flying SAFETY

NOVEMBER 1992

A Year of Training

THERE I WAS

■ I still believe the best part of Tweet training was the solo rides. Not solo formation, but the advanced contact rides where they let you go to the area to practice aerobatics. A lot of us had our own stories to tell each other at the bar, but there was one I never told anyone.

On a clear, March morning, I was scheduled for C-3505, a solo ride to the area. Although I asked for a "low" area, Center had cleared me to a high one. I wasn't surprised, since the low areas usually went to the IPs. The problem with the high areas was you had to climb forever before you got enough energy to do aerobatics.

There were almost no straight roads in our area, so I flew straight over the top of a well-known rock formation in preparation for a Split-S. Everything looked good — the airspeed was around 150 knots, and I still had over 1,000 feet to go before I busted out the top of the area. I set the throttles, brought the nose up a little, rolled inverted at 120 knots, and began to pull.

I was pulling through a little crooked, like usual, so I attempted to straighten out the bank while pointing straight down to the desert. I was surprised to see the airspeed indicator already passing through 200. There was nothing to do now but pull.

"I'd better pull, or I'm going to blast past 275," I thought. Wait a minute! I'm 30 degrees nose high with a little right bank. Why would I want to pull? How'd I get here? Wasn't I doing a Split-S?

I leveled the Tweet, set the throttles, and flew border patrol for the next 10 minutes. The only thing I could think of was I had blacked out. I couldn't remember when I did, but I was sure I had been in a Split-S a few moments ago. Or ... it only seemed like a few moments. What happened?

I never found out. I never told anybody else about it. I certainly never told my IP. I was afraid if I told him, I would be washed out for sure. I thought I'd rather die than be washed out of pilot training.

I almost did. ■

SHARE YOUR STORY

Send us that story about those moments of hell that taught you a lesson you'll remember forever. There are some of our readers who may need that lesson to save their tail. Don't worry about spelling or grammar; we'll clean it up (and print it anonymously). Send it today addressed to:

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SPECIAL FEATURES

REGULAR FEATURES

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

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YEAREND REPORT

T-37/T-38

CAPT RICH DUBLIN
Safety Agency Action Officer

■ The T-37 and T-38 aircraft enjoyed another solid safety year, experiencing only one Class A mishap in the T-38 and two Class A mishaps in the T-37, with no Class B mishaps. Several units extended by another year their several-year-long mishap-free record. Special congratulations go to the folks in the 559th Flying Training Squadron, Randolph AFB, Texas, who have never had a Class A or B mishap in their 25-year-plus history.

This phenomenal safety record was achieved during a period of tremendous changes. Air Training Command experienced a large influx of experienced pilots, primarily from fighters, the departure of many FAIPs to long-awaited assignments, or civilian employment, decreased student loads, and restricted flying hours.

Despite the few number of serious mishaps, a high number of Class C mishaps in FY92 reflect many recurring problems which could easily lead to disaster if mishandled. Outstanding training and flight discipline have averted many potential mishaps this year.

Two of the three Class A mishaps this year were with aircraft in formation. Both involved collisions, one with a turkey vulture and one with the other aircraft in formation.

What your first IP taught you about "clearing" remains as pertinent today as it ever was. Neither of these mishaps were caused by mechanical malfunction; so, operators, pat your maintainers on the back for doing another great job this year.

Formation Gets a Hard Look

This year's first T-37 Class A mishap was a midair collision between two Tweets on a continuation training sortie. A last-minute schedule was followed by a rushed briefing (with many items briefed as "standard") trying to avoid a very late takeoff. During a fifth set of extended trail, the wing aircraft drifted well forward of the "cone" and was unable to avoid impacting the lead aircraft.

Both aircraft became uncontrollable, and all four IPs made successful ejections — evidence of their outstanding life support equipment and training.

This mishap highlighted some room for improvement in briefing procedures, training, and extended trail procedures.

I'll be the first to admit many a formation briefing has thrust me into a battle with the sandman, but in order for an item to be briefed as "standard," written standards must exist which everyone flying those aircraft understands.

It doesn't matter whether these are flight, wing, or other standards. But, they must be published, agreed to by supervisors, and understood by all before they can be briefed as "standard." No formation brief is complete without discussing lost-sight, breakout, and knock-it-off procedures. These last two procedures can be easily confused during extended trail. Make sure you understand how and when they apply.

To have a successful training sortie, pilots must overcome an inherent tendency towards complacency. Here are a few tips:

■ Avoid long-winded briefings by

pressing supervisors for accepted standards which cover those mundane portions of the brief that put everyone to sleep.

- Challenge yourself! A pilot who is alert is less likely to experience a mishap.
- Vary your profiles. Conduct rejoins at various airspeeds. Do multiple formation approaches. Practice turns in route. Split up into separate areas. Do some acro; then, coordinate for a formation recovery. Use your imagination.

Unfortunately, a second T-37 mishap occurred as we were going to press. We will be following the investigation and provide you a wrap-up as soon as we can.

Our Luck Ran Out

The lone T-38 Class A mishap this year occurred when a turkey vulture penetrated the windscreen of the lead aircraft on a two-ship low-level mission, fatally injuring the IP in the front cockpit. The IP in the rear cockpit did an outstanding job of recovering the aircraft.

Undoubtedly, the Tweet and Talon experience hundreds of bird strikes each year. This year, none were serious enough to cause Class C damage to the Tweet. Nineteen Class C bird strikes to the T-38 were reported. In the last 10 years, there have been about 10 instances where birds have penetrated the windscreen of T-38s, but no aircrew members have been seriously injured. This year, despite a strong BASH program, our luck ran out.

Along with the glory of flying the "white rocket" comes a much higher risk of a devastating bird strike than when flying the Tweet. An aircraft striking a bird at 400 knots will receive four times the damage of one striking a bird at 200 knots. The current T-38 windscreen can survive a 4-pound bird at only 200 knots. The T-38 fleet is currently slated to receive a new 400-knot windscreen within the next few years.

GLOC Again

As expected, physiological incidents, primarily GLOC to student pilots, plagued the Tweet again this year. The most often reported T-37 mishaps were physiological incidents, comprising about 40 percent of the Class Cs this year.

No formation brief is complete without discussing lost-sight, breakout, and knock-it-off procedures. These last two procedures can be easily confused during extended trail.

Engines — Good Thing We've Got Two

Engine-related malfunctions comprised about a third of Tweet reportables and half of T-38 reportables. As the sensitive J-85 engine ages, maintainers will increasingly monitor them for signs of fatigue and then modify accordingly. Talon drivers, if you're going to have an in-flight emergency next year, odds are it will be engine-related.

Oops!

Let's all learn from the careless errors several pilots made this year. A T-38 driver decided to fly awhile at negative 2 Gs (legal, but unnecessary), which dislodged a loose rivet in the boattail, jamming the flight controls. Fortunately, he was able to break the rivet loose with a sharp tug on the stick.

Then there was the Tweet driver who displayed the pins to the crew chief in preparation for taxi. He cringed as one of them slipped out of his hand and down the left intake, causing considerable damage. Luckily, the only injury either pilot received was a bruised ego.

What's Ahead

In FY93, the new F41 replacement will come on line. T-1 training continues on schedule with currently approximately 20 T-1s on the ramp at Reese AFB, Texas, training the initial cadre. Various modifications and improvements to our existing aircraft will continue to stretch their lifespan toward the next millennium.

The T-37 SLEP (Structural Life Extension Program), which beefs up the wing, fuselage and tail, will continue. Some continuing programs in the T-38 are new aluminum flight controls, improved brakes, new compressor blades, modifications to the skin and airframe, and numerous cockpit modifications.

Again, congratulations for another terrific safety year! To the instructors in the T-37 and T-38 I can confidently say although your task is usually a thankless one, rest assured that in FY92, you did your job as well as anyone, and very safely, too. From the Air Force Safety Agency, your T-37/T-38 Action Officer wishes you happy flying in '93, and keep your head out of the cockpit! ■

HONDO

The First Squadron

MAJOR DAVID BITTING
1 FSS/SE
Hondo Airport
Hondo TX

■ How can Hondo be referred to as "The First Squadron"? The answer is quite clear considering the mission and record of the First Flight Screening Squadron at Hondo Airport, Hondo, Texas (a squadron under the 12 FTW at Randolph AFB TX).

The mission of "The First" is to identify individuals who possess the physical and mental ability to complete Undergraduate Pilot Training (UPT). Flying the T-41 *Mescalero*, the unit provides flying training to international officers and conducts flight screening for all potential Air Force pilots except Air Force Academy Graduates.

The mission of "The First" is to identify individuals who possess the physical and mental ability to complete Undergraduate Pilot Training.

The "blue suit" instructor cadre are all topnotch professionals from varied Air Force weapon systems backgrounds. They represent a cross-section of experience such as former KC-135 pilots, ATC FAIPS (First Assignment Instructor Pilots), and former Tactical Air Force pilots.

Their current assignment is to quality control the operations side of

The "blue suit" instructor cadre are all topnotch professionals.

There are also "blue suit" administrators. These administrators, besides "smooth flowing" all the normal squadron paperwork, do student in- and out-processing.

The T-41 Mescaleros are '65 and '67 model Cessna 172s.

the DOSS AVIATION INC. contract. They check the quality of instruction of the contract civilian instructors, many of whom are retired Air Force pilots. This includes flying student sorties, administering check rides, and inspecting contractor operations. All this activity is geared to ensure Air Training Command's customers get the best possible product ... a student who can make it through the rigors of UPT.

There are also "blue suit" maintainers and administrators. The maintainers ensure contract compliance and safety are the "First" priorities with the contract maintenance complex. The administrators are made up of two "blue suiters" and a highly experienced civil service secretary, who has been with the flight screening operation since January of 1974. These administrators, besides "smooth flowing" all the normal squadron paperwork, do student in- and out-processing.

