Flying SAFETY

MARCH 1992

Mishap Summaries

THERE I WAS

■ As a command pilot, I learned why standard operating procedures need periodic review and, sometimes, revision. One morning, we were preparing our F-100s for a cross-country flight from Carswell AFB, Texas, to Kirtland AFB, New Mexico. We used cartridges for engine start, which was a quick way to get the flight ready to go. If a cartridge misfired, our procedure was to leave it in the starter breech and hook up an MA-1A external pneumatic power cart. This saved the 15-minute wait for cooling recommended by the Dash-1.

On this day, my cartridge didn't work, so rather than hold up the flight, I used an MA-1A to get started. We were soon ready to go and taxied out. Takeoff and departure were uneventful.

For the short flight to Kirtland AFB, we climbed to 26,000 feet in a spread formation. Leveling off, we set up 0.8 Mach cruise, and lead told me to move from the no. 4, slot position, to the outside wing. I eased the throttles back and started to move aft when I noticed the rpm winding down through 50 percent. Then I heard it — a loud explosion from the back of my jet! The fire warning, flight system fail, and master caution lights were all brightly lit. I informed flight lead that I had just **flamed out!**

A wingman, flying just forward and to the left, felt the explosion. He moved back so he could watch me and radioed that I had what appeared to be large quantities of fuel coming out of a crack on the aircraft. I started a gentle left turn toward Reese AFB, Texas, which was 78 miles away and the nearest emergency landing field. It was very quiet as I established a 250-knot glide. My rpm was now reading zero.

I slowly advanced the throttle, but the engine invariably began to compressor stall. More warning lights illuminated, and the aircraft started a slow roll to the right. I corrected with left aileron and rudder which would only temporarily correct the problem.

The next radio call really caught my attention. There was a **60-foot flame** coming from my tail section! I applied left controls to level the aircraft before ejecting, but it was useless. The left rudder pedal moved freely to the full forward position without any aircraft response. The entire warning panel was now illuminated, ironically with the exception of the overheat light. All my controls were frozen. It was time to part company with this jet, and I ejected at 17,000 feet. Fortunately, that ride went smoothly.

Once free of the seat, it was a freefall down to 14,000 feet, where the parachute opened as advertised. I completed the four-line cut and got a great view of part of west Texas. There was plenty of time to choose a landing spot, and I landed without injury.

As luck would have it, a real Texas cowboy saw me coming down and drove over in his pickup truck and helped me gather up all my gear. He took me to a small, nearby town where I enjoyed some great Texas hospitality. Later on, I met up with my flight at Reese.

As it turned out, the explosion came from the cartridge that had been left in the engine. In our rush to take off, we had disregarded the recommended Dash-1 procedure and lost a valuable asset.

As a result of that mishap, our operating procedure was changed. A misfired cartridge *must* be cooled for 15 minutes and removed before engine start. Sometimes standard operating procedures can be improved to find smarter and safer methods. Check six and happy landings! ■

UNITED STATES AIR FORCE

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FY91 was our best year! We had 41 Class A mishaps in FY91, and for the eighth fiscal year in a row, our Class A mishap rate remained below 1.8. It was the first time our fighter/attack aircrafts' rate was below 2.6.

SPECIAL FEATURES

REGULAR FEATURES

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

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MAINTENANCE MATTERS

What a Concept!

■ The Phantom had been cruising with the rest of the gang for nearly 3 hours when suddenly it pitched up for no reason. The crew decided now was a good time to head for base and started back.

A few miles out from the TACAN, the airplane began to gyrate about all 3 axis with a mind of its own. The crew declared an emergency and turned off all the stab aug switches. The controllability check revealed another pitch-up at 210 knots. On a ½-mile final, the F-4 began to gyrate again and the crew did a go-around. The second time, they got it safely on the ground.

Eventually, the following came to light. A fitting had previously developed a leak, and somebody did an unauthorized patch job using an oversized fitting and heat-shrink tubing. Later, some maintenance troops found the tubing was loose and covered it with more heat-shrink tubing. Months later, the tubing failed under the continuous hydraulic pressure, rendering parts of the flight control system useless.

How could all this have been prevented? Simple. Enter failed parts into the MDR system and follow the TO when making repairs. Wow! What a great concept!

Wire Specifications

Murphy sets his first trap at the bench stock board before we even get to the aircraft. Generally, the type of wire to be installed is provided by tech data. However, in many cases, tech data guidance is lacking and the specialist must choose the type of wire to be installed. Unfortunately, choosing the correct wire for an aircraft system is not simply a matter of selecting the proper voltage rating or wire size.

Over the years, manufacturers have developed many types of wire designed to operate in a variety of functions and environments. Some are resistant to fluids, such as fuel or hydraulic fluid. Others are designed to operate at extremely high temperatures.

The different qualities of aircraft wires are dictated to us by strict standards, or military specifications, developed by the various branches of the armed forces. To choose the correct wire, when one is not already specified by the TO, is a simple matter of selecting the MIL SPEC with the desired characteristics.

For example: MIL-W-22759C specifies a wire with a fluoropolymer insulation which is resistant to fluids and suitable for use around fuel and hydraulic systems. MIL-W-25038 has a fire-resistant glass or asbestos insulator and is used in a high-temperature environment such as engine bays or near bleed air ducts. It will endure temperatures of up to 2,800 ºC for short periods during an emergency.

The Defense Department publishes thousands of MIL SPECS. A complete edition alone could fill several shelves in a publication library. Fortunately, the MIL SPECS for aircraft wiring are also contained in TO 1-1A-14, "Aircraft Electric and Electronic Wiring," which can be found in most TO libraries.

EOR Error

A Phantom was preparing for a two-ship mission. The launch went well until the bent wing fighter arrived at EOR. Following procedures, the weapons specialist approached the aircraft from the right side and removed the ALE-40 pins and the AIM 9 nose cover. As usual, he stowed the ALE-40 safety pin inside the nose cover. However, this time the streamer of the pin was left hanging out of the nose cover. As the weapons technician passed just aft of the intake, the streamer, along with the safety pin, was ingested by the engine.

In another EOR incident, an F-4 engine swallowed a crew chief's hat after sucking it from under the chief's field jacket epaulet.

These recent mishaps serve as a reminder of the hazards of end-of-the-runway operations. In these incidents, the EOR people were in a hurry, because there were aircraft stacked up waiting to be armed. Not only did these mishaps cause serious damage to the aircraft engines, but they also indicate that EOR people get too close to the intakes. Remember, jet engines not only ingest safety pins and hats, but they also have an appetite for maintainers. ■

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conference calls and ground runs, the decision was made by the maintenance supervisors, NDI labs, and propulsion shop chief to release the aircraft for a one-time flight back to home base. This was a reasonable decision since the lab results after the ground runs revealed the trend had stabilized and was well within the normal range IAW TO 33-1-37-3, Appendix 115 and 116.

The mishap sortie's taxi, takeoff, and climbout were normal. Upon leveling off at high altitude, the engine suffered a bearing failure and eventually seized. The pilot successfully ejected, and the aircraft crashed.

As a result of this mishap, maintenance action regarding abnormal oil samples are being further defined, as well as allowable wear-metal limits.

The Class B

The mishap aircraft was flying about 500 feet AGL when a large bird struck the radome. The pilot climbed, and after a controllability check, landed without further incident. This was a Class B mishap due to the dollar costs of replacing damaged parts.

Fixing Past Problems

The logistics people are working hard to keep the A-7 flying safe until retirement. The cracks found in the lower wing skin have been identified and repaired, plus new inspection criteria have been established to detect any further cracks before they become critical.

The main and the nose landing gear have had some problems with bolts and pins cracking or breaking, causing unsafe landing gear conditions. Several safety TCTOs are in effect to solve these problems.

Looking Ahead

So what's next? Although we had 2 good years in a row, FY92 isn't shaping up so well — three A-7 Class A mishaps through January 1992 indicates we need to keep our attention focused. Though some of you have taken the jet down to sunny Tucson and the storage yard, we are still flying the A-7 and will for some time, so we must guard against complacency.

It will take a concentrated effort by everyone involved to keep the A-7 flying safely until the last one lands at DM. ■

Photo by 1352 AAVS

A/OA-10

MAJOR MARK PENDLEY
Air Force Safety Agency

■ Each year we recap the past fiscal year and try to remember lessons learned. This is one way to prevent the same mishaps, with just different people involved. At least we avoided the same problem we had in all three Class A mishaps in FY90 — controlled flight into the ground, with no ejection attempt.

The bad news is FY91 saw two Class A mishaps with three Hogs and two fellow Hog drivers lost. However, this was our best year ever as far as the mishap rate goes, **plus** we gained some respect by "spanking tanks" in Desert Storm.

A Look at FY91

In FY91, we had our best mishap rate ever: 0.88 mishaps per 100,000 hours which equates to two Class A mishaps in 228,273 flying hours. That is very impressive, considering we deployed and fought a war halfway around the world. This article will recap the year and look ahead to a promising future.

Class A Review

In FY91, we had two Class A mishaps with three lost jets. One Class A was a midair collision destroying two A-10s (which counts as a single mishap), and the other was a single A-10.

Logistics-Related Class A Mishap

This mishap involved an A-10 setting up for a bombing attack on a tactical range. Inbound to the target, the mishap pilot felt a "jostle," called knock-it-off, and started a climb. His wingman acknowledged, joined to chase formation, and told him he was trailing smoke but was unsure where it was coming from.

The mishap pilot visually checked both his engines, engine instruments, and fire lights, which appeared normal. He then checked his caution panel and saw the following lights: RGEN, Pitch SAS, L Hyd Press, L Hyd Res, L Wing Pump, and either L Main Fuel Low or L Main Pump. Right hydraulic system pressure was decreasing, but the left system was stable in the normal range at approximately 3200 PSI. The fuel quantity gauge decreased rapidly, reached zero, and began to increase again. The airspeed indicator read zero, but the pitot tube was undamaged.

The MP noticed a red light in the gear handle with no warning tone, so he visually checked the gear and determined they were up. The MP noticed the flap gauge was continuously cycling, with no associated flap movement. Are we having fun yet?

With evidence of right generator failure and multiple electrical anomalies, he started the APU to provide electrical power in case of an engine shutdown. Fifteen seconds later, smoke began to pour into the cockpit. His wingman told him his left engine was on fire, so he performed the Bold Face for an engine fire as well as for an APU fire light, since he noticed the APU fire handle light on. Almost immediately thereafter, the stick moved forward, and the nose pitched down 10 to 15 degrees. He pulled back on the stick, but the aircraft did not respond adequately.

The range control officer and his wingman directed bailout when they saw the nose pitch down. The ejection was successful, and the aircraft crashed and was destroyed.

This entire mishap sequence, from start to ejection, took only 1 minute and 17 seconds! It can happen that fast. Are you ready to "punch out" in a moment's notice?

The fire was not an engine fire but was a result of a hydraulic fire caused by an electrical wire bundle chafing against the right system hydraulic lines and subsequent arcing, which caused a leak in the hydraulic line. The atomized hydraulic fluid was ignited by the arcing which caused a very hot fire in the leading edge of the left wing next to the fuselage. The fire damaged other wires which resulted in all the strange cockpit indications.

There is a good fix for this one, and, hopefully, it won't happen again.

