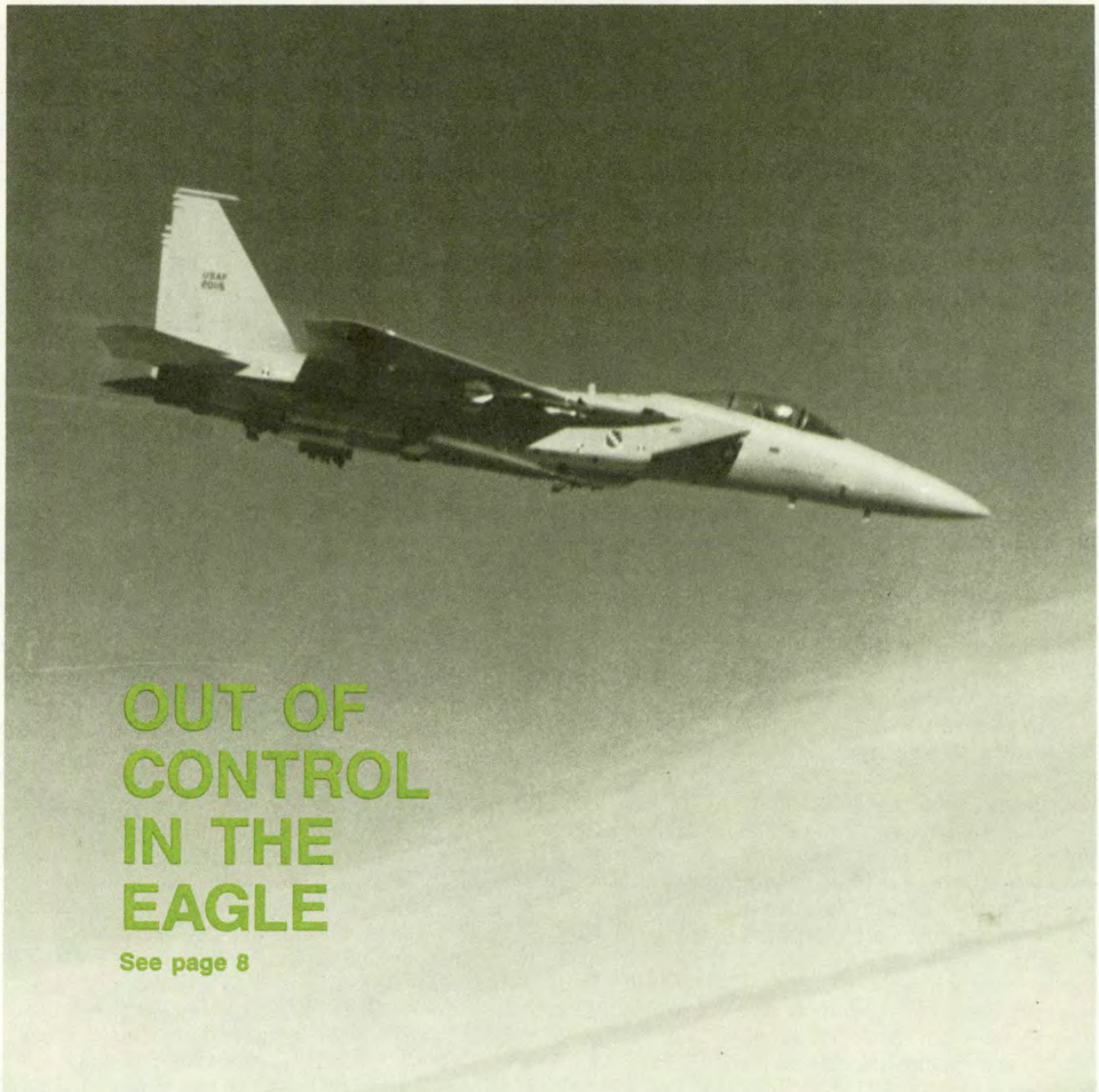
flying SAFETY

AUGUST 1988



THERE I WAS

■ I was in the center seat of the HH-53C, part of a six-man crew on an RWR/threat countermeasures training sortie against some radar emitters on the range. We were eager to get the mission underway and see if we could defeat the radar threats and avoid being "shot down." The guns were loaded, the ALE-40 chaff programmers were set, and the RWR set was warmed up — we were ready!

We arrived at the range uneventfully, descended down to 100 feet AGL, and proceeded to our operating area taking maximum advantage of the terrain to mask our movement from the "bad guys." Once we arrived at our designated area, we elected to start things off by flying several approaches to practice combat insertion landings. On short final of the fourth approach to the LZ, the RWR scope began to show some acquisition radar activity off to our 11 o'clock. They were starting to look for us, and the "cat-and-mouse game" was about to begin.

My finger was itching on the ALE-40 chaff release switch — I was ready! We landed all right, and after a minute, the copilot initiated the takeoff. We climbed to 100 feet AGL, leveled off, and began to accelerate. At 100 feet AGL and 60 KIAS, the RWR scope lit up like a Christmas tree with the missile launch light flashing and the audible warning blaring — they had us!

"BREAK RIGHT, BREAK RIGHT! MISSILE LAUNCH 11 O'CLOCK, CHAFF'S AWAY, CHAFF'S AWAY, they still have us locked up, punching more chaff, CHAFF'S AWAY!" My eyes were glued to the RWR scope, and I worked the chaff release switch as we continued the right turn in an effort to break radar lock until the tail scanner yelled "STOP DOWN! STOP DOWN! CLIMB! CLIMB!"

The pilot and I both quickly looked through the pilot's right side window, and my heart froze as I saw individual grass hummocks go flashing past. I was sure this was it and rotor blade contact with the ground was only milliseconds away! The pilot yelled "ROLL OUT! CLIMB!" at which time I snapped out of it and made a quick instrument cross-check to find that we were in a 30-degree right bank and at 40 feet AGL! The copilot rolled the helicopter level and initiated a climb up to 200 feet AGL where we all began to breathe again.

Lessons learned? Talk about channelized attention! The crew was so intent on defeating the radar threats that we almost defeated ourselves by flying into the ground. As for me, I was so focused on the RWR scope and working the ALE-40 system that I allowed my normal instrument cross-check to break down. Missile threats don't have a PK (probability of kill) of 100 percent, but the ground almost always does! ■

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CONTRIBUTIONS

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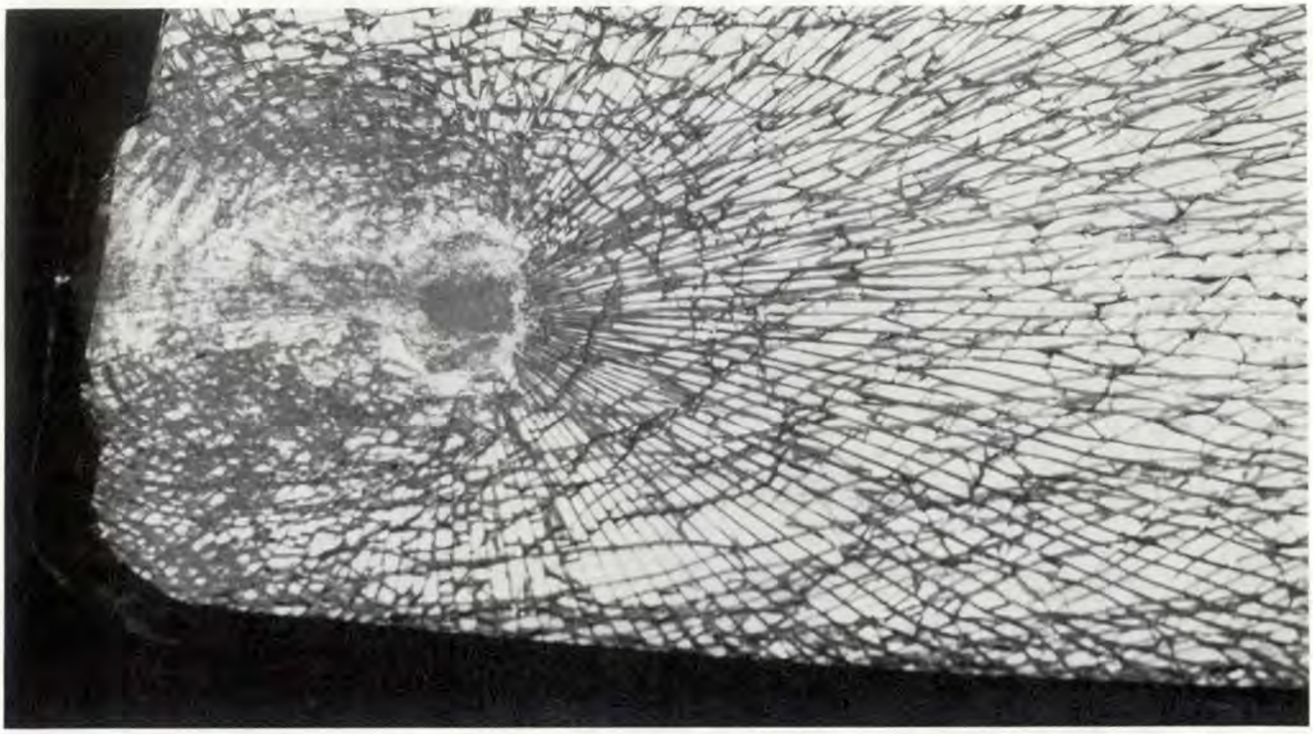
SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, OSAF

PURPOSE — *Flying Safety* is published monthly to promote aircraft mishap prevention. Use of funds for printing the publication has been approved by Headquarters, United States Air Force, Department of Defense, Washington, D.C. Facts, testimony, and conclusions of aircraft mishaps printed herein may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in mishap stories are fictitious. The contents of this magazine are nondirective and should not be construed as regulations, technical orders, or directives unless so stated. **SUBSCRIPTIONS** — For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Changes in subscription mailings should be sent to the above address. No back copies of the magazine can be furnished. **REPRINTS** — Air Force organizations may reprint articles from *Flying Safety* without further authorization. Non-Air Force organizations must advise the Editor of the intended use of the material prior to reprinting. Such action will ensure complete accuracy of material amended in light of most recent developments. **DISTRIBUTION** — One copy for each six aircrew members. One copy for each 12 aircrew support and maintenance personnel. Air Force units must contact their base PDO to establish or change requirements. AFSP 127-2 is entered as a publication at the Second-Class rate (USPS No. 586-410) at San Bernardino Postal Service, 1331 South E Street, San Bernardino, CA 92403 and additional entries.

1987 Air Force Bird Strike Report



CAPTAIN RUSSELL P. DEFUSCO
Bird Aircraft Strike Hazard — BASH Team
Bolling AFB DC

■ The Air Force suffered its most disastrous year in loss of life and aircraft damage due to bird strikes in 1987. There were 2,559 bird strikes, costing $242,628,224 and 5 fatalities, that were reported to the Bird Aircraft Strike Hazard (BASH) Team. Included in these figures were three Class A mishaps.

- An F-4E struck a 16-pound griffon vulture during a range mission. The bird penetrated the windscreen and canopy of the aircraft, striking the pilot and killing him instantly. Bird remains and pieces of canopy ripped through the cockpit, impacting the weapon systems officer. His injuries and visual impairment caused by the strike prevented escape from the aircraft, and he was killed upon ground impact.
- A B-1B on a low-level training mission struck a 16-pound American white pelican. The bird strike set up a chain of events which resulted in an intense fire. Aircraft control was lost, and the crew initiated ejection. Three crewmembers ejected successfully. The three remaining crewmembers were killed upon ground impact.
- An E-4 struck approximately 40 snow geese shortly after takeoff. The crew jettisoned fuel and managed to land safely despite extensive damage to the airframe and engines. Both wings, the radome, and two engines sustained significant damage costing over $1,650,000.

