flying

SAFETY APRIL 1991

The F-16 and LANTIRN

Avoiding Fuel Coupling Problems

Dollar Ride in the F Model F-111

How Close Is Too Close?

Focus On Fighters

THERE I WAS

■ There I was, flying a ho-hum Saturday morning functional check flight on an A-10. The jet was approaching hangar queen status, so we'd ginned up a weekend flight to get it airborne and, if our luck held, released. It wasn't meant to be.

Ground ops were normal, and I had the working area to myself once I got clear of the control zone and a large adjacent airport. The jet was doing fine until I got to the manual reversion check. After controlling the initial pitchup during transition from normal flight controls, all indications looked good, and pitch trim seemed to be working.

I pulled up to check out the low speed flying characteristics, then pushed it up to military and lowered the nose into a 20-degree dive to check out the high speed end. Terrain elevation normally kept me from getting very close to the 390 KIAS manual reversion limit, but I normally saw 360 to 370 during any pullout which avoided the ground by a comfortable margin.

Pulling back on the stick, I felt the normal heavy-nose characteristic of manual reversion and put in a click or two of trim to help start the pullout. The nose didn't move. I held the trim button aft. Still nothing. The airspeed was approaching the 390 KIAS limit, so I whipped the throttles to idle and tried to extend the speed brakes (they stayed in since hydraulic power is not available in manual reversion).

The ground was becoming more and more of a factor as I grabbed the stick with both hands and pulled as hard as I could. The nose wouldn't come up, and I couldn't quite believe it, but I'd apparently have to eject. I moved my left hand from the stick to the ejection handle. As I looked down to confirm I had the handle, the last thing I saw in my peripheral vision was my nose starting to tuck down, even with full back pressure from the one hand I still had on the stick.

As I reached for the ejection handle with my ejection decision made, a thought popped into my head — get out of manual reversion! I'd gone from a boring FCF to a real scary situation in about 5 seconds, and by now, my mind was in extremely high PRF. In the one additional second it took me to get from the ejection handle to the manual reversion switch, I had time for an amazing number of coherent and disturbing thoughts.

First, I'd made an ejection decision which probably would have let me survive, but had reversed it at the instant I grabbed the handle, which didn't seem wise. Second, the prescribed airspeed range for transition to and from manual reversion was 180 to 210 KIAS, and I was approaching 390 with no clue as to what gyrations the jet would go through when I threw the switch. Third, I'd found the manual reversion switch more quickly than ever before. When I threw the switch, I got an instantaneous negative 3 Gs due to aileron movement toward powered flight position, but

continued

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SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, OSAF

PURPOSE — *Flying Safety* (USPS 586-410) is published monthly by the USAF, Norton AFB CA 92409-7001, to promote aircraft mishap prevention. Use of funds for printing the publication has been approved by Headquarters, United States Air Force, Department of Defense, Washington, D.C. Facts, testimony, and conclusions of aircraft mishaps printed herein may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in mishap stories are fictitious. The contents of this magazine are non-directive and should not be construed as regulations, technical orders, or directives unless so stated. **SUBSCRIPTIONS** — For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Changes in subscription mailings should be sent to the above address. No back copies of the magazine can be furnished. **REPRINTS** — Air Force organizations may reprint articles from *Flying Safety* without further authorization. Non-Air Force organizations must advise the Editor of the intended use of the material prior to reprinting. Such action will ensure complete accuracy of material amended in light of most recent developments. **DISTRIBUTION** — One copy for each six aircrew members. One copy for each 12 aircrew support and maintenance personnel. Air Force units must contact their base PDO to establish or change requirements. AFSP 127-2 is entered as a publication at the Second-Class rate at San Bernardino Postal Service, 1900 W. Redlands Boulevard, Redlands, CA 92373 and additional entries. **POSTMASTER:** Send address changes to *Flying Safety*.

There I Was continued

was rewarded with immediate resumption of hydraulic power and normal pitch authority.

I pulled back on the stick till it felt right and avoided the ground by 500 to 1,000 feet. It was several minutes before I could talk well enough to declare an emergency and get a RAPCON clearance back to the field, but there were no other flight control problems, and the landing was uneventful. The maintenance line chief was not pleased with a nonrelease, but got off my back when I told him why I wasn't pleased with the jet either.

It turned out the trim motor was intermittent in manual reversion, and even extreme pilot inputs without operative trim may not be able to deflect the elevator into the airstream at high speed. I'm not convinced to this day I'd done an adequate in-flight check of the trim in manual reversion, but the trim had seemed to change slightly when I'd put in a click to test it right after I'd transitioned. It had definitely checked good during the preflight manual reversion checks.

In any case, my in-flight manual reversion trim checks improved greatly on subsequent FCFs. So did my awareness of the possibility of quickly switching out of manual reversion if problems developed, even after I'd transitioned successfully and begun to wrestle the airplane through the zoom and dive required to quickly check the low and high speed ends.

Despite the excitement in the area, the most chilling part of this whole episode happened on the way home for landing. My heart was still going a thousand miles an hour, but everything at least seemed to be under control, and I even sounded coherent on the radio. But as I looked around the cockpit, I discovered I'd forgotten to arm the ejection seat prior to takeoff. I never did that again. ■

Send Us Your "There I Was"

■ Our readers tell us you like our "There I Was" feature. You have some great stories out there just waiting to be told, so how about jotting them down. You can duplicate the sample outline (including the address on the back) found in this month's issue of *Flying Safety*. Don't tear out the page — five more readers have a great story to tell.

This is a totally anonymous program. It is not meant to encourage reporting of other peoples' shortcomings, not a grievance system, and there will be no retribution or confidentiality breaks. The inputs will receive the immediate personal attention of the Editor, and any items which may be useful to the operators and maintainers of our aircraft will be disseminated as soon as possible.

We'd like to cash in on the lessons learned from the close calls, near misses, errors of judgment, or whatever, which come from your "There I Was" story.

This is an ongoing program, so FSOs, dig out your "There I Was" outlines for local dissemination. You can write to AFISC/SEPP, Norton AFB, California 92409-7001, for additional information. ■

THERE I WAS . . .

Provide additional sheet(s) as needed to complete your story.

Fold

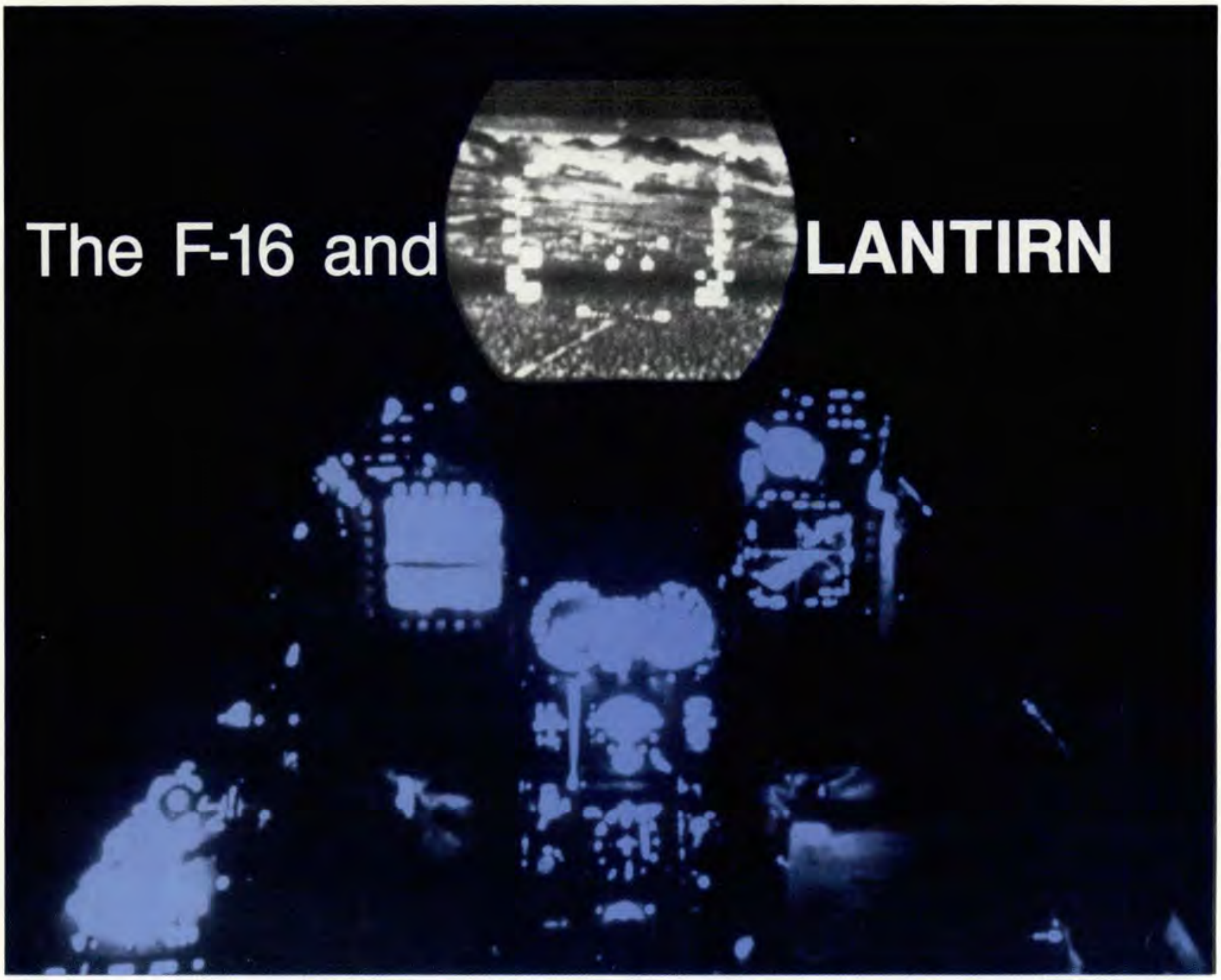
HQ AFISC/SEPP
Norton AFB, CA 92409-7001

"There I Was"
Flying Safety Magazine
HQ AFISC/SEPP
Norton AFB, CA 92409-7001

"EYES ONLY" for the Editor

Fold

The F-16 and LANTIRN



The ease with which we adapt to sophisticated aids to flying will never release us from our primary responsibility of being fully in charge of the operation of our jet.

CAPT DOUG SLOCUM
310th Tactical Fighter Training Squadron
Luke AFB, Arizona

■ My sortie was a typical low altitude navigation and targeting infrared for night (LANTIRN) day RTU training mission. I was no. 2 on a low-level mission northwest of Luke AFB, Arizona. After three legs of the low level, I experienced a system-generated fly-up for a terrain following radar (TFR) transmitter failure. As I climbed to my route abort altitude, I attempted to troubleshoot the problem without success. My TFR was done for the day.

I removed my vision restricting device and decided to finish the profile as a day VFR low level to South TAC range. I descended into a valley, checked my gas, my timing, and pressed on towards the upcoming mountain ridge. Shortly thereafter, I got the scare of my life. I was not flying this airplane. I was waiting for it to fly itself over the ridge! I was lucky I recognized it early and was able to safely clear the rocks. But what had happened?