The Hog had a superb year. Not only did it gain respect as a tank killer during Desert Storm, but it had its safest year with a .88 Class A rate.

The Other Class A

This mishap involved a two ship of A-10s which collided with one another, resulting in the tragic loss of two pilots and their aircraft. Both pilots became visually separated, and they failed to ensure deconfliction while not in visual contact. It is possible the pilots failed to see and avoid due to blind spots caused by the windscreen front panel frame, or improper clearing techniques, or both.

Class C Mishaps

FY91's most common Class C mishaps were engine failures. The second most common were bird strikes, followed by engine FOD and landing gear problems. In FY90, engine failures topped the list as well, followed by pressurization failures, engine FOD, and bird strikes. So the odds are your next emergency could be one of the above. Keep that engine failure checklist handy.

One of the big irritants to A-10 drivers happened when, upon landing or takeoff, a main tire tread separated and spit rubber into the engines, flaps, gear doors, etc., sometimes causing significant damage. This problem has been fixed (hopefully) with higher quality tires.

Combat Safety

Yes, there **is** such a thing as flight safety in combat, so we don't do the enemy a favor by killing ourselves.

continued

Photo by 1352 AAVS

The Low Altitude Safety and Target Enhancement mod will reduce ground collision mishaps (and make it an even more deadly tank killer).

A-10 continued

The A-10 had zero noncombat losses during Desert Shield/Storm with some impressive logistics numbers which pilots, maintainers, and support people should be proud of. Overall, the A-10 tied for first with the F-15E among all USAF aircraft with an impressive 95.5 percent mission-capable rate compared to a 90.4 percent peacetime rate. The Hog loves to fly and fight.

While the A-10 was staying ready to fight, it was also used more during the war, flying an average sortie duration of 2.37 hours wartime versus 1.58 hours peacetime, and attaining a phenomenal UTE rate of 47.5 wartime versus 22.5 peacetime — more than double the peacetime rate!

The A/OA-10s deployed to Desert Storm logged over 8,100 sorties and punished Saddam's war-fighting capability by destroying over 1,000 tanks, 2,000 other vehicles, 1,200 artillery pieces, and 2 helicopters (the only air-to-air gun kills of the war). This is what being a Hog driver is all about!

Safety Modifications Update

Even though the A-10 is getting older, there are still many improvements being made to make the jet safer. The Low Altitude Safety and Targeting Enhancement (LASTE) modification should be complete soon, which should further reduce collision-with-the-ground mishaps. In addition, the targeting enhancement portion of the LASTE modification makes the A-10 more accurate and will rival the Vipers or Mud Eagles at any weapons competition (check out the results of Gunsmoke '91!).

The fuel cell foam fire problems of the past should be solved with an improved fuel cell foam being installed when the jet is in for the LASTE modification.

Another fuel system improvement which should be implemented soon is placing shock mounts on the fuel system's intermediate device. This will cut gun-firing-induced vibration in half, thereby reducing false fuel quantity indication problems.

Bird strike resistant aluminum leading edges are being installed on the wings to prevent problems caused by a bird penetrating the leading edge and damaging hydraulic lines and wing spars.

The FY92 Challenge

Improvements in the safety of modern aircraft make them safer than ever before. The history of the A-10 shows the majority of the time operations (usually the pilot) is the cause of major mishaps. When you are trying to make your bomb scores better, or improve your Top Gun standings, you focus on the "biggest error," and we safety folks do the same. Our "biggest error" is operator error. Operators must become safer to keep from losing valuable people and machines. One fix is a human factors training program to better equip pilots to recognize and compensate for their human factor errors. There are some super programs around, and if you haven't been exposed to one, hopefully, you will be soon.

FY91 was the best year ever for the A-10. Your challenge is to beat last year's record by flying smart, tactically sound, disciplined, and safe. ■

F/RF-4

LT COL PETER H. N. SCHALLER-KALIDE
Air Force Safety Agency

■ It is time again to summarize FY91 for those of you in the F/RF-4 community. At a quick look, FY91 was a much better year in comparison to the last. We lost only four aircraft — two RF-4Cs, one F-4G, and one F-4E. This makes for a rate of 3.70 total, 4.75 for the RF-4C and 3.03 for the F-4s, the fourth best year ever. In those four Class A mishaps, we lost only one crew, but one too many. They could still be alive, if . . . Remember my words in last year's article about that noticeable trend, "CREW COORDINATION."

Ops Mishaps

The mishap aircraft was no. 2 of a two-ship local training mission. The mission included medium altitude tactical turns in a military operating area, followed by low-level navigation training, including popup target acquisition and defensive threat maneuvers. During self-defense maneuvering to avoid simulated AAA, the mishap pilot rolled and pulled his aircraft to a nose-low attitude from which a recovery was impossible. The WSO initiated an unsuccessful, out-of-the-envelope, dual-sequenced ejection.

What happened, you just read; but *why* did it happen? What causes a mishap like this? There is not only one answer. Often a mishap is caused by a chain of events, which if interrupted, does not allow the mishap to happen. In this case, it was not interrupted.

Let's look at some factors which can make flying in such an environ-

continued

During Desert Storm, the F-4G Wild Weasel provided valuable defense suppression support.

F/RF-4 continued

ment and under such conditions dangerous.

Operating at low altitude for prolonged periods in a hot desert environment in an aircraft whose air-conditioning system is not overpowering can cause dehydration and other physiological stresses. Decreased performance and increased susceptibility to spatial disorientation is likely.

What to do? Splitting the mission into a high and a low altitude portion, keeping the exposure time to a minimum for these conditions, may counter this.

Operating in a deployed area, being away from home and family, etc., can all cause psychological stress, compounding all the other problems.

Very often, pilot performance deterioration starts showing in advance. Crewmembers, flight members, crew chiefs, and unit members notice here and there an irregularity, not big or alarming to them as a single occasion. But all together, they send up a flag — it is a "thumb up" and very alarming because the victim often doesn't notice the problems or doesn't want to — his ego might get hurt and ruined. Very often he is the last to recognize the creeping-up trouble he is getting into.

What to do? Turn the guy in? Talk to him privately? Make him talk to someone? An answer to this is very difficult. How often did you overhear talks about somebody's problems, little irregularities, mistakes, performance, etc. Worse, after a mishap involving such factors, very often everybody knew about the performance and behavior problems. Then the question arises: Could anyone — from flying buddies to supervisors — have intervened and prevented this mishap? How about his WSO? Given the same indicators, what would you do? If we don't look out for each other, who will?

Another phenomenon of desert flying is the lack of contrast on the ground and often no horizon due to blowing dust. Pretty similar conditions to flying over water.

Especially when flying defensive maneuvers, which are safe at altitude, it may not be at all safe at low level with the factors mentioned above. In a case like this, it can turn out to be fatal.

What to do? Here, in particular, it is important to divide the burden of work, responsibilities, and attention. Cockpit management and crew coordination are the keys to success. One crewmember should be watching the aggressor while the other is flying the aircraft safely, not both looking at the enemy and no one watching the flightpath of the aircraft.

The second mishap involved a loss of control, too. The crew, playing the defender, disregarded the slow tone and also operated several times in the very slow tone regime, departed the aircraft and had to eject. The crew was two instructors. The WSO was on his second recurrency ride for basic fighter maneuvers.

Not much to say about this mishap. The aircraft responded as advertised. Those warning devices are installed to help the crew in the heat of the fight and bring them back to reality, not to be ignored. Disregarding such help can get you in trouble, especially if there is not enough altitude left for a safe recovery.

Log Mishaps

During takeoff roll, the mishap aircraft lost its nose strut piston assembly. Shortly after, the no. 2 engine failed due to FOD. The mishap crew continued the takeoff and jettisoned the two wing tanks. The crew prepared for a single-engine, gear-up landing. Turning onto long final, they were directed to accomplish a controlled ejection, which was successful.

What happened? The nose landing gear strut was underserviced with hydraulic fluid causing the loss of dampening effect on the strut.

During several inflation checks, this was not discovered. Over time, the locknut was forced over the threads causing the separation of the nose strut piston assembly. A portion of the nose gear scissor bolt then FODed the engine.

Often, not following TOs is the problem in cases like this. Sometimes they are taken as "references" only. Wrong! Everyone knows what impact Air Force regs, manuals, TOs, Dash-1s, checklists, etc., have on our daily work. They are information, guidelines, procedures, help, and **minimum musts!**

Other factors are sometimes complacency, discipline, and laziness. For just inflating a strut, by "the wrong method," who needs all the necessary gauges, equipment, and tools? **"TLAR"** (that looks about right) worked out fine 'til now, why not this time? Wrong! The cost to the taxpayers of such an action can be easily $3.5 million and more.

The second log mishap was encountered shortly after takeoff. The crew had problems with several aircraft systems, noticed smoke in the rear cockpit, and smoke coming first from the right, then left engine louvers. The lead crew saw trailing smoke, and the mishap crew felt several explosions. After the second explosion, the right rear fuselage was engulfed in flames. The pilot initiated a successful dual-sequenced ejection. The aircraft impacted the water.

Door 22/16 is the Achilles' heel of the F-4. Almost every aircraft system goes through this area — fuel, hydraulic fluid, oxygen, oil, electrical wiring, and bleed air. In this log mishap, a bleed air duct probably failed, and the escaping hot air started to scorch electrical insulation causing chafing, shorting, and arcing through lines carrying combustibles or oxygen. The rest was a matter of time.

Bleed air shutoff valves at the engines, like the Navy had installed in their F-4s, might have saved this aircraft. But the Air Force decided earlier not to install those valves and to accept the risk.

In other words, this means you have to live with it. With bleed air duct failure, you don't have any indications from a warning light or system. The indication of smoke or fumes, especially in the rear cockpit, could be a bleed air leak, or an electrical fire in the consoles, or a failed cooling turbine. With those last two analyzed, you might solve the problem, but with the first situation, you are out of luck. So, if in doubt, don't fool around. Get the bird on the ground ASAP, or you might be in for a skyrocketing ascent and a nylon letdown.

Safety Issues

Cockpit management and crew coordination are still problem areas, not just in the F-4 community. In both of this year's ops mishaps, cockpit management was involved. So put more emphasis on this subject during the whole mission, from planning and briefing through taxi, takeoff, departure, penetration, attack, egress, recovery, landing, and shutdown. Especially during BFM and defensive reactions at high or low altitudes, cockpit management is of vital importance. Departure, or collision with the ground, are often the result of not being organized. During emergencies, the other crewmember can be of great help and should be involved and used.

With only three active and five Guard units left flying a total of about 360 Phantoms, the fleet has been reduced drastically but did not get younger. Some of the birds carry more than 7,000 hours on their backs and start showing fatigue even after structural enhancement programs. Depending on the mission, some parts are more stressed than others. Especially high G-forces take their toll and might put a bird out of business. So, if you want to fly your Phantoms safely to the very end, think of this and have the maintenance people take a close and good look at the most stressed areas to find fatigue damage early. Don't wait to find out what breaks at the mishap site.

Summary

FY91 was the safest year the USAF ever had. F-16s and the F-4s were the losers, with class A mishap rates of 4.55 and 3.70. Three of the four F-4 mishaps could have been avoided. Cockpit management and aircraft performance knowledge went along with the ops mishaps, lack of discipline, and complacency with one log mishap. Human failures were involved in all three. We need to cut mishaps like these down to zero. They are unnecessary and cost not only taxpayer money, but too often the life of a crewmember.