These examples are but a few of the devastating effects birds had on our aircraft in 1987. The severity of many of these strikes is due to encounters on high-speed, low-level missions. The Air Force's increased emphasis on realistic low-level mission profiles places our aircrews in prime avian habitat. High airspeed and large numbers of birds often result in significant damage to or destruction of our aircraft.

Mission planning and airspace development to avoid birds require more emphasis as our low-level role increases. Several major commands have initiated aggressive bird strike reduction programs to combat these problems. Despite the staggering losses during 1987, many units reported significant reductions in their bird strike rates.

The overall Air Force bird strike rate was 69.9 per 100,000 flying hours in 1987. This figure is more than 10 percent lower than 1986 and represents an improvement in base-level BASH programs and a heightened awareness of BASH reduction strategies. The BASH Team has noted a vast improvement in base-level BASH plans and commends those responsible for developing and implementing them. Bird strike damages can be further reduced through a variety of operational and environmental modifications adapted to the unique mission requirements of each unit.

The following summary of bird strike data reported throughout the Air Force during 1987 is offered to illustrate the impact birds had on our aircraft. While thorough statistical analysis is not yet available on these data, general trends can be used to concentrate BASH reduction efforts for each mission profile.

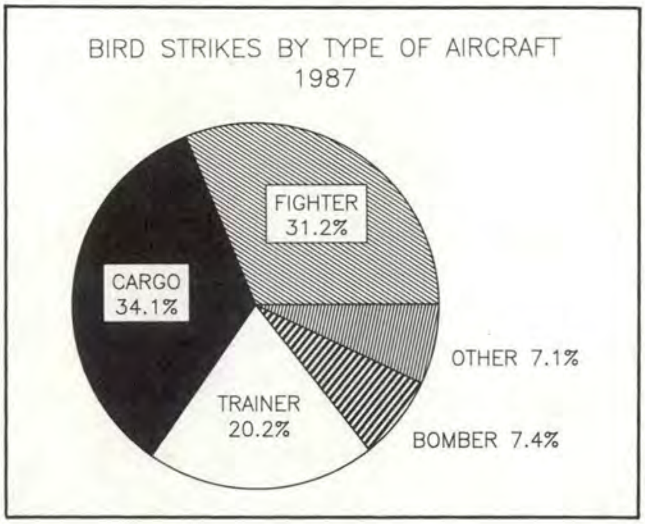


Figure 1

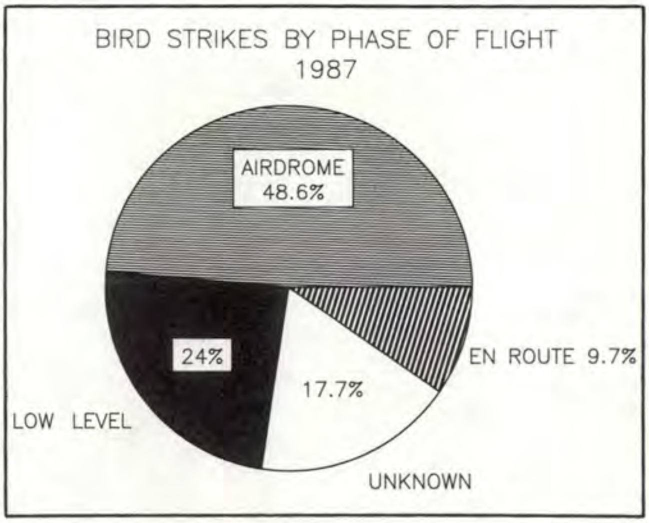


Figure 2

TABLE 1
Bird Strike Rate by Aircraft
1987

Aircraft	Number of Strikes	Strike Rate*
A-7	44	52.9
A-10	217	98.6
A-37	4	16.2
B-1	27	217.8
B-52	155	150.6
FB-111	8	41.6
C-5	44	73.8
C-9	34	117.5
C-12	7	22.0
C-18	3	320.2
C-20	4	71.8
C-21	27	46.9
C-23	5	32.1
C-130	274	76.9
C-137	1	44.2
KC-10	70	179.3
KC-135	288	111.7
C-141	85	30.1
E-3	7	22.8
E-4	12	655.0
F-4	87	40.7
RF-4	50	69.0
F-5	11	42.9
F-15	76	37.2
F-16	183	58.5
F-106	10	86.5
F-111	115	134.6
H-1	6	15.0
H-3	2	7.8
H-53	4	33.2
H-60	3	107.8
O-2	0	0.0
OV-10	9	28.1
T-37	207	66.1
T-38	305	87.8
T-39	2	49.2
T-41	0	0.0
T-43	12	76.2
T-33	4	17.9

*per 100,000 Flying Hours

TABLE 2
Bird Strikes by Impact Location
1987

Impact Point	Percent of Total
Windshield/Canopy	21.4
Engine/Cowling	18.0
Radome/Nose	16.8
Wings	16.3
Fuselage	8.8
External Tanks/Pods/Gear	6.4
Multiple Locations	10.0
Other	2.3

Aircraft Involved in Bird Strikes

Virtually every type of aircraft in the USAF inventory received bird strikes during 1987. Figure 1 shows the percentage of strikes by aircraft type. Cargo and fighter/attack aircraft led the list in most reported strikes. Bird strikes to cargo aircraft are increasing each year as their low-level missions increase.

Bird strike rates per 100,000 flying hours are reported in table 1.

Impact Locations

Distribution of bird strikes to various aircraft components is basically random and related to the frontal surface area. Table 2 shows the percentage of total bird strikes by impact location.

Windshield and canopy strikes topped the list again in 1987. Two fatalities and several injuries due to canopy penetrations resulted from these strikes. Aircrews should always keep their visors down when flying in prime avian habitats. We also anticipate future problems with canopy strikes and penetrations as the Air Force's low-level flying role increases.

For example, the current F-15 canopy is only capable of withstanding a 4-pound bird at 250 knots. Pilots of the Strike Eagle must be very cautious when flying high speed on the deck when birds are present.

Bird Strikes by Phase of Flight

Birds can be, and have been, struck in all phases of flight. Approximately half of the reported strikes occurred in the airfield environment during 1987 (figure 2). Fortunately, most of these strikes were not as severe as in previous years. A substantial improvement in airfield grounds maintenance procedures and bird dispersal techniques in the past several years have resulted in improved flight safety in the airfield vicinity.

While only one-quarter of reported strikes occurred in the low-level and range environments, the vast majority of damages and all five fatalities resulted here. Reduction of bird strikes in this environment can only be accomplished by careful airspace planning, development, and scheduling to avoid potential hazards. The Air Force must focus its efforts on reducing the low-level bird hazard in the future.

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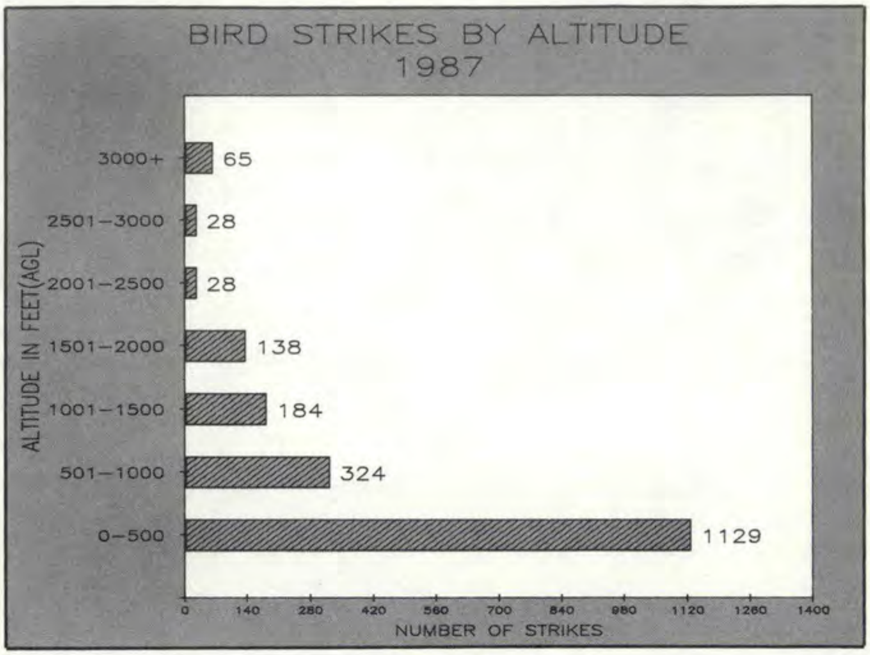


Figure 3

The BASH Team is currently working on several major projects to address these hazards. Expansion of the Bird Avoidance Model (BAM) to include all high-risk bird species and all theaters of operation is being researched. The current model includes population and movement data for waterfowl and some species of raptors (birds of prey) for the continental United States. Units using the current model reported up to 70-percent reductions in strikes to these birds. Support from the MAJCOMs is needed to fund and direct the proposed expansion of this invaluable tool for flight planning and scheduling.

Another area currently under research is the use of radars, particularly the Next Generation Weather Radar (NEXRAD), to help observe birds and potentially provide aircrews with usable bird hazard warnings. The BASH Team is sponsoring the development of a bird recognition algorithm for potential inclusion on this system.

With these systems operating, we anticipate a future reduction of the severe bird strike hazard in the low-altitude flight environment.

Bird Strikes by Altitude

Birds can be encountered at nearly all flight levels. The highest strike ever recorded was to a vulture at 37,000 feet. However, most birds fly much closer to ground level, and over 95 percent of all bird strikes are reported below 3,000 feet AGL. Figure 3 shows 1987 bird strikes by altitude.

Strike rates rise significantly as altitude decreases. This is partly due to where we fly, but mostly because birds are commonly active close to the ground. Any gain in altitude represents a substantially reduced threat of bird strike. Pilots should consider higher altitudes whenever crossing known bird concentration areas, particularly during migratory periods.

Times When Bird Strikes Occur

Bird strikes occur around the clock and throughout the year, but are most likely during certain peri-

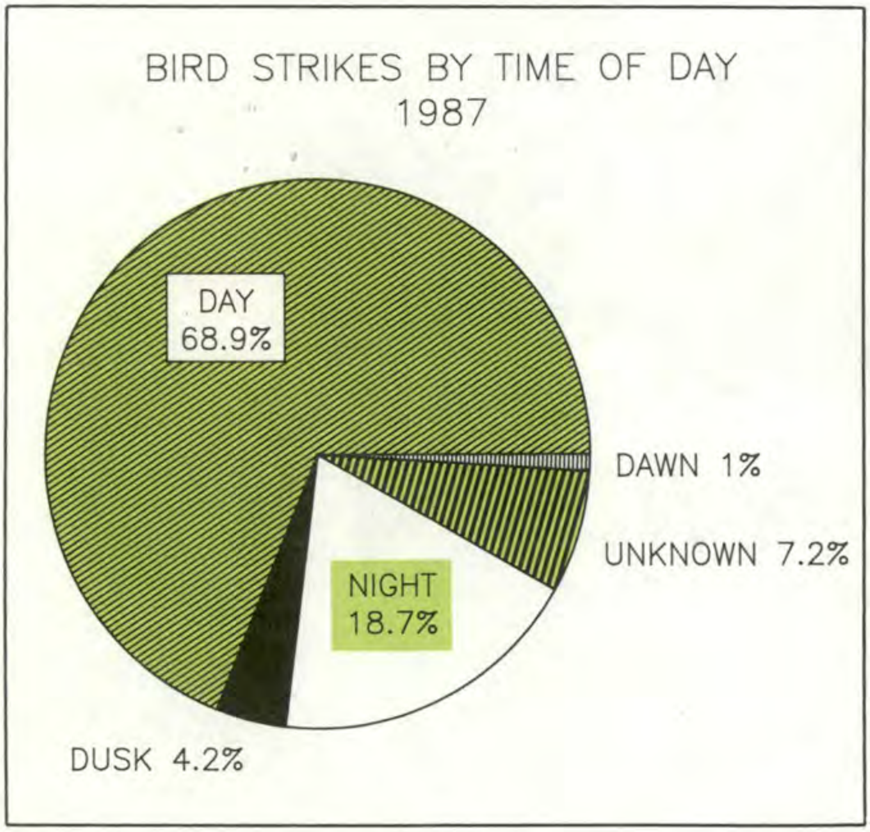


Figure 4

ods. Figure 4 shows the distribution of bird strikes by time of day. Most strikes are reported during daylight hours when we do most of our flying. Despite the low numbers, dawn and dusk are particularly hazardous times since many birds are most active at these times. Several bases have limited operations during these periods and have reduced their strike rates as a result. Most nighttime strikes are reported during migratory movements of birds. Many species migrate primarily at night, and extreme caution should be exercised when flying night operations in spring and fall.

