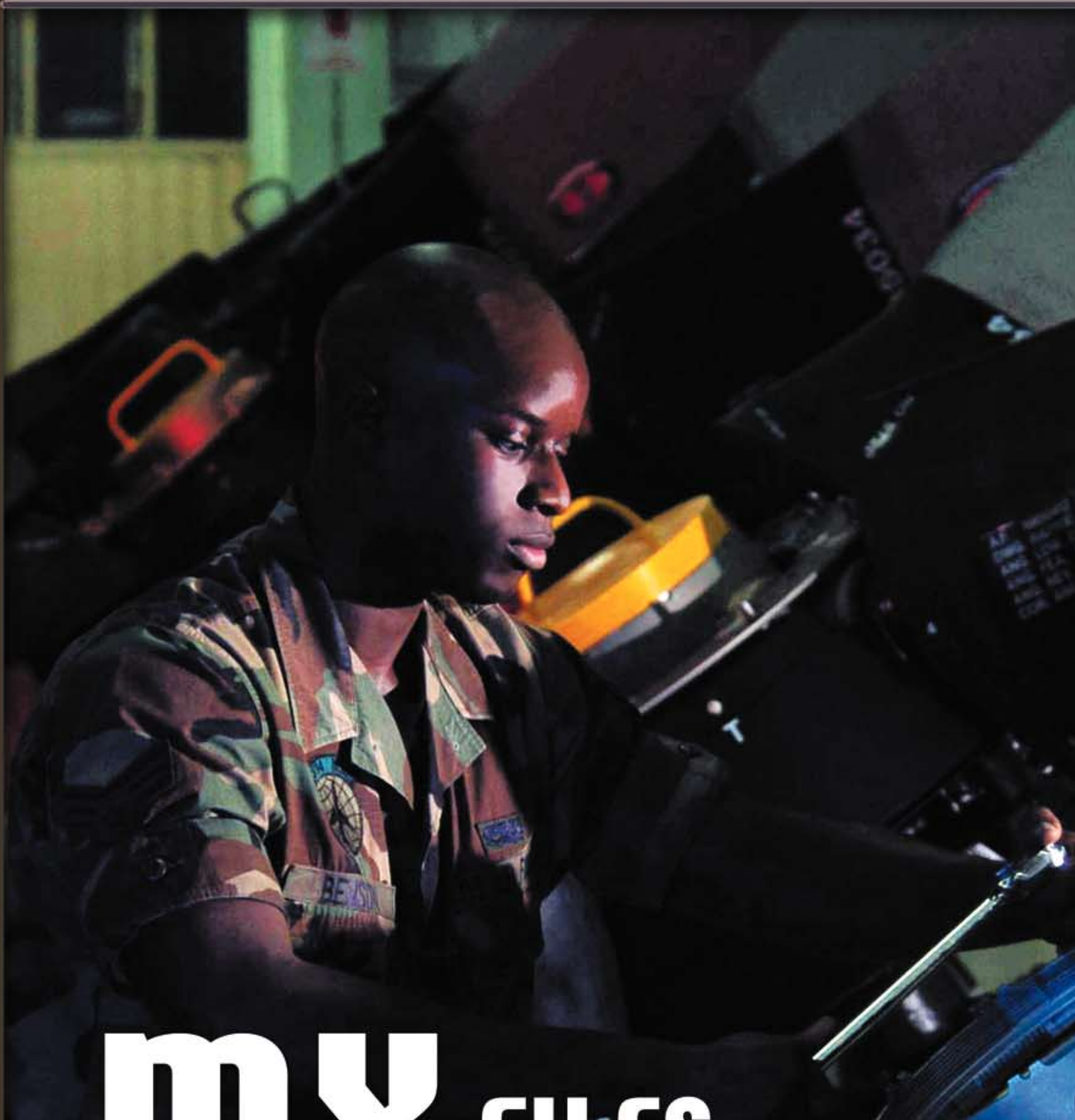
UNITED STATES AIR FORCE

FSM

AUG 2004

FLYING SAFETY MAGAZINE



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FLYING SAFETY MAGAZINE

AIR FORCE RECURRING PUBLICATION 91-1

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SAFETY SAGE

AIRCRAFT TOWING MISHAPS

AFOSH Std 91-100 in Para 2.1 states: "When properly accomplished, aircraft towing is not a hazardous operation. However, the potential for damage and (or) injury if a mishap occurs is high."

If this is the case, why have we had six *reported* towing mishaps so far in FY04? We have had one Class B, four Class C, and one Class E mishap. Towing is supposed to be a routine and easy task. Unfortunately, we have let complacency, bad supervision, failure to follow tech order, and bad choices damage our aircraft and add work to our busy schedules. We have damaged:

1. A C-5 nose gear when the tow crew exceeded tow bar limits.
2. A C-32 when the rudder hit the hangar.
3. A KC-135 when the vertical stabilizer and nose radome struck the hangar.
4. An MQ-1 when the tow bar failed.
5. An MC-130H when it hit a safety harness cable that wasn't removed and the supervisor didn't notice.
6. An F-16 when it hit a clear water vertical structure.

Maybe on your next safety or training day or just a regular day, you can review with everyone the towing rules for your location along with the AFOSH requirements. If you haven't taken a look at your potential towing hazards, here is a great ORM exercise. If you need any information or help for the training day, start with your wing safety office. In addition, you can always contact me here at the Safety Center, DSN 246-0972 or Jeffery.Moening@kirtland.af.mil.

If you need to know what rules apply, here are a few:

- AFI 21-101, *Aerospace Equipment Maintenance Management*
- AFI 11-218, *Aircraft Operations and Movement on the Ground*
- AFOSH 91-100, *Aircraft Flightline—Ground Operations and Activities*

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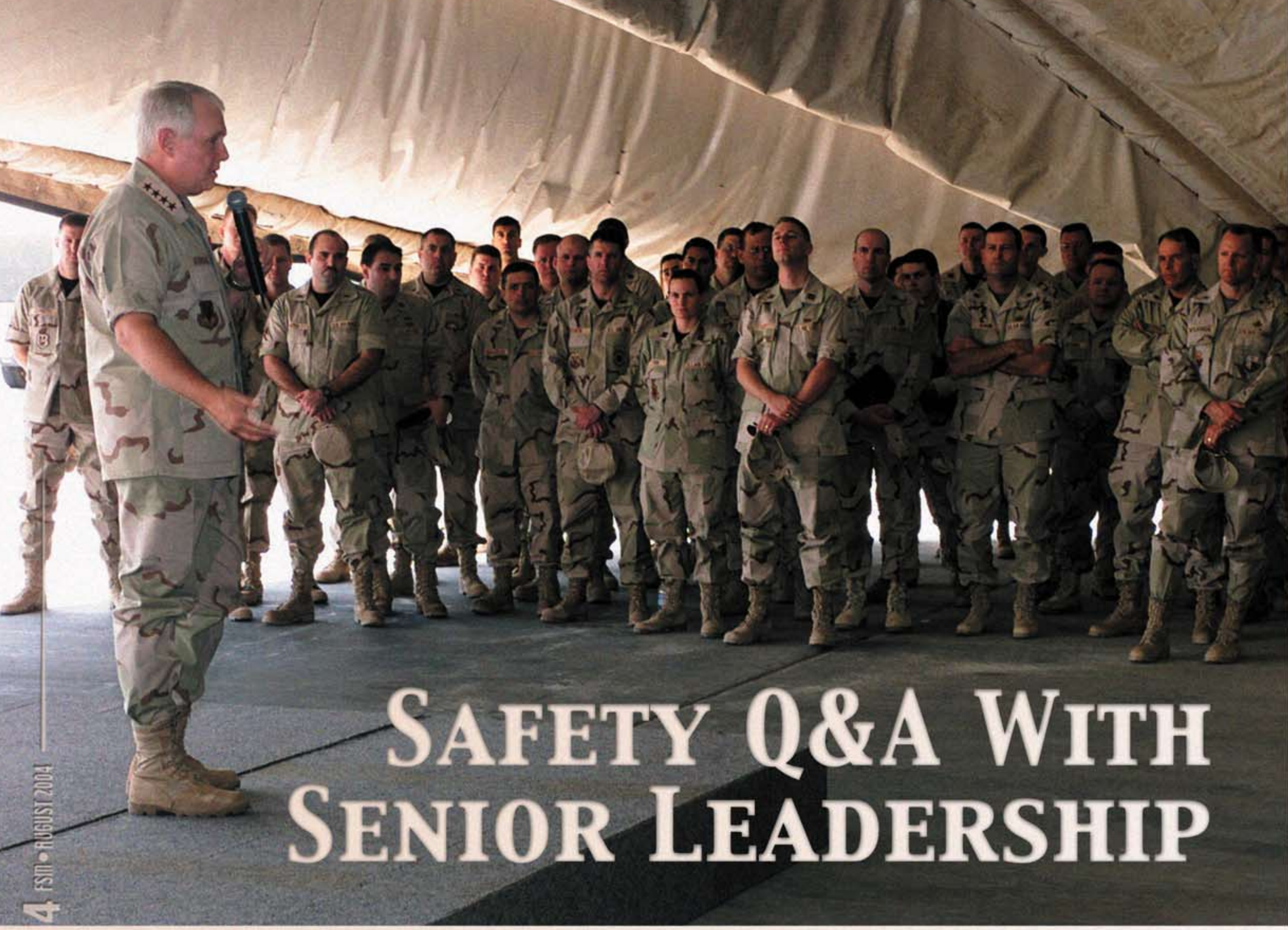


Safety Q&A With Senior Leadership

USAF Photo by SSgt Timothy Cook

GENERAL HAL M. HORNBURG
Commander, Air Combat Command

FSM: As ACC commander, what are your priorities as far as improving our safety efforts?

People are ACC's No. 1 asset. The loss of even a single individual has a tangible impact on morale, our readiness and war fighting capability. Thus, our ultimate goal is to have zero mishaps.

In May 2003, Defense Secretary Rumsfeld challenged us to reduce our mishap rate by 50%. We're currently well on our way toward achieving this reduction by focusing on three key safety areas: leadership, training, and accountability. ACC leaders know they can't accomplish the mission without taking care of their people. Ensuring the safest possible work environment, the use of personal protective gear, and adherence to proper procedures is a primary function of all my commanders. Likewise, precursory and recurring job skills training lays out the right path Airmen must follow to meet the challenges of the mission without endangering themselves or others. We've had notable success reducing some mishap categories by reviewing how we train and continuously assessing and improving training program syllabi. While leadership and training are fundamental, an equally important priority is accountability. Just like the first two, accountability applies across all three safety disciplines—flight, ground and weapons. Being accountable for our actions, both on and off duty, is crucial. Most of us recognize our actions have consequences. Accountability simply means being willing to accept those potential consequences—good or bad. Most ACC Airmen are mature beyond their age. Yet, on-the-job pressures and off-duty activities often cause some to momentarily let their guard down. Like terrorism, there are ever-present threats in each of our lives—from the seemingly routine act of driving to and from work to effectively employing multi-million dollar aircraft in combat. Only a very small percentage of our personnel work in safety offices. Yet, I expect everyone in ACC to be a safety officer. Safety is a way of life in ACC. It's a cornerstone of our culture. It is an attitude and a force multiplier. In sum, safety is our combat edge.

