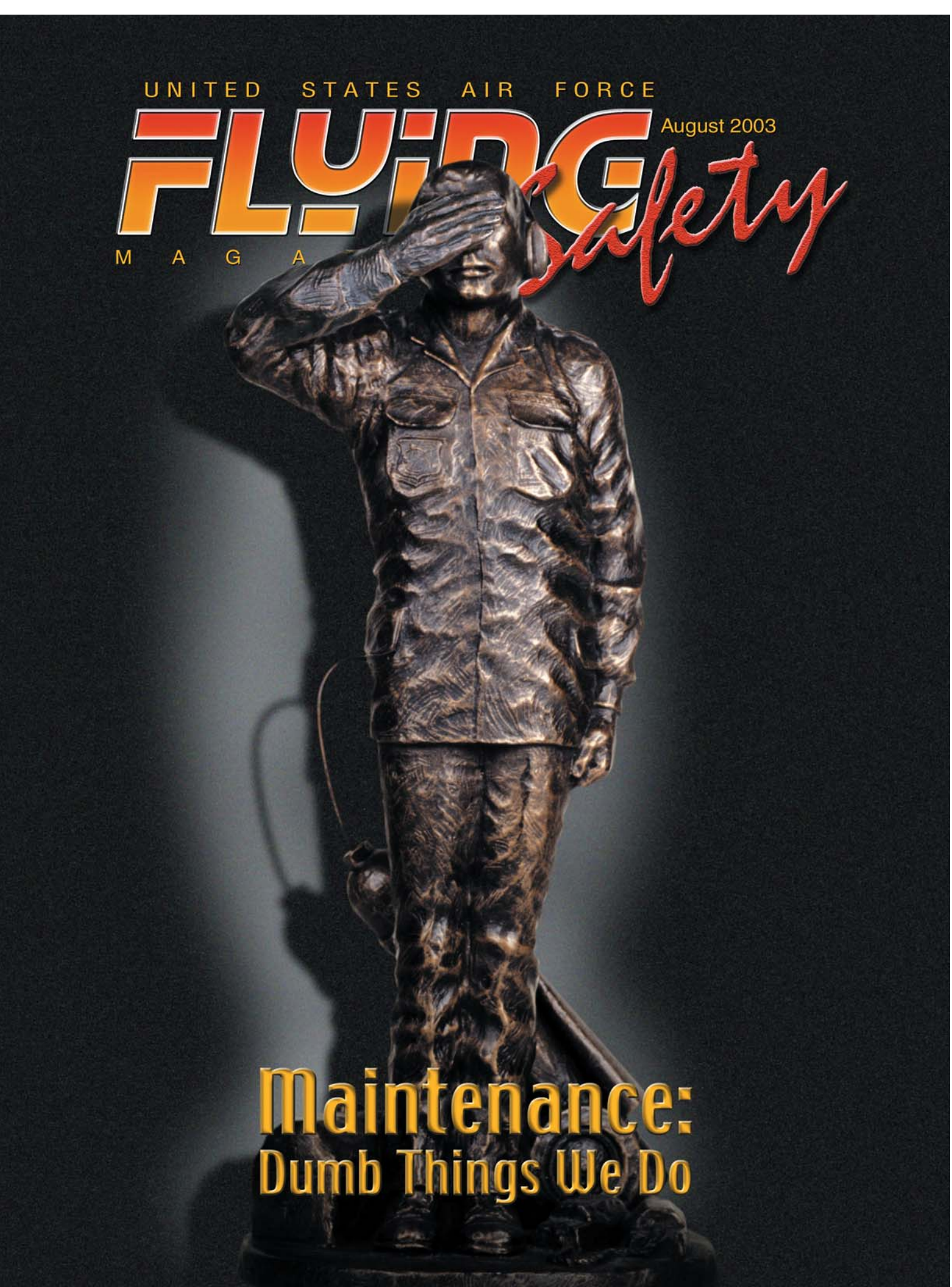
UNITED STATES AIR FORCE

FLYING Safety

MAGAZINE

August 2003



Maintenance: Dumb Things We Do

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Photo Illustration by Dan Harman

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FLYING Safety

MAGAZINE

GENERAL JOHN P. JUMPER
Chief of Staff, USAF

MAJ GEN KENNETH W. HESS
Chief of Safety, USAF

COL KIRBY HUNOLT
Chief, Safety Education and Media Division
Editor-in-Chief
DSN 246-2968

JERRY ROOD
Managing Editor
DSN 246-0950

CMSGT JEFF MOENING
Maintenance/Technical Editor
DSN 246-0972

PATRICIA RIDEOUT
Editorial Assistant
DSN 246-1983

DAN HARMAN
Electronic Design Director
DSN 246-0932

TSGT MICHAEL FEATHERSTON
Photo Editor
DSN 246-0986

Commercial Prefix (505) 846-XXXX

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

24-hour fax: DSN 246-0931

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SAFETY sage

In "RTO: The Go/No-Go Decision" in the April issue of *Flying Safety*, we omitted a couple of charts, without which the information in the article was confusing. The staff of *Flying Safety* regrets this error. Here are the charts:

Chart 1 *

GROSS WEIGHT	V_1 SPEEDS DRY/WET
300K	109/109
350K	112/109
400K	124/111
436K	132/120
450K	135/121
500K	141/128
550K	153/138
590K	165/149

Chart 2 *

GROSS WEIGHT	APPROACH SPEED	V_1 SPEEDS DRY/WET	LANDING GROUND ROLL DRY/WET
300K	131	109/109	2010/3976
350K	141	112/109	2346/4639
400K	151	124/111	2672/5284
436K	157	132/120	2921/5777
450K		135/121	3017/5968
500K		141/128	3365/6656
550K		153/138	3763/7442
590K		165/149	4115/8139

* Generic numbers @ 20°C, Sea Level
ETOLD Computer used to generate numbers
Reduced Power was used to max extent possible
10,000 runway available (R.A.) used up to 500K weight
11,000/12,500 R.A. used for 550K and 590K weight
Your chosen R.A. will affect numbers for heavier weights

Dumb Things We Do

CMSGT JEFF MOENING
HQ AFSC/SEMM

Once upon a time there was an Air Force that was considered the greatest in the world. The aircrew and maintenance personnel were the best trained and prepared, and they had shown they could kick butt, rescue innocent civilians and provide humanitarian relief all over the world at a moment's notice. Most importantly, they were known for the fact that they never had accidents. Their planes never crashed because of aircrew error or improper maintenance. They always followed the book and took the extra steps to ensure their safety and the safety of their passengers, and they never damaged an aircraft because of bad maintenance practices.

Did I just take a trip to Fantasy Island or what? There is an Air Force that is the most respected in the world, and that is ours! We have the best trained and educated aircrew and maintenance personnel. But what we don't have is an accident-free Air Force. From FY93 to FY02 we lost 1,024 lives, 243 destroyed aircraft and $10.6 billion in mishap costs. Does that reflect the most respected Air Force in the world?

If you read the Jan-Feb 03 issue of *Flying Safety*, you read the End-of-Year summaries and saw that FY03 was no better. For the purpose of this article I am going to focus on the maintenance side of this puzzle. The fact is that we had a bunch of preventable aircraft maintenance mishaps. The people involved didn't follow tech data, didn't use protective gear, or just did dumb things.

HQ AFSC Photos by TSgt Michael Featherston
Photo Illustration by Dan Harman

Most people don't think of human factors when they think of maintenance, but it is a large player in mishaps. How do we know? Read a few examples of mishaps, and that should answer the question.

• Worker removed a panel from the top of the aircraft and set it on the canopy ledge. While descending the ladder, the worker lost his footing and hit the panel. It fell off the canopy and struck him in the head. Did this worker make the right choice in placing the panel in an unsafe position?

• Worker injured when he was walking backwards and fell over a winch cable and landed on his buttocks, injuring it and his back.

• Five workers were injured when they deviated from tech data and pulled the landing gear down lock pin and moved a switch. The landing gear collapsed. (See the AIB report in this issue for the whole story.)

• Worker was inspecting an aircraft and fell through a floor opening. Someone didn't bother to block the opening or take steps to prevent others from falling through the hole.

These little accidents, and the major ones, caused millions of dollars in damage to Air Force equipment and an untold amount in personal injury and lost productivity. How do we, the maintenance community, stop these little mishaps? We are all human and we all make mistakes, but how do we mitigate the risk? How can we make them as foolproof as possible without limiting our working or mission capacity? How can we ensure common sense is used and people step to the plate and make the right choice?

To start with, supervision/leadership must be involved. Without the involvement and guidance of the people in charge from the wing commander down to the immediate supervisor, the workers will not follow the rules. If they see that leadership only pays lip service to safety, they will follow the leader. Leadership must set the stage for the young troops. Yes, we have a mission to accomplish, and flying and maintaining aircraft is an inherently dangerous business, but we can do it safely. What can supervision do?

Start with taking a look at your current situation. Your ORM tools come in handy here. Perform an inspection of your area to determine if you have set your people up to have an accident.

1. Are there hazardous areas that are not properly identified and marked so that the average individual would miss them?
2. Are there chemicals in the workplace that haven't been identified and people are not trained for?
3. Do you have all the required protective equipment for the hazards identified?
4. Is there equipment that is not properly marked?
5. Are there accepted practices that go against the rules?
6. Are you using too many "workarounds" to just get by?
7. Is there enough money to replace a piece of defective equipment or provide safeguards?
8. Is the tech data current and its use strictly enforced?
9. Does supervision enforce the safety rules at all times, at all levels?
10. Do your people think about safety and risk mitigation when performing tasks?
11. Can people speak up about safety and be listened to?
12. Can you stop the mission if safety is compromised?

By performing an inspection, you can determine if the system is setting your people up for mishaps, and what area may need work.

Once you have identified your current situation, you need to look at where you want to be. What kind of safety attitude and presence do you want in your work center? Are there areas that need to be reworked to make them safer? You need to assess the attitude of your people and see if they have the work habits that lead to safe maintenance. You must set the example and by looking at these areas you can improve the work center. If your workers think that you care enough to ensure they have a safe work environment, the right tools for the job, and leadership support, your work center will succeed in completing the mission.

What can you do about the situation? To begin with, document all the issues. Bring that documentation to your leadership, and ask for help. If you need money and funds aren't available, have you documented the need and is the item on the unfunded wish list as a safety issue? Have you developed methods to mitigate the risk if it can't be eliminated?

If they see that leadership only pays lip service to safety, they will follow the leader.

As supervisors and workers, it is our responsibility to prevent mishaps. The best way is to use ORM and good common sense (which isn't so common anymore), look for ways to improve our capability and ensure we minimize the environmental hazards that we face. There are many hazards in the aviation world we must work in, but we can mitigate the risks to a level where injury and damage is not a result of the working environment.

If your environment is safe, how do we reduce the human aspect of the puzzle? This is the hardest question to answer, and there are many possibilities. I have found no one who has the "catch-all" answer, and if you do, please let us know so we can tell the world. The most important thing you can do is enforce the rules and use of tech data. That alone will reduce the mishaps. To me, the key is attitude—a safety attitude.

What is a safety attitude? From our perspective, a safety attitude is one where the climate in the unit or workplace puts safety at the same level as mission accomplishment. Without safety, the mission will be degraded, if not stopped, and not just in a slogan. Supervisors from the top down do not accept anything less than full compliance with technical data and safety regulations. The standards may be a pain to comply with, but think of the cost of non-compliance. If you don't have time to complete the task safely, where are you going to find time to react to the mishap, perform the safety investigation, and repair the damage to aircraft or work without a worker? If the supervisors do not enforce the rules, the workers sure won't. Here are some examples where safety attitude by workers and supervisors caused mishaps.

