UNITED STATES AIR FORCE

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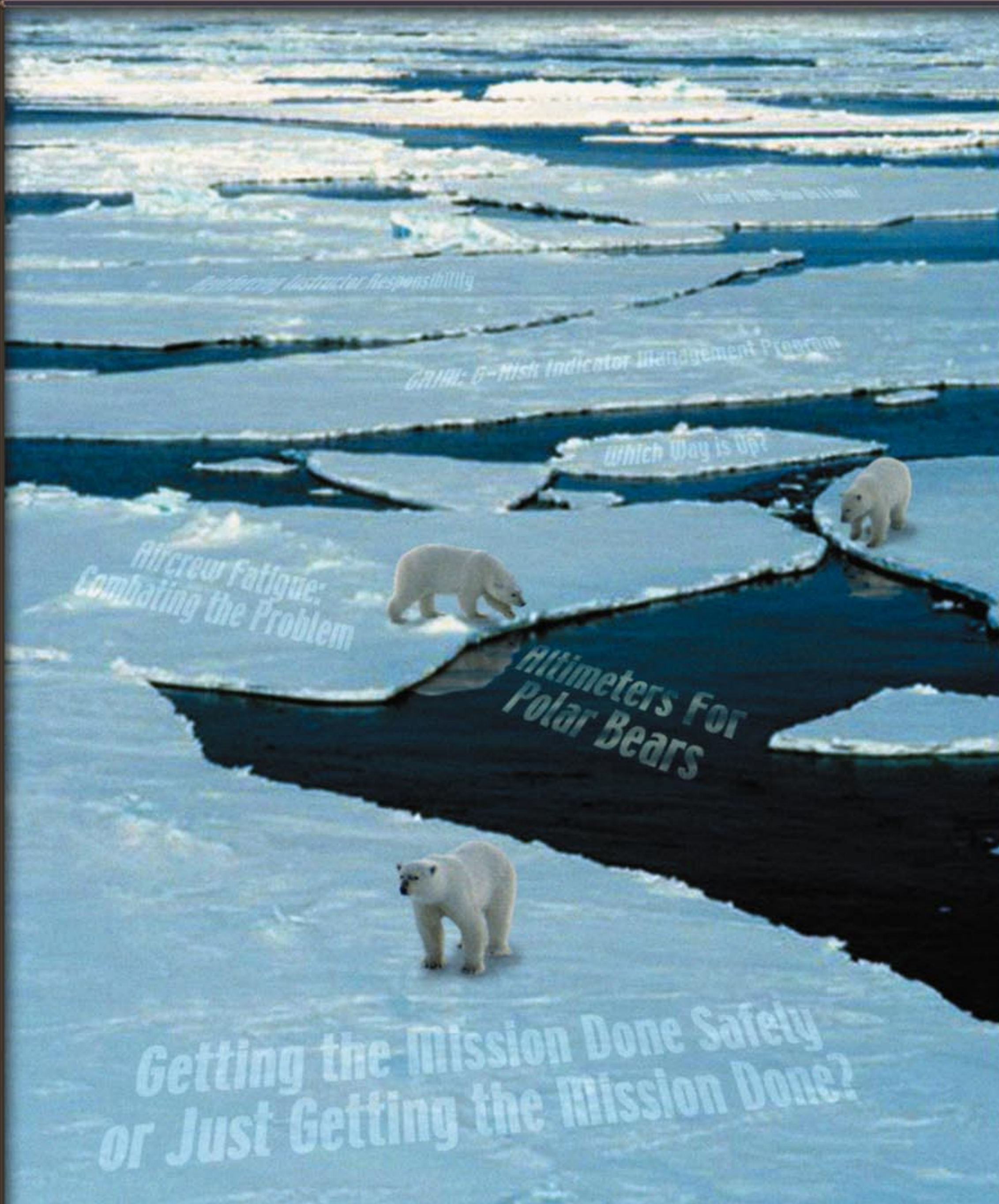
FLYING SAFETY MAGAZINE



FSM
FLYING SAFETY MAGAZINE
AIR FORCE RECURRING PUBLICATION 91–1

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U.S. AIR FORCE

Flying Safety Magazine on line: http://afsafety.af.mil/magazine/htdocs/fsmfirst.htm

Flying Safety Honored With Award

Flying Safety Magazine has won the Crystal Award of Excellence for 2004 from the Communicator Awards. This is the fourth consecutive year we have been so honored. The Crystal Award, in the "Print Media" category, recognizes superior achievement in publications, and places *Flying Safety* in the top 10 percent of more than 3000 entries, including those from some of the world's largest corporations. The Communicator Awards was founded by communications professionals, and judging is done by those professionals on the basis of quality, creativity, and resourcefulness.

The Crystal Award of Excellence goes to publications whose work is highly regarded by their peers, and whose ability to communicate puts them among the best in the field. The competition is open internationally to all companies, organizations or individuals involved in producing any kind of communication materials for external or internal audiences.

GENERAL JOHN P. JUMPER
Chief of Staff, USAF

MAJ GEN LEE MCFANN
Chief of Safety, USAF

LT COL RICHARD BURGESS
Chief, Plans and Policy Division
DSN 246-0738

JERRY ROOD
Managing Editor
DSN 246-0950

CMSGT JEFF MOENING
Maintenance/Technical Editor
DSN 246-0972

PATRICIA RIDEOUT
Editorial Assistant
DSN 246-1983

DAN HARMAN
Electronic Design Director
DSN 246-0932.

TSGT MICHAEL FEATHERSTON
Photo Editor
DSN 246-0986

DEPARTMENT OF THE AIR FORCE — THE CHIEF OF SAFETY, USAF

PURPOSE — ***Flying Safety*** is published monthly to promote aircraft mishap prevention. Facts, testimony, and conclusions of aircraft mishaps printed herein may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. The contents of this magazine are not directive and should not be construed as instructions, technical orders, or directives unless so stated. SUBSCRIPTIONS — For sale by the Superintendent of Documents, PO Box 371954, Pittsburgh PA 15250-7954. REPRINTS — Air Force organizations may reprint articles from *Flying Safety* without further authorization. Non-Air Force organizations must advise the Managing Editor of the intended use of the material prior to reprinting. Such action will ensure complete accuracy of material amended in light of most recent developments.

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E-Mail — jerry.rood@kirtland.af.mil
Address Changes — patricia.rideout@kirtland.af.mil

24-hour fax: DSN 246-0931

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USAF Photo

Safety Q&A
With Senior Leadership

GENERAL PAUL V. HESTER
Commander, Pacific Air Forces

FSM: As you serve as Commander of PACAF, what are your priorities as far as improving our safety efforts?

First of all, let me say how proud I am of the strong safety programs we have in Pacific Air Forces. Every day, commanders, supervisors and our safety management professionals are out there ensuring we're focusing on safe operations, both on and off duty. Yet as our Chief of Staff, Gen Jumper has stated, "The only acceptable mishap rate is zero, since anything else implies that some mishaps are acceptable, which clearly they are not."

Here in PACAF, our priorities for improving our safety efforts are unit commander focus and immediate supervisor involvement. In all of our units, a commander is the person ultimately responsible for mission accomplishment. Safety is foundational to that effort since mishaps degrade a unit's ability to successfully accomplish its mission. Broken or lost equipment exacts an obvious toll on unit readiness. Injuries or deaths of comrades or family members have an even more devastating impact, both organizationally and personally, not only on the unit and wing, but our entire Air Force family. Clearly, mishap-free operations are a prerequisite for mission success. Our commanders must understand this fact and therefore bring a strong focus on mishap prevention into their unit's command culture.

As important as the role of our commanders is, the focal point of mishap prevention resides in the involvement of immediate supervisors with their subordinates. Engaged leaders understand not only the technical and professional proficiency and capability of those under their charge, they also understand the off-duty activities their people are involved in and proactively ensure personal risk management becomes second nature. As a supervisor, I should know who my motorcycle drivers are, and whether or not they've had the required training courses and certifications. Better yet, I should also be familiar with each rider's proficiency level (new driver or old veteran) and if needed, walk my riders through a personal risk assessment before they take off for their next road trip. If my newest subordinates have never lived near an ocean, I should ensure they understand and respect the hazards associated with the local shorelines before they head for that first trip to the beach. If my youngest nuggets have never driven an auto outside their home states, I want to ensure they're competent drivers, aware of the local laws and customs, before blasting off for a left-hand drive through downtown Tokyo. Better yet, perhaps I need to ride "shotgun" with them once or twice to point out the hazards and more rapidly increase their proficiency.

Immediate supervisors who are engaged leaders will understand when and where their people are taking unnecessary risks, both on and off duty, and therefore, will "be there" to ensure personal risk management becomes ingrained in both our work and leisure pursuits.

One of the tools we've developed in PACAF to facilitate commander focus and supervisor involvement is the Comprehensive Assessment of Risk and Evaluation System (CARES) program. It is a web-based assessment tool which guides members through a personal risk assessment of off-duty, "high-risk" activities such as mountain climbing, scuba diving, motorcycle riding, etc., and provides not only an assessment of the risks involved, but a guide to discuss how to mitigate those risks. We've just completed the final test phase of this new program and will soon make it available command-wide.

Our ongoing strong safety program, in the hands of focused commanders and involved supervisors, will continue to improve our already solid safety record and prevent future mishaps.

FSM: What do you believe we, as AF members, can do to improve our safety record in flight safety?

When talking flight safety, we need to keep in mind that we've come a long way with regard to reducing our annual number of flight mishaps. In PACAF, just five years ago we had seven Class A flight mishaps; last year we had two. We need to focus on the successes that helped bring about the overall reduction in flight mishaps, not just in PACAF, but Air Force-wide. Timely implementation of the recommendations from Safety Investigation Boards has helped, ensuring lessons learned are included in training. An emphasis on following the rules and tech order guidance has also contributed. But the bottom line is discipline, both from the operators and the maintainers. Discipline to follow Dash-1 guidance, discipline to follow the AFIs, discipline to follow maintenance T.O. guidance, the discipline to be a strong flight lead or wingman. And the discipline to speak up and call a "knock it off" when you see a dangerous situation developing. Unfortunately, a lot of guidance we live by today is written in the blood of past mishaps and incidents. We still see quite a few mishap reports that reference failure to follow established guidance. Supervisors need to emphasize the importance of discipline and the dire consequences of not following aircrew and maintainer guidance. Combat capability and the preservation of our most important asset, our people, depend on it.

FSM: What do you believe we can do to improve our safety record in POV mishaps?

We take time to provide on-the-job training to our young Airmen to ensure they perform their professional duties in the safest manner. We pass on the benefits of our experience and correct mistakes to help them succeed. We must place the same emphasis on their operation of privately owned vehicles. An Air Force-level integrated process team is currently reassessing all of our driving training programs. Additionally, the Air Force is also testing a program for motorcycle mentorship that allows experienced operators to mentor and train the novice. This should help inexperienced riders to develop their skills and knowledge base for safely operating a motorcycle. The bottom line…each of us must accept responsibility for mishap prevention, both for our subordinates and ourselves. Personal risk management is the key…buckle up before you turn that ignition key, don't drink and drive, and don't attempt to drive too far without proper rest and nourishment. The challenge is to create a culture in which personal risk management becomes second nature.

FSM: What special concerns are posed by our war efforts?

Shortcutting safety is a major concern. Obviously, there is a heightened sense of urgency with our war efforts, a sense of urgency that unfortunately can result in equipment being damaged and personnel lost when corners are cut. Although it might take a little extra time to go step by step through the T.O. guidance, Gen Jumper said it best in his February 2004 Sight Picture when he said, "The warrior or piece of equipment killed or destroyed in peacetime will never get to war…." That is one of our primary safety challenges…to ensure the sense of urgency doesn't overwhelm the discipline required to follow established guidance. Commander and supervisor emphasis in using ORM to guide decisions, even when time is critical, can help make a difference here.

FSM: Speaking of our war efforts, do you see any special concerns with the support side of aviation—our maintainers, weapons, security, supply, transportation and the rest of the Air Force?

The support side of aviation has done a fantastic job of keeping global reach and force projection assets in the air and effective. They are the unsung heroes, toiling to preserve and enhance our air and space power. And they've done it many times under austere conditions many miles from home for extended periods of time…a tremendous sacrifice both for our Airmen and their families. As supervisors, we need to be sure that we're not only looking out for the warriors, but their loved ones on the home front as well. Supervisors need to be engaged to keep the squadron family informed and taken care of. Then, that's one less thing for those deployed to have to worry about. If deployed folks know their families are being cared for, they can better focus on the task at hand. And with better focus comes improved safety.

USAF Photo

FSM: What role do you believe supervisors and/or co-workers play in ensuring our Air Force works and plays safely?