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

In two words: be accountable. Despite a positive trend since the start of this fiscal year, aircrew error remains the leading cause of aviation mishaps. We, as leaders, continually emphasize adherence to training rules, mastery of the basics and flight discipline. A tool that finely complements leadership, training and accountability is Operational Risk Management (ORM). Command-wide integration of ORM into daily decision making has paid off. ORM checklists help quantify qualitative operational and human factor considerations. That allows clear vectoring of responsibility for accepting risk to appropriate leadership levels. It also formalizes a process for all of our warriors to regularly identify and control risks. Throughout the calendar year, ACC dedicates flying hour program days to Flight Leadership, Realistic Training Reviews, and other flying safety special interest items. Our aviators regularly receive ACC Safety Grams and vignettes of lessons learned from previous mishaps. Despite the popular myth, flying is not inherently unsafe. However, aviation is especially unforgiving of arrogance, ignorance and complacency. That's why leadership, training, and personal and professional accountability are so vital.

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

Newspapers and insurance companies all tell us there's been a nationwide increase in two- and four-wheel POV accidents. While no less troubling, it's no surprise ACC and Air Force statistics reflect this negative trend. Factors such as speed, alcohol, inexperience, nighttime and failure to wear seat belts often combine to worsen the severity of damage and injuries. Personal Risk Management (PRM) decisions not to speed, not to drink and drive, not to press your limits and to always buckle up will improve our POV safety record in all off-duty activities.

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

Our warriors are very mission focused. This does not mean their safety focus is reduced. On the contrary, safety mishap rates for our deployed personnel are consistently lower than those who are at their home stations either reconstituting from or regenerating for their AEF taskings. We deployed and continue to send seasoned flight, weapons and ground safety experts to all overseas bases. They perform their duties as an additional set of eyes and ears for the commander and remain vigilant for early indicators of potential hazards that may arise in the deployment environment. Overall, I'm very proud of our safety record at deployed locations. While many present unique challenges, our success is clearly indicative that safety is instilled in a balanced spirit of "mission first, people always."

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?

We have and maintain the finest expeditionary combat support structure in the Air Force. None of our aviators would ever turn a wheel in combat unless our combat support teams first turn a wrench, an arming pin, a key or even an omelet. Our people know, all too well, the stresses of sustaining around-the-clock combat operations from austere locations while enduring extreme climates. Yet, they keep the jets flying, load the weapons, secure the base perimeter and make living conditions suitable. By doing so, they also keep the unique and inherent flexibility of airpower alive. I salute their dedication and sacrifice, and pledge my personal interest in their safety.

USAF Photo by Lawrence R. Crespo

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

The supervisor's role is critical. While safety starts with the individual, we must look after each other. I urge each commander, leader, supervisor or friend to do all they can to ensure safety remains the highest priority. In particular, direct supervisors are in the best position to see and know all of their subordinates—their behaviors, habits, motivators and interests. Who better to counsel them? Based on feedback from ACC-wide video-teleconference (VTC) briefings, I directed fatality briefings be incorporated into the ACC's squadron commanders' course. We commend practices such as First Sergeant's Safety Notes and insist the entire leadership chain prepare for the annual "101 Critical Days of Summer" campaign. I encourage everyone to read *Flying Safety*, and also ACC's *The Combat Edge* safety magazine. Use them as a springboard to discuss your own safety issues and concerns. They're full of safety stories and lessons learned the hard way—from personal experience.

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

As I said before, ORM and PRM must be second nature for all of our people, all of the time. A primary tenet of ORM is to reject unnecessary risks. In ACC, we've condensed the six-step ORM process down to three basics known as "A-C-T": assess, control and take action. If we reject unnecessary risks and be aware of and mitigate unavoidable hazards, we will continue to significantly reduce the chances of being unpleasantly surprised by situations where none of the alternatives offer particularly desirable outcomes. I'm so convinced ORM is worthwhile that I've made formal ORM training mandatory for all ACC commanders and supervisors. Still, accountability is imperative.

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

As in other major commands, automobile and motorcycle accidents are the leading off-duty safety issue. Not only as the ACC commander, but as a husband, father and grandfather, I'm dismayed by the all-too-frequent combination of factors such as speed, alcohol, inexperience, darkness and failure to wear seat belts. As members of the ACC team, it starts with our own behavior. Next, we've got to adopt the corporate safety focus found in roll calls, Airmen Against Drunk Driving, motorcycle mentorship and "Click It or Ticket" campaigns. Working together as a team, we can break the chain of events that lead to many tragedies.

FSM: When you have completed your tour as ACC commander, what would you like to have accomplished?

Safety is about people and resource protection and preservation. In that vein, it would've been ideal to not have received a ground fatality briefing or a Class A flight mishap briefing on my watch, but that wasn't and isn't the case. Our goal—like CSAF's goal—is zero mishaps. Every ACC team member is irreplaceable and we must do all we can to ensure we don't lose another Airman to a preventable tragedy. The defense of our nation depends on each of us, so it's imperative we put leadership, training and accountability at the forefront of our safety sight picture. ★★★★

USAF Photo bt A1C Joshua P. Strang

The 4 Horsemen of Landing Gear Apocalypse!

USAF Photos
Photo Illustration by Dan Harman

DOUG WISER
Deputy, Landing Gear Commodity Council

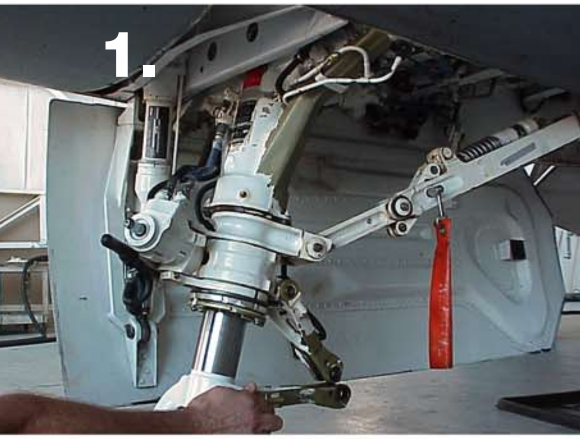
The Ogden ALC landing gear product engineering team has an unofficial motto: *"We hold up the Air Force."* Our small team of system engineers is responsible for the design and performance of most USAF landing gear systems. If you have a landing gear problem, odds are several engineers at Hill AFB have been burning the midnight oil working on it.

Landing gear systems can be a very challenging business. A quick review of the second to last page of any recent *Flying Safety* magazine will reveal how challenging. Historically, roughly 20 percent of all non-pilot error mishaps are landing gear-related. In our team of 16 engineers, five lead engineers and one chief engineer, we have advised or served over 100 Class A and/or Class B safety mishap investigations.

Accordingly, we have an unofficial warning that we pound into the skulls of every new landing gear engineer: *"Beware the Four Horsemen of Landing Gear Apocalypse."* These unpredictable killers are: Hydrogen Embrittlement, Burns, Stress Corrosion Cracking (SCC), and Fatigue. Common and routine maintenance work can invite one of these horsemen into your landing gear!

Most modern landing gear structures are designed from very high-strength, low-alloy steels. The most common alloy is 300M, which can be heat treated to 280,000 PSI tensile strength. At this level, 300M has a 40 percent strength to weight advantage over 7000 series aluminum. This strength level is higher than virtually any other structural metallic alloy on earth (Titanium alloys wimp out at around 180,000 PSI, but are much lighter). Steel is also very stiff and cheap, with fairly common manufacturing processes. Accordingly, landing gear designers looking for a light, cheap, manufactureable material that will make the smallest possible structure love 300M…We hate it! Along with this great strength come subtle, but serious environmental shortcomings. The ultra-high strength steels are quite vulnerable to three of the four horsemen.

Looking at the landing gear components depicted in photos 1 and 2, which do you think concerns the typical landing gear engineer the most? If you chose photo 1, you are mistaken! A typical OO-ALC-trained engineer will look at the part and think: *"Which item is most likely to have been cleaned excessively or with unauthorized fluids?"* Why? The most dangerous horseman is Hydrogen Embrittlement (HE). HE is a phenomena where atomic hydrogen atoms permeate the metallic structure, and disrupt the molecular bonds that give the alloy its strength and toughness. If sufficient hydrogen infuses, the material loses virtually all ability to withstand damage: the part may fracture into pieces just sitting on your workbench. The infused hydrogen *is not detectable* with any non-destructive instrument. If the hydrogen is not forced out of the steel (by heat) within a very short number of hours, it will form metal-hydride bonds that cannot be dissolved without melting the part. Once embrittled, no test/inspection will detect its presence, and you are in a very short race against time to prevent irreversible damage. In short, HE leads to sudden, undetectable, unpredictable failure of your landing gear. Photo 3 illustrates a typical HE failure. This F-16 main landing gear (MLG) failed in flight, with no external loads applied. Lucky circumstances upon the resulting emergency landing prevented a Class A mishap.



What causes HE in high-strength steel landing gear parts? How about, every @&# thing! Here's a short list: Water (tap and di-ionized), most cleaners on earth (except a tiny handful), rust strippers, every electroplating solution, hoof and mouth disease disinfectants, soft drinks, etc., etc. When steel landing gear parts are exposed to any fluid except authorized cleaning fluids (such as P-D-680), our engineers are programmed to suspect HE and react accordingly.

During routine depot repair, many operations are embrittling. Great care is taken to ensure any such process is followed by a 23-hour, 375° F. bake within the prescribed time window. Our landing gear depot facility is designed with process controls aimed precisely at this requirement. Several are computer-controlled and monitored, so no human error can accidentally bypass the required processes. In addition, we run test coupons continually to test our solutions and processes for HE (photo 4). It's a daily, hourly, constant battle; one that has been lost occasionally (power failures cause a missed bake that may lead to condemnation of vital and expensive components). In the early 1990's, every F-XYZ aircraft at base ABC was grounded for about a week due to HE of wheel tie bolts. An overzealous wheel shop troop found that dipping high strength steel wheel tie bolts in rust stripper sure cleaned them up nice and shiny! Shortly thereafter, several dozen bolts were failing on aircraft and in the inflation cage. The USAF has suffered fatalities due to tie bolt failures; but we were lucky that time. A quick grounding of several dozen aircraft and replacement of all suspect bolts solved the crisis. The suspect bolts were easy to identify; they were all brilliantly shiny!

For Organizational and Intermediate level maintenance, how do you prevent HE in your landing gear? The answer is simple: Do not allow embrittling fluids to come into contact with the bare steel material! Our primary defense is the barrier coatings we apply to the steel components: chrome and nickel plating, and paint. If the HE-inducing fluid does not touch the steel, it cannot embrittle it. Go back to the two photos. The component in photo 1 is the one most likely to have been embrittled. It appears to have been power washed aggressively enough to remove paint. It is likely that water and/or aqueous cleaner has been applied. The bare steel areas have almost certainly been exposed to embrittling fluids. Was it enough to pump hydrogen into the part? Did sufficient hydrogen infuse the steel to cause trouble? What exactly did he mean when he used the word *"undetectable"*? The typical landing gear engineer has all these things bouncing around his brain while remembering that HE has caused Class A mishaps, and has killed people…the risk is very real.

The other defense is to ensure the only fluids that touch the bare steel are approved, non-embrittling fluids. All hydraulic fluids are safe, as were most of the now-banned low-VOC solvents (drats!). Use only those cleaners as approved in your specific landing gear technical order (T.O.), or the general strut T.O. 4S-1-182. AF drawing 9825019 lists approved low-embrittling aqueous cleaners for use on landing gear struts.

Common and routine maintenance tasks can also induce horseman number three, Stress Corrosion

Cracking (SCC). SCC is a failure mode similar to hydrogen embrittlement. In fact, metallurgists frequently have difficulty telling the two failure modes apart when examining fractured parts with a scanning electron microscope (SEM). It is not uncommon to need additional information about part history to make the HE/SCC call. SCC is a cracking mechanism that is not really related to landing loads or operations. SCC is a failure mode that requires three elements.

• First is a corrosive mechanism, by any means (dissimilar metals, corrosive fluids, etc.).

