flying

SAFETY DECEMBER 1984

Coming In From Out Of The Cold

Slip'N and Slid'N Away

A Guide To Booze

Emergencies In Combat

THERE I WAS

■ *"Go around!"* Those were the words I screamed as I came on the controls and shoved the throttle forward.

Up to this point, the mission had been OK — not perfect — but OK. We had taken off at night for a B-52 refueling mission but canceled en route to the track due to thunderstorms. The pilot was scheduled for a pilot proficiency ride, so we recovered back to home base. It didn't look as if the weather would be a factor there for awhile.

We completed the pilot's work which included three engine landings and a simulated jammed stabilizer trim approach using speed brakes to trim. Since we had time to fly out, I put the copilot in the left seat for some work.

He was a fairly senior copilot and was doing a super job. After a couple of approaches and touch and go landings, Tower informed us that they had a tanker inbound with an engine shut down and would be switching runways so it could take advantage of a three-knot headwind.

I had been an instructor for about a year, but had only been at the base for a couple of months. We accepted sequencing to the other runway to be Number Two behind the IFE. As we were being vectored, the pilot in the jump seat was running the checklist for us. This was the first time I'd flown an approach to this runway, but I didn't feel it would be a problem — it would just require a little more attention. I elected to have the copilot fly a simulated jammed stabilizer approach so he could experience trimming with speed brakes.

The weather in the area was deteriorating at this time, and I had the navigator check radar. At the same time, I asked the pilot to call METRO and get their input on the weather.

At this point, things started getting busy. Inputs were coming from all directions. The IFE was on short final, and we had also been cleared to land. The copilot was flying a good approach with speed brakes for trim. A thunderstorm was 10 miles from the field, so I made a decision to full stop this approach and call it a night. I was VFR, and we could see the IFE, still in the process of clearing the runway. Cross-checking the approach and airspeed, the co was right on. Finally, the IFE cleared the runway, so we continued and went visual to land. The copilot put us in a nice flare and slowly brought the throttles to idle as he had been briefed.

That's when it happened. The warning horn went off, and my mind started racing. We had just flown one of three approaches, so I knew it wasn't the speed brakes being extended. I knew the flaps were at 50 degrees because I'd checked that to verify the copilot's airspeed on final. Whether the fact just registered, or the light in the handle caught my eye, I don't know, but I realized the *gear wasn't down!* That's when I yelled *"Go around!"* and came on the controls.

The airplane started to accelerate, and I put it in a gentle climb. Once we were climbing away from the runway, I brought the flaps to 30 degrees and requested a closed visual pattern to a full stop. I flew the full stop without any further problems.

As we rolled out of downwind, I asked the rest of the crew if they understood why we went around. How had we gotten so close to landing without the gear? Three pilots, a navigator, and a boom had all missed it. Habit pattern interception was one factor. Weather and the concern about the IFE clearing the runway had broken up my attention, along with monitoring the approach and the copilot. Instructor pilot task overload is what that boils down to. Cockpit lighting was also a factor. We had the forward floods on, which put everything on the instrument panel in a reddish hue. The jump seat pilot, who had been running the checklist, had been distracted by his call to weather. Discussions with the boom and navigator revealed that they never look up front to verify gear down, though they'd hit the ground just as hard as the rest of us. Where were Tower and Foxtrot?

First of all, it isn't in any way their fault that we didn't put the gear down, but you always hear stories about them sending people around for it. Foxtrot was involved with the IFE recovery and Tower couldn't see our gear at night.

Fortunately, the lessons learned were cheap. I'd never done that before and doubt that I'll ever have it happen again. I'm writing this so that you might get a cheap lesson on lighting, checklists, and crew responsibilities. ■

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page 9

page 16

page 18

SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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The Flu Shot— Why Me? Or—How One Year I Got Away

LT COL DAVID E. PORTERFIELD, MC
Directorate of Aerospace Safety

■ Flight surgeons have been known to be pesky about flu shots. I recall following a fellow flight surgeon to the club on Friday evening. He had offered in-squadron shots on Friday (a good idea) and was out to track down escapists in a spirit of humor. I followed with an emergency kit and ambulance he had neglected to take with him!

As the winter season rolls around again, we will be faced with another round of rough weather *and* rough bouts with various illnesses. Some of us will be wondering why we have to go through the flu shot routine again. Aren't we all immune to most of those viruses after all those yearly jags? The answer is no. There are hundreds of ever-changing viruses. Further, for those of you who got by a year without it and did not get sick, there is an explanation other than good luck. (Lest we create a community of escapists!)

Although some years the program does in fact prove more valuable than in others, it had been a success. It prevents epidemic-type spread among military members of the agents projected by surveillance to be a problem. The price is a much less severe reaction on the part of a few of those who receive the shot. Of course, the rationale is that readiness can be maintained and, at the same time, we can avoid our hospitals being overwhelmed by large numbers of "flu" cases who cannot be watched safely in the barracks or at some TDY location. It does work . . . last year, we in the Air Force were less afflicted than were civilians.

We do not mean to imply that is not what hospitals are for. Indeed, anytime you feel ill (perhaps the flu?) and you do not have anyone to care for you, be sure to check in with the hospital or clinic sooner than you otherwise might. Some "minor" illnesses get worse (and some do so rapidly)!

If you are one of the few who did not get the shot a time or two and escaped the "flu" as well, thank your friends. The fact that they got the shot (the Air Force requires high completion rates) created "herd immunity." This prevents the person-to-person epidemic spread simply because not enough "victims" are available. Hence, you got a "free ride." This year, do your part, and if you haven't, get the shot promptly. Leave the "free ride" for those with documented allergies who cannot receive it. ■

Coming In From Out Of The Cold

. . . Or I Can Stand The Heat

MAJOR JAMES M. TOTHACER
Directorate of Aerospace Safety

■ There comes a time in life when you have to take a stand no matter what the consequences. Custer knew it, and so do I. Enough of this "be a good soldier" and "ours is not to reason why" malarkey. I've had a gut full of it. I've already been advised, "it's not worth falling on your sword over," and "it will reflect in your OER." So what! The powers that be once banished Billy Mitchell to San Antonio for heresy, but what can they do to me? I've been to San Antonio, and I like it. So, "damn the torpedoes and full speed ahead."

After five years in safety, they had the gall to assign me the task of writing an article reminding aircrews of the dangers of winter flying operations!!! Why don't I just write an article reminding everyone to breathe. I mean, even the dead horses we beat know low ceilings and winter weather go hand-in-hand. Don't forget about icing. There's a good one! If I had a nickel for every reminder on the hazards of icing I've read, I could buy all the cows in Texas. Snow on the wings, frost on canopies, water in the control hinge areas — the endless list chills me to the bone. Don't tell me about poor visibility in Europe or high oil pressure when it's cold. After three winters at Minot, I know if you ain't got high oil pressure, you ain't nobody.

How about a couple of paragraphs concerning landing on runways with patches of dry surface? There's a new subject. Talk about locking your wheels and skidding, it's enough to make anyone go "up and locked." Taxiing on ice and hard-packed snow is another lulu. Would you reduce taxi speed and increase normal interval between aircraft under these conditions? Or would you speed up and get real close to another aircraft so as to reduce time on the ice, and if you started to slide, you would slide away from where you were — which was next to the other plane — so no problem.

Probably my favorite of all is the personal preparation ad nauseam drill. "Dress properly for the environment, you might have to eject and spend the night out in the elements." What a revelation!! I can never remember from year-to-year whether it's coats in December and shorts in July or vice versa.

Well, I can't think of a way to stop my tirade, but it certainly won't end with me reminding you to review the cold weather procedures section in your Dash One. I know you don't know there is such a section in the Dash One and have no idea that it contains a lot of relevant information. Anyway, I feel a lot better knowing I refused to compromise my principles over a silly winter weather article. Like I said before, what can they do to me? They changed Billy Mitchell's rank to colonel — it's OK if they make me a colonel. ■

Slip'N and

MAJOR JOHN E. RICHARDSON
Editor

■ RCR 08. Braking action — poor. Runway — wet. What do those terms mean to you as a pilot? Before you answer this rather obvious question with the obvious answer, think again. They can also mean a lot of trouble if you take them too lightly.

What do I mean by too lightly? Well, a somewhat cynical philosopher has averred that "familiarity breeds contempt." In this case, I would suggest that the proper phrase is "familiarity breeds complacency." Any pilot with more than a few hours has landed on a wet runway. We who consider ourselves steely-eyed professionals do it regularly (well, sort of regularly). Anyway, we know about wet runways. We also know all about the different kinds of hydroplaning and $7.7\sqrt{p}$. That's our problem. We have heard so much for so long, and we have all experienced hydroplaning and slippery runways to a greater or lesser extent. So, we know we can hack it. No problem!

Unfortunately, there is a problem, as our statistics show. And if you still doubt it, go find a pilot who has really experienced the feeling of absolute helplessness you have in a total hydroplaning situation. I am sure he will tell you that it is not an experience to be recommended.

Given that running off a runway is not the best way for the DO to get to know your name, perhaps a quick review of some of the points about wet/slippery runway landings are in order. The underlying concern is, of course, the mission. We are — or better be — mission oriented. To complete the mission, we have to land. Now as a "pilot in command," we are expected to make decisions. One decision that is not particularly popular, but could be the decision which saves you a lot of heartache, is the decision to divert. So, the approach this article will take is to review some of the factors which have a bearing on your decision whether or not to land.

Coefficient of Friction This, like the coefficient of lift, which you learned about in Applied Aero, is a nice abstract number which is supposed to tell you something about how your airplane will act in certain situations. There is a nice formula, $M=F/N$. But this formula is unimportant if you already are convinced that braking action is a variable based, among other things, on the runway surface condition. To put it in simpler terms, it gets slippery when it gets wet.

Definitions Aside from giving Stan/Eval some questions for their exams, the definitions of hydroplaning have used as reminders that hydroplaning can occur from touchdown all the way to 0 KIAS with very little moisture present or on a patchy runway.

■ Reverted rubber hydroplaning occurs when the pilot locks the brakes. During a prolonged skid, the tire slides on a layer of melted rubber or steam generated by friction on a wet surface.

■ Viscous hydroplaning occurs on wet runways with a smooth surface or one covered with melting ice or rubber deposits. During viscous hydroplaning, a tire displaces only a portion of the moisture on the runway surface.

■ Dynamic hydroplaning occurs when an aircraft tire is completely separated from the runway by water. Dynamic hydroplaning is affected

Slid'N Away

by the ability of the tire to break through the layer of water.

Tire Pressure An aircraft will continue to experience dynamic hydroplaning until it decelerates to a speed below $7.7 \times \sqrt{\text{tire pressure}}$. This is a good figure to learn for your aircraft since, for some, that speed is well below landing speeds, putting you in the hydroplaning range at touchdown. This is also the speed below which you can expect to get improved braking, provided you don't encounter viscous or reverted rubber hydroplaning.

Tire Condition Tread patterns greatly affect a tire's ability to break through a limited amount of surface water. Maintenance can prove that those "slicks" are good for at least two more landings, but if those landings will involve standing water, you might want to exercise your prerogative as aircraft commander and have them swapped for a good set of water diverting, deep grooved tires.

Runway Composition/Surface While you are mission planning that cross-country or deployment, it would be a good idea to check out the runway composition and type of surface for your recovery base and any alternates. A concrete runway is usually more desirable when you are trying to avoid viscous hydroplaning. There are, however, some newer forms of asphalt which give similar results.

The type of runway surface is also important. A grooved runway helps water escape from under the tires and reduces the risk of dynamic hydroplaning. A porous friction surface on a runway also helps water drainage. Such surfaces have their own problems. There have been cases where an aircraft landed short of the friction surface, hydroplaned, then as the tires hit the dry surface, blew out before they could spin up. Drainage itself can be a problem. There are several bases with poor drainage. In fact, some runways are literally under water during moderate rain. Such information would be very nice to know. Unfortunately, it is not always available in the FLIP Supplements. You can, however, often find out by calling the airfield manager at the base or by talking to someone who has operated out of that base. While you are checking the supplement, you might also make note of some other factors — like runway length and whether there are any overruns.

Look at the runway gradient. If you have a choice of runways, landing uphill may make a 500′ difference in your landing distance. Look, too, at the size of the "zero zone" (distance from the end of the runway to the first marker).

You should also be aware of the snow removal capabilities of your destination. Many civilian and civil/military aerodromes do not have extensive snow removal means. Airliners with thrust reversers don't need it.

Aircraft Capabilities When was the last time you looked at the winter operations section of your Dash One? Or, how well do you know the crosswind and stopping capabilities of your aircraft? Are you really familiar with antiskid, braking, and other such vital systems?

Your Proficiency Review your own capabilities. Have you been just getting minimums for the past few months? How long has it been since you made an honest, no-kidding approach in real weather? Busting minimums to a wet or icy runway is not the time to be finding that your in-

continued

Slip'N And Slid'N Away

continued

strument skills are rusty.