As I stated earlier, supervisor involvement is absolutely vital to our efforts. As engaged leaders, supervisors will know their people and the activities they engage in both on and off duty. They will lead by example when using risk management to guide personal decision-making. They'll intervene when the "hair begins to stand up on the back of their neck" and the risks exceed the benefits. Co-workers obviously have a part to play here as well. They are often the first to see a problem developing and therefore have the first opportunity to respond before a mishap occurs. A unit culture that emphasizes mishap-free operations requires everyone to do their part: commanders, supervisors and co-workers alike.

FSM: What role do you see ORM playing in our on- and off-duty safety efforts?

Operational Risk Management is a proven methodology for mitigating or eliminating unnecessary or unacceptable risks. It is the "doctrine" we've chosen to focus our mishap prevention efforts on, and it works. It provides a common decision-making frame of reference for all Air Force members, from our Chief of Staff to our most junior Airman. It is flexible enough to be used at an organizational level, be it wing, group or squadron, and simple enough to guide individual decisions. ORM is foundational to who we are as Air Force members, and each of us has a responsibility to understand, apply and communicate its principles all the time.

FSM: What do you see as the greatest safety problem with reference to off-duty activities?

First of all, we all have to shed the notion that safety is a concern only when "on duty." No matter where we are…at home, on vacation, or driving our vehicle, personal risk management is critical to our safety and must be practiced 24/7. Seat belts do not work if you do not buckle them; helmets do not save lives if you do not wear them and wear them properly. Here again, the role of the engaged supervisor is vital to ensure subordinates consider risks and make appropriate decisions relative to off-duty activity. Subordinates must be taught this mindset; leaders must lead. Complacency here can kill or maim, so leadership is vitally important. Mishaps are preventable…there are always instances or opportunities where a supervisor, co-worker or friend could have influenced the outcome. Creating a culture where risks are properly identified and managed, both on and off duty, is the key. Leadership from commanders and supervisors will make that happen.

FSM: When you have completed your tour as Commander of PACAF, what would you like to have accomplished?

First, let me say how proud and humbled I am to be serving in this great command. PACAF owns a distinguished heritage filled with phenomenal accomplishments, and that continues to this day. I'd like to see our heritage continued and preserved by commanders who focus on mishap prevention while accomplishing the mission, and by supervisors who are fully engaged in the lives of their people and take seriously their responsibility to manage risk, both on and off duty. I'd like to see evidence that ORM is used continually, both organizationally and personally, to guide decision-making and energize mishap prevention. In short, I'd like to see our great people accomplishing PACAF's missions successfully and safely. ★★★★

REINFORCING INSTRUCTOR RESPONSIBILITY

LT COL JIM PETERSON
HQ USAF/SEI

When commanders and organizational leaders make assumptions in dealing with risk and responsibility in flying operations, that spells trouble. There are many ways to fool oneself in this context, but this article will focus on one: The assumption that instructors completely understand the increased responsibility inherent with being an instructor. I'm not trying to be dramatic with that statement. I base it on my daily review of all mishaps and events across the Air Force. The evidence is there to see.

Last year, I believed I had seen an all-time low in instructor performance in one of the fighter mishaps. Looking at that mishap objectively, there was no doubt of the Instructor Pilot's (IP) complete and total failure to act responsibly in *his* role as the IP. How bad was it? For starters, he failed to properly assess the risk when he allowed an upgrading pilot to rush into a terrible BFM set-up. His irresponsible behavior went much further as he violated numerous AFI 11-214 training rules (particularly regarding altitude minimums), failed to heed multiple altitude warnings from his jet, and exhibited an overall lack of situational awareness regarding the degraded learning environment and the subsequent transition to an extremely dangerous situation. In other words, he failed to perceive the very things we would expect an IP to recognize and prevent. Result: One lost aircraft.

Fast-forward to this year and look at the *Air Force Times* account of the Savannah T-6 incident. Like many, I could only shake my head in disbelief. It was almost painful to read the excruciatingly detailed description of the numerous blatant flying violations, the heavy use of alcohol and the general misconduct of two instructors who managed to kill themselves and destroy an aircraft. The general comment in the office was, "In this day and age, it's hard to believe anyone is still doing this stuff." Apparently, they are.

Since August of 2003, there have been several Class A mishaps containing elements of poor supervisory oversight, improper risk assessment, disastrous judgment, inept airmanship and inexcusable flight discipline…by the instructors. Even the Chief of Staff, Gen Jumper, conceded one of the mishaps was the "most disappointing mishap I've seen in my 39 years of service." You can see a lot in 39 years.

Within these mishaps, though, there is one common thread: All of the mishaps could have been prevented if the instructors on those flights would have exercised the airmanship, judgment and flight discipline consistent with the *normal expectations of an instructor*. While there is a valuable lesson for all aircrew in this context, because we all have *normal expectations* in our positions, the greater lesson here is for our commanders and senior leaders. This is especially true of those who always seem surprised when instructors exhibit such poor behavior. It's a lesson about culture and its importance.

A squadron culture starts with the commander; he or she sets the tone, makes and enforces the rules and is ultimately responsible for safe operations in his or her squadron. Part of that frontline culture sits squarely with the instructor. In the operational environment, there is a continual need to grow instructors. The pressures and demands on our forces are obviously in a heightened state. As a result, there is more reason for commanders and senior leaders to continually review the quality of instructors and not assume that the selection process for, and subsequent behavior of, instructors is continually at a high standard.

Commanders must question and review the process. Who makes the final call on which pilots or aircrew will upgrade? Who sets the criteria for these selections? Who reviews and approves the grade sheets as the upgrade progresses? Who officially certifies the pilot or other aircrew as a competent instructor? Who sets the standards and expectations and communicates them to the instructors, flight leads and wingmen? All of these are important questions, and commanders must be involved with the answers—and keep asking them on a continual basis.

That being said, it is still up to *all* the leaders in a flying organization to create a culture where professionalism, flight discipline and airmanship are simply basic and unquestioned. It starts with the commander and works its way down through the operations officer, flight commanders, instructors and flight leads. Still, it is often the instructors who have the most direct influence on and the most insight into the culture of a flying organization, and they absolutely must recognize this responsibility.

In too many mishaps, the investigators are finding that some instructors have forgotten the importance of their roles, and have fallen short in areas such as proper risk decisions, airmanship and flight discipline. In effect, they have failed as leaders. As an instructor, it's okay to trust those you supervise, but it's never okay to let that trust turn into complacency, or as one investigation board put it, "a false sense of security." All instructors must remember that, in the end, they are responsible for the conduct of *any* flight in which they play a role—no matter how small that role may be. That responsibility simply cannot be taken for granted.

Altimeters For Polar Bears

Photo Illustration by Dan Harman

MAJ MONIQUE YATES
Air Force Advanced Instrument School
Randolph AFB TX

If polar bears could fly, they would know about cold weather altimeter settings. That's because the correction factors are required at most of the locations where polar bears frequent. Before you warm weather pilots tune out, you too have probably flown to at least one location requiring a cold weather altimeter correction. In fact, any time the ground temperature beneath an aircraft drops below 0 degrees Celsius, a correction should be made to altitudes in the departure/arrival spectrum.

To understand the error, it helps to compare the atmosphere to the ocean surface. Many different things cause "waves" in the atmosphere, such as high/low pressure systems and temperature changes. Our altimeter surfs along a line of equal pressure. For example, over the continental U.S. at FL 190 with 29.92 set, the altimeter will follow a line of equal pressure, which will not be a constant true altitude. The true altitude (actual altitude above sea level) will vary as the aircraft moves along this line of equal pressure. We can lose up to 40 feet of our true altitude for each 10 degrees C below standard as measured at ground level at the altimeter source.

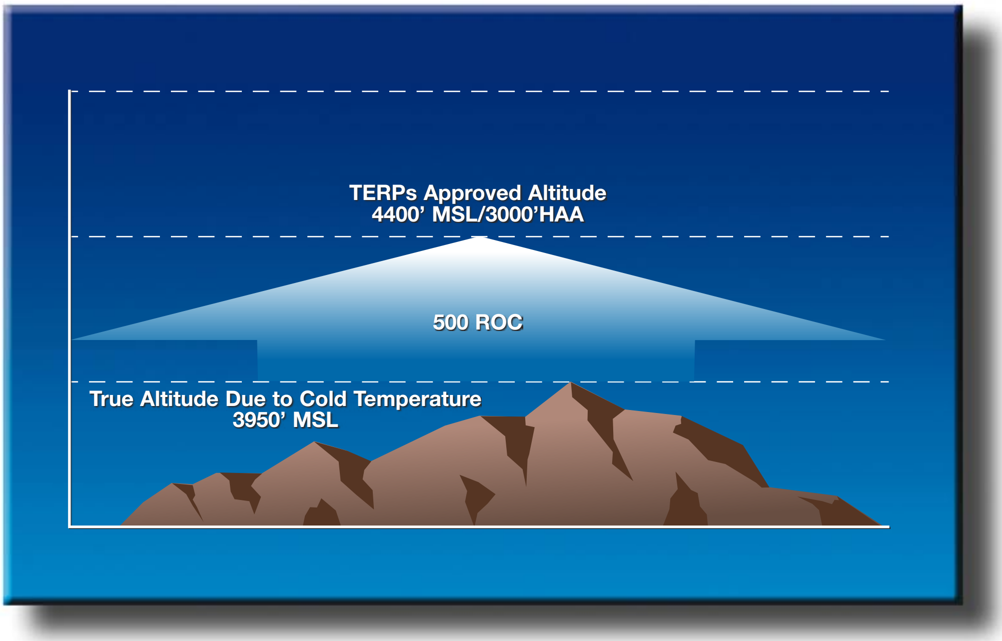
It might be easier to understand this by studying a real-life example. An air carrier was flying into Kelowna, British Columbia on the Localizer 2 DME to runway 15. The weather on the airfield was -27 degrees C. The aircraft commander opted to execute a missed approach when the ground proximity warning system (GPWS) went off for terrain closure. The instruments, however, indicated he was right on altitude. His altimeter was working as designed and set correctly, but his true altitude was dangerously lower than that indicated.

That crew could have benefited from a resource we, as military aviators, don't often think twice about—the Flight Information Handbook (FIH). (As a side note, although civilian aviators don't have the FIH, the AIM covers this same subject.) Look at page D-15 of the FIH. It contains a chart (see Chart 1) to determine a correction to be added to your altimeter for lower-than-standard temperatures. The aviator starts with the HAT/HAA (Height Above Touchdown/Height Above Aerodome) on the bottom scale and comes up the side of the chart with the temperature at the aerodrome. The correction factor provides an approximate value of how many feet to add onto the indicated altitude so the aircraft is at a true altitude closer to what the TERPster intended when the approach was designed.

If you have never used the chart, try this example. You have a HAT of 3000 feet AGL and an indicated altitude of 5000 feet. The temperature at the airfield is -20 degrees C. Using the chart below, you will see that you need to add a correction of 420 feet onto your indicated altitude. So, you need to fly at 5420 feet indicated to really be at true altitude on this cold day.

Temperature Correction Chart (Feet)

Airport Temperature °C \ HAT/HAA	200	300	400	500	600	700	800	900	1000	1300	1500	1800	2000	2300	3000	4000	5000
0	0	20	20	20	40	40	40	40	60	80	90	110	120	140	180	240	300
-5	10	20	30	30	50	50	60	60	80	110	120	150	160	180	240	320	400
-10	20	20	40	40	60	60	80	80	100	130	150	180	200	230	300	400	500
-15	20	30	50	50	70	80	90	100	120	160	180	220	240	280	360	480	600
-20	20	40	60	60	80	100	100	120	140	180	210	250	280	320	420	560	700
-25	30	50	60	70	90	110	120	140	160	210	240	290	320	370	480	640	800
-30	40	60	60	80	100	120	140	160	180	240	270	330	360	410	540	720	900
-35	40	60	70	90	110	130	150	180	200	260	300	360	400	460	600	800	1000
-40	40	60	80	100	120	140	160	200	220	290	330	400	440	510	660	880	1100
-45	50	70	90	110	140	160	180	210	240	310	360	430	480	550	720	960	1200
-50	60	80	100	120	160	180	200	220	260	340	390	470	520	600	780	1040	1300



Let's consider the aircraft that was going into Kelowna again. Remember, the airport temperature was -27 degrees C. In the intermediate segment of the approach, the TERPster only planned for 500 feet of required obstacle clearance. At the TERPS-designated altitude on the approach plate, the aircraft should have had 500 feet above any terrain or protruding obstacle. The altimeter was indicating 4400 feet. The height above the aerodrome at that point on the approach was 3000 feet. So, while the crew was confidently flying the appropriate altitudes listed on the IAP, they didn't realize they were actually only 50 feet above the terrain because they didn't apply the correction to their altimeter. It doesn't take a rocket scientist to figure out why the GPWS went off in the terrain mode.