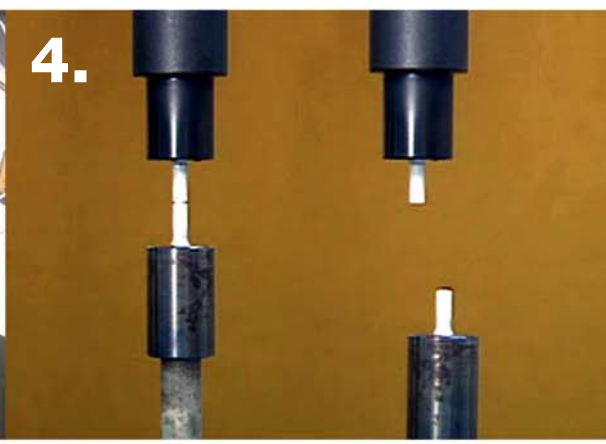
• Second is *sustained* tensile stresses, emphasis being on *sustained*. Stresses induced during landing, taxi or braking are not SCC drivers. Such stresses happen for a brief few seconds during a flight cycle, during which corrosion doesn't really react with the steel material. The stresses that drive SCC are those stresses that are present 24/7, day in and day out, in flight or parked. They include stresses to support aircraft weight while parked, stresses due to internal nitrogen pressure, and residual stresses created during initial manufacturing or operational damage. Because landing gear structures support aircraft weight most of the time, they are SCC factories!

• The third key element is the steel material's susceptibility to SCC. For 300M, if the sustained stresses are above approximately 115,000 PSI, any corrosion activity will lead to SCC growth. Below that stress level, any corrosion will simply lead to pitting corrosion without crack growth.

Simple problem to avoid, right? Just have the shiny-pants design engineers keep those pesky stresses below that level and no worries? Not so fast! Remember most steel landing gear parts are manufactured from forgings, and residual stresses from manufacturing can be as high as 40,000 psi. We cannot accurately measure residual stress values in a finished part. Add a chip or maintenance-induced ding in the wrong place, and let loose the grody bugs (a highly technical term invented by Hill AFB metallurgists to describe SCC, and dearly beloved by us!) In addition, interference fit bushings and pins impose high tensile stresses that are not easily calculated or measured, and are certainly sustained 24/7. Photo 5 shows a C-5 MLG bogie failure caused by SCC. Unfortunately, our group has a large and growing library of similar SCC failure photos. Bottom line: SCC is an unpredictable failure mode that has caused many failures and mishaps.

How do you prevent SCC failures? We attack it three ways. The first is design. Newer landing gear are designed with a 1G-load case that calculates the "sitting on the ramp" stresses. We include factors for reasonable manufacturing residual stresses, shot peen (good!) stresses, and typical aircraft weight growth. Any area with "1G" stresses above 100,000 are carefully reconsidered and potentially redesigned. When necessary, we attempt to redesign and retrofit old components at risk for SCC, although this is frequently prohibited by weight and envelope restrictions.

USAF Photos



4.

5.

The second SCC-avoidance step is to do everything possible to prevent corrosion. Exposed steel surfaces are plated with cadmium or coated with ionized vapor deposited (IVD) aluminum. These coatings provide the optimum galvanic protection, and will slowly corrode sacrificially to protect the base steel material. We cover these coatings with a barrier paint topcoat. Chrome and nickel plating, used for wear surfaces, act as a barrier coating but offer little galvanic protection. All these coating processes degrade over time. They either chip and flake away (barrier coatings) in routine service, or they corrode sacrificially as designed (galvanic coatings). Either way, the coating will not last the life of the landing gear, and needs to be periodically restored. This is the primary reason for our insistence on programmed depot maintenance (PDM) or time-change requirements.

The last way to attack SCC is to focus on residual tensile stresses, good and bad. Shot peening imposes a sustained, residual compressive stress that can offset the bad tensile stresses. Shot peen stresses can be relieved in service by heat, so certain components need periodic re-peening more than others. During depot repair, we obsessively shot peen every part like fiends! The other residual stress focus is local damage. Any ding or dent is closely evaluated with SCC as the primary focus. Because of its close proximity to the ground, landing gear are routinely damaged. Improper jacking is a common source of damage, and is also usually on the bottom where sustained tensile stresses are highest (think the bottom of a KC-135 MLG Truck).

For the future, we are developing a new high-strength stainless steel that will greatly diminish the three vulnerabilities of current alloys. This new alloy, Ferrium S53, is currently undergoing testing to develop material and design properties to include in a new specification. The next step will be to manufacture prototypes and qualify select landing gear components. The goal is a 500% improvement in SCC performance, greatly increased HE resistance, and much higher tempering temperature (for burn resistance). We have achieved these goals, and are working to optimize structural properties. In addition, we expect the new alloy will not require Cadmium or Chromium plating (passivate and Nitride instead). Hopefully, we can begin to use the new alloy for spare components in about 2007.

Cleaning activities can prevent corrosion if done properly, but is detrimental if it damages the coatings or washes grease out of joints. Generally, power-washing is always to be avoided. We like to say a dirty gear is a happy gear. Obsessively cleaning landing gear may help prevent some forms of

The 4 Horsemen of

By the last breath of the burner blow
better raise your gear,
The sound of doom knocks' hangar door
Lock up your crew chief and Airmen now
It's time to wield the chrome…
For now you have got some company
The Horsemen are drawing nearer
On the stealthy steeds they ride
They have come to take your life
On, through the dead of flight
With the four Horsemen ride,
or choose your fate and die
You have been dying since the day
You were forged
You know it has all been planned
The quartet of entropy rides
A cracking once, a cracking twice
No need for plating now!
Cause now you've got
the fight of your life

The Horsemen are drawing nearer
On the stealthy steeds they ride
On through the dead of flight
With the four Horsemen ride
or choose your fate and die…

Fatigue
has taken its toll on you
the cracks that line your surfaces
on hand can stay its growth

Embrittlement
your body,
hydrogen has pierced
if tip-toed to the edge,
hell's heat can avail

Illustration by Dan Harman

corrosion, but it may cause more harm than good. It is for precisely this reason we have seriously contemplated changing the paint color of landing gear from white to gull-gray. Most commercial landing gear are painted gray to avoid highlighting every minor smudge that tempts unnecessary cleaning. Several years ago, we assisted AMC in the production of a video about landing gear cleaning and maintenance. You can find this excellent video at http://www.hill.af.mil/lg2/video/

The last two horsemen are Fatigue and Burns. Although fatigue problems can occasionally be initiated by field maintenance, it is primarily a design problem. Burns (both electroplating and grinding) are created during manufacturing and depot repair processes. In recent months our office has been handling a significant grinding burn crisis caused by one of our primary manufacturers. You may have been impacted by one of the resulting TCTOs to find and remove the suspect items. Although these two horsemen are of significant concern to us, they are not typically created by field maintenance and are addressed in a different forum.

Hopefully, this information will help you during landing gear maintenance tasks, and keep the Four Horsemen at bay!

(Editor's Note: For more information about landing gear, vsit the Ogden landing gear web site at: http://www.hill.af.mil/lg2/WebLGH.htm)

LANDING GEAR APOCALYPSE!

Stress Corrosion Cracking
certain death for you
comes slinking under the wing
you're helpless, metallurgically

Grinding Burns
unseen malignant damage
you watched hell's heat too long
carve your flesh or die
So gather round young engineers now
and fire up your HPs
Killing scores with circles, Mohr's
Now is the death of doers of clean
Swing the forging hammer down
Safely inside cadmium,
paint and grease

The Horsemen are drawing nearer
On the stealthy steeds they ride
On through the dead of flight
With the four Horsemen ride
or choose your fate and die…

USAF Photo by MSgt Val Gempis

HUMAN FACTORS AND AIRCRAFT MAINTENANCE

MAJ ANTHONY WURMSTEIN
MAJ MICHAEL SHETLER
CMSGT JEFF MOENING
HQ AFSC/SEF

Human factors and aircraft maintenance, what's a maintainer to do? If you look at past mishaps, we spend a lot of time looking at aircrew human factors, but what about the person turning the wrench and making the aircraft fly? They are a human factor, and the Air Force needs to look at how we can prevent the maintenance human factor mishap. We hope to provide you with some information that you, the supervisor and the individual, can use to help understand human factors in aircraft maintenance.

What is Human Factors?

Human factors is the science of analyzing the limitations of humans as we interact with the environment and preventing or mitigating the inevitable human error. The limitations of humans come in five flavors and are known as the Five Ps: Physical (heat, cold, etc.); Physiological (oxygen, blood flow, etc.); Psychological (senses, information processing, etc.); Psychosocial (team interaction, communication, etc.) and Pathological (illness, injury). Each of these areas is a profession by itself, but together they make up the field of human factors. Human factors lets us look at not just individual human failures but the failures in the systems that we humans create. "OK," you say. "That's all great, but how does it help me?" Well, in order to analyze these failures and develop strategies to prevent them, you need a structure or "taxonomy" to organize the different types of failure.

What Is the Human Factors Taxonomy?

This is how we apply human factors to a mishap to determine the cause of the human failure or error that contributed or led to the mishap. If you look at the human factors taxonomy charts (Charts 1-4), you can see we start at the organizational influences and work our way down to the individual acts. This ensures we look at all aspects of the mishap to find the root cause—not the easy answer.

We start by looking at organizational influences or culture (Chart 1). These are the factors in a mishap where the decisions of upper-level management directly affect supervisory practices, conditions and actions of the operator, and result in system failure, human error or unsafe situation. This could be resource management or acquisition, organizational climate or organizational process.

These factors apply when upper-level management sets up or fails to provide an adequate safety environment, structure, policies, procedures or equipment that influences individual actions and results in human error or an unsafe condition. The processes fail when operations, procedures, ORM and oversight negatively influence individual, supervisory, and/or organizational performance and results in unrecognized hazards and/or an uncontrolled risk. Have you ever heard of a mishap where the cause was a procedure that was overlooked as being wrong until the mishap? It happens every year and even cost one maintainer his life.

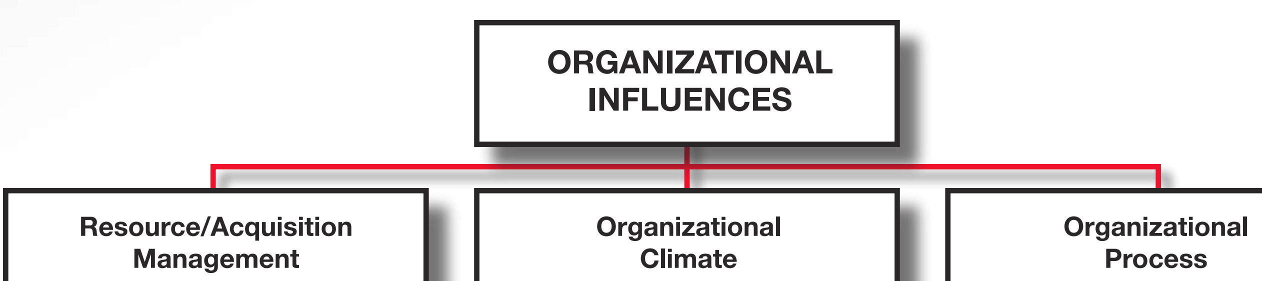


Chart 1

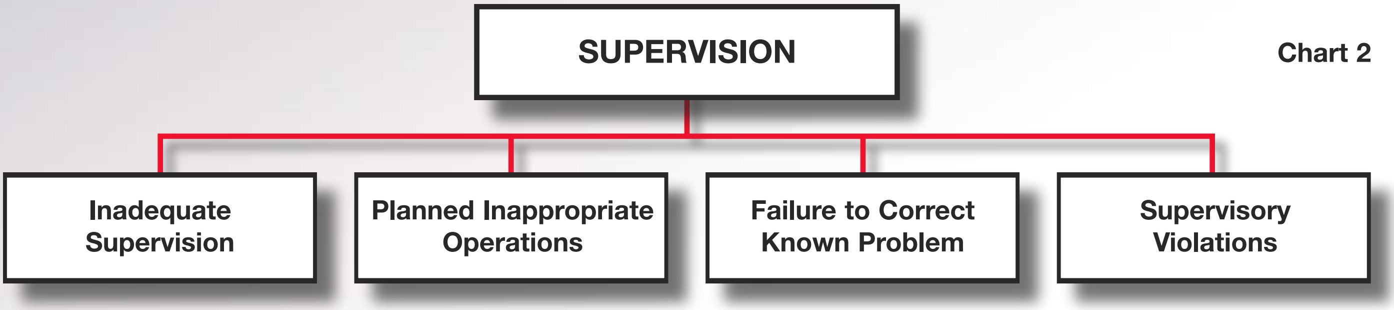


Chart 2

The next level is supervision, which is a factor in a mishap if the methods, decisions or policies of the supervisory chain of command directly affect practices, conditions, or actions of individuals and results is human error or an unsafe condition (Chart 2). The main aspects of the supervision factors are inadequate supervision, planned inappropriate operations, failure to correct a known problem and supervisory violations.

