Flightfax

ARMY AVIATION RISK-MANAGEMENT INFORMATION
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U.S. ARMY COMBAT READINESS CENTER

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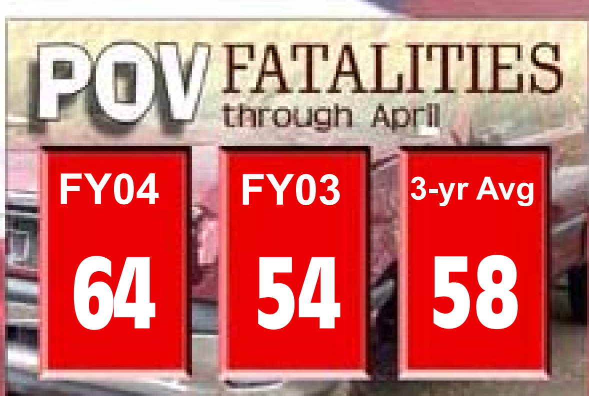

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JOSEPH A. SMITH
Brigadier General, U.S. Army
Commanding

POWER MANAGEMENT...

Why is it still an issue?

CW4 Dennis
Donald Fox,
McDougall,
CW4

Time and time again, we read an article in *Flightfax* about aircraft accidents that involve lack of sufficient power to complete a maneuver. With today's complex, modern, and dual engine aircraft, you would think this would not be an issue. However, with demanding operational environments such as Afghanistan and Iraq, our aircraft and aircrews are being pushed to the limit.

To address the issue of power management, we must understand how we got here. During the Vietnam era, all Army aircraft were single engine and operated at or near maximum gross weight. Pilots had to learn to adapt to complete the mission and return the aircraft and crew home safely. This operational environment gave individuals an increased awareness of their abilities and their aircraft in relation to operational requirements.

As aviation technology evolved, newer, bigger, and stronger airframes like the UH-60 and AH-64 were developed. We now have the ability to carry more weight, fly farther and faster, all the while maintaining a more comfortable power margin than we previously had known. Even with improvements in engines in all our advanced aircraft, aviators continue to crash aircraft due to not understanding power issues. Why?

Current missions place aircraft in an operational environment where the margin between power required and power available is narrowed to the point that sometimes the mission cannot be accomplished. This is where a failure in training becomes an issue. It is not a mystery why aircraft are not staying airborne, that is simply a law of physics and gravity. It is the pilot's failure to recognize, understand, or manage the power that *is* available.

With modern aircraft, the gap between power required to accomplish a training mission and power available has become an ever-increasing margin. Instead of a few percent of torque, we regularly have as much as 30 to 40 percent between power required and power available. This has allowed us to become complacent during training where power is concerned. As a result of this complacency, we have accepted a standard of using this extra power to give us a false sense of security. "What's an extra 5 to 10 percent, among friends, as long as I landed in the general area?" When was the last time you predicted the amount of power you were going to use on an approach to a specific point, actually used that power, and landed at that exact point? When was the last time you critiqued your performance as a crew after completing this approach? Did you shoot the approach at, below, or above the predicted power required? Why?

A "post-task analysis," a term coined by the High-Altitude Aviation Training Site (HAATS) in Eagle, CO, can answer these questions and assist you in changing your behavior toward more efficient performance. By adopting the HAATS power management system, failures to perform to a higher standard are identified from the perspective of situational awareness. This gives us the ability to effect positive change in the cockpit and save aircraft and lives.

What is situational awareness? Multiple thoughts on the definition exist in the aviation community. HAATS has defined it as "the ability to accurately predict." (See HAATS' article in this issue of *Flightfax*.) In the case of power, we need to be able to "predict" how much is available, how much is required, when it is required, and how much time is required for a particular amount to be effective. This will increase our situational awareness about power and what affects power. Combining situational awareness and power management allows us the ability to predict how much power we will use for takeoff, landing, in-ground effect and out-of-ground effect hover, crosswind or downwind flight conditions, climbs, turns, etc. This increase in situational awareness provides us the ability to continue risk mitigation during the mission.

We all understand that our operational environments will be extreme. Further, we have to understand that we will always have a demand for carrying larger loads and more ammunition, thereby increasing our risk. How do we allow ourselves the ability to mitigate these risks from the cockpit?

First, we have to address how we train. We have all heard the phrase "train as you fight." Training involves the use of tools; one of these tools is the torque gauge. HAATS developed power management training and the use of the four-torque reference system (*Flightfax* June 2003). In this system, the torque gauge becomes an objective standard for all maneuvers. Because few units have the option of loading an aircraft up to max gross weight for training flights, another method becomes necessary. Thanks to the Power Management Training System, we can simulate this maximum gross weight condition by using predicted power as our power limit to conduct all maneuvers. If we are cognizant of power during all aspects of training, then it will not be an issue when power actually is limited. This method of training will be most effective only if we incorporate these ideas and techniques in Flight School XXI (the schoolhouse environment) up through the most senior aviators and leaders. Junior aviators must embrace this training not only because they are going to continue to see combat in a short time after completion of flight school, but because this method will continue to save lives and prevent aircraft accidents in peacetime.

In as much as warrant officers are the technical experts, we must influence changes of how we train and enforce a higher standard in how we do business. Because of the non-linear operational environment and continuously changing conditions, we must develop the ability to analyze and mitigate risk on short notice from the cockpit. Knowledge of the aircraft, the pilot, and the ever-changing environment gives us an advantage in identifying hazards. With increased situational awareness through power management, we will have the ability to perform cockpit risk management while in the mission profile. The time is now for change in the Army Aviation community, and we can make it happen. After all, the life you save could be your own. ♦

—This article was written by CW5 Fox, CW5 Lindgren, CW5 McDougall, CW4 Banks, CW4 Coates, and CW4 Wojtala as a class project while attending Warrant Officer Senior Staff Course 05-03 at Fort Rucker, AL.