Sometimes it's easier to see this in an illustration.

On a colder-than-standard day, the column of air up to 4400 feet MSL is compressed and thus several hundreds of feet smaller. The compression of that column of air, and a resulting lower true altitude, is what made the GPWS go off in Kelowna.

On a warmer-than-standard day, the column of air is expanded, resulting in a higher than normal true altitude, corrections are not required because you are well above the obstacles.

AFMAN 11-217 actually addresses this problem. It states:

If the temperature is 0 degrees C or less, add corrections to....

–The DH/MDA (Decision Height/Minimum Descent Altitude) and step down fixes inside the FAF (Final Approach Fix)

–All altitudes in designated mountainous terrain

If the temperature is -30 degrees C or less and/or the procedure turn, intermediate segment, or HAT/HAA is 3000 feet or more above the altimeter source, add corrections to….

–All altitudes in the procedures

AFMAN 11-217, Vol 1, para 8.1.4.1

At the Advanced Instrument School (AIS), we teach, as a technique, to apply the corrections all the way through the approach. You could find yourself in a situation where the temperature is just above -30 degrees C and the HAT is just below 3000 feet. In this case, AFM 11-217 would have you wait to make the correction until inside the FAF. You could still fly significantly close to the ground even though you're outside the FAF. That is something you will have to take into consideration as the situation presents itself. Study the terrain on the approach to decide if you will adopt this technique of correcting throughout the approach. That being said, always apply the corrections from the IAF (Initial Approach Fix) inbound if the temp is -30 degrees C or less, the HAT/HAA is 3000 feet or more above the altimeter source, or you are operating in mountainous terrain.

Also, be advised that many controllers do not understand cold temperatures result in altimeter errors, so telling a controller you need to fly higher may not always be the easiest thing to do. In these cases, try to explain in plain English that you need a higher altitude to correct your altimeter for temperature deviations. In the Northern US, Canada, and Northern Europe, the controller will probably be familiar with the procedures, but if they are not, remember that you are the final authority for providing terrain clearance. Do whatever you deem safest to fly a safe approach, to include executing a missed approach.

Overall, cold weather altimeter settings have not been attributed as the sole cause of any aircraft mishap, but the Airline and Pilots Association has connected temperature errors to eight near misses with the terrain. A likely reason that these near misses do not happen more often is that it is normally VMC when the temperature is that cold. So, keep your guard up if it is cold and you are in IMC. Remember the chart in the FIH and watch out for those flying polar bears. (You might have bigger problems than simply cold weather!)

Getting The Mission Done Safely

CMSGT JEFF MOENING
HQ AFSC/SEFF

The following story was on the AFNEWS website, and it's a great story about our maintainers who make the mission happen in numerous locations around the world with less than ideal conditions. However, as I read the story it brought my thoughts to the hundreds of mishap reports I have read, and how this could have been the preview of a mishap report. The Air Force flightlines face time crunches every day, and we have to make the sorties, but at what cost? Here is an example where there was no mishap, but if you look at the story you should see several areas where you might question the risk assessment of people or ask if tech data was being followed. I have been deployed to this type of operation and you have to make do, but at what cost? Here is my take on where risk was taken and tech data usage or maintenance practice wasn't what I would have done. (I have removed identifying information because it is not pertinent to my comments.) You can agree or disagree with my assessment, but we must ensure safety is at the forefront of the mission. Safety is not a byproduct, but a force multiplier.

Senior Airman X and Airman 1st Class Y are perched high atop a C-130 Hercules trying to solve a mechanical problem. The No. 3 engine had a prop replaced a week before, and flight deck indicator lights now point out a malfunction. It is a mild 78 degrees at 8:50 a.m. when their supervisor stops by and turns up the heat.

"A flight crew will be by at 10 to preflight the jet. Think you can have it done by then?" Tech. Sgt. Z yells up at them from his truck. The fact that it is a Saturday has no bearing on these maintainers. "Yeah, no problem," they say.

Do we have a scheduling problem here? Who drives the schedule, ops or maintenance? I wonder what would have been the effect if the troops had said no?

He knew they were going to say that. He said his Airmen are not afraid to tackle a dilemma—even if it happens half a world away from their home base at (base). "We've got our A-team out here," Sergeant Z said. "I'd take these guys anywhere, any place, anytime."

After their supervisor drives away, a troublesome screw gives Airman Y difficulty. Airman X quits working on the prop to give his buddy a hand. As Airman Y uses his weight to push a metal engine panel down with his foot, Airman X tightens the loose screw. By the time they fit the panel into place, it is 9:10 a.m. Time's ticking....

In my training, if you had to use your foot to close a panel, odds were that something wasn't right underneath the panel, and you needed to reopen the panel and look inside. I know there are some tough panels out there, but this could be a bit excessive.

By now, it is 9:20 a.m. He does not want to do it, but Sergeant Z has to take his crew away from their current job so they can recover another C-130, which is expected to land in a few minutes with problems.

USAF Photos / Photo Illustration by Dan Harman

Or Just Getting The Mission Done?

Task interference or steps missed when workers left one job for another were contributing factors in many of our past maintenance mishaps. The rule book requires that if you leave a task you are to write up in the forms where you stopped. Do you think this crew had the time to do that? Supervisors are always faced with the choice of taking their limited people supply to meet multiple tasks, but we must ensure we don't miss one thing for another in the process.

"These guys not only deploy a lot, but they put in some long hours," the supervisor said. "After 12 hours, most people get tired, but not Y. When he hears of an engine problem, he's chomping at the bit to get to it." When the troubled C-130 lands a few minutes later, Airman Y jumps out of the van as if it were on fire. By the time the other C-130 lands and Airmen Y and X connect it to auxiliary power, it is 9:35 a.m. before they get back to finish their original job.

They clamor into the flight deck, put on headphones and crank up the No. 3 engine to see if they fixed the problem. They are looking for the indicator light to blink on, then off.

Having been in a C-130 squadron before and looking at the time they had here, I wonder if they followed every step in the checklist for engine operation? Not having all the information, I would hope so, but they were very fast. We damage engines every month from engine runs gone wrong, either from FOD or maintenance that wasn't done correctly. Time is always short, but some things can't be rushed.

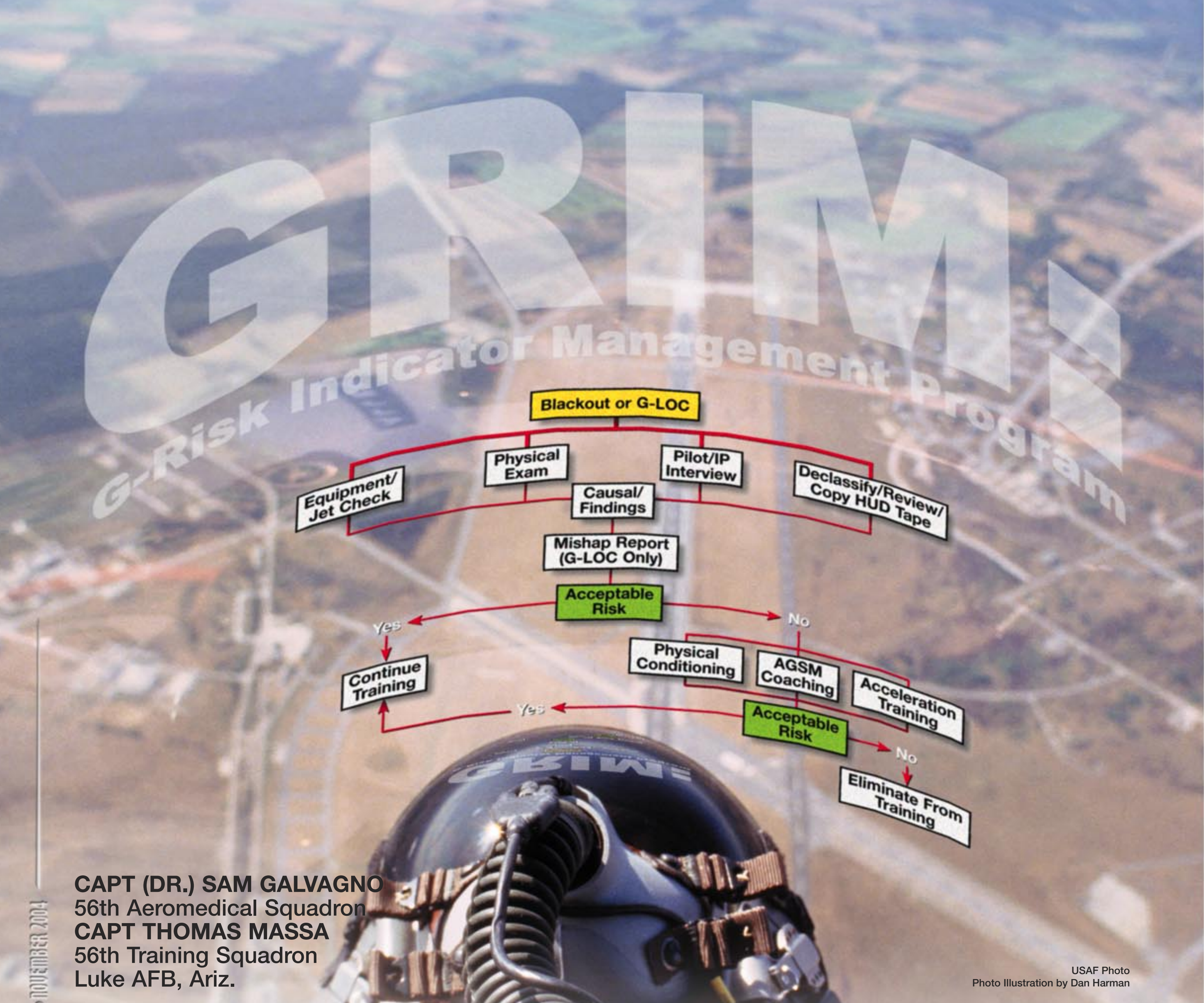
By now, Sergeant Z hears over the radio that the flight crew is on its way out. With the engine running, he cannot be heard so he walks close to the aircraft and points his thumb up, then down, then shrugs his shoulders, using signals to ask the two if the system checks out. They return with thumbs-up, and finish with five minutes to spare.

Now, they have got to get started on that other C-130, the one they recovered a half hour ago. Another deadline is set. The clock starts, again.

The goal of this article is not to label these guys as bad maintainers with no regard for tech data. They are like every other maintainer in the Air Force, mission hackers. They face countless deadlines, austere working conditions, low manning numbers and low experience levels. What counts is how we, the supervisors and managers, handle these problems through adequate risk assessment to ensure we meet the mission safely. We must be able to sleep at night with every decision we make, and unfortunately, this year we had a maintenance fatality due to people taking a shortcut. Management, experience, and how leaders set the example is what trains our replacements. We must ensure everyone follows the books. Safety and adequate risk assessment must be part of your daily tasks.

If you disagree with my opinions, please write and tell us what you think.

GRIM: G-Risk Indicator Management Program



USAF Photo
Photo Illustration by Dan Harman

CAPT (DR.) SAM GALVAGNO
56th Aeromedical Squadron
CAPT THOMAS MASSA
56th Training Squadron
Luke AFB, Ariz.

"Viper check," "Two" is the call as two F-16s launch from Luke AFB for some Basic Fighter Maneuver (BFM) training. They check into the airspace, prime real estate with 20 miles visibility, an unlimited ceiling, and a 115-degree barren desert below. After the G-check, "Fight's on" is called, and the two Vipers begin their BFM engagement. Viper 2 accelerates and enters the turn circle. With his mind on a kill and fangs full out, he hits the turn circle and puts a blistering 8.4 Gs on the jet.

Suddenly the aircraft nose dips down, the Gs quickly bleed off, and Bitchin' Betty starts screaming as the ground rushes towards the falling jet. The instructor pilot in the back seat promptly calls "knock it off," recovers the aircraft, declares a physiological incident, and returns to base. The student is peeled out of the cockpit by the flight surgeon and life support team upon landing, and later, during the Head-Up-Display (HUD) tape review, the physiologist points out the cause of the student's G-induced loss of consciousness (G-LOC): The student held his breath and failed to perform a correct anti-G straining maneuver (AGSM). How many times have you heard this before?

The physiological and operational impact of acute exposures to high-G acceleration has been well documented. According to data obtained from the Air Force Safety Center database, from 1982 to 2002, 29 aircraft in the USAF were lost to G-related mishaps with a 79% fatality rate; over 487 G-related physiological incidents occurred throughout this period. Notwithstanding advances in anti-G protection such as the Combined Advanced Technology Enhanced Design G Ensemble (COMBAT EDGE)/ Advanced Technology Anti-G Suit (ATAGS) and the standard CSU-13 B/P anti-G ensemble combined with centrifuge-based skill performance and training programs, the incidence of G-related physiological incidents has remained relatively stable over the past two decades.