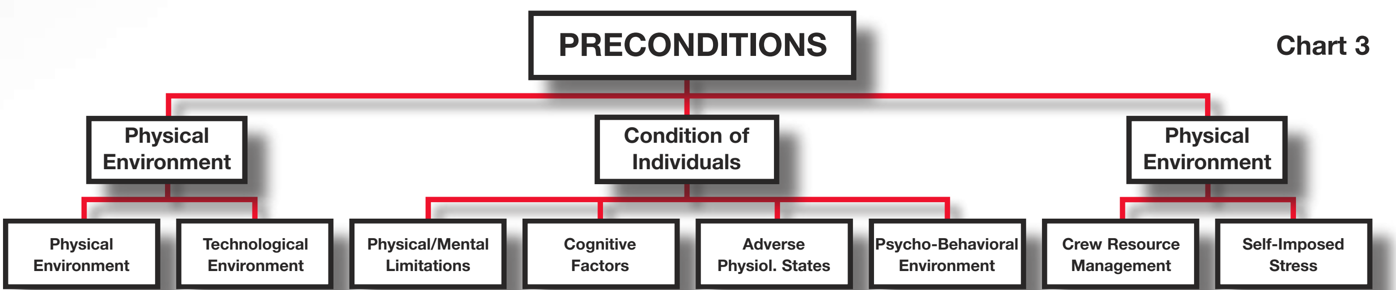


Chart 3

How do we define inadequate supervision? In a mishap sequence, it would be when supervision proves to be inappropriate or improper, and fails to identify a hazard, recognize or control a risk, provide guidance, training and/or oversight that result in human error or an unsafe situation. How about when supervision is supposed to perform an In-Process Inspection and doesn't?

The next supervisory item is planned inappropriate operations. This is a factor in the mishap sequence when supervision fails to adequately assess the hazards associated with an operation and allows for unnecessary risk. Additionally, supervision may allow non-proficient or inexperienced personnel to attempt missions/tasks beyond their capability or when crew or flight makeup is inappropriate for the task or mission assigned. We had one mishap during an engine run where supervision planned an engine run operation that ended up with the aircraft jumping chocks.

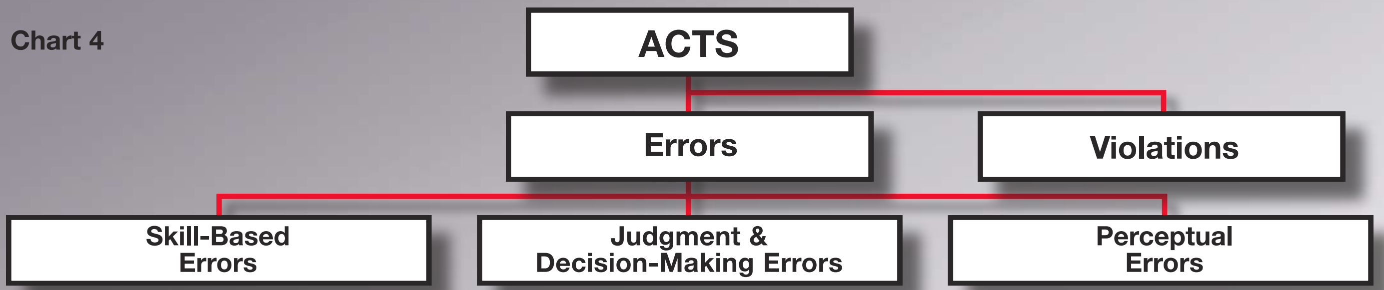
Another factor is failure to correct a known problem. This is when supervision fails to correct known deficiencies in documents, processes or procedures, or fails to correct inappropriate or unsafe actions of individuals and this lack of supervisory action creates an unsafe situation. How often do we hear, "This is the way we have always done it?" Too often! Supervisors *knew* the people were violating the rules, or supervision said to violate the rule, and nothing was done to prevent the mishap. How many cases are out there today where supervisors watch a young inexperienced troop do things wrong and don't correct them on the spot? This sets the person up for failure in the future.

The final supervisory factor is supervisory violations. This is the most serious factor after failing to correct the problem. Here is where supervision, while managing organizational assets, *willfully* disregards instructions, guidance, rules or operating instructions, and this lack of supervisory responsibility creates an unsafe situation. Any supervisor guilty of this act needs to be shot. When we visit units, we always ask the question, "Are you told to violate tech data?" The answer we get is no, but… "You have 20 minutes to get the job done by the book." Is this a supervisory violation?

The next group of factors is the preconditions (Chart 3). These mishap factors are the active and/or latent preconditions that include three main areas: the environmental factors, the condition of individuals, and the personnel factors that result in human error or an unsafe condition.

Environmental factors are the physical or technological factors that affect practices, conditions and actions of individuals. Some examples of the physical restrictions are reduced vision due to weather, workplace, or noise. Technological conditions are when aircraft, vehicle or workplace design affects the actions of individuals. This could be anything from switch positions to small confined spaces.

Chart 4



The condition of individuals is the physical/mental limitations, cognitive, adverse physiological states, and psycho-behavioral factors. The physical/mental limitations are when the person lacks the capabilities either physically or mentally to cope with the situation. This could be their learning ability, technical knowledge, or memory issues.

The cognitive factors are attention management conditions such as inattention, channelized attention, cognitive task saturation, confusion, distraction and habit pattern interference, a key factor for maintenance. We are creatures of habit, and many mishaps are caused when habit lets us forget to do something, like install a cotter pin or properly torque a nut.

The adverse physiological states are when the person is on prescribed drugs, or when an injury, illness or a pre-existing injury, illness or deficit affects your ability to perform the task at hand. Fatigue is found here, as well as sleep deprivation and physical task over-saturation. Physical task over-saturation is one we maintainers need to look at. It occurs when the number of manual tasks to perform in a compressed timeframe exceeds the individual capacity to perform them. How many of us can relate to compressed schedules and too much work?

The last part of these factors is the psycho-behavioral factors. This covers such things as a pre-existing personality or psychological disorder, emotional state, personality style, overconfidence in capabilities, pressing beyond known capabilities, complacency, inadequate, misplaced, or excessive motivation, overaggressive behavior, and–one many maintainers may look at–burnout or motivational exhaustion. All these together look at the condition/state of the people performing the task at the time of a mishap to determine if there were other factors that could have led them down the mishap path.

The final set of preconditions is the personnel factors or self-imposed stress or crew resource management (CRM). Many people think CRM is just for aircrew, but they are *wrong*. CRM applies to maintenance, because we have tow crews, refuel crews, launch and recovery crews, hot-pit crews... and how many other crews can you name? CRM deals with communications between team members, preparation for the mission, crew leadership, analysis of the situation and crew coordination. Any slip of these factors and we can damage an aircraft or cause an injury in seconds. Just look at the number of towing mishaps we have had in the last few months, and you can see where CRM needs to be applied.

We are responsible to take care of ourselves, and self-imposed stress is the last of the personnel factors. This deals with our physical fitness for the mission, our nutrition, crew rest (Yes, maintenance needs rest as well; see AFI 21-101), self-medication and unreported disqualifying medical condition. Aircrew can't fly on medications or when sick, so why should the person who makes the aircraft fly be able to work? This isn't an excuse to get out of work, but you need to look at your capability to safely and correctly perform the mission.

The last set of human factors is acts (Chart 4). These are the factors most closely tied to the mishap and can be described as *active failures or actions* by the operator that result in human error or an unsafe condition. These can be an error or a violation. A violation is the most serious, as it is the *willful* disregard for rules and instructions and lead to an unsafe condition. *Violations are deliberate acts.* Examples are failure to follow tech data or an accepted procedure/practice, and lack of discipline. This is the disregard for normal and necessary procedures and restrictions in *published* instructions, regulations, rules of engagement or other official direction. Remember: If the rules are wrong, there are methods to correct them.

Errors are when the mental or physical activities of the operator fail to achieve their intended outcome as a result of skill-based, perceptual, or judgment and decision-making errors leading to an unsafe act which is *unintended*. This is what many people would call an "honest mistake."

Skill-based errors are inadvertent operation of a machine, checklist or procedural error, and over- or under-control of a system. This could be such things as hitting the wrong button, missing a step in the checklist or responding inappropriately to system operation.

The next group of errors is judgment or decision-making errors. This could be risk assessment, task mis-prioritization, rushed or delayed necessary action, ignored caution or warning and improperly executed procedure. Every day on flightlines around the world, our maintainers are faced with many decisions that rely on their judgment and expertise to be exact. How well we train them to deal with these choices determines if we create an unsafe situation or not.

The final error is the perceptual error or the misperception of an object, threat or situation that results in human error. This can apply to towing mishaps where the tow supervisor or driver misjudged the distance between the aircraft and another object. We have listed a bunch of different factors that most of you should be able to see on your flightline, and hopefully you can use them to prevent a mishap.

How is Human Factors applied to a mishap?

Now that you have the basic description of the different human factors that can apply to maintainers, how are these applied? We took a look at the Class A and Class B maintenance mishap causal findings in FY03 to see what we could determine. The three of us, a human factors physiologist, a maintenance officer and a maintenance chief, spent four hours going over the mishaps, and many times our judgment of what was the true cause was different. Not being part of the investigation, we had to rely on the mishap narrative to make our conclusions. Some mishaps have more than one cause, so don't try to add up the numbers.

The first category of causes we found was supervision, which wasn't a major factor in the majority of mishaps but was a cause in eight of them. The most frequent was inadequate supervision, oversight or leadership. Here, we have mishaps where supervision failed to detect bad safety wire, or a person was directed to perform a task they weren't proficient at, with no supervision. We have a young maintenance force that needs the help of the old hats to ensure they have proper training, adequate supervision and follow-up to key tasks.

We found that organizational influences were causes in 12 mishaps, with organizational processes being the cause of 10 of the 12. How many times do we find out after a mishap that there is a process that has been going on for years that everyone "accepts" as the right way? An example of accepted practice is the MH-53 helicopter rotor blade weights. After a Class A mishap, it was found that the wrong hardware had been installed. An inspection of the fleet showed that only one aircraft had the correct hardware. Everyone had been installing the wrong length bolts, nuts, and washers, even though the tech data was correct. The biggest factor is that the safety hazard was *unrecognized*. A method to help prevent this unrecognized hazard is to have someone from outside your organization take a look at your practices. A good place to start is your wing safety office and their annual inspection. You can request a staff assistance visit from headquarters and view it as helping you prevent a mishap. It is easier to be proactive than to react to a major mishap. Then you get help you really don't want.