Figure 5 indicates bird strikes by month. Strike rates peak during the spring and fall migratory periods. These rates are perennially highest during September and October as birds head south. Bird populations are highest at this time following the summer breeding cycle. Birds, often in large flocks, frequently stop to rest at even the most well-managed fields during this time. Bird dispersal and operational techniques are essential to reduce these hazards.

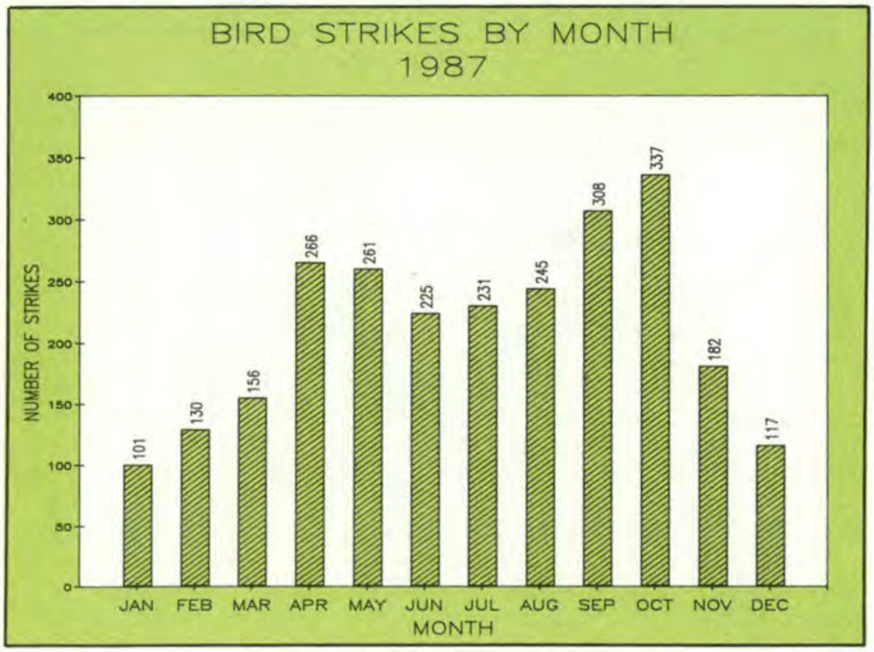


Figure 5

Summary

The Air Force continues to suffer tremendous losses to bird strikes each year. In 1987, we experienced our most disastrous year in terms of aircraft damage and lost lives. Recent incidents have caused a great deal of interest in BASH reduction efforts. Much needs to be done to reduce the hazards in all operating environments, but especially away from the airfield.

The BASH Team considers development of complete bird population and movement data, and issuance of bird hazard advisories in our low-level and operating areas among its top priorities for future reductions of bird strike hazards. Armed with this information, we anticipate safer flying conditions and substantial savings of resources throughout the Air Force. ■

Believe it or NOT!

CMSGT AUGUST W. HARTUNG
Directorate of Aerospace Safety

■ Perhaps you've seen the newspaper series called "Ripley's Believe It Or Not!" At one time, there was even a television show with the same title. Although difficult to believe, the incidents are said to be true.

In looking at some of our recent foreign object damage (FOD) reports, we might ask ourselves if, as bizarre as they may sound, they actually happened. Sad to say, the answer is a sheepish yes. Here is the first example. Believe it or not.

■ **C-130 Inlet Covers** While performing touchup painting on the engine inlets of a C-130, a corrosion specialist placed the inlet duct covers *inside* No. 1 and 2 engine inlets. He didn't mention it to anyone nor did he place an entry in the aircraft forms.

Later, when the crew chief was unable to locate the inlet covers following the paint job, he found two spares and installed them on No. 1 and 2 inlets. Then a maintenance crew towed the C-130 from the paint hangar back to the flightline and began a preflight. To remove the "spare" inlet covers, the maintainers used poles.

Now the flight crew showed up, preflighted the aircraft, and started engines. During the before-taxi checklist, No. 2 engine compressor stalled, so the crew shut down all engines and aborted the aircraft.

During the troubleshooting inspection, the flightline crew was surprised to find the original inlet covers inside No. 1 and 2 engine inlets! Subsequent investigation revealed each of these engines had ingested a brass inlet cover attaching hook and bungee cord.

This particular unit removed the inlet cover poles from service to ensure ladders are used during inlet inspections, as well as during cover removal and installation. Also, only flightline and isochronal dock people are allowed to install or remove the inlet covers.

■ **F-16 Video Tape** In still another FOD incident, an F-16 engine ingested a video tape recorder (VTR) tape. Here is the suspected scenario. Believe it or not.

The pilot arrived at the aircraft and caught the crew chief, a newly assigned cross-trainee, unprepared for his arrival. The crew chief was on the opposite side of the jet completing required tasks.

While waiting for the crew chief, the pilot removed the VTR tape from his helmet bag with his right hand. Now the crew chief handed the forms to the pilot and rendered a salute. The pilot accepted the forms in his left hand, laid the VTR tape and case on the inlet under the recorder door, and returned the crew chief's salute.

The pilot continued with his preflight and assumed the crew chief would load the VTR tape. But the crew chief had never been trained to do this and had only loaded the tape on two other occasions. He assumed the pilot would load the VTR, as most pilots had done in the past.

The engine was started and the aircraft taxied uneventfully. But through normal aircraft movements during taxi, the tape moved closer to the intake. The final brake application at end of runway moved the tape close enough to the lip of the intake to be sucked in. The plastic tape came out of the unlocked case as it moved down the intake and was ingested into the engine, while the case was impaled on the compressor inlet variable vanes.

The pilot failed to ensure the inlet area was clear prior to boarding the aircraft and strapping in. In addition, the newly assigned crew chief did not ensure the intake lip was clear prior to engine start.

■ **FB-111 Arming Pins** The aircrew arrived at the aircraft on time, but maintenance problems led to extensive delays and two aircrew preflights.

In an attempt to prevent a lost sortie, the aircrew expedited the second preflight. During the rush, both missed the checklist item requiring pylon and weapon pin removal on station 5 prior to engine start. While the crew strapped in, there was a maintenance shift change, so the crew chief turned over his duties to a second crew chief.

With the pins still installed in station 5, the navigator and crew chief mistakenly cleared the pilot for engine start. When a munitions crew arrived and reminded the crew chief of the pins, the pilot left the engines at idle and asked the crew chief and munitions team to use caution during pin removal.

Two munitions individuals set the bomb intervalometer on the SUU-20 rack and pulled the MK-106 bomb pins. After one individual left to secure a pin bag, his coworker noticed the pylon pins (MAU-12 rack pin and ejector valve pin) were still installed. So the coworker pulled the outboard pin and, finding the cord securing the pins together too short, left it hanging as he proceeded around the pylon. Seeing this, the crew chief grabbed the outboard pin as the munitions person removed the inboard pin.

When the munitions person on the inside of the pylon near the engine intake and blow-in doors pulled on the cord, the crew chief let go of the attached, outboard pin. The suction of the idling engine pulled the outboard pin and cord across the pylon, and then pulled the inboard pin from the hand of the munitions person into the idling left engine.

Lessons Learned

As long as we are in the business of flying and maintaining aircraft, FOD incidents are going to be with us. But damage to our aircraft engines can be decreased considerably through proper training and a lot of communications. Constant reminders are needed at rollcalls in the operations squadrons, the maintenance units, and any other agencies whose people visit or work on the flightline.

And let's not pass up training. This is one of the most important things we can do up front to eliminate FOD. People have to know the term FOD means more than the debris on the ramp that is usually sucked up by operating engines.

It means proper discipline in everything we do in and around our aircraft because, "believe it or not," we've even had people fatally ingested into aircraft engine inlets. In addition, there have been many close calls by folks who were able to pull themselves free of engine inlets and lived to share the frightening experience with others.

Final Comments

Good luck with your FOD prevention program. Consistently effective FOD prevention programs use technical innovations and aggressive selling techniques to educate and involve. Let's face it. We would all rather experience the rewards in increased safety and readiness, rather than read about FOD mishaps in a safety magazine, or even worse, be involved in such a mishap.

"Believe it!" ■

With all jets you have to be sure the engine intakes and the danger area around the intakes are clear of foreign objects. With the F-16, you also have to make sure the area between the top of the intake and the bottom of the fuselage is clear. This area can be a handy shelf.

The F-111 also has a special danger area to be wary of — the blow-in doors on the side of each engine intake. This is particularly true when working around the inboard weapon pylons with the engines running. Keep a close watch on pylon pins, comm cords, headsets, etc.

OUT OF CONTROL IN THE EAGLE

MAJOR MARTIN V. HILL
Directorate of Aerospace Safety

■ Loss of control (LOC) is historically the leading operational loss cause for the Eagle. It alone has accounted for 40 percent of the losses in the operational category, and almost 20 percent of the fleet lifetime losses for all reasons. The following is a summary of some of the losses and incidents that are on record, with emphasis on those that illustrate stability and control issues and pilot perceptions.

It is important to note that these are incidents that actually occurred to operational pilots on operational missions, and not in test programs whose goal was to explore the flight envelope of the jet. Experience levels ranged from new lieutenants to test pilots and FWIC graduates.

The idea of listing mishaps in this format is not new, and in fact, TAC Safety published a similar summary of all F-15 mishaps several years ago. What has been attempted here is to focus specifically on loss of control and to expand the descriptions to include specific entry parameters, where known, as well as other details to try to clearly describe the situation from the pilot's point of view.

These descriptions are sanitized to exclude privileged information as defined in AFR 127-4, *Investigating and Reporting U.S. Air Force Mishaps.* No mishap investigation board's formal findings, causes, or recommendations are included. The purpose is not to assign guilt, but rather to reemphasize some important lessons that have been learned by others the hard way.

All these aircraft were centerline fuel tank equipped, except where noted, and if fuel or other asymmetry was believed to be a factor, it is indicated. None are included where flight control malfunctions were seriously considered to be a factor in the mishap.

Pilot perceptions are included where known and relevant, and serve to illustrate the point that despite the overall loss record, few Eagle pilots have ever been truly out of control, and fewer yet have actually departed, let alone gotten into a spin. This has led to a feeling that "the properly operating jet is not supposed to depart" or "only Hormel®-handed pilots need to worry" about loss of control. This is simply not true, as this listing should demonstrate.

■ **F-15A** During a BFM engagement, the mishap pilot attempted a negative-G guns jink, which he had never done before, to defeat a gun attack near the ACT floor. He was in a slightly nose high left turn at 7,000 feet AGL and 200 knots, and put in full left rudder, forward stick, and some left aileron. The aircraft reacted properly to the flight control inputs by rolling right at negative G with a large left sideslip, but the pilot misinterpreted this opposite direction roll (due to opposite rudder deflection at negative G) as an autoroll condition.