HAATS

HIGH-ALTITUDE ARMY AVIATION TRAINING SITE

The Case For Precision In Training

CW5 Michael A. Moore
HAATS, COARNG

For nearly 20 years, the High-altitude Army Aviation Training Site (HAATS) has been an advocate of a unique training program known as power management. Essentially, this program uses power to quantify maneuvers, the environment, aircraft requirements and capabilities, as well as to evaluate pilot awareness and understanding. Our power management techniques provide the ability to conduct comparative analysis of maneuvers, pilot opinions, and control inputs using the torque indicating system. The student is able to observe the realities of his understanding and beliefs as well as aircraft capabilities in an objective and safe manner. Profound insights are gained in an objective, efficient, yet controlled method. Gone are the days when these insights had to be gained through surviving an unforeseen, hazardous event where chance is often the judge of the result. This program, HAATS Power Management Mountain Training, revolves around the idea of *precision*—precise perceptions, thought, speech, and actions—and promotes its usage throughout aviation but particularly training.

In the final analysis, power and controllability are all that really matter to a helicopter pilot. When they are available in excessive amounts, as they are in most habit-forming training flights at sea level with light aircraft weights, the need for high levels of pilot awareness, insights, and finesse are nearly irrelevant. An empty helicopter is akin to the old joke inquiring as to where an 800-pound gorilla can sit … a pilot can do almost anything in a light aircraft without consequence. This reality has insidious consequences upon deployment. It is insidious in that the habit-forming, day-to-day routine of training at low weights and altitudes forms and reinforces the psychology, awareness, and finesse of our *own* 800-pound gorilla. The substantial consequences of this type of training are written in the history of our deployments. As a matter of course, our deployments have demanded high-gross weight operations in extreme environmental conditions as the norm rather than the exception. The number of aircraft lost or damaged in a given theatre of operations, particularly in the first months, is evidence of the lack of the pertinent pilot awareness levels and skills when confronting requirements that are *known to exist* in typical deployments. The obvious solution to this issue is to determine the composition of a quality training program that addresses *deployment* needs, compare the findings to current training, amend as necessary, and execute it. A good place to start is in looking at the issue of habit formation.

To ignore the lessons of our experiences is, as we know, to continue to invite repeated failures.

The imperatives of combat, enemy threat, high multi-tasking, and high, hot, and heavy aircraft operations create a stress level that has a significant impact on our perceptive field. As time available to assess and execute diminishes, our perceptive field narrows, cognitive functions diminish, and responses become more reflexive, with the resultant behavior, decisions, actions, and consequences reflecting the quality of our training experience. This is one of the great truths in all human educational experiences. To ignore the lessons of our experiences is, as we know, to continue to invite repeated failures. If high-weight demands and extreme environmental conditions are a fundamental reality upon deployment, it is imperative that we identify what awareness levels and execution skills are necessary for operating an aircraft routinely with little or no margin of error and make them part of our everyday, habit-forming existence. How can our training regimens reflect the known need? First and foremost is to demand precise, quantifiable standards in the execution of flight maneuvers. This can be accomplished, as you might have guessed, through the use of power as the standard. The following diagram (Fig. 1) conceptualizes a precision approach. The relationship of airspeed to power is seen to require a continuous proration throughout the approach—as airspeed decreases, power increases proportionately or the angle will change. It is understood that the aircraft will be in the same continuous rate of deceleration from the moment the angle is intercepted regardless of the speed at which interception occurs. The references to loss of main and tail rotor effective translational lift, transverse flow shudder, and pitch-up of the fuselage are intended to acknowledge aerodynamic events that will occur during the approach for which anticipation and compensation by the pilot is required to maintain angle and heading. If executing to a pinnacle or ridge (as depicted in Fig. 1) using a rifle sight to maintain the angle, under or over arcing is detected instantaneously. However regardless of the type of approach, at detection of under or over arcing, the pilot should note airspeed, power, and *distance remaining*—one or both of speed and power is incorrect for the distance remaining. Subsequent approaches will determine what the correct combination should be. *The most important external visual reference to be refined in this approach (or any other) is the distance remaining to termination.* This is particularly critical as so many of our operational environments have missing or offer