The F-16 and LANTIRN

A psychologist would call it "negative transfer of training," but as I see it, it's simply a disaster waiting to happen. The LANTIRN business is new to the F-16 community, and it's the only single-seat weapons system in our arsenal capable of fully automatic terrain following flight. Although this equipment provides us with some formidable capabilities, it can also set us up for some potentially dangerous situations. Our cross-check is different, we're accustomed to TFR ops, and our comfort level can be abnormally high for the adverse conditions in which we fly.

First of all, flying the LANTIRN mission requires a different cross-check than normal F-16 procedures. The forward looking infrared picture provides a horizon reference F-16 pilots normally wouldn't have. As we go about our cockpit tasks,

continued

F-16 and LANTIRN continued

this peripheral cue helps us maintain situational awareness and keep our spatial orientation. It also allows us to use a daytime VFR-style cross-check because we have a flightpath marker — a "real world" relationship to manipulate — not what we would normally use on a night flight.

A LANTIRN cross-check is also more complex because we now have the E-scope (elevation versus exponential range for you engineer types) and forward looking infrared in-flight tuning and interpretation, as well as the myriad of cockpit tasks such as weapons deliveries, fix-taking, altitude calibrations, air-to-air radar search, avionics management, as well as the standard low-level maintenance checklist items. It seems the LANTIRN pilot's cockpit tasks are more numerous than our day VFR counterparts, and yet we accomplish them all at 500 feet, in the mountains, at night.

Flying This Mission

Our ability to handle this workload under these circumstances is possible with compliments to Texas Instruments and the auto terrain following feature incorporated in the LANTIRN system. These avionics allow us to divide our attention among the many tasks while monitoring the flight profile. How much work would we be able to accomplish if we had to fly our entire mission "hands on" in manual terrain following mode?

We teach, when flying manual terrain following, that you spend 99 percent of your time ensuring your flightpath marker is in, or above, the G-command container. Auto terrain following is a wonderful system, but it might be teaching us bad habits. TACR 55-116, *F-16 Pilot Operational Procedures*, Chapter 9 (TAC Sup), states when conducting night operations, "at all times aircrew will cross-check instruments to ensure ground clearance."

It seems to me we give the LANTIRN pod a check ride after takeoff (the "confidence" checks) and then clear it "supervised solo" for the remainder of the mission. The system incorporates numerous safety devices to trigger "fly-ups" if it cannot cope, if it fails, or if the pilot demands too much from it. There is a significant potential for a learned complacency (there's that buzz word) where we might relegate our responsibility to "fly the aircraft first" to a bunch of transistors and capacitors. The system works, but realize the fact we are now comfortable with high task-loading in less-than-optimum conditions.

. . . The proven adage says we'll fight like we train, and, with LANTIRN, we're training with some out-of-the-ordinary procedures.

Experience flying the LANTIRN missions also raises our comfort level. We hold and jump off on our low levels using more than 30 degrees of bank, we fly direct pops rolling 180 degrees and meeting delivery parameters, and we egress off the target jinking and maneuvering as required (as long as we're above our planned "no-TER" altitude). We fly with fewer visual cues than we would during the day, and yet we accomplish all of our mission tasks in a very demanding single-seat environment. Our day, VFR-only counterparts must think we're nuts!

What's the Point?

So what's the point? My opening

With the addition of LANTIRN cockpit tasks, we now have more to do than our VFR counterparts. And we do it at 500 feet, in the mountains, at night.

story is just one example of how LANTIRN habit patterns can influence our behavior. The proven adage says we'll fight like we train, and we're training with some out-of-the-ordinary procedures.

Take, for instance, a situation where a LANTIRN pilot is flying a standard, non-LANTIRN night profile. The artificial horizon cues are gone (no forward looking infrared), your standard night LANTIRN cross-check habit patterns are disrupted, and some of your orientation cues are gone. You are used to being able to, at least somewhat, focus your attention on any one given task, and you're used to being able to accomplish much more than you should under these circumstances. Now, throw in the proven potential for spatial disorientation/misorientation from misleading vestibular inputs and/or optical illusions. Then top it off with the fact we regress to our most comfortable habit patterns during periods of higher-than-normal stress (i.e., equipment malfunctions, poor lighting conditions, poor mission planning), and the conditions are dangerously ripe for a mishap.

Our First Priority

The LANTIRN business opens new horizons of war-fighting capability for the F-16 (just ask the Iraqis), but our first priority has been and always should be to not hit the rocks. The Air Force, your family, your friends, and your colleagues do not want to see your name on a fatal Class A. Let's do what we can to prevent it. Fly safe! ■

What Can We Do?

■ So what can we do? There are a number of things which might prove beneficial:

1. F-16 LANTIRN pilots need to recognize their susceptibility to this negative transfer of training. Past mishaps have shown even the most experienced and talented pilots are subject to human factor vulnerabilities.
2. Discipline yourself for comprehensive mission planning so you can spend more time "heads up" allowing you to have more situational awareness throughout the flight.
3. Memorize no-TER altitudes and parameters and "chair fly" your profile so you know what to expect.
4. Never accept being too low or not being on parameters. Your adherence to them might save your life.
5. Honor system-generated fly-ups until there is no doubt in your mind you can resume safe and smart terrain following ops.
6. Use all available avionics to help maintain situational awareness and spatial orientation. These could include radar altimeter, MSL floor, radar horizon, etc.
7. Remember the forward looking infrared is just a small window into the darkness — it certainly does not turn night into day.
8. Finally, *never, never, never* forget the basic instrument cross-check you learned at UPT. Practice it and use it as much as you can. Realize the need for upholding the simple performance and control relationship. ■

Avoiding Fuel Coupling Problems

By CURT ALTHAGE
F/A-18 Technical Data Engineer

LASZLO HERTELENDY
F-15 Technical Data Engineer

NEAL ODER
AV-8B Senior Technical Data Engineer

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with
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Technical Editor, Product Support DIGEST

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All fuel couplings are designed to do the same job—join fuel lines together. However, all fuel couplings are not mechanically similar. Good maintenance practices, coupled with the knowledge of coupling installation techniques, are the keys to preventing fuel leaks and loss of valuable Phantoms, Eagles, Hornets, and Harriers.

■ Fuel leakage resulting from fuel coupling problems has caused aircraft fires and losses. Actual incidents vary, but most can be considered very dangerous — affecting the safety of flight. How dangerous? Let's look at a mishap and an incident and see what the results were.

■ *Loss of an aircraft* A wingman advised his leader fuel was exiting from every opening in the aft fuselage area. Almost immediately, the pilot of the crippled fighter observed a BINGO fuel warning, which was followed by dual engine flameout. Aside from the monetary loss, there were some positive aspects — the pilot was rescued from the sea, and the leaking fuel did not find a source of ignition. However, fire, "the dread of all pilots," is not always avoided when fuel couplings fail.

■ *In-flight fire* Non-installation of a coupling on a line to the airframe mounted accessory drive boost pump on this fighter was the major contributing factor which resulted in an in-flight fire. Because the coupling was not installed on the feedline, the coupling sleeve assembly misaligned, resulting in a massive leak and fire. Heat damage to the aft fuselage and both engines was extensive.

Because of serious in-flight incidents and mishaps, it is evident there are some misunderstandings concerning installation techniques of fuel couplings. Anyone involved in maintaining a fuel system which uses fuel coupling assemblies needs to acquire a thorough knowledge of how to properly disassemble and assemble couplings.

Before we get into a discussion of how to properly remove and replace fuel couplings on your particular aircraft, it is important to gain some insight into why certain fuel couplings are so commonly used on MCAIR aircraft. As one would expect, there are several manufacturers of fuel couplings, such as Wiggins and Hydraflow. Depending on the type of coupling installed in your aircraft, you will be confronted with a variety of designs and styles. It is important to be aware of the features of these couplings, as well as why they are used. Couplings allow for:

- Angular alignment axis of 4 degrees in any direction
- Approximately ¼ inch of line expansion and contraction in axis
- Ease of installation and removal of segmented fuel lines and fittings in limited access areas, and
- Structural and line assembly tolerances (i.e., any expansion and contraction).

It is important to note installation requirements vary between the type of couplings installed in Phantoms, Eagles, Hornets, and Harriers. Self-locking couplings in the F-15 are not required to be safety wired, as opposed to the F-4 couplings which *are* required to be safety wired.

Self-locking couplings on the F-15 are not required to be torqued, whereas F-4 couplings are *not* self-locking and *must* be torqued.

Couplings are manufactured from different materials. Just because it fits correctly on a line does not mean it is the correct part number required for that particular location. For example, engine and secondary power bays in the Eagle require couplings which will withstand excessive heat in the event of a fire.

Now that we have some insight into why these couplings are utilized throughout aircraft fuel systems, let's discuss why couplings malfunction — *leak*. Often, leakage is the result of installing the wrong size or type of packing, damaged surfaces on lines, and/or an improperly installed coupling nut or locking mechanism.

This may come as a surprise, but all too frequently parts are omitted during coupling assembly. Packings, especially on vent lines, retainers on Phantoms and Eagles, and wave washers used for bonding on the Eagle can easily be left out during installation. If someone hands you a fuel line with the coupling attached, be certain the correct parts are installed and compatible with the connecting fuel line ends.

There is one important fact to keep in mind: *An improperly installed coupling (parts omitted) will not always leak during an initial checkout*. Why? Because seals tend to improve their sealing ability when internal pressure is applied within a fuel line. Therefore, always take the time to account for all the parts in an assembly and ensure they are the correct part numbers.

Now then, let's discuss an item which needs some special handling during coupling installation — *packings*.

Packings

Throughout this article we will continually mention the word *packing* (commonly referred to as an O-ring). Packings are installed between the mating surfaces of the fuel lines and components to ensure a fuel-tight connection. They are made of fuel resistant materials, such as acetaldehyde or zinc chloride, to ensure their sealing capability (performance). As a general rule of thumb, synthetic rubber packings, such as Buna N, are used on lines and components where temperatures will be less than 200 degrees F. Fluorosilicone or fluorocarbon packings are used in locations where temperatures could exceed 200 degrees F.

Maintenance procedures stipulate that during assembly, packings must be replaced prior to a coupling being reinstalled/replaced. Under no circumstances should packings be *reused* or *replaced* with ones which are the wrong size or type. Your illustrated parts breakdown (IPB) provides a complete listing of authorized part numbers, including their *suitable* substitutes. Using an incorrect part number packing will only delay making an aircraft airworthy. The slightest change in packing size will result in a fuel leak. If the leakage is from a coupling within a fuel tank, it will most likely show up as a continuous venter. Troubleshooting a leak of this type is very difficult, and it may require going through an entire fuel system component by component, replacing each packing until the culprit is found.