Fliers need an organized cockpit and knowledge of personal, as well as aircraft, limits. The Phantom has a hard time maintaining controlled flight beyond AOA 29 at 250 knots in a full rudder supported roll and pull.

TOs are not references only — they are minimum "musts" and ought to be followed to the letter and figure.

The Phantom has seen almost 30 years in service. Professional flying and maintenance will allow those remaining to be parked at Davis-Monthan when the time is ready and not end up in an unnecessary crash. ■

F-15

MAJOR GRAHAM A. LARKE, CAF
Air Force Safety Agency

■ It is annual review time again for the Eagle community. How does the F-15 report card read when it's all said and done? Well, first of all, we had a much-improved record over the previous year (FY90), with only three Class A mishaps, compared to seven, and two Class Bs, compared to six. Here are some numbers: In FY91, 276,393 hours were flown with an Air Force Class A rate of 1.11. The fighter Class A rate was 2.51 with 1.09 as the F-15 Class A rate.

Let's take a closer look at the report card. Maybe there are a few lessons to be learned from our mistakes which will make us smarter when we "step" for our next sortie.

Loss of Control

Loss of control claimed two Eagles in FY91. The first was a 1V1. During post-merge maneuvering, the mishap aircraft departed controlled flight and entered a spin. When recovery attempts failed, the MP successfully ejected. Why did the aircraft depart?

First of all, the mishap aircraft was configured with an asymmetric configuration (AIM-9 PTM on station 8A, ACMI pod on station 8B, and the M61A1 gun). The possible dangers of flying at high AOAs with asymmetric loads were known, and a MAJCOM FCIF directed wings not to use this configuration for training purposes. Wing stan/eval, however, did not agree with the FCIF and had not distributed it while coordinating a withdrawal.

During the third engagement, the aircraft developed a 700-pound fuel imbalance on the right side, most probably due to an internal wing transfer pump failure. The pilot decided to continue the mission while limiting his maneuvering to 30 units AOA. When his wingman maneuvered into weapon param-

Human factors were cited in all F-15 Class A mishaps (FY91). Basic airmanship could have prevented them all.

eters, the mishap pilot unintentionally maneuvered his aircraft beyond the Dash-1 limits, and the aircraft departed as advertised.

The other loss-of-control mishap occurred during a 1V1 BFM engagement. As no. 2 closed to a guns position (from a perch setup), lead initiated a right pirouette maneuver with full right rudder and full aft stick with the intention of rolling under and forcing the attacker into a rolling scissors. The mishap aircraft ended up approximately 60 degrees nose low in a loaded right roll at 16,000 feet.

The pilot noted the BFM floor approaching and initiated recovery by terminating the roll with rudder and increasing backstick. As he applied the controls, his Eagle began a rapid uncommanded right yaw and roll (with the departure warning tone sounding) and entered a spin. No. 2 began calling altitudes, and after determining the aircraft was out of control, commanded a bailout. The crew initiated a successful ejection at 7,000 to 8,000 feet.

There are some important lessons to be learned from this mishap. The pilot was very aggressive in air-to-air maneuvering — in fact, it was a consistent theme in his grade book. While an aggressive style is not all bad, supervisors must constantly be wary of an *over*-aggressive aviator.

Is one of your pilots continually hearing "WARNING — OVER G" on his tape? Is he getting the yaw rate beeper during maneuvering? And, most importantly, are you saying something about it every time? Allowing overly aggressive flying to go unnoticed implies it's an accepted technique. This technique may work, most of the time, but the one time it doesn't can be very costly. A good rule of thumb to use: Would you fly the airplane as aggressively if you *paid* for it?

Another point worth mentioning (again) — the yaw rate beeper says you screwed up, *not* that you're max performing the jet!

Collision With Ground

Collision-with-the-ground mishaps in the Eagle are now "tied" with loss-of-control mishaps as the leading causes of mishaps.

The one collision-with-the-ground mishap occurred on a five-ship cross-country. Upon arrival at destination, ATIS weather was 1200/3 in light rain and a scattered deck at 400 feet. The flight lead directed radar-assisted trail recoveries to TACAN approach, full-stop landings. On final, the mishap pilot (no. 5) descended into the trees on a ridge in IMC. His aircraft sustained extensive foreign object damage which failed both engines. Unable to maintain level flight, he ejected with minor injuries.

We are familiar with the "accordion effect" on radar-trail assisted departures. This mishap happened in the turn to final. No. 4 intentionally delayed his turn to final for spacing, but no. 5 didn't pick up on this and eventually ended up .8 nm behind no. 4. To gain separation, no. 5 commenced some aggressive S-turns to the point where he encountered buffet and heard the AOA warning tone going off in the background of this fury. In a short time, he encountered airspeed and altitude control problems.

This, coupled with an unrecognized vestibular illusion, a now more demanding instrument cross-check, and further radar interpretation requirements, set the pilot up for task saturation. The finale was a loss of SA.

Would you let things go that far? An early decision to go around was in order when he realized his proximity to no. 4. Aggressive S-turns under IMC go against basic airmanship principles. Once task-saturated, a go-around decision was probably not possible in his thought processing. He was indeed "FORTUNATE" to have survived this situation. COULD THIS HAVE BEEN YOU? Or your wingman?

Loss of control caused two of the three Eagle Class A mishaps.

Class B Review: LUCKY OR WHAT!

Both Class B mishaps could have ended in disaster. On the first, the pilot did not follow the Dash-1 procedures for braking (night landing). He waited until 2,000 feet remaining and found out he had no brakes. After shutting down both engines and preparing for the MA1A barrier, he made a last-minute decision to make the end turnoff at approximately 80 knots. The aircraft skidded left and departed the prepared surface. The nose and main landing gear collapsed,

continued

Although F-15s experienced three Class A mishaps during FY91, there were no lives lost.

F-15 continued

causing the wing to strike the ground. Had he commenced braking after lowering the nose, he could have easily taken the BAK-14, or if he had selected the antiskid switch to PULSER, he may have been slow enough to make the turn. Or, had he stuck with his initial game plan to take the MA1A, he would have stopped without mishap. Basic airmanship.

The second was a midair. The mishap pilot was in route formation (recovery) and thought he had matched his lead's left turn. Misprioritizing his tasks, MP had his head down in the cockpit rewinding the HUD and VSO tapes and collided with lead. Again — BASIC AIRMANSHIP.

Class Cs and HAPs

After reviewing FY91 Class Cs, HAPs, and HATRs, two things stand out: The Eagle is starting to show signs of age, and you are handling emergency situations in a professional manner. Take a look at some of these, and see if you would have done the right thing.

- ECS turbine bearing and bearing seal failure, allowing turbine oil to leak into the ECS cabin airflow. The pilot's eyes are burning, and he's having a hard time communicating due to pressure breathing. When he drops his mask to be able to talk more easily, he finds himself breathing caustic air.
- Stabilator upper control cable frays beyond limits, resulting in an uncommanded roll.
- Right rudder shear rivet fails at splitter junction, resulting in an uncommanded roll. Regaining control at 50 degrees nose low, 6,900 feet MSL, the pilot's recovery attempt results in another uncommanded roll. The pilot manages to regain 300-knot level flight at 2,000 feet MSL in full AB.
- Rudder pedal adjust spring handle fails. On landing, aircraft departs the runway.
- Afterburner balance segment fails (tired iron), resulting in an aft engine fire.

More than 20 years since its first flight, the F-15 is beginning to show signs of age.

Safety Concerns

Current safety efforts involve improvements to the F100 engine, the wing/conformal fuel tank transfer pump failure warning, the exterior lighting, a windshield overtemp warning, an improved high G-suit valve, the aft bay fire detection/warning, and the cabin pressure failure warning light. These improvements should solve a lot of our Eagle problems and are either being installed now or in the not-too-distant future.

Other concerns include wingtip, horizontal stab, or vertical stab pieces coming off in flight, FOD problems from improper maintenance procedures, and GLOC. The airframe structural problem is presently being worked, but the FOD problem demands topnotch "quality control" on the part of Eagle maintainers and SMART engine runup procedures. The GLOC problem can only be solved by Eagle drivers checking their G-suit connection, getting adequate exercise, and being ready for G onset.

Summary

Overall, FY91 was a good year for the Eagle with only three Class A and two Class B mishaps. More importantly, there were no lives lost. You are making the "early decision to eject" when things go wrong in the jet. This is a record we want to tie every year on the Eagle report card.

So, hats off to you jocks, maintenance troops, and support personnel! While this was not a record year for the Eagle, it was a "good" year, and you are commended for your efforts. Remember, though, SOUND BASIC AIRMANSHIP would have made FY91 a mishap-free year. There's the challenge for FY92. ■

Photo by Maj Roy A. Poole

AIRCRAFT STATIC DISPLAYS

LT COL JAMES E. HUMPHREY
Explosives Safety Division
Air Force Safety Agency

■ One of the more visible ways in which the Air Force presents itself to the public is through aerial and static displays of aircraft. Over the years, the requirements for safely displaying aircraft in the static mode have become more and more stringent, primarily because of some unfortunate incidents involving the Air Force or other services.

During the late 1970s and early 1980s, a major effort was made to upgrade the safety of aircraft static displays in the wake of several deaths and serious injuries involving DOD aircraft at civil events and on permanent static display. A complete inspection of all aircraft on permanent display was done, and a requirement was levied for aircraft system managers and program offices to develop technical order procedures specifically for making safe aircraft which were going on any type of static display. This resulted in the 00-80G-series technical orders (TO).

At present, a 00-80G TO exists for the B-52D/G/H, F-15, A-7, F-111, F-16, A-10, F-4, B-1, and T-1. These TOs give explicit instructions on what procedures to perform on these aircraft for the various types of static display, ranging from "No Public Access" through "Cockpit Open" to "Permanent Display."

The procedures are designed to guarantee safety of the public during the time the aircraft is on display and naturally become more complex, time-consuming, and complete depending on how much public access to the aircraft is granted. The most complete make-safe procedures are required for aircraft going on permanent static display since, in most cases, the Air Force will not be able to directly control the degree of public access to the aircraft when it is parked or on a pedestal at an airport.

Given that make-safe procedures are already published or are being developed for aircraft in the active duty inventory, commanders should ensure the procedures are accomplished each and every time their unit participates in a static display.

Because of the complexity and extent of the disassembly needed for some aircraft types to meet the requirements of the make-safe procedures, it may even be necessary to limit the scope of the static display. However, unless, and until, appropriate TO changes making static display easier and safer are implemented, there is no valid reason to not comply completely with current procedures. The Air Force has both a moral and legal responsibility to completely protect the public whenever an aircraft is placed on static display. ■

F-16

MAJOR JEFF DAVIDSON
Air Force Safety Agency

Fighting the Good Fight

■ War in the Gulf riveted our attention in FY91 and proved the lethality of the Viper's bite. But the Viper can bite back: 21 Class A mishaps, 21 destroyed F-16s, and the loss of 5 good friends and fighter pilots is sobering testimony for flying smart and flying safe.