Current Weather Conditions Checking the weather doesn't stop when you get your 175-1. Wintertime means rapid changes, often unexpected. Keep up with current conditions. It is far better to know the weather while still at cruise altitude than to find out after penetration that things aren't good enough for a safe landing. Beyond that, there have been numerous cases of unexpected rainshowers on final causing short landings or hydroplaning after landing.

RCR Runway condition readings give you a good estimate of what kind of braking action to expect. If you believe stopping distance may be critical, don't hestiate to ask for more information on that reading. How old is it? Was it taken right behind a snowplow? What is the RCR in your stopping zone? The reported RCR is an average and may be quite different at different points on the runway. Has any precipitation fallen since the last reading? Finally, an RCR is an artificial number. A lot of factors affect it. If the RCR you get is close to a limit, consider being prepared to go around should braking action not be what you expect.

Phase II Now that we have gathered all the information possible and have decided that landing is preferable to diverting, it is time to consider the factors which will affect us between the final approach fix and a full stop.

Go Around You won't go off the end of the runway if you still have the ability to take off. Think of all the things that can go wrong with a landing. You may find that the information on which you based your landing decision was incorrect. The RCR you were given may be incorrect or old, as we discussed earlier. Water may have turned to ice. Precipitation could have increased while you were on final. You might have been fast or bounced on touchdown, etc., etc. Of course, the go-around must be planned. Not every pilot can just cram it AB and press on. One way to simplify your go-around vs stop decision is to use your Dash One to develop some reference figures on how slow you can go at various landing weights and still take off. For example: At normal landing weight and 125 knots, you might need 2,000', at 100 knots — 3,000', at 75 knots you might need 4,000'!

Reconsider After one attempt, you have much better information on conditions. You may want to rethink the whole idea.

Landing Speed Extra speed on landing adds distance to your flare and ground roll distances. It doesn't matter where the extra speed came from: Pilot deviation, turbulence, configuration or gusts, the additional runway needed to dissipate that energy may exceed the runway available. If you are hot on touchdown and stopping distance is critical, an early go-around may be your best option.

Firm Landing The conventional wisdom is that a firm landing is best on wet runways since a firm touchdown can dissipate as much as 15 knots. That is true if you are following Dash One speeds. If you are hot, you could bounce and end up with one of the three things most worthless to a pilot – runway behind you.

Braking Technique Here again, the Dash One procedures are best. If your aircraft is capable of aerobraking, use it. In fact, all aircraft have some aerobraking capability. Remember when you start braking that to be

Follow Dash One speeds . . . "A firm landing is best on wet runways since a firm touchdown can dissipate as much as 15 knots."

"While you probably won't die from sliding off a taxiway, the hassle you will encounter makes extra care in taxiing worth it."

effective the wheels must spin up first, othewise all you will get is some blown tires and a very unpleasant ride. Also, locked wheels hydroplane at a much lower speed than do rolling wheels.

Which Side Of The Runway To Land On There are a lot of factors here and no simple answers. Landing in the middle of a crowned runway is usually the driest spot; however, a crosswind prevents water from running off the upwind side as fast as the downwind side. If you move slightly off centerline, you risk putting your tires on the slippery, painted centerline stripes. Moving slightly farther to the downwind side puts you on a side slope with a crosswind pushing you toward the short side of the runway. A drag chute is another force which will help push or — in this case — pull you toward the side. If you land on the upwind side, you have the problem of your aerospace vehicle weather-vaning into the short side of the runway. Then, as you drop below dynamic hydroplaning speed, your aircraft will gain directional control pointed toward the side of the runway. You may also run into patchy conditions. Puddles of water, ice, or snow can cause reverted rubber hydroplaning. Take your choice!

Directional Control The Dash One tells you the best means of directional control. For most aircraft, this is the rudder. However, the ailerons can play a large role in steering as well as correcting for crosswind. Improper use of the ailerons can hamper braking since it places uneven weight on the wheels. Before considering nosewheel steering, remember that unless your nosegear is the same size and pressure as the mains, it will hydroplane at a different speed. Therefore, you may just complicate your problem. If you do use it, be sure your rudder pedals are centered. It is very distracting to have your aircraft suddenly lurch toward the side of the runway after surviving a hairy touchdown and rollout.

Asymmetric Braking/Thrust

While asymmetric braking may work more effectively than nosewheel steering, it costs you in stopping distance. Big airplane drivers might consider using asymmetric thrust. Of course, like asymmetric braking, it will cost you. And, there is the possibility that, in the rush to control the airplane, you may grab the wrong throttle. That will obviously be a serious problem.

The Hook Some of us are lucky enough to have another option when faced with a slippery, wet, icy, etc., runway. If you are one of those whose aircraft is equipped with a tail hook, don't be afraid to use it. It is not a sign of weakness to resort to an approach end arrestment. Navy pilots do it routinely. (Rumor has it that some Navy fighter jocks get scared when faced with 10,000 feet of clear concrete.)

Seriously, for those of you who may not remember, we proved the value of barriers and hooks during the monsoons of Southeast Asia. If you can, ask one of the old heads about the joys of landing at Ubon in the rain.

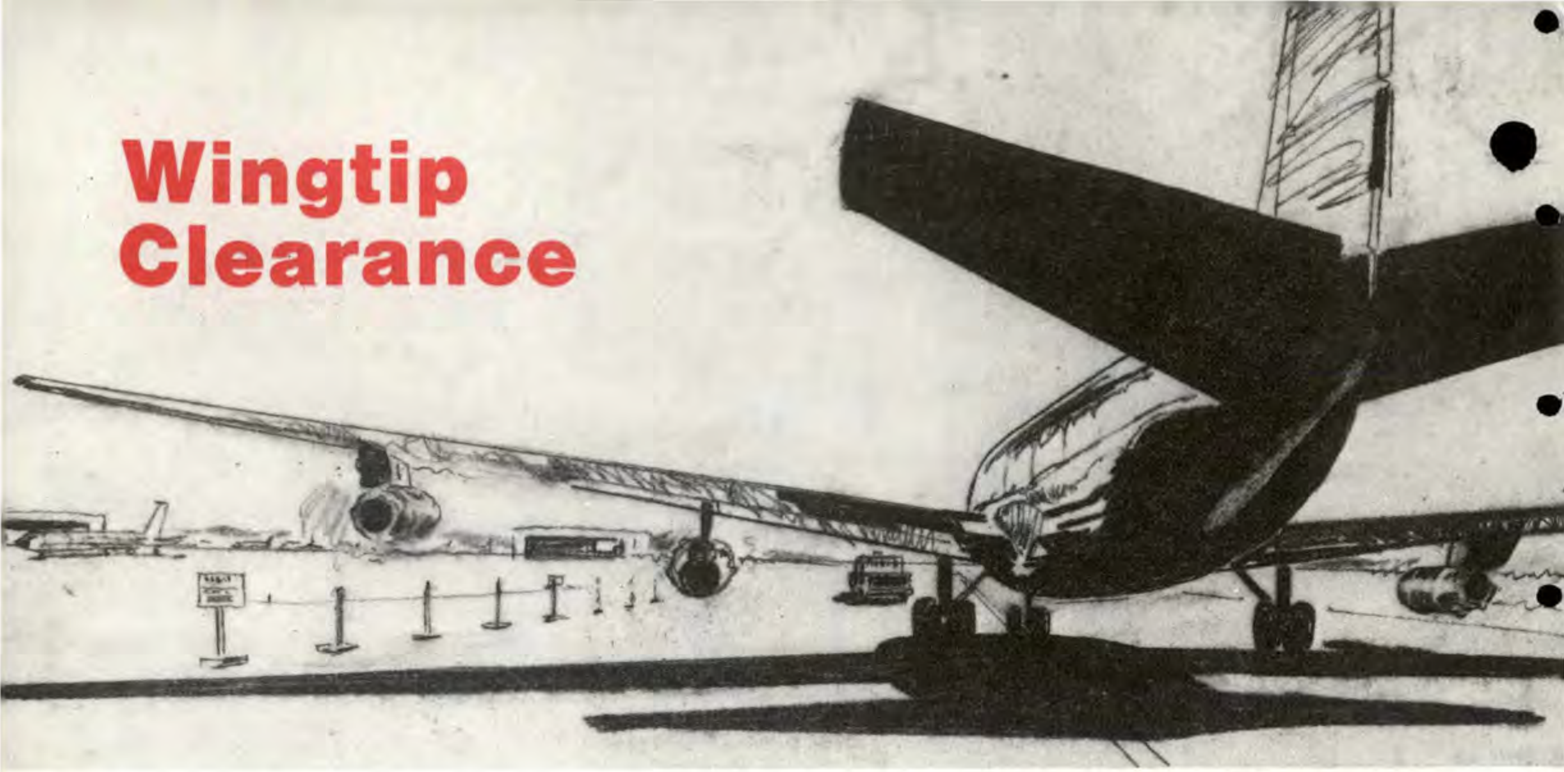
If you have a tail hook, preflight it carefully when you anticipate wet weather. Review the speeds and procedures for an engagement before you need them.

Finally, be mentally prepared to use the hook if it looks like stopping will be questionable. Don't overlook the departure end barriers (if installed). Of course, you did a good job of preflight planning, so you know the capabilities of the barriers and cables at your landing base, right?

After Landing Just because you successfully made it to the turnoff is no reason to relax. Very often, runways are reasonably clear, but the taxiways are a mess. While you probably won't die from sliding off a taxiway, the hassle you will encounter makes extra care in taxiing worth it. If it really looks bad, consider shutting down and asking for a tow.

The slippery season is here. If you do the things suggested in this article, you will be better prepared to cope with the problems as you encounter them. And you will be more likely to be able to breathe a sigh of relief after safely negotiating an icy runway to end a successful mission. ■

Wingtip Clearance



CAPTAIN GUY J. WILLS
5th Tactical Deployment Control Squadron, Tinker AFB, OK

■ Several recent articles and messages have flashed across my desk in the last few months that say in short, "Taxiing on the yellow strip does not always ensure sufficient wingtip clearance." This becomes a true statement overseas, especially. These articles and messages, in turn, have been passed on to aircrew and aircraft commanders.

Some of the taxiways and parking areas barely provide enough area for fighters, much less a big C-135 or C-141. I feel that most aircraft commanders I know realize this when operating overseas. Many a time I've had my outboard engines "hanging out in the weeds" while still running. Unfortunately, we become complacent at stateside locations.

I recently had a scare put into me at a large SAC Air Force base (that shall remain nameless). This base has had bombers, tankers, and large, heavy aircraft (C-5s and KC-10s) operate from there on a daily basis. I landed there to pick up passengers for a trip back home. Upon clearing the runway at midfield, I was met by a Trans Alert vehicle and directed to park in front of Base Ops. With thrust reversers, we are required to wait five minutes prior to shutting down engines during taxi back, therefore, all four engines were still running during our taxi into parking.

Being a smooth and competent driver, I straddled the clearly-marked yellow taxi line. The route into the parking area appeared free from any obstacles, i.e., there were no parked aircraft in the way. Being fat, dumb, and happy, thinking about the grease job I had just made upon landing, I looked out the left window and saw my number 1 engine appear about to suck up some marker poles designating an Entry Control Point. I swerved to the right missing the poles.

Once in parking, being somewhat irate and ticked off, I asked the Trans Alert folks about the poles, and their reply was, "Sir, you had a good 10 feet from your engine, no sweat!" I promptly pointed out that AFR 60-11, Aircraft Operation and Movement on the Ground or Water, states that the aircraft will not be taxied within 10 feet of an obstruction. Aircraft taxied within 25 feet of an obstruction must have a taxi signal man at each wingtip, as well as a marshaller. These rules are for *wingtip* clearance and not engine clearance.

The next answer was, "Well, we only do what we're told, and that's taxi you in on the yellow taxi lines." Since no damage was done, I started to calm down and proceeded into Base Ops to find the Base Operations Officer/NCO. They were not sure what I was talking about and stated that they had no problem in the past since it was an old tanker/bomber base.

Not satisfied, I proceeded to write a hazard report and fill out an aircrew questionnaire stating my objections and recommendations. You know what the results were? Upon investigation, the Safety Office found out that indeed the wingtip of the aircraft was extended past/over the marker poles by six feet, and there were approximately 10 feet between the engine and poles. When Trans Alert personnel were questioned, they stated that pilots had complained before but that was all they had experienced, a few complaints. The poles were immediately removed from the area.

All I could think about at that moment was that I could have FODed a quarter of a million ($222,000) dollar engine and damaged my Air Force career.

The point I'm trying to make is: When taxiing, keep your eyes open. There are all kinds of little objects just waiting for the chance to jump out in front of your airplane and do some damage.

Second, if you see something that isn't quite kosher, take the time and research it or talk to the right people.

