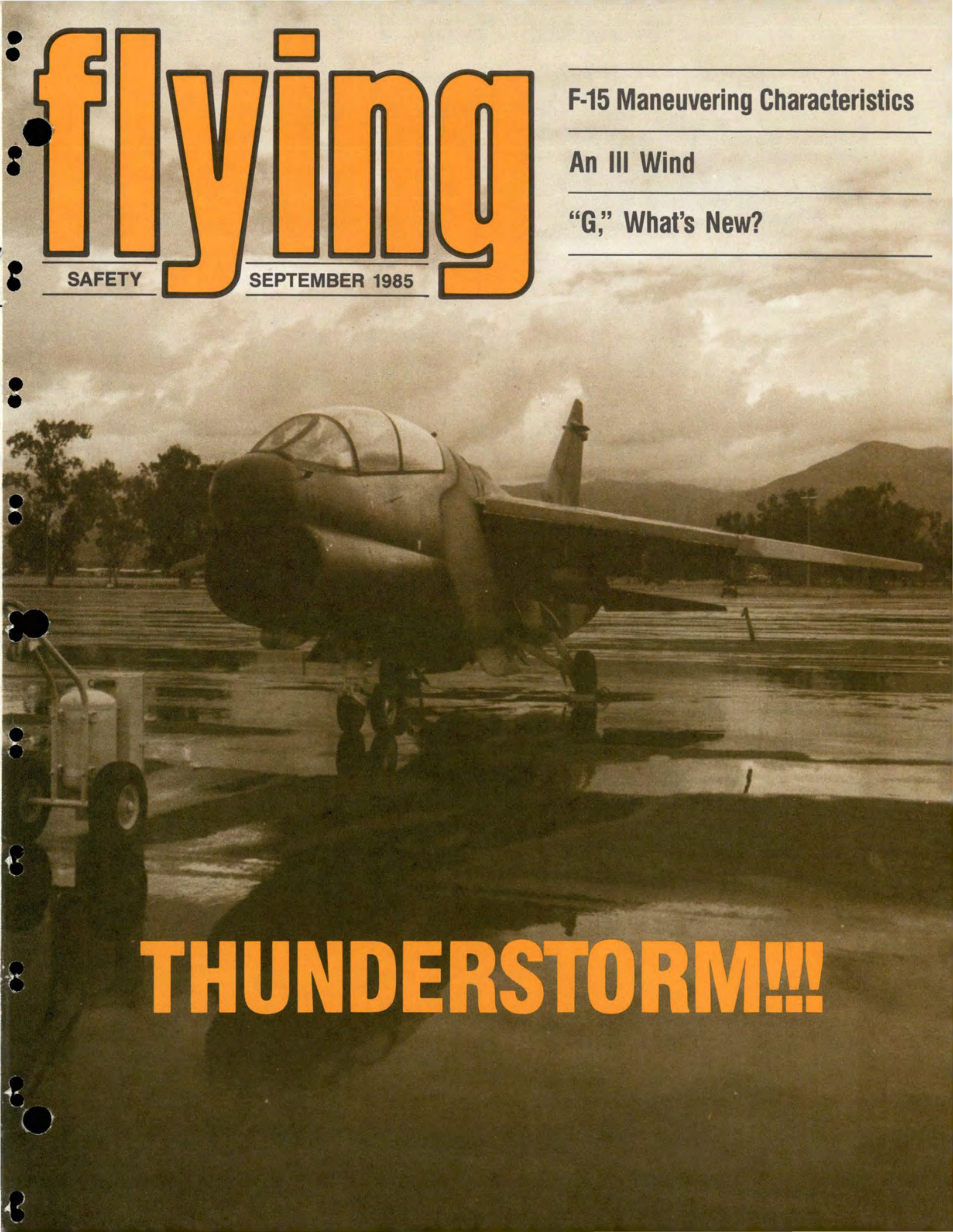
flying

SAFETY
SEPTEMBER 1985

F-15 Maneuvering Characteristics

An Ill Wind

"G," What's New?



THUNDERSTORM!!!

THERE I WAS

■ . . . a victim of circumstance. The mission was a routine one — a 1600 takeoff with two stops and then back home. Lieutenant P.H. and I checked the weather, NOTAMs, and filed the flight plan noting that it looked like an easy day. Everything was running smoothly. Even the DV had shown up on time.

Then the No. 1 engine failed to start. After several attempts at starting the engine, we suggested to our passengers that the Officers' Club might be a better place to wait while a specialist tried to solve the problem. Unfortunately, there were no spare aircraft available.

Three hours later, we were airborne. Luckily, the weather was holding up at our destination. I told the DV, "We'll get you there, even if we have to push the jet." Little did I know how true my statement actually was.

Thirty minutes out of our destination, I gave the standard inbound arrival message to the Command Post. They acknowledged, "Roger, we copy all and know who your DV is. You are not cleared to land." Thinking that I was hearing things, I asked them to confirm that we were cleared to land at the base. "Negative, you are not cleared to land." The Command Post suggested that we divert to a civilian aerodrome 15 minutes away from our present position. After further inquiry, we learned that our proposed arrival time was 5 minutes after the start of the base's quiet hours. No one could land.

After coordinating the diversion with Center, arranging for a staff car to meet us, and briefing the new approach, we found ourselves on final to an aerodrome neither of us had been to before. Approach Control informed us that the Tower was not operating and to stay on approach frequency after landing.

On rollout, Lieutenant P.H. directed me to pull out the aerodrome diagram. According to the diagram, all taxiways were open and all led to a parallel taxiway. Lieutenant P.H. started a turn onto the nearest taxiway (unlighted) while I ran the checklist. I looked up just in time to see grass growing out of a supposedly open taxiway. We both groaned. The taxiway was too narrow to turn around, and since all taxiways led to the parallel (according to the diagram), we elected to slowly press on. The taxiway extended a hundred feet forward, a hundred feet to the left, and ended. We were stranded on an unlighted, closed taxiway at an unfamiliar, uncontrolled aerodrome with no one to talk to except Approach Control. We were on our own.

We favored one side of the taxiway and used differential braking, differential thrust, and nosewheel steering in an attempt to "kick" the aircraft around and leave the same way we came. We ended up sideways without enough room to complete the turn. Since Transient Alert was nonexistent that late at night, we were on our own to try and get out of the mess we were in.

We had to shut down both engines and unload all the passengers. Everyone, including the DV, had to help push the aircraft backwards enough to complete the turn. I acted as fireguard while Lieutenant P.H. started the No. 2 engine. We taxied to parking without any further mishap.

Looking back on the mission, there were five factors which contributed to our problems:

- A 3-hour maintenance delay.
- Being diverted to an unfamiliar aerodrome.
- An incorrect aerodrome diagram.
- Lack of ground agency.
- Taxiing on an unlighted taxiway.

Of all the factors, the one we could have prevented was taxiing on the unlighted taxiway. By rolling out to the end of the runway and taking the lighted taxiway and a little more time, we could have saved ourselves a lot of grief. Aerodrome diagrams normally are correct. The one that affected us has now been corrected. Take some advice. Take a little more time to analyze the situation, and use a well-lighted taxiway. ■

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Special Features

Regular Features

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FLIGHT SAFETY

IT'S YOUR SUCCESS STORY

BRIG GEN ALBERT L. PRUDEN, Jr.
Director of Aerospace Safety

■ Being the Director of Aerospace Safety is one of the most satisfying jobs I have had in the Air Force. One thing that makes it so is the outstanding record you have attained in flight safety over the past few years. Safety is one of the real success stories in the Air Force. In 1922, the first year we have accurate records, the rate was 506 flight mishaps per 100,000 flying hours. In 1942, we had over 20,000 major accidents which destroyed 1,200 more aircraft and lost 1,100 more people than we lost in combat. Since then, our successes have been spectacular, as Figure 1 shows, even considering the fact that much of the dramatic decrease prior to 1960 was due to reporting criteria changes. Our best year ever was 1983 with a Class A mishap rate of 1.73 per 100,000 hours. In 1984, we came close again with a rate of 1.77, and this year we are keeping close to a record pace.

These successes are the direct result of your efforts, and I congratulate you for them. But we still have some work to do. Despite these record reductions in numbers and rates of mishaps, we still have a lot of room for further improvement. When we examine each mishap in detail, we find that the majority result from human factors. Newer aircraft and new technology have made our machines more reliable. There has also been a significant improvement in the mishap rate caused by human error, but this area remains elusive and presents the greatest potential for progress. Additionally, the chart shows a rising trend in the total cost of mishaps with each passing year since 1970. This represents a significantly increasing loss in combat resources and, therefore, combat capability.

I have said that our safety record is your success. I can explain that graphically with Figure 2. Here we are looking at the last 10 years mishap experience. Note that the trend is going down — but slowly. More importantly, we have divided the rates into logistics and operations factor mishaps to give a clearer picture of what the numbers mean. As you can see, logistics-factor mishaps have come down to the .5 to .6 range. These low rates reflect hard work as well as the phasing out of older aircraft, modifications in existing inventories, increased management and supervisory effectiveness, and the acquisition of inherently safer, newer aircraft. From 1979 to 1983, the ops-factor rate decreased also. However, in 1984, we saw an upturn in the trend.

FLIGHT SAFETY HISTORY
CLASS A RATE AND THEN YEAR DOLLARS

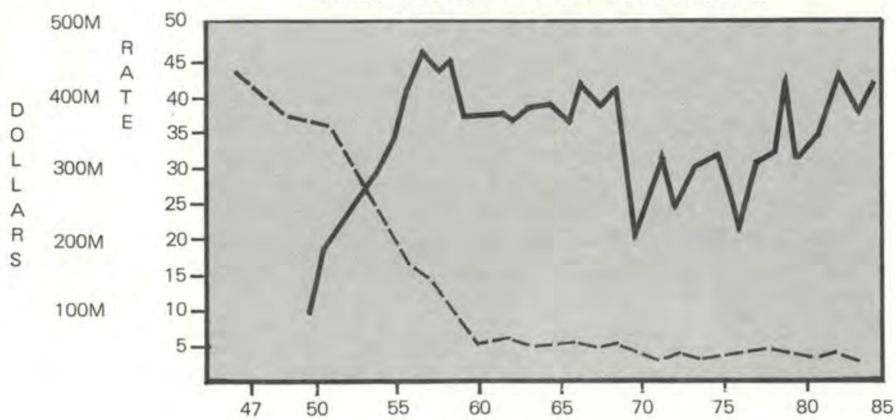

Figure 1

Seventy-one percent of the ops-factor mishaps in 1984 were collisions with the ground or control losses. There were 20 collisions with the ground which resulted in destroyed aircraft and fatalities. Based on safety investigations, the majority of these involved pilots unintentionally flying into the ground because they channelized their attention too long on something other than terrain avoidance. It could have been anything from an attacking aircraft, to a warning light, to a mission-related task such as changing a switch setting. Another group of pilots flew into the ground because they were "dis" or *mis*oriented, or, in some cases, we suspect that they were incapacitated by G-induced loss of consciousness.

Fatigue is a suspect factor in about one-third of these collision-with-the-ground mishaps with task saturation and distraction rounding out the causes. In most mishaps, at least two of these factors were present. Through the end of June, we have already had 9 aircraft collisions with the ground. There are no surprises in the cause factors.

Last year's 11 control loss mishaps held no surprises either. *The predominant factor was lack of basic flying knowledge or skills*. Most of the mishaps involved improper technique to fly a maneuver or to recover from a situation which lack of skill, knowledge, or technique had caused. This year, by June, we'd had 4 loss-of-control mishaps.

Discipline, training, strong awareness programs, and ground proximity hardware are the issues we are working and must continue to work to avoid collision-with-the-ground and control loss mishaps.

I have mentioned some of our mishap experience for the first half of 1985. Figure 3 shows how we are doing overall, and Figures 4 and 5 show the breakdown of ops and log mishaps. As you can see, we are doing fairly well in the log category, but the ops and totals are right on the prediction line. We definitely can improve here.