In an effort to enhance combat capability and safety for student pilots enrolled in the USAF Basic Operational Training Course F-16C/D (B Course) at Luke AFB, Ariz., the G-Risk Indicator Management (GRIM) Program was implemented in April 2000 by two flight surgeons, Drs. William Hallier and Rolland Reynolds, and an aerospace physiologist, Thomas Morrison. The purpose of the GRIM Program is to enhance combat capability and safety by identifying pilots with a propensity for poor G-performance while assisting these aviators in the development of habit patterns and lifestyle decisions that will enhance both G-performance and G-discipline throughout F-16 conversion training and beyond. By assessing the risks and implementing control measures, the GRIM Program serves as an example of how the principles of Operational Risk Management (ORM) can be used for training fighter pilots. The following is an example of how Luke AFB uses the six steps of ORM to manage G-Risk in F-16 student aviators:

1. The G-Hazard

Some student pilots continue to demonstrate G-performance inadequacies before and during F-16 aircraft conversion instruction despite extensive G-tolerance testing and training throughout the fighter pilot pipeline. These problems may become apparent during F-16 training since this aircraft, unlike other high-performance training aircraft such as the T-6, T-37 and AT-38, is capable of initiating and sustaining instantaneous acceleration forces up to 9 Gs.

2. Assessing G-Risk

The potential for G-related risk is identified by three variables: 1) the pilot's physical conditioning at the start of F-16 training, which is evaluated using scores from the Fighter Aircrew Conditioning Test (FACT), 2) performance results of the pilot's F-16 centrifuge qualification training, and 3) AGSM comments provided by instructor pilots during and after Undergraduate Pilot Training (UPT), Introduction to Fighter Fundamentals (IFF), and after high-G sorties in the F-16.

3. Analyzing G-Risk Control Measures

While in the GRIM Program, risk control options include a mandatory monitored physical conditioning program and AGSM coaching by the flight surgeon and aerospace physiologist. Enrolled students require frequent assessment of the AGSM. This assessment is made with a formal HUD tape review by the student's instructor pilot as well as the aerospace physiologist or flight surgeon after specific high-G sorties throughout the curriculum. For example, a HUD review is required after the student's first F-16 flight (TR-1), first offensive BFM engagement (BFM-1), and first defensive BFM engagement (BFM-5). Physical conditioning and AGSM review comments are added to the student's grade book by the aerospace physiologist upon completion of all required HUD reviews. This review consists of an individual assessment of the student's weekly physical conditioning progress, noting any significant changes in strength or overall conditioning and performance of the AGSM during high-G flying tasks. Changes to a student's exercise regime or execution of the AGSM technique are administered, if deemed necessary.

4. G-Performance Decisions and Controls

Student pilots with poor physical condition (poor FACT results), known AGSM deficiencies from centrifuge qualification, and prior UPT/IFF grade book comments indicating problems with the AGSM are separated from other students who apparently do not require close follow-up. Luke AFI 11-401 outlines the threshold values used for assignment to the GRIM Program (contact the authors for specifics). Any individual score at or below any threshold value results in immediate assignment into the GRIM Program.

5. G-Risk Control Implementation

Failure to demonstrate adequate G-tolerance or G-endurance results in either commander-directed remedial acceleration training or elimination from F-16 conversion training. Students identified as having ongoing problems with AGSM performance receive one-on-one AGSM coaching and are closely followed throughout the F-16 conversion curriculum. The GRIM Program not only identifies potential poor G-performers, but also provides a flowchart for managing G-related incidents (Figure 1).

Indeed, the greatest strength of the GRIM Program is the provision of a framework for commanders to follow potential poor G-performers closely throughout their training.

6. G-Process Review

From 1994 to 1999, pre-GRIM, there were 16 reported G-incidents at Luke AFB. Post-GRIM from April 2000 to August 2004, there were nine reported G-related incidents. None of these incidents resulted in lost aircraft or pilot death. The relatively low number of G-related incidents, as compared to the 169,000 flying hours and 163,000 sorties flown at Luke for this four-year period, is a testament not only to the outstanding G-discipline and G-tolerance of training aviators, but also to the successful implementation of an effective risk control program for G-related physiological incidents.

The question of exactly how well the GRIM Program helps prevent G-LOC remains to be answered with future prospective studies. For now, the program provides reasonable first steps to take when monitoring pilots with poor G-performance. Since the majority of G-related incidents continue to occur at training bases for student pilots, we recommend the risk control measures included in the GRIM Program as a practicable model for ORM and the enhancement of combat capability and safety in high-performance aircraft.

I Have No HUD, How Do I Land?

MAJ BRETT T. HERMAN
435 FTS/SE
Moody AFB, Ga.

You have just finished the last fight of the day. After completing the Battle Damage check, you split the flight for separate straight-in approaches. The weather is good, so you decide to cancel and proceed with a visual approach. You line yourself up on a five-mile final, configure and set the Flight Path Marker (FPM) in your Heads-Up Display (HUD) on the approach end and begin the descent with a 2.5 to 3-degree glidepath. Everything is looking good until about two miles from touchdown, when the HUD disappears and now you have no FPM to fly your approach. Are you a "HUD baby" and go around to troubleshoot, or do you continue visually? Most of us would say continue, but what do you use for a glidepath reference? PAPIs, VASIs, or the good old "Mark 1" eyeball with aircraft references?

Landing a HUD-equipped aircraft is no different than landing a non-HUD-equipped aircraft. The trick is to use the information in the HUD to help you and not distract you from the approach. Knowing how to incorporate the HUD into all of your approaches can help you transition to landing visually without the HUD at a moment's notice and land "old school."

We were all trained in UPT to use aimpoint and airspeed to land the aircraft on a 2.5 to 3-degree glidepath, but do we really remember how? Yes, we all say "aimpoint-airspeed, aimpoint-airspeed," but what are we really using? What information do we get and use from the HUD? The HUD itself is a great addition to aircraft, but it can also be a hindrance if we concentrate solely on the HUD for our glidepath

Photo by Bruce Peterson
Photo Illustration by Dan Harman

and airspeed information and forget the basics. The HUD and all of its wealth of information was designed to assist the pilot in all phases of flight, not be the primary reference for any one phase. We can gather a lot of information from altitude and airspeed to DME ranges and fuel remaining.

What do we need to make a successful visual approach? And how do we filter out the necessary information to back up what the HUD is telling us and what we know is a good visual approach? The only way is to practice what we learned in UPT—aimpoint-airspeed. Think back to how we were all taught to land on a 2.5 to 3-degree glidepath using the 3 to 1 rule or 300 feet AGL at one mile from touchdown, 600 feet AGL at two miles and so on. This rule of thumb and thought process still works in a HUD-equipped aircraft, as long as we are processing the information correctly.

To land a HUD-equipped aircraft, we still need to concentrate on the basics and be able to look through the HUD and use outside references. Whether you use the approach lights or back all of your visual approaches up with the ILS or localizer, that's up to you, but we need to be able to successfully land the aircraft visually without the HUD and without incident. I know you are all saying, "That's easy, I can do that, no problem." OK, when was the last time you did a practice or real-world HUD-out approach? How did it go? Was it steep, drug-in or did you end up having a long landing because you shifted the aimpoint early? Or did you have a hard landing because you flared high due to a slow crosscheck and basically stalled the aircraft? Well, that can all be fixed if you practice HUD-out approaches.

So, how do we really land a HUD airplane HUD-out? There are many thoughts and ideas on how to accomplish this. One of the best ways is to use the HUD at first to help gain the landing "sight picture" and then practice HUD-out approaches. That doesn't mean setting the FPM on the threshold and just concentrate on the HUD until it feels right. It means having a composite crosscheck of all the primary aircraft instruments, the HUD FPM, outside references, the old ROT of 300 feet AGL at a mile and AIMPOINT-AIRSPEED! Training ourselves to use all the references available to us and not just the easiest one, the HUD, will help in transitioning to a totally visual approach and help to gain that "sight picture."

Now that you have the "sight picture," it is time to go HUD-out! You can do this in the simulator or the aircraft, it doesn't matter; but it needs to be practiced. When flying your first HUD-out approach, whether it is in the simulator or in the aircraft, you may be saying, "This sucks, I will deal with it when it happens, go around and get vectors for an ILS." Well, that may not be an option when you are on two-mile final, low on gas and there are multiple aircraft behind you.

A HUD-out approach hasn't changed from UPT. All the basics are the same to set yourself up on a 2.5- to 3-degree glidepath. The use of aimpoint-airspeed, the PAPIs/VASIs and aircraft references will never change. If you practice HUD-out approaches and are able to easily transition to a full visual approach, you will be able to safely land the aircraft without incident and be confident in your abilities.

The HUD is a great tool for pilots and aircrew to use during all phases of flight, but remember it is only a tool. The aircraft still flies without a HUD and can be successfully landed without the HUD, too. So, practice HUD-out approaches to help build a better "sight picture" and be a better pilot rather than a "HUD baby" who had to go around, declare emergency fuel and mess up the approach sequence because you were not able to land HUD-out. Think about it, plan for it and practice HUD-out approaches.

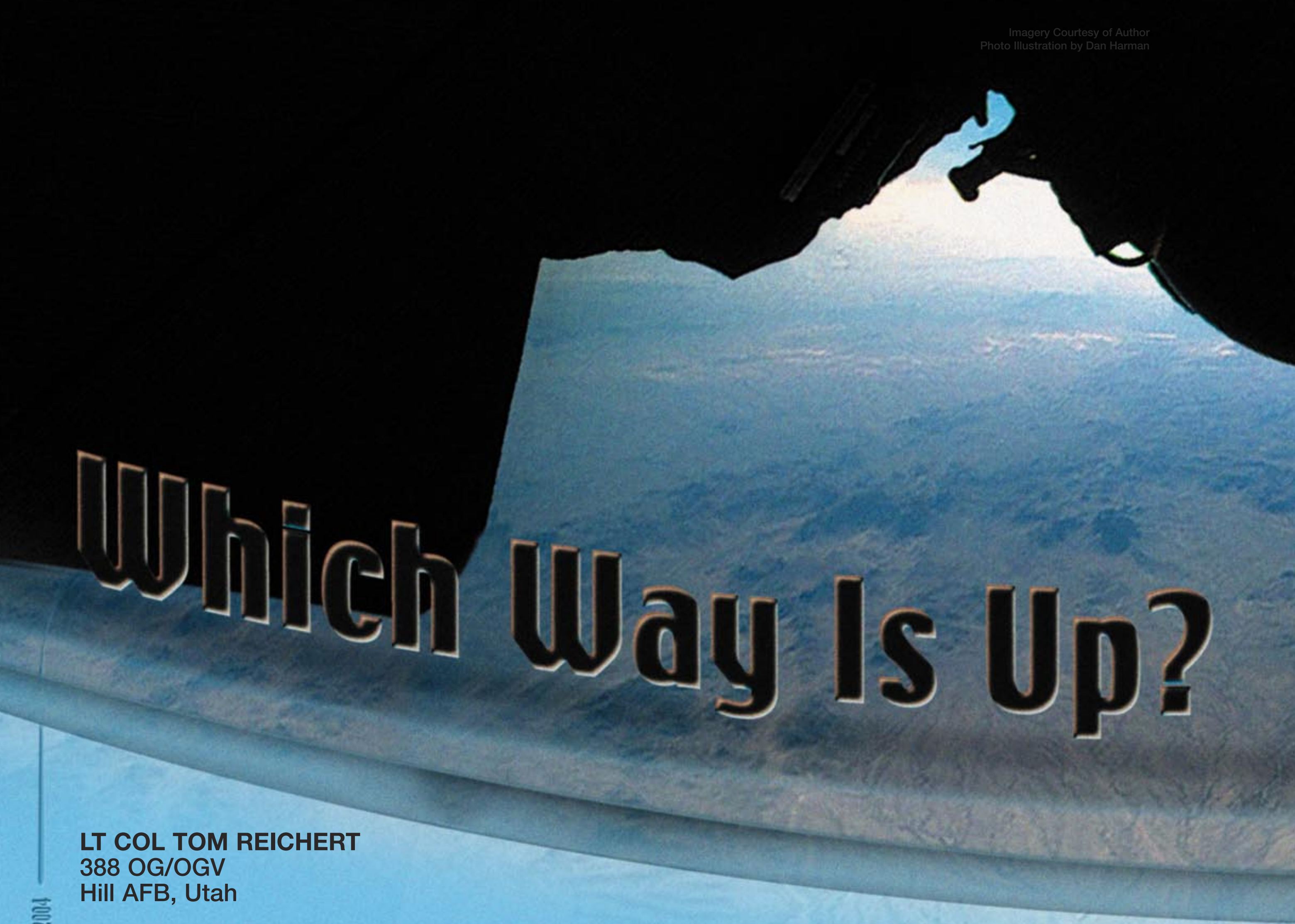
Crashes From Ashes...