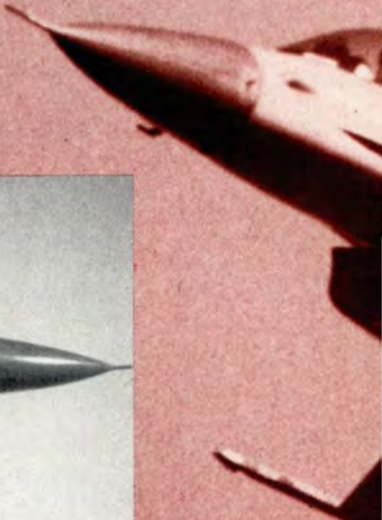
The year ahead will require outstanding flying, diligent maintenance, and quality logistic and engineering support to lower our rate of 4.5 Class A mishaps per 100,000 flying hours. Cutting our losses in the coming year will require our continued vigilance and best efforts. Fight the good fight. Fight safe — it's the smart fight.

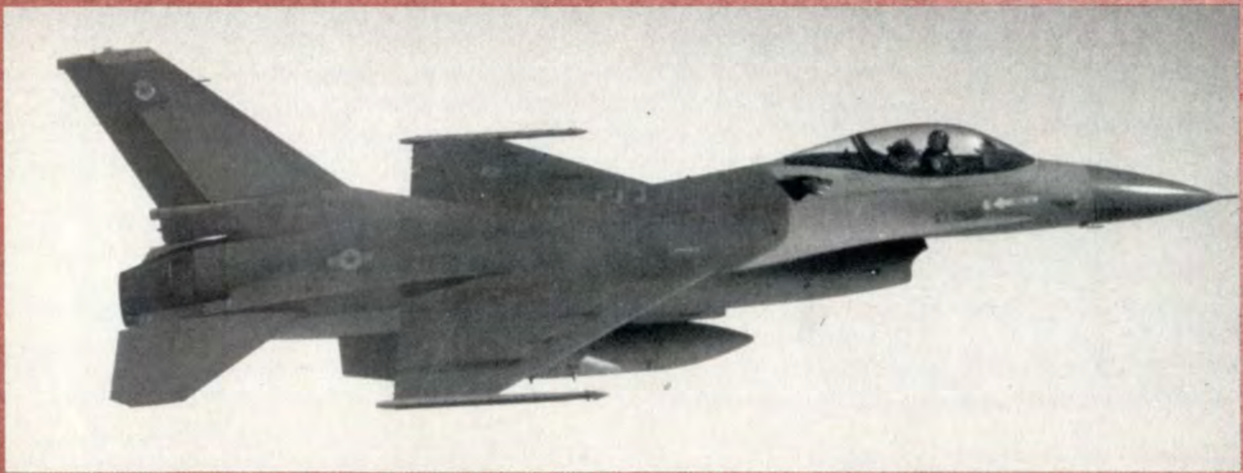
Collision With the Ground

During FY91, we had five collision-with-the-ground (CWG) mishaps. CWG is the largest operator-caused mishap category, accounting for nearly one-third of the 155 F-16s we've lost since that first flight in 1975. And CWG is the largest killer of our pilots, accounting for 75 percent of the 47 pilot fatalities in the F-16, including the ones below.

One CWG crash involved an F-16C during medium altitude night operations on the IP-to-target run. The pilot had initiated a radar lock onto lead while descending to avoid some weather. The flight lead ensured altitude deconfliction and directed a turn to keep the flight in their working airspace. The pilot transmitted a terminate call and impacted the ground shortly thereafter with no ejection attempt.

Desert Storm proved our night capability, but also reaffirmed its inherent risks. There are systems in the F-16 to provide ground collision warning. These systems are useless unless we take the time to use them, understand their operation, and continually write up those systems when they fail. We lost three pilots this year in mishaps like the one above because we failed to use or to understand the operation of our ground collision avoidance systems (GCAS).





Another preventable CWG mishap involved a pilot flying a night ASLAR approach on the wing. The pilot failed to maintain proper formation spacing. Drifting wide of lead, he became disoriented and crashed in a steep high-banked attitude with no attempt at ejection. The why of this mishap was lost with the pilot in the crash. An "altitude low" warning set at or above the final approach fix altitude may have provided warning in time to recover.

The third night CWG mishap this year involved a LANTIRN-equipped aircraft entering the low-level structure in mountainous terrain. At impact, all LANTIRN terrain-following systems were capable of operation, but for an unknown reason, the pilot did not have those systems activated. This prevented reception of ground proximity warnings and disabled the autopilot fly-up features. As a result, he flew his aircraft into the ground and was fatally injured.

The common strain in these three mishaps is the human factor. Failure to use, or use properly, available ground avoidance systems can have fatal results. Systems knowledge: It's just as important as threat knowledge — know and use your systems; defeat our most lethal threat — THE GROUND.

G-induced loss of consciousness (GLOC) and weather-related spatial disorientation (SDO) accounted for our next two CWG mishaps. In the GLOC mishap, the MP was flying his first sortie after a 17-day layoff. GLOC occurred during a high-speed, high-G vertical conversion. The aircraft impacted the water with no ejection attempt.

Long layoffs reduce G tolerance. G-warmup maneuvers are incorporated into our flights to make us aware of our G limitations for the day. They don't give you instant nine-G tolerance. Know your limitations! Some days you're a G monster, other days it hurts just to pitch out.

The SDO mishap involved the wingman maneuvering his jet to avoid a perceived flightpath conflict with his element lead. He became disoriented in the avoidance maneuver and failed to verify his attitude on the ADI. His disorientation resulted in control inputs which prevented recovery; perceiving the aircraft was not responding to his control inputs (when in fact it was) and noting ground rush, he made a timely decision to eject.

The remaining four operator mishaps were old lessons relearned. We had one each: Midair, loss of control, pilot-induced stick jam, and pilot-induced flameout. The midair cost us the life of our fifth pilot for the year and the loss of two Vipers.

The mishap engagement was a continuation training sortie for two IPs and began as a high-aspect basic fighter maneuvers setup and degraded to a high AOA, low-speed fight, ending with the midair. In the final sequence of events, the flight lead (fatal) *lost sight* (never called it) and was slicing down towards what he perceived no. 2's position to be. No. 2 was pitching up toward his flight lead but had *lost situational awareness (SA)* with the horizon. No. 2 was tally but could not determine

continued

Collision with the ground was the largest cause of operator-related F-16 Class A's during FY91.

F-16 continued

no. 1's aspect due to the shadowing effects of the sun. Low SA on the part of both pilots and failure to communicate led to late recognition of their convergent vectors. Poor energy management prevented them from maneuvering clear of one another.

Bottom line: Strong flight discipline, egos in check, and adherence to the ROE would have resulted in a knock-it-off early enough to prevent the midair. Set clear obtainable objectives, adhere to them, and if things don't feel right, KNOCK IT OFF, KNOCK IT OFF, KNOCK IT OFF.

Pilot-induced loss of control cost us one jet this year. That's better than the three predicted, but it was our first loss of a "big tail" F-16. A

Viper Bytes

■ At the close of FY91, 1,897 F-16s have been delivered to the USAF: 785 F-16A/Bs and 1,112 F-16C/Ds. Seventeen countries, plus the US Navy, have purchased an additional 1,043 F-16s, for a total of 2,940 aircraft. End strength USAF F-16 force levels are fluid as we restructure following the breakout of peace, but scheduled conversions through FY93 reveal 17 ANG/AFRES units converting to or upgrading their F-16s. Conversions range from Block 15 ADF jets to showroom-new Block 50/52s.

Several upgrades are underway or on the horizon for the F-16 community. They include for the F-16A/B models completion in FY92-2 of the Air Defense Fighter (ADF) modification, giving ANG Air Defense units Block 15 jets with an AIM-7, advanced IFF, and HF radio capability (Check 12, VIPERS with a FOX 1 capability). These, and some other ANG/AFRES A/B models, are also undergoing an operational capabilities update (CY93 completion) to bring their cockpits up to C/D standards (up-front controls, multifunctional displays, and a larger HUD) and avionic upgrades. Finally, the midlife update (mostly a European effort) will upgrade 130 ANG/AFRES jets to a Block 50 cockpit configuration, with an improved weapons computer and a digital terrain system, but this upgrade won't start until FY97.

Production of USAF C/D models continues. Block 40/42 equipped with LANTIRN, GPS, wide-angle HUD, and digital flight controls will be completed in CY92.

USAF Block 50/52 incorporates all Block 40/42 enhancements sans LANTIRN. Deliveries began in September 1991 and will continue through March 1994.

All original Block 25 aircraft have been updated to Block 30/32 avionics standard. A close air support modification (modular mission computer, digital terrain system, improved data modem, night attack system, laser spot tracker, moving map display, plus improved countermeasures) is planned for 300

Block 30 jets in FY98. The midlife update program is planned for remaining Block 30/32 jets in FY97.

Significant subsystem safety upgrades for all F-16s include improvements to the combined altitude radar altimeter (CARA) and the HUD. CARA is currently installed on all production aircraft and will be installed on all F-16s through various vivid reminder: Even the big tail can be departed.

In this mishap, the pilot flew his aircraft into an extremely slow-speed (below 90 knots) high-AOA (greater than 29 units) condition with the speed brakes extended in idle power just above the area floor while executing a loaded roll. Stick inputs exceeded the capabilities of the flight control computer in pitch; and, combined with his roll inputs, a low-speed AOA overshoot and departure occurred.

The pilot should not have been surprised the jet departed (the Dash-1 warns us to avoid these situations). Disregard for aircraft flight limitations, poor energy management, and low SA set the stage for this mishap. Although the pilot broke the departure quickly, he was staring through a HUD full of rocks without the altitude to recover and made a timely decision to eject.

Poor cockpit management claimed another F-16. While preparing to use a piddle pack, the pilot unbuckled his lap belt and inadvertently placed it between the seatpan and the side-stick controller. When he raised his seat to use the piddle pack, the lapbelt buckle jammed the stick right and forward, forcing the aircraft into a descending spiral. The pilot paddled off the autopilot and tried backup flight controls to no avail, not realizing the stick was physically jammed.

The tight fit of the F-16 cockpit requires pilots to stow loose items and to be alert to any form of side-stick interference. The most routine of functions on the ground require diligence to perform while strapped to an airborne fighter. This time we lost only a jet. In the past, the price of stick interference has been tragically higher. Review your techniques for cockpit management and stick interference, especially in the family model. Are they adequate for the F-16's cramped cockpit and side-stick controller?

The last ops-related Class A mishap in FY91 was a result of the pilot failing to restart his engine after shutting it down due to a region two compressor stall. The single most important mistake was going to JFS start 2 at around FL 240 and 130 knots, well outside the JFS envelope. The JFS didn't run (as advertised), and the pilot erroneously focused attention on FTIT, vice airspeed. The rpm bled off to virtually nothing.

Descending through an undercast, he realized he was over icy waters and established max glide-range airspeed. This glide profile did not provide the 12 percent rpm required to recharge the JFS bottles, precluding any chance of a JFS-assisted BUC airstart. Rapidly running out of altitude, airspeed, and options, the pilot ejected safely over land. As we'll discuss below, if there is one section in the Dash-1 you need to know cold, it's section three — ENGINE MALFUNCTIONS.

continued

mod/retrofit programs by the end of FY92. A fix for false warnings and false lock-ons to the inlet duct has been identified and should be fielded by late FY92, eliminating this problem.