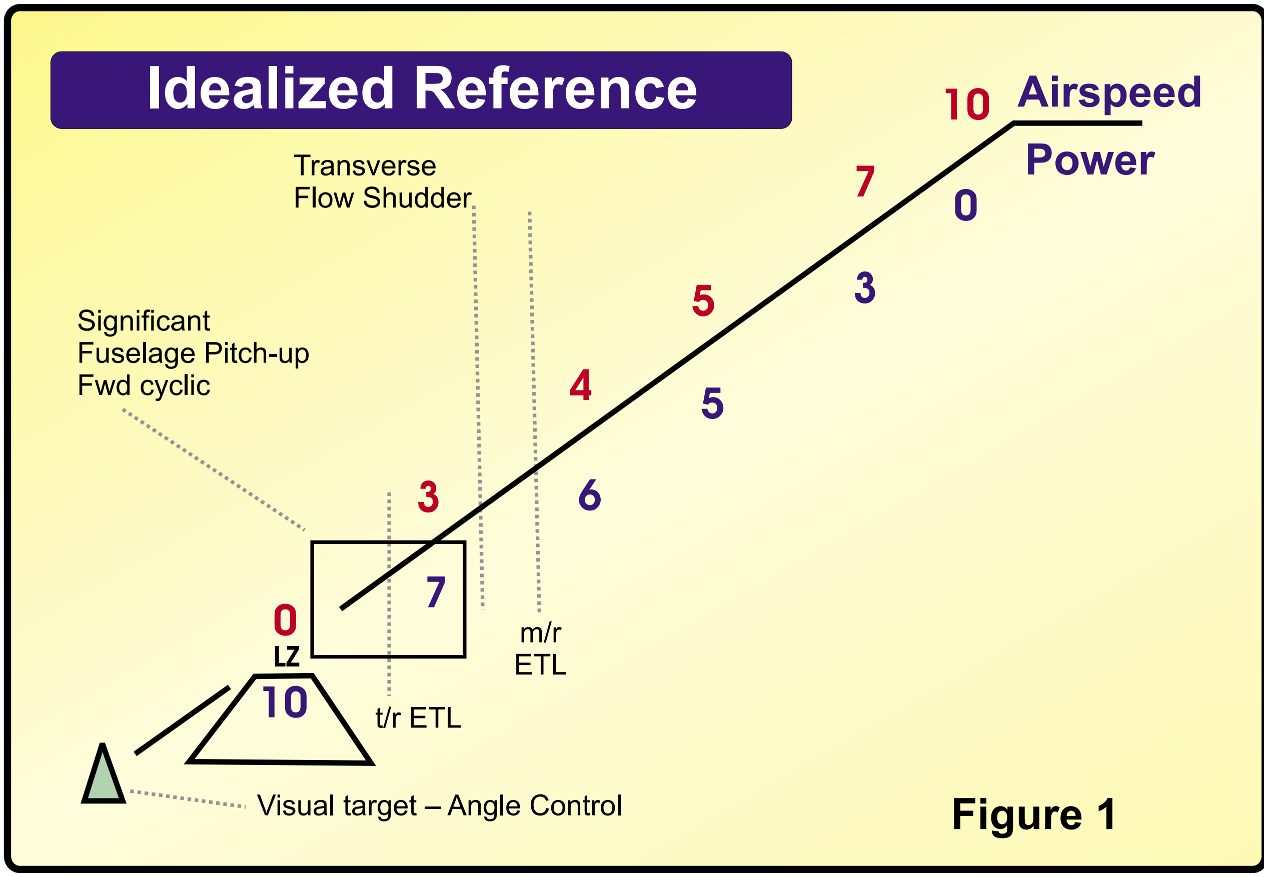

Figure 1

distorted vertical and lateral cues. The ATM tells us *when* to go around but does not tell us upon *what* the decision should be based. The above process provides the answer to that question—in the distance remaining I can or cannot arrest the vertical or horizontal speed applied with the power available. The correct combinations of airspeed and power as well as the location of each aerodynamic event are to be retained in the pilot's memory for future reference. Understanding the components of a precision approach, coupled with knowing the power required, allows the pilot to conduct an efficient and effective analysis of his understanding and execution of the maneuver upon termination.

A pilot should not only know how much power is available for a maneuver but also *how much* is required, *when* it is required, and how much *time* must be available for a *limited* amount of power to accomplish a given end. A pilot should be able to accurately *predict* the necessary power, control, and timing required to land, takeoff, accelerate, decelerate, climb, descend, and turn. This isn't an exercise conducted prior to takeoff such as a performance planning card (PPC), but rather a determination and prediction preceding *every* maneuver. When *every* maneuver is followed by either a formal or informal analysis of the results *vis-a-vis* power, the above questions can be answered. Comparing both power *predicted* and power *expended* to what is actually *required* provides the necessary insights to environmental and execution issues. Execution errors fall in the following categories: horizontal speed too fast or slow, vertical speed too fast, power applied too late, or the aerodynamic issues in Fig. 1 were not anticipated requiring reactive overcontrolling. Focusing on power in every maneuver breeds the necessary habits and awareness required for the current deployments and those to come.

Let's analyze an ordinary task, VMC Approach, taken from TC 1-237 *UH-60A/L ATM*, as an example of how one could dramatically improve the relevant learning experience using more precise standards simply by adding a few words. The second standard requires the crew to "ensure that sufficient power is available for the type of approach/landing desired." This standard could be significantly improved by also demanding that the crew correctly predict the *required* power as well. As noted, in order to accurately predict the required power, one must possess substantial awareness of those things that affect power (DA, weight, wind, surface issues, aerodynamics, control inputs, control timing—variables going well beyond a PPC), as well as the *degree* to which they affect power. Power management techniques accomplish these goals quickly.

The seventh standard, "Perform a smooth and controlled termination to a hover or touchdown to the surface," evaluates the termination phase of the approach but is actually counterproductive. This standard truly belongs in the category of "unintended consequences." It has been our observation that the vast majority of pilots achieve this standard by slowing horizontal speed early and using power indiscriminately. When power and control are limited, horizontal speed control is critical. Possessing the above *habit* is deadly. When the desired angle is maintained, the correct amount of power is used (typically that power required to hover at a desired height or smoothly contact the surface without rolling), and the correct power is used at the correct *time* (action, sequence, and timing), "a smooth controlled termination" is a *by-product* of the more precise standards. Having a single standard for termination rather than four (correct power, correct timing, constant angle, full-stop) is the equivalent of conducting GPS navigation while only receiving one satellite. Slowing down early and/or using power indiscriminately to achieve the current standard has established incorrect ground speed cues for the actual required speed demanded by precision execution. When precision execution is demanded due to limited power and control, limited space, adverse environmental conditions, or abrupt changes in conditions, all previous landings at lower standards have left most pilots ill prepared. It is easy to see, when power is critical, how a pilot might slow to his usual speed, fall through, droop the rotor, and crash short of his destination. Accident synopses are rife with this scenario and its variants. They needn't be. It is our obligation to provide aircrews training *equal* to the demands we know they will face. Quantifiable, precise standards are an essential starting point. ♦

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BROWNOUT ON THE BATTLEFIELD

CW3 Patrick Quinton (Team Leader), CW4 Christopher Suddarth, CW4 Ui Chong,
CW3 Stephen Bandeira, CW3 John S. Carlson, and CW3 Guillermo Soto
WOSC 05-04/05

We were on a typical mission in Afghanistan; however, the conditions were not favorable. Moon illumination was zero, and it stayed that way the rest of the night. In that part of the world, it's dark! Everything was going as briefed with the reconnaissance party inbound mirroring what we saw during planning. We could barely make out the landing zone (LZ), but fortunately we identified our objective and started the approach. At about 30 feet above ground level (AGL), we browned out. One of the crew chiefs said, "Hold your down!" I had already transitioned inside the cockpit to my hover instrumentation and was able to hold a steady hover around 10 feet until the dust cleared. There wasn't much room for error in this particular LZ, with compounds on the right and higher terrain to the left. We landed the aircraft after repositioning and completed the mission without fouling the entire objective area. This success was possible only because of the equipment installed on the aircraft—namely, hover symbology.

Deliberate air assault missions are challenging entire crews during operational rotations in Afghanistan and in Iraq, with dust landings being the norm. Unlike resupply missions to established firebases, deliberate air assaults have LZs in unimproved areas. It is not uncommon to land on dirt roads, open dry areas, or on dusty mountain peaks. It is also not unusual to find yourself flying *without* the benefit of hover symbology specific equipment, such as the Brownout Situational Awareness Upgrade (BSAU) system profiled in the October 2004 issue of *Flightfax*. Unlike the situation in the introductory paragraph, most pilots must rely upon improvised tactics, techniques, and procedures (TTPs) to minimize the potentially catastrophic results of landings made under brownout conditions.