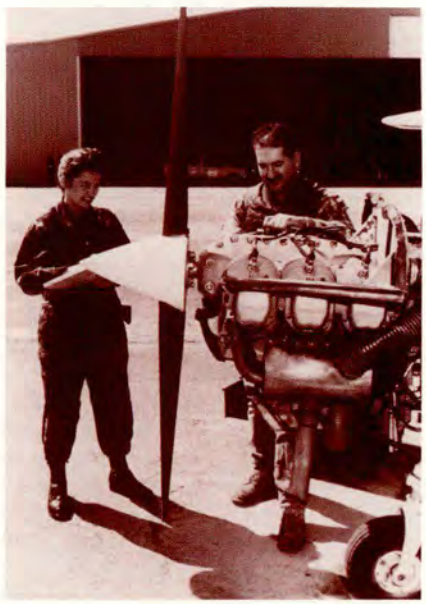
In the coming months, Hondo's instructors, maintainers, and administrators will bring the new enhanced flight screener (EFS) on line. The EFS will be a high performance replacement aircraft for the aging T-41s, which are '65 and '67 model Cessna 172s.

Because of its aerobatic and overhead pattern capability, the EFS will introduce the students to more of the maneuvers being flown at pilot training. The EFS will better challenge the students and improve the screening process significantly.

The safety performance of "The First" is highly enviable. The civilian instructor with the longest tenure began in September of 1974. The last Class A mishap occurred 1 year prior to his arrival. The record speaks for itself. How it happened can be summed up in one word — professionalism. At Hondo, this word is defined by dedication and integrity in doing the job right, the "First" time and in the safest manner possible.

"The First" at Hondo is where the standard for safe, professional performance is being set for many of tomorrow's Air Force aviators. Considering the investment in our flying resources (lives and weapon systems), the standard must be a solid one. The "First" is the leading edge of establishing this standard. Their 19-year and 230,000-hour safe flying record speaks for itself. ■

The instructor cadre also includes civilians, many of whom are retired Air Force pilots.



The Only Pair of Eyes You'll Ever Have

D. W. PRESSGROVE (United)
Courtesy *Air Line Pilot*, Jul 92

■ Of all the things that can happen to our eyes, four are most common, and we can do little to prevent them: cataracts, detached retina, glaucoma, and macular degeneration.

I recently experienced a detached retina, an event which — if left untreated — will almost certainly lead to blindness in the affected eye. The severity of my injury was far greater than it would have been had I begun treatment in the earliest stages. Why did I delay? Like most people, I had absolutely no frame of reference for determining what was happening, or why. With the hope of preventing anyone else from needlessly losing part — or all — of their vision in one or both eyes, I wrote this article after discussions with an ophthalmologist and a surgeon, and both specialize in retinal disease and treatment.

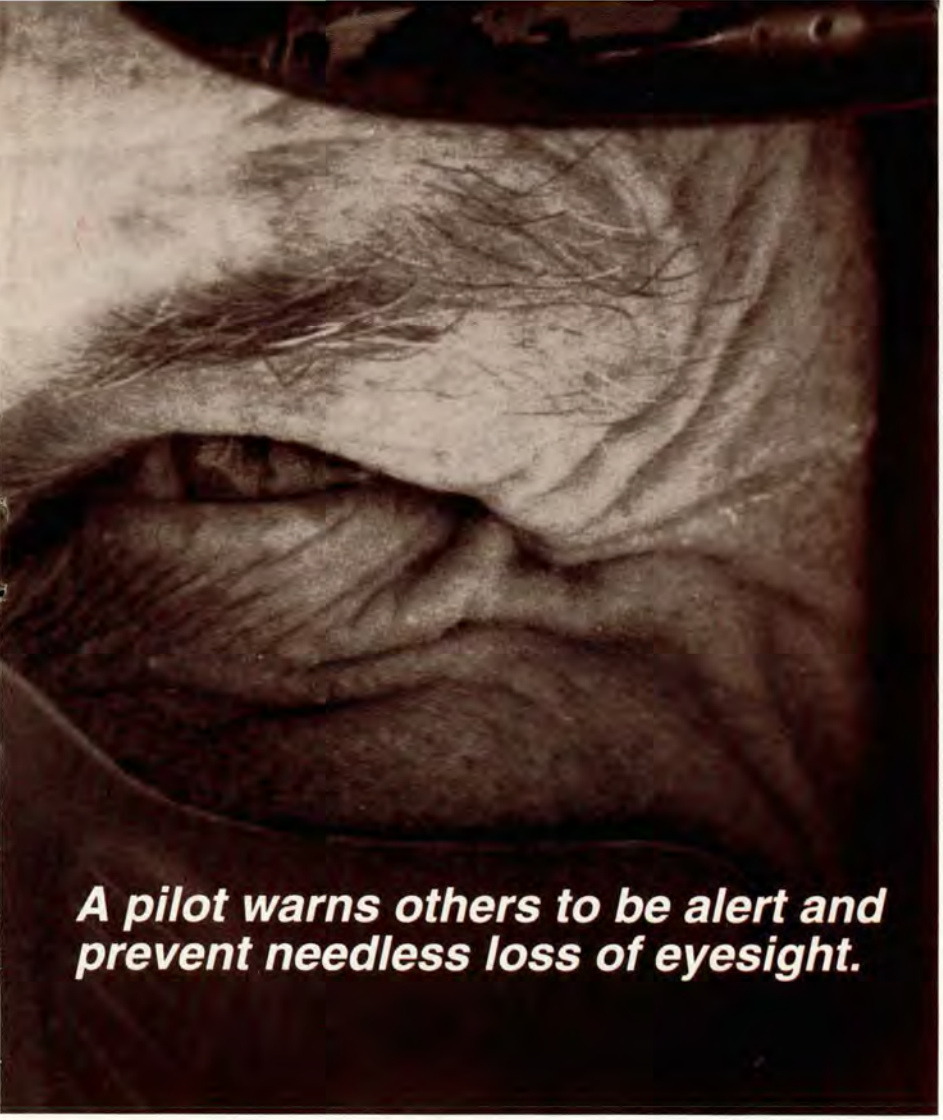
To better understand what happens, and why, we need to understand a little basic physiology of the eye. The center of the eye is filled with a gelatin-like substance called the vitreous humor.

Starting at about age 30, the center of the vitreous humor begins to liquefy. The fluid center takes less space than the vitreous humor, and the entire mass begins to shrink. The vitreous humor has attachments to the inner lining of the eye — the retina.

The retina is a very thin layer of cells on which are located the rods and cones that actually receive light and convert it to electrical signals that are carried to the brain. The retina is mounted on another layer called the sclera. When the vitreous humor begins to pull on the retina, if the level of attachment is great enough, the retina can be torn. The process can occur repeatedly. (I had 15 tears in the right eye and 5 in the left.)

Once the tears exist, the fluid in the center of the eye may move to the outer edge and seep through the torn area. Once through the torn area, the fluid can begin to work its way behind the retina and begin displacing it from the sclera, and — behold — a detached retina.

What can be done? That depends almost exclusively on the time lapses between the retina detaching and treatment beginning. The sooner the patient begins remedial efforts, the greater the possibility of complete recovery. The longer the delay, the greater the probability of irrecoverable blindness. How can we know that we are experiencing such a potentially calamitous event? That, my friends, is a very tough call. The onset can produce symptoms ranging from the immediately, literally blindingly, obvious to an onset so



A pilot warns others to be alert and prevent needless loss of eyesight.

insidious that being able to tell, day to day, that something really serious is happening is difficult.

What are the odds on an individual suffering such an event? Approximately 1 in 15,000. A comforting number? About 8,000 pilots currently fly on "my" airline (United). With those numbers, over a 10-year period, five pilots can be expected to experience a detached retina.

During a recent conversation with my FAA-designated flight surgeon, the doctor stated that he had been practicing aviation medicine for 30 years. In the last 2 years, he has seen more detached retinas than he has seen in the preceding 28 years. Why? No one knows!

I was not fortunate enough to have experienced the "quick and dirty" type of detachment. Have you ever experienced the phenomenon called a "floater" — those little things that float around in one's field of vision for a while, then just sort of disappear? According to the "experts," a floater is a relatively common result of liquified vitreous floating in the field of vision. It is later absorbed back into the body. I had experienced "floaters" from a very young age. Other than the nuisance of momentary distraction, they were irrelevant.

Awakening in the middle of an otherwise peaceful night and walking to another room nearby (all in total darkness), I experienced star bursts, flashes of light, and a sort of "corona" effect, even though no light was discernible anywhere. The "pyrotechnics" were a little startling, but not painful. When I awoke later that morning, I could see a large (make that very large) number of floaters in my right eye. While annoying, they were nowhere close to being incapacitating. During that day, my only real discomfort was wondering about a major escalation of an old experience and a general feeling of "whaaaat?"

As I had experienced before, over the next 4 days, the floaters began to break up and dissolve, at an ever-increasing rate. On the sixth day, I could see a small opaque spot in the lower left corner of the field of vision of my right eye. While the site was illuminated, something was obviously in the way. My immediate reaction was, "With all that debris, perhaps that's where it settled (I hope, I hope, I hope)." The next day, the spot might, or might not, have been a little larger. The third day, I had no question about its being slightly larger. The fourth day, the opaque spot had increased to about one-third of my total field of vision in my right eye and appeared to be speeding up its rate of change. By midmorning, my need for help became not "if" but "when." A call to an ophthalmologist produced an office visit and an appointment for surgery.