Lubricants are used to prevent packings from spiraling (rotating) or being cut during coupling installation. Failure to use lubricant on packings during assembly is one of the main causes of coupling assembly difficulty. If a packing binds or rolls, not only will it give resistance

Failure to use lubricant on packings during assembly is one of the main causes of coupling assembly difficulty. ►

Fuel Line Alignment

to nut rotation (F-4 and F-15), but the chance for a leak is increased. Always use the proper lubricant specified in your maintenance instructions. Fluorosilicone-type packings are particularly easy to damage.

Since we have packings down to a science, let's move on and discuss a maintenance task that is critical to proper coupling installation — *fuel line alignment*.

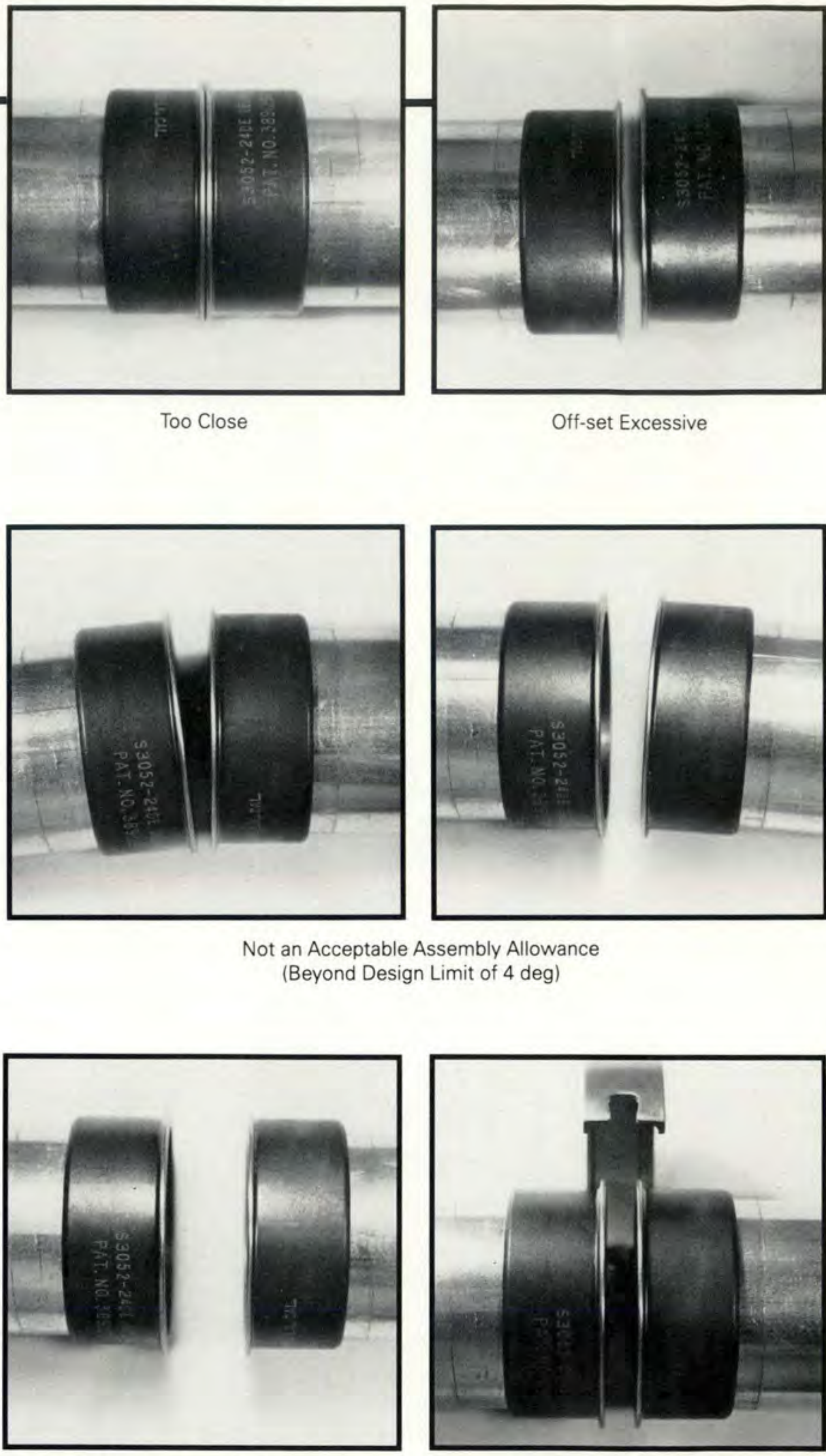
Fuel Line Alignment

There are many causes for alignment problems between lines. Usually, these result from improper clamping of two or more line assemblies. During installation, line ends should not exceed 1/16 inch offset alignment (see figure 1). More than 1/16 inch offset makes it extremely difficult to properly install the retainers or sleeves. Improper positioning of the retainers will not allow the body of the coupling to slide over the retainers.

Whenever two or more fuel lines are installed in a series with all the gaps at their minimum, there is a good chance an excessive gap at the last line segment will exist (see figure 1). To avoid this, assemble the couplings and only partially secure them until all the couplings are evenly spaced, and the last one is assembled with nominal gap. Obviously, this technique is not a change-of-shift operation, and it should be afforded a second-person inspection upon completion.

It is important for fuel lines to be properly supported with supports and/or clamps as they are installed. If not, tubing or coupling failures can result. Whenever supports and/or clamps are not installed to prevent fuel line movement, vibration and loads applied to an unsupported fuel line may cause it to fail. Also, if maintenance procedures dictate removal of several fuel lines, always identify the appropriate position (inboard, outboard, etc.) and location (top, bottom, center, etc.) within the fuel tank.

Figure 1. Tubing Alignment



Too Close

Off-set Excessive

Not an Acceptable Assembly Allowance
(Beyond Design Limit of 4 deg)

Gap Beyond Assembly Allowance

Optimum Alignment
(Shown is the Retainer Required for an F-15)

Proper maintenance practices will save time, avoid confusion, and ensure the correct installation of fuel lines. Now that you have a good understanding of fuel line alignment, let's discuss specific *fuel coupling techniques* for the Phantom and Eagle.

F-4
Coupling Installation Techniques

One of the major fuel coupling problems on the Phantom is caused by overtorquing. This can cause a depression in a fuel line, weakening it at that point as well as providing a possible leak source. Prior to installation, always take the time to inspect each line to ensure it is free of dents and depressions, especially at the packing seating surface.

When installing torqued-type couplings in the F-4, not replacing a previously used packing can prevent you from obtaining the proper torque on the coupling. There's a good chance the coupling will eventually back off. It is interesting to note this is the reason for many leakage problems — not only fuel coupling problems. Failure to properly install packings into the appropriate recesses produces pinched packings and/or cracked and warped flanges.

Always use the recommended torque value listed in your maintenance instructions whenever access to the coupling permits. When you are prevented from using a torque wrench, the following information found in your maintenance instructions. TO 1F-4 ( )-2-10, will ensure the coupling is properly torqued: Tighten the coupling hand tight plus ½ turn — except for the -24 coupling which should be tightened hand tight plus ⅓ turn.

Safety wired couplings seldom back off unless the safety wire was forgotten, the wire was pulled through a safety wire hole, or the wrong size wire was used. See figure 2 for proper installation and safety wire techniques.

Part 2 will appear in our May issue and will cover F-15 coupling installations and electrical bonding of aircraft fuel couplings. ■

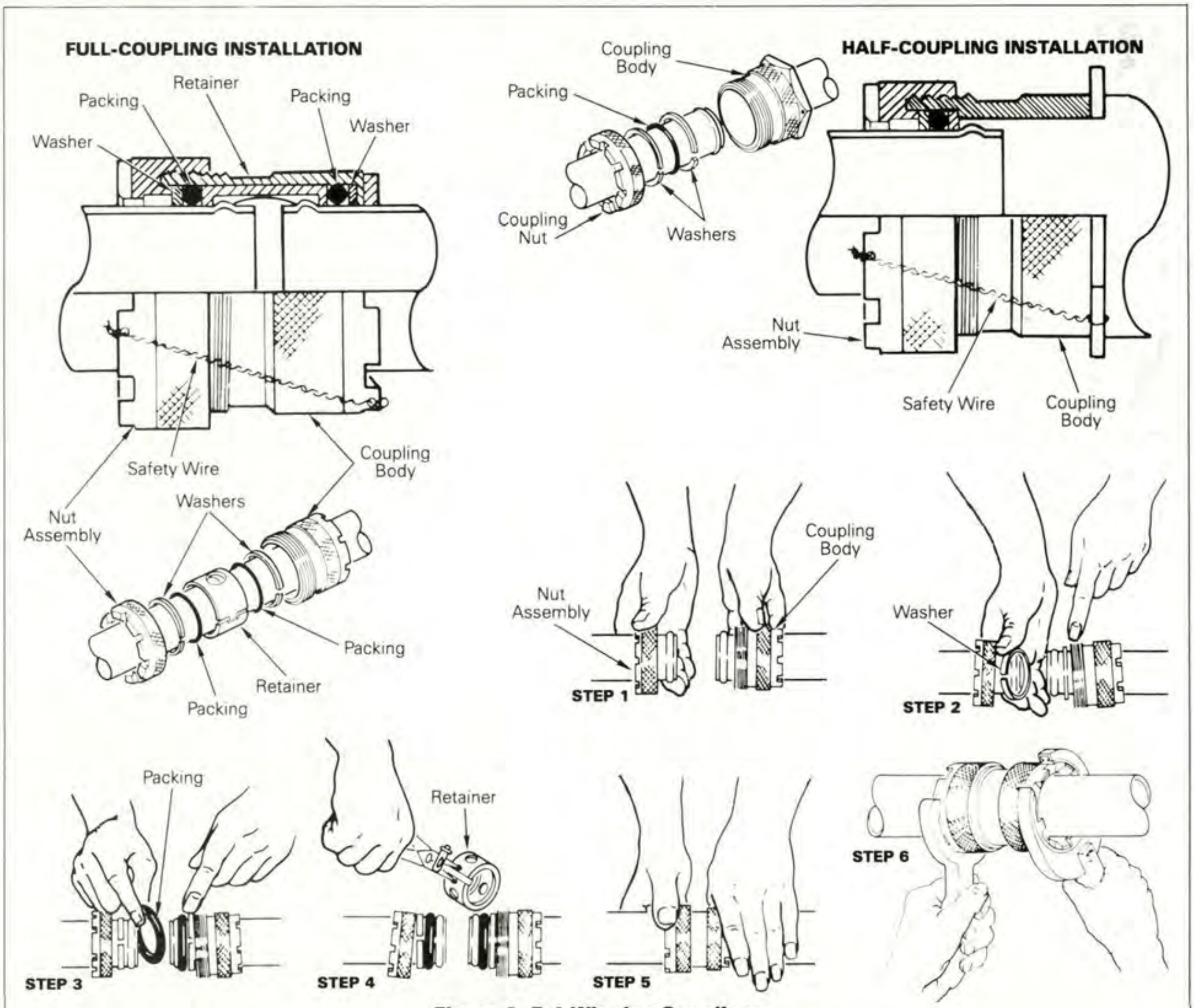


Figure 2. F-4 Wiggins Couplings

FY 90 USAF EJECTION SUMMARY

ROBERT L. CAMPBELL
Escape Systems Safety Manager
Directorate of Aerospace Safety

TSGT LARRY E. CLUCAS
Egress Technician
Wright-Patterson AFB, Ohio

■ The year ended with 51 escape system-equipped aircraft involved in Class A mishaps. The mishaps involved 81 crewmembers who had the capability to eject — 20 failed to eject, 14 ground-egressed with minor injuries, and 47 made the decision to eject. There were 24 fatalities — 20 that did not make the ejection decision, 3 out of the envelope, and 1 system failure. The ejection survival rate for FY90 was 91 percent, much improved over the FY89 rate (80 percent) and the overall Air Force rate of 82.5 percent (lifetime). Figure 1 shows the aircraft involved in Class A mishaps during FY90.