Most of all, *remember* staying on the taxi line does not always ensure your airplane of proper wingtip clearance or an obstacle-free taxi route. ■

A Guide To Booze

Macduff: Was it so late, friend, ere you went to bed, that you lie so late?
Porter: Faith sir, we were carousing till the second cock, and drink, sir, is a great provoker of three things.
Macduff: What three things does drink especially provoke?
Porter: Marry sir, nose-painting, sleep and urine.

MACBETH ACT II SCENE 3

ROGER GREEN
Principal Psychologist
RAF Institute of Aviation

■ Most aircrew will, at some time, have had personal experience of the accuracy of the Porter's final statement. Unfortunately, Shakespeare does not have very much to say about the effects of alcohol on flying performance. This article has, therefore, been written to complement the advice on the use of alcohol that has recently been circulated to make aircrew more aware of alcohol's potential effects.

That might seem unnecessary, but in recent years it is likely that alcohol use has been a contributory cause in a small number of accidents. Those accidents did not involve notorious drunks, but people who indulged in normal social drinking, which is for many members of the Air Force, an almost inevitable part of their lifestyle. In this article, I have tried to answer some of the questions about alcohol that are of particular relevance to aircrew.

Why Does Alcohol Change Behavior?

Alcohol depresses cortical (brain) activity; it is a sort of sedative. The first obvious processes to be hit are our social inhibitions; as they are repressed, we become more talkative and sociable. It's interesting, though, that there is some evidence that this becomes a conditioned phenomenon in experienced drinkers: If you give alcohol to someone inexperienced and also to someone hardened to its use, both become more talkative. However, if you give both of them a placebo, which they believe to be alcohol, the experienced drinker gets merry but the inexperienced one doesn't. That is to say, booze oils the social wheels, but eventually the expectations become just as important as the physiological effect.

Without any doubt, alcohol also degrades performance in almost every task that you do, but in a particularly pernicious way. First, it makes you worse: Reaction times increase, tracking performance is impaired, distance judgment is degraded, and visual acuity is decreased. Second, it makes you feel as though you are doing better: People constantly mon-

continued

A Guide To Booze continued

itor their own performance, and it is this monitoring process that is hit.

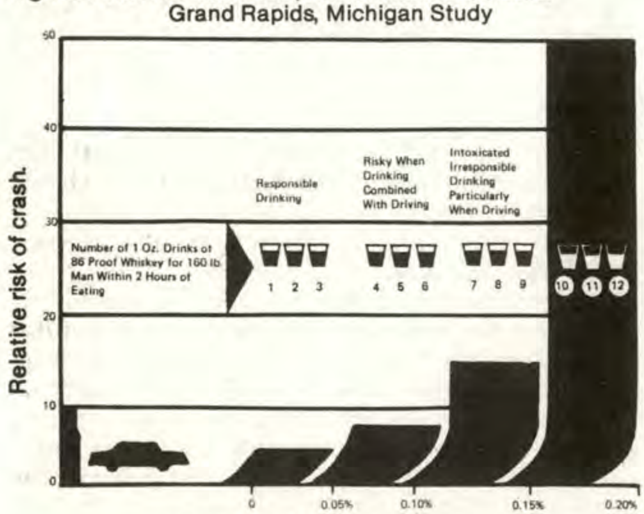
The best example of this effect is an experiment that used bus drivers as subjects. They were asked to judge whether they thought that they could drive their bus between traffic cones without knocking them over. The more they drank, the smaller became the gap that they thought they could get through, and the more sure they became that they could do it. As the Porter goes on to say in Macbeth, alcohol "provokes the desire, but takes away the performance." (Actually, he was speaking of lechery, but the same holds true for other skilled activities.)

Just How Much Difference Do These Changes of Behavior Make to Your Likelihood of Being In An Accident?

A big difference. As far as road accidents are concerned, one estimate is that:

- 1½ pints of beer doubles the chance of an accident.
- 2½ pints of beer increases the chance four times.
- 3 pints of beer increases the chance six times.
- 5 pints of beer increases the chance 25 times.

Figure 1 As BAC increases, risk of crash increases. Grand Rapids, Michigan Study



Blood alcohol concentration.

But What About Flying Accidents?

It is very difficult to give any precise figures. Certainly as far as the RAF is concerned, it is impossible to know; first because so few accidents occur, and the second because the blood alcohol levels of aircrew while flying are not known.

However, there is some experimental work that shows the same sort of exponential rise in performance decrement that the table suggests. One such experiment that was actually performed in the air required pilots to fly ILS approaches at night while they had blood alcohol levels of 0, 40, 80 or 120 mg%.

Figure 2 Change in tracking error.

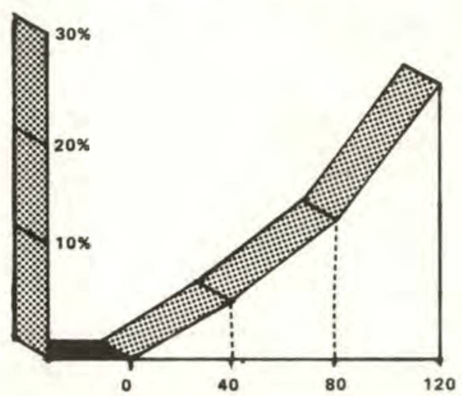


Figure 2 shows the percentage change in ILS tracking error from the control score (i.e., 0 mg% blood alcohol), but probably more important were the procedural errors or mistakes made by the pilots. Of the 32 flights that were made at each alcohol level, ". . . the safety pilot had to take control of the airplane once during flight at 40 mg%, three times at 80 mg%, and sixteen times at 120 mg%. To quote the experimenter again, "We have not determined a blood alcohol level that is not detrimental, and our evidence suggests that such a level, if it exists, may be extremely low."

If This Is So and Blood Levels Below 80 MG% Affect Behavior, Why Is Our Car Driving Limit 80 MG%?

Don't ask me. The maximum legal level for drinking and driving in some countries is 0 mg%.

Is There Any Evidence From Post-Mortem Studies?

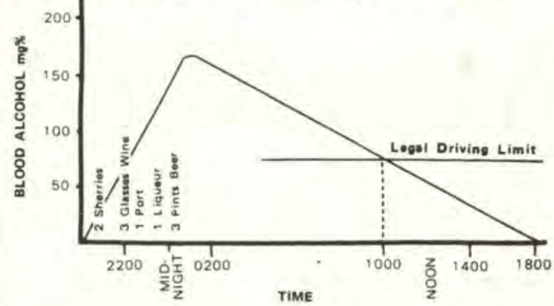
Yes, there is some evidence, particularly from fatal general aviation accidents. In one study carried out in the United States it was found that 158 bodies (six months worth) that received routine toxicological study, 56 were positive for alcohol with a blood alcohol in excess of 15 mg%.

Figure 3. Alcohol Involvement In All Aviation Accidents:

1975 through 1981

	1975	1976	1977	1978	1979	1980	1981	TOTAL
All accidents	4,232	4,217	4,306	4,498	4,061	3,820	3,715	28,849
Fatal accidents	674	704	706	794	687	675	707	4,947
Conclusive toxicology tests*	428	494	506	553	500	481	524	3,536
Positive alcohol tests	3.0	52	48	54	39	60	55	358
Percent positive	10.5	10.5	9.5	9.8	7.8	12.5	10.5	10.1
Other known alcohol-involved accidents**	19	19	24	18	8	5	9	102
Total alcohol-involveo accidents	69	71	72	72	47	65	64	460

Figure 4. Blood Alcohol Generated By A Mess Function



How Can I Tell What My Own Blood Alcohol Level Is? Isn't Eight Hours "Bottle to Throttle" OK*

You can't tell for sure what your own blood level is as it will be determined by how big you are, the rate at which you drink, your food intake, the rate at which you metabolize alcohol, and, of course, by how much you drink. Therefore, it is not really practicable to give hard and fast rules. Having drunk a certain amount, one person may be free of alcohol after a given time, but a different person — or even the same person at a different time — may take much longer to cleanse his system of alcohol.

Additionally, we know that the residual effects remain after the blood alcohol level has reduced to zero — a point that I will cover in more detail in a moment. For these reasons, it is dangerous to assume that eight hours "bottle to throttle" is OK. The present advice is that there should be a minimum of 12 hours "bottle to throttle," but that time interval applies only to an average person, under average conditions who has drunk a moderate amount — say three pints in an evening.

However, to go back to the first part of the question, it is possible to make an informed guess about your own blood alcohol level. Roughly speaking, we can define one "glass" as ½ pint of beer, one measure of spirits, or one glass of wine. Drunk over a short time, it would take about four to five "glasses" to bring you up towards the driving limit of 80 mg%.

The rate at which people metabolize alcohol varies widely but you can reasonably expect to eliminate it from your blood at least at 10 mg% an hour. Thus, it could take up to eight hours for the alcohol from a few pints of beer to be totally eliminated. Twice as much beer will take twice as long to eliminate, and if you go on a real bender and manage to get your blood alcohol up to or beyond 300 mg% (and some car drivers have been caught with more than that), then this could take up to 30 hours to eliminate.

Figure 4 shows how your blood alcohol might increase during an evening's drinking at a dining-in night and then subsequently reduce. There are a couple of points to note about this diagram. First, it assumes that no more alcohol is drunk during the 24 hours that it takes to eliminate the alcohol from one evening's drinking. Second, it shows that 12 hours "bottle to throttle" is definitely not OK in this case: It's quite possible that you would not even get down to the driving limit until well after you get to work and that you would not be completely free of alcohol until early evening.

But Presumably Some People Can Hold Their Drink Better Than Others?

Certainly. How used you are to drinking determines to some extent how much your performance is degraded. Also, if you are skilled at performing a certain task, then your performance on that task will be degraded less than the performance of a beginner. However, both statements are relative, and the evidence strongly suggests that everybody is affected by even quite small amounts of alcohol.

Do All the Behavioral Effects of Alcohol Disappear When the Blood Alcohol Gets Down to Zero?

Unfortunately not, but this takes a bit of explaining. Some of you may have noticed that after a heavy night's drinking, you have, as they say, to wait for the bed to go past before you can jump on to it and that things get even worse when you lie down. That happens because of the relationship between vestibular (inner ear) stimulation and eye movements.

The semicircular canals, Figure 5, are best regarded as angular accelerometers. Each one is a fluid-filled tube with a watertight swing door across it. The fluid tries to stay still because of its inertia and deflects the door one way or the other depending on the direction of the head's angular acceleration, whether produced by voluntary head movement or by some external motion such as aircraft yaw, pitch, or roll.

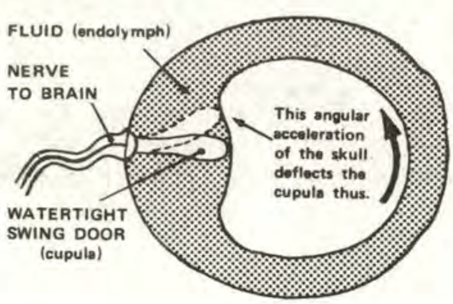
continued

*Editor's note: Eight hours is a British rule. Current AF directives require 12 hours "Bottle to Throttle."

**The graph depicts an excretion rate of 10 mg% per hour. Actual excretion rates range from 10-20 mg% per hour. Source: Armed Forces Institute of Pathology.

A Guide To Booze continued

Figure 5. Semi-Circular Canal



Head movements detected by this system are used to stabilize the visual world on the retina by the elicitation of eye movements, i.e., eye movements are made to compensate for head movements in order that the world does not appear to fly about on the retina. You can check that this happens by nodding while reading this — you should still be able to read it. If, however, you wave *Flying Safety* up and down instead of nodding, then you cannot read it.

In order for this system to work, the watertight door must be unaffected by linear accelerations such as gravity and, to be so unaffected, the door must have the same specific gravity as the fluid. Alcohol in this system disturbs this specific gravity balance. The flap tends to float, and the deflection is interpreted as a head movement and a compensatory eye movement is made. However, as no real head movement was made, the eye movement is inappropriate, and the subject perceives the world to move.

This effect follows closely on the consumption of alcohol and is known as Positional Alcohol Nystagmus (Phase 1) or PAN 1. As the fluid and flap come into alcoholic balance, there then follows a phase when there is an absence of abnormal eye movements, and this is followed by a second phase of Positional Nystagmus. This further phase (PAN 2) is caused by an imbalance of specific gravity between the fluid and the door as the system loses alcohol. (Alcohol remains in this system well after blood levels have become negligible.) With increased G, the imbalance is effectively amplified.

The upshot of all of this is that the abnormal eye movements that are evidence of vestibular problems can be produced up to two days after drinking the equivalent of only a couple of pints of beer if the subject is exposed to two or three G, and this effect can be demonstrated long after no alcohol can be detected in the blood.