To no one's surprise, unsafe acts were the main cause of the maintenance mishaps, with violations being the No. 1 cause. Of the mishaps we looked at, we found skill-based errors to be the cause in three mishaps, and judgment and decision-making errors the cause in 10 mishaps. As we had suspected, *intentional failure* to use accepted procedure was the *No. 1* cause of mishaps. When people willfully disregard tech data, we are setting ourselves up for failure, and a lot more work during a very busy time in our Air Force. Some examples of failing to follow tech data are an engine technician failing to properly safety wire bolts and the engine failing on the test cell, and a tow supervisor deciding to tow an aircraft into the hangar without wing walkers. These are bad choices that you can't write off as an honest mistake.

How can I use Human Factors to prevent mishaps at my unit?

The best thing you can do is work with your people, wing safety and the medical folks to ensure you stay alert for changes and problem areas at your location. By being aware of the human factors that influence our workforce and which affect their decisions and ability to perform the mission, you can prevent a mishap and/or recognize when unsafe conditions are created. In addition, you can use this to educate your supervisors, upper- and mid-level, to look beyond the task at hand and take care of your people. There are people at your base who can help if you don't understand the human factors puzzle. Few people do. Your wing safety office has received training on human factors, plus almost every base with a flying operation has a flight surgeon and someone trained in human factors in the medical group. These experts are there to help. All you have to do is ask.

It's very hard for us to read a mishap narrative and get the information needed to make an accurate assessment of what were the human factors, so we need you to help us. When you perform an investigation of a maintenance mishap, look at the human factors to help determine the root cause. If you need help, your wing safety office and medical group are there to provide assistance. Be safe, and never forget that we are human beings!

USN Photo by Journalist Seaman David Ham

TOP TEN CAUSES OF MAINTENANCE MISHAPS

1. Failure to follow published Tech Data or local instructions.

2. Using an unauthorized procedure not referenced in tech data.

3. Supervisors accepting non-use of Tech Data or failure to follow maintenance requirements.

4. Failure to document maintenance in the AFTO Form 781 or engine work package.

5. Inattention to detail/complacency.

6. Incorrectly installed hardware on an aircraft/engine.

7. Performing an unauthorized modification to the aircraft.

8. Failure to conduct a tool inventory after completion of the task.

9. Personnel not trained or certified to perform the task.

10. Ground support equipment improperly positioned for the task.

Brake Leaks are Out-Numbering Worn Brakes

USAF Photo by MSgt Val Gempis

MSGT MAURICE CALVO
136th Airlift Wing, Texas ANG

In recent years brake leaks contributed to the majority of brake changes in the C-130H community; in other words, more brakes were being changed due to leaks than worn brakes. Replacing leaking brakes not only diminishes supply's inventory, but in some cases has caused maintenance to perform CANN-actions, therefore, doing the job twice, not to mention the cost. When these brakes are disassembled in the shop, the majority exhibited a common deficiency, evidence of seal deterioration within the brake housing piston assembly.

Seal deterioration permits hydraulic fluid to come in contact with the brake surface and could ignite if the brakes are hot enough. This represents a potential fire hazard and several T.O.s address this potential.

There is a couple of contributing factors leading to seal deterioration. For example, some C-130H brake housings are over two decades old, manufactured from magnesium, aluminum and steel. Considering the elements of the weather, rocks and dirt, the assemblies are very susceptible to corrosion, especially around the piston cavities of the housing. Once the housing reflects evidence of abnormality, they are shipped to an overhaul facility. The facility treats and reams out any piston cavities that have scratches or corrosion to save cost. This directly affects the seating of where the brake piston seal rests within the piston cavity. Once the piston cavity is reamed, the overhaul facility must stamp a mark near the corresponding piston area in the housing assembly, identifying to the technician in the shop what size of seal is required in that particular piston sleeve (e.g., OS, 2OS). There have been instances where the stamp is sometimes incorrect or not stamped at all.

Another contributing factor for the housing to leak is parts sub-contractors. Parts such as piston sleeves are not uniform because they have been produced by several manufacturers, and usually the lowest bidder gets the contract. From time to time, you could have three or four slightly different sizes of piston sleeves. These piston sleeves have a groove where the seal seats and it must be within tolerance. If the specifications are not within tolerance, seals have a tendency to roll, allowing them to deteriorate.

Bearing in mind their age, wear and tear does take a toll, some of these brake housings have been around twenty plus years from when they were first treated and manufactured. The point is, everything has a life span, and we should not wait until it fails.

All of the above have one common denominator that is contributing to brake leaks with the same results. This is deterioration caused by a loose fit within the piston cavity of the brake housings that have been reamed to maximum size because of their age. This deterioration is minimizing the seal lifespan and consequently results in high levels of brake leaks on the C-130 aircraft.

Watch out as you work on the brakes of your aircraft to prevent a safety issue from leaky brakes, and identify any bad parts through the system to improve the quality of parts you receive.

Photos Courtesy of Author

Bird Strikes! What's a Maintainer to Do?

1ST LT MELANIE PRESUTO
HQ AFSC/SEFW

The Bird/Wildlife Airstrike Hazard (BASH) Team knows the scenario: A "Whisper-pig" (C-130) returns from another dark night of flying in the low-level world, and as the crew heads for the limo, uh, crew bus, and another late night meal at the flight kitchen, the Nav looks over at the ECM pod and groans, "Hey, what's that stuff on our bird?"

The co-pilot glances at the gunk, grimaces, and asks, "Which bird, ours or the previously live one now gracing the pod?"

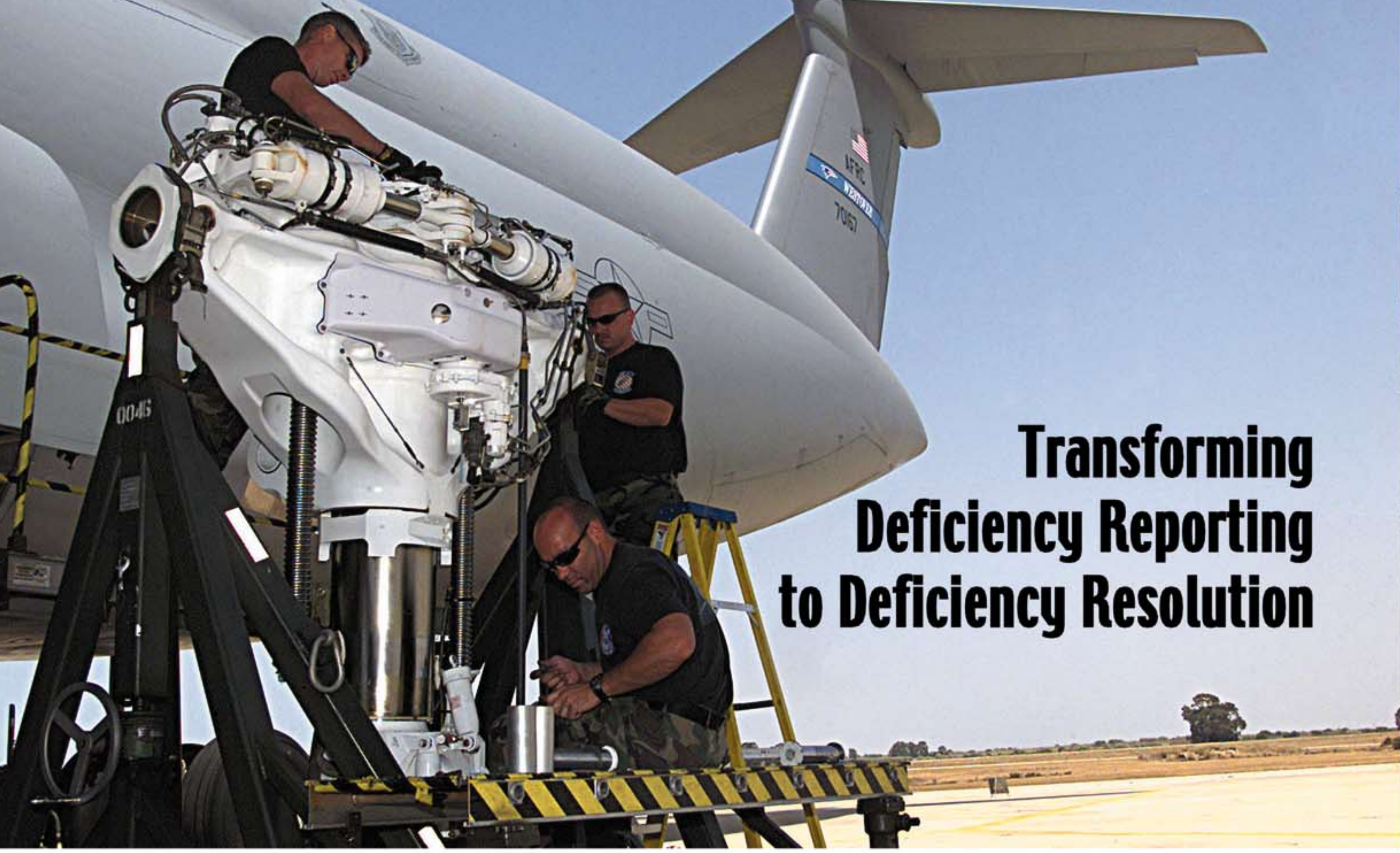
"Whatever! Just make sure maintenance knows we hit something and to look for any problems."

What's a maintainer to do when he/she sees blood and guts smeared on the side of their aircraft rolling in? Grab the Windex and a paper towel? NO! Ready the hose? BASH says, ABSOLUTELY NOT! That "snarge" as we call it (a very technical term, by the way, from the Feather Lab Scientists at the Smithsonian Institution) is the key to the identification of a bird or wildlife strike. Air Force Manual 91-223, *Aviation Safety Investigations and Reports*, a supplement to AFI 91-204, *Safety Investigations and Reports*, provides additional guidance for investigating and reporting aviation mishaps, to include BASH. Under Investigative Evidence, 5.4.2.1., the directions for bird and wildlife strike remains, are outlined. This includes everything from whole carcasses to just feet, beak, feathers or even blood smears, or "snarge." Further instructions may be found on-line at the BASH website: http://afsafety.af.mil/AFSC/Bash/wild.html.

In many instances the members of the BASH Team read the reports for quality control and find that maintenance personnel or pilots had noted a blood smear in their report, yet no remains were sent to the Smithsonian. In these cases, it is important to let the personnel in charge of aircraft upkeep know that blood smears might contain minute pieces of bird feather or other fleshy remains, and even if they don't, the Smithsonian now has feather identification technology that includes DNA analysis.

The best action for personnel to take is the "blot" method. DO NOT SCRUB! No "wax on, wax off." Just as Mom told you that scrubbing blood into clothing kills the chances of saving your favorite tee, scrubbing "snarge" off of an airplane could destroy any microscopic evidence that could've been used to identify a bird. Resist the urge to use the old vigorous circular motion! Instead, as AFMAN 91-223 outlines, spray the blood smear with water, blot with a clean paper towel, fold the towel and place it into a labeled zip-loc bag. Send a copy of the corresponding AFSAS report along with the strike evidence to the following address: Smithsonian Institution, Feather Identification Lab, NHBE 610 MRC 116, 10th and Constitution Ave. NW, Washington, DC 20560.

