then rapidly gained altitude and airspeed. Total elapsed time from engine failure to translational lift was a matter of seconds with a safe altitude and airspeed reached in less than a minute. Later calculations showed that there was no 50-foot hover capability. The aircraft barely had single engine hover capability at the time of engine failure, but once the rotor system dropped to 95 percent, even that luxury no longer existed. The skill of the pilot and the coordination of the crew saved a valuable aircraft and possibly prevented loss of life. WELL DONE! ■

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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.

LIEUTENANT COLONEL
William A. Johnson

FIRST LIEUTENANT
Stephen W. Gardner

366th Tactical Fighter Wing
Mountain Home Air Force Base, Idaho

■ On 2 November 1982, Colonel Johnson, Aircraft Commander, and Lieutenant Gardner, Weapon Systems Officer, were flying chase in an F-111A for their wingman's return to base with a minor aircraft problem. While configuring for a formation approach, Colonel Johnson and Lieutenant Gardner discovered that their gear would not extend, and after a lead change, the wingman confirmed that neither the main nor the nose gear had extended. All efforts to extend the gear using the normal system were unsuccessful. When the alternate extension system was used, the nose gear extended, but the main gear remained up and locked. The aircrew then prepared for a main gear up approach end barrier engagement. To improve chances for a successful engagement, Colonel Johnson flew three practice approaches. Lieutenant Gardner used the radar altimeter to assist with altitude control. An experienced pilot observed from the Runway Supervisory Unit (RSU) and advised the aircrew of the hook height above the runway. Colonel Johnson planned to touch the hook down 200 to 300 feet prior to the barrier and then gently land the aircraft as barrier engagement was confirmed by the RSU. The approach, level off, and hook touchdown were perfect, with the hook touching the runway 200 feet prior to the barrier and engaging on centerline. As the hook engaged, Colonel Johnson gently landed the aircraft. Impact damage that would have resulted from the aircraft being pulled to the runway was avoided. Damage was confined to skidding damage to engine bay panels and strakes. The excellent crew coordination of Colonel Johnson and Lieutenant Gardner not only minimized damage, but may have saved a valuable aircraft and averted serious injury or loss of life. WELL DONE! ■

Not Feeling Well . . .?

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