Believe it or not, on a Sunday afternoon, he not only responded, he came — almost galloping — to the rescue, and earned both my eternal thanks and my respect. Unfortunately, and not his fault, during the period between the exam and the surgery, the detachment progressed through the fovea — the rear center of the eye, where the macula is sited — and pulled that loose as well.

Once the fovea becomes detached, the possibility of regaining normal vision becomes increasingly problematical with the passage of time. After 5 days, the chances appear to be almost nil. Fortunately, my problem appears to have been caught within 24 hours. The outlook, at this writing, appears to be about 50-50 for full recovery.

The lesson to be learned for all this? If you experience any — any — any change in what you normally see, run — do not walk — to the nearest ophthalmologist and say, "Hellllppp"!!!! If it's a false alarm, all it will cost you is your time and some money. If you really needed that "help," it will be one of the cheapest investments you ever make.

In good health, salud. ■

An Ounce of Fire Prevention

MR GREG GANDEE
Air Force Safety Agency

It Happens

■ There you are, flying along in the clouds without a care in the world when all of a sudden the master caution lets you know there is a problem. A quick check reveals you have lost one of the hydraulic systems. Now, this normally isn't a problem since we all know modern aircraft are equipped with redundant hydraulic systems to "solve" problems like this. Further, the old nemesis of hydraulic fires is behind us now since we are using the new fire-resistant fluid. Not to worry, right? Wrong!

Whoops! Now things get a little hot. Your wingman reports you are on fire! Depending on which aircraft you are flying, this may or may not be your lucky day. Take your choice from one of the following:

- F-16 with "System A" hydraulic fire migrating to the wheel well area.
- A-10A with a right hydraulic system depletion and your wingman telling you "fire on left side."
- B-1B with multiple unusual indications on equipment in the aft avionics bay.
- T-39B with aft hydraulic compartment fire.

Each of these fire scenarios are real, and in three of the four cases, we had a Class A mishap. Fortunately, everyone survived in these mishaps. However, if you chose either the F-16 or A-10, you unhappily also got to test the ejection system. The B-1 fire went out due to lack of oxygen to sustain it. The T-39 was in the landing pattern when the fire occurred, so it made it to the runway in time for the crew to ground egress unharmed and the fire department to save the aircraft.

It is unsettling that each of these mishaps *could have been avoided* if there had been more awareness of how a seemingly small problem can burn you … in the literal sense! Let's look at a typical pressurized hydraulic fire so we have a better understanding of what was happening in these mishaps.

Pressurized Hydraulic

High pressure hydraulic systems operate at pressures between 3,000 to 4,000 psi. The fluid lines are constructed out of high strength stainless steel, titanium, or aluminum. Our track record is very good, and there are few leaks. However, a loose coupling or a pinhole leak from a pressurized line is a fire hazard. *It doesn't matter what the combustible fluid is*, the pressurized spray will make it flammable.

How does this happen? A pressurized leak from a small opening will create a very fine mist and vapor cloud. In this mist condition, the fluid acts like a flammable such as propane or gasoline. A small spark is all that is needed to ignite the mist. Once ignited, the spray will continue to burn as long as there is

pressure and the mist remains fine. If, however, the droplet size in the mist increases (becomes large), the fire may self-extinguish.

The best way to understand a fire like this is to think of the home heating oil furnaces used in cold climates. These furnaces are igniting a spray of oil in a burner with a little spark. The system is consuming less than 1 gallon of fluid per hour, and there is no problem keeping the house warm. Think of how hot it would get if you were heating only a small closet or if the flow rate of fluid was much higher. This is the same scenario you have in the aircraft fire.

Spray or Mist Burning

A torch-like pressurized hydraulic fluid fire will rapidly heat up the area and elevate the temperature of any unburned fluid pooling in the immediate area. Once the temperature of the fluid is above the flashpoint, flammable vapors will then come off what is normally a safe fluid. The burning process vaporizes additional fluid, adding to the fire. Fluid migration also means fire migration. The fire goes wherever it wants!

This scenario of a pressurized hydraulic fluid leak fire negates any safety benefits from the higher flashpoint MIL-H-83282 fluid. When the fluid temperature is below its flashpoint, there are insufficient vapors to burn. The heat from the fire must vaporize the fluid. Thus, the rate of fire expansion is slower when the temperature is below the flashpoint.

The spray, as noted previously, keeps the fire going unless the initial leak produces a coarse spray. This coarse spray is difficult to keep burning once the ignition source is removed. However, as will be explained, mishaps begin with a pinhole leak and a continuous electrical arc. They eventually blossom into a catastrophic fire and the loss of a valuable Air Force asset.

Wire Chafing

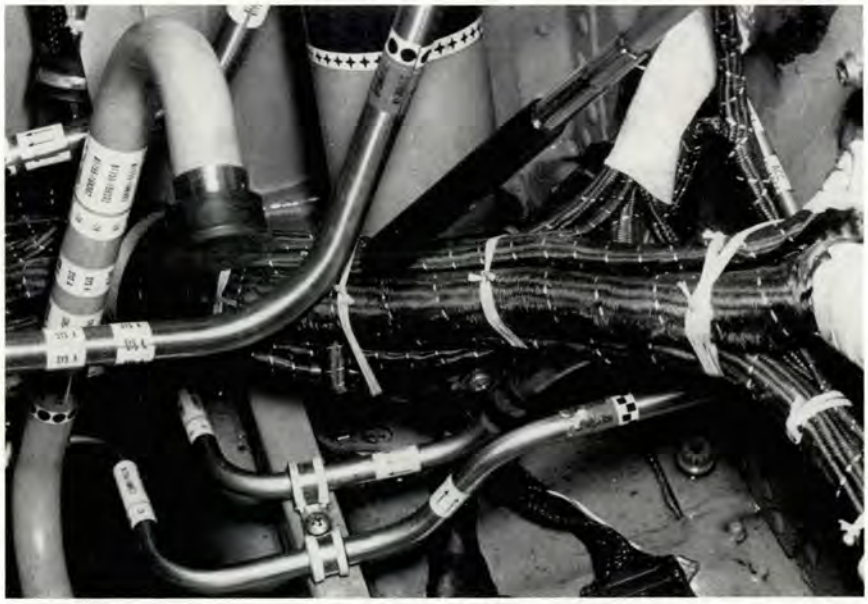
How are these fires started? It's quite simple. It is called electrical wire chafing. Any maintenance or safety person can tell you how common this problem is. Rubbing wire bundles against structure removes insulation and erodes metal. If allowed to go undetected, you have the potential for an electrical fire. A review of our safety data base reveals we have had 225 similar electrical chafing problems during the past 10 years.

To make it more interesting, let the chafing occur when the electrical wiring is carrying current *and* the structure being rubbed is a pressurized hydraulic line. Once the bare electrical conductor is exposed by the chafing action, it can arc to the line. Most wiring has some minor movement due to vibration, and there can be intermittent contact and arcing.

Each arc contact eats away some

continued

Our record is good, and there have been few leaks from pressurized lines in high pressure hydraulic systems. But it only takes *one* loose coupling or pinhole leak to create a fire hazard.



In contrast to hydraulic system leaks, any maintenance or safety person can tell you wire chafing problems are common. As shown above, wire bundles against structure remove insulation and erode metal. If undetected, the potential for an electrical fire exists. Our safety data base reveals we have had 225 chafing-related mishaps in the last 10 years.

of the line material. (Circuit breakers seldom respond to an arc of this short duration. In fact, circuit breakers can take this type of current and not trip. Even if they do trip, the first thing a crew does is reset the circuit breaker.) Thus, within a short time, electrical arcing has eroded a considerable amount of the hydraulic line's wall. One final arc weakens the wall to where internal pressure bursts it, creating a fine mist. At the same time, there is electrical arcing. The end result is a fire.

To create the above situation, we had dual failures. First there was chafing, and then there was a fluid leak. Our aircraft fire protection systems are not designed to protect against this type of event, so the crew may not be aware of the problem. Since many of these areas are not fire zones, i.e., we don't expect a fire, there is no fire extinguishing capability. Think of how hard and expensive it would be to try to protect against fires in all areas where this condition could exist.

Solutions

What leads to problems like this? First of all, most fighter aircraft are space-limited, and designers must cram all of the wiring and fluid lines in the same general areas. Designers are generally aware of these problems but may not appreciate the severity of the outcome as do the maintenance troops and crews. The guidance is there but may be ignored in the rush to meet deadlines.