It's that easy; and for BASH, it's that important! Now, go and wash your hands—you don't want any "snarge" on them. Even if there was zero damage, the BASH Team still uses that information to report on the frequency of strikes of different species around the world. This data may later be used to update the Bird Avoidance Model to provide better information to flight crews to prevent bird strikes, and reduce your workload. So the next time you, the maintainer, are armed with hose in one hand, scrub brush in the other, think twice! Think "snarge"! Think BASH!



Transforming Deficiency Reporting to Deficiency Resolution

USAF Photos by SSgt Sarah Webb-Frost

MR. GREG BERNITT
HQ AFMC/ENPM

How many times have you heard that the Deficiency Reporting (DR) process is a waste of time? The responses never seem to address the real issue, nor does the corrective action, if any, seem to prevent recurrence. Or at least that seems to be the common perception from the field or *Originator* level.

DR Everything, Let Them Figure It Out

From the DR receiving side, there are opposing views that believe field activities are abusing the DR process. Since a DR submission results in an exchange cost credit, the perception is that DR submissions are only encouraged to help manage unit level organization and maintenance funds. For acquisition programs, it is common for program offices to perceive that test organizations are making unreasonable demands to correct conditions on systems for which there are no requirements.

The truth of the matter is that these perceptions are right…and wrong. The DR process is sound and viable, but there are problems that require changes to business as usual. To address these concerns, the USAF Deficiency Reporting and Investigating System (DRIS) recently underwent an assessment to review policy, procedures, system processes/tools and training.

Although problems were found in all areas, the first and primary target of opportunity was to clarify the policy, methods and procedures defined in Technical Order 00-35D-54, *USAF Deficiency Reporting and Investigating System*. The T.O. defines the processes used for deficiency reporting and resolution, which provide the foundation for training and outlines the requirements for system tools. After approximately a year and a half, we are finally prepared to publish the first major revision to deficiency reporting and resolution criteria. The following highlights some of the many changes underway to improve DR credibility and to emphasize DR resolution.

Focus On Operational Safety, Suitability And Effectiveness

It was found that the program has lacked management level attention at all levels to keep the focus of the DR process centered on the resolution of conditions that impact operational safety, operational suitability and/or operational effectiveness (OSS&E). These terms are integral to sound system engineering and the correction or acceptance of risk associated with reported conditions. These terms have been infused in the revised T.O. as the basis of the deficiency reporting process. To learn more about OSS&E, refer to AFI 63-1201.

DRIS and the processes of T.O. 00-35D-54 provide standardized methods, supporting databases, tools and procedures to identify, investigate and resolve deficiencies that impact OSS&E. During Test and Evaluation, deficiency reporting identifies deficiencies or proposed enhancements at a point in develop-

USAF Photos by SrA Stacia M. Willis

ment where changes may be made at a significantly reduced cost. Throughout operational deployment and sustainment, these procedures provide a method to formally communicate user/operator concerns to managing activities for analysis and resolution.

The Submission Process

Providing insufficient details of the deficiency being reported is the number one complaint of resolution organizations and has often resulted in reports being closed without the intended consideration.

Valid Reporting Is Key To Timely Resolution

The Originator is responsible to identify and document deficient conditions and ensure potential exhibits and supporting data are secured and available for evaluation. Routine component or system failures or conditions that occur after initial use should not be reported as deficiencies unless there is reasonable cause to suspect errors in workmanship or nonconformance to specifications, or when failures are supported by specific trend criteria.

The DR should typically contain a detailed problem description focused on only one problem and, for software deficiencies, one program. For system integration deficiencies or when deficiencies are linked by multiple failures, reports should be against an end item and reference subordinate reports. When applicable, DRs may provide recommendations for fixing the problem. Originators are strongly encouraged to provide digital files, photos and/or other electronic media to support the reported condition. Examples include digital photos of the reported item showing the extent and location of the deficient condition, and photos that provide proof of manufacture, overhaul/repair, warranty data, condition tags, etc.

Understanding The Deficiency Reporting Mechanisms

A DR is a DR is a DR, right? Yes, this may be true to some extent, but the criteria for reporting and the expected outcomes are different and require improved understanding. There are several types of deficiency reports and labels within these types that need to be understood. The primary types of reports include:

- *Product Quality Deficiency Report.* This is a report of deficiency that is suspected to be the result of failed quality-related processes such as workmanship, design, processes or procedures during manufacture or overhaul. These type deficiencies are typically failures "out of the box" when or shortly after the item is placed in service.
- *Materiel Deficiency Report.* This report type is used to report an unacceptable condition such as a component/item failure, or recommendation for an enhancement that impacts the OSS&E of a system, subsystem or component. It may include aging system issues or trends, improvement recommendations or requests for investigation to determine the root cause or condition that induced the failure.

• *Acceptance Inspection Deficiency Report.* This report type is used to report discrepancies discovered during acceptance inspections performed on aircraft, engines, engine modules and major assemblies, support systems and equipment. Reportable discrepancies are those that are attributed to non-conformance to applicable quality specifications during manufacture, repair, modification or maintenance associated with the general work requirements and contract specifications of the work performed.

• *Test and Evaluation Deficiency Report.* These are reports of deficiency identified during formalized test and evaluation. These include, but are not limited to, those deficiencies that are the result of incompatibility or failures as measured against required capabilities, applicable product specifications, procedures, or test equipment and recommendations for enhancements to improve OSS&E.

• *Warranty Deficiency Report.* These include the reporting of failures that occur on contractually prescribed warranted items within the warranty period.

Additionally, reports may be further classified as one of the following:

• *Dropped Object Report.* A report of a materiel or quality deficiency involving any aircraft part, component, surface or other item lost during aircrew operations from engine start to engine shutdown that is confirmed or suspected to be the result of a materiel or design deficiency.

• *HAP/Mishap Deficiency Report.* These are materiel or quality deficiencies that have been identified as having High Accident Potential (HAP) or that are a known or suspected cause of an Air Force mishap.

• *Software Deficiency Report.* These include but are not limited to an error, omission or enhancement in statements or instructions that comprise a computer program for a system or component. The deficiency may consist of syntax, logic or other discrepancies that cause the program to fail or inadequately perform the intended functions.

Deficiency Reporting Criteria

Deficiencies that impact the OSS&E of systems or equipment shall be reported through DRIS to the appropriate managing activity. Deficient conditions shall be identified according to criteria and report type and categorized according to their impact to mission and/or safety.

Report deficiencies on Government-owned products to include, but not limited to premature equipment failures; products in use that do not fulfill their expected purpose, operation, or service requirement due to deficiencies in workmanship, nonconformance to applicable specifications, drawings, standards, processes or other technical requirements in design, materiel, manufacture, repair, modification or maintenance; and known or suspected causes of Air Force Mishap/HAP incidents.

Deficiency Categorization And Priorization

The deficiency category and associated risk priority is used to capture the severity of the condition by relative importance and the urgency of response. The submitting organization will be diligent in the categorization of deficiencies, analyzing each deficiency for its overall impact to OSS&E.

Category I deficiencies are those which may cause death, severe injury, or severe occupational illness; may cause loss or major damage to a weapon system; critically restricts the combat readiness capabilities of the using organization; or which would result in a production line stoppage.

Category I deficiencies require immediate risk mitigation from the system Single Manager and Chief/Lead Engineer and therefore shall be validated prior to submission by the appropriate authority within the reporting organization.

Category I deficiencies require immediate attention and response to mitigate risk and/or limit/resolve mission impact. Therefore, strict application of Category I criteria is essential. If a

USAF Photos

Category I condition is noted or suspect, assess safety, mission, or operational impact and include a detailed statement outlining the safety, mission or operational impact to the system or end item. Suspected Category I deficiencies shall be validated as such by the appropriate authority level within the reporting organization. If any doubt exists concerning the category of a report between Category I and Category II, it will be coordinated with the wing safety office and/or other authority to aid in assessment of the deficiencies impact.

Category II deficiencies are those that impede or constrain successful mission accomplishment (system impacts OSS&E but does not meet the safety or mission impact criteria of a Category I deficiency). It may also be a condition that complements, but is not absolutely required for, successful mission accomplishment. The recommended enhancement, if incorporated, will improve a system's operational effectiveness or suitability.

Conditions that do not meet the criteria of a Category I or Category II report should be investigated by the identifying organization to determine if other reporting avenues are available. These may include, but are not limited to, product and component improvement working group action items, as well as transportation and supply discrepancy reporting. *Resolution does not always mean correction.*

Responsibility For DR Resolution

Follow-up and status determination is as much the originating organization's responsibility as the deficient items' managing activity. Originating organizations must ensure follow-up on reported deficiencies to obtain timely exhibit disposition and ensure the DR has been received and resolution is timely. However, resolution does not always mean correction. Deficiencies that are determined to be low risk and/or that do not provide a valid benefit for correction in terms of cost, schedule or performance may be closed for acceptable risk.

An example of this situation may be associated with failures of components upon initial installation after receipt from supply. Due to the USAF method of 'On-Condition Maintenance' (only repairing to return item to serviceable condition, not overhaul), it is accepted that a small percentage of items will fail due to unpredictable materiel failures. For example, a black box with 14 circuit cards comes in for depot repair. The item is tested and circuit card A1 is found bad and replaced. The component operationally checks serviceable, and the item is placed back into the supply system. Upon receipt at field level, the item fails operational checks and is subsequently reported as deficient. Upon investigation, it is determined that circuit card A3 is now bad; an unpredictable materiel failure. Unless trends indicate an excessive failure rate or unless repair center workmanship or other quality conditions exist, it is likely that failures of this type will be considered as an acceptable risk and closed without corrective actions.

Deficiency Report Processing, Investigation And Resolution

The Single Managers (SM), consistent with OSS&E guidelines and T.O. 00-35D-54, define the administration of DRIS processes for a particular system, program or directorate. The following describe the key functional roles of the DR resolution cycle.

- *Single Managers*. SM are responsible for implementing the DRIS processes for their weapon, military system or end item consistent with the preservation of OSS&E baselines. The SM may delegate responsibility to lateral organizations, such as the Supply Chain Manager, to investigate and resolve deficiencies on items managed by them. However, the SM shall maintain accountability for the actions and activities affecting the weapon system/end item.

• *Chief/Lead Engineers.* Chief/Lead Engineers are integral members of the DRIS program for their system. They support SM-established DRIS processes, specifically providing technical oversight and direction for risk analysis and impact mitigation of deficiencies against their assigned system.

• *Screening Points.* Screening Points are the receiving activities designated focal point for the receipt and processing of DRs. Screening points review DRs for proper categorization, validity, and correctness of entries, accuracy and completion of information addresses. They assign the DR to the proper Action Point, establish routing and tracking mechanisms, and maintain an audit trail for each DR.

• *Action Points.* Action Point(s) are assigned by the Single Manager, Program Director or equivalent, and typically administer the DR process on assigned DRs. They perform resolution oversight of DRs by working in conjunction with in-house and Support Point subject matter experts such as item or inventory managers, equipment and quality specialists, engineers and contractors. They serve as the Service Screening Point for DRs transferred for resolution across component lines.

• *Support Points.* The Support Point assists the Action Point by conducting investigations, trend analysis, exhibit processing, and recommending and implementing corrective and/or preventive actions.

$100M In Exhibits Awaiting Investigation

Incorrect and inefficient exhibit handling and processing are key factors in lengthy investigations and reports being closed without resolution. Strict discipline and strong oversight is required to improve this area, and exhibit metrics are being established to measure our performance. The only way to reduce languishing exhibit status is to either increase the capacity for performing exhibit investigations or to reduce the number of investigations performed.