The precise significance as far as flying is concerned is difficult to determine — but it can safely be said that if you find yourself in an unusual position being subjected to unusual accelerations, then the effects discussed above may well lead to you becoming disoriented when you might otherwise not have been and, once disoriented, will make it more difficult for you to recover the situation.

OK, But Alcohol Is Just One Thing — There Are Many Other Factors That Affect My Performance, So Why Make Such a Fuss About Just One of Them?

Because alcohol is certainly an enormously powerful factor in affecting performance and causing accidents. If it were invented today and put on the market as a drug that caused some pleasure, release of tension, and social facilitation but which, unfortunately, also vastly increased human error and generated fairly long-term vestibular abnormalities, do you think that the authorities would:

- Ban it for aircrew?
- Have it available on prescription only?
- Have a special place in the Mess where it was readily available, and encourage its use at social functions?

Of course, they would ban it. It seems to me that the only reason it remains available is tradition: A tradition that is unlikely to change until attitudes change fairly dramatically. Our society does not censure the hard drinking, hard living person (remember what the headmaster said "work hard, play hard") and this ethic goes hand in hand with the traditional image of the fighter pilot ("kick the tires, light the fires") that many pilots may subconsciously be at pains to preserve.

The object of this article is to inform rather than to preach. Nevertheless, it seems unreasonable to finish without offering suggestions for staying out of trouble.

A Pattern of Drinking That Puts Us Least At Risk?

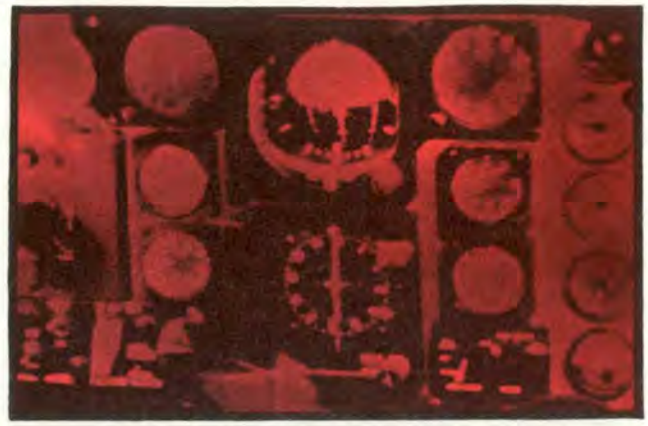
- Always respect alcohol. Remember that in small amounts at the right time it can give pleasure; in excess, it will always cause trouble.
- Always try to eat something when drinking. Don't drink on an empty stomach.
- Drink slowly; never gulp.
- Resist the pressure from anyone to buy a round. To avoid appearing mean, offer to pay for something else.
- Never drink undiluted spirits.
- Never drink and drive.
- Never feel obliged to drink alcohol. Nor should you ever feel conspicuous when drinking a non-alcoholic drink.
- Set a limit to the number of drinks you want, and do not be persuaded to exceed this limit.

And remember:

- To enjoy life to the full, it is not essential to drink.
- Heavy drinking is not a sign of toughness, adulthood, sophistication, or manhood.

— Adapted from *Flight Safety Review* ■

COCKPIT COLOR REVOLUTION



FREDERICK V. MALMSTROM, Ph.D.
and
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■ Anybody who hasn't been living in a Stone Age cave for the past 10 years is probably aware of the virtual explosion of electronic information displays which have come onto the market. The human race seems to have gone bananas over everything from digital watches to very elegant computer-generated combat action scenes. During this video revolution, you may have noticed nearly all the hottest-selling video displays are in what the television industry used to call "living" color.

The aircraft cockpit instrument display panel hasn't escaped this electronic video revolution either. The move towards electronic displays is so pronounced that within 15 years, we predict, virtually every new aircraft flight instrument display will be not only electronic, but color or color-capable. Self-luminous electronic displays are probably a good idea, largely because they are not dependent upon ambient illumination. But why do they need to be in color?

Do we *need* color in electronic cockpit displays?

The answer is a flat "no," not any more than we *need* Christmas, but it sure is nice to have. From the viewpoint of human engineers, we could probably design a monochrome (single-color) or black-and-white electronic display which would be every bit as effective, or even better, than a fancy one with a dazzling splash of rainbow colors. The decision to use color in electronic cockpit displays, as in the television and home computer industry, is probably as much due to customer preference as anything else. The fact is that pilots who fly airplanes as well as secretaries who use word processors *like* color displays more than they like black and white. If you add this preference for color to the realization that the relative costs of color are less than they used to be, then it's a pretty sure bet that the widespread use of color cathode ray tubes (CRTs) will be a fact of life.

When should color be used in electronic displays?

The answer to this one is also quite simple. Color for aircraft electronic displays should be used only when "absolutely necessary," and that means either to increase the safety-of-flight margin, or to decrease pilot and aircrew workload. The other side of this statement says that color should *never* be used merely because it's "pretty" or "entertaining." Color can, of course, be used to highlight the information you want, but you should stop to consider that color can also be used equally well to camouflage information from you. Hence, a CRT which uses color improperly can be either useless or even downright dangerous.

Is color coding better than any other identifiers?

Again, as you may have guessed from the tone of this article, the answer

Figure 1 A modified stroop chart. Except for the first word, the words and their colors carry nonredundant information.

is generally "no." There are many other ways to encode information: Words, sizes, shapes, intensities, blinking lights, etc. Perhaps the biggest problem with color information is that the human mind processes it very slowly. You can recognize words a whole lot faster than you can recognize colors, so color is at its best when it's a *redundant* source of information, and at its worst when it's nonredundant. In fact, you should always ask yourself the following question: If the color were to fail on the aircraft CRT, would I still be able to get all the necessary information I need? If the answer is no, *then don't use color!*

Let's illustrate the use of nonredundant color coding with the following demonstration. Figure 1 shows a modified so-called "Stroop Chart" containing some information. In this figure, except for the first word the colors are nonredundant with the meanings of the words. Time yourself with a stopwatch, and read the list of *words* as fast as you can. Next, time yourself naming the *colors* of the words as fast as you can. If you're a normal sort of person, it probably took you two to three times longer to name the colors error-free. In fact, were you to partake of a couple of martinis before attempting to name the colors, you might find the task hilariously impossible. For adult humans, verbal information processing nearly always takes priority over color information processing. In the other case (not shown here), if all the colors match the meanings of the words, then the colors carry redundant information. And in that case, there is a slight improvement in the time to read the words, perhaps by about three percent.

What are the ideal colors for CRT displays?

Now, that's a more involved question. There are lots of situation-specific variables to be considered; like shading, brightness, relative contrast, foveal v. peripheral vision, and individual contrast sensitivities. What was once an "ideal" color display under dim illumination may reveal itself as a very poor one under bright illumination. In fact, the trade-offs between color, brightness, saturation, and contrast may make the human engineer wish the whole issue of color had never been raised.

The first good rule of thumb in the design of color displays is that the colors should be as "pure" and as widely spaced from each other on the color spectrum as possible. As we'll show, that's nearly an impossible rule to follow.

In order even to describe what color is, we'll need to introduce something called the 1931 CIE (the French equivalent for International Commission on Illumination) chromaticity diagram, which is something you will immediately recognize as a visual aid which, for once, *ought* to be in color.

The curved portion of this strange, sail-shaped object is actually the boundary of wavelengths of the so-called "spectral" colors — the pure single wavelength colors you'd get if you held a prism up to sunlight. The chromaticity diagram also shows about 90 percent of all possible colors can be generated by adding various proportions of the three primary colors: red, green, and blue. (For those of you who thought the primary colors were red, blue, and yellow, that's another school of color mixing called the subtractive process. Sorry.) For example, if I add proportions of .555 "red" and .445 "green," I get a color called "orange,"

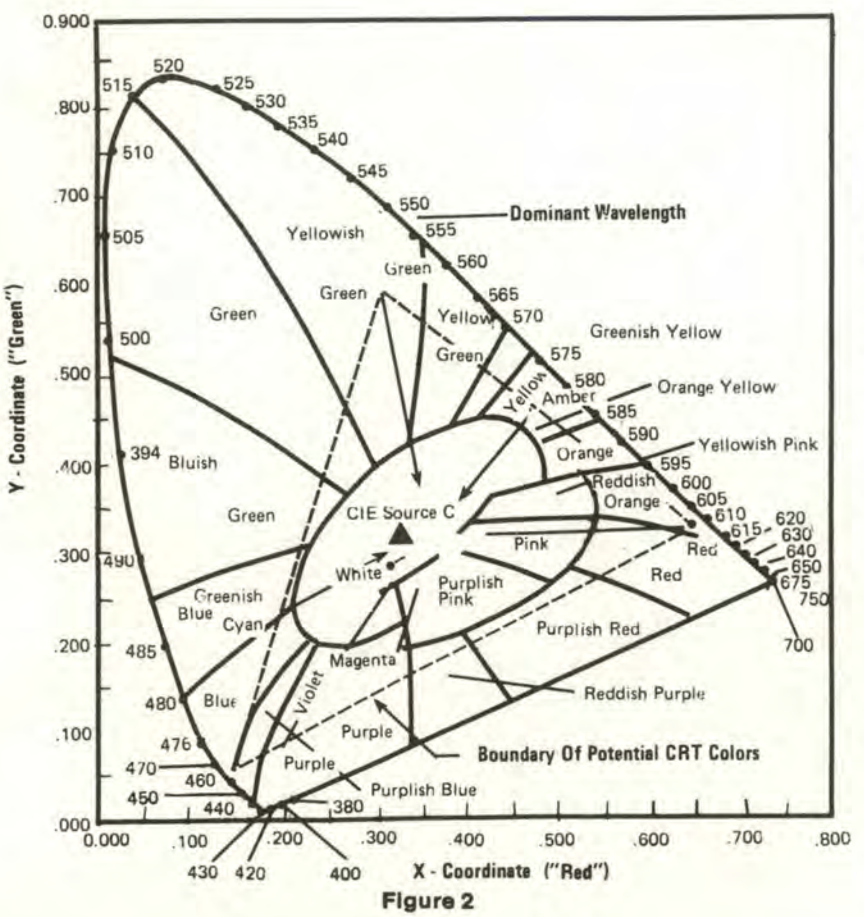

Figure 2

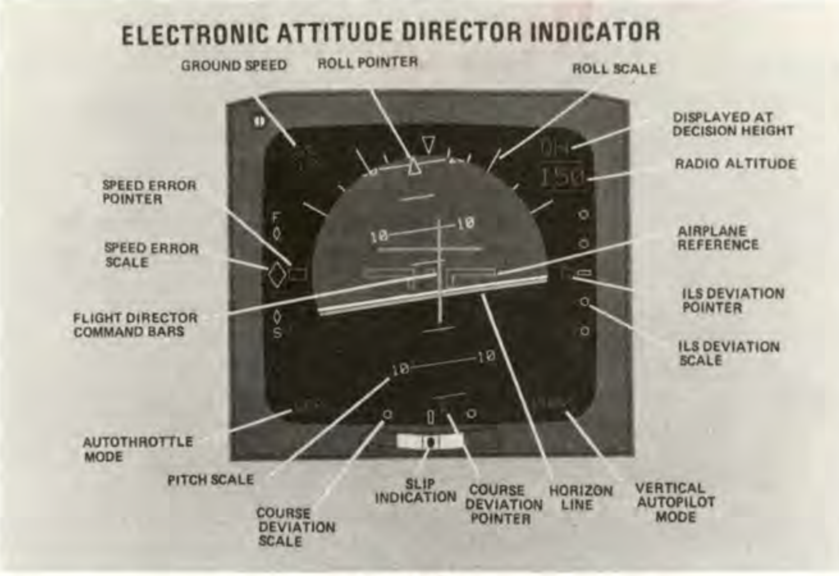

Figure 3

A typical state-of-the-art electronic display intended for a large commercial transport.

which is indistinguishable from pure spectral orange. A spectrum analyzer can spot the difference, but your eye can't. Furthermore, if you start placing sunscreens over a color CRT, you never know whether you're filtering over a spectral color or one which is a combination of two or more primaries. The resultant color observed in this case might not be the intended one. This caution, of course, implies that color CRTs must be used with a sunshade or a hood rather than a sunscreen, which *can* be used on either a monochrome or a black-and-white display. So, you can't use color effectively in high ambient illumination, such as in direct sunlight.

So, why not turn up the brightness you ask? Good thinking — but there's another tongue-twisting catch there called the Bezold-Brucke phenomenon, which says that as you increase the intensity of a color, it tends to shift its apparent hue. For example, red viewed at high intensities takes on a definite orange-to-yellow cast; yellow-green viewed at high intensities appears as a more intense green. In fact, there are only three very narrowly defined "pure" colors which retain their apparent hues at both low and high intensities —amber, cyan (blue-green), and green.