Flight Hazards Come

To Ashes From Crashes

USAF/USGS Photos
Photo Illustration by Dan Harman

In All Descriptions



Imagery Courtesy of Author
Photo Illustration by Dan Harman

Which Way Is Up?

LT COL TOM REICHERT
388 OG/OGV
Hill AFB, Utah

Several months ago I lost a brother warrior and friend in an aircraft mishap on our local training range. He apparently became spatially disoriented on a clear, VFR day. All of us who knew him wondered how this could've happened to such a talented aviator. Recently I had the uncomfortable distinction of finding out…firsthand.

I was performing an F-16 functional check flight (FCF); the weather was "clear and a million." A front had passed through the night before. The large amount of rain, unable to be absorbed by the hard sand, had created a shallow lake over much of the area. This lake was as smooth as glass…in fact, it acted like a mirror, perfectly reflecting the surrounding mountains and sky. Overall it was a beautiful day to be flying.

I was "in the groove," well ahead of both the jet and my checklist. All of the engine checks were completed and the jet was performing flawlessly. I was going to have extra JP-8…and there were always other flights of F-16s from my unit on the range. A little Red Air in a slick Viper is always fun.

One of the required FCF maneuvers is the FOD check. This involves rolling the aircraft upside down (à la Thunderbird 5) and holding it there for several seconds. Any foreign objects will "fall" to the top of the canopy, where they may be retrieved. This can be a bit challenging, retrieving objects while maintaining inverted level flight, but it is not impossible.

I normally perform this check just prior to exiting the airspace, at about 10,000 feet MSL (5000 feet AGL in the area I was working). Because I was so far ahead of my flight profile I elected to perform the check before departing 20,000 feet. I rolled inverted and bunted to hold level flight. I wasn't surprised when a rubber band flew up in front of my face; it was the nickel and the half bag of M&M's® candy that caught me off guard. I managed to pin both the coin and rubber band against the canopy with one hand, but as I took my hand off the stick to grab the M&M's®, things started to go downhill…in more ways than one.

The candy exited the opening in the bag, further distracting me from what should have been my primary task (maintaining aircraft control). Since both my hands were occupied, I was no longer actively flying the jet and my Viper did what Vipers are wont to do…seek 1G flight. The nose dropped and, as it did, the FOD began to fall "up" into my lap. I was moving my "brain bucket" rapidly in an attempt to keep track of the FOD.

I now have a better understanding of all those flight surgeon lectures regarding the inner ear and spatial disorientation (SD). I was completely "eyes

USAF Photos by
TSgt Michael Featherston
and SSgt Jeffery Allen
Photo Illustration by Dan Harman

in" the cockpit, the jet was inverted and falling at 1G, I had no outside horizon reference, and the bottom of the jet was blocking the sun (strong "up" cue). About this time (less than 10 seconds from the beginning of the maneuver), I glanced up to check my attitude. Remember the rain, the lake, and the perfect mirror on the desert floor? It looked (and felt) like I was in 10-15 degrees of climb, with nothing but blue sky above me. Since I felt I had the aircraft under control, I continued to retrieve the FOD in the cockpit.

About now (15 seconds according to a review of my HUD tape), the hairs on the back of my neck began to stand up. How had the jet gotten upright? I didn't remember rolling it back that way. I looked outside again and was comforted by the view of the blue sky above me. Then I looked at the HUD…it didn't look like it was supposed to. I crosschecked the attitude indicator and what I saw shocked me—and made me drop the FOD I had collected. All I saw was brown…and the numbers were upside down! I executed the unusual attitude recovery procedures (you know…those "worthless" exercises they make us do in the simulator) and brought the jet back to level flight just as my cockpit "line in the sky" altitude alert sounded (set at 11,500 feet MSL for this mission).

I flew straight and level for a minute or so and then carefully finished the check profile. I sheepishly took my extra JP-8 home with me and landed. When I reviewed the tapes, I discovered I'd initiated the recovery 60-degrees nose low and in 175 degrees of bank, and I'd lost about 8000 feet of altitude from start to finish. If I'd have performed this check at my normal 5000 feet AGL I might not have recovered prior to ground impact.

I shared this episode with my squadron at our next pilot meeting. I figure if an instructor with over 3000 fighter hours can tell everyone this can happen to him, maybe it will get others thinking about SD and how it can happen to anybody…even to them…even on a clear day.

I have no idea what was nagging at me after looking outside the jet and convincing myself all was well…when it wasn't. Maybe it was my T-37 IP, who beat instrument crosscheck procedures into my skull all those years ago. Maybe it was the unusual attitudes I had to perform during my last instrument simulator mission. Maybe it was all those boring flight surgeon lectures on SD. Or maybe it was just my friend's way of telling me there were no fighter cockpits open in Heaven's Air Force just yet…and making sure someone could answer the question of how SD can happen on a beautiful VMC day.

Check Six.

Aircrew Fatigue: Combating The Problem

Including modafinil, the new go-pill

JOHN A. CALDWELL, PH.D.
AFRL/HEPF
Brooks City-Base, Texas

USAF Photo by TSgt Michael Featherston
Photo Illustration by Dan Harman

On a daily basis, the news stories from the Middle East remind us how continuous, sustained operations are stressing our personnel to the limits. The challenges can be particularly great for aircrew, who fly to distant destinations, put bombs on target, and then journey home, just to turn right around and do it again. The folks in charge of re-supply missions and troop transport are in the same boat. Our planes and equipment can handle this grueling non-stop pace with relative ease, but we humans just weren't designed to take continuous, around-the-clock operations—at least not for very long.

Causes Of Fatigue-Related Problems

Modern warfare has become a long-range, 24/7 affair, and the physiological realities of sleep, fatigue, and circadian rhythms often get in the way of optimal performance. As they say, "The spirit is willing, but the flesh is weak." The truth is that humans simply weren't programmed to handle the continuous, sustained pace that has popped up over only the past 50-100 years.

The National Sleep Foundation says people slept an average of nine hours a night in the early 1900's, as compared to the under seven hours we get today. It has only been during the last 100 years that around-the-clock operations have become possible, and it has only been since the 1950's that night vision technology has allowed us to "own the night." These new capabilities have been unbelievably stressful from a human-endurance standpoint. The rapid changes in transportation technology has further complicated the mix. In the early 1900's, it took about 7-9 days to cross the Atlantic Ocean on an ocean liner; today it takes only seven hours on a plane. We can arrive before our internal clocks figure out we've even left the house!

All of this rapid technological change has outstripped the human capacity to keep up. The result has been a dramatic increase in fatigue associated with shortened and/or disrupted sleep, and something called circadian desynchronosis (disturbances to the body's internal clock). These problems add up to decreased alertness, impaired reaction time, inattention, disturbed mood, and fatigue-related physical discomfort, which threaten operational safety and effectiveness.

It would be great if we could modify our physiology to keep up with technological changes, but we can't. We are faced with adapting to the chronic sleep restriction and total sleep deprivation that often come with today's operations, and we must have help. We cannot train ourselves to get by on less than 7-9 hours of sleep, and adapting to new time zones or work/rest hours generally takes a lot longer than we would like to believe.

Restricted Sleep And Sleep Deprivation

Recent studies show that even relatively small amounts of sleep loss will have immediate negative effects on performance. Sleep restriction (less than 7-8 hours per day) quickly creates a sleep debt that threatens operational safety and performance. In fact, one study found that sleep loss of only 2-3 hours per day affect mental functioning to the same degree as drinking 3-4 beers. Further, people don't readily adapt to shortened sleep periods, and they don't recover quickly from chronic sleep loss.

Total sleep deprivation impairs the ability to perform useful mental work by as much as 25-30 percent per day, while dramatically increasing the number of involuntary, uncontrolled lapses into sleep ("microsleeps"). These lapses, plus the other fatigue-related cognitive impairments, could double or triple the risk of mishaps. As shown below, sleep deprivation significantly degrades the performance of even proficient active-duty pilots. One study showed that just 20-25 hours without sleep produces cognitive effects roughly equivalent to those observed at a Blood Alcohol Content of .10 percent.

Circadian Rhythms

The body's clock, or changes to it, can pose additional problems for aircrews. Our internal 24-hour rhythms (circadian rhythms) naturally dictate low alertness at night and high alertness during the day, so night work and early-morning departures can result in sleepiness, befuddled thought processes, bad moods, and other problems. Transitions to new time zones or new work/rest cycles invariably make the situation worse (at least for a while) since it's difficult for the internal clock to change by more than an hour per day. Rapid schedule changes desynchronize internal rhythms, leading to disturbed or shortened sleep that adds a new source of fatigue. Night work, shift work and jet lag can also significantly affect in-flight alertness. (See charts on p. 24.)

What Is The Solution?

Of course, the best fatigue countermeasures are to *ensure that everyone gets enough sleep on a daily basis and to keep shift work to a minimum*. Since these are unlikely, administrative or behavioral strategies should be tried, and if these fail, there are now two effective pharmacological counter-fatigue alternatives.

First, *aircrews and leadership should be well educated about the dangers of fatigue* so they can conduct accurate pre-mission risk assessments and counter any identified risks. Operator-focused fatigue training is available at Brooks City-Base, Texas. (For more information see http://www.brooks.af.mil/afrl/hep/hepf/).

Second, fatigue management in long duration flights should include *out-of-cockpit on-board sleep opportunities* in aircraft where crew augmentation exists and on-board sleep arrangements are available.

Third, for lengthy two-pilot missions (such as B-2 bomber flights), *in-seat cockpit naps should be permitted during non-critical phases of flight.*

Fourth, frequent *controlled rest breaks should be implemented*—allowing pilots and crews on lengthy flights to switch duties, stand up or move around (when feasible), or simply relax for specified intervals.

Fifth, *computerized scheduling tools should be used to optimize crew work/rest schedules*.

Nonpharmacological Alertness Enhancers

- **Education about fatigue and fatigue remedies**
- **In-flight out-of-cockpit sleep breaks**
- **Cockpit naps**
- **Controlled activity breaks**
- **Good work/rest scheduling for crews**

Pharmacological Solutions

If the situation calls for more drastic measures, two other options (one old and one new) are available.

When despite everyone's best intentions, sleep is temporarily impossible to obtain, pharmacological countermeasures can be extremely helpful—in fact, they can make the difference between life and death. In the March 2003 *Flying Safety*, I discussed dextroamphetamine, long proven to be a safe and reliable way to mitigate fatigue on long flights. At that time it was the Air Force's only approved go-pill. However, a recently authorized go-pill known generically as modafinil (trade name Provigil®) has been introduced for alertness enhancement in prolonged aviation missions.

The traditional go pills, amphetamines, have been available in the U.S. since 1937, and the military has used them in operational contexts since World War II. Amphetamines can sustain performance at baseline levels even after two to three days without sleep. The Air Force allows 10-mg doses to be taken at four-hour intervals. Examples of the effects of this dosing strategy are shown in the following graphs (Figure 1).