However, an interface problem between the analog signal data converter and the digital CARA will cause the CARA to "LATCH UP" (lock onto an altitude and stay there regardless of AGL altitude). Engineers are working the problem, but they need help from the pilots. They need 781 writeups. Don't accept a bad or malfunctioning CARA as standard. Write them up every time and in detail. It's the one input line pilots have into making system changes happen. The CARA is essential to reducing our CWG mishap rate. Write up the bad ones so we can identify the problem and make the CARA a trustworthy system for the pilot.

HUD improvements: The extended horizon line provides a much easier-to-read full HUD-width horizon line. The ghost horizon line provides a constant horizon reference by changing the horizontal line to a dashed line anytime climbs or dives place the actual horizon above or below the HUD field of view. This provides the pilot with an easily interpreted picture of which way is up. This mod makes maintaining or regaining spatial orientation much easier, reduces recovery times, and increases pilot SA. This mod is currently being incorporated into A/B models; however, incorporation into the C/D model is more difficult and will take longer, but is a top safety priority. ■

Photo by 1352 AAVS

F-16 continued

Logistics: Motors and More

Engine-related mishaps account for 78 percent of all F-16 logistics-related Class A's. This mishap cause category is the largest (37 percent) of all F-16 ops/log Class A mishap cause categories. But logistics is more than just engines. In FY91, we experienced nine logistics-related mishaps, including six engine-related, one main fuel shutoff valve closure, one hydraulic-electrical line chafing fire, and one failed nose tire/runway departure/fire.

The battle to correct these problems is waged by thousands of dedicated professionals from our crew chief on the line to the engineer at the drafting table. Ongoing engineering improvements, coupled with painstaking and diligent application of installation, inspection, and servicing criteria by depot and field level maintenance personnel, have helped make the F-16 the safest single-engine fighter in USAF history.

With over 2.8 million flight hours, the F-16 enjoys a better record than the F-4 or the F-111 at a similar stage of maturity. Impressive as that sounds, when you fly over 400,000 hours annually, there will be plenty of flameouts, compressor stalls, oil problems, blade failures, augmentor burnthroughs, and the like to keep a number of our pilots' fingers walking through the yellow EP pages. The good news is we've had only one logistics-related pilot fatality, and that was 10 years ago.

More

The main fuel shut-off valve has been implicated in three F-16 Class A mishaps, two in FY91. Concerns with the valve resulted in addition of "fail-safe" circuitry in the early '80s, and more recently, recurring inspection, cleaning, and lubrication of the valve's electrical connectors. What to do with the valve has generated a great deal of emotion-charged debate. An intensive engineering evaluation following the most recent mishaps has identified three remaining possible problem areas.

First, the cockpit fuel master switch can inadvertently be left in an intermediate position supported by its red guard. This intermediate position is difficult to detect visually from the pilot's seated viewing angle and can be missed during preflight checks. Engine vibrations, or loose cockpit items (which snag and pull the switch), can cause the switch's closed side contacts to close, driving the main fuel shutoff valve to "off." To eliminate these problems, a new lift-lock fuel master switch is being installed, after modifying the existing red guard, beginning in December 1991.

Secondly, while theoretically possible, stray voltage to the valve circuitry has never been shown to cause an unintended closure. However, since it was possible to eliminate this possibility by providing a ground to the uncommanded side when the new fuel master switch was procured, this was done.

Finally, vibration-induced shutoff valve clutch disengagement was implicated in one FY91 Class A mishap. If the clutch disengages while a second failure has removed electrical power from the valve, the valve can migrate toward the closed position due to fuel flow torquing. Initial engineering testing and analysis indicate this is a remote possibility, but the clutch disengagement phenomenon remains under study. Valve vendors have designed a new valve which prevents a de-clutched, unpowered valve from torquing closed.

So, when will the main fuel shutoff valve safety wires be snipped? Wellllll, final analysis of the vibration risk is not complete, and MAJCOMs need to evaluate their individual operational environments. An elevated rate of F-16 stuck or binding throttles during the past year puts increased pressure upon commands for a fully operational main fuel shutoff valve. Pilot control over the shutoff valve is essential and increases the odds of successful recovery of stuck throttle aircraft, particularly during night/instrument conditions. A decision restoring the valve to operational status needs to be made when the new fuel master switch has been installed and will hinge on whether the clutch disengage phenomenon or stuck throttle situations appear to pose the greater hazard.

As a closing note, our greatest area of concern is the human factor. It's present in everything we do and in every way we interact. The human factor and its frailties go into every aspect of our aircraft — its design, the maintenance performed upon it, the agencies controlling it, and especially the pilot flying it. We are all a potential link in the chain of events which make a mishap. It is the human factor which will have the greatest effect upon reducing the FY92 mishap rate. Stay heads-up, ready to break the mishap chain. Flight safety is a tough and continuous fight. Fight the good fight. Fight safe — it's the smart fight.

GOOD LUCK AND CHECK SIX. ■

MOTIVATING THE F-16

Photo by Maj Roy A. Poole

■ Currently, we are flying three different motors in the F-16 (five if you count the Pratt & GE Improved Performance Engines [IPE]). Engines are our biggest logistics Class A-related rate producer. Current safety concerns by engine include:

▪ **F100-PW-200** This engine has accumulated approximately 2.2 million F-16 engine flying hours with 44 engine-related Class A mishaps, for a 2.03 lifetime rate per 100,000 flying hours. One area of concern is third-stage fan disk failures due to fan rotating stall. This phenomenon subjects the fan to loads exceeding design limits. The excessive blade loading results in fatigue failures of the dovetail slot that holds the blade in the fan disk. At disk failure, liberated blades can cause thrust loss, catastrophic engine failure, or massive engine fire.

To correct this problem, TCTOs are being incorporated to reduce blade stresses and increase disk strength. Field inspections have removed all cracked disks, and increased inspection cycles offer the best method of risk management until all mods are complete.

Another area involves first-to-second fan spacer failures. Failure of the spacer is caused by vibratory stresses which crack and subsequently fail the flat plate seal due to high cycle fatigue. The root cause of the vibration has not been determined, but continuing engineering efforts, increased inspection cycles, and a one-time field inspection removing all cracked parts from service has managed the risk until a fix is found.

A new concern has been the rising number of partial power (non-afterburner) stalls experienced recently by F100-PW-200 users. Both Air Force and contractor engineers are actively working to identify this anomaly. Until we know more, be heads-up for non-AB stalls, and be ready to handle a restart. Don't hesitate to get the EEC off, or go to BUC, as needed. IT WORKS!

The best fix for the F100-PW-200 problems is a modification currently underway, upgrading the engine to the F100-PW-220E configuration. This high-priority mod will take several years to complete, but it incorporates all the advantages of the F100-PW-220 listed below.

▪ **F100-PW-220** This engine has accumulated approximately 124,000 F-16 engine flying hours with one engine-related Class A mishap, for a .8 lifetime rate per 100,000 flying hours. It incorporates all Pacer Growth hardware to eliminate augmentor nozzle burn-through problems, replaces the unified fuel control, with a much more reliable digital electronic engine control. A longer life core, an improved fuel pump design, and other safety modifications should help keep this the most reliable F-16 motor to date.

▪ **F110-GE-100** This engine has accumulated approximately 528,000 hours, while suffering 10 engine-related Class A mishaps, for a 1.90 lifetime rate per 100,000 flying hours. An area of concern is third-stage fan vane failure. Fan vanes have been subjected to higher-than-anticipated stresses and have failed prematurely. A corrective TCTO has reduced vane susceptibility to this failure mode.

Another problem involved engine sealant compound coming loose and blocking augmentor cooling airflow, resulting in burn-through. This damaged an exhaust nozzle oil line, draining the oil reservoir, and finally seizing the engine. Removal of nonessential engine sealant, inspection for proper installation of remaining sealant, and retrofit of an improved engine oil tank now used on the F110-GE-129 engine will correct the problem. ■

The F110 augmented turbofan engine.

F-111

MAJOR NEIL T. KRAUSE
Air Force Safety Agency

■ Congratulations to all the warriors in Southwest Asia for a job well done! Although at times left out of the news reports, no one can deny the effectiveness of an F-111 with a load of iron or a rack of jammers! The war also validated a concept we always knew to be true — the more you fly the Vark, the better it works. Mission-capable rates were up significantly from our peacetime experience.

On the down side, however, we lost four of our own in two crashes — an F-111F in a training mishap shortly after deploying and an EF-111 in combat (the first and only EF ever destroyed).

This year also marks the departure of SAC's FB-111A. The last jets left the ramp at Plattsburgh in June, ending almost 24 years of service for that model of Vark. We also say goodbye to nearly all of the A models, with only a couple remaining for testing at McClellan AFB. Unfortunately, this is only the beginning of fleet down-sizing in the years to come.

The F-111 finished the fiscal year with a 1.13 Class A rate per 100,000 flying hours, down from 5.86 the year before. This rate is well below the predicted three mishaps and on a par with the overall Air Force Class A rate of 1.11. The F-111 also finished the year at less than half of the fighter/attack Class A rate of 2.54.

The single Class A mishap last year occurred on a night range mission practicing GBU-24 tosses. The crew flew a low-level route into the range and made one pass on the target with the wingman in 8-mile trail. On downwind for the second pass, the mishap crew directed a radio change which no. 2 acknowledged. That was the last transmission received from lead. The mishap crew continued with the next pass and crashed in the recovery from the toss maneuver.

Later, many factors came to light. Few of them are unique to this particular mishap:

- The night, TFR, and weapons delivery missions are individually very demanding — put these three together and you have a scenario which requires 100 percent concentration. If you can't give it this level of attention, 'fess up and knock it off until you can.
- Impending war seems to encourage some people to throw out rules and guidelines they used in training. A few are lucky and may even become heroes, and a few don't realize their good fortune. But, the majority eventually learn training rules and guidelines are there because it's a smart way to do business. For example, lowering

toss recovery altitude by 500 feet may seem like a tactically sound thing to do, but it also reduces margin for error on the recovery and changes the dynamics of the maneuver (encouraging the tendency to overbank). Is a night attack on a target the first time you want to try this maneuver? Serious risk/benefit analysis is called for — remember the P_k of the ground is almost always 1.

■ Fight the way you've trained. Sound familiar? More than likely, you've heard the first part (train the way you'll fight) as a reason for realistic training scenarios. The flip side of that is equally important. If you feel you are not properly trained or find yourself not current in some aspect of the mission, then it's too late to "get trained" or "get current" on Day One of the war.

Leaders need to make hard calls on the abilities of their people. Don't advertise a capability in some mission if your people haven't trained in it or aren't proficient in it. This means *actual* proficiency, not necessarily a hard number in a training document. It also means *actual* training, not a program thrown together to fill the "Letter of X's." Proper supervision, grading, academics, film review, and debriefing are the standard at home. Training at the deployed site demands as much.

■ One last point: Communication is a two-way process. Top-down transfer is only "direction." Leaders: If you stifle the upward flow, then you don't have the full picture upon which to base your decisions. Your people probably have good ideas — use them. Some may have serious concerns — investigate them. In either case, your people are probably closer to potential problems than you are. If you "shoot the messenger," you break a valuable link to the trenches.