- Supervision allowed personnel to not write up IPIs on separate write-ups. Procedure was there but supervision didn't enforce the rules, so people got lax. Destroyed aircraft.
- Worker needed some engine oil, lifted three cases by himself and strained his back.
- Worker installed a tri-axis gyro backwards and did not document the work—aircraft crashed.
- Workers failed to properly service a landing gear strut, aircraft landed with gear up.
- Supervision routinely permitted maintenance personnel to deviate from tech data. Damaged aircraft.
- Maintenance did not follow tech data and improperly rigged a fuel control, resulting in the inability to shut the engine off.

Now, to me, not using the tech data or supervision knowing people are not following the book and not stopping it, is a failure of the basic principles we were taught from day one in basic training. Integrity is key to our profession and the safety of our workers and our aircraft.

What did I provide to you in this article to help you with your safety program? Hopefully, I made you think about looking at your area to see if there are things that can cause mishaps and if there are procedures to prevent injury. Most importantly, do people have the ability to bring unsafe practices to leadership to get them fixed? If you need more information about ORM or help improving your safety program, start at the wing safety office. In addition, the Safety Center is here to help, and if we can, we will! Safety Attitude is everything!

The standards may be a pain to comply with, but think of the cost of non-compliance.

USAF Photo by MSgt Terry L. Blevins

Grumpy's Five Rules Of Maintenance

Illustration by Dan Harman

MSGT SCOT D. WHEELER
58th Maintenance
Operations Squadron
Kirtland AFB NM

Back in 1991, I was assigned as a maintenance instructor in the Maintenance Training Flight at the 86th Fighter Wing at Ramstein AB, Germany. Each month, we conducted our maintenance orientation course, which introduced all the new maintenance troops to the 86th and fulfilled their initial ancillary training requirements they needed before they went to work on the flightline. Part of the class was a briefing by the Deputy Commander for Maintenance (the DCM for us old guys).

Our DCM was Col John Edenfield. He was one of those DCMs you always heard about…the no-nonsense type who didn't put up with a whole lot of tap dancing and could display the temperament of a badger with a migraine. That's why his call sign was "Grumpy."

When Col Edenfield briefed our maintenance orientation classes, he always briefed what he called "Grumpy's Five Rules of Maintenance." As I look back, I find that he was ahead of his time. His five rules integrated our Core Values and Operational Risk Management years before they became a part of our Air Force Culture.

Grumpy's Five Rules of Maintenance:

#1. Honesty. You must always be honest, even when the news is bad. It was always much easier to take the wrath if you were honest, than it was if you lied and got caught. As it says in our Core Values, "Our word must be our bond."

#2. Integrity. Always do the right thing, even if nobody's looking. Again, our Core Values state, "No person of integrity tries to shift the blame to others or take credit for the work of others." Do the job right every time, be responsible for yourself and your troops, give credit where it's due…that's integrity at work.

#3. Safety. Col Edenfield always briefed this third, but it was always his first priority. He covered all the basics of what we now call TKC: Think ahead, Know the risk and Choose to be safe. He taught us to think before we did anything, understand what could go wrong and how it could affect us, then minimize the risk to do the job safely and correctly every time. If it wasn't safe, you didn't do it.

#4. Tech Data. Col Edenfield demanded 100% T.O. compliance from every maintainer on the flightline, from the Pro Super to the lowest airman. T.O.s were to be open and used on every job.

#5. Common Sense. All of us were born with enough common sense to know when something's not right. Col Edenfield expected us to use that common sense, and empowered us to act on it. If it just didn't seem right, he expected us to step back, call for backup, then resolve the problems and get the job done right.

Honesty, Integrity, Safety, Tech Data and Common Sense. These five rules have stuck with me all these years, and I've found they're valid both at work and at home. They're five simple rules we can live by.

What If

Illustration by Dan Harman

CMSGT JEFF MOENING
HQ AFSC/SEMM

This issue is mainly about aircraft maintenance and mistakes we have made in the past that have caused mishaps. Now, is every mishap preventable? Yes, it's possible. Can we maintain the number of aircraft we have in the USAF and not have accidents due to faulty maintenance? Yes, if we train our people correctly, give them the tools needed to perform safe quality maintenance and provide quality supervision. Hindsight is 20/20, and it's easy to sit in an office and second-guess a mishap based on accident investigations. But we need to learn from others' mistakes, and that is the purpose of this article. Let's look at a few accidents and see what could have happened if steps had been taken to stop the chain of events or different choices had been made.

At a depot, two workers were tasked to remove the ball screw and sprocket assembly from a C-5 landing gear. A common task at the depot. The workers were working overtime, and on the day of the mishap, the gear was disassembled to a point where the main outer cylinder was ready to be removed. Like all things mechanical, this strut had become attached, and many attempts to remove the cylinder had failed. The strut was stuck. This caused the workers to deviate from procedure and remove the sprocket and ball screw before removing the main outer cylinder.

The two ball screws on the gear are removed one at a time and they use a padded four-inch stand to support the ball screw while they lower the disassembly stand. This, in turn, lowers the ball screw to the padded stand, preventing the ball screw from contacting the concrete floor, and holds it in place while the final bolts are removed. When the bolts are removed the disassembly stand is raised, allowing the ball screw and sprocket to slide out of the yoke. A worker positioned on the floor holds the ball screw and sprocket assembly upright and guides it out of the yoke until clear of the stand.

Because the main outer cylinder had not been removed, the task was more difficult and workers could not lower the ball screw down to the floor as normal; it was six to eight inches above the padded four-inch stand. The two workers were positioned on the floor, and a third worker was watching. The two workers removed the last two bolts holding the

ball screw and sprocket assembly, and it, too, was jammed and would not release. One of the workers used a drift punch and three-pound steel hammer to hammer on the top of the ball screw to loosen it. After it had moved about an inch, the bearings had moved past the landings and the sprocket assembly started to turn. The worker not hammering on the strut reached up to stop the sprocket from spinning. As he reached up to stop the sprocket, the ball screw let go and he suffered an injury to his hand, costing the government $250,000 and lost job time while the individual received treatment.

"What If" time. What if the workers had made the choice to take the steps to remove the main outer cylinder first instead of pressing on with the ball screw? What if, seeing as how they were using a workaround, they had created another workaround to allow the padded four-inch stand to cover the gap made by the main cylinder still being installed? What if the third worker, who was overseeing the operation, saw the dangers and stopped the task until the risk could have been mitigated? ORM is out there, and it works great when you have to deviate from normal procedures. The workers were trained on the task and were trying to get the job done. What if one of them had stopped the task until they could have better ensured their own safety? What would you have done differently if this were you performing the task?

Here is another example of a past mishap. An F-15E was traveling cross-country for an air show. At the air show location, the travel pods were downloaded and the aircraft performed the show. The next day, the travel pods were uploaded and the aircraft took off for the next location. During the flight, the flight lead did a battle damage check on the mishap aircraft and found the front lug on the right travel pod had released and the pod was turned 90 degrees. The pod lost the front and back ends, and they struck the aircraft as they departed. The aircraft then landed uneventfully.

Now, the hooks for the pod can be in one of three positions—full open, full closed, or intermediate. Post-mission inspection of the aircraft showed the hooks for the right pod to be in the intermediate position. This would hold a store and it would appear to be closed, but the over center feature has not been reached. In this condition, air loads may exceed the holding strength of the hooks. The front hook, the one that came open, passed the 150-pound release test as required by the tech data.

The main cause of this $125,400 mishap can't be told here, but you can get the report from the safety office. I'm sure you can guess why the front lug let go inflight. Time to "What If." What if the crew chief and pilot had performed better preflights to ensure the pod's integrity? Many of the unit pilots thought the weapons security requirements didn't apply to travel pods. What if the travel pods had stayed on the aircraft for the air show flyby and were not removed? The aircraft configuration had changed while at the air show, so the crew chief was unprepared for the last-minute change. Since he didn't know of the change, he did not have the proper T.O. with him on the TDY. What if the crew chief had told the aircrew that he couldn't remove the travel pod, since he had no tech data for the task? Could the crew have completed their mission as planned? If you don't have the T.O. for the task, don't perform the task. If you are going to change procedures, make sure everyone can adapt to your changes. Have the guts to stand up and do what's right.

A final example. A worker was tasked to transport some classified equipment to TMO for shipment. The worker, using a 4K Hyster forklift, went to the supply warehouse vault, picked up the equipment and took it to TMO.

Unfortunately, TMO was unable to ship the material that day, so it had to go back to the vault. While traveling back to the supply warehouse vault, the worker was driving forward with the mast blocking her view, and she was looking out the side. She crossed the yellow safety line and struck one of the building support poles. The impact crushed both boxes and the equipment inside, causing $840,122 in damage to the classified equipment.

Now, we all remember our forklift training and AFOSH standards that state you must go in reverse when the mast or load blocks your forward view. What if this individual had chosen to stop at TMO first before bringing the materials? This way she would have been sure they could have been shipped. What if her supervisor had checked to ensure TMO was able to ship the material before tasking her? What if she had followed the requirements of AFOSH and her training? What if she had arranged for a spotter to guide her if she could not go backwards? If she had made some different choices, she would have prevented this mishap.

These few examples show that it's hard to make choices and it's easy to see where the bad choices were after the fact. But if people have a safety attitude, think ahead, follow technical data, and have supervisory involvement, even when it would be a tough call, it can make a big difference to the Air Force.

The high cost of these mishaps and the injury potential make it mandatory that we reduce these kinds of mishaps. We don't have the time to be redoing work, injuring people or losing valuable equipment and aircraft to bad choices. People are human and humans make mistakes. The key is to minimize the mistakes and take all the steps necessary to prevent a mishap. By using ORM and having the guts to make the right call to stop a bad situation, you can break the safety mishap chain and prevent a mishap. It is everyone's duty to prevent mishaps and step in when needed. Where do you stand on mishap prevention?

USAF Photo

LT CHRIS FIELD, USN
VAQ-134

I never thought it would happen to me, but a lapse in the "attention to detail" department caused me a brief moment of panic followed by a day's worth of embarrassment. Foreign Object Damage (FOD) is something we in the Navy take seriously, especially when something the size of a quarter can cost millions of dollars, let alone lives.

It was a good flight, an easy jaunt around the state of Washington with some sightseeing of Mounts St. Helens and Rainier. I was in the front right seat, the best view in the house. The flight and landing were uneventful. Thoughts of scrambling out of the squadron early floated through my head, maybe even hit the O club or host an impromptu cookout. What I should have been thinking about was the hot switch evolution. How many times have you heard, "The flight's not over 'til the paperwork's done"?

We taxied into the holding area to swap crews. Of course, the skipper was switching into my seat (he always seems to be there for any kind of JO screw-up). We went through the checklist and unstrapped. The pilot shut down the left engine, popped open the canopy and the crew on the left side got out. As the new pilot started to get in the jet, I remembered my chart stashed in the radar boot. I pulled it out and the half page of AP1-B information that was glued on the back peeled off. It was kicked up by the wind and went straight into the right intake! As I watched it get sucked in, I thought, "Well, that's gone for good; nothing but ashes now." Then, "Damn!" as I looked up at the approaching skipper. I saw the Plane Captain signaling us to shut down the right engine. Yup, even though it was a small piece of paper, we still needed to take a look at the engine. I told the replacement pilot to secure the right engine for FOD. He did so and then looked at me for a better explanation. I gave it to him, and he gave me a big rolling of the eyes.