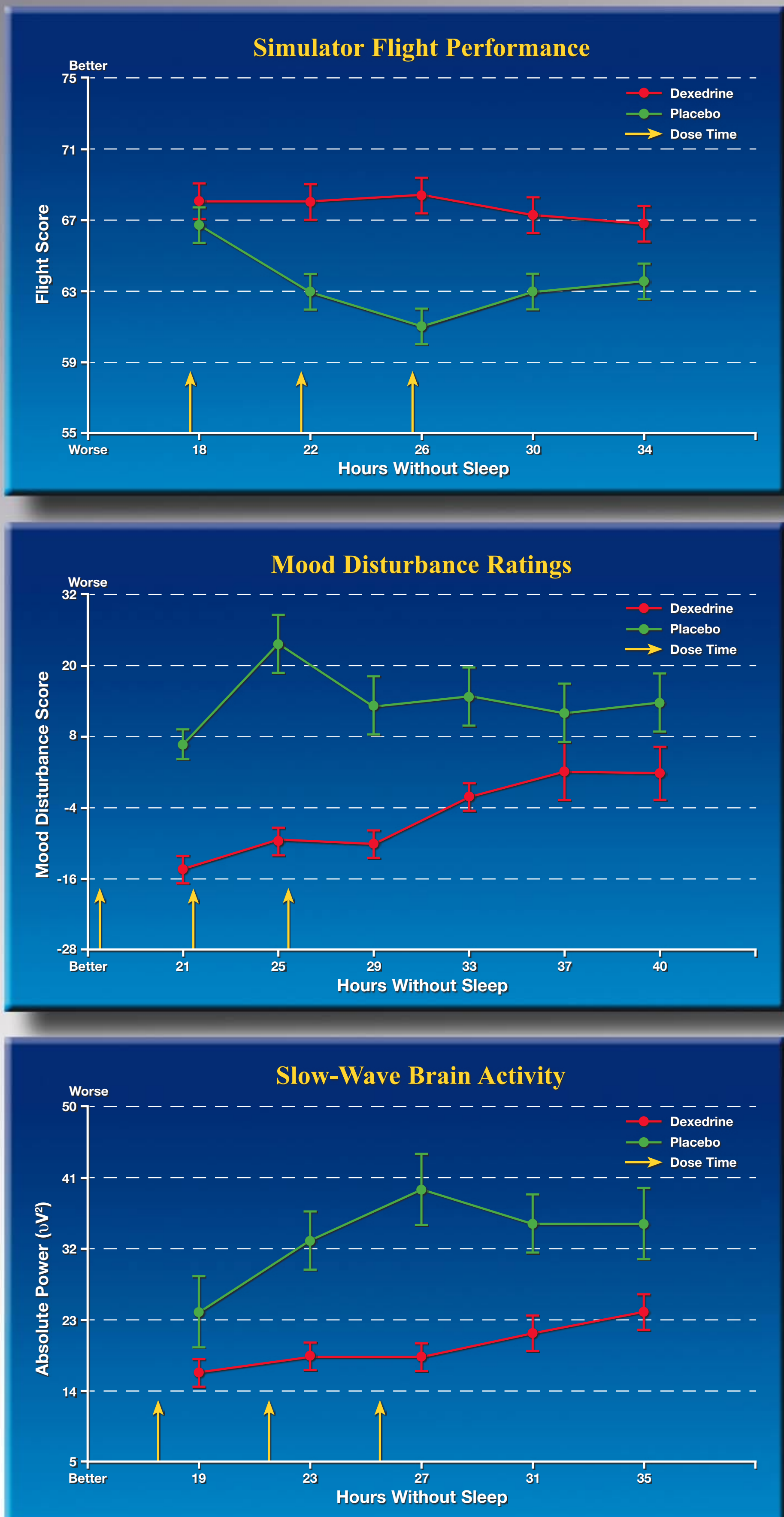


Figure 1. Pilot Performance Work with Dextroamphetamine

Flight surgeons and pilots have reported that dextroamphetamine has safely mitigated fatigue in continuous, sustained operations, and that it has been helpful for maintaining performance during those operations without producing unwanted side effects. Dextroamphetamine is authorized for certain situations today, when provided in accordance with carefully planned guidance and used in a well-controlled fashion.

The New Go-Pill—Modafinil

In December 2003, the Air Force authorized the use of modafinil to combat fatigue in certain types of aviation missions. Doses of 200 mg (not to exceed 400 mg within 24 hours) can be used to sustain pilot alertness in two-seater bomber missions greater than 12 hours in duration. Also, modafinil has been authorized for F-15C WSOs for missions longer than eight hours. To date, modafinil has not been approved for single-seat operations or for use by fighter pilots "pending further investigation," but approval for fighters is expected in the very near future.

Modafinil was only approved by the FDA in December 1998. Originally, it was approved for treating narcolepsy patients, but earlier this year it was also authorized for the treatment of severe alertness deficits in shift workers. Testing of modafinil in aviation-relevant (and other military) contexts is somewhat limited in comparison to what has been performed with dextroamphetamine, but a few well-controlled studies have been conducted. An investigation with Army helicopter pilots (using 600 mg modafinil given in three divided 200-mg doses) indicated modafinil was capable of sustaining simulator flight performance at near-rested levels despite over 30 hours of sleep loss. A more recent fighter-pilot study (with 300 mg modafinil given in three divided 100-mg doses) indicated that modafinil sustained the flight control accuracy of sleep-deprived F-117 pilots to within about 27 percent of baseline levels, whereas performance under the no-treatment condition degraded by over 82 percent (see Figure 2). Modafinil also improved self-rated psychological status and reduced the types of slow-wave brain activity that are known to reflect physiological fatigue. Although the 300 mgs of modafinil used within a 24-hour period in this study was less than the amount prescribed by Air Force policy, other research with non-pilots has shown that the approved dosage of 200 mg every eight hours offers significant alertness enhancement without causing unwanted effects.

Some of the differences between modafinil and dextroamphetamine are:

• Modafinil does not significantly increase blood pressure and heart rate (a common side effect of amphetamines).

• Modafinil has a lower abuse potential than dextroamphetamine, and therefore creates fewer complications in terms of medical oversight or drug control.

Although not an issue for pilots, an overdose of modafinil is significantly less likely to result in a medical emergency than an overdose of dextroamphetamine. Thus, in general terms, modafinil is viewed to be somewhat safer than the more traditional go-pill. On the slightly negative side, modafinil's alertness-enhancing effects are sometimes not as self-noticeable as those produced by dextroamphetamine, and this could lead people to inappropriately increase the dose in an effort to "feel" modafinil's effects. However, this should not be a problem as long as personnel are informed not to expect the "buzz" that they may have come to associate with stimulants such as amphetamine or caffeine. Just because you don't

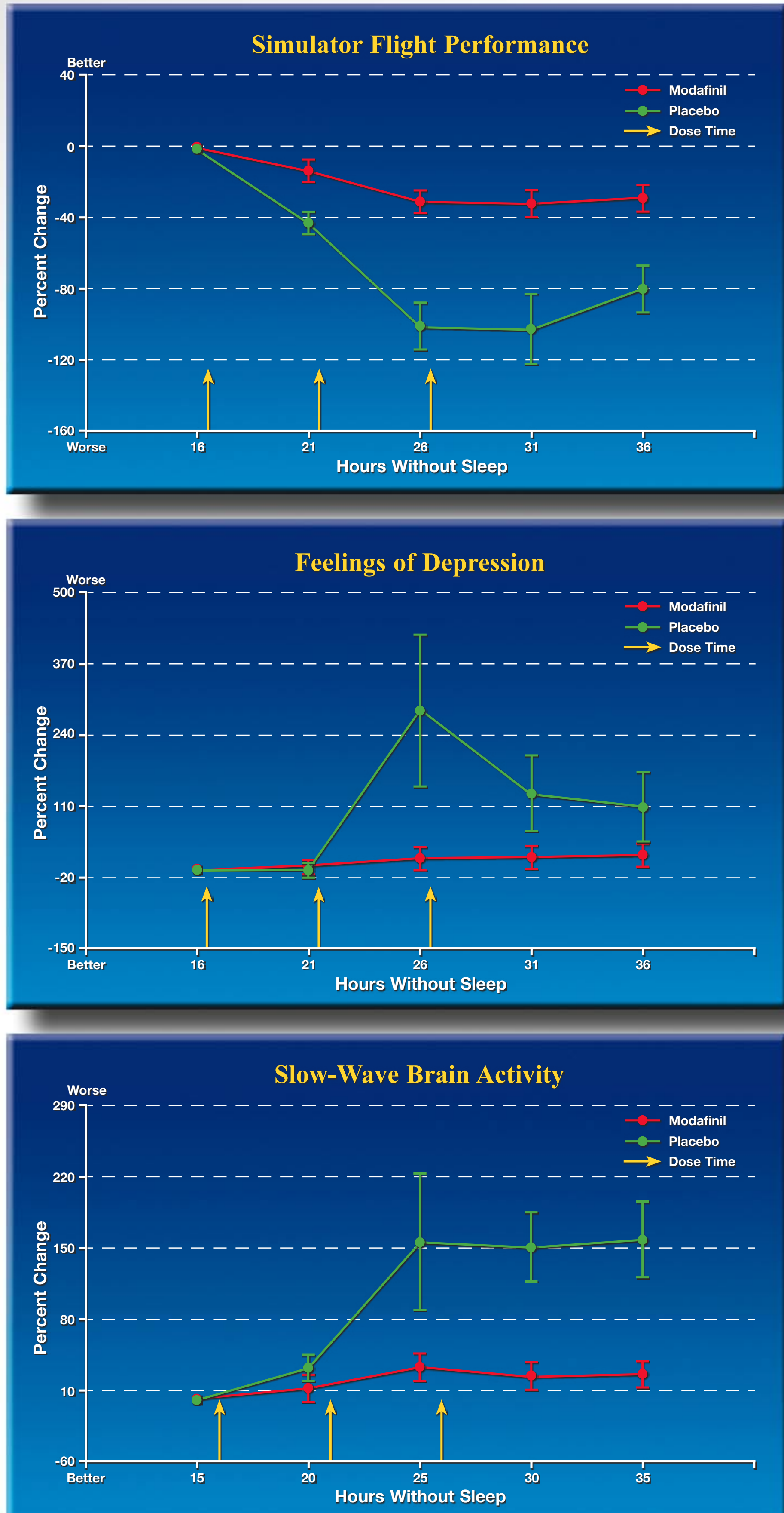
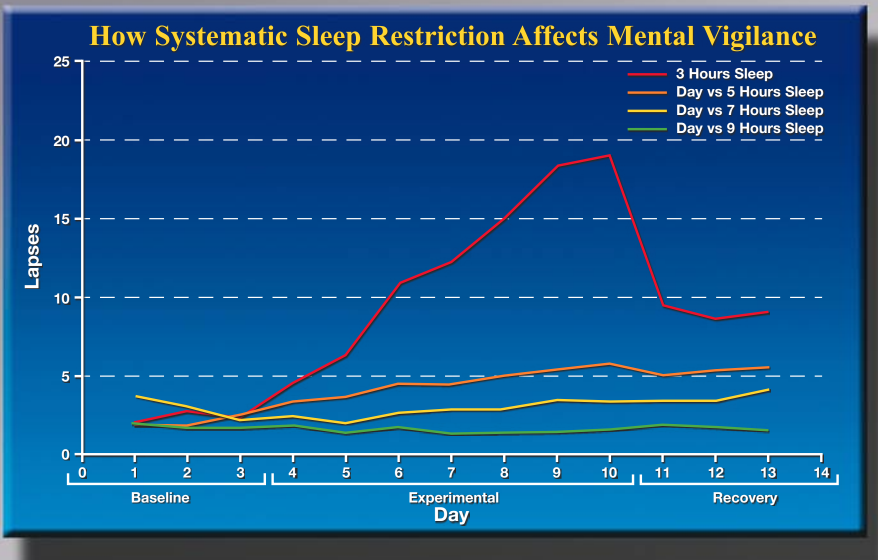
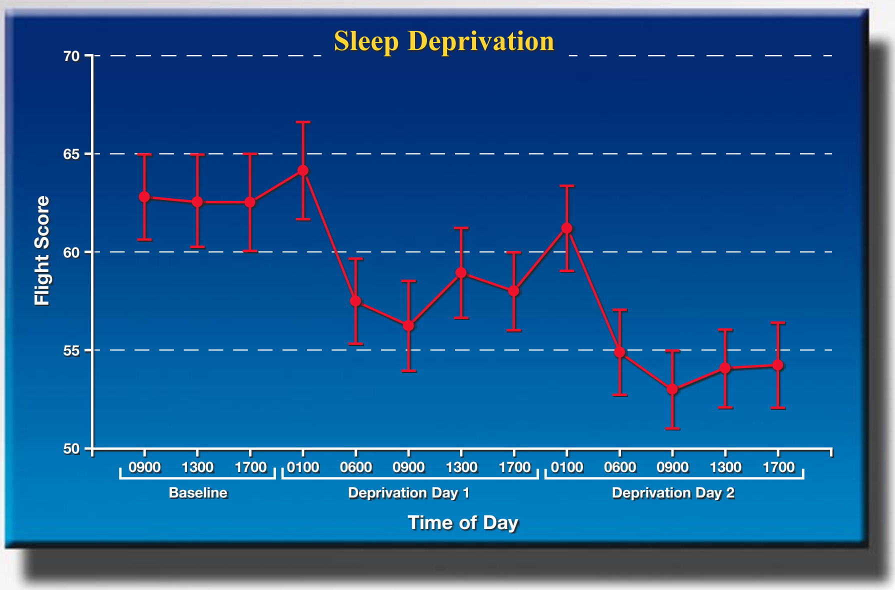


Figure 2. Pilot Performance Work with Modafinil



feel it, doesn't mean it isn't working. From an effectiveness standpoint, there is some evidence from studies performed on patients with excessive daytime sleepiness that modafinil may be slightly less effective than dextroamphetamine. However, there are other studies that show modafinil produces alertness and performance benefits that are within the range of those associated with the more traditional go-pill.