Next, if I combine equal proportions of .333 "red," .333 "green," and an implied proportion of .333 "blue," I get something called CIE source C, or "white." Likewise, if I add various amounts of "white" to any of the spectral colors, the colors move more and more to the center of the diagram. That is, they become less "pure" and more pastel, or "washed out." The dotted triangle in Figure 2 indicates the typical "color space" of just about every CRT on the market; almost none of them are capable of generating pure spectral colors. What they deliver, in fact, is a restricted range of pastels. So much for our rule of purity and spacing.

How many colors should the CRT have?

Fortunately, the research on color usage says that accurate human information processing tends to decrease when we get above five colors. Overkill on color is actually a "bad thing" and tends to be distracting, so a safer margin usually limits the number of colors to four. We can now pare down the list of available colors quite fast.

Research on color CRTs says, for example, that purples are lousy and are universally disliked by aircrews and scientists alike. That's probably just as well, because purple isn't a spectral color — it's a mixture of reds and blues. Blue can't be used for extremely small symbols, because it then appears to shift to gray. Likewise, blue isn't usually used for large backgrounds, because it tends to induce temporary myopia. Red is, by convention, commonly reserved for out-of-tolerance or warning conditions. But, red also isn't very recognizable in peripheral vision, so it won't do much good to place red warning codes outside the line-of-sight. Browns aren't even described on the CIE diagram and are, in fact, very difficult to generate properly on most color CRTs. And so the restrictions and caveats go on and on.

These are only some of the reasons why on airborne color displays, you'll see an unexciting preponderance of ambers, cyans, and greens on your CRT, and only very sparing uses of reds and blues. This narrow range of "safe" colors is a far cry from the Disney World range of "living" colors you thought the cockpit video revolution was going to bring you.

Won't all cockpits have "Star Wars" displays eventually?

We think that's going to occur only in the movies. The whole trend in designing electronic cockpit displays is one of *very* conservative steps. Figure 3 shows a typical state-of-the-art electronic display intended for a large commercial transport. Does it look too much different from the standard electro-mechanical display you're probably used to? It shouldn't, because care was taken in the earlier design stages to make the electronic CRT display an exact visual analog of the standard electro-mechanical one. There are minor improvements, such as the use of color, but any really dazzling changes will evolve only very slowly. The introduction of color into electronic cockpit displays is probably an improvement in the way information is presented, albeit a rather small improvement. It's for this reason we view the use of electronic display color as only something which helps to push up the safety margin another percentage point or so. ■

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Mountain Flight

MAJOR JOHN E. RICHARDSON
Editor

■ "How does the weather look northeast of here up in the Chugach?"

The NCO on duty at the base weather shop looked up from the weather flimsy he was preparing. Glancing at the sergeant leaning on the weather counter, he turned to the charts hung behind him.

"What route and altitude will you be taking?" he asked.

"VFR to the Sheep Mountain and return. We want to spot some sheep."

"Your weather en route and in the area should be good. It is currently clear with unlimited visibility. There is a broken deck moving in from the west at 8,000. The only problem I can see is the possibility of light to moderate turbulence in the mountains." The forecaster reached under the counter for a weather briefing sheet.

"OK, thanks a lot." The NCO turned and left the weather counter. The forecaster watched him leave, then shrugged, and putting the briefing form back on the pile, returned to his other duties.

After leaving the weather office, the NCO went directly to the Aero Club. Once there, he made arrangements for a Cessna 172. He discussed the proposed flight with several instructors.

"You know there is supposed to be some turbulence up there today?"

"Yeah, I got that at the weather shop."

"OK, you've flown in the mountains several times but just a reminder, those winds aren't anything to fool with. The turbulence could be bad, too. Be really careful about getting boxed in by being too low in one of the valleys up there."

"No sweat. I'll be real careful. I know about that area."

"All right, I see you're planning a 1700 departure with a three hour flight time. Here's your approval. Take 247. Have a good flight."

The NCO waved and left the Aero Club for his aircraft along with his three passengers whom he had met at the Club office. As they were loading the aircraft, another Club pilot stopped for a moment.

"Say, are you taking four in that plane?"

"Yeah, why?"

"Well, you better check the weight. I think you're over gross."

"Oh, it's OK. I've got a reduced fuel load."

"Oh, well, in that case . . ." The second pilot walked on, and the NCO continued his preparations. He directed the two larger passengers to sit in the back so they would have more room. For a brief moment, the other pilot's caution made him think about weight and CG. But he shrugged it off. He was sure they were OK, and besides he didn't want to delay anymore.

Soon the 172 was climbing into the bright afternoon sky with the snow covered peaks of the Chugash Range glistening in the distance. The four

friends were happy and excited about the prospects of the flight. The weather and the flight were both beautiful until they drew close to the mountains. At that point, the ride got a bit bumpy. The two men in back became worried, but the NCO pilot calmed their fears. He didn't tell them that, at first, he had been a bit concerned. The aircraft just didn't seem to handle the way he was used to. It seemed both slow to respond and at the same time very sensitive in pitch. But he became used to it and forgot about the problem.

The turbulence got a bit worse, but the aircraft pressed on. After about an hour of flight, the pilot spotted a promising ridgeline. He slowed, and with flaps lowered descended into a valley. The passengers avidly searched the floor of the valley, looking for signs of sheep. The pilot divided his attention between watching the valley and maintaining control of the increasingly unstable aircraft in the turbulent air. As the aircraft flew farther up the valley, the turbulence increased. Finally, with the end of the valley approaching, the pilot started a turn to return down the valley.

Suddenly, the turbulence increased rapidly. The pilot fought to control the bucking aircraft, but the aft CG and the heavy weight were too much. When he instinctively pulled back on the yoke, the nose pitched up, the airframe shuddered, and the little plane dropped off rapidly on its right wing. Frantically, the pilot tried to recover. They were too low. The aircraft struck in a near vertical dive, bounced, landed on its tail, and broke apart. The sound of the crash echoed across the valley. A herd of sheep started momentarily, then, when nothing further happened, resumed their grazing.

"Palmer Flight Service, N7568, how do you read?"

"N7568, Palmer, loud and clear. Go ahead."

"Palmer, 7568 has just found what appears to be an aircraft crash about 70 miles northeast of Anchorage. It's in a valley. I can't tell if there are any survivors."

7568, Palmer. Can you make out the number? We have an overdue report for an aircraft in that area."

"Negative, Palmer, I tried twice to get down close, but the turbulence in that valley is wicked. I couldn't get below 5,500 feet. I am orbiting now at 6,000."

"Roger, we have notified search and rescue. Can you remain in orbit for a while? There is a helicopter en route, ETA 30 minutes."

"7568, sure."

The helicopter soon arrived and, the scene identified, proceeded with their tasks. Shortly, the radio in the Flight Service Station crackled.

"Palmer, Police 79. There are four fatal here, tail number is N16247. Is that the one you're looking for?"

"Police 79, that's affirmative." ■

Emergencies in Combat

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■ Train like we plan to fight. This is the basic premise for realistic training like Red Flag. But it's not all done in the air. There are areas which we must think about on the ground. This article discusses one of them. What would you do if faced with an aircraft emergency in combat?

Of course, we are not currently in a combat situation, so several of Lieutenant Constantino's points are for discussion and future reference. Today, faced with an emergency, we don't have to worry about a MIG or AAA. But, on the other hand, the very process of thinking through how we would handle an emergency in combat and the extra systems study to make our plan effective will, without doubt, make our peacetime exercise flying more effective and safer.

So let's continue to train as we plan to fight, and part of that training is planning to survive the fight.

After sitting in a cap for 40 minutes each day for the last eight days without any action, you are understandably excited when your 2-ship finally is committed by AWACS. Two contacts. You see their pincer and deploy your wingman to out-bracket them. The sorts are called and, going pure-pursuit at 10 miles, you obtain a tally. Then at eight miles, a master caution light appears. A glance at the caution panel shows "L INLET," "AV BIT," and "HYDRAULIC." You shift your sights to the BIT panel and it reads "UTL A" and "RDR." What would you do . . . Captain Sackacookies?

"Well, first I'd call 'Knock it off, then I'd start a climb, . . ." Try again.

"Well, I'd pickle a Fox 1, get a tally-ho through the TD box, select full AB, hit the deck, and blow through supersonic." Still not right.

Discussion of EPs usually assumes a benign environment, i.e., daytime, in the local area, CAVU. What if you are engaged with a Flogger over enemy territory or rolling out on final for a low angle pass? At night? KIO and climb doesn't hack it when you see the proverbial master caution light. But neither does selecting full AB and hitting the deck, necessarily. My point is that, as they unfold in combat, emergencies demand handling which may be considerably different from that on a peacetime training mission. As with anything else we do, some thought, discussion, and good use of sim time will prepare us for most situations.

The purpose of this article is to bring up some ways in which EPs might be dealt with differently in a tactical (real combat) environment. I will first examine three steps for handling any emergency and offer some advice for each one, then consider three specific problems: Utility A Failure, Structural Damage, and Engine Stall/Stagnation. Though this is written by an F-15 pilot for other F-15 pilots, many of the concepts apply to other aircraft as well.

This is meant to be a provocative treatment. Pilots with experience in combat tend to have very strong ideas about certain EPs, and some may even have had an engine fire or a hydraulic leak or two over Southeast Asia — tap this insight (even if it means having to buy a round at the club). Finally, I suggest incorporating these topics into flight briefings and the SEPT Program.

I wish to emphasize at the outset that the suggestions and facts printed here are not prescriptions for action in peacetime. Nor should it be read as a cavalier interpretation of Chapter 3 of the Dash One. I simply acknowledge that priorities may be different in combat when you are about to be shot!

Certainly, the three basic steps espoused in all Air Force manuals still apply, with qualifications:

Maintain Aircraft Control Of course. If you hit the mountains, that solves the Fulcrum's problem.

Maintain Situational Awareness It is important that you remain aware of what is going on around you. Try not to focus all your attention inside the cockpit. Is the jet flying normally? How are the other aircraft reacting? Do they know that I'm hurt? Which way is home? The FEBA? Tanker support?

Analyze the Situation and Take Proper Action This is not so easy anymore. Your immediate task may be to defeat an Aphid or jink from AAA. Can you judge the extent of your problem with one eye on the caution panel and the other on the Mig? You may be so caught up with the fight that your first indication of a problem is an abnormal response to a flight-control input or adverse yaw.

Here's where your judgment comes into play. You must answer this question: How much is my performance degraded and what systems are affected? The extent to which you will be able to answer that depends on your general knowledge and, just as important *your familiarity with past problems in the systems of the F-15.* Why may a single generator failure be serious? Because, at times in the past, it has been followed by a fire (so much for my thinly-veiled pitch to read accident reports)!

So, what should your first action be?

■ **Disengage How?** Think of a few situations, and you will come up with some possible actions. You will need to do one or more of the following: Shoot a missile or the gun, drop a bomb, jettison tanks and/or ordnance, light the burners, drop chaff and flares, take it up, take it down, head for the clouds, point towards a safe area, etc. If you are defensive or neutral, your BFM skills will be tested.

Can you get out of this mess on your own?

■ **Call for Help/Re-establish Mutual Support** If your wingie is there, be directive. Otherwise, get on the horn, and see if you can get someone else on the way. Mutual support becomes paramount when a flight member is having a problem. Try to envision fighting your way out with an engine fire — *alone!* It's not a very pleasant scenario.

OK, now you are free from the immediate threat with your wingman in a supporting formation. What next?

■ **Head for Friendly Territory** Read almost any account of an emergency in combat, and you will gather that heading for home (or feet-wet in Southweast Asia) was foremost in the minds of those afflicted. The pain and loneliness of a POW camp was well-known by pilots, so the incentive was patently obvious.

If the emergency demands an immediate ejection (i.e., out-of-control), an initial heading will help you once you hit the ground. (Did you remember to file your EPA?) If you must eject, know that you're in good hands, initially. The ACES II seat has an enviable record which is well-documented. One Eagle driver got out at 485 KIAS, 8,000′ MSL, with a 240 degree per second roll rate and suffered only from bruises and abrasions. It's nice to know that you can hit the ground running!

Of course, very few problems with the F-15 require ejection at all. But, consider what battle damage might cause: Flight Control or structural anomalies, oil/fuel/hydraulic leaks, *injury to the pilot!* In this case, you may have a limited amount of time in which the aircraft is flyable, so you *must* know which way to point.

■ **Land as Soon as Practical** Yes, and maybe not from where you departed! In fact, how about that highway landing strip marked on your chart? Look closely at a map of Southwest Asia, and you'll see a number of these.

continued

Your ability to handle an emergency situation may be hampered by a number of other circumstances. You may not have free use of the radios (couldn't get the Have Quick to work today); you may be alone (my wingman split at the merge, and that's the last I saw of him); you could be injured (some AAA is pretty accurate); you may be lost (those green hills/sand dunes all look the same to me)! Think about how these would complicate your plan for a safe recovery.

Let's look now at the three specific emergencies and identify some important considerations.