Fessing up to the skipper was the worst. As I did, it dawned on me that I had just made their day a little longer. What was supposed to be a 20-minute evolution was now going to be an hour. Damn! Why did it have to be the skipper? So, there I was, standing next to my CO, stressing out over what a piece of paper and my luck could do to a J-52 engine (nothing) and feeling bad that I just made the next crew's flight an extra 40 minutes longer.

All of this could have been avoided if I had taken the time to care for my stuff. Complacency also had a hand in this. One should never take for granted that everything on a flight will be like the last. A little "attention to detail" and forethought can save a lot of heartburn. Check your gear, make sure it's all together, and keep your mind in the plane. ✪

(VAQ-134 is a US Navy Expeditionary EA-6B squadron.)

What Have You Done For Airman Snuffy?

Illustration by Dan Harman

CMSGT JAMES M. JOYNER, USAF
55 MXG
Offutt AFB NE

Airman Snuffy is a fictional character famous throughout the LGM community. For us, Snuffy typifies every two-striper who busts butt out on the flightline or in the shop. Snuffy works in rain or snow and in blistering heat with 100% humidity or sometimes in a climate-controlled lab, but always under pressure. Snuffy carries a toolbox, works Mids and weekends, sweeps hangars, and shovels snow when told. Snuffy just became a 5-level with a 93 on the EOC and does more than a fair share of extra hours.

Our airman remembers how to march and is frequently selected to do so proudly in retreat ceremonies and retirement parades. Snuffy maintains a mobility bag ready to go to Egypt, Alaska, or Chitlin Switch, Arkansas—wherever, whenever the equipment and the airplanes go. Should anyone ask, Snuffy will proudly inform them exactly who fixes the Hobart/radio/o'scope/bomb/airplane (and whose rear gets chewed if it isn't right).

Snuffy's bosses are like stars in the sky…without number and high above. They are all alike because they all know what needs to be done, how to do it and who should do it…Snuffy! Some probably don't appreciate Snuffy's work enough. Despite that, Snuffy works hard and works proud. If you are reading this, you are probably one of Snuffy's bosses. Ask yourself, "What can I do for Airman Snuffy?"

Sometimes Snuffy needs a hand. You have invaluable system expertise. It can be enlightening to help Snuffy fix a unit or solve a technical problem. Sometimes you can learn new ways to approach old problems. Snuffy's shiny new enthusiasm rubs off on fellow workers and supervisors. This is your opportunity to train the right way, by the book, and to show off the techniques that you've acquired over the years. It's also a perfect chance for you to praise Snuffy for work well done.

Another way to help Snuffy is to ensure the proper tools are available for the job. Nothing is more frustrating for Snuffy than to try to make do with inadequate tools. That goes for T.O.s, too. When Snuffy finds a problem, help him fill out the AFTO 22. Explain why it is everyone's job to identify and correct tech data. Try not to dampen enthusiasm with negative remarks like, "We've always done it that way," or "I don't care what the books say."

Give the kid a break. Sometimes hardworking maintenance folks neglect their educational opportunities. Sometimes supervisors make it difficult because we don't allow time to pursue them. We owe Snuffy a chance to learn more about the job. Sometimes the opportunity to excel means a chance to go to FTD instead of to the flightline. CTO or a three-day weekend is a positive reward for hard work or overtime to repair a broken unit. Used sparingly, CTO is the most effective reward that first-line supervisors have to give.

Give Snuffy a leg up. If Snuffy reminds you of yourself when you were an "Airbaby," fresh and new to the Air Force, then try to be the sort of boss Snuffy would like to be someday. You are the role model for the airmen who work around you. You can be a STAR in Snuffy's sky or a black HOLE where all hope and enthusiasm are sucked up. Remember, some of the credit we get for work done well belongs to Snuffy. Think about it. What have you done for Snuffy lately?

Aircraft Maintenance Training

Photo by Mr. Yuichi Imada

MAJOR TIM NESLEY, USAF
Avionics Production Division
WR-ALC/MAIP

In the 20 years of my Air Force career, I have seen maintenance training metamorphose as the career fields have consolidated and philosophies change. But, one thing that has not changed is the goal of having the best-trained airmen in the world, ready to respond to all the worldwide contingencies that face us today. Over the years, I have learned our process of instruction, formal education and On-The-Job-Training (OJT) is second to none. While the formal education has changed to match the times and organizational changes, the OJT process has not changed. It still relies on the seasoned veterans of our ranks teaching knowledge and experiences to the next generation of flightline leaders, armed with AF Form 623s and the checklist of material they are to know.

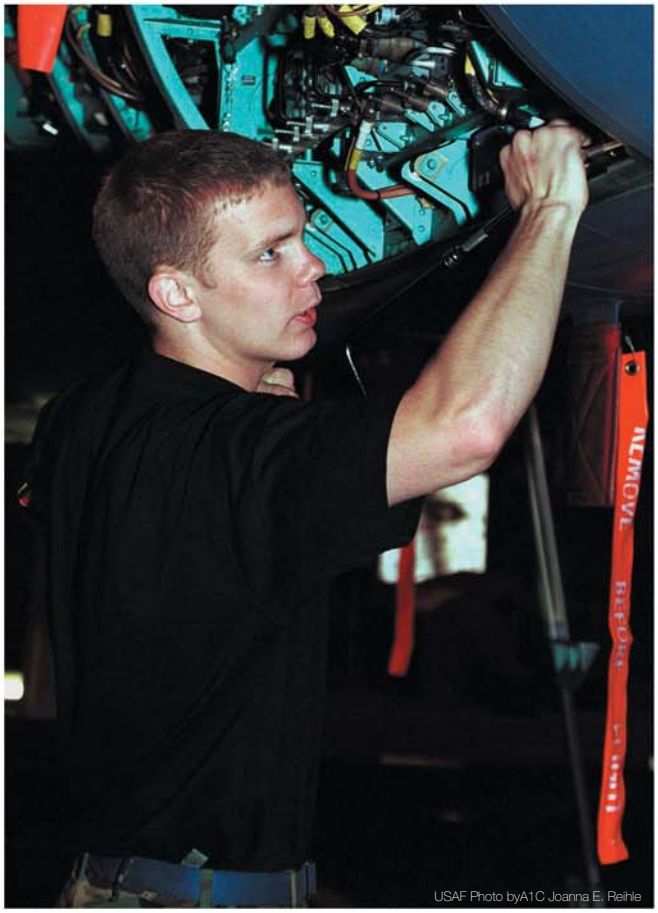
After completing the Aircraft Maintenance Officer Course, I started out as a bright-eyed 2Lt attached to the 320th Avionics Maintenance Squadron. Not knowing the formal education process, I was impressed with the organizational structure of SAC Regulation 66-1: having all sorts of shops (Comm-Nav, Doppler, Bomb/Nav, ECM, Instrument, Autopilot, etc.) with a seasoned MSgt as the Shop Chief. All the technicians in their shops were masters of their systems. When a plane landed with an in-flight discrepancy and the crew debriefed, I enjoyed the interaction of the shop chief with his shop. Like the old family doctor, he would listen to the symptoms and direct his NCOs and airmen to look in certain directions during their troubleshooting to solve the mysteries of the failed system. Upon isolating the fault, the maintainers would bring the "box" into the shop, pop the top, run it across the mock-ups and further isolate the fault, down to the electronic component or broken wire. The maintainer would fix the fault, run back to the flightline and perform an operational check on the system to validate the repair. The end result: We had maintainers who understood their systems cold. I had the opportunity to watch 7-level TSgts and SSgts teaching the young airmen the physics on the ASQ-38 B-52 Bomb/Nav Radar operation on a blackboard, and how they refine the system to perform at peak operational capacity, providing the crewmembers the best we could. In their spare time, the Shop Chiefs would send their NCOs and airmen out to research the Tech Orders, providing test questions to find. As a Shop Chief told me, "Busy hands are happy hands." Through these Q and A sessions, refined and honed by practical work experience, our airmen of that generation set the stage for the transformations of the future.

In my next assignment as an AMU OIC, the Air Force underwent its first major classification reorganization, Rivet Workforce. Like career fields were combined (Instrument-Autopilot, Comm-Nav, Electro-Environmental, Sheet Metal-Structures, etc.). OJT became more critical as our 7-levels were not only training the 3 and 5 levels, but each other.

But, armed with our Job Qualification Standards (JQSs), we plowed through this requirement and became stronger for it. But still, our 7-level maintainers, backed by the seasoned Senior NCOs, were the rock on which we built our house.

Similar changes have taken place with the Career Field Education and Training Plan (CFETP). Jobs consolidated, new requirements levied, and new challenges given. But armed with our checklist of tasks and lessons to learn, and that experienced maintainer to teach, we will continue to excel. It is the role and duty of each NCO, to not only teach via OJT all the parts of the job, but also mentor the leaders of tomorrow with war stories and experiences of our past, to pass on what we have learned. As an AMU OIC, I relished the time I rode with my production supervisor and assistant OICs, imparting my philosophy and debriefing the results of the day's staff meetings.

As an AMC Squadron Maintenance Officer, before a contingency exercise, I would show/teach my officers and production supervisors the wartime plans they impacted (to their security level), how the timing of each aircraft in the lineup impacted other events and aircraft. This would show them, in the heat of a generation, that there is method to the madness, and they were then able to provide better inputs and responses to the directions.



USAF Photo byA1C Joanna E. Reihle

In the Depots, the civil service workforce performs the vast majority of the work. In the WR-ALC Maintenance Directorate alone, there are approximately 6500 team members, of which about 50 are blue-suiters. To train the employees, they use a system very similar to the blue-suiters. Production Acceptance Certification (PAC) is a certification by Depot maintenance task. First, the individual must have basic skills training (i.e., basic sheet metal training, electronics, etc.; generally formal training), then systems-specific training (MDS-specific, generally a mix of formal structured training and OJT) and then task-specific training (primarily OJT). There are also general and task-specific recurring training requirements such as corrosion, safety, ESD, etc., and finally, special skills requirements such as egress, welding, NDI, flight control rigging, refuel, etc., that require extensive formal training and structured OJT. Once all training is complete, individuals must demonstrate proficiency before they can be certified to perform the tasks. Only then can the supervisor certify the individual to perform the task. After they have completed the task, they perform a self-inspection and then certify the Work Control Document, signifying that the work meets all technical requirements. Each PAC-certified worker must get personnel evaluation by Quality Assurance at least once every two years. Documentation of PAC is in the Production Acceptance Certification Standard System (PACSS), which tracks all the training and certifications.

This is a paperless system that uses PINs to authenticate the actions. If recurring mandatory training is missed, or the individual for any reason does not perform the tasks correctly, they can be decertified. This system started in the early 1980s and has been improved over the years. We are in the process of developing civilian training plans (similar to military CFETPs) that will be used in the PACSS system to identify core training by civilian job series.

In the corporate world, employees are hired with a certain job qualification. From there, the training is almost solely OJT, using blueprints and technical manuals, to master their area. But, there is not the same requirement to "dig" through the books, and hence the training is only as good as the person doing the training. Likewise, the documentation process is not nearly as formal as the Air Force blue-suit or civil service. Hence, the first levels or leadership/management orchestrate their folks to the areas required and as needed.

As a maintainer who has been around the block a few times, I am very pleased and confident of our training process in the Air Force. Armed with the teachers/trainers/mentors in our present ranks, and a lesson guide like PACs and CFETP, we will continue to exceed the challenges put before us in the future, and make those who have walked in our shoes before us proud of what we are doing.

The Aviation Well Done Award is presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Mishap Prevention Program.