In the past 5 years, there have been 11 Class A, B, and C aviation accidents involving Chinook aircraft with brownouts being the trigger event. These mishaps have resulted in 16 non-fatal injuries and equipment damage costs in excess of $37 million. Ten of the eleven aircraft were not equipped with a symbology system usable during brownout conditions. The current aviation equipment upgrade policy relies on

pilot-specialized training and experience levels, coupled with lessons-learned improvisation, to minimize the potential negative consequences of landing in brownout conditions.

The successful outcome of any maneuver is predicated upon aircraft control. That control is enhanced through visual cues. The preferred method is to keep the dust cloud behind the pilot's door before landing so the pilot always has a clear view of the LZ, thus maintaining aircraft control. A roll-on landing can accomplish this and is the current preferred course of action. Environmental factors such as wind and surface conditions, along with aircraft gross weight, approach angle, aircraft formations, and enemy situation, are factors to be considered when selecting the airspeed and rate of descent to maintain aircraft control.

A control measure to minimize brownout accidents is vigorous roll-on landing training. Standardization and instructor pilots of units rotating out are heavily involved in the process of training up their incoming counterparts in theater. Another control measure is to "stack the deck" on goggle flights. During day air assault missions, use a door gunner from another platoon in the company and, at night, always use non-rated crewmembers in the back to aid in clearing the aircraft and man the guns.

You will encounter dust

in the CENTCOM areas of operation. While the majority of takeoffs and landings are in hard-surface areas, there will be many occasions when you will have to take off and land on unimproved areas. This trend undoubtedly will continue and expand as the Global War on Terrorism progresses over the coming years, predominantly in Third World areas like Africa and Southwest Asia with topographical and climatic conditions that cause brownout.

When landing at areas other than hard-surface airfields or familiar areas, we can accomplish roll-on landings using TTPs to keep the dust cloud behind us. However, this will not always be the case. If the tactical situation or the ground commander requires it, and the current intelligence supports landing to a narrowly specific area—we must be prepared to plan accordingly.

The Chinook is being used in the assault role more and more, which means possibly landing in smaller LZs. The objective also could have a vast area to put multiple helicopters in, but the terrain might not allow a roll-on landing. Prepare to "stick" a landing because you do not want the ground force to cover more terrain than they must. If you are in a dust cloud at 30 feet AGL, do you continue or go around? This will be a sporty maneuver, but you should have a plan to help this approach end successfully. Hover symbology is not a crutch; it is a tool to help mitigate risk during a dust landing. A properly trained pilot will transition inside to the hover page only when he can no longer maintain visual reference.

Integration of the hover flight symbology in the BSAU should not be limited to only brownout. BSAU will enable flight crews to fly a precise hover not only in brownout and whiteout conditions, but also in situations where pilots have limited references. Examples would be hovering in fog and over terrain such as water or a pinnacle where the pilots have no reference because the terrain drops off abruptly behind the crew's field of view. Reducing the workload in any aspect of flight will enable the flight crew to concentrate on and more readily react to unexpected situations, including emergencies or enemy engagement.

The Army has aircraft in their inventory that have BSAU-type technology that provides flight symbology to the aircrew, but the MH-47D and E are the only Chinook models currently configured. All aircraft will kick up dust, but the Chinook produces the largest dust because of the size of its rotor system and its weight. The Chinook is not only the workhorse of the fleet, but it is often the platform of choice due to its size and lift capability, as well as its ability to operate at higher altitudes. If any aircraft could benefit from having hover symbology to assist in a tight situation, it would be the Chinook. The cost is estimated at approximately $100,000 per aircraft.

The aforementioned policy of relying upon TTPs and experience while fulfilling a short-term requirement to expeditiously address a serious problem, nevertheless, possesses inherent risks that include the following: periodic structural damage and long-term wear on aircraft attributable to frequent roll-on landings; the possible consequences of landings in soft, rocky, or wadi-infested terrain using a roll-on; tactical considerations of small or channelized LZs; and the consequences of the constant drain of roll-on experienced senior aviators from the force over the coming years. The Army's needs and requirements must be, and always are, delicately balanced against funding and resource availability. It is our hope that an objective quantitative analysis of the facts outlined above will lead to the decision to fund and integrate the BSAU during the next fiscal year. ♦

—This article was written by CW4 Suddarth, CW4 Chong, CW3 Quinton, CW3 Bandeira, CW3 Carlson, and CW3 Soto as a class project while attending Warrant Officer Staff Course 05-04/05 at Fort Rucker, AL.

Valuable Lesson in Power Management

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Every person who flies Army aircraft will at some point ask himself, "Do I have what it takes to deal with that 'Ahhhh sh@#$!' situation when it happens?" Some people might go their whole flying career without answering that question; but most will have a "There I was" story to share with our fellow aviators. Sometimes these stories are in the spotlight for all to see; other times you'll only hear about them when you buy that old guy the next round. But they all have two things in common: they are all tales of how a crew came together to handle a critical situation and lived to fly again, and they all have lessons that can be passed on. In keeping with Army tradition, here is one of those stories.

There I was, left seat in the Cobra, inverted, Air Medals dangling in my face. We were pulling so many G's that we were now in the H's! Seriously, I was flying a Huey on what turned out to be the last REFORGER in Germany. We were Chalk 4 in a 6-ship mission. Every aircraft in the formation was loaded to the gills, max gross weight for the environmental conditions.

As we departed the landing zone (LZ) in our pre-briefed, straight trail formation, my copilot (on the controls) did not stay at the desired altitude with the aircraft directly in front of us. We began settling with power shortly after we went through effective translational lift (ETL). We were heading for the tree line about ¼ mile in front of our flight path at about 40 knots indicated airspeed. I failed to maintain situational awareness, trusting the sandbag in the other seat could handle the takeoff.