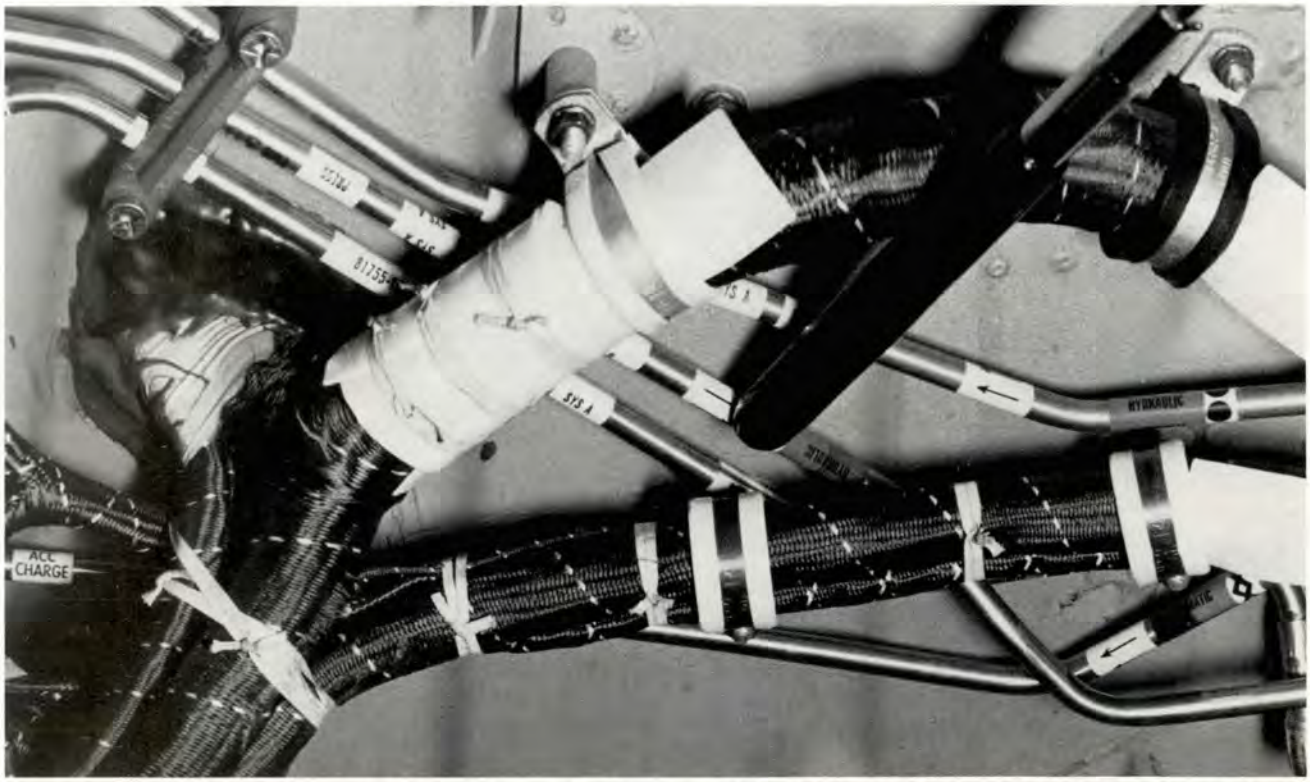
Guidance can be found in the wiring specification, **MIL-W-5088C.** It states, "If clearance is less than 2 inches, separation shall be maintained by attaching cable clamps. The minimum clearance shall be 1/2 inch."

As aircraft space became a premium, a later spec, **MIL-W-5088E**, was changed to state, "Wiring must have distinct physical separation from all fluid and gas-carrying lines and tubes." This physical separation includes antichafing guards such as spiral wrap or heat shrink material.

Guidance is also found in the aircraft TOs. TO 1-1A-14, which covers electrical wiring installation, recommends maintaining 0.5-inch separation criteria as does the electrical inspection TO, 8-1-1. These TOs also recognize the need for antichafing guards.

What can you do to minimize this potential safety hazard? Make sure the guidance of general series TO is folded into daily maintenance activities. Further, make everyone aware how serious the problem of electrical wire chafing can be if there is a chance for the fire scenario to occur. Additionally, in tight structural areas, you need to inspect for antichafing guards. If they are not there, add them. Also, if they are properly installed, check for any signs of wear.

Hindsight is always 20/20. However, you can safely hypothesize that if the appropriate antichafing measures had been taken, the lost aircraft noted at the beginning of this article might still be flying. ■



Current standards state "Wiring must have distinct physical separation from all fluid and gas carrying lines and tubes." This physical separation includes antichafing guards such as spiral wrap or heat shrink material. Wire chafing is obviously a very common problem, and we should make sure the guidance of the general series TO is included in daily maintenance activities.

Gearing Up for Winter

The winter months at many "northern" bases, as many old heads will attest, bring a combination of cold temperatures, high winds, low ceilings, and low RCRs that are often coupled with blowing and drifting snow.

LT COL CHARLES K. BERGMAN
410 BW/SE
K.I. Sawyer AFB MI

■ K. I. Sawyer AFB, Michigan, receives about 140 inches of snow per year, with winds and temperatures routinely driving windchill factors to -35 degrees and colder. Weather conditions change rapidly due to the influence of "lake effect" snow, often producing limited visibilities as well as slick runway and taxiway conditions.

Yet, in spite of the weather, our flying operations go on much as they do during the milder weather months. Successful winter flight operations are no accident! Careful planning and continuous awareness of cold weather hazards are mandatory.

How can we fly a rigorous training schedule while satisfying higher headquarters' mission taskings, all within the highest standards of safety? The answer lies in proper planning and in attention to detail during execution.

The winter "culture" of a safely executed sortie begins first with proper outfitting and training of maintenance and aircrew personnel. This "culture" continues with specialized winter weather procedures and techniques by our maintenance troops to prepare the aircraft for aircrew acceptance.

The next step in this process involves aircrew mission planning, preflight, and flight operations. Here, crews anticipate severe weather conditions and compensate for their potential to detract from mission effectiveness.

The final link in this safety chain is supervisors at all levels. They respect the potential hazards of the environment and plan for it. They take care of their people and remain focused on the details which result in mission effectiveness in this challenging cold weather environment.

Outfitting and Training

One of the most important aspects of dealing with severe winter weather hazards is ensuring maintenance and aircrew members have and *wear* adequate clothing. Clothing includes heavy Sorel®-type boots (they come in both steel toe and regular) which keep feet warm and dry. Specially approved one-piece insulated coveralls help keep our maintenance people warm and minimize the risk of frostbite.

Aircrew members wear (or have readily available) Nomex® thermal underwear, leather flying gloves with wool inserts, heavy-duty (N-4B) mittens, and heavy winter Nomex® flying jackets with hoods. Sorel-type boots or mukluks are also provided for aircrew use. Of course, the arctic parka is in vogue and approved from 1 October through 15 May each year. A review of applicable aircrew life support regulations will give crewmembers guidance on what is specifically required for your locality.

Our annual training is conducted in the early fall of each year. It highlights the hazards of winter operations and stresses such things as techniques for driving on ice and snow, vehicle speeds, operations on the flight line, recognizing cold and frostbite symptoms, and the impor-

continued

Cold weather maintenance can be hazardous, and precaution must be taken to protect crewmembers. When the windchill is less than 35 degrees, the "buddy" system is critical to their safety.

Gearing Up

continued

tance of the "buddy" system (used when windchill is less than -35 degrees). Both maintenance and aircrew personnel receive briefings on how to avoid slips and falls.

Additionally, we provide back support belts for those personnel involved in lifting activities. In summary, we ensure our folks understand and plan for the hazards of the environment and supply them with adequate clothing and equipment. Supervisors at all levels are kept aware of current conditions so they can take care of the troops.

Maintenance Magic

Perhaps the most important aspect to recognize from a maintenance preflight perspective is that additional time is required to prepare the aircraft for flight. Maintenance preflight time for B-52s is increased by approximately 50 percent (12 hours versus 8 hours).

Extra attention is paid to snow and ice removal from the aircraft and to preheating such areas as starter control valves, fuel controls, and engine inlets/exhaust, as well as the crew compartment area. Snow removal generally begins with brushing or sweeping (personnel wear appropriate safety harness) from the fuselage and wing surfaces. Additionally, a 3/4-inch rope may be manipulated along surfaces to remove snow (see TO 1B-52H-2-2MS-3).

"Lake effect" snow is often fluffy and easily swept away, but if an icy surface remains, a mixture of heated water/deicing fluid can be used to quickly clear the remaining ice buildup. Caution is also taken to insure runoff does not refreeze in flight control areas or balance bays, pitot or static source areas, or crew entry hatch and window areas.

A timely wipe-down of shock struts and actuators and cleaning of snow and ice particles also decreases the chance of hydraulic leaks.

One of the most important tasks performed by maintenance is to insure ground heaters are in use at each aircraft to warm personnel and various aircraft components. The heaters are started in the shop, then towed to each parking location for use. Supervision insures they are rotated with new heater carts periodically, as these units run about 8 hours on a tank of fuel. The heaters are crucial to aircraft preflight operations, as well as "morale" builders to warm our people and keep them safe and effective.

To recap the maintenance magic aspect of wintertime ops: Allow additional time for aircraft preflight to remove ice and snow and to preheat frozen components. Likewise, allow additional work time to insure your maintenance people can warm themselves when required.

Aircrew Operations

Safe flight ops in wintertime conditions demand increased attention to detail from the mission planning phase through postflight shutdown. For brevity, we'll consider from mission planning through takeoff only.

Mission Planning Here are some important points to consider during mission planning.

- A fuel consumption plan based on the need for anti-ice for departure, low level, and the local penetration phases of the mission.

■ Mental preparation for bad weather and low RVRs/RCRs. Aircraft commanders should talk with their copilots on what they expect during bad weather approaches.

■ A review of predicted local and en route weather.

■ A review with crewmembers of takeoff performance for dry, wet, icy, or crosswind conditions.

■ Compliance with AFR 60-16 and MAJCOM supplements on weather minimums, visibility only filing, alternates, and fuel requirements.

■ A review of needed alternates and the fuel required for diversion.

■ A review of any specific crew techniques due to unusual conditions of mission requirements.

■ A plan to arrive at the aircraft *early* (B-52s use 1+45 before takeoff at K. I. Sawyer). This time is used for deicing, increased taxi times, etc.

When you arrive at Base Operations prior to flight, pay particular attention to temperature/dewpoint spread (anti-ice use), freezing level/cloud coverage, and alternate airfield conditions for takeoff and landing as well as local RCRs for runways, taxiways, and aircraft parking areas.

Taxiing If you have been delayed during preflight, don't try to make up lost time during taxiing. Start coordinating new times and routing if necessary. Taxi lines may not always be visible from the cockpit.

Takeoff Taxi onto the runway slowly. There will probably be more ice in this area than anywhere else on the runway. Follow the radius lines.

■ The runway center line will be the cleanest portion of the runway since it gets the most attention from the snowplows. In the most adverse condition, it may be the only portion which has been swept/plowed. Get on it and stay on it. Expect reduced visibility during blowing snow conditions.