MAJ JEFFREY G. OLESEN
99 RS/DO
Beale AFB CA

Maj Jeff Olesen was flying his U-2S above 70,000 feet in support of Operations Southern Watch. Three hours into the sortie, the engine began to experience "rollbacks." The fuel-flow fell toward zero with an accompanying severe loss of thrust. The rollbacks each lasted approximately one second, followed by the engine accelerating back to full power. Maj Olesen turned immediately toward Prince Sultan Air Base and followed the T.O. guidance of placing the engine mode to secondary. In secondary mode, however, the engine began to vibrate violently causing the aircraft to shudder, and all the engine instruments began to roll back toward zero. Expecting imminent engine seizure, Maj Olesen placed the engine mode switch back to primary, which significantly reduced the vibrations.

As the rollbacks become progressively more pronounced and more frequent, Maj Olesen tried in vain to stabilize the engine at different RPM settings. Realizing that the engine could flame out at any moment, and in any case would not sustain sufficient thrust for a return to PSAB, Maj Olesen began a descent toward a divert field 80 miles away. At idle power, the rollbacks subsided. At 20,000 feet, Maj Olesen tried once again to find a reliable power setting other than idle, hoping that the difference in altitude may have helped. Unfortunately, idle continued to be the only safe throttle setting, which meant that, while he would have the benefit of electrical and hydraulic power, there would be absolutely no go-around option on this approach.

Once he was definitely within flameout glide range of the divert field, Maj Olesen lowered the landing gear and configured for a flameout landing. U-2 checklists provide guidance for flameout landings at different weights and configurations. However, there is no checklist which covers a descent from high key with the engine stuck in idle. Maj Olesen would have to rely on his best judgment to establish a high key altitude and maneuver to a safe landing. He would also be landing without the assistance of a qualified "mobile" officer. Because the U-2 is an extremely difficult aircraft to land, particularly when the pilot is wearing a full pressure suit, another U-2 pilot always follows the aircraft down the runway in a "chase" car, giving assistance over the radio. Always, that is, except in the event of an emergency divert to a base with no U-2s.

Maj Olesen descended in a series of figure eights over the field, managing his energy so as to arrive at the proper high key altitude. He then flew a flawless flameout pattern and landing, preserving a valuable national asset for future use.

The Aviation Well Done Award is presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Mishap Prevention Program.

LT WILLIAM M. GOTTEN, USN
44 FS/SE
Kadena AB Japan

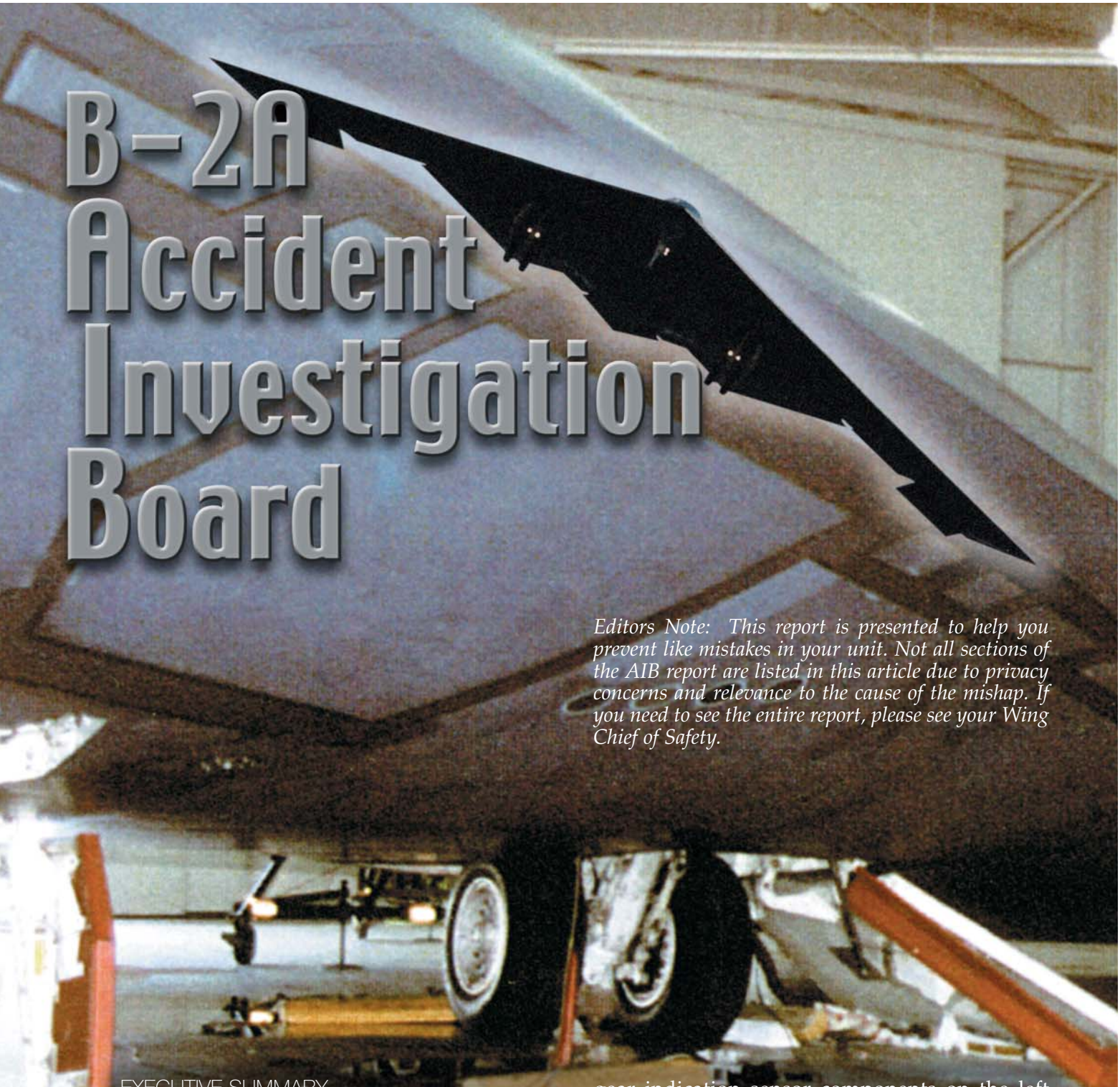
On 23 Jan 02, during the final Knock-It-Off to a Basic Fighter Maneuvers (BFM) mission, Lt Gotten's F-15C suddenly entered an uncommanded roll to the right. This newly mission-ready pilot used his quick thinking and accurate inputs to continue flying his aircraft just above the bailout altitude while informing his flight lead of the situation. He immediately began a climb to a safer altitude while pointing directly to the home field. With full left trim and almost full left stick inputs to keep the aircraft flying straight, Lt Gotten continued to analyze the situation. While simultaneously completing the appropriate checklist items and reviewing his aircraft system knowledge, Lt Gotten visually noted his right aileron stuck in the full upright position. A battle damage check with the flight lead confirmed the right aileron deflection with no other problems.

Lt Gotten and his flight lead accomplished the checklist procedures for flight control malfunctions, but despite their efforts the problem persisted. Combating fatiguing flight control inputs to keep the aircraft from rolling inverted, Lt Gotten configured his F-15C for a controllability check. The heavy control forces remained unchanged and the aircraft was still very susceptible to roll right but he determined his F-15C was safe to land. Meanwhile, deteriorating conditions at the home base of Kadena and a left-to-right crosswind of over 20 knots, complicated the recovery of the problem aircraft. Lt Gotten's thorough understanding of the F-15C flight control system allowed him to make the correct cockpit actuations, allowing him to fly the aircraft home. The foreign and in-training controlling agencies, heavy left-to-right crosswinds, and turbulence added to the already challenging situation. Nonetheless, he flew a flawless straight-in approach and successfully engaged the approach end cable despite his limited directional control.

Lt Gotten demonstrated superb airmanship and skill in handling an unusual and complicated emergency situation, thus saving himself and a valuable Air Force aircraft.

B-2A Accident Investigation Board

Editors Note: This report is presented to help you prevent like mistakes in your unit. Not all sections of the AIB report are listed in this article due to privacy concerns and relevance to the cause of the mishap. If you need to see the entire report, please see your Wing Chief of Safety.



EXECUTIVE SUMMARY

The left main landing gear on a B-2A collapsed while the B-2A was undergoing nonroutine diagnostic maintenance on the left main landing gear to eliminate false computer indications of the gear's position. Five maintenance personnel were under the aircraft when it collapsed and were injured. Aircraft damage from the mishap included the left main landing gear, the left weapons bay and main gear doors, the left wing and its control surfaces, and a yet to be determined amount of internal structural damage. Shortly before the gear collapsed, maintenance personnel were removing gear indication sensor components on the left main landing gear.

The primary cause of the mishap was improper maintenance practices not sanctioned in the aircraft technical orders and maintenance job guides. The AIB determined that a main landing gear safety pin was improperly removed by one of the maintenance personnel, followed by the same individual pushing up the lock-link assembly into an unsafe retracted condition. Without hydraulic power, the aircraft collapsed under its own weight. Material failure and design flaws were ruled out as possible contributing factors.

5. MAINTENANCE

a. Forms Documentation.

At the time of the mishap, the 781 forms for the mishap aircraft were in the dock with the aircraft as required. Both the 781 forms and CAMS were reviewed and found to be current and accurate for the mishap aircraft. Specifically, all immediate, urgent, and routine Time Compliance Technical Orders were accomplished with no noted problems. Weight and balance records show the weight of the aircraft with a specific fuel load and internal stores (armament) as well as the center of gravity for the aircraft in its current configuration. All weight and balance records were current and accurate.

c. Maintenance Procedures.

After reviewing the maintenance and training records, the maintenance procedure being performed at the time of the gear collapse was determined to be the cause of the mishap.

d. Maintenance Personnel and Supervision.

The AIB thoroughly reviewed all pertinent training records, maintenance procedures, practices, and performance. Each member of the maintenance career field has a set of training records, which includes the Career Field Education and Training Plan (CFETP). Each maintenance member will have a plan in his or her records and it is supposed to indicate Air Force, ACC, and work center requirements. Any work that a member is performing must be indicated in their training records. For each maintenance shop, there is a master CFEPT. The master CFEPT lists all training requirements for each work center, and it is to be used as the training guideline that each member is supposed to follow.

Training documentation throughout the Aero Repair (A/R) shop was inconsistent with current training guidelines. Specifically, the A/R shop's master CFEPT included most of the duties of an A/R Technician; however, it does not specify troubleshooting or rigging and adjustment of the main landing gear as a training requirement for technicians seeking to upgrade their training to a higher skill level, nor is this procedure listed as an option for training. Items necessary are marked with a circle. Thus, there is a whole set of tasks that A/R technicians are required to perform, and are performing on a routine basis, that are not required in the Master CFETP. Ultimately, this omission led to incomplete and inadequate training. Throughout the Air Force, maintenance personnel are prohibited from performing tasks on which they have not been trained, regardless of the adequacy of training documentation.

f. Unscheduled Maintenance.

The B-2A aircraft is highly computerized. It has sensors that tell an onboard computer when the landing gear is retracted in the wheel well and when the gear is fully extended for landing. On a previous sortie, the aircrew reported that the left main landing gear (MLG) was slower to retract than the right upon takeoff, and that it would not retract at all after the first touch and go. Maintenance inspection revealed that the left MLG's truck position actuator (TPA) lower mount bolt was broken. The TPA is the component that stows the tires in an up position, which then allows the landing gear to retract into the wheel well. This TPA bolt is located inside the main landing gear and cannot be repaired without taking the landing gear apart. Thus, the landing gear had to be removed and sent to a central depot maintenance facility, and an entire new landing gear had to be installed on the aircraft.