Suddenly I heard a call from the aircraft behind us on our family FM frequency, "What are you guys doing?" As I looked up outside the aircraft and saw us approaching the trees, I grabbed the controls and immediately turned left to exit the downwash of Chalk 3. Simultaneously, I adjusted collective to max torque available and we gained just enough altitude to clear the treetops. Later, in the mission after-action review, several aircrew members in the flight commented they knew they were witnessing an accident. I admit my "pucker factor" was a little bit high initially, but through the excellent training provided by my previous IPs, I knew how to react to the situation. I feel the other members of my crew learned a valuable lesson in power management that day also.

Considering most of my flight time has been in single engine aircraft, I have a lot of respect for power management. I still find myself doing minimum power maneuvers in the UH-60. Knowing I have additional power available is a good thing, but if I don't need it I don't use it. Unfortunately, I have more stories related to the topic, but I'll save them for a different time. ♦

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Investigators' Forum

Written by accident investigators to provide major lessons learned from recent centralized accident investigations

Three Seconds to Disaster

Situational awareness is fundamental to maintaining aircraft control. However, sometimes an event, activity, object, or person inside or outside the aircraft takes our attention away from flying the aircraft. We may become distracted from flying in response to a lower priority demand such as answering radio traffic, moving an object, adjusting a control, or by fixating on a target. To maintain situational awareness, we must rely on continuous scanning and good cockpit teamwork.

On a clear, calm, and sunny day, the AH-64D crew's mission appeared simple, straightforward and routine. As part of their preparation for deployment into the area of operations, the crew was to conduct daytime practice running fire attacks and complete functions checks on the 30mm chain gun and aerial rocket systems.

After validating the gun, the crew proceeded to conduct three similar running attack fire engagements. The first was a dry-fire engagement for range familiarization and the next two were live-fire engagements. The crew began each run by flying off-axis to the targets. Before crossing the range start-fire line the pilot in command (PC), who was occupying the back seat, initiated a turning cyclic climb or "bump" to gain altitude, lose airspeed, and then orient the target. With the aircraft inbound to the target area, the copilot gunner (CPG) acquired the target with the target acquisition and designation system (TADS) and the PC fired two salvos of rockets. To complete the attack, the CPG suppressed the target area with three 10-round bursts of 30mm to cover the aircraft as the PC executed an egress turn.

On the third and final run, the PC bled off more airspeed on the "bump" than he had on the previous runs. Consequently the aircraft closed faster on the targets, giving the crew less time to shoot and safe the armament systems before their egress turn. The PC entered the final egress turn to the right at 370 feet above ground level (AGL) and 104 knots, faster than the two previous turns, and entered at 77 and 96 knots, respectively. The turn lasted 7 seconds before the aircraft impacted the ground.

What happened?

Mission data recorder information revealed during the first two seconds of the turn, the

PC's head was oriented to the right and in the direction of turn. During the next 3 seconds, the PC turned his head to the left to observe and actuate the ARM/SAFE button to safe the armament system. With neither crewmember monitoring the flight profile, the aircraft entered a 15-degree dive at a 2,500-foot per minute (FPM) rate of descent, increasing the bank angle from 30 to 60 degrees. Two seconds before impact, the PC turned his head back to the right in the direction of the turn and announced to the CPG, "You're safe," referring to the ARM/SAFE button. One second before impact the aircraft's audio warning system announced "ALTITUDE LOW," which signaled a descent below 100 feet, the minimum warning altitude set by the crew.

Unfortunately, the warning came too late because their rate of decent was now 3,900 FPM. The PC reacted to the impending ground impact by pulling the cyclic aft, but he failed to increase collective to arrest the decent. The accident investigation board suspects the PC was unable to make a collective application because his left hand had not returned from the ARM/SAFE button to the collective. The aircraft impacted the ground at 134 knots in a nose-down, 26-degree right bank. The CPG suffered fatal injuries, the PC experienced critical injuries, and the aircraft was totally destroyed.

The accident investigation board determined this accident was a result of inadequate scanning, failure to properly direct attention outside the aircraft, and improper application of aircrew coordination elements and basic qualities.

Lessons learned

Crew coordination qualities and principles, as stated in our aircrew training manuals, could have prevented this accident. The PC could have *directly assisted* the PI to action the ARM/SAFE switch or he could have transferred the flight controls. He also could have *announced his actions* to the PI by using the standard phrase "I'm inside." The PI, recognizing the turn, could have ensured the workload was equitably distributed by *offering assistance* to assume aircraft controls, clear the aircraft's turn, or direct his attention outside the aircraft. With the PC's attention focused on the aircraft controls, the PI could have assisted him by providing aircraft control and obstacle advisories regarding airspeed, altitude, or obstacle avoidance.

Conclusion

The AH-64D is arguably one of the most demanding cockpit workload intensive aircraft in the Army's inventory. The proliferation of new technologies and complex missions and systems will continue to inundate us with potential distractions. However, we must not redirect our attention and make the distractions a priority. It's okay to miss a radio call or delay resetting the transponder. When flying, maintain situational awareness by ensuring proper crew coordination and scanning. As demonstrated in this accident, it took just 3 short seconds to lose situational awareness.

Digitized aircraft and demanding flight environments require crew members to continually process and analyze an increasing load of competing mission tasks. As we attempt to juggle these tasks, we can be lured into taking shortcuts or do more than we are capable. Crew members must *always* identify and prioritize competing mission tasks and never ignore flight safety and other high–priority tasks. The bottom line is **we need to hold to the standards and give priority to those tasks that are essential to safe flight**.

—Comments regarding this accident may be directed to the Accident Investigation Division at the U.S. Army Combat Readiness Center, DSN 558-9552 (334-255-9552).

Using Peripheral Vision Restricting Devices for Instrument Training

Arthur Estrada
USAARL

For decades, civilian and military flight instructors have used peripheral vision restricting devices (PVRDs) to enhance instrument flight training being performed during periods of visual meteorological conditions (VMC). In fact, most Army fixed- and rotary-wing aircrew training manuals (excluding those of the Apache and Kiowa aircraft) specifically require the use of a PVRD when performing an instrument task in VMC as a condition of the flight task. If you're like most pilots, wearing a PVRD is not very popular.