■ Some other do's and don'ts:

– Do not take off under conditions of freezing rain or freezing drizzle.

– Do not take off with slush on the runway.

– Takeoffs should not be attempted when runways are covered by excessive water depth. Consult your tech order for maximum water depth coverage for takeoff.

– Consider leaving the landing gear down approximately 30 seconds to allow moisture to be blown clear prior to freezing.

Supervision is Key

Special training and outfitting play an important part in helping us deal with severe winter weather. Equally important is the additional time and techniques used by maintenance people to clear snow and ice from the aircraft and to preheat its systems, insuring the aircraft is ready for aircrew preflight.

Aircrews contribute to the safety "culture" by proper mission planning and preflight procedures for cold weather operations. The final link in the safety chain is keeping supervisors at all levels fully plugged into the process — aware of deteriorating weather conditions and focusing on those details which result in mission effectiveness in the cold weather environment. Extra preparation and additional preflight time, coupled with maximum supervisor involvement, "insures mission success." ■

During the cold months, it is critical to remember that maintenance time is significantly increased. Extra attention must be paid to snow and ice removal from the aircraft and preheating such areas as starter control valves, fuel controls, and engine inlets.

Contact the Safety Specialists

Here's your guide to the folks at the Air Force Safety Agency and how to reach them by phone, FAX, or mail.

As of 28 October 1992

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SEFM (Maintenance)
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SEFB (Bomber / Transport)
LTC Pete Magargee
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SEFD (Data Analysis)
LTC Jerry Perkins
X4948

SEFC (Technical Assistant)
LTC Joe Marksteiner
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SEFC (Final Evaluations) (F-117 / B-2)
LTC Frank Snapp
X7001

SEFF (F-4/OV-10)
LTC Peter Schaller-Kalide, GAF
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SEFF (A-10 / A-7)
MAJ Mark Pendley
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SEFF (T-37 / T-38)
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SEFB (Helo / CU-22)
LTC Ron Cunningham
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SEFB (C-130 / Aero Clubs)
LTC Pete Magargee
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DOCTOR'S STUFF:

Chronic Fatigue Syndrome

J. ROBERT DILLE, MD
FAA Aviation News, Jul-Aug 92

■ I concluded my recent column on fatigue with the following:

"Recently, reports have appeared in the medical literature on Chronic Fatigue Syndrome. (Symptoms are) confusion, difficulty concentrating, mood changes and other emotional disturbances, headaches, balance difficulties, and other neurological symptoms, and flu-like symptoms lasting for many months. This syndrome is felt to be due to chronic active infection with the Epstein-Barr virus, a member of the herpes group that causes infectious mononucleosis. You will need medical help to diagnose and treat this cause of fatigue."

Since that time I have (1) seen Chronic Fatigue Syndrome (CFS) referred to as the disease of the decade if AIDS had not come along; (2) read a firsthand account by a physician-pilot victim who could have had an aircraft accident due to his symptoms; (3) heard of many more cases; (4) learned that the Epstein-Barr virus is probably not the cause of CFS; and (5) read about a recent national conference where three dozen researchers reported their work on CFS.

The syndrome has probably been around since the mid-1970's and diagnosed as postviral syndrome, atypical polio, chronic active Epstein-Barr virus infection, and myalgic encephalomyelitis. The number of cases, articles in the literature, resulting physician awareness, and research activity have increased mostly in the late 1980's.

The physician-pilot mentioned above was tested extensively with essentially normal findings. Diagnoses considered included viral myocarditis, stress, psychosomatic illness, Lyme disease, brucellosis, lupus, and AIDS. (Hypoglycemia, fibrositis, environmental allergy, and, if female, candidiasis hypersensitivity syndrome, chronic candidia-

Chronic fatigue—symptoms can range from confusion to mood changes to headaches, and even to flu-like symptoms.

CHRONIC FATIGUE SYNDROME

Tired all the time? Bad mood? Forgetting routine checklist items? Can't concentrate? You may have a viral illness known as chronic fatigue syndrome (CFS). Consult your flight surgeon.

In the last 3 years, the Air Force has had only one confirmed case of CFS in a pilot. Perhaps it is not common among aircrew. Or, perhaps fliers are not communicating the whole range of symptoms to their flight surgeons.

Whatever the reason, CFS is real. If identified, it can be cured. You don't *have* to feel bad all the time. There is help.

See your flight surgeon!

drome, or polysystemic candidiasis also have been considered.) His CFS was diagnosed by a coworker — an engineer — at the National Aeronautics and Space Administration who also had the illness.

Virologists report immune system activation that they say proves there is a real disorder; they just have not yet found one virus or combination of viruses that was consistently present. However, there are still skeptics who feel that CFS is psychosomatic or due to mass hysteria, and, therefore, nonviral. Perhaps in some diagnosed cases it is.

The clinical course reported by the physician-pilot is considered typical. First, there were the usual symptoms of influenza — fever, sore throat, headache, severe muscular aches, and lethargy. The symptoms recurred 2 weeks later. Remissions and recurrences alternated for several months. Resumption of jogging was accompanied by an unusually high heart rate for him and a relapse of the flu. Soon, he did not feel well, even during remissions, and his work began to suffer. Perhaps because of this, extreme depression and withdrawal appeared by the end of the second month. Also, headaches increased in number and severity.

Between the fourth and sixth months, cold sores and sensory symptoms, including luminous patterns in the visual field, intolerance to light, flaring of lights at night, decreased visual acuity in low levels of light, persistence of visual images, problems of balance, and ringing in the ears were noted. Fatigue was severe and, at times, profound.

Although he was an experienced flight surgeon, he seems to have gone flying while experiencing many of these symptoms! On one flight, he had difficulty remembering his flight plan and recalling aeronautical terminology he had used for 26 years. He confused right downwind for runway 32L with left downwind for 32R and shook up the tower controller when she could not locate him until he was halfway down final for the wrong runway.

He had trouble with concentration, word recall, and word substitution, and became confused in the traffic pattern on another flight. Fortunately, he did not have a mishap and realized he should not fly any more until he found what was wrong with him.

The next month, concentration on his work became nearly impossible. Trouble sleeping, constant nightmares, and abnormal sensations over the face (usually associated with encephalitis) began. Not surprisingly, anxiety occurred with the failures to diagnose the disease and later increased when he found the cause of CFS was unknown and there was no cure.

He did discover (1) there were support groups in several cities; (2) Congress had approved CFS research funds for the Centers for Disease Control (CDC) and for the National Institutes of Allergy and Infectious Diseases starting in FY89; and (3) information is available from the CDC by calling its CFS hotline (404) 332-4555 (follow the recorded instructions) and from the NIAID, Office Communication, Building 31, Room 7A-32, Bethesda MD 20892.

Should you have persistent symptoms similar to these, you should not fly until you see a doctor. Even then you may have to ask, "Could this be Chronic Fatigue Syndrome?" Knowing the cause and any effective treatment are unknown may cause anxiety and depression. Hope for slow improvement in your condition and a breakthrough in effective treatment from the research which is finally underway is helpful. Check on support groups and contact CDC and NIAID in order to stay fully informed. CFS is not very contagious; some people have immune system changes without symptoms, and it is not fatal — be thankful for that good news.

As with many new suspected diseases which have been identified during the same 15 years — such as Legionnaire's Disease, toxic shock syndrome, post-traumatic stress disorder, Agent Orange effects, AIDS, environmental allergy syndrome, and candidiasis hypersensitivity syndrome — early information about causes and risks is usually incomplete and frequently incorrect. Considerable controversy is often present during the years it takes to develop working definitions, diagnostic tests, and effective prevention and treatment.

Chronic fatigue syndrome can affect aircrew performance and aviation safety no matter what its cause. Therefore, I believe you should know something about it. ■

Chronic

DALE A. MATTHEWS, M.D.
Director, National Center for Chronic Fatigue*

■ **What is chronic fatigue?**

Chronic fatigue is a condition in which for a period of time (at least a month or so) you feel unusually or excessively tired and don't get better after sleeping or resting. You may feel exhausted after your usual activities, notice less energy for tasks requiring effort or concentration, or, when it's very severe, an inability to do any significant mental or physical work. Sometimes even thinking about doing mental or physical work can bring on fatigue.

What is chronic fatigue *syndrome?*

The term "chronic fatigue syndrome" was introduced in 1988 by the Centers of Disease Control to refer to those patients suffering persistent, disabling chronic fatigue whose activity level has been reduced at least 50 percent below its usual level for a period of 6 months. In addition, patients with chronic fatigue syndrome often report a sudden onset of their fatigue and other symptoms, which may include fever, sore throat, swollen glands, muscle aches and weakness, joint aches, prolonged fatigue after exercise, sleep disturbance, headaches, depressed mood, and problems with concentration and memory. On examination, some patients demonstrate lymph gland swelling, fever, or throat irritation or infection.

What are the causes of chronic fatigue?

At present, there does not appear to be a single cause of chronic fa-

Fatigue — Questions and Answers

tigue. There may be a variety of *predisposing*, or background, factors in your past (such as a history of frequent infections, allergies, or depression). There may also be *provoking*, or triggering, factors which initiate your illness (such as a viral infection or major illness, a major stress in your life or environment — divorce, death in the family, job change, or move). And, there may be *perpetuating* factors which seem to keep you ill (such as lingering infection or illness, sustained side effects from medicines or treatment, a failure of treatment, improper eating habits, lack of exercise, avoidance of social activities, ongoing depression and anxiety, problems in coping, and personal or family issues).

There are a variety of medical illnesses, psychiatric illnesses, and other factors (including sleep, nutritional, exercise, social, emotional, lifestyle, and spiritual factors) which may also influence your condition.

What are the medical causes of chronic fatigue?