The improvement I am talking about is in the area which you can

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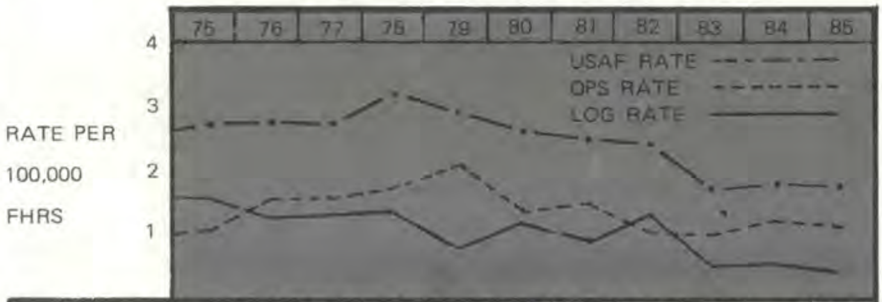
TEN YEAR CLASS A OPERATIONS/LOGISTICS MISHAP RATES



	75	76	77	78	79	80	81	82	83	84	85
USAF RATE	2.77	2.81	2.78	3.16	2.92	2.57	2.44	2.33	1.73	1.78	1.74
OPS RATE	1.04	1.52	1.55	1.74	2.04	1.35	1.42	1.01	0.97	1.19	1.07
LOG RATE	1.55	1.20	1.23	1.32	0.82	1.09	0.93	1.22	0.53	0.58	0.45

Figure 2

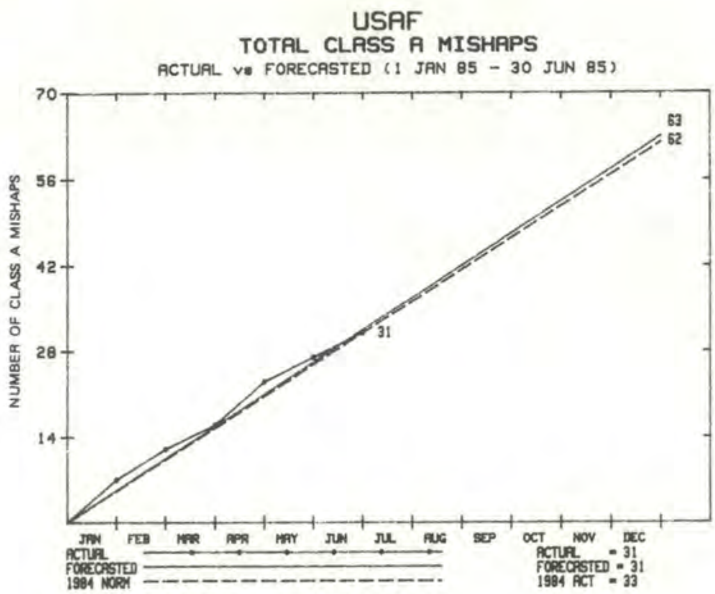


Figure 3

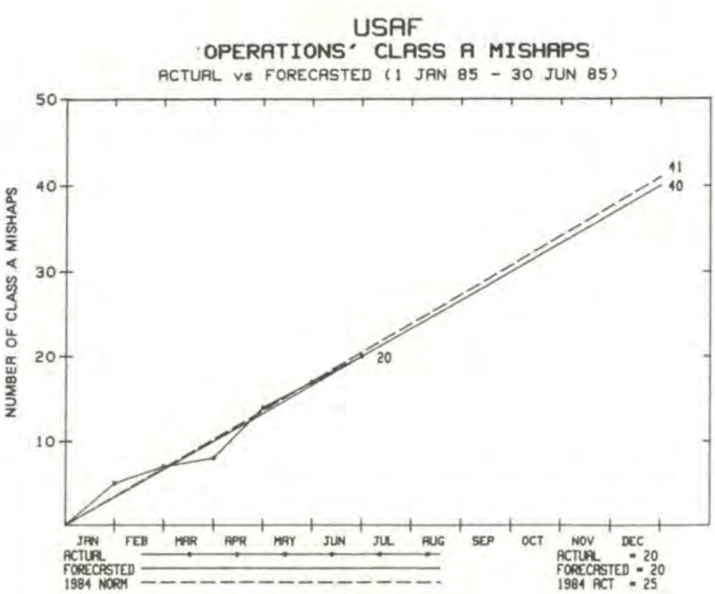


Figure 4

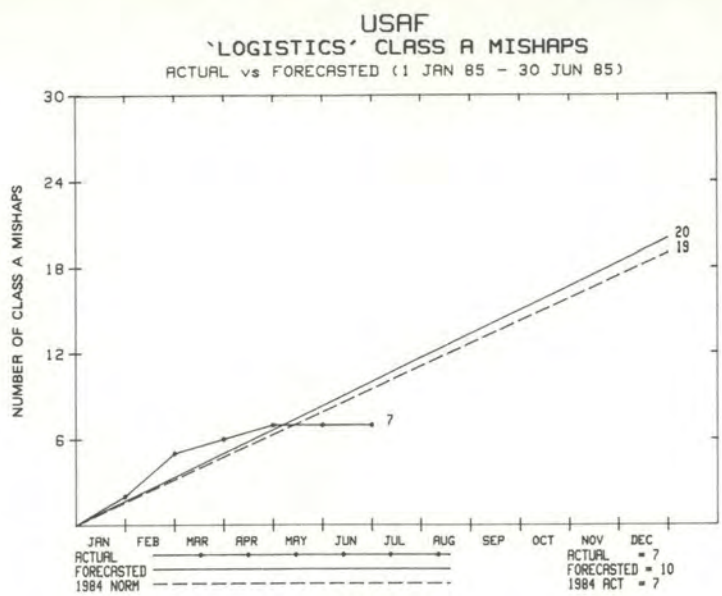


Figure 5

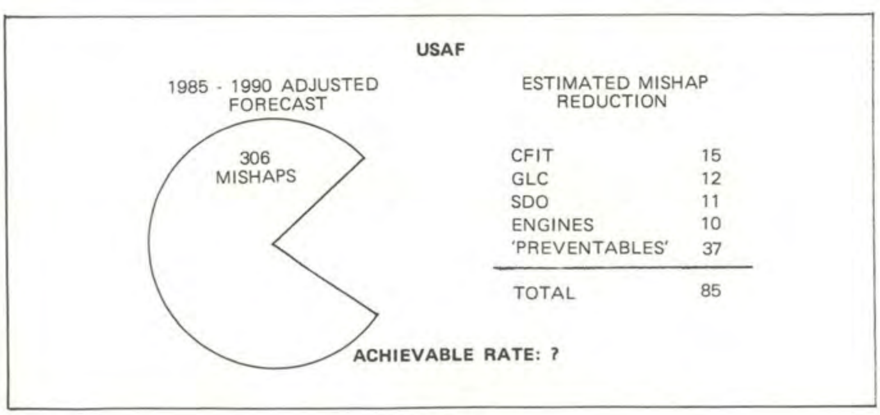


Figure 6

most directly affect. These are the easily preventable mishaps — the ones I call "dumb accidents." They are characterized by inadequate supervision, an undisciplined approach to flying, or a lack of professionalism. Some examples are disregard for regulations and proven procedures, running out of fuel, gear-up landings, and premature gear retraction on takeoff. There were 28 mishaps in 1983 and 1984 that fell in this category, and so far, in 1985, at least 5 mishaps qualify.

I firmly believe that command emphasis and involvement is the quickest and most effective way to reduce mishaps. It is particularly effective in reducing those "preventable" mishaps. Commander involvement and motivation is the key to the kind of leadership that instills the desire for total professionalism in those operating and maintaining Air Force aircraft.

Extending our present 1.8 mishap rate out for the next 5 years, the people in our safety analysis branch say we would experience a loss of 391 aircraft with a total cost of 5 billion dollars by 1990. Those figures are mind-boggling and demand action to reduce them. I am convinced that if we aggressively pursue already identified mishap solutions, we can achieve reductions like those shown in Figure 6.

These savings represent more than a wing of aircraft and approximately a billion dollars. With the combined effort of everyone — commanders, supervisors, aircrew, and maintenance personnel — I believe we can, through ongoing programs, achieve a Class A mishap rate of 1.25 within the next 5 years.

The flight safety story through 1984 is your success. It is also your challenge. Although the reduction in the mishap rate over the years has been impressive, there is still ample room for improvement and opportunities to save resources and lives while increasing our readiness and combat capability. As professionals, we can do no less. ■

F-15

Stalls, Spins, and Autorolls

GLEN LARSON
Senior Experimental Test Pilot
McDonnell Aircraft Co.

An article of the length and detail of this one and which addresses such a complex subject requires a great deal of assistance from the engineering community. Special thanks are due to several individuals who were key contributors to what you are about to read. Jack Krings, currently Director of Marketing for Navy and Marine programs in Washington, DC, flew the original F-15 spin tests and deserves special credit for his pioneering effort in the program. Dave Thompson, Director of Program Engineering for the F-15E, and Clarence Mongold, Branch Chief, F-15 Aerodynamics, were of invaluable assistance. Extra recognition goes to Pat Wider, Lead Engineer, F-15 Aerodynamics, who patiently reviewed multiple rough drafts for engineering accuracy.

■ Aircraft loss of control and spins have been with us since shortly after the Wright Brothers' flight at Kitty Hawk, and by 1916, spins had become fairly common events. For awhile, they were used as defensive maneuvers in air combat, but as such were of limited value; an attacker simply waited for his target to recover and then resumed the attack. Aircraft design theory evolved to more modern designs, and for the first time, pilots encountered the flat spin which proved difficult to stop. Aircraft with weight concentrated in the fuselage (such as the century-series fighter) will flat spin and also exhibit some exciting gyrations during spin entries.

Spins should not be feared — understood and respected, yes, but not feared. Our purpose here is to impart some general understanding of loss-of-control and spins and, specifically, how the F-15 behaves during high angle-of-attack (AOA) flight. The F-15 has successfully demonstrated numerous spins and spin recoveries. The spin characteristics are well known; and with sufficient altitude, the recovery procedures are reliable — there aren't any deep dark secrets or hidden surprises.

Spins in any aircraft share some common characteristics. For example, spin entries at high speeds will be more violent, and spins entered at high gross weights tend to be higher-energy spins from which it takes longer to recover. Also, the character of a spin entered at 40,000 feet doesn't differ significantly from one entered at 20,000 feet. Current generation aircraft such as the F-15 have design features that make it difficult to spin. If you do manage to enter a spin, other design features make recovery easier.

The F-15 flight control system is designed to provide comfortable, predictable response throughout the flight envelope, and the aerodynamics provide honest, straightforward handling characteristics. Directional stability remains positive at any AOA normally attainable in flight, which makes entering spins difficult. In addition, the control system has features that prevent inadvertent pro-spin inputs at high AOAs. As a result, it isn't necessary (as it was with other systems) to "fly with your feet" when at high AOA. The F-15 system lets the pilot do what comes naturally — fly with the stick. Nothing magic about it. The mechanical flight controls simply blend rudder and aileron together to provide coordinated flight using very little rudder at low AOAs, but rudder almost exclusively at high AOAs.

Rudder rolls are really uncoordinated maneuvers. Some aileron is needed during a rudder roll; but in the heat of battle, it's tricky to use just the right amount of aileron. Using too much aileron can result in adverse yaw which can lead to a departure. Your flight control sys-

continued

F-15 Stalls, Spins, and Autorolls continued

tem blends the proper amount of aileron and rudder for relatively coordinated flight during all flight conditions. The system doesn't eliminate aerodynamic phenomena such as adverse yaw or the dihedral effect (roll due to yaw); it uses the dihedral effect to your advantage and keeps adverse yaw under control.

To help understand the complex world of high-AOA flight, we need to establish some definitions for a common frame of reference; review the causes of departures/spins and autorolls; as well as briefly explore aerodynamic, kinematic, and inertial coupling.

Definitions

Exactly where a stall occurs in a modern high-performance aircraft is difficult to determine. In some older fighters, a stall is an exciting event. The AOA gets high enough that as the wing quits producing lift, directional stability breaks down and yaw rates can develop rather quickly. As a result, AOA limits are often imposed in an attempt to prevent departures or spins. These are artificial limits, since high AOA isn't the source of the problem. The real cause is the breakdown in directional stability, which makes the aircraft susceptible to developing a yaw rate. However, a stall in an F-15 is a "non-event." It's not possible to exceed the point of maximum lift (i.e., the "classic" stall) even with full aft stick. A stall is characterized by moderate wing-rock and buffet and a high sink rate. Accelerated stalls behave much the same way, assuming a symmetrically-loaded airplane. The most important thing is that total directional stability remains positive.

Departure and out-of-control aren't as easily defined. As an aircraft progresses from controlled flight to a spin, several events occur. For the purposes of this discussion, we will use operationally-related definitions of out-of-control and departure. Simply put, out-of-control is the point at which the aircraft no longer responds in pitch, roll, or yaw to pilot inputs. With this definition, it's possible to be out of control for some time before actually departing, since we define departure as the point where the aircraft flight path changes drastically from the expected. In case there is any doubt, if the yaw-rate tone is steadily beeping, the aircraft has departed.