In addition to limiting a pilot's view only to the primary flight instruments, PVRDs also cause the artificial exclusion of the full cockpit environment; i.e., overhead switches and gauges, and those on the center and opposite-pilot side of the instrument panel. If a pilot wishes to view the center console or instruments in the center of the instrument panel, the limited PVRD field of view requires turning the head, which then blocks the view of the flight instruments. These restrictions and loss of peripheral information and spatial orientation can, and do, cause adverse physiological and psychological effects on some pilots. An informal survey of 121 Army helicopter pilots by the U.S. Army Aeromedical Research Laboratory (USAARL) discovered that 51 percent (62 out of 121) reported at least one adverse effect (table below). Some reported multiple effects.

Instructor pilots teach the basic fundamentals that learning is strengthened when accompanied by a pleasant or satisfying experience, and that learning is weakened when associated with an unpleasant feeling (the Law of Effect). A consequence of such adverse effects may be the triggering of defense mechanisms which hinder effective training and can result in poor flight performance.

According to the results of the informal survey, there is no *standard* device used by Army Aviators, although five devices were identified as being used (two types of hoods, a visor sticker, Foggles®, and a DA Form 2408-12). Visits to pilot-supply stores and an internet search for PVRDs indicate that the devices (minus the paper form) identified in the survey were representative of those commercially available (manufacturer variations were minor). Basically, there are hoods, which extend outward from the forehead or helmet; partially frosted glasses, which are worn on the face; and a plastic sheet, which is attached onto a helmet visor.

Note that the USAARL does not recommend the use of a DA Form 2408-12. The fields of view are dependent on how far the card is pushed up into the visor protector.

USAARL PVRD Study

In an effort to identify the most preferred PVRD (presumably, because it minimizes the adverse effects and serves as the best training aid relative to the others) among those devices reportedly used by the survey population, USAARL conducted a study during which participants performed instrument flight tasks while wearing three different types of PVRDs: the hood, Foggles®, and a visor sticker, and then rated each.

Uneasiness	Despair	Distraction	Nausea	Claustrophobia	Loss of Situational Awareness	Spatial Disorientation	Miscellaneous Negative Effects	No Negative Effects	Did not answer
18	6	10	7	9	16	35	9	48	11
15%	5%	8%	6%	7%	13%	29%	7%	40%	9%

Figure 1. Hood

Figure 2. Foggles®

Figure 3. Visor sticker

Figure 4. Novel Hood
(note the "side window")

The hood that was used (Figure 1) is the one that's available through the government supply system (National Stock Number 8415-01-394-8453). It is made by the Gentex Corporation and snaps onto the HGU-56/P helmet.

The Foggles® used (Figure 2) were those used locally. Although available in different colors, white shading with clear lenses was selected for the study.

The visor sticker used during the study (Figure 3) was the device used by 61 percent of the surveyed population.

Study results

The hood was easily identifiable as the least favored overall. It received generally poor performance appraisals and caused a relatively sizeable number of reported adverse effects, including loss of situational awareness and spatial disorientation. At a cost per unit of $52.40, it is hard to justify its continued procurement and use.

The Foggles® received "worst" ratings in both the field-of-view and comfort categories. Additionally, the Foggles® produced a noteworthy number of adverse effects including four reports of considerable distraction. Selected as the last choice by one-third of the participants, the Foggles® have a tendency to break the helmet ear seals of those wearing them. They run approximately $20 dollars a pair.

The results of the study indicated that the most preferred device among those readily available for use by aviators appears to be the visor sticker. The device received "best" ratings in comfort and ease of use/application and second place in field-of-view. Its cost of about $3 per device adds to its favorability. USAARL suggests using a visor sticker that is at least 2 inches wide from top to bottom.

USAARL has explored new PVRD options, such as adding side "windows" to the standard hood allowing cockpit-side peripheral vision (Figure 4). In other words, a pilot seated on the left side of the aircraft and viewing his/her flight instruments can open the right "window" allowing a scan of aircraft system instruments and/or the center console. Opening this area for viewing decreased some of the reported negative effects such as claustrophobia.

Until other options become available, USAARL recommends the visor sticker as the best current choice for use during instrument training. The complete technical report, *"A Comparison Study of Peripheral Vision-Restricting Devices Used for Instrument Training,"* USAARL Technical Report No. 2005-06, is available at the USAARL Science Information Center or online at **http://www.usaarl.army.mil/** under *Technical Reports*. ♦

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CORROSION
Prevention and Control

In 2002, the Center for Army Analysis published the results of a study on corrosion and its effect on Army readiness. This study revealed that corrosion has the greatest impact on the airframe, rotor system, and ground support equipment. During 1998-2004, Army Aviation averaged $45 million annually to repair damage from corrosion. This cost does not reflect the man hours expended to effect these repairs.

Corrosion repairs fall into the category of "unscheduled maintenance" which directly affects mission readiness. It is estimated that 40-60 percent of corrosion is preventable; taking the time up front for good corrosion prevention practices, like proper preservation of steel hardware attached to magnesium components when performing maintenance will save man hours and component replacement costs in the long run.