He countered the right roll by continuing to hold full left rudder, and as the aircraft accelerated its roll to the right, he perceived this resulting roll with yaw excursions as an entry into a right spin (although at no time did he hear the departure warning tone activate). He immediately applied antispin controls (full right aileron), but that further ag-

The F-15 is an excellent fighter that is spin resistant, not spin proof. A lot of good pilots have lost control in the Eagle. Major Hill presents an interesting look at some loss-of-control mishaps. He concludes with lessons learned and tips to avoid such mishaps.

gravated the situation.

After several uncoordinated negative-G nose low rolls, and now at low altitude, the pilot decided to eject. When he released the controls in preparation for ejection, the aircraft recovered; however, the pilot was disoriented by the continuous rolls, did not recognize the recovery, and ejected. The aircraft impacted the ground in a wings-level dive at 350 knots.

■ **F-15C** The pilot was leading a neutral military power BFM engagement. The weather was 12,000 feet undercast with a "milk bowl" effect to 14,000 feet. He positioned his aircraft 60- to 80-degrees nose high at less than 80 knots, and passing 17,000 feet, the aircraft stalled. He released the stick as the nose fell through the horizon, and the aircraft pitched past the vertical, sustaining some rolling negative G in its diving recovery as it sought its approximately 1-G trimmed condition.

The pilot became spatially disoriented due to the negative-G rolls and the "milk bowl" effect, and never retook control of the aircraft. At no time did he recall hearing the departure warning tone activate. He felt the aircraft was out of control and not self-recovering, and decided to eject after entering IMC passing 12,000 feet. He ejected passing 7,000 feet at 450 knots, and the aircraft crashed in a negative 110-degree pitch attitude at over 600 knots.

■ **F-15A** The pilot was leading a military power BFM engagement, and while performing a pure pursuit conversion on the bandit at 11,000 feet AGL, he attempted to transition from a 30- to 40-degree nose low, 250 knot, 4- to 5-G right turn to lag pursuit. When the pilot reduced right stick displacement and relaxed back pressure, the aircraft began an uncommanded rapid left roll, probably an inertially coupled departure, to an inverted dive position.

The pilot did not recognize the departure from controlled flight and immediately applied full aft stick instead of neutralizing the controls. The aircraft, still experiencing large roll and yaw moments, continued its departure. The departure warning tone came on, and the aircraft entered a flat left spin from which the pilot successfully ejected at less than 1,000 feet AGL.

■ **F-15C** During a 2 v 2 ACT mission, the aircraft developed an estimated 1,500-pound internal wing fuel imbalance that was not detected by the pilot. The aircraft passed the merge in a left climbing turn, then broke hard down and right for a bandit at right 5 o'clock. The mishap pilot rolled with both aileron and rudder as he pulled down into the attack, and at about 250 knots and 22,000 feet, the aircraft violently departed controlled flight. The departure warning tone came on, and the aircraft immediately entered a flat spin to the right.

The pilot initially neutralized controls, then applied and held antispin controls after he had confirmed spin direction. Following an initial oscillation, the spin quickly stabilized and was described as very smooth and steady with no pitch oscillations and strong "eyeballs out" G forces. After three turns, when recovery controls did not seem to be working, the pilot momentarily applied prospin controls, at which time the yaw forces significantly increased and the spin rate accelerated. He then reapplied and held antispin controls. When passing 10,000 feet, with no indication of the aircraft recovering, the pilot successfully ejected.

■ **F-15A** During a BFM engagement, the pilot attempted a maximum performance nose high rudder reversal at 10,000 feet AGL and 275 knots to take advantage of his adversary's overshoot. At the apex of the reversal, approximately 40- to 60-degrees nose high and in 110 degrees of right bank, the aircraft performed an uncommanded nose high hard left yawing roll to inverted, and the departure warning tone came on.

The pilot neutralized the controls, but the aircraft continued through the horizon and into an upright nose low slice with left yaw and roll, and a momentary increase in the rate of the yaw tone. The pilot perceived at this time he was in a right spin and applied antispin controls (full right aileron/left rudder). After another post departure oscillation with no indications of recovery, the pilot ejected at about 7,500 feet AGL. The aircraft impacted the ground in a wings level vertical dive at over 450 knots.

■ **F-15A** The aircraft was configured with three external tanks for a 2 v 2 ACT mission; however, all were dry prior to the mishap engagement. During a left nose low defensive turn at approximately 14,000 feet and 250 knots, the pilot initially applied full aft stick to tighten his turn, then quickly unloaded and rolled rapidly right in an attempt to defeat a gun attack by rolling to the outside of the turn. The aircraft rolled and yawed right much faster than commanded,

continued

most likely in a departed condition due to the aft stick application.

Not realizing he was out of control, the pilot applied left aileron to stop the roll, which was a prospin input in the aircraft's departed condition. At that time, the departure warning tone came on, and the aircraft entered a right spin. He then neutralized controls and felt pushed forward in the seat with a steep nose low attitude and some aircraft yaw. He applied antispin controls, and after three turns, felt the aircraft begin to recover.

The aircraft rotation stopped and the departure warning tone ceased. The nose pitched down to the vertical passing 7,500 feet, still with some residual yawing motion, and the pilot released the antispin controls. As the pilot applied aft stick for recovery, the aircraft began to roll and yaw right. The pilot neutralized controls again, perceived he was too low to recover, and ejected in a vertical dive passing 5,000 feet AGL. Although not proved, there was some evidence that there was a 500-pound left internal wing fuel imbalance.

■ **F-15D** The mishap aircraft was configured with conformal fuel tanks (CFT) and no other external stores, and had a known 400-pound left fuel imbalance in the CFTs. The pilot leveled at 31,000 feet and attempted an accelerated stall demonstration by rolling into 70 degrees of left bank at 240 knots and then abruptly applying full aft stick. As the aircraft dug in, he abruptly applied full right rudder and the aircraft rolled/yawed in a nose low slice to the right, and the departure warning tone came on.

The pilot neutralized the rudder, still maintaining full aft stick, but the aircraft continued its departure with a high yaw rate and the nose dropped below the horizon. He then brought the stick forward from its full aft position, and the aircraft rapidly entered a stabilized erect spin to the right. The spin was described as very smooth, stable and flat, with no pitch excursions and a low sustained yaw rate. After several turns with the controls neutral, with no effect, he applied and held antispin controls.

The recovery controls had no apparent effect, and passing 15,000 feet, the pilot lowered the landing gear. This appreciably slowed the spin rate, but with still no recovery apparent after three turns, he retracted the landing gear. The spin rate increased again to what was perceived as an even higher rate than before, and he ejected passing 10,000 feet.

■ **F-15C** At the beginning of a BFM engagement at 20,000 feet and 410 knots, the pilot rolled left and started a hard (7-G) level defensive turn. He felt some early onset of buffet, but continued and applied full aft stick to maintain maximum turn rate. Somewhere after 90 degrees of turn, the aircraft violently departed controlled flight in a rolling/yawing maneuver.

The pilot, although disoriented, neutralized and then released the controls. The departure continued, the departure warning tone came on, and the aircraft rapidly entered into a flat spin to the left. The spin was smooth and rapid, with moderate "eyeballs out" G forces. The pilot applied and held antispin controls, and passing 12,000 feet, the departure warning tone appeared to cease and the spin rate slow.

He relaxed antispin controls, believing the spin to be recovered, and the spin redeveloped and the departure warning tone came back on. Further antispin controls had no effect, and the pilot ejected when still out of control below 10,000 feet. The aircraft wreckage was not recovered for analysis.

■ **F-15C** During a 2 v 2 ACT engagement in a turn at 250 knots and 26,000 feet, the aircraft violently departed controlled flight and immediately entered a flat left spin. The pilot applied and held full antispin controls, and the spin broke at 13,000 feet. He recovered to level flight at 8,000 feet. Review of the pilot's VTR tape showed the departure warning tone was on for 45 seconds. The aircraft had a failed wing fuel transfer pump that resulted in a 1,500-pound right internal wing fuel imbalance.

■ **F-15A** During an ACM engagement at 19,000 feet, after turning right approximately 150 degrees at 265 knots, the aircraft violently departed nose low to the left and experienced pitch excursions in excess of 45 degrees. The pilot immediately neutralized the controls, and the aircraft recovered at about 13,000 feet and prior to spin development. The aircraft had a failed wing fuel transfer pump and a 2,500-pound right internal wing fuel imbalance.

■ **F-15C** While performing a hard turn during a medium altitude ACM engagement, the aircraft violently departed controlled flight at 250 knots and immediately entered a flat spin to the right. The pilot applied antispin controls and held them for five turns. Passing 10,000 feet (as the pilot was preparing to eject), the aircraft began to recover and regained level flight at 5,000 feet AGL. The aircraft had a failed wing fuel transfer pump and a 2,400-

The Eagle can normally be recovered from a loss of control if the pilot recognizes what the aircraft is doing, applies the proper control inputs, and has enough altitude available.

The loss of control may be the result of mishandling the aircraft, a fuel imbalance, or pilot disorientation. But, if it isn't brought under control, the final outcome is the same.

pound left internal wing fuel imbalance.

■ **F-15A** During a defensive BFM engagement, the pilot started a military power, 135-degree slice at 350 knots and 18,000 feet. He then rolled and pulled hard up into the vertical, selecting afterburner, and felt one of the engines compressor stall. The pilot retarded the throttles and relaxed "G" to check the engine instruments, and the aircraft immediately departed controlled flight nose high to the right.

He neutralized controls; however, the aircraft sliced down and to the right and entered a flat spin at 16,000 feet. The departure warning tone was on steady, and there were moderate "eyeballs out" G forces. The pilot applied full antispin controls, and after three turns (at about 13,000 feet), perceived a reduction in yaw rate and the nose pitched down slightly. After three more turns, now at about 11,000 feet, the yaw rate further decreased, the yaw tone slowed and then stopped, and the nose pitched further down. The pilot then neutralized the controls and recovered at 9,000 feet.

After recovery, the pilot noticed a small (less than 500 pounds due to a defective thermal bypass valve) right wing heavy fuel imbalance, and the right engine stagnated at 36 percent RPM due to its afterburner blowout and stall. The aircraft also had an AIM-9 training missile on the right pylon, contributing further to its right wing heavy asymmetry.

Lessons Learned

Several observations from these incidents are relevant. First, only 8 of the 12 incidents actually involved confirmed spins. Of these, six had fuel asymmetries as a contributory factor, with three of them severe asymmetries due to failed wing fuel transfer pumps. Three of the other instances involved not spins, but rather serious pilot disorientation, sometimes from last ditch guns defense maneuvers close to the bottom of the area. The point is that not all loss-of-control mishaps result from spins with contributing wing fuel imbalances.

Several other pilot "lessons learned" result from this mishap experience and need to be examined.

■ First, the rudders work in reverse when the stick is forward, which is demonstrated on every flight control check. Analysis and flight test have also shown the rudders are actually more aerodynamically effective in this regime, offering much more response for the same input. It requires rudder *with* the roll to recover — an unnatural response to most pilots — and rapid roll/yaw rates can be generated at slower speeds than in positive-G flight. This brings up the issue of negative-G guns jinks, which is the maneuver that most pilots would use to put themselves in this particular regime.

Negative-G guns jinks pre-date the Eagle, and have been around quite a while in other weapon systems. Some commands prohibit them in the Eagle; others do not, and they are not specifically addressed in the flight manual. When properly executed, it is a violent and unpredictable maneuver intended as a last ditch attempt to defeat a guns tracking solution.

The first and most common error made in attempting a negative-G guns jink is to not apply negative G at all, but execute it at zero or slightly positive G. Usually the aircraft has just been at high AOA and slow airspeed and may have some sideslip or yaw present due to the last out-of-plane maneuver. A rapid unload to zero G and a commanded

continued on page 24

Safety Warrior

DAMN THE

VERNET POUPITCH

PILOT LOSES PASSENGERS—THREE LEAP IN FOG . . .