Utility A Failure

The situation at the head of the article depicts the one hydraulic problem with major repercussions in the F-15. The radar antenna is powered by Utility A, so if you had a lock, you won't anymore. The antenna should fall downward, though, and allow you to use the flood horn (remember to limit this to stern, medium- to high-altitude look-up shots, close in). But it may simply flail around, privy to the G loads, since there is no pressure to hold the antenna down. Heaters are usable, too, but you won't have radar slaving for the AIM-9L/M. When given this situation, most pilots get so wrapped up with the radar problem that they forget an important point: The left inlet ramp and doors are inoperative. The Dash One imposes airspeed and G limits, in this case, to keep smooth, subsonic airflow to the face of the engine and prevent a stall.

If you are already supersonic, don't reduce the throttle below mil. The inlet problem may spawn an EEC anomaly, so watch for engine problems as well. With a supersonic bugout, you may induce a stall, or possibly even damage some blades with the dreaded "inlet buzz." Try separating on the deck at high subsonic airspeeds for this one.

If post-mission refueling is necessary, you will have to use the emergency switch. Of course, you will have the standard problems with landing gear, brakes, and steering. In wartime, the SOF/airfield commander may be more reluctant to let you close the runway by taking the barrier, so think about special braking techniques using the backup system.

Structural Damage

First, let's examine damage to the aft end. For example, consider what problems a hit from a heat-seeking missile might cause. The best approximation we have for this is our experience with augmentor-burnthrough on the F100 engine. The symptoms are there: Structural damage, fire, and loss of thrust. You may not have any indication of the fire due to the position of the detection loop, so your first indication may be a violent jolt and noise, or no indication at all. In any case, you're probably going to experience a loss of thrust — at least on one engine. Call for help, as you'll be quite a bogey-gatherer trailing those flames. Consider the following.

- You may have to jettison everything to keep flying — depending on the status of the engines.
- If the fire is too far back for the loop to detect, chances are good that discharging the bottle won't help either. With an augmentor burnthrough, deselecting AB will usually put out the fire. In this case, it may not. If the flames are confined to the AB area, the fire *should* blow out eventually. If the fire persists, it's your decision whether to stay with the jet or not. Note, though, that there has been *no* tendency for the F-15 to

Emergencies In Combat continued

explode even after a prolonged engine fire.

■ If a chase determines that one or both nozzles are damaged, turning the EEC(s) off will probably increase thrust.

■ I'd dump fuel and land on the first appropriate piece of concrete.

In the case of damage to other parts of the aircraft as with, say, an AAA hit, the possibilities are many. In some instances, the jet may immediately depart controlled flight. With lesser damage, it may simply be less than fully controllable.

As an example, take an F-15 that was involved in a midair collision a few years ago. After the incident, the PC2A and PC1B BIT lights were illuminated, and all the CAS were off the line and would not reset. The left slab was completely gone, and the left wing was heavily damaged. The pilot was able to begin a gentle climb after it happened. In combat, there is no telling whether the now-deformed and fatigued fuselage would be able to handle the stress of a high-speed separation or a turning fight. So, the method of egress is the result of an evaluation of tactically sound speeds and altitudes versus safe ejection speeds and altitudes versus controllable regimes.

Anything you can do to decrease the weight of the aircraft will help. Jettison (or shoot at someone) and dump fuel if able. When closer to home, some foresight and trial and error will clue you as to how the jet will fly. In this case, the pilot found that he could make only right turns, for initiating a left turn would cause the aircraft to fall off and start vibrating badly.

Engine Stall/Stagnation

Have you ever tried to restart in the sim while fighting? How about a JFS restart? It's not too hard. After experiencing a stall or stagnation, you should answer a few questions: Was the stall pilot-induced? If not, there may be a problem with the UFC, nozzle, EEC, etc., and it may happen again. Cycle the EEC and check for proper nozzle movement. With a hard EEC light, idle-through afterburning power should still be available if you move the throttle slowly and match the rpm/FTIT with that of the good engine. If an overtemp was experienced, how long did it endure? This will give you a clue as to how much damage was incurred. Expect the stall margin to be reduced. I'd try to restart the engine right away. You'll need about 350 KIAS to hold sufficient rpm; under G loads, you may need more airspeed.

For both of these reasons, a JFS-assisted restart is advantageous (remember the restricted envelope if you choose to retain the centerline pylon). Surprisingly, you can still go pretty fast with one engine in AB —it just takes longer to get there.

If the engine stalls while out of AB, the variable vanes may be malfunctioning or you could have some broken blades. Try setting the throttle just below mil, as the engine has a better stall margin there.

There are many other emergencies which would create special problems in combat: Fuel leak, oil leak, ECS light, bleed air light, etc. Even items that are briefed daily become totally different beasts when placed in the context of battle. Try to brief "Landing Immediately After Takeoff" given a configuration of three bags, eight missiles, a low ceiling, and a runway that has just been cratered. That's one sure way to liven up your next briefing or SEPT! ■

About The Author

Lieutenant Constantino is a distinguished graduate of UPT with a total of 610 flying hours, 380 in the F-15. He was the first air-to-ground Top Gun in the 1st Tactical Fighter Wing.

Bird Strikes 1983

CAPTAIN ROBERT C. KULL, Jr.
Air Force Engineering and
Services Center
Tyndall AFB, FL

■ Since 1975, the Bird/Aircraft Strike Hazard (BASH) Team, located at Tyndall Air Force Base, Florida, has been responsible for maintaining all Air Force bird/aircraft strike data. The data base contains information as far back as the early 1960s; unfortunately, that data is fairly sketchy. One of the reasons for the lack of detailed information was the change of reporting criteria over the years. Only within the last few years have all Air Force bird strikes been reported. However, one problem still is that pilots coming home after a long flight, perhaps to include a low level flying mission, have a hard time finding the energy to fill out one more report on a bird strike that did little or no damage to their aircraft. The crew chief of the aircraft wipes off the evidence and everyone presses on with the mission. However, this is not always the case. Many aircrews realize the importance of reporting all bird strikes and do so according to the regulation.

The Bird Strike Hazard Reduction Program, AFR 127-15, requires that all bird strikes — those that cause $1,000 or more in damage, as well as those that don't — be included in the overall statistics to properly define the problem. Only when all bird strikes are reported and analyzed can we view the true nature of the hazards birds cause to our aircraft. The remainder of this article will give you some of what we have learned.

From 1980-1982, the BASH Team recorded over 3,900 bird strikes to Air Force aircraft. In 1983, over 2,300 strikes were reported. Either the Air Force is hitting more birds each year, more organizations are reporting bird strikes, or both. We believe that because of the increased emphasis on the importance of reporting strikes, more bird strikes are being reported. Likewise, with increased low level flying, we do expose our aircraft to environments in which more birds are found. Thus, we could also be seeing an actual increase in the bird strike rate. Unfortunately, at this time, critical information is not available in order to perform a proper quantitative analysis.

Table 1
Percent of Bird Strikes by Impact Point

IMPACT POINT	PERCENT
Engine/Engine Cowling	22.3
Windshield/Canopy	20.6
Wings	19.3
Radome/Nose	15.1
Fuselage	8.9
External tanks/pods/gear	6.7
Multiple hits	5.2
Other	1.9

Table 1 shows that all areas of the aircraft are potentially vulnerable to birds. Of course, where a bird strikes the plane is a matter of chance, unless the pilot is able to see the bird and maneuver the aircraft in such a way that the bird perhaps strikes the underside of the wing or radome. Normally, engine and windshield strikes pose the greatest damage and are the greatest threat for a crash or fatality. In reality, five percent of the windshield/canopy strikes resulted in birds penetrating the canopy, but only a few cases occurred where minor injuries resulted. Fortunately, in 1983, the Air Force did not lose any aircraft or aircrew due to bird strikes; how-

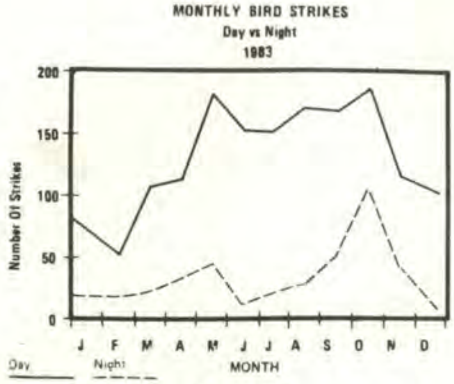


Figure 1

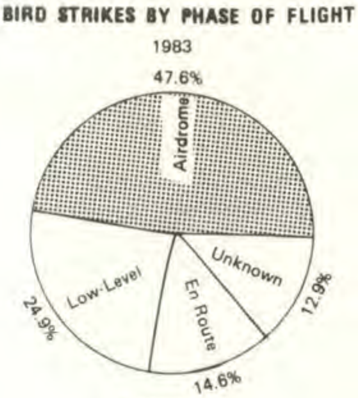


Figure 2

ever, total cost in damage was on the order of $4 million.

Time of Bird Strike Occurrence

Most bird strikes occurred during the day (67 percent), but a large number occurred at night (18 percent). Only five percent of the bird strikes occurred during the twilight hours. Since most of our flying is during the daylight hours, these statistics are not surprising. Unfortunately, we do not calculate a bird strike rate for day and night flying since it is difficult, time consuming, and expensive to obtain exact flight times per hour of the day. We do know, however, that birds are most active in early morning and late afternoon hours and that many bases we visit restrict flying during these times. Some bases restrict takeoffs and landings for an hour or more during dawn and dusk to reduce the chance of a bird strike.

Bird strikes occurred during all months of the year; however, there were times of increased strikes. This increase coincides with the times of migration for birds. As seen in Figure 1, the number of bird strikes peak in the spring when birds are migrating north to breed; however, we observe a much higher peak in the fall when adult birds and their offspring are making the journey south for the winter. Since most birds begin their migratory flights shortly after dusk, the number of night strikes greatly increase while the number of day strikes only moderately increase.

By understanding the reasons why bird strikes increase during certain times of the day and year, we can assist aircrews in avoiding these higher risk times. We ensure that our bird strike awareness programs receive emphasis before the fall and spring migration periods by sending out messages that give pilots a "heads up." When bird activity increases in the early morning, the director of operations at a base experiencing bird strikes may delay takeoffs — which could prove to be very prudent.

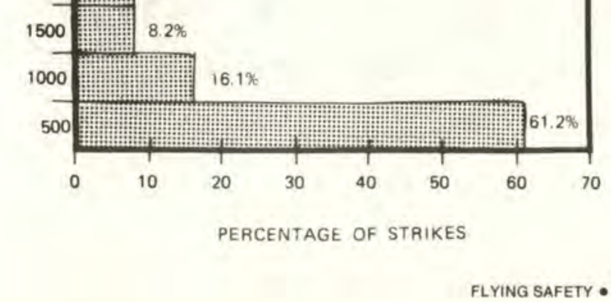
Where Bird Strikes Occur

Figure 2 shows almost half of the bird strikes occurred within the traffic pattern of our bases (e.g., takeoff, landing, approach). Obviously, by reducing the number of birds attracted to an airfield, we can effectively reduce the risk of bird strikes. Therefore, airfield environments receive the greatest emphasis in attempting to reduce the occurrence of strikes. Also, by increasing traffic pattern altitudes, we can reduce the chance of a bird strike in the majority of the environments flown.

The second most vulnerable phase of flight, with respect to hitting birds, is during low level operations. High speed (350-500 knots), low level (1,000-500 feet above ground level (AGL)) routes traverse the country in rural, sparsely populated areas, many of which are near wildlife refuges and reserves. Almost 25 percent of all strikes occurred in this flying environment. Since windshield/canopy penetrations by birds are more likely to occur while flying at these speeds, especially for our fighter aircraft, the risk of aircraft/aircrew loss is greater during low level operations. As seen in Figure 3, most bird strikes occurred at or below 500 feet AGL. Should a bird penetrate the canopy, pilots have

continued

Figure 3



Bird Strikes 1983 continued

little time to react due to sudden loss of vision, possibly lack of aircraft control and loss of engine thrust, or some other severe circumstance at these low altitudes and high airspeeds. We recommend pilots increase low level flight altitudes and reduce airspeeds when operationally feasible.

Types of Birds Encountered

The BASH Team has an ongoing program to identify bird remains as a result of bird strikes. Air Force safety officers send feathers and other nonfleshy remains to the BASH Team for identification. Of the 2,300 strikes, approximately 26 percent are placed in a "bird-type" category (e.g., shorebirds, gulls). Without remains, another 22 percent are placed in a "small, medium, or large bird" category, depending on pilot observations. The remaining 52 percent are unknown as far as the type or size of bird impacting the aircraft.