After the gear change, the aircraft flew four times with no reported discrepancies for the left MLG. However, on the last sortie before the mishap, the onboard computer reported two errors. The left main landing gear was two-to-four seconds slower than the right, and the left main landing gear proximity sensors indicated a temporary failure-to-lock indication. After one second, the failure indication cleared. Following these errors, a tiger team was formed at the request of the bomb squadron, to perform troubleshooting of the problems. It was decided, at a meeting, that the focus of the troubleshooting would be the failures of the proximity sensors and not the slow retraction problem, because although the main landing gear was slower than the right, it still retracted within technical order guidance timing.

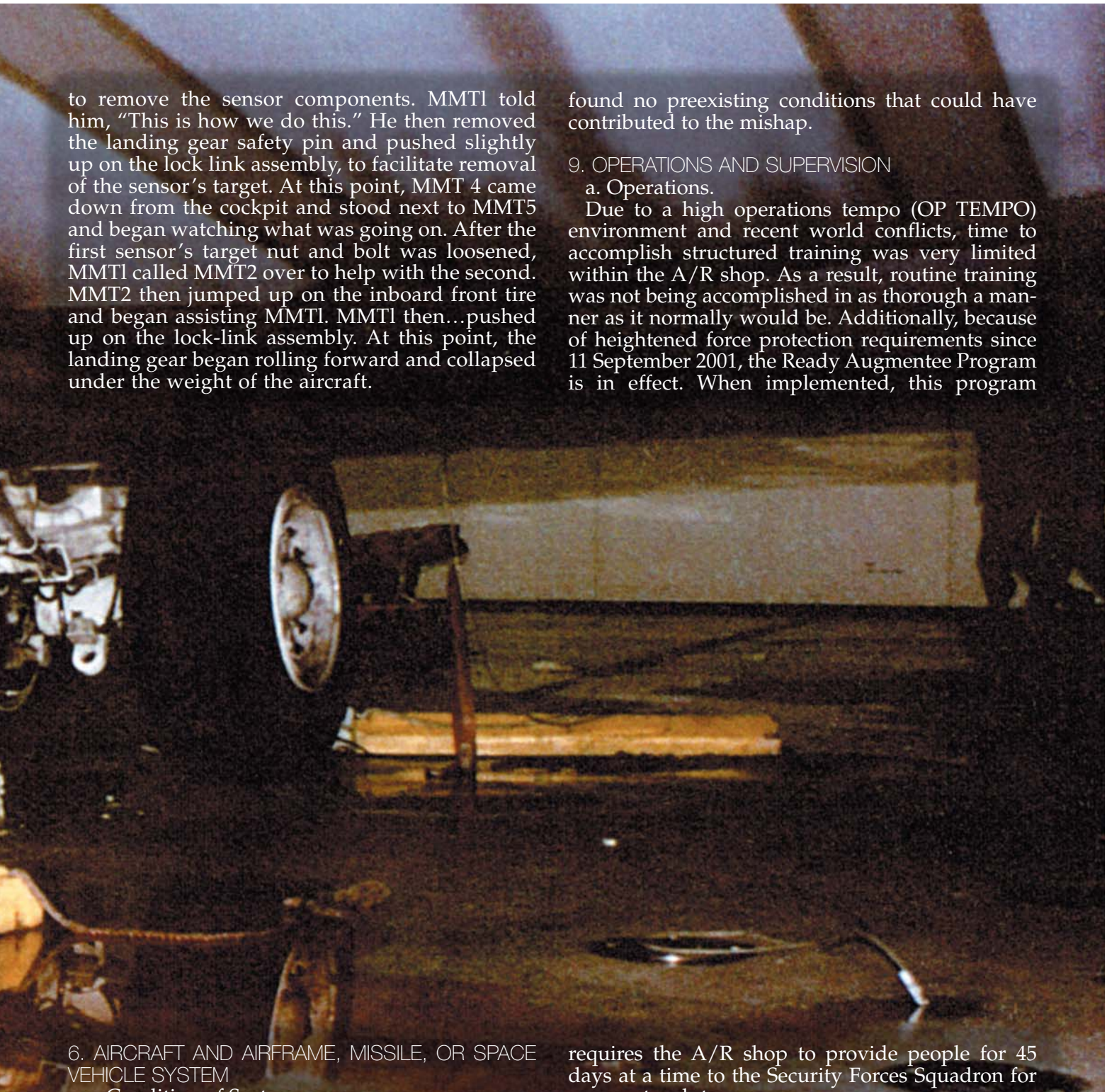
A tiger team is a group of maintenance technicians formed to fix a single aircraft malfunction. A senior maintenance technician, with an in-depth knowledge of the malfunctioning aircraft system, usually leads it. All technicians assigned are typically experts in their specialty. The type of technicians assigned depends on the malfunction. This particular team included members from A/R, Hydraulics, and Electro-Environmental (E&E) shops. Members of squadron maintenance supervision chaired the meeting and told the team that they wanted the malfunction corrected. Members from the A/R shop expressed concerns over working this "problem" because it was within Technical Order (T.O.) tolerances. They knew the sensors were within tolerance because upon landing the night before, a member from the A/R shop checked the sensors. He also thought the slow-to-retract issue would be checked later, so he prepared the aircraft for gear maintenance by transferring fuel from the outboard tanks so that the aircraft could be placed on jacks.

At the meeting, MMT1 (Mishap Maintenance Technician) and MMT2 from A/R told supervision that the sensors had been checked and there was nothing wrong. The maintenance technicians reported that the sensors were set in accordance

with the technical order and the sensor problem had cleared itself. MMT1 also pointed out that although the left main landing gear was slower than the right, it was still up and stowed within the time limits designated by the technical order. MMT1 thought they were "chasing ghosts." Despite what MMT1 said, it was decided at this meeting that maintenance personnel would work on the aircraft and troubleshoot the failures of the sensors using the aircraft's "memory reads." Memory reads are cockpit indications taken from the aircraft's Data Entry Panel (DEP). This troubleshooting technique would require a hydraulics technician in the cockpit to read the indications on the computer while the A/R members manually moved the sensors in the landing gear wheel well. This method of adjusting the sensors had never been done before, and E&E personnel expressed concern because there were no procedures in the technical orders to adjust the sensors in this way. After the meeting, MMT2 spoke with others who had been in attendance. Several technicians expressed confusion as to why they were going to work on the aircraft when everything was within the limits set out in the technical orders. They considered the planned maintenance procedure as needlessly "working outside the box."

MMT4 and MMT5 were the first to arrive at the aircraft in the dock. MMT4 went up to the cockpit to start the computer, but had problems with the codes he was inputting. A civilian contractor came out to the dock and gave him the new computer codes because there had been a software upgrade. Once this was done, they began receiving the correct indications from the computer. Sometime later that morning, the other maintenance technicians arrived at the dock and they did a "safe for maintenance" check on the aircraft, including making sure the wheel chocks were in place in front and behind the landing gear tires and ensuring that the landing gear safety pins were installed in all three of the landing gear. Because they agreed upon troubleshooting procedure called for the A/R technicians to adjust the sensors to see if the cockpit computer indications would pick up the adjustments, MMT4 was in the cockpit. Again, this is a procedure that had not been done before.

All the maintenance technicians were working on individual tasks. MMT2 went to the back of the dock to begin preparing the aircraft jacks for a later task, and MMT1 and MMT3 began working on the sensor adjustment. To do this, MMT1 and MMT3 climbed up on the landing gear tires. MMT5 was on the ground in front of the landing gear near the gear door watching them work. MMT3 had never done a sensor adjustment before, so MMTl was doing most of the work. MMT3 was attempting to figure out how



to remove the sensor components. MMTl told him, "This is how we do this." He then removed the landing gear safety pin and pushed slightly up on the lock link assembly, to facilitate removal of the sensor's target. At this point, MMT 4 came down from the cockpit and stood next to MMT5 and began watching what was going on. After the first sensor's target nut and bolt was loosened, MMTl called MMT2 over to help with the second. MMT2 then jumped up on the inboard front tire and began assisting MMTl. MMTl then…pushed up on the lock-link assembly. At this point, the landing gear began rolling forward and collapsed under the weight of the aircraft.

6. AIRCRAFT AND AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEM

a. Condition of Systems:

After examining the mishap aircraft main landing gear components, to include the main strut, drag brace assembly and lock link assembly, no pre-existing conditions were found that contributed to the mishap. No previously existing damage could be found on the main landing gear retract actuator that would have contributed to the mishap. The center of gravity (CG) was calculated and determined to be within limits and not a contributing factor to the mishap. The wheel chocks were in place, but could not prevent the accident. After final examination of all aircraft systems, the AIB found no preexisting conditions that could have contributed to the mishap.

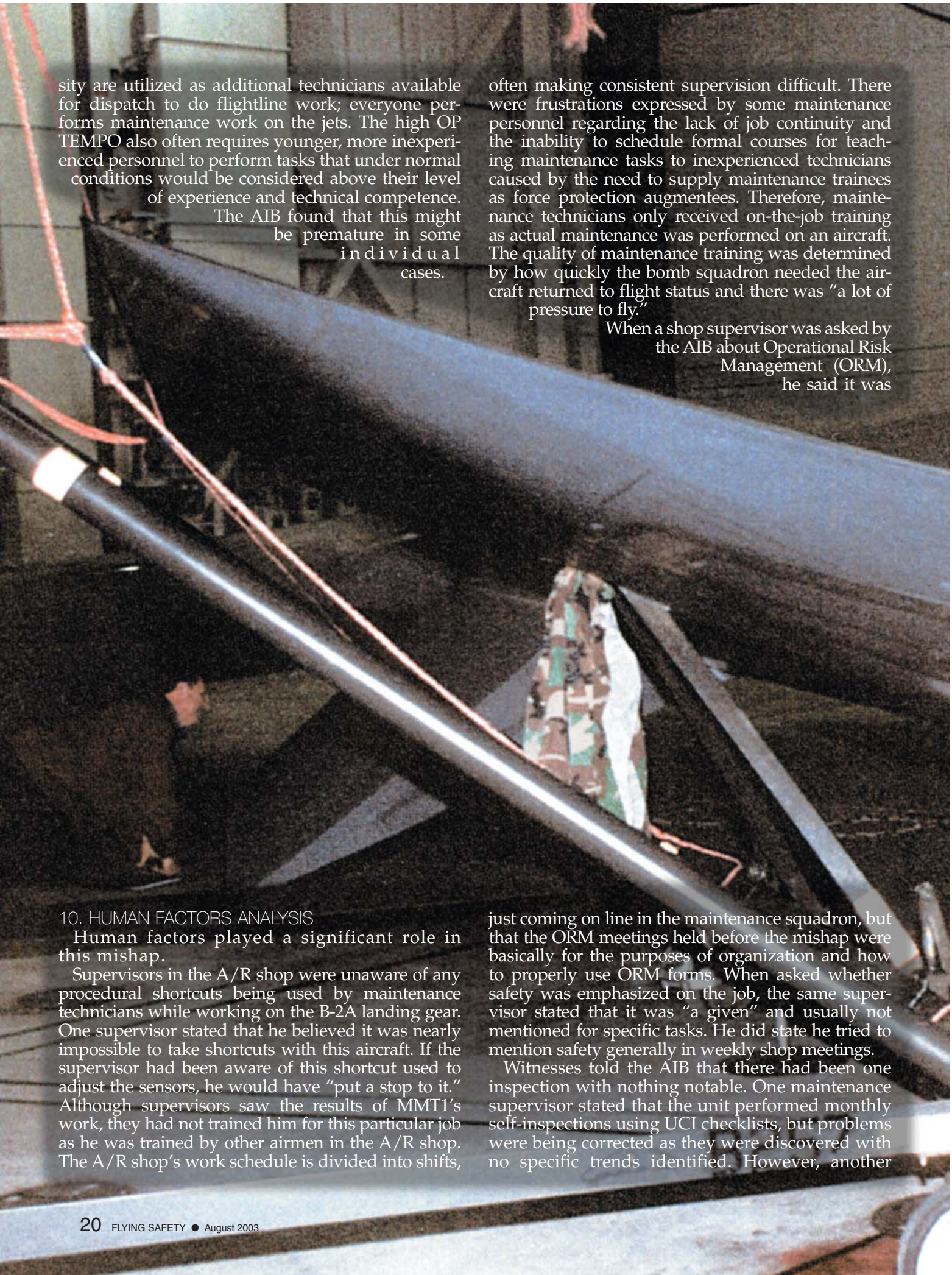
9. OPERATIONS AND SUPERVISION

a. Operations.