Causes of out-of-control or departure can be the result of a combination of circumstances. Traditionally, a spin is encountered after increasing AOA to the point that directional stability is weak enough that a yaw rate develops. As AOA increases, the aircraft will stop responding since the controls will lose effectiveness. If directional stability is weak, a yaw rate will develop, and the aircraft will seem to have a mind of its own. At this point, you are not necessarily in a spin. You *have* departed controlled flight since the aircraft is doing something you didn't command, but it hasn't necessarily entered a spin. Generally speaking, neutralizing the controls at this point will allow the aircraft to fly itself out. This phase of flight between a departure and a spin can be very brief, depending on the dynamics of the maneuver. The gyrations the aircraft goes through in this phase can be mild or eye-watering, depending on speed or energy level at departure.

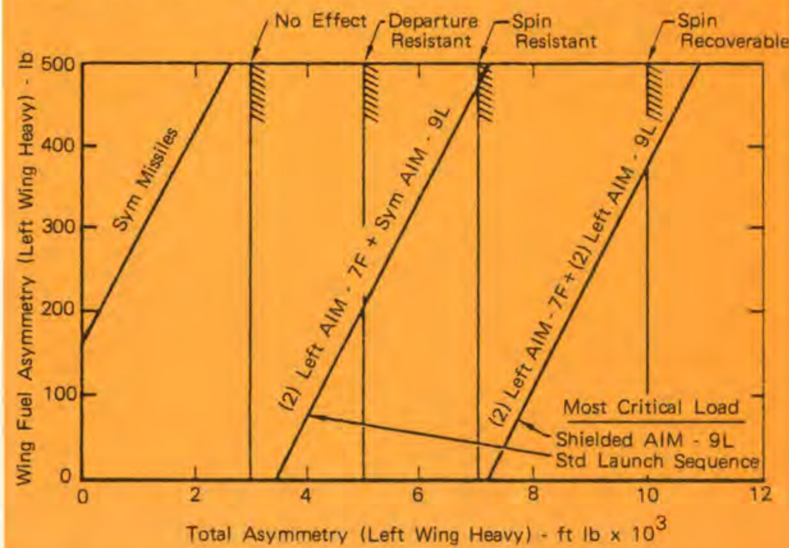
The first of two spin modes encountered by the F-15 is the oscillatory mode which, as the name implies, exhibits large variations in pitch, roll, and yaw. You can expect to see $\pm$ 30° pitch oscillations, some bank oscillations, and yaw-rate hesitation with intermittent spikes as high as 100°/second. The good news is that this mode is generally recoverable with neutral controls, but may take some time and altitude to recover.

The second spin mode is the flat spin, also referred to as a "smooth" spin. A flat spin has very little oscillation in any axis and the yaw rates will be fairly steady (generally higher than in the oscillatory mode — somewhere in the neighborhood of 66° to 130° per second). These high yaw rates can result in "eyeballs out" G-loads of 1 to 4 Gs, which is uncomfortable to say the least. During the spin test program, at least three dozen flat spins were performed, all of which recovered with full antispin aileron and stabilator. It's not necessary to first be in an oscillatory spin to develop a flat spin; under certain circumstances, the aircraft will go directly into a flat spin. Inverted spins were also tested and found to recover with neutral controls.

Departures and Spins

The contributors to spins and out-of-control conditions can be divided into major and minor categories. A significant contributor can be flight control inputs, even though the flight control system is designed to control adverse yaw or other inputs that can induce yaw rates at high AOAs. During the spin test program, it was necessary to "trick" the control system in order to enter a spin. It's also possible to trick the system during ACM and apply pro-spin controls inadvertently. If, for example, in a hard or "break" turn, the aircraft rolls out on its own (perhaps due to weight asymmetry or something else), the natural reaction is to unload and counter the roll with opposite stick. If the stick is near neutral when applying aileron opposite the roll, the result will be yaw away from the stick input and is in the same direction as the yaw that was present with the initial uncommanded roll. This combination is pro-spin. Don't misunderstand this discussion as meaning that you're going to instantly spin out of a hard turn. That's not true; but pay attention to what the air-

FIGURE 1 - LATERAL ASYMMETRY DUE TO WING FUEL AND MISSILES



plane is telling you. Any uncommanded motion is cause for neutralizing the controls and taking a few seconds to see what's going on.

During the spin test program, the "trick" used to enter a spin was to pull into high AOA, develop some sideslip and yaw rate with rudder, then suddenly move the stick to neutral and apply full opposite lateral stick while AOA was still high. This action, in effect, bypassed the aileron washout feature and the technique was successful in getting into a spin about 50 percent of the time. Power settings and longitudinal c.g. position have relatively minor effects on departures and spin recoveries. The flight conditions, altitude, and Mach number were also players, but of relatively small consequence.

AOA, on the other hand, does have some importance. Generally, as AOA increases, directional stability decreases; but as long as the dihedral effect remains strong, there's no problem. In the range of 30-35 units, the static directional stability has gone to zero or less, but the dihedral effect is very strong. Static directional stability and dihedral effect make up the total directional stability of the aircraft. In the 40-45 unit area, the dihedral effect contribution to stability is reduced but still positive; and since the static directional stability has gone negative, total directional stability is weakest. It's difficult to quantify this reduction in stability in pilot terms, but the important thing is that the total directional stability is still positive; whereas in earlier century-series fighters, total directional stability went to zero or negative at high AOA. Any time directional stability is reduced, the airplane is more subject to developing sideslip and yaw rate. The source of this yaw rate can be pilot input, inertial coupling, or anything that causes the nose to move sideways.

Aircraft configuration also has some effect on departure resistance. When the aircraft is flown with centerline tank only, the total directional stability is slightly reduced, resulting in lower departure resistance. When loaded with wing tanks, the directional stability is essentially the same as a clean airplane, but the longitudinal (pitch) stability is slightly reduced. The biggest contribution that the airplane makes to loss of control at high AOA is in lateral c.g. or lateral weight imbalance.

Lateral Asymmetry

The airplane will probably always be out of balance laterally to some degree; therefore, limits need to be established because the flight characteristics can change dramatically as a function of asymmetry. The aerodynamic characteristics of asymmetric external loads have little effect on the departure resistance of the F-15. Weight is the big factor. Incidentally, this lateral c.g. shift affects *all* aircraft. Since fighters carry wing tanks and bombs/missiles on the wing, they are subject to the effects of a lateral c.g. shift caused by weight asymmetry. I suspect that many F-4 stall/spin accidents may have been due to a large weight imbalance, either fuel or wing stores. (Experience in Southeast Asia with the F-4 bears this out. Large weight differences between left and right bomb loads were not uncommon.)

The Category II test program determined that operational loadings of up to 10,000 foot-pounds were acceptable, although the handling qualities at high AOA were somewhat degraded. The limit of 5,000 foot-pounds was recommended for training in order to avoid degraded handling qualities. Testing has shown that with an asymmetric load of 5,000 foot-pounds, the aircraft is still very departure resistant. Above 10,000 foot-pounds, departure susceptibility increases to the point that fully-developed spins can be generated in as little as 3 to 4 seconds with only full-aft stick.

Since 5,000 foot-pounds may not mean much to you, let's put it in terms of equivalent loadings. The rolling moment in foot-pounds is calculated by multiplying the distance from the centerline to where the weight is located times the weight. If the external load is balanced, 650 pounds of internal wing-fuel imbalance equals 5,000 foot-pounds (650 pounds times the 7.7 foot distance from centerline equals 5,000 foot-pounds). With two AIM-7s on one side, only 200 pounds of internal wing-fuel imbalance is needed to add up to 5,000 foot-pounds. In any case, below 30 units AOA, the aircraft will generally not depart at any level of asymmetry. That's where the 30-unit

continued

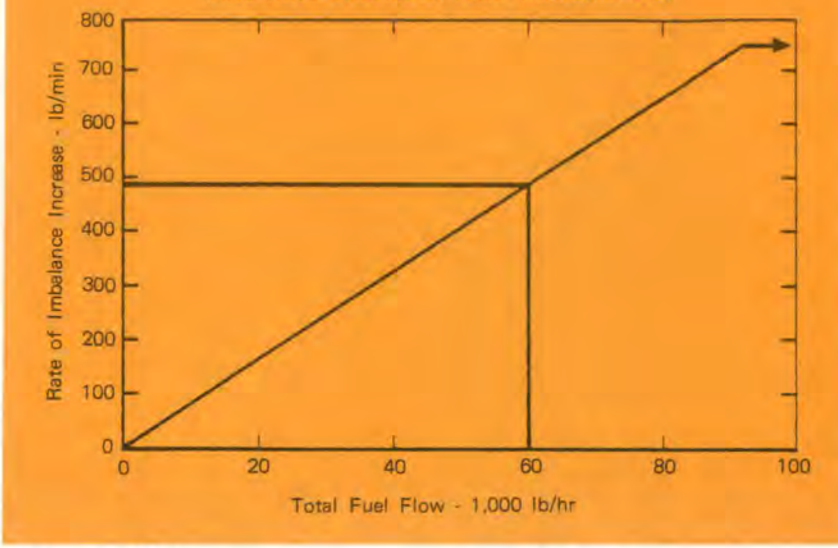
Dash One limit comes from when the internal wing fuel imbalance exceeds 600 pounds (200 pounds for imbalanced missile loads).

Figure 1 is a graphic representation of the preceding discussion. The horizontal axis is total asymmetry in thousands of foot-pounds. The vertical axis is internal wing fuel imbalance, left wing heavy. The divisions defining the points of departure, resistance, spin resistance, etc., are based partly on test data and partly on analytical data. Configurations up to one full external wing tank were evaluated up to 30 units for stalls and departure susceptibility.

The departure characteristics of a symmetrically loaded airplane are relatively straightforward. There's adequate warning in terms of buffet and wing-rock; but for an asymmetric load, these warnings may be reduced, and the first indication of departure may be the departure warning tone. If you don't back off (reduce AOA) at the first warning tone, the next event could be a fully developed spin — especially with a large asymmetry.

Just because you begin an ACM engagement with balanced internal wing fuel doesn't mean you can't get into trouble. Figure 2 shows how quickly an imbalance can develop if one of the wing fuel transfer pumps fails. Total fuel flow in thousands-of-pounds per hour is on the horizontal axis, and rate of wing fuel imbalance in pounds per minute is shown on the vertical axis. For example, at a fuel flow of 30,000 pounds per hour per engine, the imbalance will increase at a rate of 480 pounds per minute, which means that after a two-minute engagement in burner, the imbalance will be 960 pounds (equating to nearly 7,400 foot-pounds of asymmetry). *Asymmetry can ruin your whole day by quickly putting you in a high-rate flat spin, which will require a great deal of altitude to recover.*

FIGURE 2 · RATE OF WING FUEL IMBALANCE (ONE WING TRANSFER PUMP INOPERATIVE)



Recovery Procedures

The recovery procedures in the Dash One were developed to cover all out-of-control/spin events in a logical and rational manner. At the first sign of an out-of-control condition (the airplane quits responding correctly to your inputs), neutralize the controls and let the basic stability of the airplane straighten things out. If the aircraft fails to recover, it may be in an autoroll or a spin. The next step is rudder opposite the roll direction which is the best recovery from an autoroll (more on autorolls later). It really doesn't matter if you misidentify a rolling departure as an autoroll since the rudder is the appropriate control to reduce sideslip and yaw rate (assuming you use the correct rudder). Rudders alone have little effect on getting in or out of spins. A word of caution here: *Don't use aileron opposite the roll in an autoroll or rudder roll*. That's one of the quickest ways to enter a spin!

During any out-of-control event, listen for the departure warning tone as it's designed to give you specific warnings. It first comes on at 30°/second yaw rate. Except for autorolls, it was found during testing that the airplane would always self-recover if the pilot neutralized the controls at yaw rates of 30°/second. Above 60°/second, the "beep" rate of the tone reaches a maximum and positive pilot action (antispin controls) will probably be required to recover. The control augmentation system (CAS) is shut down at 42°/second yaw rate to prevent prospin CAS inputs, and the spin-recovery mode is engaged at 60°/second, allowing full aileron/stabilator deflection regardless of fore and aft stick position. If the beep rate has reached a maximum, you're probably approaching (or are in) a fully-developed spin. The last step in the procedure — lateral stick full in direction of yaw — requires a bit of thought. Spend a few seconds determining which way you are spinning before putting in any aileron. (In fact, any time the departure warning tone is on, be very careful with aileron — especially with the stick near neutral longitudinally.)

The best way to recover from a spin is to decide which way you're spinning, put the aileron in the correct direction (the wrong way accelerates the yaw rate), and *wait*. It can take up to 10 seconds (and two turns) before any change in yaw rate is noticeable. Be patient. You may not be able to detect any change in yaw rate until just before recovery. The exact time to recover depends on several variables. If the yaw rate hasn't exceeded 60°/second, you need to have the stick centered fore and aft or you won't get full aileron deflection and recovery will take longer. Large weight asymmetry will lengthen the recovery time, as will cycling the recovery controls in and out. Finally, if you're still spinning at 10,000-feet AGL, get ready to eject because there probably isn't enough altitude left to recover.