This headline appeared in the papers 53 years ago. There have been a lot of changes since then, but pilots today are learning the same lessons this pilot learned so long ago.

■ The winter was severe with numbing cold and unusually heavy snowfall. Life hadn't come to a complete stop, but nobody was out and about who could help it. The only flying being done was that considered absolutely necessary.

Then, at the Army Air Corps depot at Olmsted Field, Middletown, Pennsylvania, we received a message saying a fighter was grounded at Elmira, New York, for lack of an engine. "Would we fly an engine and maintenance crew to Elmira to make the installation?"

The aircraft and facilities in 1935 were somewhat primitive by today's standards, but there was a real "can do" attitude, so a pilot and three mechanics were found to make the trip. While the pilot was making preparations, the depot truck backed up to the Bellanca transport, and the crew loaded the aircraft with a spare engine, tool boxes, and field A frames. Three mechs and an army hitchhiker completed the cargo. The pilot was cleared, and the aircraft took off at about 10 o'clock in the morning, headed north.

Elmira weather at the time was reported to be overcast with a 2,600-foot ceiling, 10 miles visibility, temperature −10 degrees Fahrenheit, with ice in the clouds.

At Sunbury, Pennsylvania, approximately 90 miles north of Middletown, the ceiling dropped to about 800 feet. Just north of Sunbury was the Eagles Mere Ridge, a small range varying in elevation from 1,900 to 2,100 feet, lying directly across the flightpath. The ceiling dropped to zero over the Susquehanna River and all the passes. Just beyond Eagles Mere, the ceiling rose to 1,600 and finally increased to 2,600 over Elmira.

As a last resort, it would be easy to follow the iron compass into Elmira. There was no radio station at Sunbury, so the pilot could not learn of the lower ceiling until he got near enough to observe it. Now the decision had to be made whether to turn back and wait it out or poke into the weather.

The Bellanca had no wing deicing equipment, but exposure to ice would last only a few minutes. Abort or complete the mission? The

TORPEDOES!

pilot quickly cranked the world's first computer — his brain. Does the answer he got seem familiar? It was, "Damn the torpedoes, the mission must go!" So he continued, climbing the 2,500 feet into the soup and noting the time. He had verified his track and identified the last landmark. In 6 minutes, he would have crossed the mountain range and would let down until in the clear.

The Bellanca transport was a single engine, high wing, fabric-covered transport with fixed gear. One of the most efficient load-carrying transport aircraft in the air, it could lift practically anything. Every external member, including the landing gear struts, wing struts, and the fuselage, was a lifting surface, except the wheels, and they were faired. The fuselage was shaped like a thick airfoil section. In addition to the external structure that supported the large wing, there were streamline wires running from the bottom of the fuselage to the spars at about two-thirds of the span. A heavy, coarse, wire mesh separated the cockpit from the cabin. The temperature in the cabin was always ambient because it had no heat.

Just before going on instruments, the pilot checked the cabin with a quick glance and saw the hitchhiker huddled aft near the cabin door with the three mechanics, Sgt Berry, Corp Heimbauch, and Pvt Smith, nonchalantly sitting along the side of the cabin. Berry, from Arkansas, was a medium-size young man, wiry, high strung, a natural comedian, and a darn good crew chief. Heimbauch was shorter and younger, a little on the stout side, and a newcomer to the outfit. He had enlisted at Middletown. Smith was of medium height, slender, on the slow side, a good mixer, a tag-along type of an individual, and always broke. By the middle of the month, he was jawboned to the hilt. To satisfy his drinking urge, he would drink barracks shaving lotion not locked in the footlockers.

The pilot, satisfying himself that the cargo and passengers were in satisfactory condition, proceeded through the clouds on instruments, noting from time to time the clock on the instrument panel while he held his course and altitude. The windshield frosted, then iced. That was expected, but not so soon. The side windows were still clear, and he quickly observed his wing leading edge was clean, so he was not worried — yet.

Then there was a peculiar hum — he could hardly hear it at first — that developed into a deep howl. The wings were still clean, but that noise — it was different from anything he had ever heard before. This was no time to lose the engine. He

continued

Damn the Torpedoes! continued

concentrated on the instruments. Everything looked good. There was no vibration, but that howl was getting louder and louder. One more minute to go, then he would let down. Now, the side windows began getting translucent — but just hang on! That awful noise! What was it?

Finally, the 6 minutes were up, and the pilot nosed down. At 800 feet, he was in the clear and *saw* the noise (the streamline flying wires had iced into what appeared to be 1-inch rope vibrating like strings on a bass fiddle). He took a deep breath of relief and turned his head to reassure his passengers. The hitchhiker and the engine were all he saw. Fearful of what may have happened, he quickly found an auxiliary field, landed, and proceeded to ask questions.

The hitchhiker related the events as they occurred in the cabin.

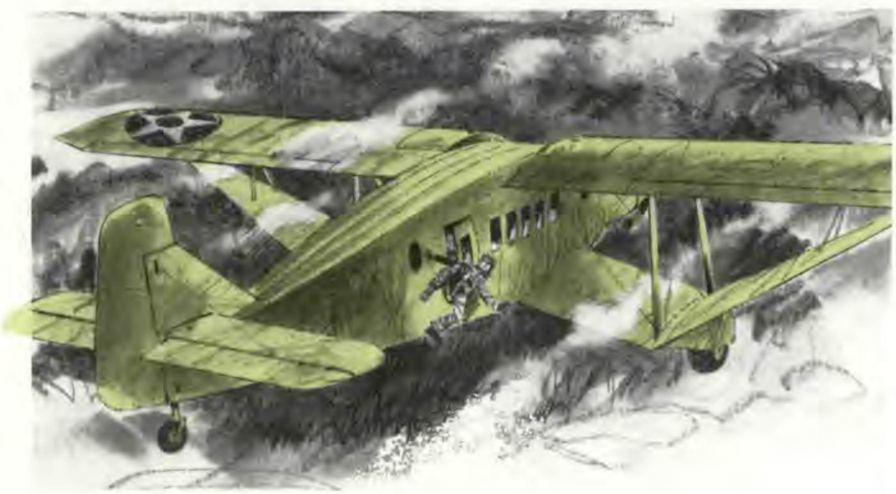
Shortly after the pilot had checked the cabin with his sweeping glance and then went on instruments, Sgt Berry was complaining of being cold, so he placed himself between Heimbauch and Smith. Heimbauch was sitting farthest aft. When the flying wires iced and began vibrating, the noise in the fuselage, amplified many times, scared Berry, and when he stood up and looked through the wire grate forward and saw the windshield iced and heard the howl rising in pitch, he panicked, shouting, "We're in a spin — get out!" and raced aft for the cabin door.

But round little Heimbauch was not asleep. He reached the cabin door first, crowded by Berry, Smith, and the hitchhiker, pushing to get out! The doorknob had to be turned before the door could be forced against the slipstream, but somehow Heimbauch managed the manipulation. Out he went, but in the crowding, his parachute harness hooked around the inside doorknob! Poor Heimie, outside in the clouds, hooked like a quarter beef in a deep freeze, but very much alive, shouted and kicked to no avail.

Berry, Smith, and the hitchhiker were clamoring to get out, each trying to outmaneuver the other. But, push as hard as they could, they could barely crack the door open. They had to free Heimie before they could open the door, so they kicked the doorknob hard with their heels and broke off the knob, saw the harness pull out, and proceeded to push each other out.

When asked why he didn't jump, the cold, frightened hitchhiker replied simply that there was no one left to push him out.

The pilot's concern now was the safety of his stampeding, jumping crew. He knew that over the mountains the clearance had been only 400 feet, and if any one of the three had delayed in opening his chute, he would buy the farm. The pilot immediately proceeded to the nearest telephone and reported to the Pennsylvania Highway Patrol, giving the route of his flight. After a short wait, a patrolman phoned to say that two of the parachutes had been recovered.



Heimbauch was alive but bruised, and Berry had only a sprained ankle. A little later Smith, about whom the pilot had the greatest concern, was reported okay. The pilot telephoned his home base, reported the incident, and was told to return as soon as weather permitted while the crew returned via Pennsylvania Highway Patrol, after hospital treatment.

Now, from the serious side, what can we learn from the story? The pilot was good and had a lot of weather experience. He had been an airline pilot, flew depot flight tests in all type aircraft, had ample cross-country time, and was familiar with the terrain out of Olmsted Field. He was at home on instruments and respectful of the radio range and their multiples, as well as of the eastern high tension lines strung across the valleys, like clothesline.

If the crew had not stampeded, the flight would have been routine, and there would have been no story to tell. From the flight safety aspect and good judgment, the pilot should have turned back to Olmsted when he saw the weather barrier. The success of the flight was not worth the odds of icing the wings and/or the carburetor. A delay of 1 or 2 days awaiting the weather would have made the flight routine.

This pilot was capable and would have been able to cope with any situation on this flight except wing icing. That he did not encounter, but he did run into the unpredictable. And *he left no margin for error.*

Over the years, pilots have learned many lessons. It's too bad that so many of their successors have to relearn those same lessons the hard way.

The pilot in this story learned a lesson that was engraved on his mind for all time: Crank in *all* the odds in your favor, and allow yourself room to spare. ■

CROSS-COUNTRY NOTES

REX RILEY
Directorate of Aerospace Safety

■ **Zaragoza AB, Spain.** Rex visited Zaragoza AB recently and found the people knowledgeable and highly motivated. Facilities were, in general, exceptionally well kept and functional. Rex salutes the people at Zaragoza AB and appreciates their outstanding service.

Elmendorf AFB, Alaska. Rex braved a snowstorm to visit this base on the Northern Tier and found the people at Elmendorf very supportive. Contract quarters were very good, with several eating facilities within easy walking distance. Excellent job by all. A special recognition goes to the newly renovated base operations. Elmendorf provides a well-organized and bright facility staffed by motivated and helpful people.

Andersen AB, Guam. Andersen AB is another jewel in the Pacific that offers a nice, quiet crewrest. The open messes provide the normal bill of fare while the Lattie Stone Grill offers some of the best barbecued ribs and chicken anywhere. Very motivated people in base ops, weather, and billeting work very hard to make your stay restful and enjoyable.

Peterson AFB, Colorado. Excellent service at Peterson made this C-141 stopover very easy and very enjoyable. Numerous off-base quarters surrounded by several restaurants, in conjunction with outstanding flightline service, make Peterson one of Rex's favorites. They have an excellent flight planning facility, too. Rex hopes to return to Peterson AFB soon.

Robins AFB, Georgia. Another of Rex's favorites located in the deep South. The excellent facilities manned by motivated people keep Robins high on Rex's list of honor. One note of caution: Robins AFB is a very large base, and when planning transportation requirements, add a little more time to your planning formula to compensate for the extra distances.

Base A. An excellent base whose consistent service has placed Base A high on Rex's list. Unfortunately, a major safety violation, involving people movement too close to the engine intake of Rex's A-7D in conjunction with inappropriate servicing of the aircraft, forces the removal of Base A from Rex's honor roll. We suggest that all transient people review a 16mm (8-minute) film entitled "Engine Intakes" (#605556DF) which highlights the dangers involved with ground operations of jet engines.