Many medical illnesses may contribute to the symptoms of chronic fatigue. Among these are inflammatory conditions (such as lupus, fibromyalgia, and various types of arthritis), or infections (such as chronic viral infections, mononucleosis, and Lyme disease). Also, hormone problems (such as pituitary, thyroid and adrenal diseases), allergies to food, vitamin and mineral deficiencies, heart conditions, and neurologic problems (such as multiple sclerosis, seizure disorders, and sleep disorders) may contribute to the syndrome.

What about Epstein-Barr virus and other viruses?

A few years ago, it was thought the Epstein-Barr virus (the cause of many cases of acute mononucleosis, or "mono") might be related to chronic fatigue, which, in turn, might represent a type of "chronic mono" in which the virus becomes reactivated in the bloodstream after many years of lying dormant in the body.

Further studies, however, did not support a specific role for Epstein-Barr virus in patients with chronic fatigue. Although some patients have high levels of antibody to Epstein-Barr virus in the bloodstream, this is not a specific finding, as many patients have high levels of antibodies to other viruses as well. Additionally, many other patients with chronic fatigue do not have high levels of this or other viral antibodies in the blood stream.

The role of enteroviruses such as Coxsackie-B, human herpes virus-6 (HHV-6) and retroviruses is unclear at present, but research is continuing to explore the possible relationships between fatigue and viruses.

Is chronic fatigue contagious?

Although chronic fatigue may occur in members of the same family or among the same cluster of friends or acquaintances, there is no good medical evidence at the present time to suggest the illness is contagious. You need not worry that you are spreading this illness to others.

What about the immune system?

Some patients have changes in their immune system and show either an overactivation or underactivation of certain components of the immune system, such as the T cells and B cells. Underactivation of the immune system can lead to infections, while overactivation of the immune system can lead to allergies and to certain types of diseases (particularly arthritis and certain bowel and thyroid conditions). These changes in the immune system are not found in every patient and are not easily detected with standard laboratory tests. Sophisticated and expensive tests are necessary to evaluate the immune system fully, but no specific treatment of the immune system and possible problems has yet been developed.

The immune system can also be affected by ongoing medical and psychiatric illnesses and by lifestyle issues and stress.

What are the psychiatric aspects of chronic fatigue?

The most common psychiatric conditions which contribute to, and overlap with chronic fatigue include depression, anxiety (particularly panic disorder and phobias), and somatization (i.e., multiple aches and pains without any probable medical explanation).

Depressed mood, fatigue, sleep disturbance, and problems in concentration and memory are symptoms both of depression and of chronic fatigue. In addition, other symptoms of depression include a lack of interest or pleasure in usual activities, problems with sleeping, appetite, or weight, difficulty making decisions, a feeling of guilt or

continued

Chronic Fatigue: Questions and Answers continued

worthlessness, a feeling of being slowed down or speeded up, and thoughts of death or suicide.

Tension, aches or soreness in the muscles, fatigue, difficulty concentrating, trouble with falling or staying asleep, and irritability are characteristics both of anxiety and of chronic fatigue. Patients with panic disorder report sudden attacks of feeling fearful or anxious. They also notice shortness of breath, pounding heart, chest pains, sweating, choking, upset stomach, dizziness, numbness or tingling, trembling, and feelings of unreality or fears of dying. Sometimes patients develop a fear of going out of the house alone, being in a crowd, standing in a line, or traveling on buses or trains and begin avoiding these activities because of a fear of having one of these attacks.

It is sometimes difficult to determine which comes first: the fatigue, the depression, or the anxiety. The good news is symptoms of anxiety and depression often improve with appropriate medicines and counseling and may lead to more energy.

How does one treat chronic fatigue?

Because there is not a single cause for chronic fatigue, there is not a single form of treatment for all patients. Chronic fatigue is best treated with a "whole person" approach in which all factors of your illness including medical, psychological, social, lifestyle, and spiritual factors are all considered.

Each of these aspects of your individual, personal experience should be addressed for proper treatment. Therefore, proper diagnosis and evaluation by a physician experienced in taking care of chronic fatigue is essential.

If medical problems (such as hormone deficiencies, inflammatory conditions, infections, or sleep problems) are identified, these can be treated with appropriate medicines. If allergies are identified, these can be treated with changes in diet or environment. If depression or anxiety is detected, counseling and medicines are helpful. Social, lifestyle, and spiritual issues can be addressed on an individual basis.

Do patients with chronic fatigue get better?

In our experience, approximately two-thirds of patients get better with appropriate treatment. Only 5 to 10 percent of patients get worse with time, and the others tend to remain the same. Your willingness to look at your chronic fatigue as a "whole person" problem, learn new coping skills and behaviors, take medicines and undergo careful followup, and your patience are very important ingredients for getting better.

Approximately two-thirds of chronic fatigue patients get better with appropriate treatment. "Getting better" requires taking proper medicines and undergoing careful medical followup.

When should I seek help for chronic fatigue?

If you have noticed yourself being unusually tired for at least a month, without an obvious cause (lack of sleep, overwork, change in shift at work, or poor eating habits), you should seek medical attention, preferably from physicians who can address all aspects of your individual experience as noted above.

Referral to a specialized center for patients with chronic fatigue may be necessary if you are not responding to treatment from your primary care physician or a comprehensive approach to your problem is not available. For further information regarding the National Center for Chronic Fatigue in Arlington, Virginia, please call 1-800-989-2066 or 1-703-527-2066 or write the National Center for Chronic Fatigue, One Colonial Place, 2111 Wilson Boulevard, Suite 1120, Arlington, Virginia 22201. ■

An Electric Jet?

LT COL ROBERT E. LUNDIN
Air Force Safety Agency

■ When the T-38 student pilot punched the number one starter button, he experienced a mild electrical shock. The instructor pilot in the rear seat tried his start button with no problem. They discussed the shock and decided to continue their sortie.

Just after takeoff, approaching the departure end of the runway, the student suffered a shock to the left hand that caused him to scream in pain! The Talon pitched up sharply as he reflexively pulled aft on the stick. He was even more surprised to find out he could not release the stick! The IP assumed control but it took him a few moments of questioning the dazed student to ascertain what had just happened.

After an uneventful landing, the flight surgeon determined the student was not injured and returned him to flying status.

Maintenance investigators found the culprit. A broken front cockpit trim button on the control stick exposed an open 115VAC contact. When the student's thumb touched the trim button just right, electrons flowed from the open contact, through his thumb and body, and to his left hand which was grounded against the throttles — ZAP!!!

Although the student did not recall touching the trim button during the engine start, he most probably *was* touching his hand or arm on the trim button. This incident demonstrates how elusive the electrical migration can be — shocks on the left hand from a starter button and fistful of throttles turn out to originate from a defective trim switch the right hand is touching.

The incident wing conducted a one-time inspection of its T-37 and T-38 fleet and found one other Talon with a similarly busted trim switch. Hangar flying with action officers at the Air Force Safety Agency reveals the U.S. Navy has had similar problems — an A-6 driver was shocked due to a broken trim switch.

This incident is good reason to consider "what if's" for a minute. What if the pilot had been incapacitated? What if the shock "froze" the incapacitated pilot to the controls and another pilot attempting recovery could not physically overpower the controls? What if this had been an armed fighter and the loose electrons inadvertently activated a missile or bomb release impulse cartridge?

There is no room for electrical shocks in a modern cockpit. If you feel one, there is something wrong that could get worse — don't fly the jet! ■

Aircraft Maintenance

Yesterday and Today

CMSGT ROBERT T. HOLRITZ
Technical Editor

If today is an average day, Air Force aircraft accidents will kill one person, injure another, wreck one airplane, inflict major damage on three, and minor damage to two.

Flying Safety, 1949

■ But if you think those stats are bad, consider the 1921 major mishap rate of 467 accidents per 100,000 hours! We have come a long way since then. Almost without exception, our mishap rate has declined every year. And, with a Class A rate of 1.11 per 100,000 flying hours, last year was our best yet.

We have whittled away at the mishap rate by providing pilots with better training, designing more reliable aircraft, and changing the way we maintain them.

Old Sarge

During the post-WW II era, when the Air Force was a new service, aircraft mechanics were basically hard-core wrench-benders. They knew every rivet of their aircraft. And, whether it be a sluggish engine or a jammed gun, it was the crew chief's job to get the aircraft ready for the mission.

The pockets of his one-piece gray uniform contained a variety of sockets and miscellaneous parts. He, typically, had no leadership training. And since the formal concept of OJT was not adopted by the Air Force until the mid-fifties, he was not even tasked with training his assistant, if he had one. But somehow, the young mechs managed to survive with the basic skills taught in tech school and gradually gained enough expertise to carry on the mission when "Old Sarge" retired.

Sarge rarely used technical data. It usually stayed in the shop unless, on an extremely rare occasion, Sarge ran into a problem and needed to refer to the manual. As a result, it was not uncommon for parts to be

Whether it be a sluggish engine or a jammed gun, it was the crew chief's job to get the aircraft ready for the mission.

The crew chief's pockets of his one-piece gray uniform often contained a variety of sockets and parts. He rarely used any technical data, and it was not uncommon for parts to be improperly installed. This contributed significantly to the high mishap rate of the early days.

improperly installed. This contributed significantly to the high mishap rate of the early days.

Sarge's system worked well, as far as he was concerned, until the coming of jet aircraft in the early fifties. Systems suddenly became much more complex, and mechanics began to specialize on engines, hydraulics, avionics, or just plain aircraft in general. (Thus was born the term APG.)

FOD

Foreign objects had always been a problem. But the jets added to the problem by eating anything left near the intake. Still, while foreign objects became an increasing problem, they were considered just another hazard of taking to the skies. In fact, it was not until 1956 the term FOD became part of the Air Force's vernacular.