Class B Mishaps

The F-111 community had a significant increase in Class B mishaps in FY91. Last year's Class B rate was 7.64, compared with 1.17 the year before, and well above the normal Class B trend for the 1980's. Some obvious reasons for this increase are superior airmanship and a rugged airframe (and luck) transferring potential Class A mishaps to Class B status.

Each one of these incidents is similar to previous Class A mishaps. Although dollar damage (and in one case, personal injury) was significant, the aircraft returned to the ramp with two crewmembers able to talk about their experience. Here is a recap.

Bird Strikes

■ The mishap aircraft was holding at 2,500 feet when it ingested a bird down the right intake. After landing at a divert base, the postflight inspection revealed several second-stage fan blades had ruptured the fan case, exited the engine, and punctured the finger fuel tank.

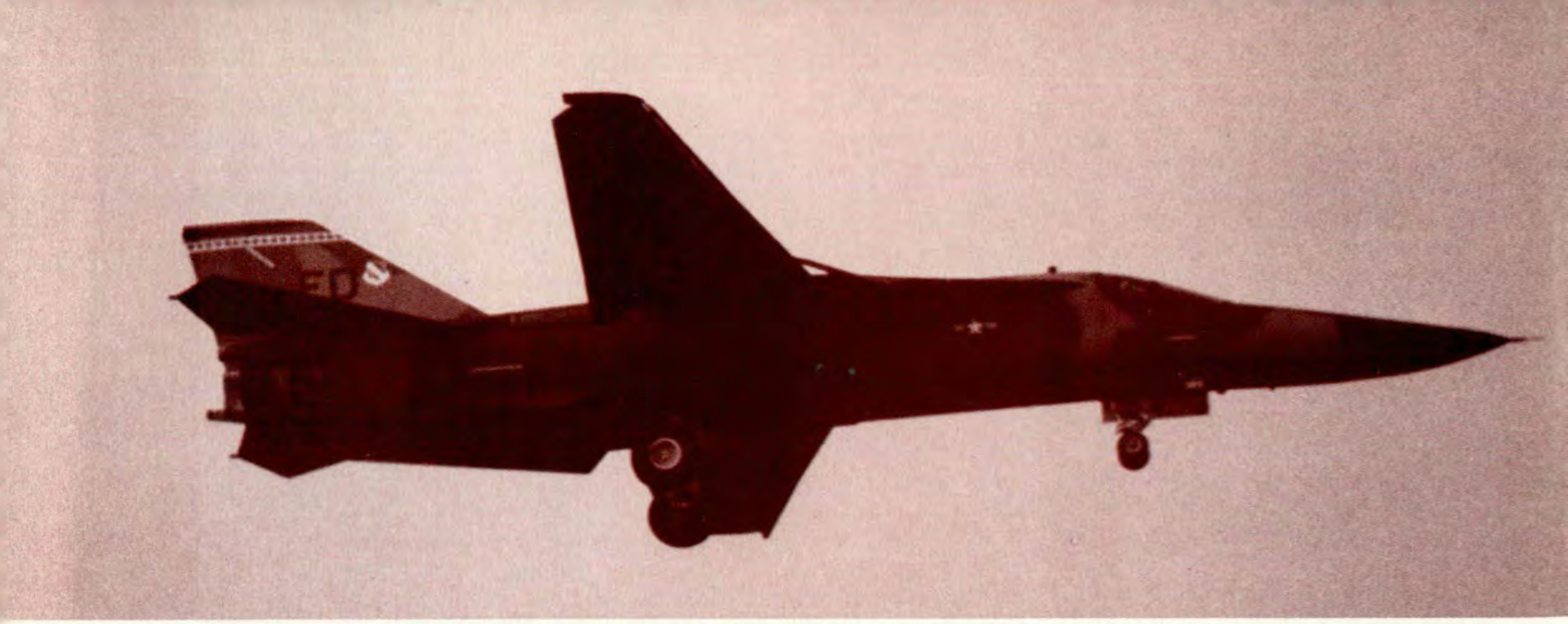
■ While on final for a loft weapons delivery at 550 knots and 400 feet AGL, the mishap aircraft struck a bird, shredding the radome. Experiencing a rapid deceleration and severe vibrations followed by pitch oscillations, the crew initiated a climb and turned for home base. Turning off the pitch damper stopped the oscillations. With one engine compressor stalling, the crew began an approach for landing. Pulling the good engine out of afterburner to start the descent, the crew realized the afterburner would not relight and turned direct for a 2-mile final. Running out of airspeed and altitude, the crew barely made it to the runway, landing at high angle of attack.

■ In another incident, the aircraft was also in the range pattern, at 480 knots and 2,000 feet AGL. A large (estimated 8 to 10 pounds) vulture impacted the right front windscreen and entered the cockpit. The WSO was struck in the mask, visor, and helmet, sustaining severe eye injuries. The pilot landed after a chase aircraft determined no other aircraft damage.

In each bird strike case above, the crew had little or no warning of the hazard. Bird conditions were "green" with no reported activity.

So what can you do to minimize the risk? First, stay as high as practical. Second, call out birds in the pattern if they may be a factor for someone in your flight. Third, always fly with your visor down, especially at low altitude. continued

The F-111 finished the fiscal year with a 1.13 Class A mishap rate, down from the rate of 5.86 in FY90.



Bird strikes, midair collisions, and engine problems contributed to the 7.64 Class B mishap rate.

F-111 continued

And fourth, if your radome disintegrates, follow the guidance in the Dash-1 supplement. It has now been "ops checked"! Expect engine stalls, rapid deceleration, and pitch oscillations. Don't deselect an operating afterburner until you no longer need it and minimize *any* throttle movement. Also be prepared for an ejection — don't delay the decision.

Midair Collisions

▪ The mishap aircrew had just completed night air refueling and descended below the tanker while accelerating to make route timing. One crewmember called out traffic below, and, while both diverted their attention to search for the traffic, the aircraft entered an undetected climb. The mishap aircraft struck the tanker, damaging the tanker's fuselage and no. 2 engine and the F-111's right wing and vertical tail. Both recovered successfully.

▪ In a second incident, two F-111s were rejoining straight ahead at night. Too late to correct an excessive overtake, the joining aircrew pushed down and banked away but struck the leading aircraft. The joining aircraft received a deep cut in the left wingtip, and the leading aircraft lost a good portion of its left stabilator. Both recovered successfully after separate controllability checks.

Once again, here are two mishaps which easily could have resulted in destroyed aircraft and fatalities. Notably, in both mishaps, the crews involved KNEW THE OTHER AIRCRAFT WAS THERE! In fact, they had a VERY good idea of where the traffic was. Both resulted from a moment of distraction or inattention at an inappropriate time. The lesson is obvious.

Engines

▪ During postflight inspection, maintenance discovered major engine damage from FOD. The crew noticed no abnormal indications or operation. The FOD was found to be a bracket sheared off by a binding cable in the inlet spike.

▪ Another incident occurred on an ocean-crossing sortie for depot maintenance, 200 miles from land, in the weather, on a tanker's wing. The crew heard a bang, followed shortly by an engine fire light. After completing the Bold Face items, the fire light went out, only to come on again a while later. The crew reconfirmed the Bold Face accomplished and followup items finished. The fire light went out again, but failed to test good. The crew continued to the closest divert base, 30 minutes away. After landing, postflight inspection revealed a catastrophic engine failure and severe engine bay fire damage. A fan blade had failed, rupturing the fan case and cutting fuel and oil lines.

Engine failures in the F-111, as in

all aircraft, account for the greater portion of logistics mishaps. Out of just under 140 Class C and HAP mishaps in the F-111 last year, engine-related problems accounted for about 40 percent. If there is one system that should demand more attention in simulated EP training and discussion, engines qualify.

The Future

Following the rash of fan blade liberations in recent years, Sacramento Air Logistics Center is investigating methods of containing broken fan blades to prevent damage outside the engine case. These modifications are expensive, and previous studies had not proven the need for containment but, since current events have altered the numbers, projected losses now outweigh the costs.

Another program receiving high-level attention is the recovery parachute system. The current 70-foot chute is very reliable and works (if used in the envelope) nearly every time. The landing, however, is rough. About 30 percent of the crewmembers receive back injuries from the capsule landing. A new 85-foot chute is designed to soften the landing but is suffering reliability problems in testing. If these problems can be solved, we may see "kinder, gentler" landings in future ejections.

The Digital Flight Control System is also proceeding with testing on the EF-111, with production installation beginning in the Fall of 1992. Expect dramatic increases in reliability and mean time between failure of the new system and, as a bonus, a ground collision avoidance system (GCAS).

In the operations area, the biggest concern is human factors in aircraft mishaps. In the last 10 years, human factors have been involved in about 70 percent of all (including logistics) mishaps. Inattention, complacency, and distraction are words describing the state of mind when concentration is misplaced on a noncritical task at the expense of one that is. This becomes particularly crucial at night, where outside cues and peripheral vision are poor (see the two midair Class B mishaps above).

The next few years will certainly bring changes in the Vark community. Tight budgets are forcing cuts in the fleet. In the Fall of 1992, expect to see only about 150 jets on the ramp (a number changing daily, but consisting of all the remaining F- and EF- models and 27 E- models). Leaders need to watch for the "finis flight" mentality — "this is our last flight, let's make it a good one." Along with that comes the end of some officers' flying careers en route to a staff assignment. If you don't think this affects concentration, ask one of these aircrews! Finally, keep an eye on the interaction of fliers (and maintainers) who participated in the war with the ones who didn't. There is potential on both sides for "showing what I can do." ■

Here are some good rules of thumb for the safe F-111 aviator:

- Fly like the TFR is trying to kill you.
- Flight control problems usually don't fix themselves.
- The next bomb is worth about 30 bucks. Your jet and your crewmate far exceed that.
- The record for the lowest low-level can't be broken, only tied.
- On a good day, the weatherman can beat any four-ship. Don't fool with Mother Nature.
- You can't fix an airplane while it's airborne. Land first.
- You only get to fly tomorrow if you come back today.

As Dirty Harry said, "A man's got to know his limitations."

Future plans for the F-111 include a larger recovery chute, digital flight control system, and ground collision avoidance system.

Write a Dumb Caption Contest Thing ...

Photo by Maj Roy A. Poole

Once again, we present the celebrated Dumb Caption Contest Thing for your enjoyment. To enter, Xerox™, or Canon™, or Mita™, or Royal™ or Savin™ the top portion of this page as many times as you want. Then, cover up our incredibly witty caption and send us your creatively concocted caption. You, too, may win the legendary Cheap Little Prize if your entry is judged to be the best we receive. Send your entry(ies) to:

Dumb Caption Contest Thing
***Flying Safety* Magazine**
HQ AFSA/SEDP
Norton AFB, CA 92409-7001

... And thanks for your continued support

THE WINNER
FOR THE
SEPTEMBER 1991
CONTEST IS . . .

Glenn Decker
Base Operations
Dover AFB, Delaware

Congratulations to this month's inscrutable captioner, Glenn Decker. His arcane quote surpassed all others for succinctness and success. The celebrated Cheap Little Prize will be loaded on a rail car and forwarded to him before his taxes are due. And lest we forget, felicitations to our Honorable Mention writers as well.