Base B. This CONUS nonfighter base was also visited by Rex in his A-7D, and while all services received met standards, the people just didn't demonstrate the spark or motivation needed to be placed on Rex's honor list. Base ops people offered little help in acquiring transportation from the flightline to billeting, and there was an overall lack of interest on the part of most people encountered. Exceptions were the billeting staff who were very courteous in arranging contract quarters and the motor pool driver who was also quite helpful. ■

THE

REX RILEY
Transient Services Award

LORING AFB	Limestone, ME*
McCLELLAN AFB	Sacramento, CA
MAXWELL AFB	Montgomery, AL
SCOTT AFB	Belleville, IL
McCHORD AFB	Tacoma, WA
MYRTLE BEACH AFB	Myrtle Beach, SC
MATHER AFB	Sacramento, CA
LAJES FIELD	Azores
SHEPPARD AFB	Wichita Falls, TX
MARCH AFB	Riverside, CA
GRISSOM AFB	Peru, IN
CANNON AFB	Clovis, NM
RANDOLPH AFB	San Antonio, TX
ROBINS AFB	Warner Robins, GA
HILL AFB	Ogden, UT
SEYMOUR JOHNSON AFB	Goldsboro, NC
KADENA AB	Japan
ELMENDORF AFB	Anchorage, AK
SHAW AFB	Sumter, SC
LITTLE ROCK AFB	Jacksonville, AR
OFFUTT AFB	Omaha, NE
KIRTLAND AFB	Albuquerque, NM
BUCKLEY ANG BASE	Aurora, CO
RAF MILDENHALL	UK
WRIGHT-PATTERSON AFB	Fairborn, OH
POPE AFB	Fayetteville, NC
TINKER AFB	Oklahoma City, OK
DOVER AFB	Dover, DE
GRIFFISS AFB	Rome, NY
KI SAWYER AFB	Gwinn, MI
REESE AFB	Lubbock, TX
VANCE AFB	Enid, OK
LAUGHLIN AFB	Del Rio, TX
MINOT AFB	Minot, ND
VANDENBERG AFB	Lompoc, CA
ANDREWS AFB	Camp Springs, MD
PLATTSBURGH AFB	Plattsburgh, NY
MACDILL AFB	Tampa, FL
COLUMBUS AFB	Columbus, MS
PATRICK AFB	Cocoa Beach, FL
WURTSMITH AFB	Oscoda, MI
WILLIAMS AFB	Chandler, AZ
WESTOVER AFB	Chicopee Falls, MA
EGLIN AFB	Valparaiso, FL
RAF BENTWATERS	UK
RAF UPPER HEYFORD	UK
ANDERSEN AB	Guam
HOLLOMAN AFB	Alamogordo, NM
DYESS AFB	Abilene, TX
AVIANO AB	Italy
BITBURG AB	Germany
KEESLER AFB	Biloxi, MS
HOWARD AFB	Panama
GEORGE AFB	Victorville, CA
PETERSON AFB	Colorado Springs, CO
CLARK AB	Philippines
MOODY AFB	Valdosta, GA
RHEIN-MAIN AB	Germany
RAF LAKENHEATH	UK
ZARAGOZA AB	Spain
TORREJON AB	Spain
LUKE AFB	Glendale, AZ
EAKER AFB	Blytheville, AR
NELLIS AFB	Las Vegas, NV
BERGSTROM AFB	Austin, TX
DAVIS-MONTHAN AFB	Tucson, AZ
ZWEIBRUCKEN AB	Germany
HAHN AB	Germany
KUNSAN AB	Korea
RAMSTEIN AB	Germany
JOHNSTON ATOLL	JQ
WAKE ISLAND	WQ

*Rex Riley list arranged in order of award date

"I'm visual"...*(I think!?)*

MAJOR JAMES C. JOHNS
Division Chief
Instrument Procedures Division
USAF Instrument Flight Center
Randolph AFB, Texas

■ How many times has this happened to you? Landing in weather right at ILS or PAR minimums, you pick up the approach lights and maybe a glimpse of the runway environment, and report to the controller "I'm visual." Then about 1 nanosecond later, you've transitioned to visual references only to find your sink rate has sharply increased, and you're heading for the overrun. Yep, that's right, the old duck-under maneuver, practiced for years by many and mastered by none.

Recently, aircraft mishaps have highlighted many such problems in the visual or transition segment, problems with pilot procedures and runway environments. These mishap aircrews found themselves in perfectly good aircraft touching down in the overrun or, in some cases, in the approach lights. How could this happen if they had the runway environment in sight at decision height (DH)?

Well, believe it or not, it's not that hard to do, so let's look at the possibilities. Several factors impact problems with transition from instrument to visual flight: Weather (type of obscuration), visual cues, cockpit cutoff angle, and even crew procedures.

Weather

During VMC approaches, an abundance of visual cues are available to judge alignment, sink rate, and aircraft attitude. However, during the transition from IMC to visual conditions, many of these cues are not present or may be misinterpreted by the aircrew. For example, the sudden acquisition of runway lights can give the illusion of being high. That, combined with the nor-

Need Help?

Do you have an instrument-flying related question you can't find an answer for? The Instrument Flight Center (IFC) at Randolph AFB can help you. Jot down your question on the attached form and drop it in the mail. They will give you a personal answer either by telephone (if you give them your number), or by letter. If you can't wait for the mail and need an immediate response to a burning question, use their 24-hour hotline — AUTOVON 487-3077.

If the questions received indicate a general misunderstanding of a particular area or procedure, IFC will write an article for *Flying Safety* addressing that subject. So let IFC know where you're having problems. They will at least explain the subject to you. If needed, they will work on making changes.

continued on page 19

MY INSTRUMENT QUESTION IS:

Fold

USAF IFC/FOT
RANDOLPH AFB, TX 78150-5001

USAF IFC/FOT
RANDOLPH AFB, TX 78150-5001

Fold

mal illusion of being too high on a narrow runway, is a duck-under waiting to happen.

A good understanding of the insidious dangers associated with individual types of weather causing poor visibility is essential since each poses different and distinct problems. A full discussion on each may be found in AFM 51-37, *Instrument Flying*, chapter 13. One more thing before we leave weather: Don't let reported runway visual range (RVR) lead you down the "primrose path." This measurement is taken on the ground and is not an indication of the true slant range visibility actually encountered by the aircrew. In fact, the slant range visibility may be considerably less, depending on the obscuring weather phenomenon at the airport.

Cockpit Cutoff Angle

This is a good place to discuss cockpit cutoff angle (or downward vision angle). Inability to see the runway environment under the nose can significantly shorten the length of the area containing visual cues that can be seen.

For example, given a 15-degree downward vision angle relative to the longitudinal axis of the aircraft, 10-degree nose up relative to horizontal, and a 3-degree glidepath, about 1,400 feet of the runway environment is not visible. Thus, at RVR 1,600 feet, you can only see about 200 feet of the runway. You are forced to lower the nose or look around it to pick up adequate visual cues for attitude control. Lowering the nose is the "gotcha" of these choices.

Visual Cues

These cues provide the connection between DH and touchdown and primarily consist of runway and approach lights, VASI/PAPI, and runway markings. They vary from airfield to airfield; therefore, their effects will be variable.

It is important to remember that these cues are sometimes the only reference available during the visual segment and that the actual touchdown point may be obscured until well below the DH. Consequently, significant changes in aircraft attitude below DH, to achieve a new "visual" aim point, could cause sink rates and thrust control problems at a point where room for error is essentially nil.

Crew Procedures

Finally, we, as aircrew members, can help ourselves a great deal by ensuring our procedures are sound and that we use everything (and everyone) in the cockpit to achieve

a safe transition. These include, but are not limited to, preflight planning, crew coordination, and instrument cross-check procedures.

Making It Work

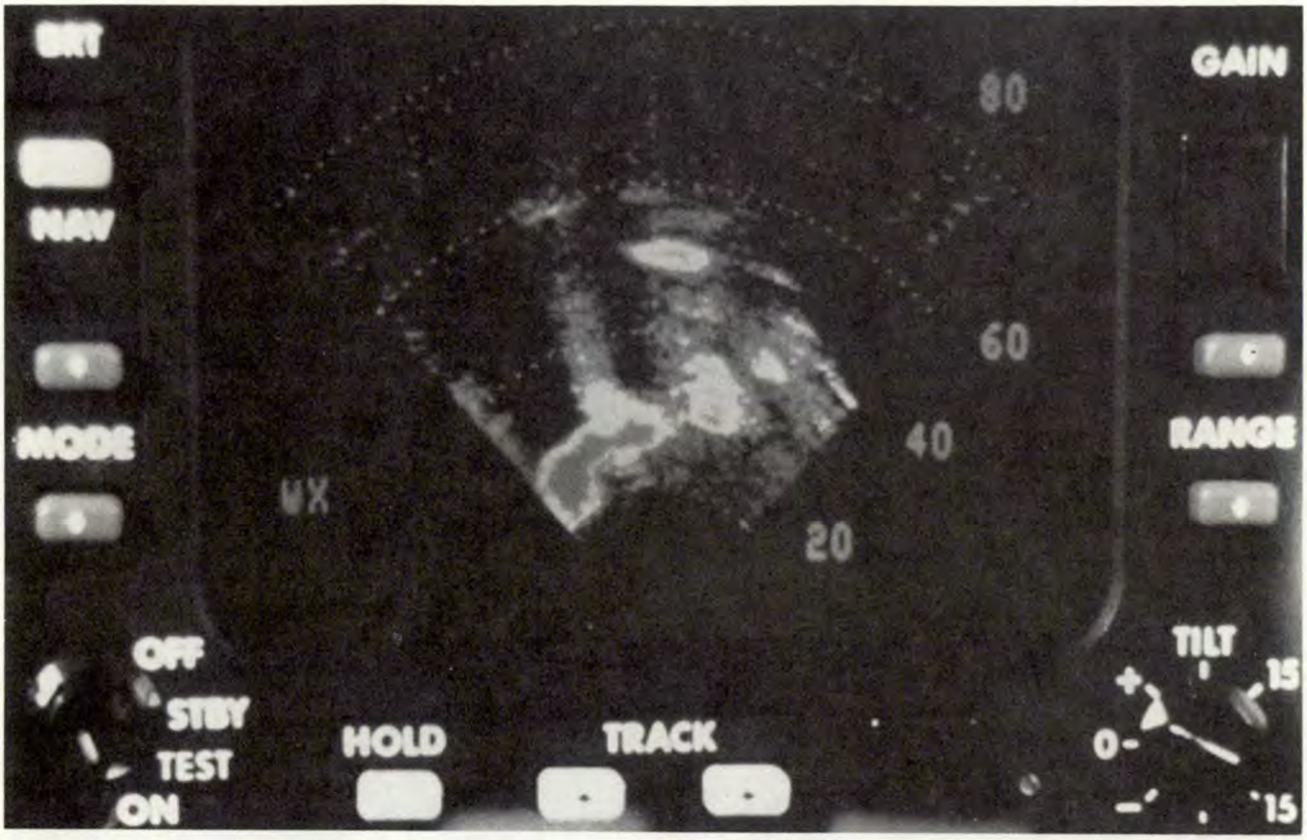
OK, I guess we've arrived at the proverbial "bottom line." We've talked about a lot of problems encountered in the visual segment and, admittedly, there's not much help out there when the weather is down around your socks. However, we do have some suggestions:

- Understand the effects of different types of weather on the visual cues available where you fly. Be sure to take time to consider the RVR and what that really means in your aircraft. Study the lights and markings at your destination to preclude surprises at DH. Take time to learn what information lighting and marking aids can provide. Chances are, you'll find it's a lot more than you were using.
- Fly the published procedure to the runway. The best way to protect yourself against a "close encounter" with the approach lights is a continuous cross-check of the glideslope indicator (GSI) or flight director during transition all the way to the ground.

Although seemingly difficult to do once transition has started, if an outside scan is incorporated early in the approach, the cross-check can easily be continued to touchdown. Adjustments to the published glidepath during transition only invite trouble, since now, you're on your own to hit the runway without hitting anything else in the process. As a rule of thumb, predetermine a maximum rate of descent for the visual segment and go around if you exceed it during the approach.

- Review crew procedures to ensure you have not built anything into training or daily operation procedures, that may lead "Blue Four" into a situation where he or she is literally "out of airspeed and ideas." A good example of this is the varied and widespread use of the HUD during the transition phase of the approach. Although a useful aid, there are no instrument certified HUDs in the Air Force at this time, and their use should be limited.