Collision with the ground (no attempt to eject) and out of the envelope are the leading causes of fatalities in escape system-equipped aircraft. During the period of 1 January 1983 to 15 March 1991, 199 crewmembers died because they did not use their escape system or they pulled the handle too late.

ACES II Upgrades

The Advanced Concept Ejection Seat (ACES II) has been operational for 15 years. With more than 200 ejection (186 USAF) attempts and no fatalities attributable to the seat design, the ACES II is a proven performer (figure 2). The ACES II is currently installed in the A-10, F-15, F-16, B-1B, and B-2 aircraft. It is the premier escape system of the Air Force. To enable this system to perform into the next century, several improvements are under way. While all of these improvements will ultimately enhance the capability of the ACES II, some are more for maintainability than others. There are some improvements which will enhance the operational capability of the ACES II.

The most significant change to the ACES II, in the near term, is the redesign of the Restraint Emergency Release System. This modification is the result of several mishaps. In several cases, crewmembers either inadvertently disconnected themselves from the seat prior to ejecting, or tried unsuccessfully to use the manual backup parachute deployment system. The redesign of the restraint release system resolves both of these problems. Time Compliance Technical Order 13A5-56-540 will lock out the system's handle while the seat is in the ejection launch rails. Additionally, the modification will provide the crewmember with an independent ballistic backup parachute deployment system for added safety.

For many years, the most significant obstacle to overcome during the design and qualification of aircrew mounted equipment has been compatibility with the fixed pitot tubes of the ACES II. These tubes were placed in their present location as a tradeoff between the clean airflow required for seat sensing and the need to provide clearance between the seat and the aircraft canopy assembly. The Air Force has designed and qualified a set of flip-up pitots for use on the ACES II. These pitots will deploy into undisturbed airflow for accurate seat sensing with all known, and projected, aircrew equipment and, at the same time, provide the crewmember with improved "check six" capability.

Production break-in of this modification for new F-16 ACES II seats is projected for early 1992. Field retrofit is possible with minimal maintenance impact if funding is made available.

The ACES II's performance is determined by the accuracy of its airspeed and altitude sensors and the ability of the recovery sequencer to process the speed and altitude inputs. The current sequencer is an analog system operating in one of three modes depending on the airspeed and altitude at the time of ejection. This system, while proven reliable in operation, has its limitations in terms of fixed performance and rising cost of ownership. The Air Force is now in the process of qualifying a new advanced recovery sequencer.

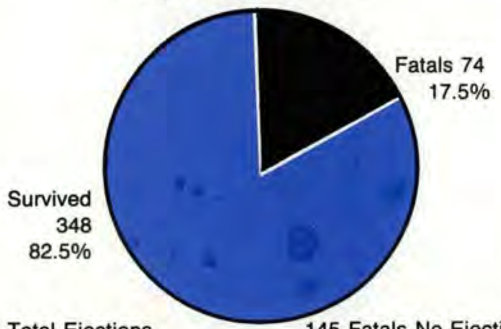
The new sequencer will provide variable recovery parachute deployment times versus the current fixed deployment timing. Improved sensors mated with a digital processor will enable the seat to adjust the parachute deployment time in response to the speed sensed at the time of ejection. Additionally, the new sequencer design will determine if a drogue parachute is required in mode II. Sled test qualification was started in April 1990 and, if successful, should be available in mid-1993.

The anticipated reduced cost of ownership, coupled with the improved performance, will enable the ACES II seat to be the Air Force ride for the 21st century. Safe flying! ■

Figure 1
Ejection Statistics
1 October 1989 - 30 September 1990

Acft Type	No. of Aircraft	Ejections Survived	Ejections Fatal	No Ejections Survived	No Ejections Fatal
F-16	15	12	1	2	4
B-1B	1	0	0	4	0
F-15	7	3	0	0	5
F/RF-4	14	15	3	4	6
A-10	3	0	0	0	3
F-111	5	6	0	2	2
OV-10	1	0	0	2	0
A-37	1	1	0	0	0
T-38	2	3	0	0	0
A-7	2	3	0	0	0

USAF Ejections
1983 through 15 Mar 91



455 Total Ejections
145 Fatals No Ejections

Figure 2
ACES II Ejection Rates
8 August 1978 - 15 March 1991

Acft	Survived No.	Survived Rate	Fatal No.	Fatal Rate
A-10	24	80%	6	20%
F-15	28	93%	2	7%
F-16	105	93%	9	7%
B-1B	11	92%	1	8%
	168	90%	18	10%

Total Ejections 186

Once Again, Thanks For Your Support!

AND THE WINNER FOR THE NOVEMBER 1990 DUMB CAPTION CONTEST IS . . .

Jim Burt
Academic Training
NAS Corpus Christi, Texas

The following letter was received by the staff of *Flying Safety* (it was slipped under the door after hours).

Following the recent, unfortunate head injury of my father, Byron Q. Lackluster, President for Life of the United Organization of Dumb Caption Writers of America, it has fallen on me to register the following compliant (sic).

The winner of this month's Dumb Caption Contest, Jim Burt, is clearly a professional. The Feburary (sic) *issue of your magazine shows him a winner and holder of three honorable mentions. Our membership roster has no record of any Jim Burt. Professionalism such as his requires membership in the only recognized society for dumb caption writers, namely the UODCWA.*

In the future, please accept professional entries from UODCWA members only.

signed, Byron Q. Lackluster, Jr.

Dear Junior,

Get a life! The only true pro's at dumb captions are our readers. If you don't believe us, check out the 10 Honorable Mentions.

P.S. Tell Daddy he doesn't have a chance. — Ed.

Honorable Mentions

1. **Let me see that map — this doesn't look like Hawaii to me.**
Col Stu Bradley, 12 FTW/MA, Randolph AFB, Texas

2. **(Left) There's nothing in here about polar bears in the cockpit. What do we do now, Colonel? (Right) I'll keep an eye open out here for any more — you go chase that one out, Major.**
MSgt G.W. Moore, HQ SAC/INCI, Offutt AFB, Nebraska

3. **Yes, it does say to close the door before takeoff: But *after* boarding — *after* boarding.**
Jim Burt, Academic Training, NAS Corpus Christi, Texas

4. **I'll drive. You California people can't drive in snow!!**
SSgt Keith Madison, 6510 TW, Edwards AFB, California

5. **Look at these guys!!! I bet they feel dumb being in the dumb caption picture. I know I would.**
Amn David Moreno-Gamino, 67 TRW, Bergstrom AFB, Texas

6. **No, sir! I don't mind you taking my flight to Hawaii while I stay here and shovel your driveway.**
TSgt David Keith, 2066 CS/XPT, Myrtle Beach AFB, South Carolina

7. **Now look here — it says "If the temperature falls below 40 degrees, the water requires heating prior to flight." Well, *I'm* not flying this plane until the toilet gets thawed out!!**
SSgt Terry L. Smith, ATC Instructor, COMM/NAV Systems, FTD 507, March AFB, California

8. **You could have finished reading it last night. You could have finished reading it this morning. You could have finished reading it on the plane. But you didn't, and it's *my* book, and I'm going home.**
Jim Burt, Academic Training, NAS Corpus Christi, Texas

9. **Here are your flight orders, Lt Flaperon. The weather is 100 & ¼ with freezing rain and a squall line enroute. I, ah . . . won't be with you on this one, Flaperon, but I'm sure you'll do just fine.**
Jim Burt, Academic Training, NAS Corpus Christi, Texas

10. **Nervous? — What's to be nervous? — You take this unverified checklist, crank up this never-before-flown gastank with wings, and zip around this uncharted obstacle course — Hey, that's why you 2nd looies get the big bucks!**
Matthew A. Sprague, Joint Technology Applications Office, Wright-Patterson AFB, Ohio

WRITE A DUMB CAPTION CONTEST THING

Never let it be said the staff of *Flying Safety* magazine harbors ill will toward the United Organization of Dumb Caption Writers of America (UODCWA). For years, we have taken the best efforts of Byron Q. Lackluster, President and Writer Emeritus of the UODCWA, and his membership and given them the first shot at achieving dumb caption stardom. He has consistently, in a word, FAILED. In addition to Byron's caption printed above, we have agreed, this month only, to challenge our readers to top two other UODCWA captions as well.

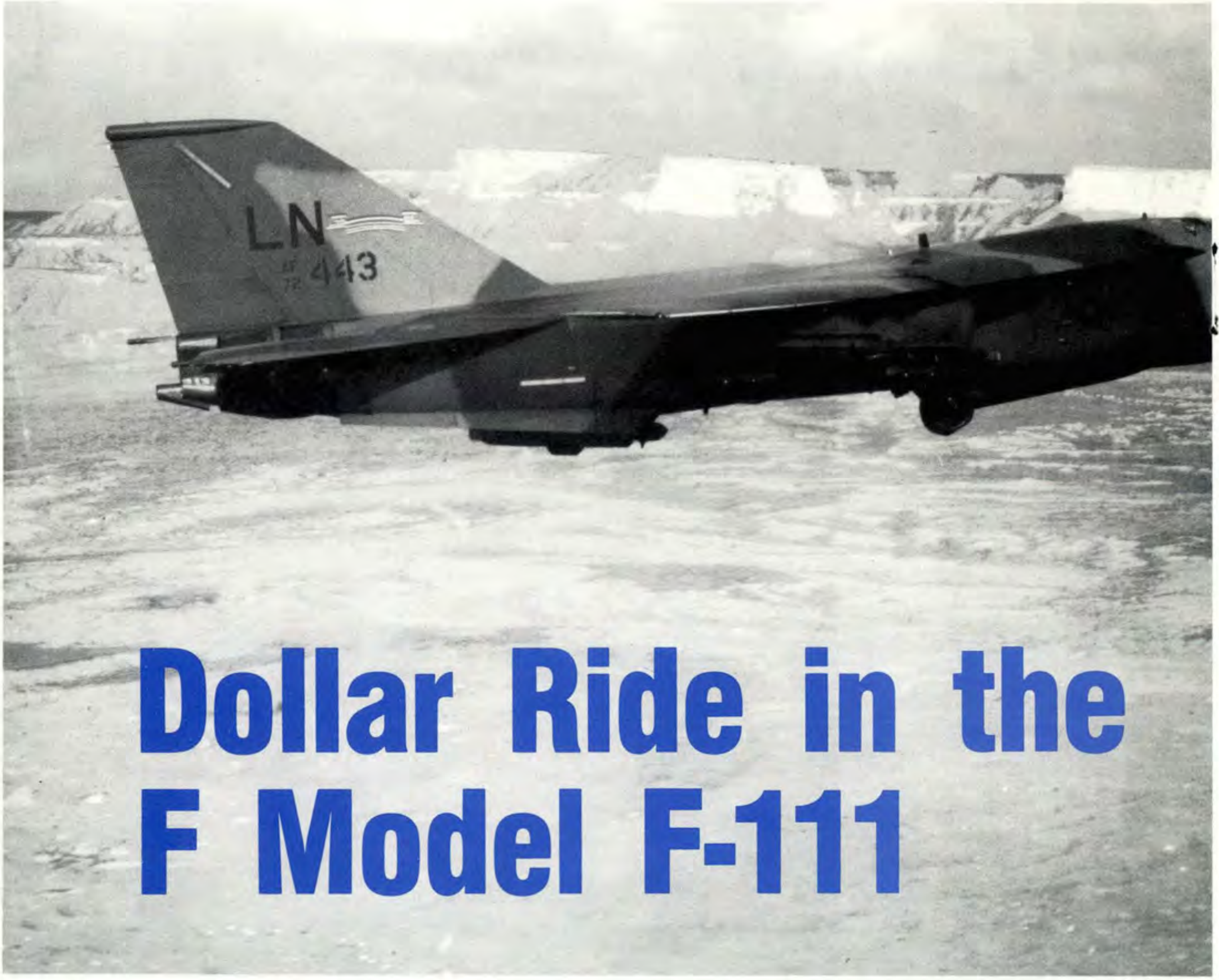
From "Al" Takriti comes this gem: (caption under cameraman) "Where's Peter when you need him?"