Bad Preservation

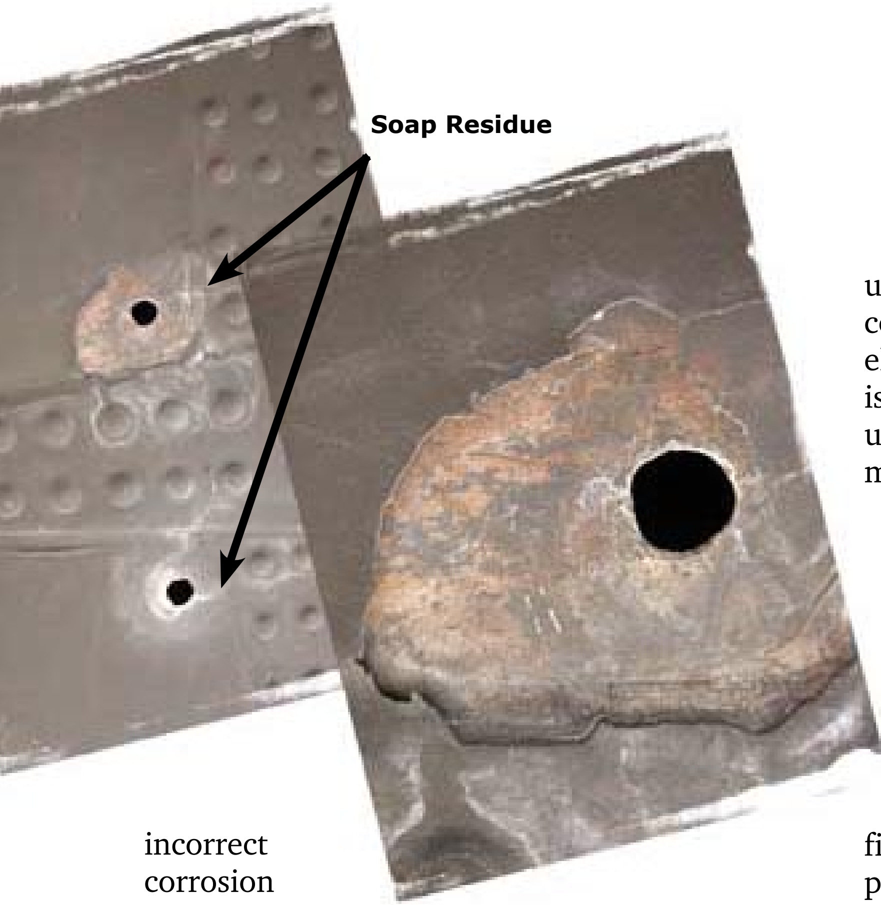
Good Preservation

What is corrosion?

Simply stated it's the metal's reaction to the environment, causing it to breakdown to its basic elements. On steel it's commonly known as red oxide or **RUST**. On aluminum and magnesium it's seen as white to grey powdery deposits.

How can corrosion be minimized?

Keeping the aircraft and equipment clean is a vital step. Scheduled aircraft washes remove sand, grime, and other contaminants. When the aircraft are washed it is very important to ensure all the soap is rinsed away. Dried soap can be very damaging to protective paint systems. The moisture in the air and overnight dew will reactivate the soap which begins to attack the paint, softening it and exposing the base metal. Performing detailed corrosion inspections to identify



incorrect corrosion prevention measures before significant corrosion occurs is a very important element of prevention. The time it takes to touch up damaged paint or replace seals and sealant is small in comparison to the time it takes to change a main transmission or replace corroded fasteners.

Because most corrosion begins on the surface, maintaining paint finishes on aircraft skin and hardware is vital to achieving the maximum service life from our aircraft. (A break in the paint coating is similar to a wound on your skin. If it's ignored, the metal surface is left open to attack.) Application of corrosion preventive compounds (CPCs) provides a temporary barrier between the base metal and contaminants. Their effectiveness cannot be overemphasized. They are simple to apply and widely available in the supply system.

MIL-C-81309 Type II: Displaces water; provides short-term corrosion protection of painted or unpainted metal surfaces during shipment, storage, and in-service use; corrosion protection of moving parts where some lubrication is required, such as hinge areas, bomb racks, and sliding parts. Can also be used as a waterless cleaner.

MIL-C-81309 Type III: All the same uses as Type II with the additional benefit of corrosion protection for avionic equipment, electrical connector plugs, and contact pins. It is the only authorized compound that can be used inside cannon plugs to clean and provide a measure of protection.

MIL-DTL-85054 (Formerly MIL-C-85054): Corrosion protection and water displacement for nonmoving parts, such as skin seams, installed fastener heads, access panel edges, and areas with damaged paint.

Corrosion preventive efforts in a sandy/desert environment present some specific problems. While dry environments are generally not conducive to corrosion; loose, fine sand, particularly with high sodium content presents not only abrasive (erosion) issues, but sets up equipment for future corrosion damage. Foamers are an excellent addition to the arsenal of cleaning tools available. They use less soap to create a foaming solution (much like the scrubby bubble bathroom cleaners) capable of clinging to vertical surfaces to soften and dislodge soils. They are preferred to pressure washers. Many are available commercially through various approved vendors and are listed in appendix B of TM 1-1500-344-23 *Aircraft Weapons Systems Cleaning And Corrosion Control Manual*.

Aircraft maintenance procedures can be tailored to the operational environment. In the absence of specific maintenance instructions, common sense must prevail. Any specific questions or concerns regarding corrosion issues should be referred to the Corrosion Prevention and Control Center of Excellence.

Editor's note: This article does not replace guidance in the specific technical manuals (TM) or standard operating procedures (SOP). Always check the TM and SOP prior to conducting maintenance for any changes. ♦

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Accident Briefs

Information based on preliminary reports of aircraft accidents

AH-64

D Model

■ **Class A (Damage)**: While initiating a left turn, the crew allowed the airspeed to decrease to zero. The aircraft leveled prior to descent into soft terrain.

■ **Class C**: During gunnery the crew experienced a suspected low-order detonation of a round in the bore of the 30mm gun during running fire.

■ **Class C**: Aircraft experienced a No. 1 engine overspeed on takeoff from a refuel point.

CH-47

D Model

■ **Class A**: Aircraft crashed when it reportedly encountered sand/dust conditions. No survivors were reported.

■ **Class C**: Damage (crack) was discovered on the trailing edge of an aft rotor blade while the aircraft was parked and moored. Maintenance assumed the damage happened during flight.

■ **Class E**: After a normal engine start sequence, aircraft was in the process of running up to flight idle speed when the No. 2 REV light came on. Both engines were shut down, but during the shutdown sequence the No. 2 engine PTIT increased to 400 degrees C. The No. 2 engine was motored until PTIT dropped below 200 degrees C. When the start switch was released, PTIT again climbed to 400 degrees. Again the engine was motored until PTIT was below 200 degrees. Again the PTIT began to rise, so the No. 2 fire pull handle was pulled and the FE confirmed the fuel valve was shut off. The engine was again motored to below 200 degrees C. This time there was no increase in PTIT. Late report.

■ **Class E**: No. 1 engine fire light illuminated during cruise flight. The FE confirmed there was no fire. The crew cancelled IFR, descended, and landed at the airport without further incident. Inspection revealed a broken fire detector sensing element on the No. 1 engine. Maintenance replaced the element and released the aircraft for flight. Late report.

■ **Class E**: The crew had performed several dust landings in the vicinity of the range and returned to home base. While taxiing, the pilot felt something dragging and dispatched a crewmember to take a look. The crewmember could not find anything wrong with the aircraft. After taxi and shutdown, another crewmember discovered the front outboard wheel was broken and the tire was busted. The commander and maintenance personnel were notified immediately. The aircraft was repaired and returned to service. Late report.