We have tried to present some ideas that may make your day a little easier and safer next time you arrive at the flightline, and you can't see the aircraft from the crew bus. We've also shown the criticality of the visual segment of an instrument approach. It may be the shortest portion of a procedure and, seemingly, the easiest to fly, but in reality, the visual segment offers the greatest potential for insidious disaster. So, next time you're at DH and report "I'm visual," be sure you don't have to second-guess that call prior to touchdown. ■



Thunderstorms and RADAR

LT COL JIMMIE D. MARTIN
Editor

■ In our last thunderstorm article, we discussed the various types of storms and how to identify them visually. We also looked at some ways to anticipate just what kind of weather to expect from each type of storm, as well as where the most severe effects would be located in relation to the main part of the storm. This month we will look at using radar as another aid to find thunderstorms, judge their severity, and navigate around them. For a discussion of types of thunderstorms and their effects, see "Thunderstorm Tip Off," *Flying Safety*, June 1988.

Weather radar detects precipitation. The precipitation may be raindrops, hail, snow, cloud droplets, or ice cloud particles. The strength of the radar return (echo) depends primarily on drop size and number of drops. The larger the drops and the greater their number, the stronger the radar echo.

Drop size determines echo intensity much more so than does drop number. Meteorologists have shown that radar reflectivity is proportional to rainfall rate, and the greatest rainfall rate is in thunderstorms. Therefore, the strongest echoes are associated with thunderstorms, and they mark the areas of greatest hazards. Hailstones are usually covered with a film of water and thus act as huge water droplets giving the strongest returns. Showers show less intense echoes, and gentle rain, drizzle, snow, and clouds give the weakest returns.

Most of our aircraft today have some type of radar system that can be used to find thunderstorms. Some even have the color weather radar installed. However, other aircraft such as the T-37 and T-38 don't have any radar at all. These aircraft and certain others may rely on ground-based radar to guide them around severe weather.

Ground-Based Radar

Air Traffic Control (ATC) Radar Herein lies the first problem. Aircrews frequently rely on ATC to vector them around severe weather. ATC controllers will help you avoid known severe weather, if possible. But, there are limitations. The controller's primary function is the safe separation of traffic, and the controller can't let any other services interfere with this responsibility.

Secondly, the controller may be limited by frequency congestion, limitations of ATC radar, and the amount and currency of the weather information available. ATC radar is designed to detect aircraft, not weather. In fact, ATC radar is specifically designed to filter out rain returns so aircraft won't be blocked out by the rain. Therefore, ATC can only paint the heaviest weather. That means they may not be able to see some very hazardous buildups.

Air Weather Service (AWS) Radar Pilot-to-metro service (PMSV) operated by military weather stations is your best source of help. This is especially true for aircraft not equipped with airborne radar. The forecaster can provide an updated forecast, pilot reports (PIREPs), and a real-time radar report. Also, AWS radars differ from ATC radars in that they are specifically designed for weather observation.

Normally, ground-based military weather radar can display significant precipitation targets within 200 NM of the station and can detect the height of weather returns out to about 120 NM. Using this radar, the forecaster can advise the aircrew of the location, movement, horizontal extent, and radar tops of *precipitation* (usually not the *visual* tops of the clouds). The forecaster can also give an estimate of the intensity of the weather returns, but *cannot* vector the aircraft.

So, the best course of action is to contact PMSV to get an accurate reading on hazardous weather location, intensity, direction of movement, and how far it extends. From this information, you can make an intelligent decision about pressing on or turning back. Then you can coordinate with ATC for the necessary course changes.

Airborne Radar

According to Archie Trammell, a noted radar expert who teaches seminars on weather radar, there is a desperate need for better training in the use of onboard weather radar systems. Even though radar has been in aircraft for about 30 years, Trammell says, "We're not doing a very good job of using it to avoid hazardous weather."

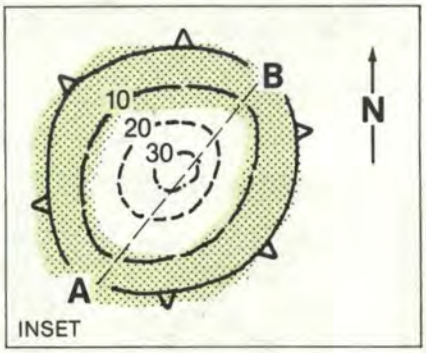
Trammell emphasizes the importance of trusting the onboard radar. "A pilot who loses confidence in the aircraft radar may allow outside sources to make decisions for him or her. Most of the aircraft that have crashed in convective weather were operating in an ATC radar environment. The controller can be a useful advisor, but ATC radar won't tell the controller much about weather, and it's not his or her job to make decisions for the pilot about avoiding hazardous weather."

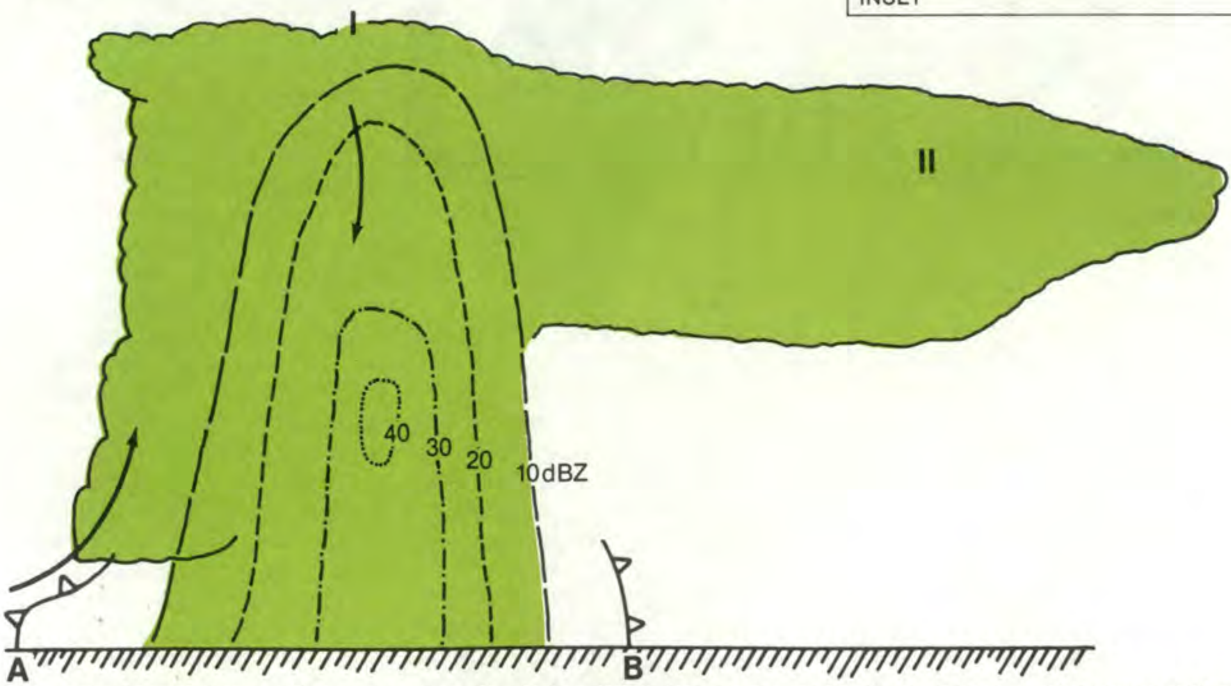
Measuring the Height There is a strong correlation between the height and the intensity of a thunderstorm. There is a 33-percent probability that a storm with a top higher than 30,000 feet is hazardous, and at 37,000 feet, the probability increases to 50 percent. "Granted that tall storms must be avoided," Trammell asks, "how can airborne radar be used to determine storm height?"

It's done just as NWS radar specialists use ground-based radar to measure cloud-top height — with precise tilt management. The first step in learning this technique is to visualize the radar beam as a cone radiating from the antenna. For air-carrier class radar, the cone is 3 degrees to 6.5 degrees wide. (Most military aircraft radars use a 3-degree beam width.)

If the tilt is precisely positioned so the bottom of the beam sweeps on

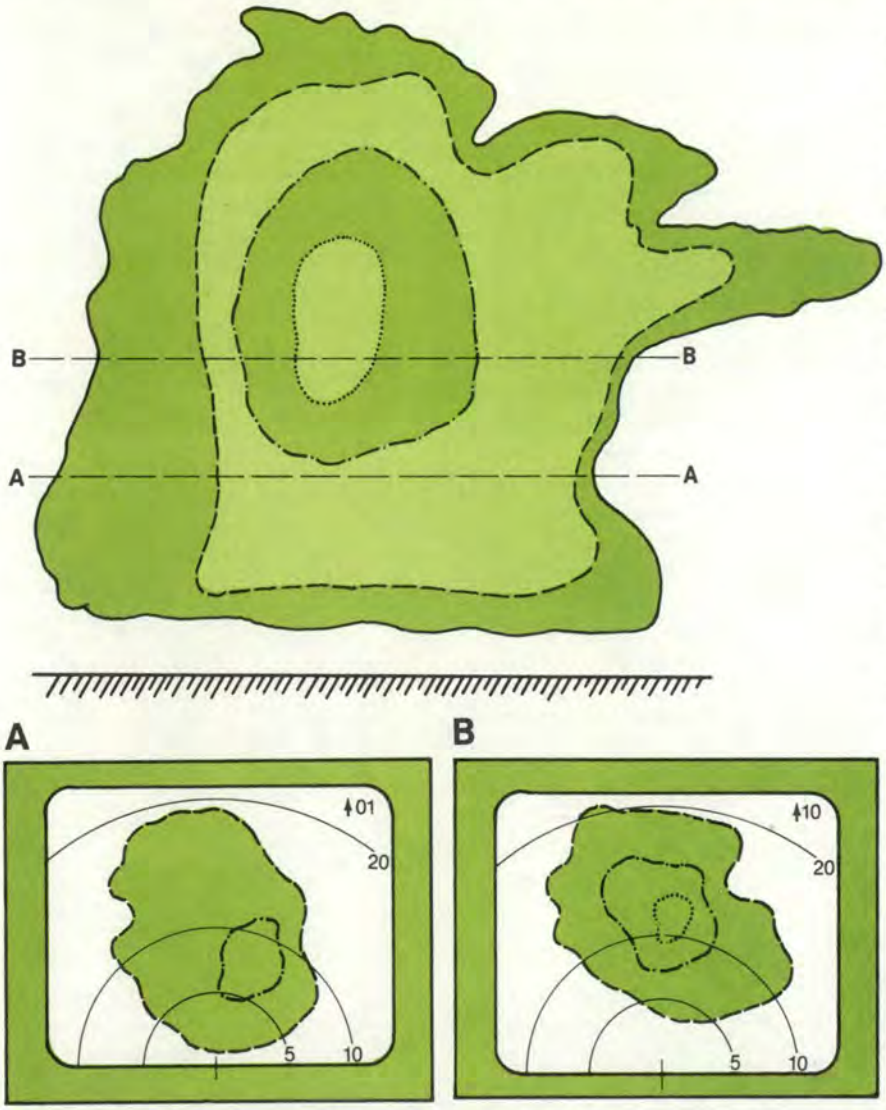
continued





This schematic diagram of the vertical cross section of a single cell thunderstorm shows the difference between what you see with your eyes and what you see on radar. The solid lines represent the visible cloud outlines while the broken lines indicate vertical radar reflectivities. **Inset:** Horizontal cross section of the storm at ground level. The dashed lines indicate radar reflectivities while the solid lines with barbs position the gust front. The regions of highest downburst potential are stippled.