Due to a high operations tempo (OP TEMPO) environment and recent world conflicts, time to accomplish structured training was very limited within the A/R shop. As a result, routine training was not being accomplished in as thorough a manner as it normally would be. Additionally, because of heightened force protection requirements since 11 September 2001, the Ready Augmentee Program is in effect. When implemented, this program requires the A/R shop to provide people for 45 days at a time to the Security Forces Squadron for augmentee duty.

b. Supervision.

In ideal circumstances, maintenance shop supervisors provide supervisory oversight rather than performing hands-on maintenance themselves. This allows experienced and more senior supervisors to stand back and observe their personnel performing aircraft maintenance procedures. This allows supervisors to move from job to job ensuring, Technical Orders are closely followed and no dangerous activity is occurring. The high OP TEMPO restricts the ability of the A/R supervisors to exclusively supervise their people. As a result, supervisors, as a matter of neces-



sity are utilized as additional technicians available for dispatch to do flightline work; everyone performs maintenance work on the jets. The high OP TEMPO also often requires younger, more inexperienced personnel to perform tasks that under normal conditions would be considered above their level of experience and technical competence. The AIB found that this might be premature in some individual cases.

often making consistent supervision difficult. There were frustrations expressed by some maintenance personnel regarding the lack of job continuity and the inability to schedule formal courses for teaching maintenance tasks to inexperienced technicians caused by the need to supply maintenance trainees as force protection augmentees. Therefore, maintenance technicians only received on-the-job training as actual maintenance was performed on an aircraft. The quality of maintenance training was determined by how quickly the bomb squadron needed the aircraft returned to flight status and there was "a lot of pressure to fly."

When a shop supervisor was asked by the AIB about Operational Risk Management (ORM), he said it was just coming on line in the maintenance squadron, but that the ORM meetings held before the mishap were basically for the purposes of organization and how to properly use ORM forms. When asked whether safety was emphasized on the job, the same supervisor stated that it was "a given" and usually not mentioned for specific tasks. He did state he tried to mention safety generally in weekly shop meetings.

Witnesses told the AIB that there had been one inspection with nothing notable. One maintenance supervisor stated that the unit performed monthly self-inspections using UCI checklists, but problems were being corrected as they were discovered with no specific trends identified. However, another

10. HUMAN FACTORS ANALYSIS

Human factors played a significant role in this mishap.

Supervisors in the A/R shop were unaware of any procedural shortcuts being used by maintenance technicians while working on the B-2A landing gear. One supervisor stated that he believed it was nearly impossible to take shortcuts with this aircraft. If the supervisor had been aware of this shortcut used to adjust the sensors, he would have "put a stop to it." Although supervisors saw the results of MMT1's work, they had not trained him for this particular job as he was trained by other airmen in the A/R shop. The A/R shop's work schedule is divided into shifts,

supervisor felt there was a trend for his technicians to fail Quality Assurance evaluations during routine maintenance practices due to lack of continuity and experience in the A/R shop.

Supervisors perceived dissatisfaction among the A/R shop personnel with squadron leadership and the appearance of being the "stepchild." In general, the A/R shop felt it didn't have a vote when told to participate on troubleshooting teams; they were just told what to do. Both supervisors and maintenance technicians from the A/R shop expressed frustration arising from their repeated warnings regarding unnecessary maintenance. Throughout the morning of the mishap, the A/R technicians, including MMTl and MMT2, expressed reservations about doing unneeded maintenance, but these concerns appeared to be brushed off by maintenance supervision present at the tiger team meeting.

On-the-job training was the primary means MMTl was trained. It appears that this training, however, did not emphasize the use of T.O. job guides. Although MMTl knew about the job guides and took them to the mishap aircraft, he was unable to recall actually referencing them or using them for this particular job. He was also asked if he read the job guide prior to the mishap and stated he was using the procedures he was taught in on-the-job training. When asked again, he stated he glanced at the T.O. in the past, but had never read it.

The T.O. job guides for this particular maintenance action allowed steps to be accomplished in no particular order. However, common sense required doing maintenance actions sequentially or as the job guide listed the events. However, the AIB found that A/R shop personnel routinely took non-job guide shortcuts for this particular task without the knowledge of their supervisors. The particular shortcut of pulling the landing gear safety pin and pushing up on the lock-link assembly had been used by A/R shop personnel long before MMTl arrived. This technique is not authorized by the tech order job guides.

MMTl stated he had removed the pin and pushed up on the lock-link assembly on previous occasions without anything happening. He also believed that it was impossible for the gear to collapse as a result of these actions. Even after the mishap, he still felt that his actions alone, with aircraft weight on the landing gear, could not have caused the collapse.

MMT2 was asked to assist MMTl during the mishap. He, too, received the same training as MMTl, but stated he "was not one for" taking the shortcut of removing a safety pin and pushing up on the lock-link assembly. He had seen it done in the past, but had never done it himself. He, too, had an impression that nothing was going to happen because of prior apparent success using this shortcut. MMT2 expressed a great deal of respect for MMTl and stated he would not have questioned MMT1's actions because MMTl knew what he was doing. He further explained that he saw MMTl do this before, but never questioned it.

As MMTl performed the actions leading to the mishap, other specialists did not question his actions because they were not sure what he was doing. The team that was formed the morning of the mishap was supposed to organize the actions to be performed by various maintenance specialists, but the extent of this organized effort primarily focused on the overall goal of using cockpit indications to adjust the main landing gear sensor components.

No one questioned whether this troubleshooting team needed to be a part of a formal Technical Order Validation and Verification. One thing became clear after the meeting: this was not routine maintenance and there was still confusion on exactly what was to be done. From the testimony of the witnesses interviewed, the AIB reached several conclusions:

- First, this B-2 maintenance tiger team did not perceive potential safety risks associated with the use of landing gear shortcut procedures.
- Second, supervisors had limited exposure to the day-to-day work practices of the individuals they supervised.
- Third, training continuity suffered because of additional taskings outside the maintenance duties of squadron personnel, Security Forces augmentee duties.
- Fourth, an outside inspection of B-2A maintenance practices in the A/R shop was ineffective in detecting training deficiencies.
- Fifth, B-2A technical orders are still in a maturing stage and are not all-inclusive.
- Sixth, individuals were complacent to dangerous B-2A maintenance practices that were performed routinely.
- Seventh, specialization within the B-2A maintenance career field led to compartmentalization, which led to complacency regarding the dangerous practices of other specialties.
- Eighth, for expediency, and by interpretation, a proper Technical Order Validation and Verification process may have been omitted regarding this method for adjusting the main landing gear sensors using cockpit indications.
- Ninth, there was undue pressure from maintenance supervision to perform maintenance on aircraft components or systems that were operating within T.O. tolerance.

STATEMENT OF OPINION

Under 10 U.S.C. 2254(d), any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.

1. OPINION SUMMARY:

By clear and convincing evidence, I have determined that the cause of this accident was the result of a maintenance technician removing a landing gear safety pin, followed by pushing up a main landing gear lock-link assembly into a retractable and unsafe condition. The landing gear then collapsed as a result of the aircraft's weight. In addition, I have determined by substantial evidence that four factors contributed to the accident.

- First, inadequate training of the maintenance technicians involved contributed to the accident.
- Second, MMT 1, 2 and 3 failed to exercise sound judgment.
- Third, the relevant section of technical order job guide (the implied basis for the training they received and actions they performed) did not direct a step-by-step or sequential method for performing the gear sensor adjustment and may have contributed to this mishap.
- Fourth, apart from MMT2, the maintenance team working on the aircraft was not fully aware of what MMT1 was going to do. The entire team, including MMT1, was unaware of the dangerous nature of MMT1's actions.

This precluded the other maintenance team members from having the opportunity to prevent the mishap.

2. DISCUSSION OF THE OPINION

a. Summary of the Investigation

The investigation was conducted over a three-week period. Nine witnesses and two supervisors were interviewed. Three maintenance technicians directly under the aircraft corroborated the testi-

mony by the mishap maintenance technician at the time of the collapse. A material and technical order expert examined the aircraft's left main landing gear and center-of-gravity. He found no pre-existing conditions that may have contributed to the mishap. Weather, toxicology, and lifestyle were ruled out as possibilities.

b. Causal Factors

1. The mishap maintenance technician removed the left main landing gear safety pin.

2. The mishap maintenance technician then pushed the left main landing gear lock-link assembly into a retractable and unsafe condition.

3. The left main landing gear then collapsed from the weight of the aircraft.

c. Substantial Contributing Factors

1. Prior to the mishap, the mishap maintenance technician received on-the-job training incorporating landing gear safety pin removal and pushing up on the gear lock-link assembly. These techniques are not found in the technical order job guide for adjusting gear position sensors. There was, at least, a two-year history of these techniques being used and taught by other technicians without supervision's knowledge.

2. Prior to the mishap, the technical order job guide did not direct a step-by-step or sequential method for accomplishing gear position sensor adjustment, allowing maintenance technicians the opportunities to interpret the steps needed and take shortcuts.

3. There was a degree of complacency due to compartmentalization. Members of the sensor adjustment team were unaware of the dangers associated with the mishap maintenance technician's actions.

4. The mishap maintenance technician and his assistant were unfamiliar with the technical order job guide procedures for this task. Further, the assistant was overconfident that the mishap maintenance technician knew what he was doing, even though he would not have removed the pin or pushed the lock-link assembly himself.

5. The mishap maintenance technician's unit is operating in a demanding environment (high OP TEMPO) with little opportunity to accomplish structured training. Also, job training continuity is suffering due to a variety of factors, to include force protection requirements.

6. This trouble-shooting maintenance was conducted using an informal process that did not adequately address whether it was routine troubleshooting or a means for testing new maintenance practices requiring a Technical Order Validation and Verification procedure.

SIGNED
XXXXXXXXXX Lt Col USAF
President Accident Investigation AIB

Editors Note: Cost to repair the aircraft: $2,522,294 and 1,948 man-hours. Or, the equivalent of 48.7 40-hour workweeks and 77.5 years of base pay for an 18-year TSgt. Just think what the Air Force could have done with the money and time we spent on a preventable mishap. What is your unit's safety atmosphere and attitude to doing extra work? Can you, the technician, stop a bad practice? Is your training plan a training plan or just pieces of paper? Do you actually use the tech order? How many work-arounds and accepted practices do you use that can/will lead you to an accident? How are YOU going to help prevent mishaps?

The Supervisor's Role: Leadership By Example

Reprinted from Aerospace Accident and Maintenance Review, February 1963

There is a certain amount of dignity attached to the title of Supervisor; and rightly so. As an outgrowth of the merit system, where an individual's experience, skill, and ability are recognized and rewarded, the title of Supervisor would naturally take on dignity and respect.

The supervisor is a leader of men. Not only can he organize and administer, but he has considerable knowledge and experience to draw upon and set the examples to be followed. Leadership by example is one of the most important functions of the supervisor.