And from Gascon P. Martine't: (caption over man with clapboard) "I wonder if he knows the battery's unplugged?"

The challenge to our readers is set: Top not one, but three attempts by the UODCWA to win this month's contest. You may send 1 or 20 entries, but send them in now.

Write your captions on a slip of paper and tape it to a photocopy of this page. Or you could use a "Post-It"® note. Or you could attach a page full of captions to a photocopy. Or you could "white out" the current caption on a photocopy and write yours in with crayon. BUT DON'T SEND US THE PAGE. Entries will be judged by a humorous panel of experts in August 1991. Bribes in excess of $100,000 are welcome, but we have been informed they will no longer be tax deductible. If we could just convince the IRS the UODCWA is a charity in need of help . . .

Send your entries to **"Dumb Caption Contest Thing"** • *Flying Safety* magazine • HQ AFISC/SEPP • Norton AFB, CA 92409-7001



Dollar Ride in the F Model F-111

MAJOR WILLIAM P. MURRAY IV
16 AF/CCE

■ I was elated about my first mission in the "F" model of the F-111. Even though I was an instructor in the F-111 "D," for years I envied the men of RAF Lakenheath who had sole bragging rights to the "fastest F-111 in the inventory." Rumor was it would fly supersonic with MIL power and not even have the throttles up against the stops!

And now I was in England, academics complete, life support training complete, simulators out of the way, two SUUs of bombs under wing, beautiful weather, on our way to an overwater range named Rosehearty. What could be nicer? "It doesn't get any better than this," I thought.

Mr Thompson's familiar Scottish voice (civilian range officer for years) breaks the silence with, "Roger, Vark 22, you're cleared hot!"

My IP, naturally trying to impress the heck out of me, set the TFs to 250 feet AGL, pushed the throttles forward a bit, and laid the ears of the Aardvark back for our 540-knot overwater approach to the range. Being a seasoned veteran of 600 hours in the F-111 "D," I knew there were more important things to occupy my attention than the attack radar on final. Absolutely certain the IP was on heading, altitude, and airspeed, situationally aware and steady, I poked my head down, hoping for a nice, bright blip — sure to be the targeted metal raft.

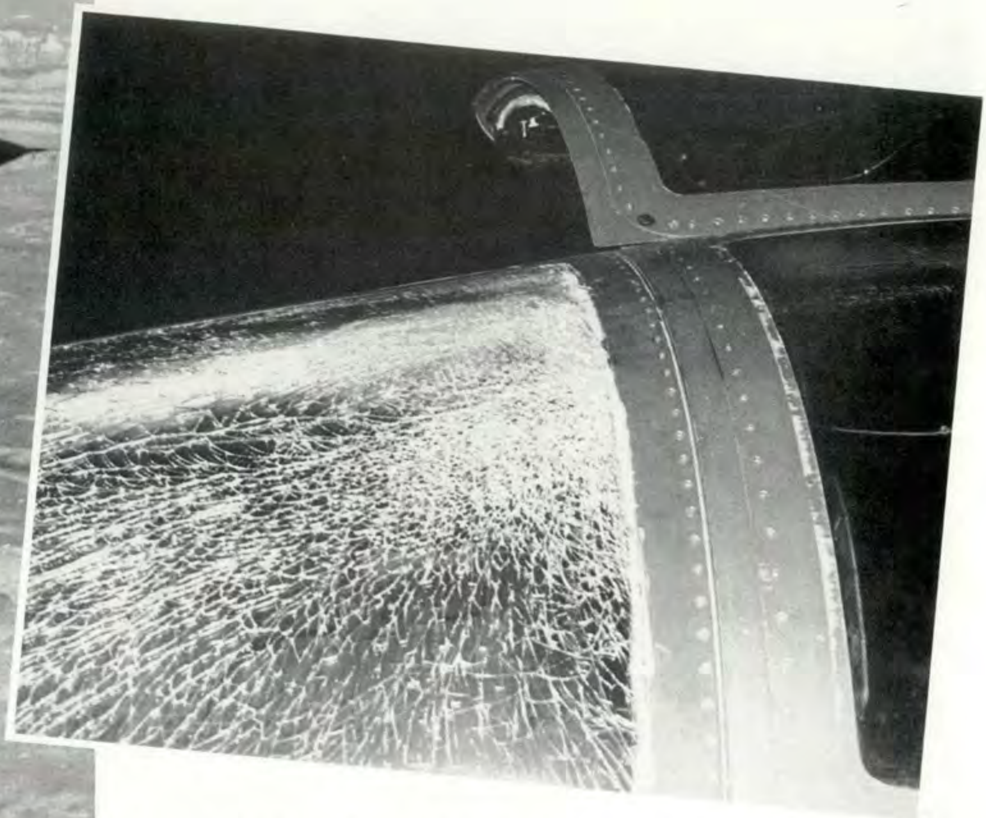
"There it is," I thought confidently. "I already like this system."

"Pilot, come ever so slightly left to . . ."

SMASH!!!!

With a heart-stopping, deafening noise, something hit us. I don't know where it came from. Where could it have come from? Everything in the world goes through our minds in milliseconds in these situations. We hit the water — no — we're still flying. I glanced up. Blood and guts all over the windscreen. Windscreen smashed — cracked so badly you could hardly see out. I can't believe it! We hit a seagull! I instinctively said, "Climb. Slow down. And get the wings forward."

And that's the point of the article.



When a bird strikes an F-111 windscreen at 540 knots, the effects can be dramatic. Despite the sound of an apparent explosion, the windscreen held together, but it was cracked so badly you could hardly see out.

Good training. Good habit patterns. Good instruction. When it counted, it came by instinct. When I was so totally disoriented from noise, excitement, and confusion, I said the three most important things you could say when you have an emergency in an F-111 during low-level flight. "Climb. Slow down. Get the wings forward." It didn't happen by accident, and it didn't happen because the checklist said do it. It happened because we had built good habit patterns many years before, reinforced during training scenarios.

We eased away from the water, wings level, maximum 5 degrees nose high. I could tell the IP was shaken up because he started to say something, stopped, and then was quiet. Everything was very tense as we began to sort things out.

We were happy just to be alive.

Obviously, had we not had the newly installed bird-proof windscreens, we'd both be at the pearly gates. The cracks seemed horrendous to me. Later, a chief would tell us in all the years he'd been around F-111s, he'd never seen such a badly cracked windscreen that did not collapse.

At FL 110, we began to talk for the first time. No control problems. We might really land. Could it be true? We dropped down to FL 90, released the pressure in the cockpit, declared an emergency, and began our preparations for landing at a nearby RAF base. Because the visibility was so bad out the front of the windscreen, I had to help talk the IP's eyes to the runway. Other than visibility, the approach and landing were uneventful. We were happy for engine shutdown. We were happy to be alive. We were happy to play golf at Saint Andrews. Ha!

And as I think back on our emergency which happened some years ago now, it wasn't a bad dollar ride for my first flight in the "F" model. It will make a good story for the grandkids, anyway. And I'm also glad my instructors had instilled good habit patterns in me during those boring simulators. Solid habit patterns don't just happen by accident. They're a byproduct of experienced teachers working with eager students to do the mission — and do it right. ■

ESD

ELECTRO-STATIC DISCHARGE

TSGT MIKE DZIURGALSKI
443 MAW/MAQI
Altus AFB, Oklahoma

. . . or how to upset a sibling in one easy lesson

■ Working under the "COMO" system in England, I hadn't opened an electronic component for years, much less try to repair one. Need I say I was more than a little rusty when I arrived at Altus AFB, Oklahoma, to work "heavies" again? After the usual settling down from an overseas move, it was time to set to and relearn the systems I left so many years ago.

During training, one of the acronyms that kept popping up was ESD. Now, I was sure I knew about this one. I thought it was something to do with electrical discharge from an atomic bomb that wreaked havoc with electronic components like computers and communication equipment. So when someone said the failure of card A-2 in the oscillating clickinsmoker computer was possibly due to ESD, I was, to say the least, concerned. I mean — how did I manage to get orders to a base with nukes going off around it! Of course, I was wrong in my evaluation of an Altoosian Holocaust, and after a time of working with this unseen monster, I started to understand it more.

ESD is an acronym for electrostatic discharge — just plain old static electricity.

Remember when you were a kid? A large portion of your life was probably devoted to making your sister's or brother's very existence a living purgatory. One of your favorite tricks might have been dragging your feet across the carpet, then (loaded for bear) touching an arm or nose. The blue bolt of electricity you saw just before the blood-curdling scream was, in fact, an electrostatic discharge, or ESD. Let's look at how this natural phenomena occurs.

The American Heritage Dictionary describes static electricity as "an accumulation of electric charge on an insulated body or an electric discharge resulting from the self-same charge." (Whew!) In other words, when you shuffled your feet on the carpet, you built up a charge of electricity on your body. Now, your sibling, laying there, talking on the phone, has less of a charge than you, so when your charged finger came close to those uncharged teeth — ZAP!! Instant gratification!

Now, apply the same ZAP to an ESD-sensitive device such as a semiconductor, an IC chip, or to the pins of a connector on any computer with ESD-sensitive components in them, and you get a damaged or destroyed device!