During the recovery phase of a flat spin, the aircraft will remain in a fairly flat attitude until the yaw rate stops. The nose will then drop, sometimes past 90°, to a slightly inverted position. At this point, it's much like the recovery from a tail slide. The airplane will do a couple of rolls while regaining flying speed. These are rolls due to sideslip, *not* autorolls.

Autorolls

The autoroll is a special case and is one of the most misunderstood phenomena in the F-15. The autoroll is not unique to the F-15; other aircraft, such as the F-111, autoroll very easily. An autoroll can be stopped with very little energy or altitude loss; but before discussing recovery, let's review the causes of autorolls. The technical reasons are a little deep, but an autoroll can consistently be entered from a specific set of flight conditions and control inputs:

- Airspeed in the 200-300 KCAS range.
- 20-30 units AOA.
- Roll and yaw initiated with a rudder input.
- Relaxing of aft stick to induce coupling.

The aerodynamics of all this are complex. The first principle is the dihedral effect which causes the initial roll due to yaw; then easing of aft stick inertially couples pitch and roll to produce a yaw acceleration. During an autoroll, the airspeed is well above the stall speed, and the AOA is held in the 20-30 unit range through inertial pitch coupling. The roll rate will be pretty fast, approximately 150°/second, and the flight path will be ballistic.

During the entry to the autoroll, inertial coupling will appear to the pilot as an increase in the roll rate as the stick is eased forward. Although the primary motion apparent to the pilot is roll, there is a yaw rate present (around 30°/second). The yaw rate warning tone may be on or off during the autoroll. The CAS aileron rudder interconnect gets in the act during the entry phase because it works as a function of AOA and roll rate and applies rudder to coordinate the roll. This rudder deflection is in the direction to get into an autoroll, but fades in a few seconds and *will not* keep the aircraft in an autoroll. If friction in the rudder cables is high, the rudders will tend to stay slightly deflected in the direction of the roll and that *will* tend to keep the autoroll going. An aircraft with little or no rudder friction or rudder displacement from whatever cause will not stay in an autoroll. In any event, it's easy to recover.

The best way to recover from an autoroll is to apply *rudder* opposite the roll. Technically speaking, the rudder is being applied to eliminate the sideslip; however, it's easier for the pilot to determine roll direction, so referencing recovery procedures to roll direction makes more sense. As soon as the roll stops, neutralize the rudder and be ready to come in with a little aft stick to counter the "nose tuck" that follows. This nose tuck is very mild and is caused by inertial coupling.

Other recovery techniques do exist, but are of academic interest only. For example, doing nothing at all will work. An autoroll will eventually stop, depending on rudder cable friction. Time and altitude loss may be excessive, therefore this technique is not recommended. Moving the stick fore or aft may possibly work through coupling, but isn't recommended since it doesn't directly affect the yaw rate and can lead to extreme AOAs. Aileron applied *with* the roll (an unnatural tendency) will break the autoroll phenomenon, but the transition from an autoroll to an aileron roll is impossible to detect. Aileron against the roll (normal reaction) is *definitely not recommended* since it is a prospin control, and it is possible to get into a spin in as little as three or four seconds. There is plenty of warning from the departure tone and aircraft motion that things are going from bad to worse.

Aircraft configuration has no effect on getting in or out of autorolls. Weight asymmetry doesn't affect autoroll entry or recovery, but does make it easier to spin out of an autoroll if the wrong recovery technique is used. Warnings are somewhat reduced, so your best indication that things are getting worse is the departure warning tone.

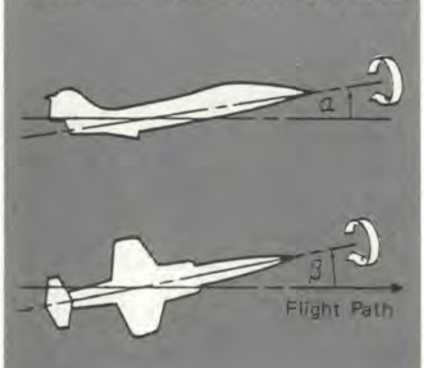
Coupling

Several times I've referred to aerodynamic and inertial coupling, both of which are complex phenomena. The good news is that coupling can be reduced to some fairly simple concepts. The term "coupling" simply refers to the response of the aircraft about one axis due to a disturbance about another. An example of uncoupled aircraft motion is the response of the aircraft to the stabilator. Pulling aft on the stick in straight and level flight causes a collective motion of the stabilator, resulting in a nose-up motion. The pilot has commanded a pitch motion, and only a pitch motion has resulted. An example of a coupled aircraft motion is the combination of roll and yaw that results from rudder deflection. The pilot has commanded a yaw with rudder and the aircraft also rolls. This particular type of aerodynamic coupling is the dihedral effect.

"Kinematic" coupling occurs if an aircraft is rolled rapidly about the longitudinal axis, as shown in Figure 3. What was AOA (a) becomes

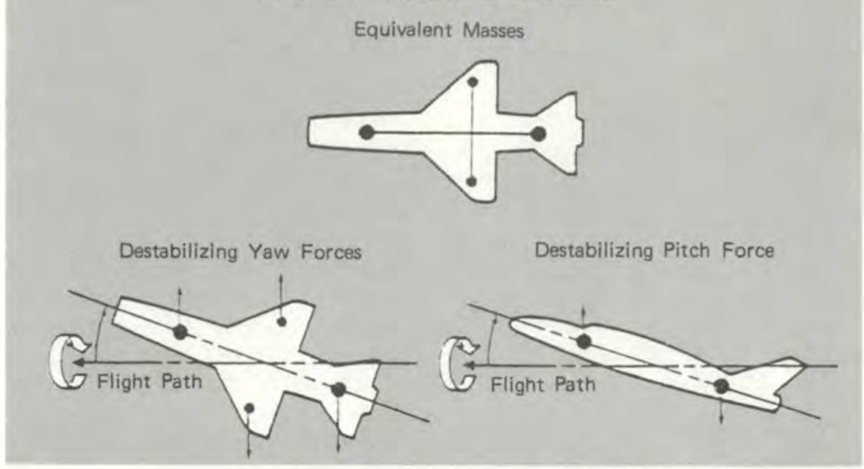
continued

FIGURE 3 - KINEMATIC COUPLING



sideslip (B), triggering roll due to yaw. Aircraft don't roll purely about their longitudinal axis, so the results are mixed with inertial coupling. To understand inertial coupling, imagine an aircraft represented by a system of weights, as shown in Figure 4. The fuselage is represented by large masses near the nose and tail, the wing by smaller masses near the wing tips. If the aircraft is rolled rapidly about the flight path (velocity vector), the masses in the fuselage will overpower the smaller wing masses and will pull the nose and tail away from the flight path. This is an example of roll coupling into pitch and is dominant at high speeds and is the reason many fighters are prohibited from continuous 360° rolls. (A more indepth explanation of this whole subject is presented in an article titled "Whifferdills, Divergences, and Other Roll Coupling Phenomena" by MCAIR project test pilot Larry Walker in *Aerospace Safety*, April 1980.)

FIGURE 4 - INERTIAL COUPLING



There are some important things to understand about coupling:

■ Aerodynamic, kinematic, and inertial coupling never operate independently.

■ It's very difficult for a pilot to judge what degree or type of coupling is present.

It's possible to get away with a coupling-prone maneuver several times; but on the next one, you could break the airplane.

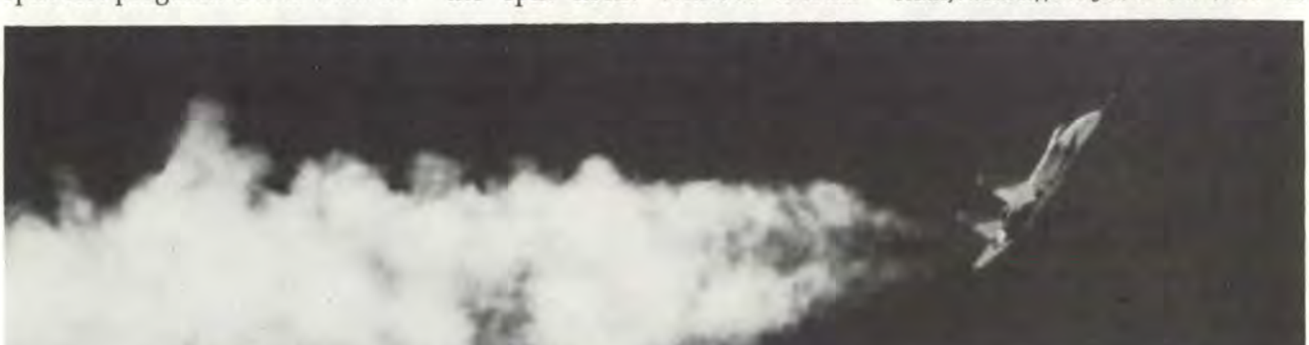
Every airplane in the world is subject to coupling to some degree, and several examples of coupling were encountered during the F-15 spin test program. Other than entering from an autoroll, they were successful in generating a spin with a clean configuration aircraft only 50% of the time. Occasionally, instead of spinning, the aircraft was inadvertently inertially coupled into a maneuver that saw G-excursions of up to +9 Gs.

Another maneuver subject to coupling is a negative G "guns jinkout" (rapidly moving the stick forward and to the right or left corner). You're walking on the ragged edge with this maneuver, and if the aircraft speeds up, it'll water your eyes. At high speeds, structural damage is a very real possibility, and at lower speeds, out of control may result. These things won't happen every time, so be careful and remember that the stick doesn't have to be against the forward stop to trigger coupling.

A third, and probably the most significant example of coupling, is the spin itself. Without inertial coupling, the F-15 couldn't spin. As in the autoroll, simultaneous yaw and roll rates inertially couple with the pitch axis, preventing a reduction in AOA. Reducing the yaw rate with recovery controls lessens the magnitude of the coupling, allowing the nose to drop.

The world of departures, spins, autorolls, and coupling is a complex one. However, total understanding of the dynamics of it all isn't necessary. An awareness of the causes (conditions/configuration) is desirable, but the most important point of this discussion is to pay attention to your airplane. It will "talk" to you and by its response (or lack of response), tell you how it feels about what's going on. The Eagle is the most stable and forgiving fighter ever built; but it can change character rapidly and become downright unpleasant if you don't pay attention to what it is telling you! ―

Courtesy *Product Support Digest*, Vol 31, No. 3, 1984. ■



For Single-Engine FIGHTER PILOTS ONLY

COLONEL JOHN M. MARVIN
ANG Advisor to the Commander
AFISC

■ Just plain good old common sense tells us that you don't shut down an engine that is running and producing thrust if it is the only engine you have — like in a single-engine fighter. Your reaction to that statement is probably, "Come on, Jack, everyone knows you don't shut down the one and only engine you have. You don't have to tell us that." But, obviously, everyone does *not* know that, and I am, therefore, compelled to say my piece.

The most recent incident involving this "lack of common sense" phenomena occurred when a single-engine fighter experienced a flashing, then steady fire warning light while descending through 18,000 feet. There was no confirmation of a fire — other than the light. The pilot made no attempt to confirm a fire by checking EGT or checking for trailing smoke. (This can be confirmed without a wingman by turning the aircraft and looking back.) He assumed he was on fire because he had a fire light and, therefore, shut the engine down at a high key position. He touched down long and fast, blew both main tires, and then jettisoned the canopy for a very rapid egress. Total cost was $48,000.

Why did he shut the engine down and blow the canopy? Because he thought the airplane was on fire. If he was convinced it was on fire and felt the light was confirmation of a fire, then he should have ejected prior to descending below 2,000 feet AGL, like the book says.

The point is that he never had a confirmed fire, or any indication of a fire, other than the fire light. The engine was operating normally. Under these conditions, common sense and logic dictate that you leave your one and only engine running until you're safely on the ground and have come to a stop. Don't panic. Take time to analyze and assess the situation. Even if every light in the cockpit is on, as long as you have power and control, maintain the status quo and get the bird on the ground as soon as practicable — utilizing an approach that will allow you to land safely if the engine does quit.

I have yet to fly a fighter that I would consider to be a good glider and will, therefore, never, never shut down my engine as long as it is running and producing thrust. (There is *always* an exception to every "never, never" rule. That exception is: If you have a stuck throttle at high power setting, then you'll have to shut it down when you've got the runway made.) ■

THUNDERSTORM!