Table 2
Types of Birds Involved in Bird/Aircraft Strikes — 1983

Bird Type	Number of Strikes
Starlings	39
Shorebirds	17
Blackbirds	22
Horned Larks	27
Meadow Larks	29
Doves	41
Pigeons	19
Gulls	122
Egrets and Herons	21
Vultures	46
Hawks, Falcons, and Eagles	126
Ducks	52
Geese	10
Unidentified Birds	
Small Birds	406
Medium Birds	38
Large Birds	50

By knowing the "bird type" causing the problem, the BASH Team and other experts can more specifically channel their suggestions. For example, should the identified "bird type" be a duck, there is less need to spray a pesticide for insectivorous birds than there is to look for a source of water to attract waterfowl. Raptors (vultures and hawks) and gulls continue to give military flying the most problems. Because of their large size, they also pose our biggest threat.

Aircraft Bird Strike Rates

The wide variety of aircraft flown by the Air Force and the missions they perform create large differences between the bird/aircraft strike rates for specific aircraft. As seen in Figure 4, fighter aircraft experience the most strikes. This is due, in part, to fighters flying more hours, as well as flying more within the 500 feet AGL and below vulnerability area. But, bombers and cargo aircraft also have a substantial low level flying mission and experience 7.9 percent and 28.4 percent of the bird strikes, respectively. Trainers also receive a large amount of strikes with 19.1 percent. By analyzing bird strike rates, we can provide information to aircraft designers so they can create a less vulnerable aircraft with respect to bird damage. Probably, the most well known of these programs is the aerospace transparency tests done by the Wright Aeronautical Laboratory at Wright-Patterson AFB, Ohio. Through their efforts, incidents of windshield penetrations by birds have been reduced. This has saved the Air Force millions of dollars in potential damage as well as aircrew lives.

Conclusion

By continuing to collect and maintain bird strike data, the Air Force has been able to channel its efforts toward reducing the risk of bird strikes to specific areas. Since we know the "bird types" most frequently hit, when bird strikes most frequently occur, and under what conditions they occur, we can more effectively minimize the hazards caused by birds. Since types of aircraft change, mission profiles change, environments are altered, and personnel concerned with the bird strike hazard continue to move from base-to-base at approximately three year intervals, the need for collecting and maintaining bird strike data will be ever present. ■

BIRD STRIKES BY AIRCRAFT GROUP

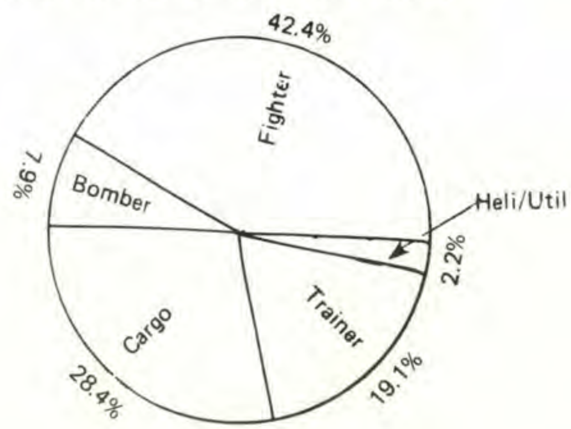


Figure 4

Bird/ Aircraft Strike Hazard

Dangerous Encounter

■ *Flyers! Be Aware!* You may be flying in uncontrolled airspace. Twelve thousand dangerous encounters have been reported since 1975. That is probably only a drop-in-the-bucket compared with actual aircraft/bird strikes, not to mention the near misses. The Air Force has lost 23 aircraft since 1964 due to bird strikes. Eleven of these took Air Force pilots' wings with them.

Every flyer has experienced a bird strike — but how many flyers have thought about the bird hazard or planned their mission in consideration of the bird hazard?

Flyers! Report Bird Strikes — How and Why???

Air Force Regulation 127-15 requires all aircraft bird strikes be reported. This is not a procedure designed to test your ability to fill out paperwork, or an exercise in futility. Recording bird strikes is the first step toward an effective bird hazard reduction program.

The Bird/Aircraft Strike Hazard (BASH) Team is tasked with reducing bird strike hazards throughout the Air Force. Bird/aircraft strike reports are vital for the BASH Team to provide technical assistance to bases and in research and development.

The BASH Team uses strike data to determine bird strike trends to assist bases in reducing the bird strike hazard. These trends can be analyzed to evaluate possible operational or environmental modifications. For example, if three hawk strikes occurred near a ridge line en route to a range during October, a decision should be made to avoid the ridge during hawk migration. On the other hand, if barn swallows have been feeding around the airdrome, the decision should be made to eliminate the food source, rather than altering operations. Bird strike data is also incorporated into a computer-generated Bird Avoidance Model (BAM) which has a 75 percent prediction rate for waterfowl strikes on all low level routes. The BAM is presently being updated to include raptors (birds of prey). Additionally, bird strike data is used for investigational engineering projects, including the use of Next Generation Weather Radar for real time bird warning, strobe light research for effects on birds, and modulated microwave for bird avoidance. In other research, strike data is used by Wright Aeronautical Labs and by private industry for aircraft design and retrofit criteria in bird resistance.

We must identify a bird hazard in the flying area before that hazard can be reduced. Birds don't cause accidents — pilots flying in the birds' environment do. Bird strikes occur near specific places, at specific times, to specific birds. The quality of a bird avoidance program is only as good as the information upon which it is dependent.

Accurate reporting is vital. Let's avoid disasters. Your flying safety officer can provide you with a bird strike reporting checklist. The 30 seconds you spend filling out this report may help prevent a tragedy.

Help us, help you, help yourselves — *report bird strikes!* ■

Bird/Aircraft Strike Hazard Film

■ The Bird/Aircraft Strike Hazard (BASH) Team (HQ AFESC/DEVN, Tyndall Air Force Base, Florida 32403-6001; AUTOVON 970-6240) supervised production of the bird/aircraft strike hazard prevention film, "Dangerous Encounter" (Number 602702DF). This pilot-oriented film promotes awareness of the increased bird/aircraft strike hazard which crewmembers face on takeoff, landing, and low level flying. It contains 21 minutes of spectacular footage aimed at fighter jocks and heavy drivers alike. Try it, you'll like it. It will increase your appreciation and respect for our feathered friends of the flying arena. The film is presently being copied for release to all active flying unit flight safety offices. It will be available to Air National Guard and Air Force Reserve units upon request. ■

IFC APPROACH

By the USAF Instrument Flight Center, Randolph AFB, TX 78150

Heads Up!

■ No, you didn't just make the call to GCI that you missed the intercept. This is about flying instruments with reference to a heads up display (HUD). With the advent of newer and more sophisticated avionics, more and more of our aircraft will be equipped with a HUD. Although the HUD's primary design function is to enhance weapons delivery, it can be a useful tool to include in your crosscheck while flying instruments. When the HUD is functioning properly, its obvious advantages include increased precision, more performance data displayed in a small area, and the pilot's ability to look up and out for runway visual cues when the ceiling is "down around your socks." However, no current operational USAF HUD is certified by either the manufacturer or the Air Force for "sole reference" instrument flight.

The USAF Instrument Flight Center is currently revising AFM 51-37, Instrument Flying, to include a greatly expanded discussion of the HUD. Until this new HUD guidance is published, we will offer a few techniques for HUD use in IMC, most of which come from USAFE Pamphlet 51-9, Instrument Flight in Single Seat Fighter Aircraft Using the Heads Up Display. *Keep in mind these are techniques, not procedures.* HUD capabilities vary between aircraft, and your MAJCOM or Dash One may specifically address HUD use when in IMC.

Remember, the HUD should never be used as the single instrument flight reference, but rather as part of your instrument crosscheck. The actual amount of time spent on the HUD during crosscheck is a function of individual pilot preference, HUD capabilities, and the instrument maneuver being performed. Problem areas you need to consider include disorientation in a dynamic flight environment, incipient HUD failure modes, an increase in the instrument workload if the HUD is not smoothly integrated into your crosscheck, mesmerization with HUD symbology, and fixation on individual HUD symbols rather than looking through them.

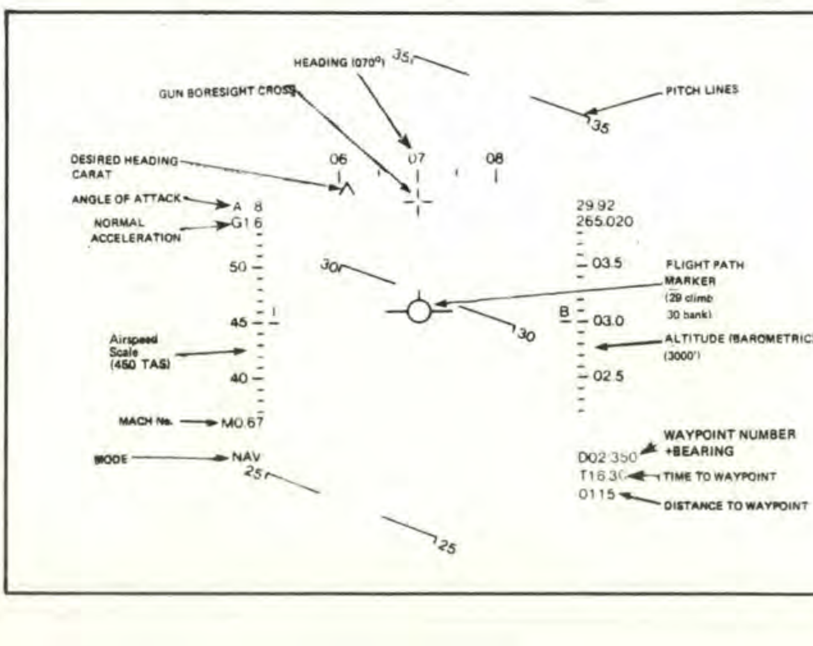
HUD Setup

Several control selections should be considered during the initial HUD setup. Intensity should be of prime consideration. A HUD that is too bright may be distracting, and HUD information that is too dim may be overlooked. Most HUDs are equipped with manual and automatic intensity controls. The manual setting requires constant adjustment in flight, especially during daylight conditions. The automatic mode, however, provides continual adjustment of brightness levels. For daylight operations, the automatic position is recommended with intensity adjusted after runway lineup. This mode is usually unsuit able for night operations since the manual adjustment feature offers greater flexibility. Whichever method you choose, set the intensity to the minimum level required and then minimize changes.

Another important part of initial HUD setup is the use of the stiffen/drift cutout switch. Selection of this feature eliminates the effects of crosswinds on the velocity vector/flight path marker (FPM) and pitch bars by centering the display in the HUD. This can easily lead to confusion since the aircraft may not be headed where the HUD is indicating; for example, the runway threshold may not appear under the velocity vector/FPM. It can also mislead you into underestimating the crosswinds for landing or navigation. Because of these limitations, selection of this position should be the exception rather than the rule for normal instrument operations.

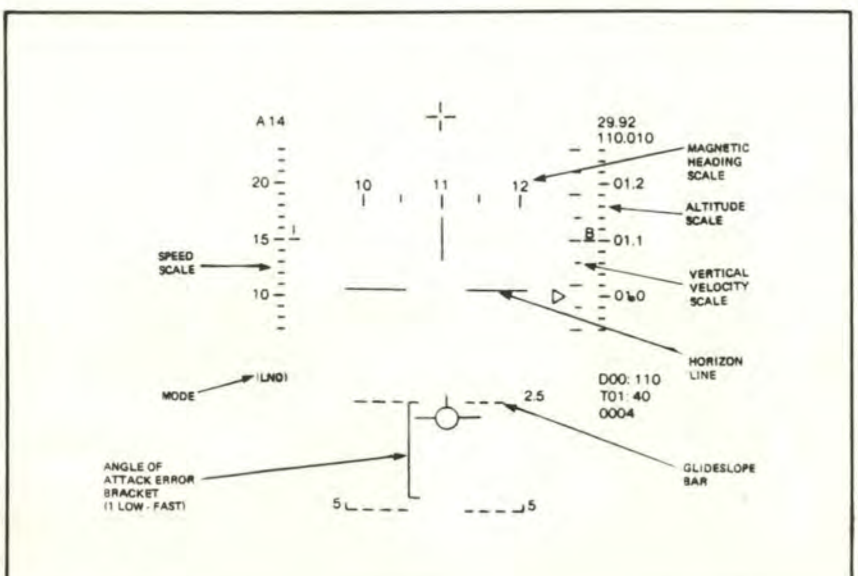
Flying With The HUD

Before encountering IMC, crosscheck the HUD and the main ADI for the desired pitch attitude. Crosscheck the performance instruments (altimeter, airspeed, HSI, etc.) for proper altitude, airspeed, and course guidance. Once the velocity vector/FPM attitude has been confirmed as valid, you can begin to use it for pitch control. For best heading, airspeed, and altitude control, fly "heads down" on the round



gauges. Remember, if you are flying a radar trail departure, fly the published instrument departure *first* and establish precise radar trail after both you and the aircraft are under control.