Don't expect a lightning bolt and a little miniature mushroom cloud where your computer used to be. In fact, you probably won't see it or even feel it because these components are so sensitive they can be

The grounding strap on this technician's hand will not only keep a big blue spark from leaping off the finger; it will also prevent unseen or unsensed voltage from damaging sensitive components.

destroyed by only a few hundred volts. You can't see or feel anything below around 4,000 volts, so you won't even know it happened.

Would you believe just walking across a carpet can, in low humidity, produce 35,000 teeth-jarring volts? You say there's no carpet in your shop? How about walking over a vinyl floor? Give that technician 12,000 volts! Even picking up a plastic bag can produce 20,000 volts!

Producing static electricity is inevitable. Destroying electronic components is not!

How do we stop ESD? By following ESD procedures in TO 00-25-234. Oh, no! I hear you say. He's quoting TOs at us! Well, yes, but only this one because although it's not a best-selling spy novel, it does have a lot of information which can save your bacon!

Here's another tasty bit of information for you to mull over. Not only can you destroy some ESD-sensitive items, but you can also weaken them to the point they will fail on the first hard landing or slight power surge. They can bench and ops check like new and still be a loaded gun. It doesn't take a Ph.D. to figure out some of the problems this could cause. Imagine you're on a low-visibility, adverse-weather landing with a pucker factor of around 6.5; add to that an uncommanded flight control input; and in one fell swoop, your fun meter is pegged!

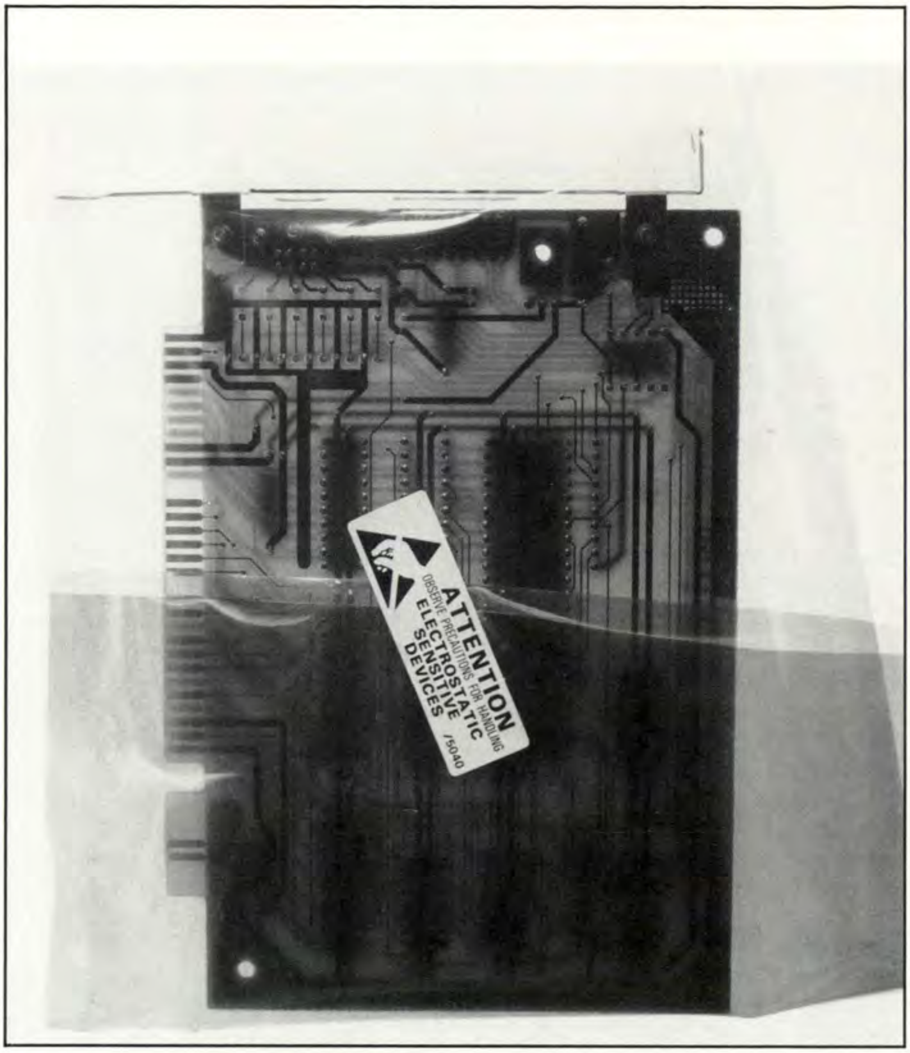
Some people have asked me: Why does a component, manufactured before I was born, suddenly become ESD sensitive overnight? It has nothing to do with fairies waving their magic wands over certain cards. You see, at depot level, some of the components used to repair cards are of the new ESD-sensitive type. So, if you see an ESD sticker on a card or component or recognize parts as ESD sensitive, you treat them as such. If you are not sure, you have nothing to lose (except a minute or two) complying with ESD procedures . . . and possibly a lot to gain. Remember Murphy's twelfth law: A shortcut is the farthest line between two points!

I hope I haven't confused you. With a few precautions, the payoff will be higher reliability, less down time and, of course, a kinder, gentler, and happier QA. Be sure to read through your 00-25-234, but don't forget the hot coffee first (you might need it!).

Well, that's about it except to say a big thanks to everyone who helped me write this article. Also, bless you to the GENIUS who invented this spelling computer I've used and abused. It is now, I might add, a quivering mound of molten plastic and roasted resisters from overuse. I might have been able to do it alone, but it's for sure you couldn't have READ IT! continued

ESD

continued



It's hard to miss the warnings about Electrostatic Sensitive Devices on a new printed circuit board. First, the instructions (which you *always* read first, right?) warn about ESD. Next, the strange, metallic plastic bag should get your attention. And finally, the warning label sealing the package reminds you to be ESD smart. ■

Some points to remember are:

■ Be sure any time an ESD-sensitive item is handled outside of its special packing it's in a protected area. A protected area consists of a grounded workbench and a personal wrist strap (grounded through the same junction point as the table or mat) that has a sufficient value of resistance to limit current flow to 5 milliamperes. That is so if your fingers do the walking through the wrong thing (high-current voltage), you don't end up looking like something that should be in a Colonel Sander's bucket! Have any tools or equipment you're using connected to a common ground.

■ Keep the bench clear of all static-producing materials. Things such as plastic bags, styrofoam cups, candy wrappers, plastic bathtub duckies, etc., etc., don't belong in an ESD area.

■ Keep protective caps on connectors of LRUs with ESD-sensitive components in them. This keeps someone from touching the pins on a connector and turning this $80,000 computer into just so much scrap metal. By the same token, if you see an electronic component laying around without caps on, don't touch it unless it's absolutely necessary, and then be careful not to touch the connectors.

HOW CLOSE IS TOO CLOSE?

CMSGT ROBERT T. HOLRITZ
Technical Editor

■ Aircraft were stacked up at EOR as they usually were on surge days. To save time, when the engine specialist arrived to check on an oil fluctuation problem on one of the fighters, the EOR team continued checking the jet. Just as the specialist told the pilot to bring the problem engine up to 85 percent, the crew chief came out from under the aircraft, and a headset went down the no. 1 intake.

When questioned by the safety folks, the crew chief stated he checked the aircraft exactly as he was trained and came out from under the aircraft the same place he had for the past several months. He could not understand why his headset was pulled from his head.

But this occasion was different. His headset was ingested this time because the no. 1 engine was cranked up to 85 percent instead of idle. The crew chief was under the potentially deadly misconception the safe distance from an engine intake is the same under all conditions. The fact is, there are many factors which have a bearing on the safe distance from an operating aircraft engine.

Power Setting

As this crew chief discovered, the engine power setting has a significant effect on the size of the danger area. It doesn't take a propulsion engineer to figure out the higher the power setting the greater the danger area.

But many flight line folks are misled by the danger area diagrams found in the Dash -1 or Dash -2 technical manuals. The problem with these diagrams is they usually depict the danger area only at one power setting, whether it be idle, mil, or AB, leaving it up to the ground personnel (and flightcrews) to estimate the hazard area at other settings. continued

How Close Is Too Close? continued

Unfortunately, it is extremely difficult to estimate the safe distance from an intake during different power settings because the pulling power of a jet engine does not increase gradually as the distance from the intake decreases. Instead, the suction force increases rapidly in an insidious curve, depicted in the figure. This can lead a maintainer to a false sense of security. As the chart indicates, a person may not even feel a hint of suction yet be only inches away from being snatched into the intake by the full force.

Area of Influence

The area of influence is also a major factor on the safety zone. For example, the pulling force increases dramatically as the area of a body opposing the suction increases. To put it in wrenchbender's terms, merely turning 90 degrees from profile and facing the inlet can double the pulling force, and standing from a crouch can triple the force!

An engine specialist learned this the hard way. During an engine run, he came from under the F-4 just in front of the inside right leading edge flap. As he stood up, he was immediately ingested up to his waist, his eardrums bursting and eyeballs tugging in the sockets. Fortunately, his presence in the intake caused a compressor stall which alerted the operator who shut the engine down. The specialist escaped with only minor injuries.

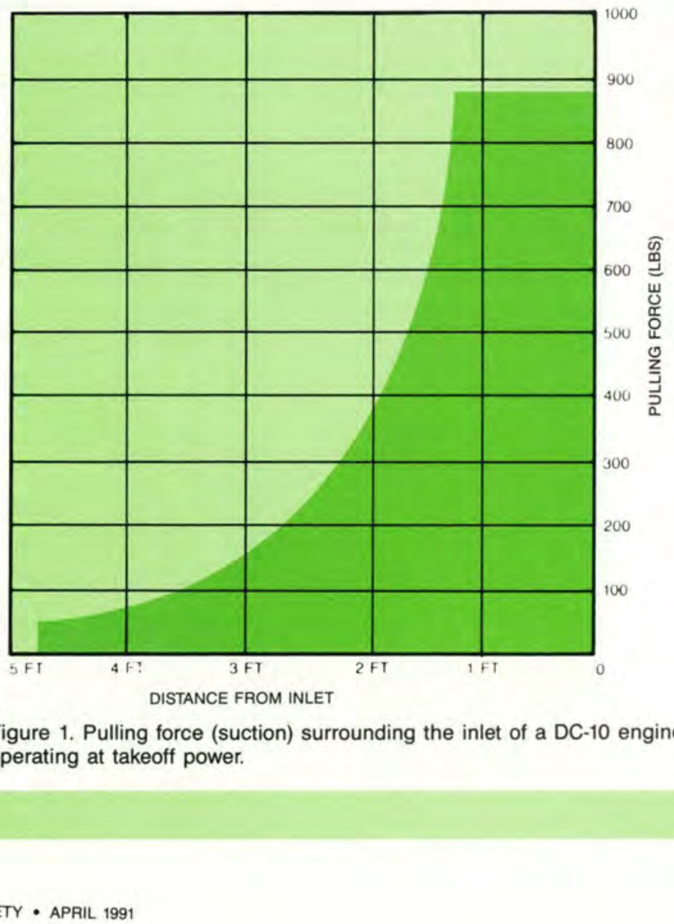


Figure 1. Pulling force (suction) surrounding the inlet of a DC-10 engine operating at takeoff power.