SSGT THOMAS C. NORATO
Air Traffic Control Supervisor
Radar Approach Control
Loring AFB, ME

■ When I left for the airport that morning, I felt like I was on top of the world. I had soloed earlier that week and had advanced to a point in my training where I was flying regularly without the benefit of an instructor. If I continued at my present pace, I would be a fully licensed pilot by the end of the month. I had no idea then that later in the day I would put myself in a situation that could not only bring my flying career to an abrupt halt, but my life as well.

I pulled into the parking lot at Delaware Air Park and met my instructor on the way in. Peter Rusanowsky had been flying for over 40 years, and to describe him as merely a competent instructor would be an injustice. He was one of the most knowledgeable and skillful pilots I had ever met. My opinion was shared by others as well. Those who knew him respected him.

All through my flight training, Pete had always stressed attention to detail, from flight plans to preflight inspections of the airplane; nothing was to be overlooked. What would often seem innocuous or even trivial to me would be stressed by him. As a matter of fact, it seemed to me the more inconsequential I considered an item, the more significance he would assign to it. I realized later this was for my benefit. Pete recognized early in my training that I possessed more than my share of youthful impatience. If a shortcut existed that would bypass anything I considered tedious, I'd be sure and find it.

Today's flight called for local air work. I had about three hours of solo time under my belt and planned to continue practicing various flight maneuvers. I would need to become proficient at several if I were to pass my check ride. I remember that day was beautiful, clear blue skies with only a few scattered clouds. Not a hint of what was to develop later. I was anxious to get going — a little too anxious as it turned out. Pete had ground school scheduled for that day with another student. I waved to him on my way out to the aircraft. He waved back and told me to "Be careful. Don't miss anything." This last statement was more prophetic than I had cared to imagine.

I spent more time on my preflight than I normally did. Pete's words were still in my ears: "Don't miss anything." As I climbed into the left seat, I kept running over the numerous checklists in my mind. Had I missed anything? Weather? No, I'd followed it item for item; twice as a matter of fact. No, I hadn't missed a thing, at least not yet.

As I taxied onto the runway, checklists again whirled in my mind. Throttle to takeoff setting, apply slight right rudder to compensate for propeller torque, slight nose-up trim, flaps full down. As the airspeed indicator reached 74 knots, I eased the wheel back. I was airborne! The exhilaration I always felt at that moment was still there. It is to this day. As I climbed out into the local traffic pattern, the morning sun flashed across the cowling. I leveled off at 3,000 feet and began my training routine.

The next hour was relatively uneventful. I had completed what I planned for that morning with time to spare. It was then that I began entertaining thoughts of branching out. I had never been out of the local traffic pattern without an instructor but thought there's no time like the present. After all, it wasn't as though I was unfamiliar with the area. I had flown through it many

I could actually hear the metal straining under the force and expected the wings to rip from the fuselage at any moment.

times in the past with Pete. It was a nice clear summer day. What could possibly go wrong?

I put the Piper in a left bank and headed east. I planned a short trip out to the Delaware Bay, a distance of not more than 20 miles and then straight back. This is where I made my near fatal mistake — not the fact that I decided to leave the local traffic pattern — that decision had been left up to my discretion. The detail I hadn't considered was the weather. Although everything appeared fine, I hadn't checked the local forecast since I'd departed. The weather patterns along the eastern seaboard can be very unpredictable, especially during the summer months. Had I checked, I would have been informed of the possibility of isolated thunderstorms developing to the west, moving east.

I was about 10 minutes out when I heard a familiar voice over the radio.

"November one five seven eight X-ray, Delaware Air Park Unicom, over."

I hesitated at first. Having always been mike-shy, I didn't like using the radio.

"Delaware Air Park Unicom, this is November one five seven eight X-ray, go ahead."

"Tom, you'd better head back. It looks like we've got something developing to the west."

Pete sounded concerned.

"On my way" was my only reply.

I began a slow 180-degree turn to the north. As the western sky came into view, I felt as though my blood turned to ice water. Just west of the airport, the sky was filled with black rolling clouds. A large thunderstorm was moving eastward. Lightning flashes darted among the clouds giving them a surrealistic appearance, like something you'd expect from a Steven Spielberg movie, certainly unlike anything I'd ever dreamed of encountering in real life. I advanced the throttle to full power. The rpm needle immediately rose to just below the red line, and the engine roared as if in protest to the added strain.

At this point, I should explain that I had many options available to me. Had I taken the time to mentally review my emergency procedures, I'd have never put myself in that situation. Call it inexperience, fear, most probably controlled panic, but like a salmon returning to spawn, I was determined to reach the airport. I had mistakenly thought I could beat the storm to the field.

I was just beginning to think I might win this race against time when I first lost sight of the airport. Although I was less than a half-mile away, I was unable to see through the heavy rain squall that preceded the main storm. I reduced to maneuvering speed and continued on my last chosen heading.

Suddenly I saw the lights come on. Pete had turned the airfield lighting to its highest intensity. Without this, I'd be unable to make out the runway. Less than a quarter of a mile and I'd be home. It was then that I entered the forward edge of the storm. Immediately, the plane surged ahead, while at the same time rising almost straight up — one, two, maybe three hundred feet. It was impossible to tell. As soon as I attempted to compensate for the upward surge, the storm's fury forced the plane back down.

This extreme buffeting was almost more than this aircraft would stand. I could actually hear the metal straining under the force and expected the wings to rip from the fuselage at any moment. Torrential rain pelted the windscreen, and I almost lost sight of the runway again.

I was directly overhead now and trying to maneuver to a safe landing. My mind was racing, attempting to recall everything I had learned from Pete regarding emergency control of an aircraft. I felt like I was at the mercy of the wind. The instruments were useless now, and if I didn't get on the ground within the next few minutes, I'd be in the heart of the storm. If that happened, it was all over.

I still had the runway in sight off my left wing. If I could just swing her around, cutting the engine at the same time, maybe I could execute an emergency landing. I lowered the flaps, began my left turn, and prayed. Halfway into the turn, the wind shifted radically. The effect was disastrous.

As my airspeed dropped off, I began losing altitude much too rapidly. If I was unable to compensate, I would crash short of the runway.

continued

Lightning flashed just off my right wing as I pushed the throttle to the firewall. At the same time, I reached down and reduced the flaps by a third and nudged the wheel forward slightly. This caused me to sacrifice even more altitude; however, it was in exchange for the critical airspeed I desperately needed to regain if I were to stay in the air.

I tried to keep the runway in sight as I felt my airspeed increase. Again the wind shifted. It seemed to be coming from different directions at the same time. I was in another updraft. Seconds later, I was too high. I couldn't believe it! One moment I'm about to crash short of the airport and the next I'm too high and about to overshoot it!

There was no time to review any checklists now. A maneuver I had seen Pete perform only once before was my only chance. I don't even remember thinking about it. It was almost as though someone else were flying the plane.

I slammed full left rudder and full right aileron. The effect, known as cross control, caused the airplane to slide sideways, straight for the runway. As I passed over the runway threshold, I quickly repeated this maneuver to the opposite side. This swung the nose around and lined me up with the runway about 10 feet off the asphalt. I cut the engine and pulled back on the wheel. After bouncing several times, I applied the brakes and came to a screeching halt halfway down the runway. The storm was directly overhead now, and I had to wait for it to pass before I was able to taxi back to the hangar.

My encounter with that thunderstorm was almost 10 years ago and needless to say, I still remember it like it was yesterday. I've since gone on to obtain my private pilot license and have overcome my aversion to using radios. As a matter of fact, I use radios for a living now as an air traffic controller. Regrettably, I've long since lost track of Pete, but I wouldn't be a bit surprised to learn that he was still instructing young pilots. To this very day, the legacy he left me has endured. Whenever I find myself preparing to undertake a venture involving uncertainty or risk, I can still hear him loud and clear, "Be careful, Tom. Don't miss anything." ■

What I ~~Want~~ Need!!! From My Flight Commander

From:
2d Lt I.M. Newguy
As told by:
MAJOR PAUL R. HERRMANN
507 TAIRCW/SEF
Shaw AFB, SC

Dear Flight Commander:

■ First, and maybe most obvious, maintain technical competence in your flying skills. We will be depending on you to know your job, indepth, as an expert. Teach us what we need to know, but don't do it only as problems arise — as a part of a "firefighting" process. Do it on a systematic and regular basis as a part of our relationship — right from the first day we begin to work together.

Be aware of your own limitations and don't try to "snow" us. You will probably be able to get away with it for a while. But when I do catch you, as I inevitably will, you're going to lose the one thing that our relationship can't really exist without, and that's credibility. It's much better to admit being wrong or even ignorant about a situation than to try to take it through when you know you're over your head. Simply put, I can handle the knowledge that you don't know everything much better than I can handle the knowledge that I can't fully trust what you tell me. So Point No. 2 is: "Be aware of your own technical limitation."

Develop good communications skills, both written and oral. "Orders" are the least effective way of getting things done in any endeavor because "personal commitment" is the key ingredient that makes for success in any effective organization. Always remember that what you say is really no more important than how you say it. Point No. 3, therefore, is to develop good communications skills.

Be skillful in your advisory role. Develop the sense to distinguish between situations that require you to simply delineate issues for your boss and those that require you to take an advocacy role, ranging from a simple recommendation to a ringing insistence. The officer who is continually excited about the issues at hand, who is always outraged, upset, angry, or absolute can't possibly be as effective in the long run as the man who knows how to vary his pitch according to the needs of a particular situation. Likewise, the smart officer realizes that he doesn't have to win every contested point in order to be successful, and saves his "big guns" for the times they're needed most. Be willing to lose a skirmish in order to win a war.

Be loyal. Be charitable of my faults, and don't play the big man by cutting me down to your peers, tempting as that may be. Criticize me face-to-face when necessary, because it's really one of the services I need from you. Never forget that your ultimate loyalty is to the wing and the Air Force mission.

Keep me informed at all times. Don't so overload me with details and worries that I lose sight of the overall picture. Be sensitive and tuned in to my need and my desire for detail. We all work for a commander whose safety responsibility is an important concern — but only one concern out of a long list. Your ability to optimize your relationship with your commander is as important to your ultimate success as is your professional competence.

I hope that at least a few of these suggestions will strike home and by doing so, help us do a better job for the Air Force. ■

Sincerely yours,

I. M. Newguy

AN ILL WIND

The effect of wind on the landing performance of aircraft is one of the first and most fundamental lessons of flying taught to all pilots. As an individual's experience level and skills increase, so too does his or her ability to safely accommodate more demanding landing conditions. Notwithstanding this, no pilot can afford to ignore the likely effect of wind. A careful assessment of surface conditions is essential before any landing is attempted. This article reviews a mishap in which a pilot did not assess the wind speed, landed with an extremely strong tail wind, and substantially damaged his aircraft, a Beech Bonanza, when he overran a 2,500-foot landing area.

The Accident

■ The pilot had arranged to take some of his family and friends out to his country property. Including the pilot, the party numbered five and, with the fuel load carried, the aircraft's weight and center of gravity were comfortably within limits.

After a midmorning departure, a routine flight to the property was made. Because the strip — which was aligned 155/335 degrees — sloped up towards the southeast, the pilot was in the habit of always landing in the 155-degrees direction. The gradient was 5 percent for about the first third of the strip, decreasing to 1 percent for about the last half.

There was not a windsock at the landing area, but a nearby windmill was often used to gauge the wind. The pilot noted from the tail vane that the wind direction was from the northwest, blowing almost straight down the 155-degrees strip. As the mill's rotary vanes were locked at the time, they could not be used to estimate the wind speed. However, the pilot was confident that conditions would be satisfactory as he had spoken by telephone to the property manager and another pilot earlier in the morning, and both had reported the weather as fine.

The approach seemed satisfactory to the pilot, who later recalled that the airspeed indicator was registering about 80 knots — the speed he was aiming for — on final. He planned to land at a point about 700 feet from the threshold, which was the crest of the 5-percent gradient. The aircraft actually touched down almost 1,000 feet from the threshold, and the pilot stated that he experienced difficulty in getting the aircraft to "stick" on the ground. He quickly realized that he was going to have problems in stopping the aircraft before the end of the runway and, as he considered a go-around was not possible, began to apply heavy braking. This did not have the desired effect so, in order to stop, he deliberately ground-looped the aircraft. This caused the left main gear to collapse and the left wing to strike the ground.

After the aircraft stopped, the pilot shut down the engine, turned off the switches, and all of the occupants exited the aircraft unhurt. On getting out of the aircraft, the pilot was surprised by the strength of the wind — which he estimated at 15 to 20 knots.

Analysis

In fact, the wind speed was on the order of 30 knots, almost directly down the 155-degrees strip. While the approach had seemed normal to the pilot, several witnesses subsequently recalled that the aircraft seemed to be traveling "very fast" on final. Some simple calculations confirm that this must have been the case.