■ **Class E**: Loud whining and grinding noises were heard coming from the forward transmission area during flight. The aircraft was landed and shut down. The No. 1 flight hydraulic pump failed. DART was launched with parts, and the aircraft was repaired and flown back to home base. Late report.

■ **Class E**: When the pilot actioned the gun and rockets, the OIL BYP UTIL HYD caution light illuminated. The crew broke formation and returned to the airfield, where the crew chief reset the impending bypass button on the filter. Aircraft took off again and, after 2.0 hours of flight, the pilot actioned the gun and rockets and the light illuminated again. The crew flew back to the airfield and exchanged aircraft. The hydraulic pump was replaced. Late report.

EH-60

A Model

■ **Class C**: While conducting a hovering turn during a 15-foot AGL hover, the crew felt a vibration coming from the rear of the aircraft. The crew hovered the aircraft approximately 60 meters away from its original hovering location. When they turned to look at the area where they had been hovering, they realized they had struck a tree. The aircraft landed and was shut down without further damage. Inspection revealed damage to all tail rotor blades and the stabilator. Late report.

OH-58

A Model

■ **Class C**: Aircraft struck wires in flight. The WSPS functioned as designed, but the wire struck and damaged the windshield and frame. The pilot suffered a small laceration and was treated and released.

DR Model

■ **Class A (Damage)**: The crew was on a single-ship training mission conducting RL progression. The aircraft landed hard during straight-in autorotation with power recovery. An installation accident investigation is ongoing.

■ **Class C**: During termination of a manual throttle run on landing approach, the engine experienced an NP overspeed of 119.32 for 3 sec. This was the third event for this engine, which will require a turbine section replacement. The crew (SP/IP) was conducting refresher training IAW the troop SOP. Late report.

UH-60

A Model

■ **Class A (Damage)**: While at a 30-foot hover, the aircraft began to yaw and spin around the vertical axis. Aircraft impacted the ground in an upright position.

■ **Class C**: Aircraft was Chalk 2 in a flight of three conducting VMC approach. Aircraft settled with power and landed hard. The lower WSPS broke, and the right M/L/G was slightly deformed.

■ **Class C**: Aircraft experienced tail rotor gearbox damage when it was started with low gearbox oil pressure.

L Model

■ **Class C**: Aircraft was participating in air assault training and landed hard. Post-flight inspection revealed damage to the FLIR turret ball.

■ **Class E**: After engine start, the PC advanced the PCL to fly and observed the No. 2 engine TGT indicating 69 degrees C at flat pitch. The engine indication was significantly higher than the No. 1 engine. The aircraft was shut down without further incident. The signal data converter was replaced, and the aircraft was released for flight. Late report.

C-12

T Model

■ **Class E**: A vibration was felt in the pedals on rollout after landing. Upon shutdown, the crew found the front tire was flat. Late report.

U Model

■ **Class B**: Aircraft was climbing to 10,000 feet in IMC conditions and experienced a lightning strike. Damage to the radome ARC-210 was found upon landing.

EO-5B

■ **Class C**: Aircraft suffered a suspected lightning strike during flight. Residual problems with the instrumentation were reported.

RQ-11A

Raven Model

■ **Class C**: Aerial vehicle (AV) experienced a GPS failure, and remote control was lost. AV has not been recovered.

■ **Class C**: AV reportedly lost altitude in flight and failed to respond to control input. AV crash-landed on major roadway.

RQ-1L

■ **Class A**: AV was airborne at 6,000 to 7,000 feet AGL when data link with the ground control station was lost. AV entered an inverted spin and impacted the ground. AV was destroyed by post-crash fire.

RQ-5A

■ **Class C**: AV experienced dual engine failure during controller shift due to suspected improper control box configuration.

RQ-7A

■ **Class B**: Shortly after launch, electrical voltage dropped below the required 24 volts. AV initiated return to launch/recovery site, but all communications with the AV were lost.

■ **Class B**: AV deployment chute did not deploy. AV subsequently crashed during recovery descent. AV has not been recovered.

■ **Class C**: AV experienced loss of engine power 5 minutes into flight. The launch crew experienced no prior indications of engine start or run irregularities.

■ **Class C**: AV crashed approximately 25 feet after the launch sequence.

■ **Class C**: AV veered off the runway on touchdown for landing. The main landing gear separated when the AV contacted the ground.

RQ-7B

■ **Class B**: AV experienced generator failure and engine shutdown while in flight and subsequently crashed.

■ **Class C**: The recovery controller reported engine failure following handoff from the forward controller. The recovery chute was launched, but the AV landed inverted.

■ **Class C**: AV experienced uncommanded deployment of the recovery chute during flight and was damaged upon landing.

■ **Class C**: AV demonstrated uncommanded flight attitude, altitude, and airspeed during flight. The operator deployed the recovery chute.

■ **Class C**: AV operator reported engine failure while the AV was in level flight. AV descended into trees and suffered wing and tail damage.

Editor's note: Information published in this section is based on preliminary mishap reports submitted by units and is subject to change. For more information on selected accident briefs, call DSN 558-9552 (334-255-9552) or DSN 558-3410 (334-255-3410).

WORKING AROUND AIRCRAFT REQUIRES EXTRA CARE

The plane had been taxied to the ramp where the wings overhung the taxiway. While preflighting the aircraft the FO had to walk into a ditch, and as he was coming back up he walked into the wing. The static wick (on Citation jets, they're a solid, straight metal-type) penetrated his eye socket 3-1/4 inches, but luckily broke off the aircraft before going any further. When they X-rayed his skull, the wick was found to be only ¼-inch from his brain. They extracted the static wick with no damage to the eye itself. The lesson learned is: Don't allow yourself to be distracted around aircraft.

—CW4 Dirk Markestein, ASO, 6th Battalion, 52nd Aviation Regiment, Los Alamitos, CA, DSN 972-1089 (562-795-1089)

Photos compliments of SARGENT.MEANS@ANDREWS.AF.MIL

Note: These pictures were posted by the pilot on his company's Web site in hopes of helping to prevent another accident.