The most cost-effective approach is to ensure that Action Points, with assistance from engineering activities, make a valid determination if exhibit teardown and analysis is required to validate a reported condition. Since an exhibit investigation commits financial resources and keeps the asset out of the reparable cycle, it is imperative that the decision is supported by objective data. Typically, investigations should be restricted to those situations where:

—New failure modes appear
—Safety of flight defects are suspected
—Workmanship and/or nonconformance issues
—Warranty failures on new or newly reworked items
—Mishap or HAP deficiencies
—Requests by safety investigation authorities
—As required by specific trend analysis conclu-sions

Do not perform an exhibit investigation based solely upon the often boilerplate request from the reporting activity.

Open DR Metrics Established

Several actions have taken place to address timely processing, investigation and resolution. Aside from clarifying specific responsibilities and DR status, timeliness measures and goals have been established. Previously, DR timeliness was measured by how long it took to close a DR. This metric provided a negative incentive to work recent reports over those that took a longer time for resolution and did not reflect the extent of DRs that were awaiting action. This closed metric was recently replaced with an open metric that now reflects DR total workload and associated age. Since incorporation of this measure, OC-ALC in particular has made significant improvements in resolving languishing reports and reducing their average days open for nearly 10,000 reports from over 200 days to approximately 80 days for Category I reports and 120 days for Category II reports.

DR Status Codes Changed To Reflect Resolution

In an evaluation of status codes, it was noted that five separate closing codes existed, none of which clearly indicated correction of the reported condition. The status codes reflected the administration status of the DR, not the resolution action. In review of over 32,000 reports closed in 2002, it was noted that only about 13% could clearly be interpreted as corrected; 47% had insufficient detail to determine if resolution occurred; and 40% (12,800+ reports), were closed without consideration for reasons such as exhibit lost or unavailable, insufficient information in report, could not determine responsibility, etc.

As a result, closing status codes will now reflect only one of two conditions, corrected or not corrected. If not corrected, it may only be due to the acceptance of risk associated with the reported condition or due to an invalid report being submitted.

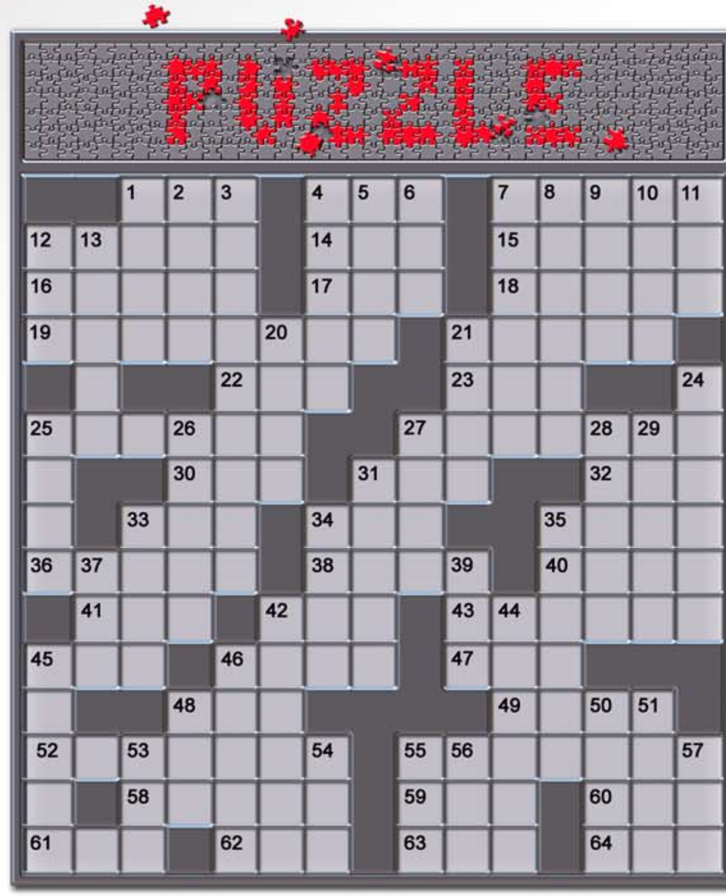
T.O. Changes Provide Solid Foundation

Changes to submission criteria, exhibit handling and processing, clarification of key responsibilities and the establishing of valid status codes are but a few of the highlights of the revised T.O. for the USAF Deficiency Reporting and Investigating System. Along with the establishment of performance measures such as the Open and Exhibit Metrics, we will have laid the foundation to ensure operational safety, suitability and effectiveness issues are identified and resolved to improve readiness and warfighter capabilities.

In closing, improving DR credibility and transforming the output of the reporting system to deficiency resolution will be a long road. Many cultural factors must be overcome and an extensive training program put in place. Future improvements to DRIS include computer-based training and portal access to deficiency data. However, with a strong foundation provided by clear and concise T.O. procedures, the trip is underway.

MAINTENANCE SAFETY

1ST LT TONY WICKMAN
Alaskan Command Public Affairs



ACROSS

1. Trig. function
4. Health resort
7. Commonwealth
12. Illuminating countermeasure
14. Head cover
15. __ Blind Mice
16. Former Houston player
17. Dined
18. Cognizant
19. The end of the flight
21. Mailing need
22. Penn movie Sam __
23. Person leading maintenance shop, in brief
25. Mementos
27. Where the pilot sits
30. College bb tournament
31. Long time
32. Simpson trial judge
33. Play on words
34. Distant
35. Foot part
36. MLB commissioner
38. Jelly
40. Top
41. Still
42. __ Abner
43. Emergency way out
45. Afternoon drink in London
46. Inferno
47. Flightline hazard to aircraft, in short
48. Expert
49. Glow
52. Dangerous military hardware
55. Gas-N-Goes for military planes
58. Bridget Jones' Diary actress Zellweger
59. Exist
60. Measure of Air/Oil/Hyd Pressure, in short
61. Boring routine
62. Trading Spaces' channel, in short
63. Golf prop
64. Spot at the end of a runway, in short

DOWN

1. School subject
2. Snack food
3. Post-flight fill up actions
4. Teem
5. Commiserate
6. Maintenance flightline equipment
7. Pitot- __
8. Hit
9. Zodiac sign (two words)
10. Maryland player, in short
11. Shoe size
12. In favor of
13. Vassal owing allegiance
20. Compass point
21. Before long
24. Women's wraps
25. Spill clean-up devices
26. Alaska Native in the Arctic
27. Dithers' wife in Blondie
28. Portion
29. Things
31. F-15
33. Guilty or not guilty
34. Even
35. Desperate for cash, in slang
37. Hurricane center
39. Ump
42. Singer Richie
44. Pointed beard
45. Airports have one
46. War border
48. Safety protective gear, in short
50. Mature
51. Airman guide in chem. environment
53. Honeymooners actor Carney
54. Part of a min.
55. Head covering
56. Mining goal
57. Mil. courtesy title

Solution on page 31

OPS TOPICS

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

Here are few more examples of miscommunication and aircraft operators. We need less HATRs and more communication!

Who Controls What?

A student on a solo was taxiing out for a contact mission. En route to the "T-37" Runway 33R, he would have to cross Runway 33L and 33C. Normally, the tower controls 33C, and Runway 33L is controlled by T-38 RSU. While taxiing towards 33L, the student "thought" he heard another aircraft being cleared to cross Runway 33L and 33C by tower. This led the student to believe tower was controlling both runways. The student approached Runway 33L at Taxiway Golf, which is approximately 6000 feet from the threshold of Runway 33L. Before he had changed to the T-38 RSU frequency, tower cleared another aircraft to cross Runway 33C. Mistaking this as his clearance to cross Runway 33L, he proceeded to cross the runway. As he was making his way across the runway, he noticed a T-38 on a touch-and-go, and elected to continue to cross so he would not block the runway. The T-38 was airborne again approximately 2000 feet prior to Taxiway Golf, and the student was clear of the runway just as the T-38 passed him. This HATR was not listed as "pilot error—USAF," therefore, cause is reported to be unknown. One can definitely see the importance of proper radio procedures, especially early on in training.

Takeoff Clearance? Abort? When?

Two T-6As, Aircraft 1 and 2, (A1 and A2) were cleared into takeoff position and told to hold soon after another aircraft was cleared for takeoff and departure. The T-6 flight commenced a wing take-off without clearance. A1 lined up on the right side of the runway with A2 on the left. At approximately 60-70 knots, tower noticed A1 on takeoff roll and stated, "A1, cancel takeoff clearance." Tower made this call because A1 flight did not have adequate IFR spacing with the previously departing aircraft. A1 abruptly aborted the takeoff despite approximately 6000 feet of runway remaining. A1 locked their left brake, and the left tire started skidding. A2 noticed the skid, informed lead and released brakes/added power to pass and thus attain separation from A1. A1 blew their left tire and stopped on the left side of the runway. A2 taxied clear of the runway uneventfully.

The aircrew and tower personnel were interviewed about this incident and their recollections were congruent. Ultimately the aircrew was at fault. They acknowledged a clearance to taxi into position and hold, yet proceeded to take off. Considering there were *four* rated pilots (two instructors and two students) on board, there was ample opportunity for aircrew intervention. The lead flight crew stated he allowed the student error and ensuing remedial instruction to distract him from the clearance. Aircrew complacency, expectation and misprioritization led to this mistake.

Unfortunately, this type of error is relatively common in aviation, and the only solution this investigator had to offer is to brief other crews of past mistakes. What makes this incident particularly interesting is how the controller chose to handle an aircrew error and made the situation more dangerous. In FY02, two similar incidents took place where aircraft departed without takeoff clearance. In both of those cases, the aircraft did not have adequate IFR separation with the previous aircraft, and the tower controllers uneventfully deconflicted the separation problem airborne. In this case, the controller chose to make a radio call stating "cancel takeoff clearance" when the formation was at a relatively high airspeed. At the time this call was made, the aircrew mistakenly thought they had clearance for takeoff and had no idea why they were being told to stop. The trainee in the lead aircraft overreacted and abruptly aborted, despite ample runway remaining for a more controlled formation abort. There was little time for the instructor to intervene at this point. The trainee's reaction to the controller's radio call could have easily led to a collision between the formation members. Though the aircrew would have been causal, the controller's action would have been considered a contributing factor.

When correcting aircrew errors, controllers need to consider whether the correction needs to be made at the precise moment the error is noticed or at a more appropriate time. This is especially true during the takeoff phase. It's not just how you correct a mistake that is important, but also when you correct it.

Who Do I Call?

The following HATR concerns an Aero Club Cessna 172 taking off without clearance. The C-172 called ground control requesting taxi for his VFR cross-country departure. The aircraft was issued taxi instructions to taxi to and hold short of Runway 19 at Taxiway November. The aircraft taxied for the intersection departure at Taxiway November and performed his engine runup. Soon afterwards, the tower controller noticed the Cessna airborne midfield off Runway 19. The tower controller attempted to contact the aircraft repeatedly. The aircraft performed a left downwind departure and proceeded northbound, climbing to approximately 1000 feet MSL. Tower was never able to establish communications with the aircraft, and it exited the Class D airspace to the North.

The investigation included interviews with, as well as written statements from, all involved with this HATR. The tower audiotapes and ATC radar tapes were also reviewed. After engine start and runup, the solo student tried to contact clearance delivery unsuccessfully. The instructor (IP) was standing by on the ramp, as the student had only flown this aircraft once and was a little unfamiliar with the radio setup. The student signaled to the IP that he was having radio problems. The IP approached the aircraft to see if he could help. After finding out what the problem was, the IP instructed the student to try to contact ground and report, "negative contact with clearance," and then moved back out to the end of the wing to monitor the situation. The student then tried ground and couldn't contact them either, so he tried radio two and got his clearance to taxi. He gave his instructor the thumbs-up signal and taxied out to hold short of Runway 19. The student said he was still hearing a lot of static and transmissions were coming in broken. While holding short of the runway, the student received a broken transmission which he thought contained some of the components of a normal takeoff clearance. Thinking this was his takeoff clearance he taxied into position and took off.