How well modafinil will ultimately work out in the operational environment remains to be seen, but there is every reason to be optimistic. Preliminary data are already being collected from pilots and flight surgeons in the field, and this will be used by the Air Force Surgeon General to help make further determinations regarding the extent to which modafinil will be used throughout the remainder of Air Force aviation. The evidence we have now suggests that modafinil will be a useful addition to the Air Force's counter-fatigue tool box, so everyone should take advantage of ground testing opportunities as they become available. At present, bomber crews who have passed a successful ground test with both modafinil and dextroamphetamine can choose either drug for use on authorized flights. A similar choice will no doubt be available for other pilots when an expanded modafinil policy is issued. In the meantime, the Air Force Research Laboratory is continuing to examine the effects of different doses of modafinil in sleep-deprived pilots, as well as in other personnel. In addition, efforts are underway to augment simulator data and field reports with controlled in-flight assessments. As was (and still is) the case with dextroamphetamine, data from a variety of sources will continue to be combined and synthesized to ensure that Air Force guidance is state-of-the-art. Expect to hear more about this in the near future!



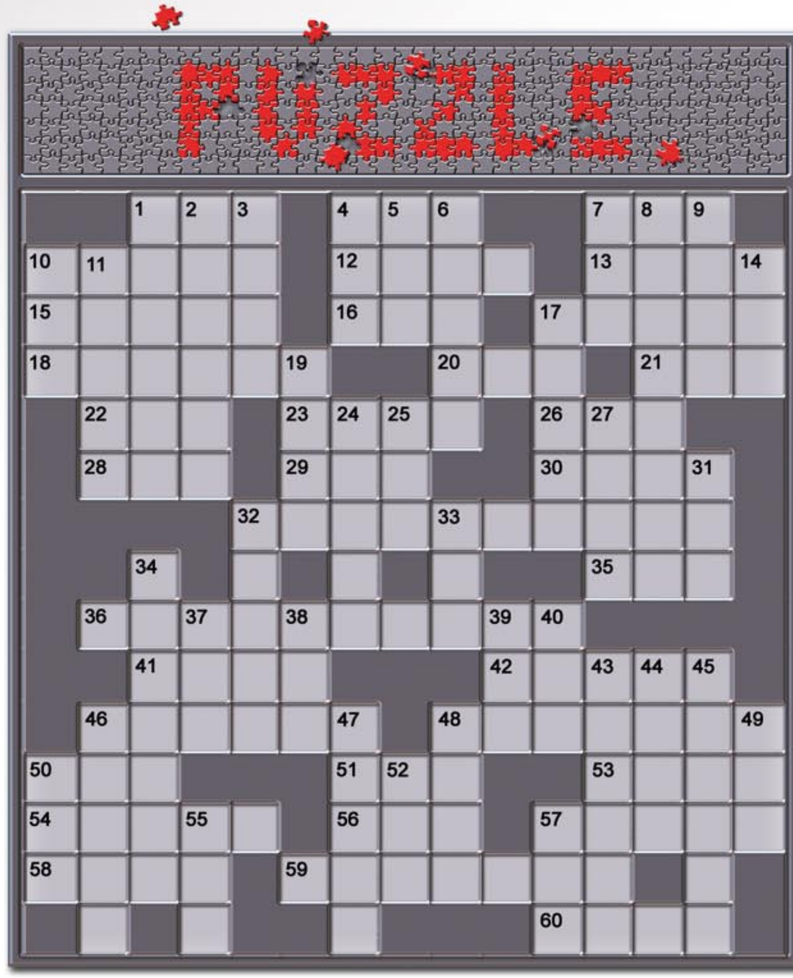
Summary

The high tempo of Air Force flight operations will continue to challenge the adaptive capabilities and endurance levels of pilots and crews, but coordinated fatigue-management strategies will help to successfully meet these challenges now and in the future. While sleep deprivation and body-clock disruptions will remain unavoidable components of around-the-clock operations, concerted efforts to:

(1) Educate personnel about the dangers of untreated fatigue.
(2) Prioritize sufficient daily sleep.
(3) Optimize work/rest scheduling.
(4) Implement behavioral and administrative counter-fatigue strategies.
(5) Employing both the new and the old go-pills, as appropriate, will ensure that Air Force pilots and crews remain the best and the safest in the world.

BASH SAFETY

1LT TONY WICKMAN
Alaskan Command Public Affairs



Solution on page 31

ACROSS

1. Tack on
4. Pie __ mode
7. Army commissioning source
10. Accept
12. Type of BASH danger
13. Clobber
15. Volleyball player Gabrielle
16. __ _ jiff; quickly
17. Signal to identify BASH dangers
18. Aircraft part in danger during a BASH incident
20. Oriole great Ripken
21. Formerly
22. Ravens player Lewis
23. Japanese sashes
26. Conjunction
28. USAF education for senior officers
29. Tire place
30. Blanc and Tormé
32. Places concerned with BASH
35. Website ending
36. Place where BASH incidents occur
41. Rear end
42. Singing registers
46. Volcano
48. Wood strips
50. Vase
51. The Greatest
53. Indian prince
54. Type of 48 DOWN; Significant BASH danger
56. Patriotic org.
57. Tack into place
58. Mows for farming
59. Barnyard
60. Alluring

DOWN

1. Stadiums
2. Devices used to scare wildlife to avoid BASH
3. Bottomless
4. USAF operating directives
5. Actor Chaney
6. Aircraft lost in BASH incident at Elmendorf
7. Bird-of-prey in BASH programs
8. *Friends* character
9. Patriarch
10. Part of a circle
11. Cogs
14. USAF formal education
17. Remember the ____!
19. Before
24. Charred
25. Simpson trial judge
27. *Finding* ____
31. Army rank
32. Teenage ire
33. Driving crime, in short
34. Famous stone
37. A Gershwin
38. ___ *Haw*
39. Basketball org
40. Dine
43. Part of BASH
44. Actor Penn
45. Possible result of a BASH
46. Balm
47. Detection device for BASH
48. Part of BASH
49. Tree resin
50. Sound of disgust
52. Young man
55. Space shuttle, in brief
57. Mil. move

OPS TOPICS

Editor's Note: The following accounts are from actual mishaps. They have been screened to prevent the release of privileged information.

What's the worst thing a pilot can do? How about land with the gear up or land on the wrong part of the aircraft? Here are a few cases where the gear wasn't where it was supposed to be and parts of the aircraft hit the runway.

Not Quite Airborne

The upgrade pilot (UP) was flying a transition sortie leading to a T-38 first pilot qualification. The UP, wanting to refine his crosswind control procedures, requested and flew a no-flap pattern. The UP applied control inputs for a right crosswind and with the no-flap, nose-high attitude caused the left main gear squat switch to sense a weight-off-wheels condition. The UP, satisfied with the landing, executed the "go" portion of the touch-and-go by raising the gear handle before advancing throttles and ensuring the aircraft was definitely airborne.

This action initiated gear retraction and activated the gear warning horn. The instructor pilot (IP) took control of the aircraft and advanced throttles to full afterburner, as the gear was in transit. The aircraft settled on its right main, continued to settle until the left afterburner exhaust contacted the runway and caused the nose to drop below takeoff attitude. The IP retarded the throttles to idle and declared an emergency. The aircrew safely emergency ground egressed after the aircraft stopped. What is your "go" procedure? Does it prevent this from happening to you?

Wingtip Strike

The C-17 mission was on a practice assault landing. The crew had four pilots on board. Pilot 1 (P1) had flown the third approach to a go-around called by the instructor pilot (P2) for not being stabilized. The mishap approach, the fourth approach, consisted of a circle to a left base for an assault landing. The aircraft was stable until 20 feet AGL, at which time the left wing dipped seven degrees. P1 initiated a rapid right lateral control input, which started a pilot-induced oscillation. P2 called a go-around, which was initiated by P1, but the right wing scraped the runway as they went around. Approach control advised the crew that sparks were reported coming off the aircraft's right wingtip on the go-around. The crew returned to home station, and a visual inspection found a damaged right wingtip. What can you say about this mishap? Is it crew procedure, bad luck, or bad pilot? You tell me.

Tail Hits First

The mishap occurred during a day transition and emergency procedures sortie conducted at an auxiliary field in an H-53 as a part of a formal training course. The crew included the instructor pilot (IP), instructor flight engineer, initial qualification student pilot (SP), student flight engineer, and mishap student instructor pilot (SIP). During the mishap sortie, the SP completed his training, and then started his transition and emergency procedures training. The mishap occurred three hours into the mission on the SIP's fifth emergency procedures approach. During an auto rotation, the SIP made errors that created an excessive sink rate and the IP failed to intervene in time. The tail rotor hit the ground, sending shrapnel into the aircraft that injured a crewman. When does the instructor step in? It has been a factor in many mishaps as the instructor is found to have let the student get too far before intervention. What are your teaching limits?

Another No-Gear Landing

The crew was number two of a three-ship night transition instructor upgrade mission. After the flight split-up in the local pattern, the crew entered the visual flight rules (VFR) pattern. On the third VFR pattern, the tower advised the crew that they were in front of traffic on a 15-mile final. A few moments later tower informed them they were in front of traffic on a 10-mile final. Neither call was acknowledged by the crew, but the crew turned base slightly early to sequence in front of the traffic. The crew made the normal gear down call, but failed to configure with gear and flaps. Tower advised the crew "appears negative landing light." The crew cycled the light switch and informed tower "appears our landing light has failed." The pilot in the rear cockpit was flying and rounded out for the flare approximately 1500 feet down the runway. The aircraft then floated in ground effect for approximately 3500 feet. The instructor pilot took control of the aircraft approximately 5000 feet down the runway, advanced the throttles to military power, and attempted to fly away from the ground. Shortly after the transfer of aircraft control, the aircraft scraped the runway for 985 feet, trailed sparks and dripped molten metal for approximately five seconds after lift-off. The IP flew an extended VFR pattern, coordinated a battle damage check with the flight lead and landed without further incident. What is your habit pattern for landing? Does it include checking to ensure the gear handle is in the down and locked position? It should, especially if the tower says they can't verify your landing light.

Runway Condition Is What?

The mission was uneventful from preflight through the en route portion of the flight. Shortly after the 20-minute warning (about 30 to 40 NM from the field, inbound), the copilot (CP) contacted the arrival base tower and got the current weather and airfield information. The crew was notified that there was a large hole on the runway south of taxiway echo with 5050 feet of landing runway available with a displaced threshold. The CP requested Runway 03 with AMP-2 covert lighting and the tower replied that they could accommodate, and asked them to report a three-mile final. At approximately seven to eight miles from the field, the crew visually detected what they believed to be the covert landing zone for the AMP-2 lighting requested.

As the aircraft got closer to the airfield, the crew also detected the rest of the runway lights. The landing zone and runway appeared to be marked with the same covert lighting. The crew noted at that time, that the landing zone appeared to be slightly offset to the left side of the runway, short of the primary landing surface, and there appeared to be no trailing strobe. These inadequacies in landing-zone markings did not concern the crew, due to the austere location. Continuing on the approach, the nav noted that the runway had a "patchwork" appearance on the IDS, which fit his expectations of a runway that had sustained battle damage and had been repaired numerous times. The different patches appeared as different shades of green on the IDS, but no depth information could be discerned from the image. At about five to 10 feet above the runway, the CP noticed a large hole in the runway but felt that the aircraft was going to pass above it, so he continued to scan further down the runway.

Just before touchdown the instructor pilot (IP) noticed a crater going under the nose of the aircraft and attempted to call a go-around, but was unable to reach his interphone switch in time, so the call was made off intercom in the cockpit. At the same moment, the CP noticed the same crater and attempted to assist the pilot in bringing the yolk back to avoid the hole. The pilot had also seen the hole and had already put in this correction. The nav had also noticed a wide colored band across the runway on the IDS picture at about that same time. The aircraft touched down with the right rear main landing gear in a construction hole in the displaced threshold approximately 1540 feet short of the primary landing surface.

When the right rear main landing gear tire impacted the construction hole, the tire blew and the landing gear strut partially separated from the aircraft. The pieces that separated subsequently damaged the right wheel well and single point refueling panel, and blew the right forward main tire. The crew stated they thought the landing felt normal except there was a loud bang and thump on the right side of the aircraft upon touchdown. The aircraft shuddered down the runway with what the crew felt was a flat right main gear tire. The tower notified the crew that sparks were coming from the rear gear area of the aircraft. The crew elected to shut down the No. 4 engine in ground stop due to the aircraft listing to the right and slowly brought the aircraft to a stop straight ahead on the runway. After inspecting the right main gear area, the crew elected to taxi the aircraft clear of the active runway to a safe area for shutdown and normal egress.

Do you know all the conditions for your area? One area addressed here was that the crew didn't have updated information on the status of the runway. Make sure you check everything, and if you are in charge of a runway, make sure the aircrew who land there know the "exact" condition of your runway.

Maintenance Matters

Editor's Note: The following accounts are from actual mishaps. They have been screened to prevent the release of privileged information.

It's time to look at my favorite aircraft, the wonderful A-10 Warthog. Unfortunately, Hog Keepers have their bad days, and have damaged a few aircraft when they didn't follow the procedures or pay attention to what was going on.