HONORABLE MENTION

1. **(Gentlemen at far left) I said, "You have to be invited to land on private property. (Balloon caption) Invited?!!!? I thought you said inverted!**
   Chuck Woodside, Kelly AFB TX

2. **I suppose this means I'll need another safe-for-solo check.**
   Jim Burt, NAS Corpus Christi TX

3. **Make it a Code Two.**
   MSgt Edward J. Wintermantel, Greater Pittsburgh IAP, Pittsburgh PA

4. **Perhaps we should delete inverted maneuvers from the training syllabus . . .**
   MSgt Charles D. Mackey, George AFB CA

Going Out With A - - - BANG

ALAN DIEHL, Ph.D.
Air Force Safety Agency

■ Vigilance is undoubtedly the price of freedom — and *safety*. It's particularly important to recognize this when getting ready to leave your old unit for a new assignment, new aircraft, or new career. A review of several recent mishaps also suggests finis flights may take on a tragically literal connotation.

For instance, in two airlifter Class A landing mishaps, the people with the yoke were in the process of separating from service. Both pilots, incidentally, were headed for airline jobs. According to both investigations, the pilots made procedural and judgmental errors. Furthermore, one of these mishaps was a finis flight.

Another recent Class A mishap involved a training jet making a simulated instrument approach in VMC. Here, the instructor pilot was also getting ready to separate from the USAF. He was daydreaming and unsure of just what type of approach was being made. Tragically, the other pilot (under the bag) discovered "terror firmis" before getting to the runway.

In another recent fatal mishap, the DO had (at the request of the IP) authorized an unqualified pilot to fly as copilot during the individual's finis flight. Although the causes of this helo crash were never fully established (both engines had flamed out), it is possible a second qualified pilot may have made the difference between an incident and an accident.

Then there was the supervisor making a one-versus-one finis flight in the electric jet. He shut down a stagnated engine and messed up the restart — and ended up doing a PLF for his last landing.

These mishaps have a couple of common messages: Never get complacent; and finis flights tend to be festive times — all the more reason for caution. Furthermore, when getting ready to depart a unit for a new bird, assignment, or especially when leaving the service, you must be careful not to let your guard down flying airplanes, driving your car, or in any other activities.

If you're checking out in another type aircraft, you may start thinking about how this new love is going to be so different. You know you're going to have to unlearn your current aircraft's checklists, procedures, etc. — items with which you, no doubt, have become very comfortable. Remember, as long as you're flying the old bird, you have got to play by *its* rules.

Similarly, if you have orders for your next outfit, it's easy to start feeling you do not have to worry quite as much about pleasing your soon-to-be former flight, squadron, or wing-king. Maybe they did some things which didn't exactly please you. So now you feel the pressure's off. Just remember, it's still *your* (not their) posterior in the pit.

Undoubtedly, the biggest psychological transition occurs with the decision to get out of the service altogether. Your whole way of life is going to change dramatically. We're all aware life events (like a divorce, the death of a loved one, a promotion, a financial setback, etc.) can affect us emotionally — even though professional aviators try to leave these kinds of problems on the ramp. In an important study of this phenomenon, a Naval Safety Center psychologist, Dr Robert Alkov, concluded making a major decision, especially getting out of the service, was highly correlated with "pilot error" mishaps. In fact, it was more highly correlated with such mishaps than any other factor*.

Know there are increased risks associated with finis flights when people are departing your unit. Be more cautious when your people are in these situations. That way we can avoid anyone *going out with a bang*. ■

* R.A. Alkov and M.S. Borowsky, "A questionnaire study of psychological background factors in the US Navy aircraft accidents," in *Aviation, Space and Environmental Medicine*, Sep 89.

Photo by CMSgt Robert T. Holritz

F110 Compressor Failures

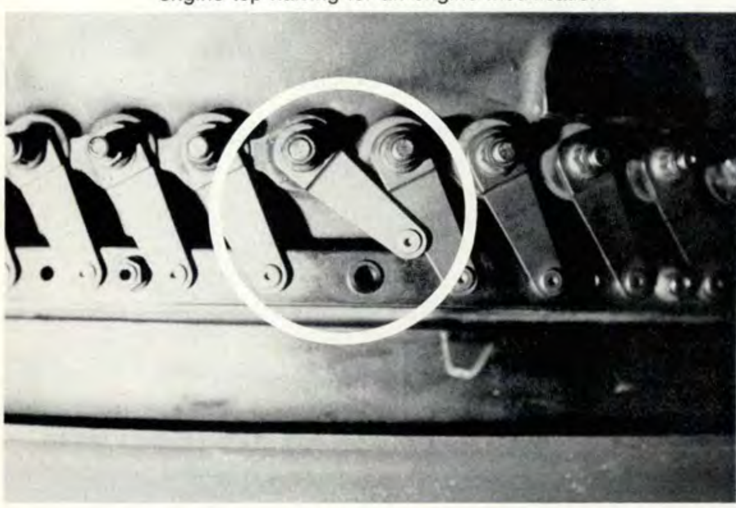
CMSGT ROBERT T. HOLRITZ
Technical Editor
ROBERT B. ENGLE
AFSA Propulsion Engineer

■ An F-16, flying at low level during a training mission, experienced catastrophic engine failure. After an unsuccessful attempt to restart the engine, the pilot punched out, and the aircraft was destroyed. A mishap investigation team determined the cause of engine failure to be an improperly installed variable stator vane (VSV) assembly in the F110's compressor.

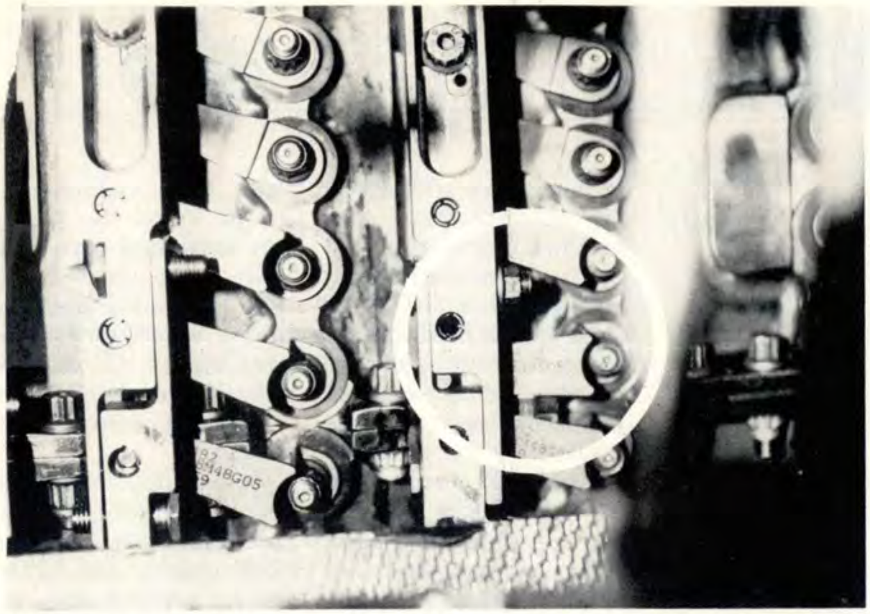
This was not an isolated incident. In fact, during a 3-week period late last year, two other F110 engines failed catastrophically and aircraft were nearly lost because of improperly installed VSVs. The sharp rise in VSV problems seems to be proportional to the increase in TCTOs. Since the F108, F101, and F118 engines use the same compressor section, they are also vulnerable.

Interestingly, the damage is not caused by a VSV breaking off and shelling out the compressor. Rather, it is the result of failure of one or more compressor blades. The blade failure occurs because the improperly installed VSV disrupts the airflow. The compressor blades feel this aerodynamic excitation once ev-

This lever arm pin dropped out of the actuation ring during engine top halving for an engine modification.



The lever arm pin is misinstalled in the rigging pinhole.



This lever arm pin is trapped between the actuation rings and not inside the pinhole.

ery revolution. This causes high cycle fatigue, and the blade eventually fails.

Catastrophic engine failure typically occurs within 50 to 200 operating hours after the VSV is improperly installed. The problem is insidious because the engine performs without any indication of trouble until, without warning, the compressor section comes apart like a $2 watch.

There are many ways to *improperly* install a VSV and cause the blade excitation. The primary ways include:

- The lever arm can be assembled with the D feature not aligned, resulting in the vane being misaligned by 10 to 30 degrees. In this condition, it is still possible to tighten the locknut enough to allow the required two threads to show.
- The lever arm pin can inadvertently be left out of the actuation ring, resulting in a loose vane.
- The lever arm can be inadvertently installed in one of the rigging pinholes which are the same diameter as the lever arm pinholes.
- During the reassembly, it is possible to trap the lever arm pin in the gap between the split ring connectors.

These problems can occur due to:

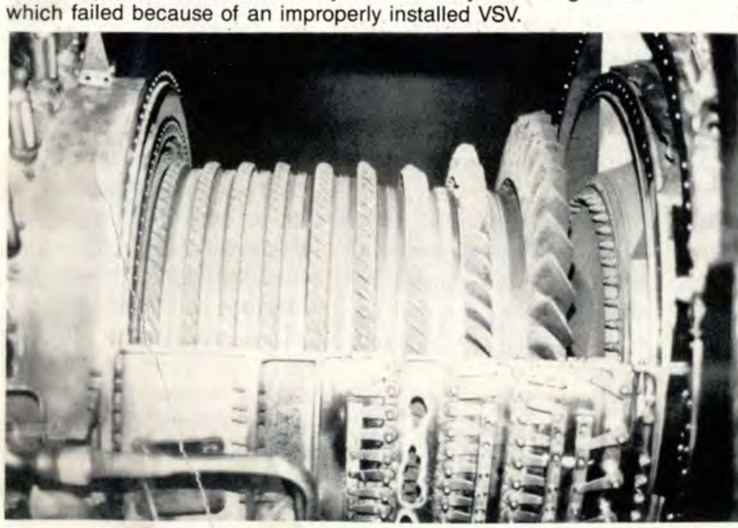
- Failure to install and inspect lever arms after reinstallation of cases.
- Improper alignment of vanes to lever arms during installation of vanes and/or lever arms.
- Failure to properly retain an actuation ring during top halving, resulting in a "dropped ring" and disengaged pins.
- Installation of actuation rings, particularly reinstallation of a dropped lower ring which is a "blind" assembly with the lower fan duct installed.

As you read this article, teams will be in the field to provide additional training on VSV maintenance. Numerous TO changes will have been issued, with more to follow. Inspection and hardware changes are also in the works. All of these changes are being developed by a joint Air Force/General Electric team of experts who have been working on the problem since early January.