Based on the approach airspeed of 80 knots, the aircraft would normally have achieved a threshold speed of about 75 knots. In normal circumstances, assuming a 10-knot headwind, the aircraft's groundspeed just before touchdown would have been about 65 knots. In this instance, with a 30-knot tailwind, the groundspeed would have been about 105 knots — an increase of about 60 percent on the norm!

See Mail Call, page 21, January 1986, FSM

While there were several factors contributing to this mishap, the matter of the pilot's failure to assess the windspeed is the most significant in terms of flight safety: Given that the pilot concerned confined himself to one-way operations on that particular strip, he undoubtedly would have abandoned his attempts to land there had he appreciated the strength of the tailwind.

Assessing Wind Velocity

At the beginning of this article, it was mentioned that one of the first lessons given to pilots is that of assessing the effect of the wind on landing, and this lesson will invariably include instruction on how to "read" a windsock. Every pilot should know that a windsock which is being blown out parallel to the ground indicates a wind of about 30 knots, while one at 45 degrees to the vertical indicates about 15 knots. (See Figure 1.)

All authorized landing areas should have a suitable means of determining the wind velocity. At any unmanned aerodrome, a windsock provides the best means by which a pilot can assess the wind velocity. However, on occasions, circumstances do arise which cause pilots to land at areas where no windsock is available. If you find yourself in that situation, then Figure 2 showing how to assess wind speed may be of use. Figure 2 is an extract of information provided to meteorological observers by the Australian Bureau of Meteorology.

Crosswind

While this discussion has concentrated on wind speed, it is also most important for pilots to be able to assess any crosswind component. Many pilot's operating handbooks contain graphs for this. Sometimes, however, it is difficult to use graphs in flight, so the following guide may be of use. If the wind direction is 30 degrees off runway heading, the crosswind component will be half of the windspeed; for 45 degrees off, it will be 0.7; and for 60 degrees, 0.9.

For example, if you were landing on Runway 36, the following crosswinds would apply.

Wind	Crosswind Factor	Crosswind Component
330/20	0.5	10 knots
315/20	0.7	14 knots
300/20	0.9	18 knots

Summary

While the effect of wind on landing performance is one of the first and most important lessons taught to pilots, some continue to ignore it — often to their regret. A careful assessment of wind velocity — that is, both direction and speed — is essential before any landing is attempted. If circumstances force you to land at an aerodrome without a windsock, then you should be prepared to be able to use the terrain to make your assessment. — Adapted from *Aviation Safety Digest* 118. ■

Figure 1

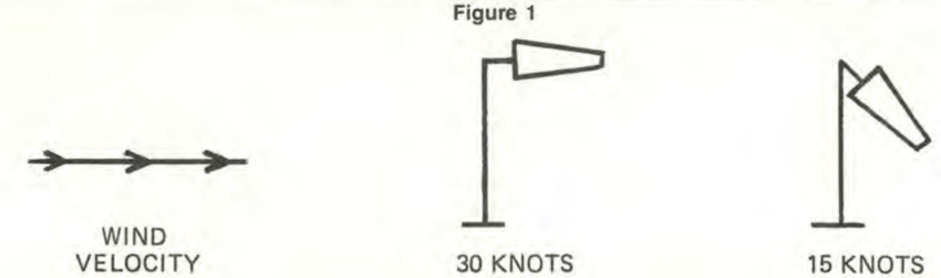


Figure 2

Description	Wind speed (knots)	Visual clues
Calm	1	Calm; smoke rises vertically.
Light air	1-3	Direction of wind shown by smoke-drift but not by wind vanes.
Gentle breeze	7-10	Wind extends light flag; leaves and small twigs in constant motion.
Moderate breeze	11-16	Raises dust and loose paper; small branches are moved.
Fresh breeze	17-21	Small trees in leaf begin to sway; crested wavelets form on inland waters.
Strong breeze	22-27	Large branches in motion.
Near gale	28-33	Whole trees in motion.
Gale	34-40	Breaks twigs off trees.

Note that if it is possible to determine the wind speed, then the direction should be obvious.

"G," What's New?

KENT K. GILLINGHAM, M.D., Ph.D.
USAFSAM/VNB
Brooks AFB, TX

Dr. Gillingham is heavily involved in research on "G" tolerance at the USAF School of Aerospace Medicine (USAFSAM). In this article, he summarizes the current state of our knowledge in the area. His comments on issues of interest include body position, recent "G" exposure, "G" suits and valves, training, physical conditioning, and assisted positive pressure breathing.

Body Position

■ A most important aspect of the GLC problem has come into focus as a result of recent mishaps. As Lieutenant Colonel (Dr.) Geoff McCarthy (F-16 pilot physician and TAC weapons system flight surgeon) has noted, most, if not all of the mishaps in which GLC is suspected have occurred when the pilot was not only pulling a high G load, but also was presumably turning his head and/or body to check for the adversary behind his aircraft.

To generate effective protection against a 7-9 G load with a properly performed anti-G straining maneuver is difficult enough under ideal conditions, i.e., with the head and trunk in line and facing forward in the seat. Contorting the body to acquire a bogey behind the aircraft most certainly compromises the efficacy of the straining maneuver, if only because coordination of all the motions involved — tensing the arms and legs, grunting cyclically, grabbing the towel rack, turning the shoulders, turning the head, looking, talking, etc., is difficult to accomplish.

It is also possible that the defensive position increases the heart-to-head hydrostatic column height, thus reducing G tolerance. The twisting of the head on the neck may even reduce the blood flow to the head, either by a direct mechanical effect on the carotid or vertebral arterial systems, or reflexively through an undesirable effect on the carotid sinus baroreceptors. I seriously doubt, however, that GLC events in the aircraft represent anything more than the inability of the pilot to strain effectively, either because he can't coordinate his straining with his "checking six," or because he doesn't know how to do a fully effective straining maneuver in the first place.

Until we do understand fully the effect of "checking six" on G tolerance, however, every TAF pilot should be warned about the extreme hazard associated with pulling high G loads while looking behind him for bogeys, and should be admonished to ensure that his straining maneuver is sufficiently vigorous when he must both look and strain at the same time. There is considerable research underway to determine the effect of defensive body positioning on G tolerance. Centrifuge training is including defensive body positioning as part of the G-training program.

Recent "G" Exposure

G tolerance is definitely improved by frequent exposure to G stress. Conversely, lack of recent exposure to high G results in the lowering of G tolerance below one's maximal tolerance level. We do not know exactly the mathematical relation between frequency of G exposure and tolerance level, but we do know that three-times-a-week exposure to high-G stress results in noticeably higher straining (cf. relaxed) G tolerance than does once weekly, and once weekly exposure provides greater tolerance than does once monthly, and so forth.

Again, we plan to do experiments on the centrifuge to determine the optimal frequency of G exposure for providing high G tolerance and to describe the rate at which G tolerance decays after a layoff from frequent and regular exposure to high G. We know enough right now, however, to advise that pilots be made cognizant of the fact that infrequent exposure to the high-G environment has a deleterious effect on G tolerance, and that returning to high-G flying after a layoff of several weeks or so should probably be accomplished in stages (i.e., by flying sorties having low and moderate G demands before attempting a high-G engagement).

"G" Suits and Valves

It is possible that a faster-inflation anti-G suit could prevent fighter/attack aircraft mishaps. The Air Force has improved anti-G connectors for the F-16, and it is working on other fighter/attack aircraft.

A new type of anti-G suit, the reticulated foam suit, is also being developed, and centrifuge testing of this suit will begin shortly. There might be something that can be done to improve the effectiveness of the present anti-G suit, however.

We at USAFSAM are aware of the advice being given to pilots that the anti-G suit should be fitted so that it is tight around the calves, snug around the thighs, and loose enough around the abdomen to allow insertion of a fist between the suit and belly wall. We do not concur in this recommendation; and we disagree with the rationale that led to it — namely, that a milking action resulting from the upward sequential pressurization of the bladders will provide a significant improvement in G tolerance.

On the contrary, we are of the opinion that the anti-G suit should fit tightly all over. If the abdominal bladder does not fit tightly, it tends to assume a spherical or toroidal shape rather than the desired pancake shape, and the less uniform pressure distribution over the abdomen results in a pinching effect, which is not only quite uncomfortable but may also impede venous return, thereby preventing maximal effectiveness.

Furthermore, it has been shown experimentally that the abdominal bladder is by far the most important component of the anti-G suit, and the calf and thigh bladders contribute relatively little to the effectiveness of the suit. Not to fit the abdominal bladder tightly would therefore seem especially likely to compromise the overall effectiveness of the suit and does not appear to be good advice.

Training

High-G centrifuge training has a greater potential for preventing mishaps due to GLC than does any other proposed near-term solution. This is because the instruction that most pilots have received on the anti-G straining maneuver has been inadequate to prepare them for the rigors of the current operational high-G environment. The fault is not necessarily with the physiological training community or the instructor pilot community, but rather with the system for not providing the pilots the chance to learn, practice, and perfect their straining maneuvers under actual high-G conditions.

High-G centrifuge training for TAC pilots was begun at USAFSAM in 1972 and terminated by TAC in

continued

"G," What's New? continued

1973. It was begun again in 1983 but terminated this time because the USAFSAM centrifuge was shut down for the high-G-onset upgrade. Training of TAC pilots began again at USAFSAM in late 1984. Centrifuge training of USAFE pilots is currently well underway: Six pilots are being trained every two weeks on the Dutch centrifuge at Soesterberg, Netherlands. Eventually, all TAF pilots will receive high-G centrifuge training at Holloman AFB, New Mexico, as part of Fighter Lead-In Training, and plans to acquire the training facility are already in the first stages of implementation. It will be early 1986 before the Holloman facility will be completed, however. Until then, USAFSAM will provide centrifuge training.

Presently, USAFSAM is refining its high-G centrifuge training methods to incorporate pilot control of G level; a tracking and shooting task; a wide-field visual display; and other devices to make the training more valid, realistic, and acceptable to the trainees. In the centrifuge, we are also demonstrating the effect of defensive head positioning on G tolerance as a part of the training for the TAC pilots.

Physical Conditioning

Our position on weight training and aerobic conditioning for G tolerance remains the same as it has been for the past five years. We feel that weight training improves G tolerance and should be part of fighter pilots' exercise habits. We also feel that a moderate amount of aerobic conditioning is beneficial, but that excessive (marathon-type) aerobic conditioning is counterproductive in that it seems to be associated with lower G tolerance, a tendency to develop cardiac dysrhythmias during and after G stress, and increased susceptibility to motion sickness. The Air Force Surgeon General's April 1983 guidance on the subject of physical conditioning for G stress is reasonable and should be followed by fighter pilots who are serious about their profession.

Assisted Positive-Pressure Breathing

The only other potential near-term solution to the GLC problem that offers substantial promise is assisted positive-pressure breathing (APPB). The program to develop and test a G-protective system based on APPB is well under way at USAFSAM, and the results so far indicate that APPB reduces fatigue due to high-G stress. We hope also to demonstrate that APPB reduces the likelihood of GLC during high G loads of rapid onset and prevents the loss of G protection resulting from "checking six" or from not anticipating the G load.

This system is part of the proposed Tactical Life Support System which USAFSAM is testing on the centrifuge in 1985. Flight testing on an F-15 is planned for 1986. Ultimately, an APPB system retrofit for the F-16s and other fighter aircraft could be provided at a relatively modest cost. Support of the APPB anti-G system should be strongly encouraged to ensure the rapid transition of this anti-G technology to the field. ■

Why Pilot Reports (PIREPs)?

SMSGT TEDDY L. FORD
HQ Air Weather Service
Scott AFB, IL

■ "Mommy, where do PIREPs come from?"

"Why, they appear like magic each day in Air Weather Service (AWS) units around the world."

It sounds silly, but some of our people must believe that to be the case since the tried-and-true procedure of "*asking*" a pilot for a PIREP seems to be a dying art! A recent meeting with aviators from throughout MAC revealed that many pilots think that AWS forecasters no longer really want PIREPs! Granted, PIREPs do take time out of an already busy duty schedule, but let's look at the consequences of intentionally neglecting these "observations from above."

The most obvious result of not obtaining a PIREP when the opportunity knocks is that significant weather phenomena (icing, turbulence, thunderstorms, wind shear, etc.) might be completely overlooked. This can be disastrous to the pilot who is subsequently briefed into that weather without forewarning. In fact, there may be no other indication that a military weather advisory (MWA) should be issued for turbulence and/or icing except for that input from a pilot who encounters the phenomena. Many times, the first indication of a thunderstorm in an area is the thunder clap that announces its arrival overhead. However, a pilot flying in that area could easily provide a heads-up warning of the approaching storm cloud if a PIREP were requested (*or voluntarily provided by the pilot*). Many more examples could be cited, but it is already obvious that it's in a forecaster's best interest to actively seek (and in a pilot's best interest to provide) a PIREP whenever the opportunity presents itself.