That Gap Is Normal

Three test cell personnel were performing a TF-34-100A engine run on a test stand in the hush house. During the run, a metal-covered test cable was ingested into the engine through a small gap between the engine inlet screen and the engine intake. External damage was visible to the engine fan blades only. After a complete teardown and inspection, several first stage fan blades were damaged and the outer shroud parts were nicked. No parts or pieces of the metal clad cord were ingested internally into the engine.

The true cause of this mishap is that the engine inlet screen does not remain tight against the front of an engine during maintenance runs. This small "gap" has been identified numerous times indicating a problem with the engine inlet screen. This gradually became accepted as "normal" operation instead of being identified as a problem with engine test stand. Tech data procedures were followed each time the inlet screen was installed. However, during each engine run the screen would be pushed away at high throttle settings and separate from the engine approximately 1-2 inches. The tech data does not state the need to continually ensure the screen stays against the engine. In addition to this "accepted practice," the crew took a shortcut as the test set cable was not long enough to allow for correct and safe routing of the cable through securing clamps and tiedowns, so it was not restrained during the engine run.

Who is to blame here, the system or the people? In my opinion both are to blame. Supervision knew of the problem and didn't fix it. The workers knew of the problem and accepted it. The team didn't apply appropriate risk assessment to their daily tasks. What else is out there that is accepted but shouldn't be?

TEMS Is Wrong, Not!

While in the local traffic pattern, a pilot initiated a planned go-around, at which time the No. 1 engine experienced a compressor stall and subsequent engine fire. The pilot accomplished appropriate critical action procedures and extinguished the fire. The pilot successfully completed a single-engine landing and egressed the mishap aircraft without injury.

Maintenance messed this one up. Engine technicians did not comply with tech data and classified actual turbine engine monitoring system (TEMS) hits for vibrations (code 36), which are grounding discrepancies, as nuisance hits a non-grounding discrepancy. In addition, the tech data the troops were using was missing a change which led the maintainers to falsely categorize the actual TEMS code 36 hit as a nuisance hit. What caused the actual TEMS hits, you night ask?

At an undetermined time, a lever arm on the second stage variable stator vane (VSV) broke and allowed the associated vane to operate independently of the other VSVs. The stalled engine actually experienced a total of seven actual TEMS 36 vibration hits on 13 prior missions, due to the third stage rotor blade vibrations. Before or during the mishap sortie, cracks developed at the base of the compressor blades as a result of high cycle fatigue. This all comes down to three things:

• How you take care of your tech data so you have the right information.

• How you interpret the information the systems provide you.

• How you, the worker, treat that information.

If you get information that says there is a problem, make sure you take all the required steps to ensure you have determined there is no problem and/or fixed the actual problem. It is easier to fix the small things than repair an entire engine.

Comedy Of Errors

An A-10 was launched as a weather ship to assess airspace conditions. If weather was sufficient, his wingman would launch, rejoin, and they would proceed on a local training sortie. However, the weather precluded tactical training and the aircraft proceeded single ship on an Advanced Handling Characteristics sortie. The mishap pilot performed several break-turn exercises, followed by two uneventful single-engine go procedures. On the third single-engine go exercise, the pilot received indications of high No. 1 (left) engine Inlet Turbine Temperature (ITT), generator failure, and hydraulic system failure. These indications are indicative of an engine failure. The pilot shut down the engine, requested assistance on the squadron common VHF frequency and coordinated a rejoin with another aircraft which was performing practice instrument approaches. The chase aircraft performed a battle damage check and assisted with checklist procedures and Fighter Resource Management. The pilot flew a single-engine approach and landed uneventfully.

Maintenance review of the Turbine Engine Monitoring System (TEMS) data pointed to a compressor stall as the initial cause of the mishap sequence. However, 52 days after the mishap, further review by the depot disregarded the compressor stall theory and pointed towards a flameout followed by a subsequent overtemp condition which caused the Class B damage. The unit shipped the mishap engine (ME) to the depot repair facility. Upon exterior inspection, three separate issues were found on the ME.

1. The B-nut securing the PS3 sensor to the top of the ME was found backed-off.

2. The canon plug connection between the T5 amp and the main fuel control (MFC) was discovered to be cross-threaded and apparently tightened with tools (against common maintenance practice of hand-tightening).

3. The MFC serial number did not match the serial number documented as being installed.

These three items, although separate in nature, proved to be directly related to the cause of this mishap. Interior engine inspection revealed significant damage to the engine aft of the combustion chamber. The HPT and LPT were completely destroyed along with the engine bearings and associated hardware parts as a result of severe overtemp conditions. Portions of the HPT had melted into molten metal and passed to the LPT and into the tailpipe causing extensive interior object damage (IOD). In addition, the outer seals on the LPT jammed as a result of the IOD and subsequently seized the engine.

TEMS data revealed the aircraft never flew in the engine disturbance envelope and the throttle was properly rigged. Investigation revealed no FOD or hardware failures occurred in the engine prior to the mishap sequence. However, lack of fuel was a factor. The fuel supply tested good post-mishap. The MFC was suspected as a cause during the compressor stall portion of the mishap investigation, and was PQDR'd. Analysis showed it was functioning as designed during the mishap sequence. In addition, the canon plug connects important signals from the T5 Amp to the MFC. However, post-mishap analysis proved the canon plug functioned despite its substandard connection. However, the loose PS3 B-nut found on the engine during disassembly contributes signals to the MFC, affecting fuel scheduling. Investigation revealed that a loose PS3 would have provided erroneous signals to the MFC, which would have caused a reduction in fuel flow to the engine below a level required for engine operation.

The investigation turned next to the cause of the overtemp sequence. The TF-34 maintains logic which, when the throttle is set at idle and the engine reduces core RPM below 56 percent, will automatically cause an auto-start attempt. This auto-start procedure would ignore the erroneous signals which caused the flameout and subsequently flood the combustion chamber with fuel to re-light the engine. This excessive flow of fuel caused the overtemp condition, which then caused the Class B category damage.

The key to the mishap remains highlighted by the undocumented MFC change. An MFC change would affect both the PS3 sensor B-nut and the T5 Amp canon plug connection. As mentioned earlier, both of these items were found and criticized for substandard maintenance practices (especially the canon plug). An MFC change would have forced the loosening (and hopefully, the re-tightening) of the PS3 B-nut. Also, the connection between the T5 amp and the MFC would have been loosened and re-tightened. However, it is impossible to investigate this change, since it was undocumented and could have occurred at anytime between the overhaul in 2000 and the mishap flight. There are no indications as to who, when, or why the MFC were switched between the ME and a second engine. Does this sound like quality maintenance? Not to me. We must document everything we do and follow the rules established to prevent mishaps.

USAF CLASS A FLIGHT MISHAPS

FY04 Flight Mishaps
(Oct 03-Sep 04)

26 Class A Mishaps
9 Fatalities
10 Aircraft Destroyed

FY03 Flight Mishaps
(Oct 02-Sep 03)

31 Class A Mishaps
10 Fatalities
22 Aircraft Destroyed

05 Oct		A C-17 had an engine failure (upgraded to Class A).
09 Oct		A KC-135E experienced a No. 3 engine fire.
14 Oct	✈	A T-38 crashed during takeoff.
20 Oct	✶	An F-22 engine suffered FOD damage during a test cell run.
17 Nov		A KC-10 experienced a destroyed engine.
18 Nov	✈	An A-10 crashed during a training mission.
23 Nov	✈	An MH-53 crashed during a mission. Four AF crewmembers were killed.
11 Dec	✶	An RQ-1 crashed after it experienced a software anomaly.
30 Dec	✶	A C-5 engine had damage from a compressor stall during a test cell run.
31 Jan		A KC-10 experienced an engine failure.
03 Feb		An E-4B had an engine failure inflight.
04 Feb		A C-5B had a right main landing gear failure.
25 Feb	✈	An A-10 crashed after takeoff. The pilot did not survive.
27 Feb		A B-1B departed the runway during landing .
02 Mar	✶	An F-15 engine was damaged by FOD during a maintenance run.
03 Apr	✈	A T-6 crashed on takeoff. Both pilots were killed.
29 Apr		A C-130 landing gear collapsed during landing.
05 May		An MH-53 experienced a lightning strike (upgraded from Class B).
06 May	✈	An F-15 was destroyed after it suffered a bird strike.
08 May		A C-5B had an engine failure inflight.
17 May	✈✈	Two F-16s had a midair collision, one pilot was killed.
21 May	✈	An F-15 crashed during a sortie; pilot ejected safely.
24 May		A C-5B scraped its tail on landing (upgraded from Class B).
06 Jun		A C-17 suffered engine damage inflight.
12 Jun		An A-10 suffered an engine fire.
14 Jun	✈✶	An MQ-1 crashed on landing.
18 Jun	✈	An F-15 suffered a double engine failure; pilot ejected safely.
10 Jul		An F-16C departed prepared surface during landing.
11 Jul		An MC-130P experienced multiple bird strikes.
18 Jul	✶	A C-17 maintainer was fatally injured during flight control maintenance.

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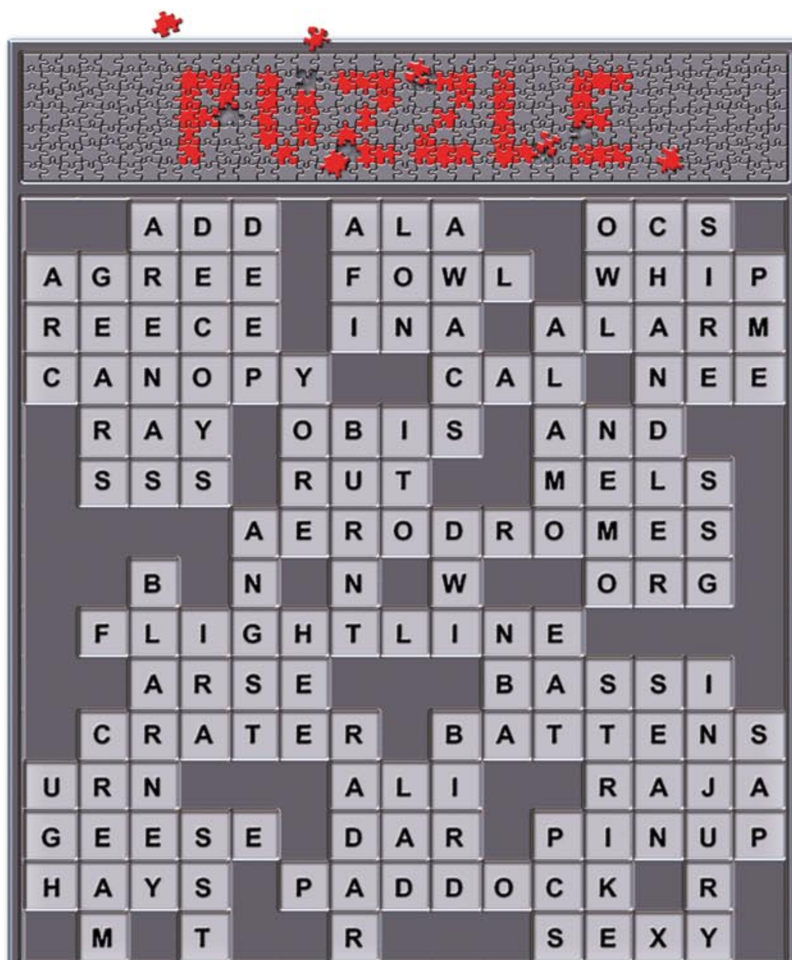
17 Aug ✈✶ An MQ-1 had an engine fire and crashed.
24 Aug ✶ A C-17 experienced engine-confined FOD damage.
08 Sep A C-17A suffered an engine fire on final approach.
28 Sep An F-22 experienced an over-G in the positive and negative regimes.

- A Class A mishap is defined as one where there is loss of life, injury resulting in permanent total disability, destruction of an AF aircraft, and/or property damage/loss exceeding $1 million.
- These Class A mishap descriptions have been sanitized to protect privilege.
- Unless otherwise stated, all crewmembers successfully ejected/egressed from their aircraft.
- Reflects only USAF military fatalities.
- "✈" Denotes a destroyed aircraft.
- "✶" Denotes a Class A mishap that is of the "non-rate producer" variety. Per AFI 91-204 criteria, only those mishaps categorized as "Flight Mishaps" are used in determining overall Flight Mishap Rates. Non-rate producers include the Class A "Flight-Related," "Flight-Unmanned Vehicle," and "Ground" mishaps that are shown here for information purposes.
- Flight and ground safety statistics are updated frequently and may be viewed at the following web address: http://afsafety.af.mil/AFSC/RDBMS/Flight/stats/statspage.html.
- **Current as of 30 Sep 04**.

Solution to puzzle on page 25




"Hey Darwin,"
"...we have three more candidates!"
USAF
Shown here sitting atop the tail of a C-5 Galaxy, enjoying the show some 60 feet above the ground.