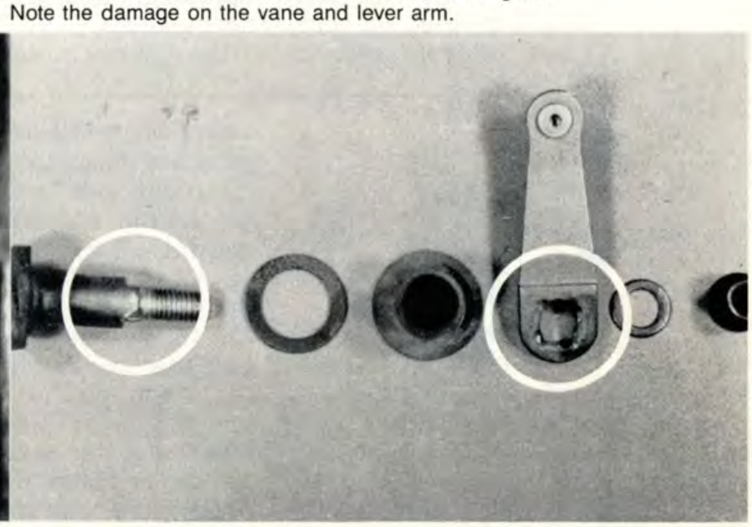
As the large number of F110, F101, F108, and F118 engines in the field undergo periodic maintenance and future TCTOs, the number of VSV-related problems will continue to increase unless technicians and supervisors at depot and field level take measures to ensure VSVs are properly installed.

THE BOTTOM LINE: Each improperly installed variable stator vane represents a time bomb which can destroy an aircraft and puts the pilot at risk. ■

This compressor section was totally shelled out by a first-stage blade which failed because of an improperly installed VSV.



This lever arm was installed without the D feature aligned. Note the damage on the vane and lever arm.



A-7

MAJOR MARK PENDLEY
Air Force Safety Agency

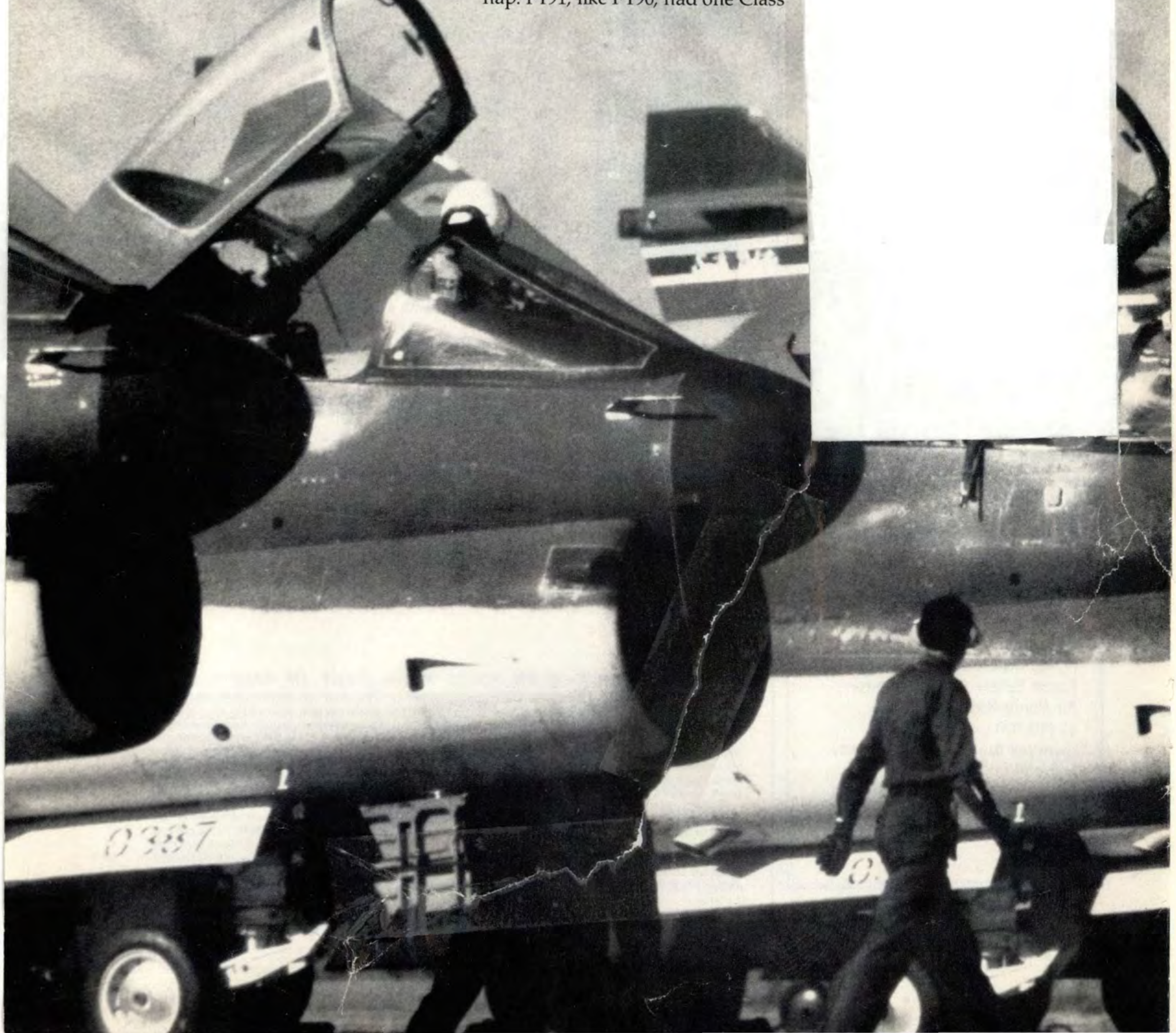
■ It's annual review time again, and just like last year, I have only one Class A mishap to talk about. FY91 was a good year for the A-7. That is impressive, considering the age of the jet and the fact many units are converting to other type aircraft. But the fact remains, the A-7 will be around for at least another year, so let's keep them flying safe.

FY91 in Review

In FY90, we had a 1.4 mishap rate, which translates to one Class A mishap. FY91, like FY90, had one Class A mishap for a very similar rate of 1.40 mishaps per 100,000 flying hours. We closed FY91 with 68,179 flying hours compared to 71,498 hours in FY90. We also had our first Class B mishap in 3 years, which I'll address later.

The Class A

The mishap aircraft flew an after-



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.

CAPTAIN

James G. Harris

355th Tactical Training Wing
Davis-Monthan AFB, Arizona

■ Captain James G. Harris was flying a single-ship A-10 functional check flight. While maneuvering in a dive with the aircraft's "cable and pulley" backup flight control mode (manual reversion), he felt a "thump" and noted an uncommanded, partial restoration of hydraulic pressure. He immediately selected the primary flight control mode and recovered from the dive.

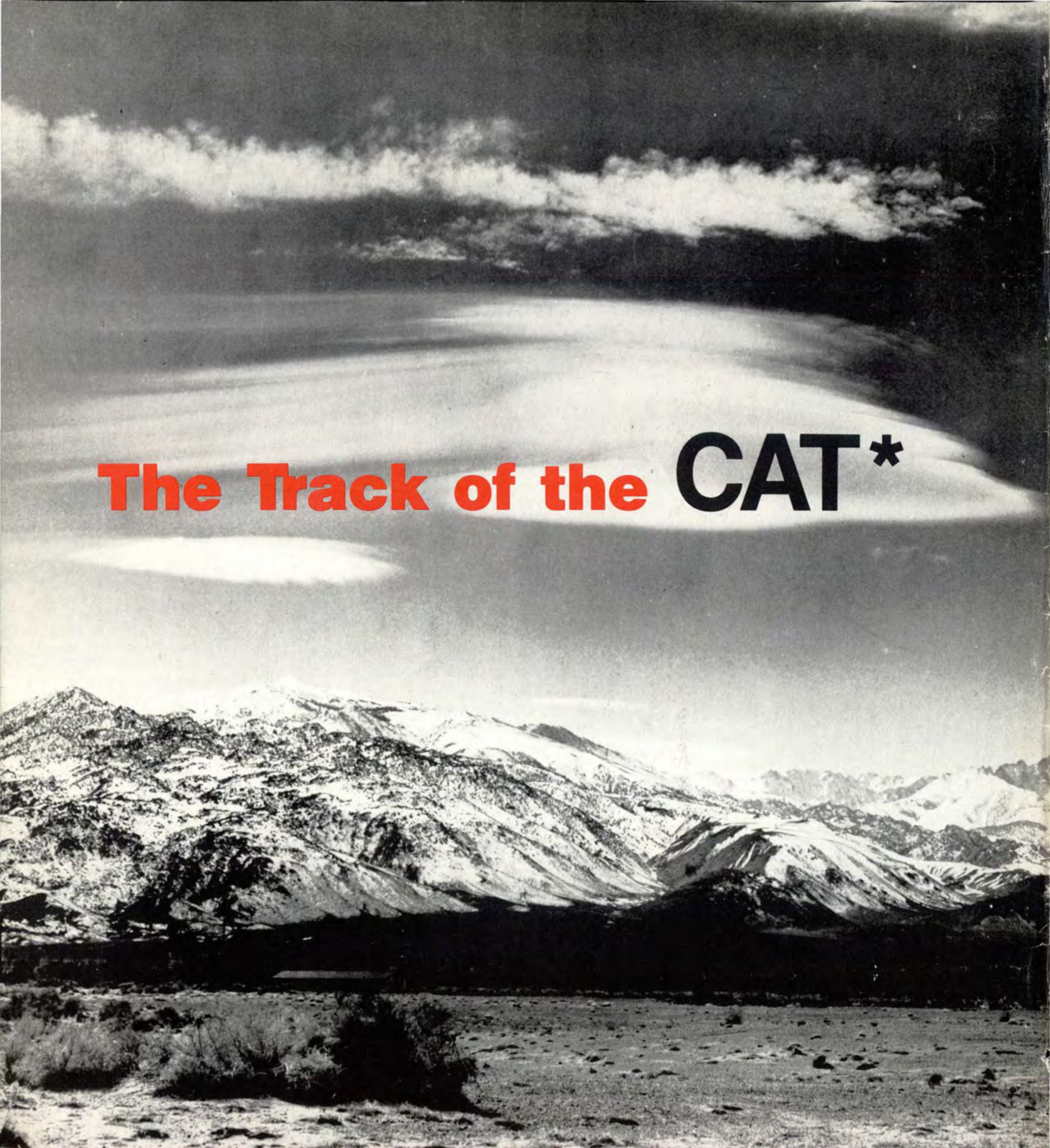
After getting the nose of the aircraft above the horizon, Capt Harris attempted to roll the aircraft using the stick but found stick movement would not displace the ailerons, only the smaller aileron tabs. Pitch and roll trim was also inoperative. Visual inspection revealed no structural damage and no leaking fluids. Capt Harris, the SOF, and depot engineers tried to solve the problem.

Capt Harris emergency-extended the landing gear and performed a controllability check between 160-200 KIAS. The engineers advised against using speedbrakes or flaps due to possible undetected damage which might further compromise aircraft control. At 195 KIAS, full side-stick deflection resulted in no roll response for 3 seconds; then, a ¾- to 1-degree-per-second roll opposite the direction of stick throw. At 180 KIAS and below, the aileron tabs did not produce enough aerodynamic load to roll the aircraft at all. Capt Harris chose to attempt to land using rudders only for roll control — a procedure never before accomplished in the A-10.

Returning to base, he flew a gear-only approach at 180 KIAS (50 knots faster than normal). As he neared the runway, Capt Harris skillfully kept the aircraft under control despite increasing turbulence and crosswinds. After touchdown, the speedbrakes did not function. The aircraft was stopped using light brake applications due to the uncertainty of anti-skid availability.

Capt Harris' precise flying and execution of emergency procedures prevented a potential loss of life and saved a valuable combat aircraft. WELL DONE! ■

The Track of the CAT*



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