Few other supervisors, if any, have greater individual responsibility than the Air Force maintenance supervisor. This is especially true when we consider the monetary value of equipment and the importance of the mission—not to mention the lives of men and women. The continuous influx and rotation of aircraft and missile maintenance trainee personnel partially accounts for the tremendous supervisory responsibility placed upon leaders. The product of leadership by example is the molding of the minds of trainee technicians to accept the responsibilities of the profession, to follow established procedures, to recognize Technical Orders and instructions as the authority to develop good maintenance techniques and practices and, above all, to perform quality maintenance.

One of the requisites of a good maintenance supervisor is that he have thorough technical knowledge of the job he is supervising. He must keep abreast of technical advances and changes in technical instructions that affect his area of maintenance responsibility. In order for the supervisor to maintain the respect and dignity of his position, he must not only exert his authority, but must practice his teachings and prove his ability as an individual. The holder of a supervisory title suffers greatly and needlessly when he abuses his position of responsibility by not enforcing the required standards; or, as an individual, when he deviates from the standards that he professes to abide by. The young maintenance technician looks to his supervisor for guidance when forming his own personal appreciation of maintenance standards. The final outcome of the trainee-supervisor relationship will be that their appreciation of maintenance standards will be very nearly alike.

To supervise is to lead. It is human nature to follow the examples set by respected and experienced leaders. With the great responsibility that the maintenance supervisor has on his shoulders, it is a source of personal satisfaction for him to know that others are prone to follow the example he sets. So, it follows that the supervisor who sets the examples that he wishes followed is, in effect, lessening the burdens of his own responsibilities.

(Editor's Note: Times have changed; many supervisors and trainees today are women, but the information here is still current. The attitude and example displayed by the supervisor is still mirrored in the troops today. How do you stand up to their scrutiny as a leader by example.)

Illustration by Dan Harman

The Supervisor's Role: In Safety

SSGT JONATHAN COLLIER
58th Maintenance Operations Squadron
Kirtland AFB NM

When was the last time you discussed safety while training or working with your troops? It is our responsibility as supervisors to train our subordinates to follow procedures, and to understand the consequences for not following those procedures. Safety should be our main concern, but the fastest way to do the job, instead of the correct way, is far too often the way maintenance is accomplished.

Some supervisors don't realize that when troops see their supervisor doing a task incorrectly or "not by the book," they are sending the message that it is acceptable to do work this way. These "do as I say, not as I do" attitudes are magnified as the subordinates pass this information on to their co-workers and trainees. Over time, these practices are reflected in statements such as, "This is how we've always done it" or "This is how we did it at base X."

We all know when we do something wrong, because our internal voice tells us. Too often we don't listen, and mishaps are the result. One incident that I recall illustrates the importance of proper training.

When I was a new supervisor, I learned a valuable lesson the hard way. I was draining the residual fuel from a fuel cell on a C-130 aircraft with two fellow airmen whom I was supervising. We had just completed the job, and I asked one of the airmen to relieve the air pressure from a low-pressure hose that was connected to the bowser used to drain the fuel. She informed me that she had completed the task and attempted to remove the hose. She was having some trouble disconnecting the hose and asked me to help. Without thinking, I went to the bowser and began to disconnect the hose. I hesitated for a moment, because my internal voice was telling me something was wrong. Instead of checking the pressure gauge myself, I asked again if she had relieved the pressure from the hose. She assured me the pressure had been relieved. I guess I was just in a hurry to finish the job. The instant I broke the seal, I realized that I should have listened to my internal voice; the hose went wild and violently flew throughout the hangar. I ran over to the pressure relief valve and turned off the air source.

Luckily, this inattention to detail didn't result in loss of life or limb, or damage to a multi-million dollar aircraft. I spoke with the airman later, and she apologized, saying that she didn't check the air pressure and assumed it had been relieved. We both learned a valuable lesson that day, the hard way. From then on, I ensured the pre-work briefing included all facets of the job, including the clean-up phase and proper documentation of the work performed.

When new airmen arrive from technical training they are like sponges, eager to practice what they have learned and to learn more. If all personnel do not practice the training provided, the airmen may pick up the shortcuts and bad habits of their colleagues. Is this the way we want to train? NO. Supervisors need to reinforce the "good" practices subordinates have learned, and discourage bad habits and improper methods. How many times have you looked back at something you have done and said, "How did I get out of that?" As supervisors, we need to ensure we teach what we should and practice what we preach.

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

We've talked a lot about "see and avoid" lately, so here are some examples where procedures were not followed and aircraft endangered each other or personnel. Know the procedures for the area, and communicate.

How Many Aircraft in The Same Space?

A KC-135 had a busy day on the refueling track at a forward operating location. The aircraft had three sets of receivers scheduled for the sortie, and had the first set on the boom. The first set had come onto the track just as the SPINS required. The KC-135 had one aircraft on the boom, another on the right wing and had just started a right-hand turn on the track. Shortly after entering the turn, the TCAS identified a target 15 NM away and 1000 feet above their altitude. Seconds later, the altitude started to decrease. When the intruder reached 5 NM and 500 feet, the crew identified the aircraft as their third receiver aircraft. The tanker crew saw the aircraft steady in the windshield and *increasing* in size. Not a good thing. They rolled wings level, and TCAS showed the aircraft 100 feet above them. At this time the intruder increased its turn and pulled up aggressively to avoid a collision. The tanker crew estimated that the aircraft came within 500 feet of them and the receiver aircraft. Steady nerves on the part of the receivers.

The problem in this case was a receiver who violated the track procedures. The tanker crew had called the airborne controller and asked him not to clear in any receivers unless they were at the proper altitude. The controller's response was, "We didn't clear them into the track." Although separation is not the primary duty of the controllers, they do advise of potential conflicts. It is up to the aircraft crew themselves to maintain separation. The SPINS state that the receiver will enter the refueling area 1000 feet below the air refueling altitude. Luckily, this incident occurred in the daytime, so it was easier to see the intruder. Just think what could have happened if this were a night refueling. Be aware of the procedures, and follow them. Refueling is dangerous enough without the added hassle of unprofessional aircrew.

Which Runway?

A pair of F-15s were cleared for a ten-mile straight-in approach to land on Runway 6. After receiving their visual approach clearance, they *incorrectly* lined up for Runway 11. Now, I think this could be a big problem. The tower visually acquired the pair of aircraft on short-final just below a cloud. At one-half mile final, the aircraft executed a go-around. Why? They barely maintained separation with a KC-135 in the VFR pattern and another KC-135 back-taxiing on Runway 11. This is the second time this has happened in the last four months. Just a short note to let you know that you can choose the wrong runway. Make sure the runway you line up on is the runway you think it is.

Is the Turn Clear?

An F-16 was recovering at a foreign airfield when the tower cleared a flight of five Mirages for takeoff. Upon returning to base, the F-16 was not cleared to land, but was told to continue by the tower. On short final, the last two Mirage 2000s were still on the runway, and the tower directed the F-16 to go around. Now the problem starts. Seeing the Mirages on takeoff roll, the F-16 pilot elected to offset left of the runway. As he passed midfield, the tower cleared the F-16 for a right closed pattern. The F-16 pilot saw that he would turn into the departing Mirages and queried the tower about the directions. He was again directed to a right closed pattern. At this time the tower supervisor came on and directed a left closed traffic pattern.

Several issues caused this incident. A controller trainee at the foreign airfield let a situation go farther than it should have. The phraseology used could have been different. Current procedure requires the pilot to initiate the closed pattern at the departure end of the runway. If the controller had stated "present position," the pilot would have known to turn immediately instead of waiting to the departure end and creating the potential conflict. Procedures are there for a reason, and we all must follow them and understand. Make sure you know the rules, and if the instructions are different or cause a conflict, as in this case, take the proper action.

How Many Aircraft In The Formation?

A Sherpa was dropping some smoke jumpers off the departure end of the runway at one of our bases and caused some problems for a formation takeoff. A flight of five KC-135s was waiting for takeoff clearance and was asked by the tower if they had the Sherpa in sight. The lead called that they had the aircraft in sight, and they were then cleared for takeoff. At about five NM on takeoff, the last aircraft in the formation was alerted by TCAS of traffic, and the aircrew visually picked up the Sherpa. The KC-135 maneuvered away and passed 1/4 mile from the Sherpa. The situation here is simple. If you are the lead, make sure the entire flight has visual on the aircraft in question before you accept the clearance.

Just Passing Through!

A C-12 was executing an approach to an overseas location, and while descending through 1800 feet MSL, he received a TCAS alert. The pilot visually acquired an RC-12 slightly below and 300 feet left of their position. This aircraft was executing visual traffic patterns at the nearby Army airfield. These two aircraft were in contact with the tower, but they were different towers. The C-12 executed a climbing turn away, while the RC-12 executed a descending turn to ensure adequate separation.

The issues: The two fields are about eight miles apart and the approach for one airport requires the aircraft to fly over the other at 3000 feet, then descend. The current procedure calls for the tower to call the other field, let them know about the aircraft and get clearance for the approach. In this case, the call was made but the tower was not told of the RC-12 being in the area. Aircrews rely on information to stay alive, especially when it comes to air traffic control. We have the procedures, we just need to make sure everyone follows them. Keep your head about you and be ready for the unexpected.

Who Owns This Airspace?

A flight of two A-10s was on an instrument check ride and had entered the MOA for the next stage of the sortie. The evaluator had moved to the chase position and observed an RWR indication from a military aircraft at their 12 o'clock position. The chase aircraft tried to clear the lead aircraft and attempted to clear the traffic with the local center. As the chase aircraft attempted to point out the traffic to lead, the pilot sighted an F-15 at 12 o'clock co-altitude. The A-10s started a descent to ensure separation when they saw the F-15 bring up the nose and climb out of sight. As they lost sight of the F-15, he was headed away from them, so the conflict ended—or so they thought. Shortly thereafter, they coordinated with the local center and started a climb back to their assigned altitude. Suddenly, they again received RWR indications and began a search for the traffic. Once again, the chase aircraft saw the F-15 at their 10 o'clock position in a 90-degree nose-low attitude, tracking directly at them. Now, this is not a good thing. Chase directed a right turn and the F-15 flew right where they had predicted he would have. Had they not maneuvered, the two aircraft would have collided. As the two A-10s recovered, they had turned to keep the F-15 in sight and saw him rock his wings (indicating he had seen the flight). They tried to contact the F-15 on the radio frequency assigned to the MOA, but received no response.

What happened here was a simple case of the A-10s' wing scheduled to be in the airspace at this time, and someone else deciding to use it as well. We have schedules and flight plans to keep our aircraft apart for a very good reason—like not hitting each other. We must follow the plan, and if we must deviate, let someone know. Thank goodness this evaluator had his eyes open, and they were able to avoid the midair.

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

We have so much time and so little to do, or is that so little time and so much to do? Maintainers seem to have a knack for creating more work for our already busy schedules. Slow down, follow the book and prevent mishaps like these below.

High-Priced Souvenir

Back shop worker one was operating a lathe to polish a brass souvenir, and was being observed by worker two. Worker one asked worker two to step back as he was turning on the lathe; nice safety gesture. As the lathe began to operate, the souvenir was dislodged and thrown directly at worker two. Worker one, in an attempt to block the thrown object from hitting worker two in the face, stuck out his right arm and was hit in the arm and hand.

Damage? The worker received a severed tendon in his thumb and a large laceration to his right arm. Cost to the Air Force for this souvenir? Seven days of quarters and lost productivity. We all like the little benefits and souvenirs we receive from our duty stations, but if you aren't sure of what you are doing and know how to properly use the equipment, STOP! Get your supervision involved and do the right thing.

Are These Supposed To Be In Here?