After his takeoff and turn to downwind, the student tried to contact tower on radio one unsuccessfully. After multiple attempts at contacting tower, the student flew approximately six NM northeast and began circling. Having no contact with air traffic control, the student called the Aero Club on radio two and relayed to them his problems with the radio. The Aero Club instructed the student to use radio two only and contact departure control for instructions. The student did as instructed and was given a heading from departure. The student turned to the assigned heading using his directional gyro. Apparently, the directional gyro was not indicating the correct heading. Departure had to correct the student's heading back to the airfield. Departure gave the student "no gyro" vectors back to a straight-in to Runway 19. The student landed uneventfully and taxied to parking.

After inspections of the plane the Aero Club found that the No. 1 radio was intermittently inoperative and changed the transceiver. The directional gyro was not actually inoperative. The type of gyro installed in this particular aircraft does not have a spring-loaded heading select knob. After setting the compass card with the heading select knob, the student did not disengage the heading select function. Consequently, the compass card was frozen and did not slave to the actual aircraft heading. How good is your training program for students on radio procedures and avionics equipment? If you aren't sure, you should be checking.

Maintenance Matters

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

In this edition we concentrate on the aircraft I started my career on—the BUFF! Here are a few issues the B-52 maintainers have had to face on the flightline.

Ladder Attacks BUFF!

A crew chief was tasked to assist with the removal and installation of the aircraft's No. 5 wheel and tire assembly. While accomplishing aircraft jacking preparation procedures for the wheel and tire removal/installation, the crew chief attempted to move a metal step ladder, which was lying on the ground underneath the No. 4 engine pod. As he lifted the ladder, the ladder swung upward striking the leading edge of the aircraft's No. 8 engine nose cowling and creating a dent at the seven o'clock position. Being a smart crew chief, he visually evaluated the dent and made an initial determination that the dent was within limits, so he did not notify anyone of the incident and proceeded with the tire change. During the aircraft panel inspection prior to flight, the panel inspector noticed the dent in the engine cowling and requested structural maintenance to accomplish an evaluation of the dent. Structural maintenance then determined the dent was out of tech order limits and was not reparable at home station.

What should have happened here? One, watch where the ladder goes. Ground equipment damages a lot of aircraft every year. Two, he should have reported the damage immediately for evaluation instead of letting someone else do his work. If something happens, report it; don't wait. It only gets worse when the reporting is delayed.

Loose Banana

The mishap sortie was briefed as a two-ship formation training sortie to include air traffic control assigned airspace activity, air refueling and transition. During taxi, a required crosswind crab check was performed and the mishap crew (MC) noticed the main landing gear (MLG) was slow to center. The centering of the MLG, however, was determined satisfactory to the aircrew. Takeoff through level-off was uneventful. The aircrew experienced no problems with the aircraft until return to base for the transition leg. Following the first touch-and-go landing, neither left MLG would retract. The aircrew rotated the crosswind crab knob approximately five degrees in both directions and was able to get the left forward MLG to retract. This is a commonly used remedy when any MLG fails to retract normally. The left aft MLG remained extended. The aircrew chose to extend all MLG, leave the gear extended and continue with transition, and experienced no problems with the aircraft during the second touch-and-go.

During the full-stop landing and rollout, the aircrew immediately noticed the MA would not track straight. The crew attempted to manually center the crosswind crab but was unsuccessful. An attempt to center the crosswind crab electrically was made, and the indicator showed centered. The aircraft then began to moderately vibrate. As the aircraft cleared the runway it became apparent there was a problem with the MLG. As the aircraft turned off the runway, the vibration increased significantly, and the crew decided to stop the MA on the hammerhead/taxiway. The MC shut down all engines and requested unit maintenance personnel respond to inspect the MLG. Once at the aircraft, the crew chiefs discovered the No. 3 MLG was turned inward approximately 20 degrees. Further inspection of the No. 3 MLG revealed the No. 3 MLG curved steering metering valve link (banana link) was disconnected from the steering valve arm assembly. The bolt that attaches the banana link to the steering valve arm assembly was found inserted in the steering metering valve arm assembly with the nut attached to the bolt. There were no other components found damaged, loose or disconnected. The banana link was reconnected to the steering valve arm assembly and the aircraft was towed to the designated parking location.

Maintenance technicians performed a visual inspection of the trunnions and structural members in the immediate areas of the aft MLG and found no damage. The No. 3 and 4 MLG strut assemblies, wheels and tires were removed and replaced, and the aircraft has flown several sorties since the incident with no problems associated with the No. 3 or 4 MLG. Why did an aircraft take off without a critical link attached?

Two workers were tasked to cannibalize (CANN) the No. 3 MLG outboard steering actuator rod end pin for another wing aircraft. The workers removed the steering actuator rod end pin IAW tech orders. There is no specific task for removal of an outboard steering actuator rod end pin. To accomplish the steering actuator rod end pin removal, technicians remove, disconnect and loosen certain MLG steering actuator components to facilitate the steering actuator rod end pin removal. The technicians indicated they did not remember disconnecting the No. 3 MLG banana link to facilitate the removal of the outboard steering actuator rod end pin. 781 series forms documentation showed the No. 3 MLG steering plates were disconnected/temporarily installed, the positioning control unit cover removed, the back lash spring disconnected, a temporary outboard steering actuator rod end pin installed and the outboard steering actuator rod end pin canned. There was no forms documentation indicating the disconnection of the banana link.

When the new steering actuator rod end pin arrived, the same workers were tasked to install the parts. It was determined that during the canning of the outboard steering actuator rod end pin, the workers disconnected the banana link to facilitate the outboard steering actuator rod end pin removal and failed to document the 781 series forms to reflect the disconnection of the banana link. Subsequently, they failed to reconnect the banana link during the installation of the new outboard steering actuator rod end pin. Proper cannibalization procedures appear to have been followed other than proper 781 series forms documentation showing the banana link disconnection. The disconnected banana link wasn't noticed during the aircraft preflight inspection, panel inspection or by the aircrew during the aircraft exterior inspection prior to flight. What do you always hear about a chain of events that leads to accidents? Here's a good example of one for you to use in your safety briefings. Technicians didn't follow procedure when removing a component, so it was missed on reinstallation, plus two qualified maintainers missed it prior to flight. Documentation is the best way to ensure nothing is missed when we take care of our aircraft.

Follow the Marshaller?

The mishap aircrew (MA) flew an uneventful 12.8 hour combat mission and landed safely at base. After completing armament safety checks, they taxied to the parking ramp. The mishap copilot (MC) taxied the MA down the parallel taxiway following the follow-me truck onto the centerline of the parking ramp. Upon turning onto the centerline of the parking ramp, the aircrew spotted the marshaller along the taxi lane centerline, and began following his direction to taxi straight ahead. The follow-me vehicle cleared the taxi lane, and a maintenance vehicle was parked off the nose of another aircraft on the parking ramp and was unattended. The aircrew noticed the parked vehicle, thought they had enough room to clear it and continued to follow the marshaller's signals to taxi the aircraft straight ahead. The aircrew did veer slightly right of centerline to allow for more room between the vehicle and the aircraft. The mishap aircraft impacted the back end of the vehicle with the left wingtip. The aircrew heard a loud bang and felt the impact. The aircrew stopped taxiing the aircraft, even though they were still receiving the taxi forward signal from the marshaller. The marshaller didn't notice the mishap vehicle until after the aircraft stopped taxiing. The aircrew shut down the aircraft and egressed uneventfully.

Here we have a blind marshaller who didn't notice a vehicle in his aircraft's path. This is a big mistake. We are supposed to be the eyes of the aircrew on the ground and ensure the path is clear, and that the aircrews go where we tell them. If you are a maintainer who has ever had to deal with an aircrew that won't follow your signals, this is one of the reasons why. Make sure the taxi path is clear to ensure the safety of your aircrew. By the way, it's the aircrew's career that goes out the window when they hit something, even though you could have prevented the impact.

USAF CLASS A FLIGHT MISHAPS

FY04 Flight Mishaps
(Oct 03-Jul 04)

24 Class A Mishaps
9 Fatalities
10 Aircraft Destroyed

FY03 Flight Mishaps
(Oct 02-Jul 03)

26 Class A Mishaps
10 Fatalities
19 Aircraft Destroyed

05 Oct	A C-17 had an engine failure (upgraded to Class A).
09 Oct	A KC-135E experienced a number 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 ✶	A C-5 engine had damage from a compressor stall during a test cell run.
30 Dec ✶	An RQ-1 crashed after it experienced a software anomaly.
31 Jan	A KC-10 experienced an engine failure.
03 Feb	An E-4B had an engine failure in flight.
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.
06 Jun	A C-17 suffered engine damage inflight.
12 Jun	An A-10 suffered an engine fire.
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.
13 Jul	An F-16D experienced an engine fire on takeoff.

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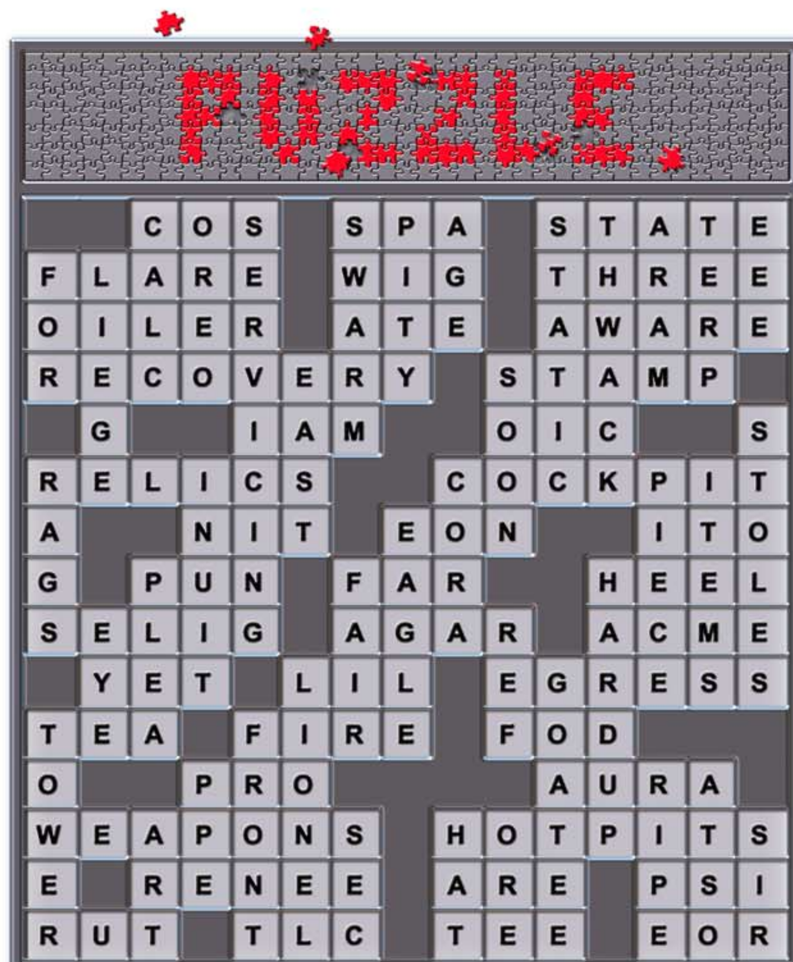
- A Class A mishap is defined as one where there is loss of life, injury resulting in permanent total disability, destruction of an AF aircraft, and/or property damage/loss exceeding $1 million.
- These Class A mishap descriptions have been sanitized to protect privilege.
- Unless otherwise stated, all 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 16 Jul 04**.

Solution to puzzle on page 25.




Consumed with safety?
...we hope so.