Use of the HUD airspeed, altitude, and heading scales differ according to pilot technique. Although all three scales have similar digital displays, most pilots consider the heading scale easiest to interpret because it looks so much like their HSI or "whiskey compass." On final, the heading rate of change is relatively slow, and the heading changes are small. Therefore, the HUD heading scale can be a valuable part of your instrument crosscheck for precise heading control. Conversely, the airspeed and altitude scales require continuous refocusing of your eyes to accurately interpret the scale data. This can be both distracting and time-consuming. In addition, the relative rate of change of the airspeed and altitude scales is difficult to judge, so it may be hard to determine a lead point for power changes and level offs. As a result, most pilots prefer "heads down" for precise airspeed and altitude control.



Unusual Attitude/Lost Wingman

This area can be addressed in one simple sentence: *Do not use the HUD for unusual attitude recoveries or when accomplishing lost wingman procedures!*

Penetration

Begin the penetration by establishing the desired nose low pitch on the HUD and then crosscheck the ADI and airspeed. When leveling for intermediate altitude restrictions, use the velocity vector/FPM to initially set the required pitch attitude, then crosscheck "heads down." The pitch scale and velocity vector/FPM should be the primary HUD references used when flying the penetration or for any maneuvering during the transition to final. Remember to continually crosscheck "heads down."

This concludes the first in our series on the use of the HUD for instrument operations. Next month, we'll discuss using the HUD for instrument approaches. For questions or comment, contact the USAF IFC/IP, Randolph AFB, Texas 78150 (Major Hart), or call AUTOVON 487-4674. ■

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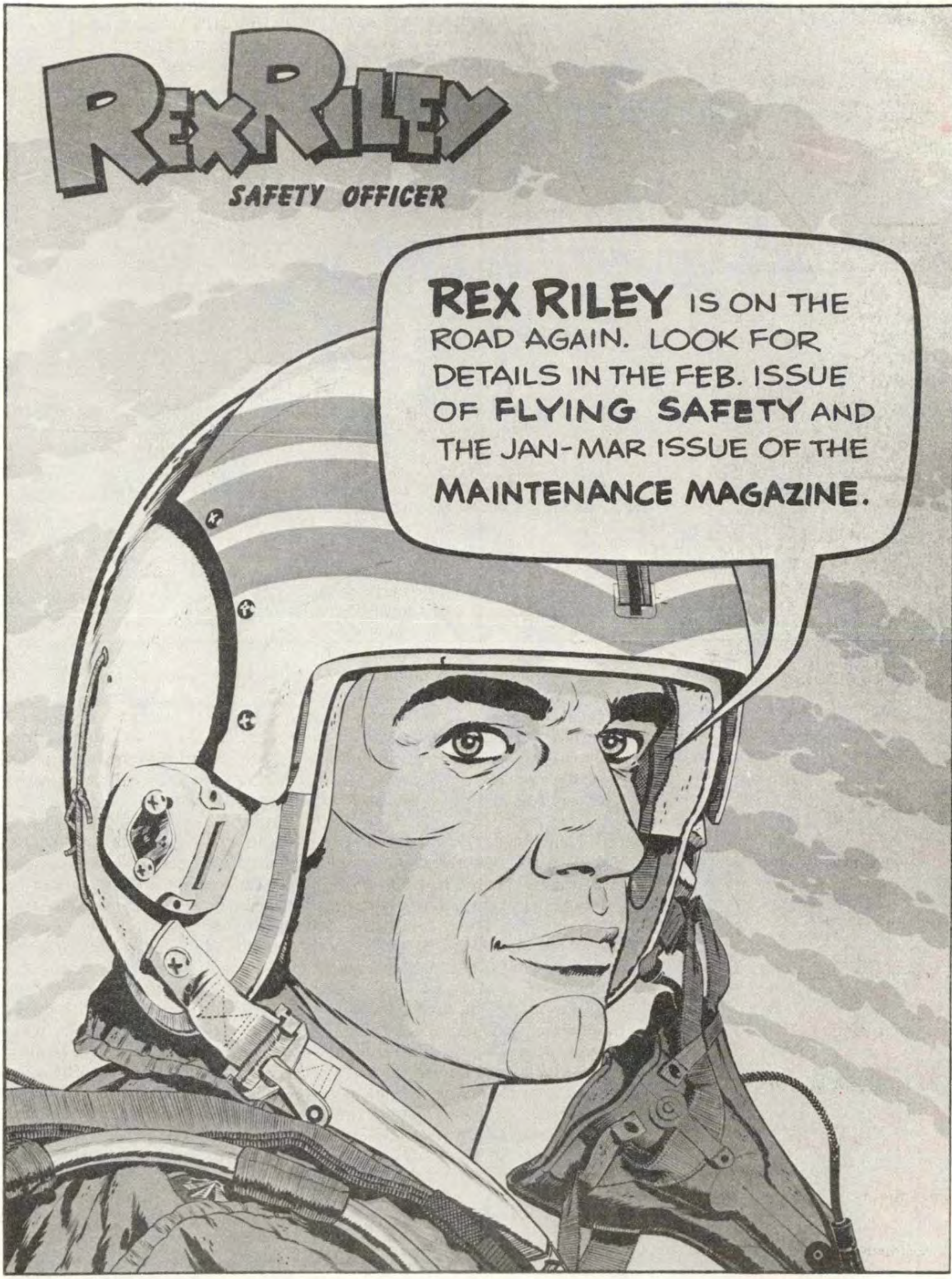

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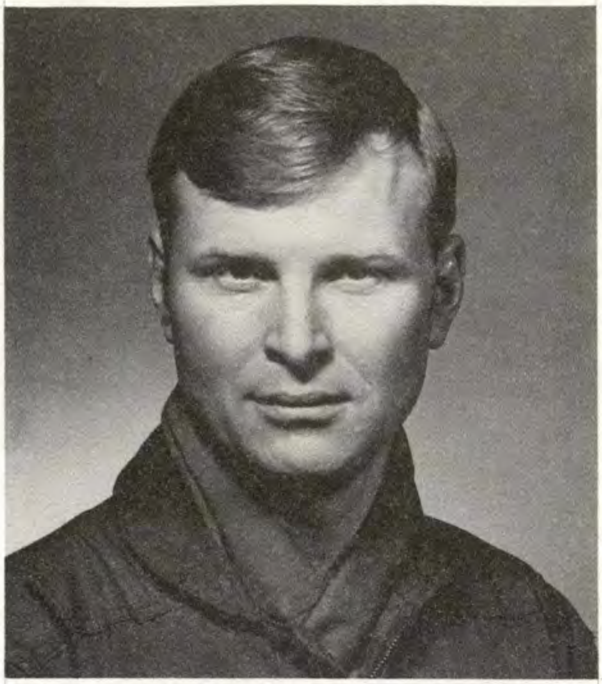


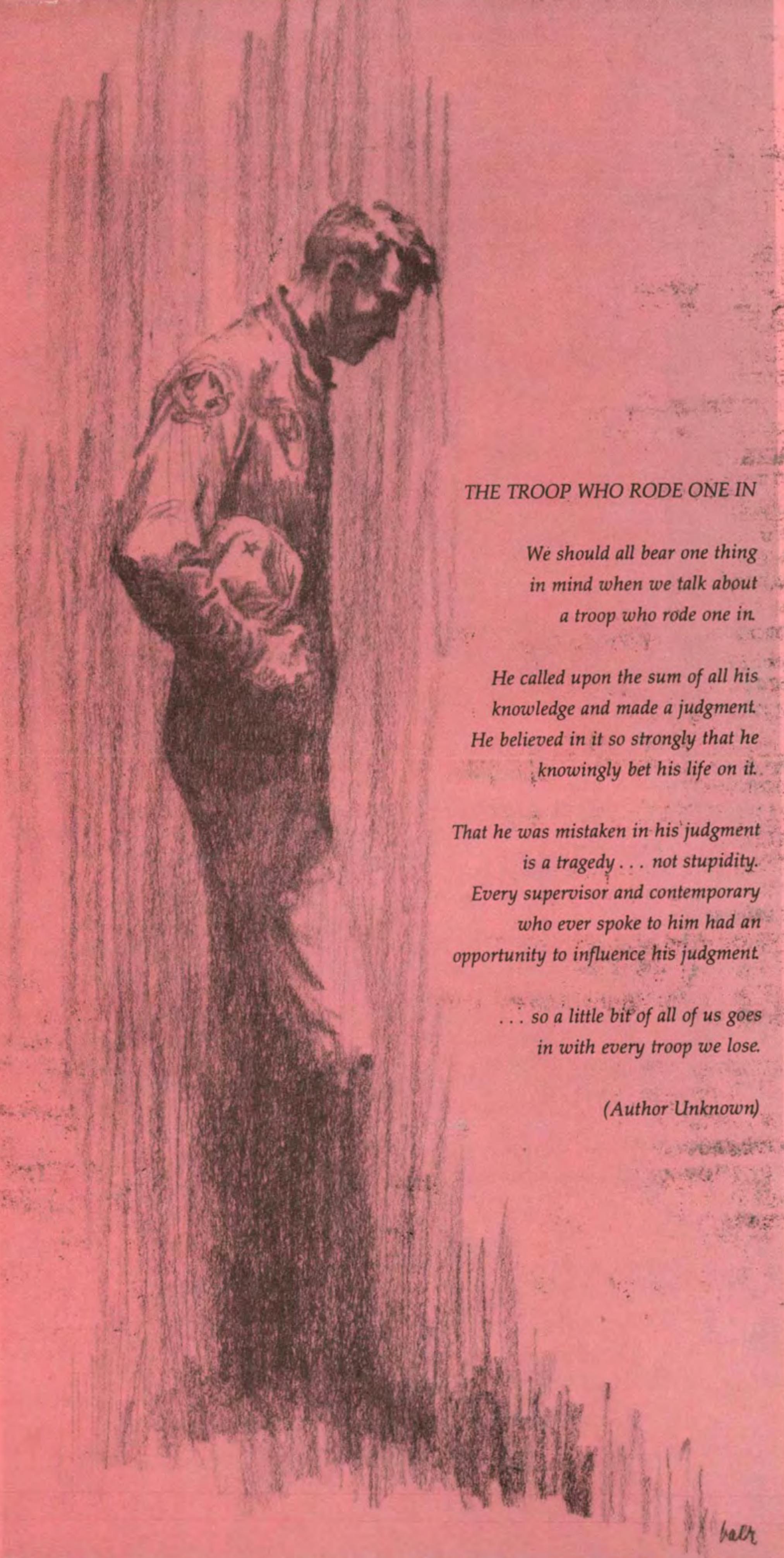
MAJOR

Thomas J. Goetz

42d Bombardment Wing

Loring Air Force Base, Maine

■ On 17 January 1984, Major Goetz was flying as an instructor pilot (IP) in a B-52 aircraft. Following a no-chute, full stop, taxiback landing by the IP upgrade in the right seat, the SOF accomplished a "last chance" inspection, and the aircraft was cleared for takeoff. Unknown to anyone, the number one wheel remained locked through the takeoff roll. After a 16-minute pattern with the gear down, the IP upgrade was cleared for a touch and go. The aircraft touched down on speed with 8,200 feet remaining. The number one wheel was still locked and left a solid skid mark to the 7,200 feet remaining point where the tire blew. The aircraft was 13 feet left of centerline, and Major Goetz, as the IP, initiated abort procedures. When the brakes were applied, the number two tire began to shimmy, and the forward left truck began to cock right. The aircraft crossed centerline left to right with 5,900 feet remaining and was uncontrollable with steering and/ or flight controls. Major Goetz used asymmetric thrust (engines seven and eight) for steering, and the aircraft stabilized 32 feet right of centerline until the 4,100 feet remaining point. Then the IP, concerned with landing roll distance, idled the asymmetric engines, and the aircraft began a rapid departure from runway heading. Major Goetz again applied asymmetric thrust with engines seven and eight. This stopped the departure from runway heading, but not until the 3,200 feet remaining point where the aircraft was 120 feet right of centerline. The right wingtip was 213 feet right of runway centerline, or 63 feet right of the runway edge. The 3,000 feet remaining marker went midway between the tip tank and numbers seven and eight engine pod. The airplane corrected slightly left, toward centerline, and came to rest 96 feet right of centerline with 2,275 feet of runway remaining. The left front truck was cocked 70 degrees right, and the number one tire was disintegrated. Major Goetz's "heads up" reaction and skillful flying resulted in the safe recovery of a valuable aircraft. WELL DONE! ■



THE TROOP WHO RODE ONE IN

We should all bear one thing
in mind when we talk about
a troop who rode one in.

He called upon the sum of all his
knowledge and made a judgment.
He believed in it so strongly that he
knowingly bet his life on it.

That he was mistaken in his judgment
is a tragedy . . . not stupidity.
Every supervisor and contemporary
who ever spoke to him had an
opportunity to influence his judgment.

. . . so a little bit of all of us goes
in with every troop we lose.

(Author Unknown)