But forecasters are not the only ones who benefit when PIREPs are obtained. Remember, a most important part of the PIREP process is the timely transmission over local and longline communication circuits. Air Weather Service regulations require that virtually all PIREPs be transmitted. This means that other AWS units throughout the country receive the information in a matter of minutes.

So, who else benefits when the PIREP is transmitted? The first will be the local customers supported by the unit receiving the PIREP. Flight schedulers, operations officers, flying unit commanders, and air traffic controllers all make many important decisions each day which impact directly on the safety of others. Obviously, the more information available during the decision-making process, the more reliable the decision. And when the PIREP is transmitted longline, the number of beneficiaries increases dramatically. When those other weather units receive the information, they use it to update and improve their pilot briefings and forecasts. Also, the forecast centers use the information in the preparation of their products, such as military weather advisories, weather warnings, special mission briefs, and weather analysis and forecast packages.

Of course, the real object of the PIREP Program is the enhancement of pilot safety, and that means that pilots are also included in the number of beneficiaries. In other words, a *lot* of people may be denied access to critical data when a significant PIREP is not transmitted, but *everyone* loses if a PIREP is never provided in the first place!

It's apparent that the success of the PIREP process depends on several people, but undoubtedly, the most important player is the pilot. The whole process is degraded if the pilot doesn't take seriously his responsibility to report significant meteorological elements or events. Probably every pilot has inadvertently flown into some weather hazard (such as turbulence, icing, etc.) and wondered why he was not forewarned. But how many have subsequently reported the phenomena in a PIREP so that other pilots can be briefed about its existence and location?

Even with today's technology, weather prediction is still a very inexact science, and when even the current weather in a particular area is unknown, the job becomes much more difficult. That's where a pilot's observations can be absolutely invaluable. For example, a pilot flying over a valley observes (and reports) that it is obscured in fog. A nearby weather detachment may not have any indication of this from normal data resources, but with the pilot's input, the forecaster can confidently brief the fog's existence and predict the time of dissipation. Other pilots could now be warned that low level VFR minimums could not be maintained through that valley. The end result of that one PIREP is a greatly reduced possibility that a pilot would fly unexpectedly into a potentially disastrous flight hazard.

The bottom line is that PIREPs constitute a valuable source of atmospheric information that should not be overlooked. It is not only important for forecasters to ask for them and transmit them, it is equally important for pilots to voluntarily provide them, whenever possible. It's a simple but effective way to ensure that forecasters have the most current and accurate data available for weather briefings. This translates directly into improved flight safety for all pilots, and we in Air Weather Service view that as our primary objective! ■

Pilot Error Mishaps... and YOU

COLONEL PAUL F. ROST
Directorate of Aerospace Safety

■ This article is written to *you* the TAF fighter pilot. Its purpose is to provide you some statistics about yourself and where you fit in the overall mishap prevention program. If you're like most of us, first of all, you don't intend to become a mishap statistic, and second, are working hard each day to see you fulfill the first. However, in the day-to-day rat race of doing the job, we unfortunately find our desires do not always match reality.

Over the years, most fighter pilots have come to believe their highest risk is when they first start in the business — at RTU, and risk goes down gradually as experience builds. Thus, we go to great effort to closely supervise our young pilots, both in the RTU and upon assignment to their first unit. But, as we move up the experience chain, several things happen.

First, as fighter pilots we have matured and hopefully are winning more than our fair share of nickels and quarters. In addition, we have progressed from wingman, to flight leader, to instructor pilot, and to supervisor.

While each new job carries greater responsibility, our increasing maturity, judgment, and technical skills allow us to handle the additional load while still reducing the mishap risk below that at the entry skill levels. After all, look at other activities in our lives. As auto drivers, our insurance rates go down as we pass age 25, surely an indication our mishap probabilities are also decreasing. Ground safety statistics also show young people are more prone to on-the-job mishaps than older workers. Everything in our heritage teaches us to jump to this conclusion; and in fact, it appears to be accepted by most of us.

Ask a supervisor what he is most concerned with regarding safety, and invariably it will be over the mishap potential of his troops. Not him, but his guys. However, have you noticed the number of flight leaders, instructor pilots, and supervisors who have been involved in pilot error mishaps recently? Our concern for this led to a study of pilot error mishaps by duty title for the active duty TAF. This article will discuss what was found.

The study reviewed pilot (ops) error mishaps in the active duty TAF (TAC/USAFE/PACAF/AAC) for the years 1980-1984. They were grouped as follows for data collection purposes:

- Wing Staff — Includes all pilots assigned or attached to the wing such as CC, DO, DOT, DOV, DOW, etc.
- Sqdn Cmdr/Ops Off — Flying squadron commanders and their operations officers.
- Flt Cmdr/ADO — Squadron flight commanders and squadron assistant operations officers.
- Wpns Off — Squadron weapons officers.
- Flt Lds — All qualified flight leads in the wing.
- Non Flt Lds — All nonflight lead qualified pilots, excluding those enrolled in RTU.
- IPs — All instructor pilots in the wing.
- RTU Student — RTU students.

The data provided the following insight into the duties/qualifications of these pilots:

- There were 113 Class A mishaps that had operator error as a cause factor. These mishaps are broken down as follows:
- 91 ops-error only mishaps.
- 9 ops error mishaps that also had log causes.
- 13 log mishaps that also had ops error causes.

In these 113 mishaps, there were 130 pilots listed as causal. To be listed as causal, the pilot had to be in the mishap aircraft or part of the mishap flight. Only one cause was counted per aircraft — i.e., only one cause counted in instances where an IP and pilot were in the mishap aircraft. In addition, situations where the Supervisor of Flying was found at fault are not included in this data. Some mishaps involved midair collisions in which both pilots were found at fault; and some involved cases where the wingman or leader with the mishap pilot sustained the mishap sequence through his own action or inaction and was therefore also listed as

Attention supervisors: Mishap statistics are pointing towards a disturbing shift in the higher risk areas. The trend is moving away from the beginning pilot as having the most mishaps per flying hour towards you, the experienced pilot, now tasked with the responsibilities of supervision.

causal. For example:

- 6 midair collisions resulted in both mishap pilots being found at fault.
- In 11 mishaps which did not involve midair collisions, the nonmishap pilot was also faulted.

Looking at our data by duty titles, we find further contradiction of our traditional expectations of who's involved in aircraft accidents. Mishap rates were calculated by duty titles and are shown in Figure 1.

Notice that squadron commanders/operations officers, squadron weapons officers, flight commanders, squadron assistant operations officers, and pilots out of RTU with less than 500 total hours all have a mishap rate above the overall rate.

Our last chart (Figure 2) shows the mishaps by various job categories and duty titles. Note that some pilots may fit several catagories — i.e., all instructor pilots are also flight leads and many IPs are also flight commanders, etc. Data is listed in both categories in these cases so the category totals will exceed the total mishaps.

Figure 1
Mishap Cause Rates By Duty Titles (1980-84)

Duty Title	No. Pilots At Fault	Avg Hrs in 1984	No. Pilots This Category	Mishap Rate
Sqdn CC/DO	10	177	240	5.1
Sqdn Wpn Off	10	230	248	3.8
Flt Cmdr/ADO	21	212	582	3.7
Less Than 500 Hrs Total (Non RTU)	17	204	489	3.7
Actual Cause Rate	130			3.45
IPs	50	218	1,517	3.3
Wing Staff	18	178	769	2.9
RTU Student	5	148	328	2.2

Figure 2
Mishap Causes By Duty Titles/Job Categories In The Active Duty TAF

Title	80	81	Year 82	83	84	Total
Total Mishaps	34	32	43	36	31	176
Ops Cause Mishaps	23	23	23	21	23	113
Total Ops Causes	25	28	25	27	25	130
Supervisors (Total)	10	12	10	7	10	49
Wing HQ Staff	2	6	2	5	3	18
Sqdn Cmdrs/Ops Off	3	1	3	0	3	10
Flt Cmdr/Sqdn ADO	5	5	5	2	4	21
Nonsupervisors	15	16	15	20	15	81
Squadron Wpn Off	1	1	2	3	3	10
Instructor Pilots	8	10	10	10	12	50
Less Than 500 Hrs Total	2	7	2	3	3	17
Flight Leads	17	17	18	18	18	88
Nonflight Leads (not including RTU)	7	9	5	9	7	37
RTU Students	1	2	2	0	0	5

Now that you've been inundated with numbers, what do they mean? First of all, I'm the first to admit a cause/effect relationship cannot be proven from the raw data. But I can provide what I believe are plausible explanations.

First, I think it is true young pilots have a higher inherent mishap potential than older pilots. We all seem to "sense" that and I too believe it is true. Notice the lowest mishap rate we have is in the RTU. However, upon graduation and arrival in the operational unit, the rate jumps above the norm during the remaining hours below 500 hours total. I believe this is a sign we manage risk more closely in the RTU environment, exposing students to new risks in a highly structured approach. Upon arrival in the operational unit, the demands of the mission put us in the mode where the structure is far more flexible, and supervision is usually not as close.

In this environment, flying skills build, and proficiency and judgment improve as the pilot concentrates on becoming a good wingman. However, soon his flying time qualifies him for flight lead duties and, eventually, instructor pilot. During this time, the mishap potential decreases slightly as the pilot continues to concentrate on being the best possible fighter pilot — and teaching others how to be one too.

The turning point comes when the now experienced pilot enters into the ranks of the supervisor as a flight commander. By this time he is an accomplished IP — in most cases. In some cases, he is a newly checked out pilot coming off a staff tour, who is called upon very quickly to take up duties commensurate with his rank. In either case, his workload has expanded significantly. Now, instead of flying and additional duties, he is also responsible for his people and their flying and additional duties.

It is about this time that I believe

continued

Pilot Error Mishaps . . . and YOU

continued

the supervisor makes an erroneous assessment of risk. In looking at his task of stuffing the proverbial "ten pounds of you know what into the five pound bag . . ." he may unconsciously develop the following logic:

■ My young troops are high risk pilots. I need to manage their exposure closely. That means I can't load them down too much with additional duties.

■ I want to get ahead, and I'm a leader; that means being where the action is and working harder than anyone else.

■ I'm an experienced fighter pilot and am no longer in the high risk category. With my experience, I am operating below my max capability when I fly, i.e., I have "reserves."

■ As a supervisor, the screw-ups that get noticed are in the paperwork/squadron management area. I can't afford to highlight myself here.

■ Since I'm a strong pilot, I needn't worry too much about my flying, but if one of my wingmen gets in trouble, it'll be my hide — so I'll watch them like a hawk.

It shouldn't take us long to realize the supervisor's attitude, desire to do the job, and the workload itself are setting *him* up as a high risk pilot. To prevent everyone else from becoming overloaded, he is taking it all on his shoulders because it's the ". . . only way it can get done safely . . ." and he becomes task saturated. He also may become a victim of chronic fatigue — either self-induced or through the mandatory demands of the job. When things are normal, he continues to "hack it," but when the unplanned stressor hits in flight (bad weather, emergency, mission not going as planned, etc.) — he may be shocked to find his reserves just aren't there. Remember, none of us think as clearly under stress as we do sitting in the snack bar drinking a cup of coffee.

Think also of the flight demands on this supervisor. He is called upon to make all the decisions; such as tactics to use, go, no-go calls, alternate missions, flight planning, etc. Many of us have regaled our young troops with stories claiming it is more difficult to lead than to follow. Well, the mishap statistics certainly seem to indicate it is!

We all "know" the RTU business is high risk. Compare our success in managing risk in the RTU business — at Luke AFB in the early 60s, one or more mishaps per month was common. Now RTUs have gone for several years without a single mishap. The Air Force succeeded there because we recognized the risks were out of balance with the training requirement. If this study helps you reassess the risk versus the requirement and aids in keeping you off the mishap charts, then it has served its purpose.

My bottom line is this. For different reasons, we are all operating at about the same level of risk. When you're managing risk, be sure you include yourself as part of that risk, rather than assuming it away. Supervisors need to be supervised too — perhaps one of their greatest faults is that with experience they have learned to "hide" the effects of stress and fatigue better than the young troops, so we tend to assume it isn't there. There are no "free lunches." What are you doing to manage *your* risk? ■

MAIL CALL

The Rest Of The Story

■ You have probably heard Paul Harvey do one of his radio segments on the rest of the story. They usually begin with some striking event or unusual circumstance, and it is only after some explaining or the telling of the whole narrative that the listener learns what he calls the rest of the story. Well, in your April 1985 issue, you have a "humdinger" — buried in Maj Huddleston's article about B-52s in Figure 2 on page 7, which breaks out causes for Class C mishaps. The very last item is "Deer Strike." If one pauses to consider all the mental images conjured up by these two words, one would agree we need the rest of the story — even if only to reassure us that the story is suitably plausible and mundane. On the other hand, if this were a large mammal's equivalent of a bird strike . . . thereby hangs a tale.