It is interesting that, although stray tools regularly caused major mishaps, tool control was lacking, and tool inventory was virtually nonexistent. Each specialist had his own tool box which contained a variety of hardware, depending on what the specialist was authorized or what he could scrounge. Occasionally, a wrench forgotten by a mechanic would jam the flight controls, and an aircraft and crew would be lost.

Unbelievably, until the early seventies, no one gave any thought to shadowed tool boxes. Today, tools are strictly controlled, and it would be considered criminal to dispatch a technician with just a canvas pouch of tools.

Supply

Control of supplies and bench stock was, at best, unorganized. The system was strictly manual. Ordering a part often took hours before finding out if it was even on base. Bench stock was often located in some unsecured place in the corner of a hangar. Establishing the correct level for each item was, at best, hit and miss.

This situation remained un-

continued

In spite of the lack of training provided to crew chiefs' assistants, somehow, the young mechs managed to survive with the basic skills taught in tech school.

Yesterday and Today continued

changed until the Air Force began to install the UNIVAC 1050 computer in the mid-sixties. While this system helped ease the load on the supply system, it required a large facility which had to be air-conditioned to cool the myriad of vacuum tubes of the huge computer. Today, a computer with the same capacity could easily fit on the corner of a desk.

Duty Day

It had long been the practice to limit the duty day of aircrew members. But for the maintenance folks, there were no such restrictions. They were expected to work until the job was completed. And it was actually considered a test of manhood to stay awake extra hours to make the mission. As a result, people were falling asleep while operating machinery. They were also making mistakes which contributed significantly to the high flight mishap rate.

This might still be the case had it not been for a munitions maintenance squadron commander who decided people who worked with nuclear weapons should be afforded the same crew rest as aircrews.

One day in 1965, he showed up at the nuclear weapons maintenance facility with several high-ranking medical people. Without compromising security, he explained the duties of the weapons specialists. He then proceeded to tell the medics that while the chance of a nuclear mishap was virtually nonexistent, it was vital to national security to ensure these weapons worked as they are designed.

Within a year, a regulation was published limiting the duty day of people who worked with nuclear weapons. It was followed shortly after by another which extended the same restrictions to all maintenance people. Undoubtedly, this new restriction was a major factor in the decrease of 13 major maintenance-caused mishaps in 1967.

Test Equipment

In 1949, test equipment available to Old Sarge was limited to his experienced eyes and ears and perhaps an uncalibrated voltmeter. However, in 1950, things began to change. The breakthrough was an airborne engine analyzer. The Air Force bought 45 of these amazing instruments and installed them in B-50s, C-97s, and the huge B-36. No longer did the crew chief have to put up with vague writeups in the Form 1A, *Aircraft Discrepancy Record* (the forerunner of the AFTO 781A).

Using the analyzer, the flight engineer could get a reading on any one of the B-36's 336 spark plugs. Although primitive by today's standards, the analyzer made diagnosis of serious engine problems much more precise. The airborne analyzer was the forerunner of built-in test systems in modern hi-tech aircraft.

SOAP

In the early days, the crew chief used to check the oil of his aircraft's reciprocating engine by running a small sample between his fingers. If it felt gritty or if there were any flecks of metal, someone would make a decision whether or not to tear the motor down and look for a worn part.

By 1962, the Army and Navy were already using spectro-analysis to check the condition of gas turbines and helicopters. Unbelievably, the Air Force did not get into spectro-analysis until 1963, and then its interest was mainly to check reciprocating engines. In fact, the Air Force did not have any facilities designed for SOAP until the late sixties. One can only guess how many engine failures and Class A mishaps could have been avoided if the Air Force had used spectro-analysis early on.

Aircrew duty days had long been limited to a minimum, but maintenance people were expected to work until the job was completed. This might still be the case had it not been for a munitions maintenance squadron commander who decided people who worked with nuclear weapons must crew rest.

Until the early seventies, no one gave any thought to shadowed tool boxes. Today, tools are strictly controlled, and it would be criminal to dispatch a technician with just a canvas pouch of tools.

Today the Army, Navy, and Air Force have a joint oil analysis program with standardized specifications. This was done to enable the services to share facilities. The Joint Oil Analysis Program (JOAP) is now used extensively to accurately detect impending engine failure.

Maintainability

Undoubtedly, the biggest problem maintainers had to face with the first jets was poor maintainability. From the first aircraft to take to the skies, designers had only two things in mind — performance and safety. The maintainer was not considered. And, while the new jets performed well, and most of the time safely, they were extremely complex and difficult to maintain. Clearly, the days of the good Old Sarge's hammer and monkey wrench were over.

The maintenance-hours-to-flying-hours ratio skyrocketed. In the mid-fifties, technology leapfrogged over maintenance until 1960 when the Air Force finally realized no matter how good an aircraft performed, it was of little use sitting on the ramp awaiting repairs, and the concept of maintainability was born.

Simply stated, the Air Force now required ease of maintenance to be a function of design for any new aircraft or piece of ground equipment. As Lt Col Edward R. Fallon, Jr., then of the Directorate of Maintenance Engineering, HQ USAF, put it, "These (design) characteristics will make it possible to meet combat operational objectives with a minimum of maintenance effort and expenditure of supplies." It also meant increased reliability and safety.

Unfortunately, the Phabulous Phantom was already on the drawing board before the concept was in effect. The F-4, the workhorse of the Vietnam war, was the last combat aircraft to be produced under the old concept and, until it retires, maintainers will struggle keeping it flying. It has stress panels with numerous fasteners of varied length. Engine changes often took days. The rear seat had to be removed to gain access to much of the radio equipment which required frequent maintenance. And, while many maintainers think fondly of the "bent-wing fighter," few will miss the Phantom "bites" from the aircraft's razor-sharp underside. It was said you could always tell if a crew chief had been to Southeast Asia by his ribbons and the Phantom's scars on his back.

The first real maintenance-friendly aircraft in the Air Force inventory was the F-5 "Freedom Fighter." One of the basic philosophies of the F-5's design and those which follow was to place those components which need frequent maintenance in the most accessible locations. Engine change time was now a matter of hours, not days.

When the F-15 came into the inventory, maintainers found it hard to believe it was designed by the same company which built the F-4. Panels were replaced by access doors with latches instead of an abundance of fasteners. Built-in test capability drastically cut trouble-shooting time, and for the first time, engine changes could be made in under 2 hours. The emphasis on maintainability eliminated many time-consuming tasks, increased reliability, and took another slice out of the flight mishap rate.

We've Come a Long Way

We have come a long way since the days of "Old Sarge." We have learned how to work smarter and safer. However, although last year was our safest yet, aircraft mishaps for the year still cost nearly $500 million. Will we ever have a Class A-free year? Perhaps not. But with better test equipment, more reliable and easier-to-maintain aircraft, we can continue to whittle away at the mishap rate. ■

OPS TOPICS

Nobody Likes to Be Blue

■ Many are the days when things don't go right. Some days are so awful you feel downright blue. After all, nobody likes it when things blow up in your face.

Recently, a crewmember on a Lancer was preparing to use the aircraft's toilet. Unknown to him, the differential tank vent valve of the holding tank had been sealed with a fuel cell sealant. We're not sure why, but we suspect the maintenance folks were trying to stop a leak. Apparently, their "fix" was not seen as a problem for inflight overpressure of the system.

Returning to the crewmember, he opened the lid of the toilet as usual. "Usual" except he knew from experience the lid should be left down until the "knife valve" was opened. These steps were not listed in the flight manual, but had become a WOM for most crews.

With the lid up, the crewmember opened the valve. An explosion of blue water erupted from the toilet as the pressure in the tank was released. His face and eyes were covered with the blue water (which contains caustic chemicals). Immediately, he flushed his eyes with water, but the burning sensation would not stop.

An in-flight emergency was declared, and the crewmember was met and soon treated by the flight surgeon for microcorneal chemical keratitis. The eyes should recover their normal vision in a little while.

Of course, there are steps being taken to prevent this from happening again. More importantly for all of us, there were steps available before this incident, to have prevented it. The Air Force Hazard Reporting Form 457 is available for use when anybody thinks an accident is waiting to happen. Additionally, the AFTO Form 22 can be used anytime. You don't have to wait until *after* somebody has something blow up in their face. ■

Fill 'er Up, Way Up

■ Just how low is low? When you ask about fuel quantity, "low" is affected by many factors. Like, how accurate is the gauge, or how far do I have to go, or what do the regulations say? Notwithstanding all these, fuel is low when your aircraft can't make it back to the airfield and taxi back to the chocks.

Recently a fighter aircraft completed a formation mission without declaring "Bingo," even though his fuel was 300 pounds below the agreed bingo amount. On the way back to the field, headwinds at altitude and on final were stronger than expected. The pilot configured the aircraft for the approach a little early, and then used numerous throttle movements to counter gusty winds during the approach.

Upon landing, fuel was down to 400 pounds remaining. (The pilot never declared a minimum or emergency fuel status.) After clearing dearm, located at the farthest point on the airfield from the hot refueling pit, the pilot elected to taxi to the hot pits for fuel. Despite the fact the local directives

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order a bypass of the fuel pits with less than 600 pounds remaining, the pilot pulled into the pits.

The pilot, now looking at a gauge showing 100 pounds of fuel remaining, urged the pit crew to work quickly. As soon as they had pinned the APU, they brought the refueling hose to the aircraft. While the hose was just inches from the jet, the engine flamed out.

The jet was impounded, checked, and refueled with 2,500 pounds of JP-4. It has run fine every day since, as expected, so long as there's fuel in the tanks.