An MH-53 was scheduled to fly an FCF for an automated flight control system (AFCS) malfunction. Everything was normal until they had an engine problem. The crew was able to maintain level flight, declared an IFE and returned to the home base. Maintenance started their initial assessment. Much to their surprise, when they opened the number two engine cowling, four unused cloth parts bags fell out. QA then impounded the aircraft and started the FOD checklist.

Where did they come from? The last major maintenance done in the area was the AFCS pitch servo change. The cowling was not opened during the engine change. However, there is a 1/2 -3/4 by 36 inch separation between the number two engine's upper cowling and the engine input cowling to the main gearbox. If you ever saw the entire cowling on the MH-53, you would understand this puzzle. The main point here is that there is room for things to migrate between the cowlings. The engine intake inspection before flight noted no defects or FOD.

Luckily for the Air Force, the bags didn't migrate into the intake. The bags did not cause the engine malfunction, they were a by-product of another task done incorrectly. We must account for everything we take to an aircraft. A few little things left over can cause dire consequences. What if they had not been able to maintain control of the aircraft? How good are your tool and parts accountability programs?

Do We Really Tighten Down Lines?

A maintainer had a really fun F-16 incentive ride a while back when the aircraft returned shortly after takeoff for a simulated flameout approach. The aircraft was shut down on the taxiway, and the engine nozzle was in the fully closed position and dumped large amounts of oil during shutdown. At least they egressed uneventfully.

The chain of events? The aircraft had been undergoing some extensive troubleshooting for an anti-skid problem, and, being resourceful maintenance people, the unit decided to complete some other work during this downtime. They complied with multiple TCTOs to include one on the engine lube and scavenge pump. Plus, the engine-driven hydraulic pump and oil tank were removed to facilitate other maintenance.

After landing and all the activities that go with the abort, maintenance serviced the engine with 41 half-pints of oil. The tank holds 45 half-pints. They dry-motored the engine, and during the check, a dynamic oil leak was discovered coming from the rod end cap off the engine-driven hydraulic pump. They stopped the dry-motor and retorqued the end cap to the required 700 inch-pounds. They added some more oil and dry-motored the engine again. This time they found a secondary leak at the head end tube nut tee fitting of the hydraulic pump. They stopped the motor and retorqued the second loose fitting to tech data specs. During the next dry-motor, the motor actually stayed dry. They took the aircraft to the trim pad and everything checked out okay, and the aircraft was returned to service.

How did these components come loose and cause all this extra work for the engine folks, crew chiefs and supervision? All we know is what they found wrong when the aircraft came back. That is the problem with these things, we can't always trace the problem back to the source. We know that two parts of the aircraft were not torqued properly. I'm sure you can figure out how that happened. Do you always torque components to their required torque, or do you just wing it?

Purge What?

A C-17 headed for the runway, and as they waited for clearance they received a reason to return to parking and turn the aircraft back over to maintenance. The flight controls had decided to move all by themselves with no input from anyone! Now, that would make for a very interesting flight, wouldn't it? Maintenance looked at the records and found that they had recently changed the number 3 primary and secondary hydraulic pumps. There were no recorded faults on the flight control computer to guide the troubleshooting. They decided to purge the hydraulic system, and much to their surprise, a substantial amount of air was removed from the number 3 system. Now, purging the system is part of changing the pumps. So, after a proper purging IAW the tech data, and a complete operational check, the aircraft was returned to flying status.

If the technicians had done the job IAW the tech data, which we are all supposed to use anyway, we wouldn't have:

- Lost a sortie
- Spent maintenance hours redoing someone else's work
- To explain to supervision why we had to redo work
- To explain why we didn't follow tech data
- To apologize to ops for being unprofessional

We have many tasks, and as you have heard a thousand times before, if not more, follow the $%^(*& book and your job will be easier. The books are there to make sure we don't make fools of ourselves and are written to "prevent" mishaps.

Sparky U-2

A U-2 was undergoing its routine 200-hour phase inspection when they had an electrifying experience. A three-person crew prepared to perform a power-on hydraulic system checkout. Now, this aircraft is the two-seat version, and there was a person in each seat. The tech data requires all workers to be on interphone, and the normal comm cord for the headsets is too short to allow full movement. The worker in the front cockpit had a locally manufactured extension for his comm cord that allowed more freedom of movement. However, the person in the rear cockpit did not have the extension, as no more were available in the tool room. Maybe they need to make some more.

As they proceeded with the checkout, the person in the rear cockpit leaned against the emergency AC and monitored DC bus circuit breaker panel, pushing it inward. Unknown to the folks in the cockpit, this caused a circuit breaker to short against an aircraft spar, exceeding the amperage rating of the wire and overheating the wire bundle. As the wire overheated, the insulation burned and caused a chain reaction, with other wires melting the insulation. When the wires shorted together, it created such heat that it vaporized four inches of the wire bundle and damaged 104 wires. Now, that is a hot spot! The crew noticed sparks from the panel and smoke coming from the aircraft tailpipe. They shut the aircraft down and egressed safely.

How do you prevent this incident? How about having enough of the tools to complete the job safely and know what you are leaning against in the cockpit? Hindsight is 20/20, but we must be aware of all the little things that can cause us extra work.

Request for Help

Maintainers, I am again asking for your help. The number of articles about maintenance issues has dwindled and I need your "There I Was" articles and any other article about maintenance that will help US reduce our mishaps. You don't have to be an English major, as we will ensure your writing is IAW the English tech order, within reason. Please help your Air Force and tell the world how you prevented or reacted to a mishap.

FY03 Flight Mishaps (Oct 02-Jul 03)	FY02 Flight Mishaps (Oct 01-Jul 02)
24 Class A Mishaps	25 Class A Mishaps
10 Fatalities	11 Fatalities
18 Aircraft Destroyed	14 Aircraft Destroyed

18 Oct	✈	A TG-10D glider crashed during a student sortie.
24 Oct		An F-15 experienced an engine failure during takeoff.
25 Oct	✈✶	An RQ-1 Predator crashed during a training mission.
25 Oct	✈✈	Two F-16s collided in midair during a training mission. One pilot did not survive.
13 Nov	✈	An F-16 crashed during a training mission. The pilot did not survive.
04 Dec	✈✈	Two A-10s collided in midair during a training mission. One pilot did not survive.
18 Dec		Two F-16s collided in midair during a training mission.
20 Dec	✈	Two T-37s collided in midair during a training sortie.
02 Jan	✈✶	An RQ-1 Predator crashed during a training mission.
26 Jan	✈	A U-2 crashed during a training mission.
06 Feb		A manned QF-4E departed the runway during takeoff roll.
11 Feb	✈✶	A QF-4 drone crashed during a landing approach.
13 Feb	✈	An MH-53 crashed during a mission.
08 Mar	✈	A T-38A crashed during a training mission.
17 Mar	✈	Two F-15s collided in midair during a training mission.
19 Mar	✈	A T-38 crashed during a runway abort. One pilot did not survive.
23 Mar	✈	An HH-60 crashed during a mission. All crewmembers were killed.
31 Mar		A B-1 received damage during weapons release.

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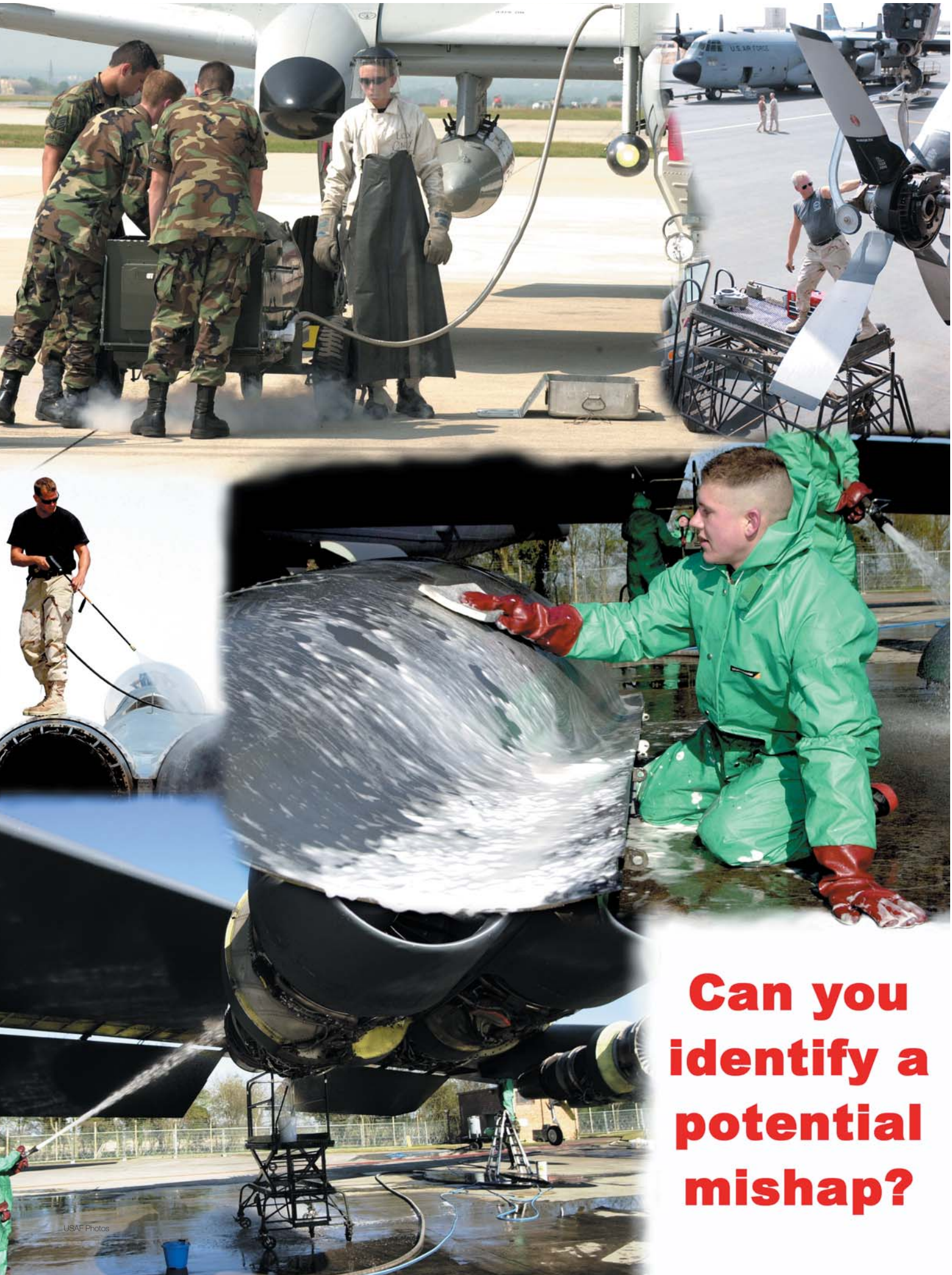
16 Apr		An F-15 experienced a single-engine failure inflight.
21 Apr		A C-17 suffered heavy damage to the MLG during a landing.
02 May		A KC-135 experienced a birdstrike during landing roll.
22 May		An MH-53 suffered severe damage to the main rotor system.
29 May	✈	An F-16 crashed during takeoff.
04 Jun	✈	An F-15E departed controlled flight and crashed.
10 Jun	✈	An F-16 crashed during a training sortie.
12 Jun	✈	An F-16 crashed during a training sortie.
13 Jun	✈	An F-16 crashed during a training sortie.

- 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://safety.kirtland.af.mil/AFSC/RDBMS/Flight/stats/statspage.html
- Current as of 08 Jul 03.



Can you identify a potential mishap?

USAF Photos