TSgt Robert Busch
Maine Air National Guard
Bangor ANG Base, ME

Yes, this was a mammalian equivalent of a bird strike. Such problems are not uncommon at northern bases. But then, the South has its problems, too. I once had to make a go-around at Moody AFB because there was a 12-foot alligator sunbathing on the runway. — Ed.

Unsafe AN/MRC-108 Depiction

The April 1985 issue of *Flying Safety* depicts a serious safety error on the cover and again on page 11. I am referring to the AN/MCR-108 Radio Jeep M416 Trailer. The MEP-26 generator mounting does not comply with TO specs. The generator pictured is located crossways at the front end of the trailer, which moves the trailer C/G too far forward. This, in turn, places an excessive load on the M151 pintle hook, which is rated at a 60-110 lb vertical load. I have been driving the AN/MRC-108 for about 16 years now (accident free) and know that it is, at best, an unstable beast. In the configuration shown, it is an accident looking for a place to happen.

MSgt Michael J. Childs
Maintenance Supervisor
Det 3, 4th Combat Information Systems Squadron

You are correct that the configuration, as pictured, does not comply with the basic AN/MRC-108 TO. However, the MRC-108 in our photographs and all combat control team units are configured, as you see, as a result of a retrofit modification in the mid-1970s.

This mod, approved by MAC and AFLC, allows combat control teams to load as much as 1,250 pounds of equipment — including the MEP-26 generator in the M416 trailer. Because the load is balanced, there is no excessive load on the pintle hook. ■

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OPS TOPICS

Unplanned Cross-Country

■ Two F-4s made a planned formation landing. Everything went as advertised until No. 2's nose gear touched the runway. At this point, the aircraft began to drift toward the edge of the runway (away from lead). The pilot engaged nosewheel steering to correct back to the center of his side of the runway. Nosewheel steering and normal braking did not seem to be working, so the pilot used full left rudder and left aileron in an attempt to correct back to the left. Again, the flight control corrections were ineffective. The pilot then pulled the emergency brake handle and applied left brake, but could not prevent the aircraft from departing the runway. The aircraft left the runway 3,500 feet from the approach end and paralleled the runway for another 2,000 feet before coming to a stop. After shutdown, investigators discovered a broken utility line to the right slat. This depleted the utility system just prior to, or during the landing.

More On Birds

Thanks to a Flight Safety Foundation bulletin, we have some ICAO bird strike statistics for 1982. Worldwide, there were 3,159, of which more than two-thirds took place in daylight. About 90 percent of the hits occurred during or shortly after takeoff, or on approach or landing. The great majority were below 2,500 feet AGL and only 77 involved substantial damage (to the aircraft). Two unexplained but interesting facts: 6 strikes occurred while the aircraft was parked; 40 of the unlucky birds hit the tail of the aircraft. Speedy birds. . . . — Courtesy ASRS *Callback*, Sep 84.

On Guard!

I wasn't a new pilot. I had over 2,500 hours, mostly B-52s. I wasn't a new IP. I had spent five months in PIT honing my instructor skills, and I had joined my new flight two months before my previous class graduated to T-38s. I figured I had seen almost everything by now and what I hadn't seen with a student, I was sure they had shown me sometime during PIT. However, this was my first "beginning" student. One of the most difficult things to teach, I found, was how to trim. To keep reminding the student during the overhead pattern my instruction might sound something like this:

OK, put out the speedbrake, trim, trim, trim, trim; no, leave the power at 60 percent; lower the gear now, trim, trim, trim, trim; lower the flaps, trim, trim, trim, trim; add some power, trim, trim, trim, trim; OK, we'll roll off the perch abeam the lake, trim, trim, trim, trim; watch your airspeed, trim, trim, trim, trim.

Sound familiar? Well, what else was I doing during this fusillade of instruction? Of course, I was watching airspeeds, aircraft attitude, ground track, clearing, and all the other things good IPs do to keep the pattern safe. What I wasn't doing was watching my student. All the time I was saying trim, he was trimming like a bandit. Unknown to me, he had full nose up, trim set, and was actually "holding" the nose down with forward pressure on the stick. I can't imagine what was going through this kid's mind, but he couldn't have gotten a word in anyway. Well, we got to the perch, and he released the forward stick pressure to roll off the perch. Where do you think we were by the time I got on the controls? That's right, 30 degrees of bank, power way back, flaps down, gear down, speed brake out, and about 40 degrees nose high with the airspeed unwinding through 100 KIAS. We lucked out and "cheated death" that time. Next time, I think I'll make sure what I say is exactly what I want done, and I'll be a lot more careful about watching how the student does it! — Courtesy *ATC Kit.*

Turn To What?

While descending on a standard arrival, our flight was apparently told to "turn to 270 degrees and slow to 250 knots." I responded, "Turn to due west and down to two five 0." As we went through FL270, we heard someone else at FL260 and immediately questioned the controller. He confirmed that the clearance was to FL270, and the speed was to be 250 knots. The aircraft had descended to 26,000 and was immediately returned to FL270. No evasive action was necessary. Flights were heavy and some aircraft had been given holding instructions. My failure to respond with proper terminology: TURN to 270 degrees and DESCEND to Flight Level 250 probably contributed to the controller's failure to catch my incorrect readback. — Courtesy ASRS *Callback*, Aug 84. ■

New Eyeglasses
available for use with
Night Vision Goggles

COLONEL HUGH N. SMITH, MC, SFS
Chief, Aircrew Standards
Office of the Surgeon General
Bolling AFB, DC

■ Recent modifications to the faceplate of the AN/PVS-5 night vision goggle (NVG) now permit standard-issue aviator spectacles to be worn with the goggles. This modification has resolved or minimized some major problem areas associated with goggle wear.

Research by the U.S. Army Aeromedical Research Laboratory indicates that while tempered glass and CR-39 plastic ophtalmic lenses provide some protection from impact, polycarbonate lenses are many times more impact-resistant. In practical terms, this means personnel wearing standard glass ophthalmic lenses in conjunction with night vision goggles are not exposed to a definite hazard while using NVG (either AN/PVS-5 with cutaway modification or the new ANVIS system). Even minor impact forces exerted on the NVG can result in the shattering of glass lenses and superficial or penetrating injury to the eye from fragments.

To protect aircrew members who wear spectacles with NVG, industrial thickness plastic (CR-39) or polycarbonate lenses must be worn in the aircrew spectacle frames in place of the standard tempered glass lenses.

Plastic lenses ground to the appropriate correction for spherical or astigmatic refractive errors can be obtained in the following manner:

- If the aircrew member has not had a refraction within the past year, accomplish current refraction.
- Send current script and cover letter requesting plastic lenses to:
  USAFSAM/NGO
  Brooks AFB, TX 78235-5301
  Attn: J.W. Miller
- One complete pair of spectacles per script will be returned to the MTF which ordered them.
- The aircrew spectacles with plastic lenses will be given to the flyer with instructions to wear them *only when using NVG*, and to protect the lenses from marring or scratching. ■

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 Accident Prevention Program.

CAPTAIN

Stephen E. Smith

36th Tactical Fighter Wing

■ On 11 December 1984, Captain Smith was leading a two-ship of F-15C aircraft on a dissimilar air combat training flight. During the rejoin after the final engagement, the utility A and PC2B hydraulic caution lights came on. Shortly thereafter, the utility system cycled and the utility B light illuminated. Captain Smith declared an emergency and began a descent toward Bitburg AB. The wingman confirmed that no fluid was visible on the outside of the aircraft. A no-flap approach and landing was planned. Shortly before the turn to final as the landing gear were lowered, the left pump light came on and the utility pressure dropped to 2,000 psi. Captain Smith then elected to use the approach end barrier and lowered the tail hook. The utility pressure continued to decrease, and the right hydraulic pump light came on indicating total utility hydraulic failure. As the ILS approach was begun with the base weather at 400 and 1½, the aircraft began a sudden roll and pitch to the left. As control inputs were made to correct the roll, the aircraft then pitched down, and all three channels of the control augmentation system disengaged. A missed approach and climb to higher altitude were initiated with the aircraft continuing to be difficult to control. Utility pressure was 1,000 psi now, and the pitch ratio and roll ratio system failed. The systems were placed to emergency, but this did not improve aircraft performance. Captain Smith performed a controllability check and found that as the aircraft speed was reduced through 200 KIAS, the aircraft again rolled left, and full right stick was required to stop the roll at 45° left bank. An increase in airspeed was required to regain enough flight control authority to right the aircraft. During this time, the chase aircraft reported that very little control surface deflection was taking place, even with the stick full right. A 250-knot approach was then planned and Captain Smith again positioned the aircraft on final. Once again, flight control transients forced a go-around on 3-mile final. On the third attempt, a successful approach was flown with only minor flight control problems which were controllable at 250 KIAS. The aircraft touched down 800 feet down the runway at approximately 240 knots, and the BAK-13 barrier was successfully engaged at 210 knots. Post flight maintenance inspection revealed that the PC2 pressure line on the right stabilator actuator had ruptured causing complete loss of the PC system and a slow drain of the utility system degrading the effectiveness of the flight controls. Captain Smith's calm and professional reaction to this in-flight emergency minimized the damage to the aircraft, prevented possible injury or loss of life, and resulted in the safe recovery of a valuable 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 Accident Prevention Program.

CAPTAIN
Guy M. Walsh

CAPTAIN
Gary G. Presuhn

10th Tactical Reconnaissance Wing

■ On 3 December 1984, Captains Walsh and Presuhn were flying on a two-ship low level tactical reconnaissance training mission in an RF-4C. While at 500 feet above ground level and 480 knots ground speed, their aircraft struck several herring sea gulls without warning. One bird smashed through the front canopy entering the cockpits, temporarily blinding both crewmembers and causing severe damage to the rear canopy, both ejection seats, and several instruments in the rear cockpit. Captain Walsh, the pilot, was struck in the left shoulder by canopy debris, and Captain Presuhn was hit by bird and canopy debris in the left shoulder and helmet. The resulting noise and windblast made intercockpit communications impossible. Both crewmembers reacted to maintain aircraft control and began a climb away from the ground and rising terrain in front of them. Captain Walsh retained positive control of the aircraft using prebriefed comm-out signals. After slowing to 250 knots, communication within their aircraft and with the flight lead was restored, and both crewmembers confirmed there were no serious injuries. Captain Walsh notified the lead aircraft of the emergency and requested that lead rejoin on their aircraft for a visual inspection. The lead aircraft rejoined and confirmed there was no visible structural damage except the destroyed front cockpit canopy and a damaged right wing tip. Captains Walsh and Presuhn turned the aircraft toward a nearby prebriefed emergency airfield, RAF Leuchars, and, 2 minutes later, the left engine compressor stalled. As the left engine temperature rose rapidly, Captain Walsh retarded the left throttle to idle where engine instruments appeared to be normal. The crew climbed the aircraft to 5,000 feet to dump fuel and notified Tower of the emergency and the need for egress and medical assistance on landing. Less than 10 minutes after the bird strike, Captain Walsh performed a single-engine approach and landing at RAF Leuchars. Captains Walsh and Presuhn's ability to function as an integrated crew in an extremely stressful situation, combined with superb airmanship, averted the possible loss of life and prevented the loss of a valuable aircraft. WELL DONE! ■

GLC* KILLS GOOD PILOTS

*G-Induced Loss of Consciousness

Awareness of GLC hasn't precluded fatalities, but always performing a timely, proper straining maneuver does.

Five steps to an effective Anti-GLC Straining Maneuver

1. Anticipate Gs, ALWAYS (especially when it's tactically distracting, for this is the biggest "killer," ask any backseater).
2. Shut your glottis (L-1).*
3. Abdominally strain (the rest of the body will follow).
4. Apply Gs at a reasonable rate.
5. Breathe at three-second intervals for duration of Gs. (If you need to talk, do it just prior to exhalation point.)

* L-1 is more efficient (employs a closed glottis, i.e., no noise).

M-1 expels air through a constrained glottis (that's why after an ACBT flight, your throat feels like its been to a double overtime/win-by-one-point basketball game where you've been screaming for two hours).

Drill each other until you can initiate the five steps in less than a quarter second (on the ground, strain only hard enough to "feel it"). Then be sure you do the same in the air, under G, in a tactical environment using tapes/VTRs to record your straining techniques. After flights, review tapes, debrief, and critique each other's straining techniques. After a few sessions, you'll be more than aware, you'll be trained to fight off GLC.