Ballooning Effect

Clothing can also be an important consideration. Garments such as parkas and rain gear tend to balloon or inflate from the low pressure caused by the flow of air in front of, and around, the intake. This, in effect, increases the person's area of influence, multiplying the pulling force of the engine's suction. This effect on the hood of a field jacket can easily pull a person into the inlet. Clothing has been a major factor in many of the ingestion mishaps which have occurred over the years.

Prevention

In spite of the complexity of evaluating the danger, there are a few simple commonsense ways to minimize the hazard. For example, engine screens or personnel guards virtually eliminate the possibility of an individual being ingested. While they cannot always be installed, using them whenever possible can greatly reduce the hazard.

If possible, avoid wearing bulky clothing, especially parkas and jackets with hoods, when working around jet engines. Most of all, stay clear of the danger areas published on the aircraft technical publications and maintain situational awareness. Since 1975, there have been three fatalities and two serious injuries due to personnel being ingested into jet engines. At a conservative rate of one every 5 years, a mishap is overdue. Don't become a statistic. ■

IFC APPROACH

The Head-up Display in Instrument Conditions: Friend or Foe?

MAJOR FOSTER BITTON
USAF Instrument Flight Center
Randolph AFB, Texas

■ I can almost hear the groans from the F-16 community now: "The Air Force Instrument Flight Center (IFC) is going to tell us to use our itty-bitty, between-our-knees attitude indicator to fly instruments because our bigger-than-life, bread-and-butter, flight director-equipped HUD isn't certified for use in instrument conditions."

The guys from the other fighter communities have a similar complaint. The instrument suites in their aircraft aren't as small or buried as deep in the cockpit as the F-16's, but many of them still find flying instruments with HUDs a lot easier than using their conventional head-down displays.

So why shouldn't you use your HUDs in instrument conditions? The truth of the matter is, AFM 51-37, *Instrument Flying,* says you can use the HUD as part of an effective instrument cross-check after ensuring it is working properly, but it can't be used as a sole-source instrument reference. "Why not?" you ask. "After all, it's better than the head-down instruments which I can use as stand-alone references."

The short answer is the flightpath marker (velocity vector, total velocity vector, etc.) moves around too much, the climb/dive ladder (flightpath scale, pitch ladder, etc.) is a symmetric booby trap, the airspeed and altitude scales don't show rate

continued

or trend in an acceptable manner, and the navigation information is incomplete.

If you want the long answer and some probable fixes which could be showing up in HUDs in the not-too-distant future, read on.

How Did We Get Here?

In 1987, IFC was tasked to find the symbols and mechanizations which could make the HUD a stand-alone instrument reference. After months of studying research material, viewing many domestic and foreign HUDs in dynamic conditions, and compiling a data base of possible candidates, we were finally ready to build the "best" HUD formats using materials we had found in current HUDs.

We weeded out the less-than-optimum HUD elements in three separate studies using simulators, and then reported our findings to representatives from each of the MAJCOMs. The MAJCOM representatives determined which symbols and mechanizations would be part of an Air Force standard HUD instrument format (pending flight testing which is scheduled to begin in the near future). The new format should be available before the next freeze hits San Antonio, Texas.

Here are some of the elements which will probably be included in the Air Force standard HUD format; but the real intent of this article is to point out why you should *not* rely on your current HUD as a stand-alone attitude reference.

Since each airplane has its own special terms for the various symbols in the HUD, let's start out by defining a few common terms. For now, we will use "flightpath marker" in place of "velocity vector," "total velocity vector," or "flightpath vector"; "climb/dive ladder" in place of "pits scale," "pitch ladder," or "flightpath ladder"; and "aircraft symbol" in place of "gun cross" or "waterline." (See figure 1.)

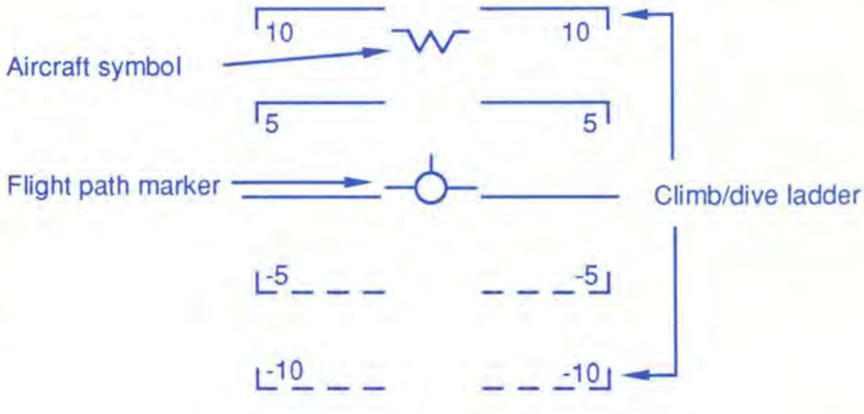


Figure 1

The HUD has enjoyed increasing popularity during instrument maneuvers for three basic reasons.

1. The flightpath marker shows where the aircraft is really going, relieving the pilot of the burden of determining an approximate climb or dive angle using pitch, vertical velocity, and head or tailwinds.

2. The scaling of the climb/dive ladder and heading scale are much larger than their head-down counterparts, making small, more precise changes much easier to see.

3. Looking constantly outside reduces head movement and enables the pilot to acquire traffic and the runway environment quicker.

In other words, using the HUD has made some aspects of flying instruments easier.

History has shown us pilots enjoy taking the path of least resistance almost as much as mortals do, so it comes as no great surprise pilots would latch onto the HUD like an orphaned piglet on a surrogate milk bottle.

The Flightpath Marker

In terms of convenience, the flightpath marker ranks right up there with sliced bread, remote control TV, and indoor plumbing. It essentially shows pitch compensated for angle of attack, yaw, and drift. For it to show the aircraft's projected flightpath, it is free to move all over the HUD's field of view. And when it has to go outside of the field of view, it grows an arrow on one of its wings to point to where it should be or it is overwritten with an X to indicate it is invalid (depending on which HUD you have).

During instrument approaches, the flightpath marker becomes the pilot's best friend because once the aircraft is on the proper glidepath and the marker is put and kept on the published glideslope angle, then the marker will be sitting on the approach end of the runway when the aircraft breaks out of the weather (as long as the pilot maintains the proper course).

Nothing could be easier. Well, almost nothing. One of the big complaints about the flightpath marker is it moves around too much. It goes to the bottom of the display during hard turns, it always seems to lag behind the control inputs, and it seldom settles down, especially on final approaches with crosswinds. Flying a precision approach with the HUD in rough air can be comparable to tying a fishhook on monofilament line in a pitching rowboat.

Part of the problem is the marker is a performance element which we treat as a control element. When we pull on the stick, the aircraft symbol moves with the nose of the aircraft, but the marker seems to be a couple of nanoseconds behind.

There's a technical explanation for the delay in movement, but for those of us who don't wish to give Stan/Eval more ammunition than they already have, let's just say changes in angle of attack make the marker act like a rock suspended from the top of the HUD with a rubberband. The harder you pull, the longer the rubberband stretches, and the quicker you push over, the greater the rock will overshoot its intended mark.

There *are* cures for the flightpath marker's excessive movement. To cure the rubberbanding movement, we can mathematically dampen it in the HUD's processor. The dampening stiffens it to the point where it no longer bobs around in search of the proper angle of attack.

The sideways motion caused by crosswinds can be corrected by centering the drift cutout time. This may sound like a radical idea, but it's not as bizarre as it initially appears. The centered marker is called a climb/dive marker since it shows only climb and dive.

The old flightpath marker is still present, but the climb/dive ladder, flight director, airspeed, altitude, and heading are displayed in relation to the climb/dive marker — making it the primary control element — and the flightpath marker is given the role of showing where the aircraft is going to touch down.

The climb/dive marker is a different symbol than the flightpath marker to avoid confusion between the two. The overall effect of locking all but the flightpath marker to the centerline is a more solid display with less extraneous movement. It doesn't tie the fishhook on the line for you, but it puts you on solid ground to do it.

The Climb/Dive Ladder

The climb/dive ladder, like a conventional attitude indicator, has three main functions. It shows the aircraft's climb/dive and bank angle; it alerts the pilot to an unusual attitude; and it helps the pilot to determine the quickest way to recover from an unusual attitude. Other than this commonality of functions, the ladder and ADI are totally different animals. Here are a few of their differences.

Climb/Dive Ladder	ADI
• Monochromatic	• Multicolored
• Shows actual climb/dive angle	• Shows pitch angle
• Displays small climb/dive scale	• Shows large portion of the climb/dive scale
• Moves all around	• Stays in one place

Current ladders do a reasonable job of showing climb/dive and bank, but they fall short on alerting pilots of an unexpected and unusual attitude.

The reason? HUDs are monochromatic, so they depend on geometric designs to differentiate between climbs and dives. In all current HUDs, the only difference between climbs and dives is climb lines are solid, while dive lines are dashed. That's easy enough to see when you are staring at the HUD, but in a quick glance at the HUD during a rejoin or tactical intercept, the "real" attitude in figure 2 might be mistaken as the "expected" attitude in figure 3. continued

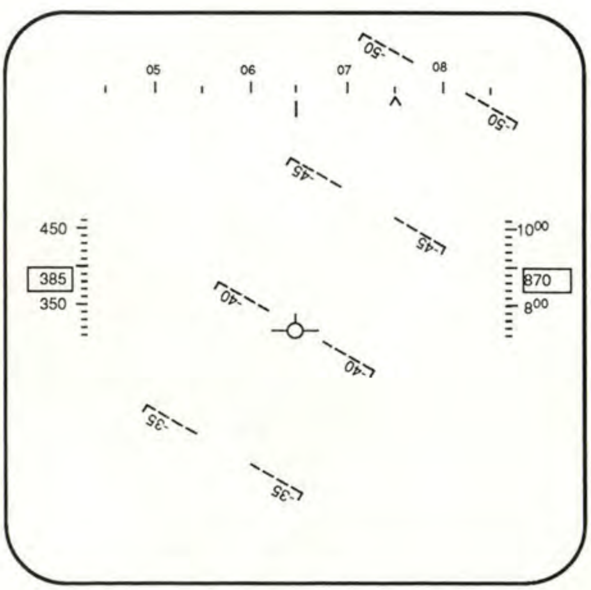


Figure 2

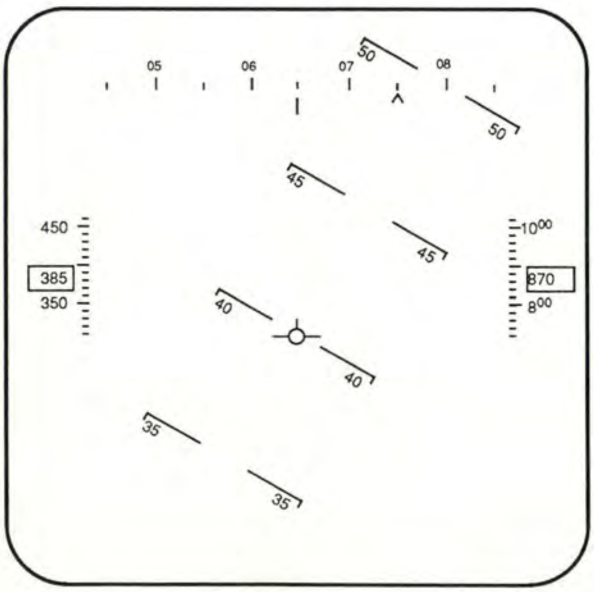


Figure 3

The HUD and You

The new symbols and mechanizations still have to be flight tested, so you won't see them in your airplane next week or even next month. New systems which are designed on the concept of using a HUD as the primary attitude reference will employ the Air Force standard, but retrofit to current systems will be based on need and available resources.