We all know there are many factors worked into Joker or Bingo fuels. But these aren't factors set in stone. Other things may occur which require a close monitoring of the remaining fuel for a safe recovery. Sometimes, all it takes is the little bit of help you receive when you declare a minimum or emergency fuel status. "Low" fuel exists anytime you have less than you planned at any time in the flight. It's something you need to know. Check it often! ■

How Full is "FULL"?

■ By far, the most popular method of inducing a forced landing in your general aviation aircraft is by neglecting to include enough fuel for the intended flight. Running out of gas is frequently the reason many planned cross-country flights never make it to their destination. It all seems a little ridiculous. How hard can it be to fill up the tanks?

Depending on what you mean by "full," it can be anything but simple. Many aircraft can carry more fuel than is allowable with a full load of passengers and baggage. Therefore, pilots will not top off the tanks, using the savings in weight to add an extra suitcase.

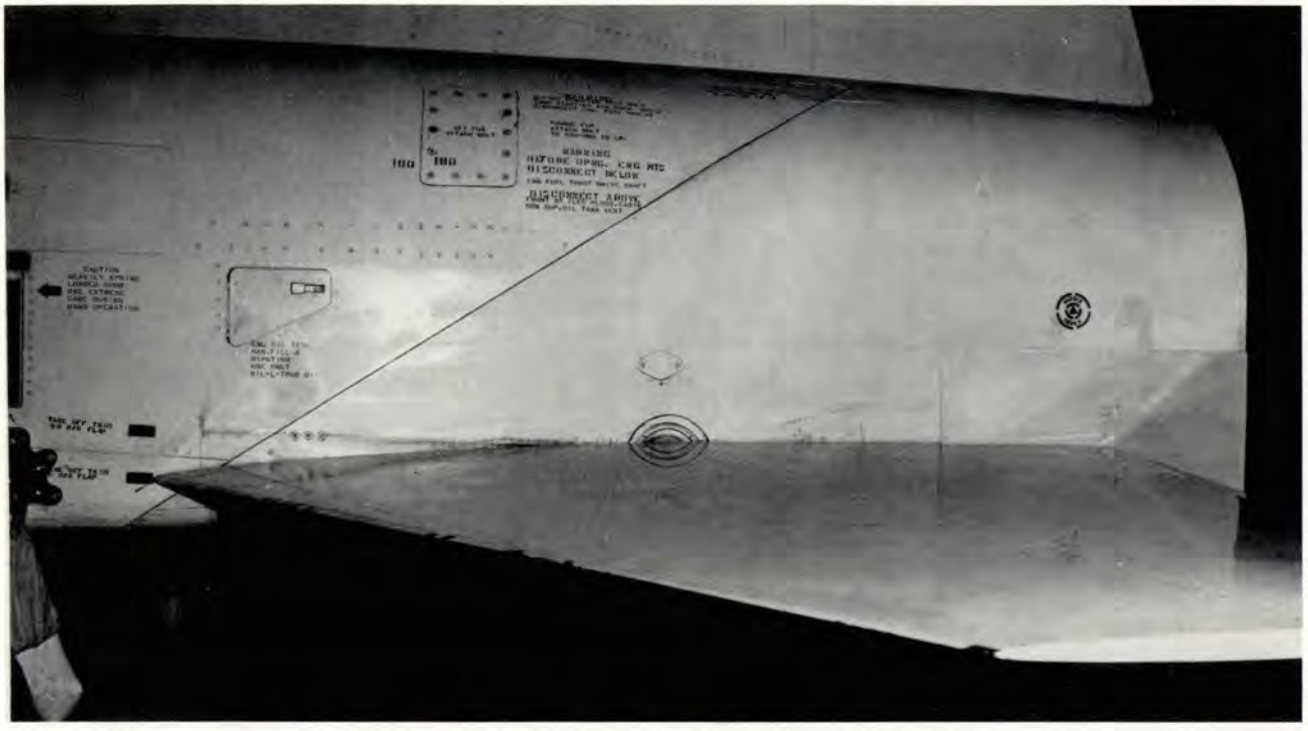
Here is where things start getting complicated. The fuel gauges on most light aircraft are notoriously inaccurate. Some aircraft still have a cork bobbing in the tank with a piece of wire attached to show the amount of fuel remaining. Still other gauges are designed to remain at the "full" indication until the 30-gallon tank is depleted to the 20-gallon point. From there, "half-full" means 10 gallons remain (or is it 15?).

As if unreliable gauges weren't bad enough, many fuel tanks have a problem with the way you fill them. First, you had better level the wings before you start pumping gas, or some fuel will never make it into the tank.

Secondly, refer to the POH for peculiarities; e.g., high wing Cessnas can gravity transfer fuel from one tank to the other, if the fuel selector is on "BOTH." The pilot must refuel one tank, fill the other, then go back and top off the first tank.

Thirdly, don't be in a big hurry to reach the fill marker inside the tank. Many aircraft, including Cessna's 210 series and Beechcraft's 23 series, will show you at the desired level if you're pumping it in under a high volume flow. If you shut off the flow and wait a few seconds, you will see the level drop below the marker. There are still a few more gallons to go in before your flight.

Maybe you already know about all the quirks and quibbles with refueling your aircraft. After all, you made the 350-mile trip to the other side of the state with fuel to spare. But is the refueling truck driver at your destination going to know as much? Simple instructions, "Fill it to the bottom of the tab," may not guarantee you have all 15 gallons (or is it 10?) in the tank. The hamburger you're going to have for lunch has been sitting on the stove for an hour anyway. Why not spend a few more minutes making sure you get all the fuel you need? ■



T-38 Boattail Bolt Jams Stab Actuator

LT COL ROBERT LUNDIN
Air Force Safety Agency

■ A T-38 was getting ready to take off when the pilots noticed a strange feel in the stick and some unusual stabilator movement. They wisely ground aborted.

Maintenance investigation found a 750 inch-pound torque bolt, one of several normally used to secure the boattail (the entire tail section) to the fuselage, jamming the left bellcrank in the horizontal stabilator quadrant. This condition allowed full control stick movement, but prevented movement of the hydraulic actuator servo arm that moves the "slab." If the pilots had not noticed this problem, the jammed slab would have certainly caused a crash shortly after takeoff.

Further investigation revealed some "**assumptions**" (we all know what that means) were made linking the "almost accident" chain of events together.

The last boattail removal team leader had inadvertently dropped the bolt — it is easy to do because of awkward access. Another supervisor tried to fish the bolt out of the difficult access area, but instead managed to push the bolt out of finger reach. The team leader said he would get it after the boattail was removed. The supervisor left, **assuming** this would be done.

For some unknown reason — distraction, shift change, higher priority maintenance — the bolt was forgotten.

The boattail was reinstalled the next day by another team. The installation team leader noticed a bolt was missing, and **assumed** it had been discarded. A foreign object check was performed with a mirror and flashlight, but it missed the bolt which was "hiding" somewhere in the compartment.

The T-38 subsequently flew a functional check flight and several more sorties before the bolt migrated to this critical jamming position — a classic mishap sequence in the works.

T-38 boattail removal is a critical maintenance action requiring many redundant supervisory checks. There are ample warnings in the tech data about foreign objects jamming flight controls. When the bolt was initially dropped, before the team left the aircraft, the missing bolt should have been documented in the 781 forms. This would have effectively broken the chain of events because maintenance troops would have kept looking for the bolt until they found it.

In the wake of this incident, unit maintenance took aggressive action to prevent it in the future: 781 entry is now required to account for all boattail bolts and a Red X is required if one is missing. A bolt holder was fabricated for attachment to boattail maintenance stands. A locally fabricated sheet metal baffle forces any dropped bolt to fall out of the access hole. Changes to the TO have been recommended. Finally, warnings to the pilots to carefully monitor flight control movements versus stick movements have been enhanced.

This close call had a happy ending — with improved procedures as a benefit. A golden rule of thumb for aircraft maintainers is: When you find something wrong, document it to ensure it doesn't get forgotten! ■

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UNITED STATES AIR FORCE

Well Done Award

Presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Mishap Prevention Program.

(L to R) Captain Gene McCormick, Jr., WSO, and Captain Randall Parker, pilot.

CAPTAIN **Randall C. Parker**

CAPTAIN **Gene W. McCormick, Jr.**

20th Fighter Wing

■ Captain Randall Parker, Aircraft Commander, and Captain Gene McCormick, Weapon Systems Officer, were on a routine F-111 functional checkflight from Bristol, England. Forty miles out over the ocean, in the midst of a required system check, the flight became anything but routine.

Thirty seconds into a fuel dump check, the switch was turned off, but dumping continued. Captain Parker turned the aircraft back toward land while Captain McCormick initiated the rapid fuel depletion checklist. With a dump rate of 2,300 pounds per minute, their total fuel of 29,000 pounds was rapidly disappearing.

The crew attempted to correct the problem by recycling the switch, turning off fuel tank pressurization, and retarding the throttles to idle. Nothing they tried, either from the checklist or their own systems knowledge, would slow the fuel dumping. At the current dumping rate, Captains Parker and McCormick calculated they had 8 to 10 minutes of fuel remaining.

The crew selected the nearest suitable airfield and prepared for a minimum vector instrument approach. Captain Parker demanded the shortest vectors through the weather to a 6-mile final. With ejection procedures reviewed, Captain Parker flew a flawless approach in gusty winds. On short final, the control tower confirmed fuel streaming from their aircraft.

The entire sequence, from the failed switch to a safe landing took just 8 minutes and 45 seconds. At touchdown, the F-111 had just 1 minute and 30 seconds of fuel remaining. Captains Parker and McCormick professionally handled an unusual situation, one which has happened only one other time to an F-111. Due to their quick, decisive actions, the aircraft was recovered safely, preventing loss of life and saving a valuable Air Force aircraft.

WELL DONE! ■

Icing dangers exist beyond aircraft

Drive smart during holiday vacations