Some of you who are comfortable with your current HUDs are probably asking if the proposed changes are really needed and wondering how they will affect your tactical mission. Responsibility for tactical displays remains wholly with the operational users and weapons system managers. The IFC's charter is to join these folks to ensure you have the tools available to rapidly determine your attitude and position at all times because no mission can be safely or effectively executed if attitude awareness is lost. Simply put, attitude awareness is a full-time requirement. You can't live without it.

The instrument mission is a full-time mission which requires as much attention from the pilots as it does from the systems' designers. Current HUDs are not perfect instrument references, so we need to deal with them as the imperfect tools they are.

- *Don't* use the HUD as a quick-glance attitude reference.
- *Don't* use it to recover from unusual attitudes or stalls.
- *Do* use it for precise heading and climb/dive changes.
- *Do* use it as part of a complete instrument cross-check.

Is the HUD a friend or foe? It depends on you. ■

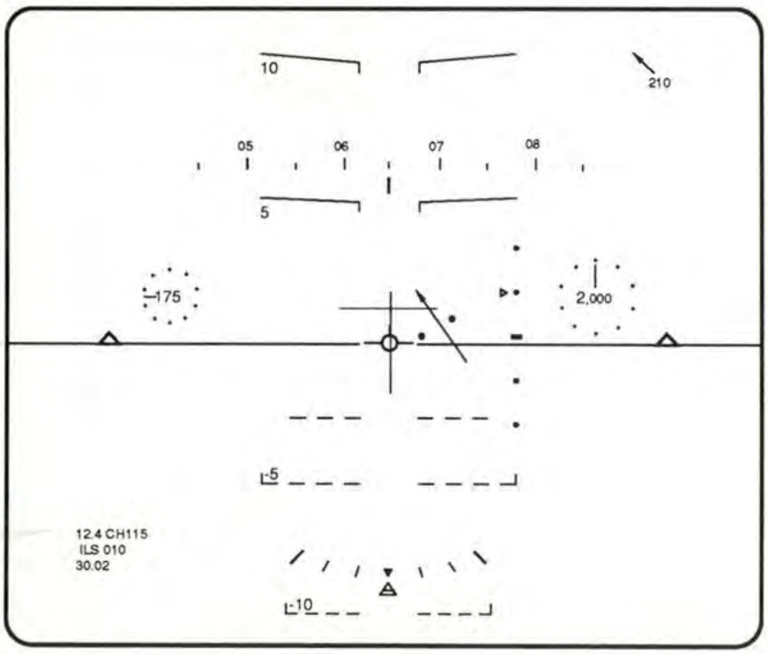


Figure 4.

Figure 4 is an example of a climb/dive ladder with some of the cues we hope will make recognition of an unusual attitude easier.

A HUD FOR IFR?

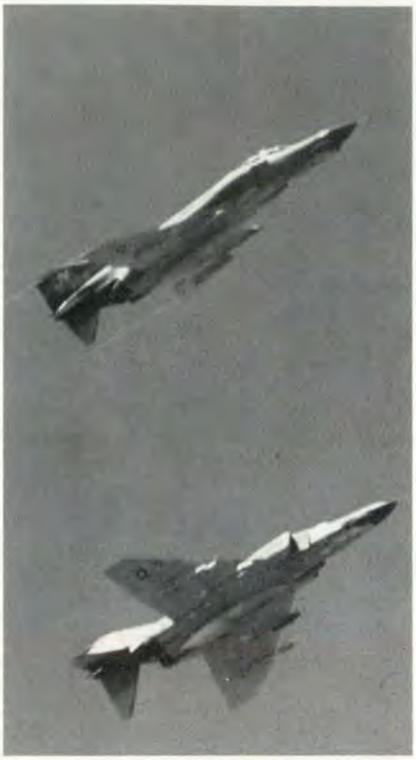
■ What's the solution? More cues! Symmetry looks nice on the engineer's drafting table, but it loses its appeal when the pilot needs to know the airplane's attitude and know it right now! The IFC is studying various climb/dive ladders which include the following elements:

1. Numbers on only the left side of the ladder when upright will be on the right side when inverted. (This only works with full-time drift cutout.)
2. Bent lines on one side of the horizon line; straight lines on the other.
3. Tabs on the outside of the straight lines and the inside of the bent lines.
4. A dashed or "ghost" horizon line which appears at the edge of the field of view when the real horizon line is out of the field of view.
5. "Sky pointer" triangles on the real and "ghost" horizon lines.

The inescapable truth is the HUD's climb/dive ladder is never going to replace the ADI. ADIs, by their global nature, are better for unusual attitude recognition and recovery. The best we can hope to do in the HUD is design a climb/dive ladder which will make it obvious when something is wrong so you can go to the ADI for the recovery. ■

MAIL CALL

Address your comments to Editor, Flying Safety Magazine • AFISC/SEPP • Norton AFB, CA 92409-7001



About That F-4 Mishap . . .

■ In the November 1990 issue of *Flying Safety* (page 7), you described an F-4 mishap involving an air-to-air weapons instructor training mission. If it's the mishap I'm familiar with, the conclusions you describe aren't the same conclusions we were told. Was there another side to the story?

Lt Col Hale
George AFB, CA (in a telephone call to AFISC)

Yes, you are right. There is another side, a more complete side, as it were, to this mishap. The article was written with information available at the time. Since then, we have received more background on the mishap. Here is the final update to the original story.

Another F-4 Class A ops mishap was an air-to-air weapons instructor training mission. Everything was briefed and talked over. The first two setups went fine. During number three engagement, it happened. The attacker was pulling off after his "kill" and was watching the defender's reaction.

Suddenly, he found himself being in the defender's position and being attacked by the defender, who might have thought the attacker's pull-off was a weakness, offering him one more chance. During this attack, the "terminate" and "knock-it-off" calls by his WSO were not (nobody knows why) followed by the now attacking pilot. The result, the aircraft collided, killing one crew and sending the other crew out of control.

It looks like the MP lost situational awareness about the closure rate and turn capability of the F-4, used poor judgment, and made the wrong decision in trying to get his kill. It also seems he was so occupied with his maneuvering he might not even have heard the "terminate" or "knock-it-off" calls from his WSO.

One question remains open. Why did the WSO, an instructor WSO, not intervene physically by using the controls? Was it policies, regulations, or too much confidence in the pilot? Think about it and find yourself an answer, especially you WSOs. Too many WSOs have been flown to their deaths without doing anything to avoid it. ■

DUAT Providers

■ Some time back we talked about the ability of pilots to access the FAA's Direct User Access Terminal, or DUAT. At the time of the article, there were three companies planning to provide the service. As of today, only two companies are providing DUAT connections.

Data Transformation Corporation, DTC for short, offers DUAT connections for free. Call them at 800-245-3828 for more information on their free, basic services, or their value-added capabilities.

The other provider is Continental Telephone (CONTEL). You can get information about their basic service or their "Golden Eagle" service by calling 800-345-DUAT.

While the basic services of DUAT allow any pilot to do a better job of pre-flight planning, the value-added services may be worth considering. They provide the ability to look at up-to-the-minute weather maps on your home computer, or to plan a cross-country flight based on the performance of your particular aircraft. In either case, a safer fight is possible with much less effort than ever before. ■

CAPTAIN

Joseph A. Lanni

3246th Test Wing
Eglin AFB, Florida

■ Captain Joseph A. Lanni, Test Pilot, was conducting an AMRAAM developmental test mission in an F-16C which required him to achieve maximum aircraft load conditions. The test called for Capt Lanni to attain an airspeed in excess of 750 KCAS while performing a maximum deflection 180-degree roll at negative one G. Capt Lanni had already performed 13 similar test points when on the 14th maneuver, he experienced major structural failure.

While at 745 KCAS in a 10-degree dive in preparation for the test maneuver, he felt an abrupt resistance to his roll input and a decrease in stability. He immediately initiated a recovery and reported his control problems to his chase aircraft. The pilot of the chase aircraft saw the left flaperon had separated from the wing but remained attached to the fuselage by the actuator rod. In addition, the rudder had separated and was missing. System A hydraulic pressure soon went to zero. To maintain control, Capt Lanni held approximately 10 pounds of right control stick beyond the maximum lateral trim limit.

During the recovery, Capt Lanni, his chase pilot, and the SOF reviewed emergency procedures. Without a rudder, Capt Lanni elected to lower the landing gear normally to preserve nose wheel steering (his only means of directional control on rollout).

During his controllability check, he discovered an 11-degree approach would exceed the maximum cable engagement speed, but he could still maintain marginal control at 13 degrees. Although fatigued from holding constant right control force, Capt Lanni flew a flawless, 13-degree approach to a successful approach-end engagement at the maximum recommended engagement speed.

Capt Lanni exhibited superior flying skill and judgment in handling this emergency situation under unique and difficult circumstances. As a result, he saved a valuable combat aircraft.

WELL DONE! ■

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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.

FIRST LIEUTENANT

Michael A. Fantini

347th Tactical Fighter Wing
Moody AFB, Georgia

■ First Lieutenant Mike Fantini was flying as no. 2 on a local F-16 basic fighter maneuver mission. Entering the practice area, Lt Fantini experienced smoke in the cockpit, and his jet began trailing smoke. Lt Fantini immediately began to squawk emergency and set the throttle at 83 percent. While setting up the return to Moody, his aircraft experienced total loss of engine oil pressure. He and his flight lead contacted the SOF and climbed to 14,000 feet.

During the 5-minute return flight to Moody, Lt Fantini carefully executed all applicable checklist procedures. At 12,000 feet over the field, he began a right turn to descend to his desired high key. At that time, he experienced a loud bang and a "chug" followed by a loss of thrust and subsequently a loss of all engine RPM. Lt Fantini maneuvered his aircraft to set up the desired base key, performed an alternate gear extension, and executed a flawless flameout approach. He stopped the aircraft on the runway and egressed normally.

Due to his outstanding airmanship, Lt Fantini successfully recovered a valuable asset.

WELL DONE! ■

CHECKLISTS

ARE NOT JUST FOR CHECKRIDES