Thunderstorms and RADAR continued



Radar indications of a storm are affected by tilt angle. An aircraft at low altitude with the tilt elevated 1 degree (Figure A and line A, A) may scan beneath areas of heavy precipitation as indicated by the dotted lines. Raising the tilt to 10 degrees (Figure B and line B, B) reveals heavy precipitation and the true hazard potential of the storm.

a plane parallel to the earth's surface, the radar will detect and display only objects that intrude through the flight level of the aircraft. This tilt position can be set very simply using a technique that Trammell teaches.

■ First, set the tilt so that ground returns are being painted from the 40-mile arc outward. Then, divide your altitude *above ground level* (AGL) by 4, and move the tilt up the number of degrees resulting from the calculation.

Example: Flying at FL 370 over 1,000 foot terrain, the altitude AGL will be about 36,000 feet, and 36 divided by 4 equals 9. Adjust the tilt so ground returns are painted from 40 NM outward, then raise the tilt 9 degrees. The bottom of the radar beam is now level at 36,000 feet AGL, and everything depicted on the radar projects through your altitude.

■ The next step is to determine the height of any echoes. Increase your tilt from the setting calculated above to the point where the target disappears from the indicator. Now the bottom of the beam is barely over-scanning the top of the target. Calculate its height relative to your altitude with this formula: The distance to the target in nautical miles times 100 multiplied by the number of degrees the tilt was increased equals target height.

Example Assume a target is displayed at 25 NM with the bottom of your beam level at your altitude. When you increase tilt 6 degrees, the bottom of your beam is sweeping just above the top of your target. Calculate the height of the target like this: 25 x 100 x 6 = 15,000 feet. The top of the target is 15,000 feet above the aircraft.

"With practice," Trammell says, "this entire process takes just 15 to 20 seconds." He advises repeating it at 2- to 3-minute intervals when you're approaching a weather system to monitor whether the storm is growing in height or dissipating. Rapid growth in the height of the radar top, or a top above 30,000 feet, indicates a very hazardous weather system. "Remember," he cautions, "that this method measures the *radar* top as an analytical input — it does not measure total storm height because ice crystals in the top of the cloud may not be detectable."

When you're cruising at a high altitude, the tilt may be adjusted downward in a similar manner to measure radar tops below your flight level.

The Radar Shadow The most revealing characteristic of all is the radar shadow. In fact, Trammell says that identifying the radar shadow is the most critical radar operating technique, and the ultimate radar rule is *never, never* continue flying toward a radar shadow.

These shadows are created when the radar beam can't penetrate completely through intense rainfall — the signal is fully attenuated (absorbed) by the rain — and nothing is reflected back to the radar antenna. In flight, there will be no ground return beyond the rain cell. Hence the term "shadow."

Putting it even more simply, Trammell says that with the tilt down, you should never fly in a direction where your radar isn't detecting anything. If the energy from your radar transmitter can't penetrate a target, there's no way you can fly through it.

Impenetrable echoes are easily identified from aloft by the shadow, but they can be identified from ground level or low altitude as well. With the tilt up, an echo your radar energy cannot penetrate will be shaped like a crescent with the ends pointed outward. A dip on the far side of the storm, pointing back toward you, is another radar signature of the impenetrable storm.

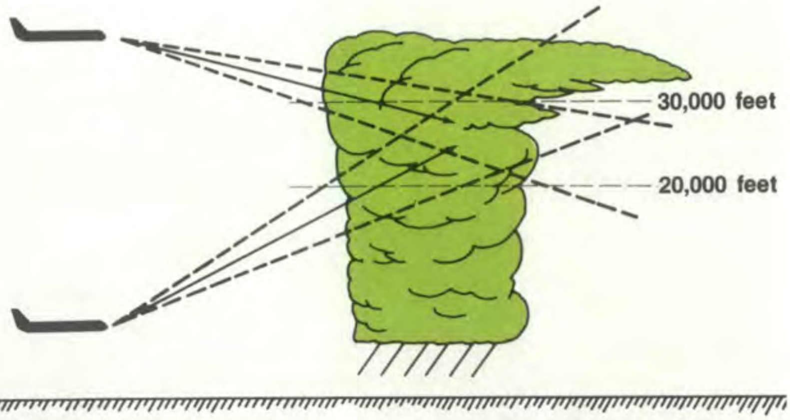
Trammell firmly believes that with proper training, pilots can use currently available airborne radar to alert themselves to the presence of any convective storm hazard other than the dry microburst. "But first," he says, "the pilot must understand that the radar is not a positive guidance device. It must be used with a knowledge of atmospheric conditions and subtle clues that distinguish merely strong or large echoes from hazardous ones. And it should never be used to make a decision to penetrate a convective weather system, but rather as a gauge of how far to circumnavigate it."

Application

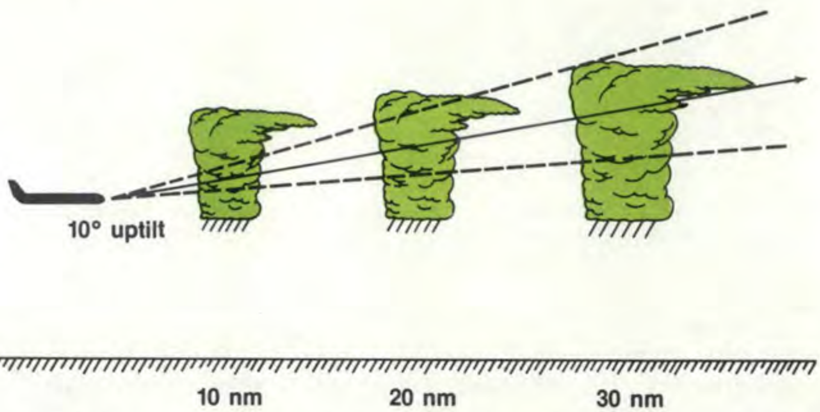
Successfully flying in weather conditions that generate thunderstorms requires using everything you have available to you. Those of you who have the color weather radar that displays the intensity of echoes in red, yellow, and green must avoid the built-in trap. As Archie Trammell points out, these familiar colors aren't a traffic light to tell you when to stop and when to go. "You can get your teeth kicked out while flying in the green," he says. "Radar is not a go/no go signal, it's a weather analysis device."

Use your radar, if you have one. Use your eyes, if you're VFR. Use PMSV and PIREPs, if available. Use ATC, as appropriate. Most of all, use that which makes the manned aircraft superior to the unmanned — your judgment. Leave your pride at home and don't hesitate to turn around and fly the mission another day if the conditions aren't acceptable. ■

Material for this article comes from AFM 51-12, Weather for Aircrews, aviation seminars and materials furnished by the Federal Aviation Agency, the Aviation Research and Education Foundation, the University Corporation for Atmospheric Research, and "Weather Avoidance in the Terminal Area" by Henry Lansford.



Tilt management is essential for detecting hazardous convective weather. At high altitudes, the radar must look down to see the mid-levels of a storm. In the terminal area, the radar must be aimed up to see the same area of the storm.



Antenna tilt angle, distance from the storm, and aircraft altitude are used to calculate the height of a thunderstorm. In the terminal area, the antenna must be tilted up to paint the most intense area of convective activity. The closer the storm, the higher the tilt.

"Never fly toward a radar shadow . . . " The absence of ground returns behind the areas of heavy rain indicates that the radar signal is being fully absorbed by extremely intense precipitation. This storm is very severe. (Photo courtesy of AOPA Air Safety Foundation.)

Out of Control continued from page 11

A beautiful aircraft flown by one of the world's best fighter pilots on an almost perfect day — what could be better? In a matter of seconds it could be out of control in a violent, disorienting ride that taxes the pilot to the maximum. The pilot must immediately take advantage of the F-15's design. Smoothly neutralizing the controls may let the Eagle do what it was built to do — *recover.*

aileron roll in this situation mimics the most successful spin entry maneuver developed in the spin test program.

Compounding the issue is that the most common Eagle fighting configuration is centerline fuel tank equipped, which decreases directional stability. Mismanagement of aileron inputs in this regime will fool the ARI/PRCA protection mechanism and can rapidly produce a spin, as is well described in the Dash 1 and the various MCAIR *Product Support Digest* articles.

Flight test in the Eagle has shown that, even when properly flown, the negative-G guns jink maneuver is more disorienting and unpredictable than in other aircraft due to the flight control effects mentioned before. Additionally, as discussed in the MCAIR publications, there is a very real risk of inertial coupling resulting in structural damage if the maneuver is entered from higher speeds. Neutral controls will always recover the aircraft to stable flight, but such maneuvers can easily produce roll rates beyond the pilot's ability to stay oriented.

■ Second, there is no room for error when at the bottom of the area and out of airspeed. Even if the aircraft has recovered, time and altitude are required for the pilot to reorient himself and recover from any resultant unusual attitude. The tragedy of some future loss of this type is that it will probably occur from a last ditch maneuver attempted right at the ACT floor in an attempt to salvage a BFM mistake made several turns before (and then also usually several seconds after the mishap pilot had already been guns tracked).

There is a training perception problem here also. These maneuvers are attempted at the ACT floor where there is no "legal" maneuvering room left to use, hence the need for a last ditch attempt, yet often still well above the actual terrain, which leads to a sense of medium altitude complacency.

Many of these last ditch maneuvers would not be attempted if actually right on the deck, nor would really be necessary if several thousand feet of fighting altitude actually remained. Train the way you are going to fight and do not do things at the ACT floor that you could not do at the real floor.

A corollary issue is how much altitude should be allowed to successfully recover from a last ditch maneuver such as a negative-G guns jink. It is obvious that if the maneuver defeats the gun attack, but the aircraft subsequently impacts the ground undamaged, there has been no net gain from the attempt.

Empirical evidence would seem to suggest that 7,000 feet AGL is not quite high enough, and this is to just miss the ground and not to stay in the working area. For most cases in combat, 10,000 feet AGL would seem to be sufficient, yet that also provides quite a bit of potential energy for more conventional fighting before being forced into a last ditch maneuver such as this.

As for training, if legal, negative-G guns jinks should be attempted at least 10,000 feet above the ACT floor, which in most cases, will be well above where most pilots now believe they will employ one.

■ Third, the first step in any out-of-control situation, just as the flight manual states, is to smoothly neutralize all controls and give the airplane a chance to recover. Any delay in applying antispin controls, when in a confirmed spin, can prolong recovery and may allow the spin to stabilize into a flat spin. However, applying antispin controls when not in a spin can have more severe consequences.

Given that the chances of previously experiencing an out-of-control situation in the Eagle are very low, and there is currently no true departure training program for the line pilot, the only solution is academic study and mental preparation before every flight.

A high priority in any out-of-control situation must be to maintain orientation. Departures can be very violent and unpredictable, and can severely challenge the pilot's ability to cope. Developed spins, on the other hand, are recognizable and are well described in the flight manual.

The pilot must know the cockpit cues associated with spins, and be prepared for the cockpit forces that others have described which no simulator can duplicate. As mentioned before, antispin controls applied when not actually in a spin can appreciably worsen the situation, especially the ability to cope with what the aircraft is doing.

■ The fourth lesson is to hold the recovery controls. It takes a long time to break a fully developed spin, and full antispin controls are required to recover from a flat spin. Any asymmetry will still further delay recovery, and there may not be enough altitude to recover — depending on where the spin started. As the flight manual says, there may be no indication of recovery until just prior to the spin breaking.

The pilot must confirm spin direction and proper controls, check altitude, and not cycle antispin controls because there is no apparent effect. Pilots in other aircraft need to be very careful about giving advice concerning spin direction, since that can be very difficult to determine even by experienced test pilots.

There is evidence that relying on the departure warning tone alone for recovery is not enough, especially since it only indicates the yaw has dropped back below the threshold rate, not disappeared altogether. Also, pilot perceptual problems can occur under the stress of this situation, especially when judging changing tone rates, so the pilot must know other indications. He needs to be prepared for recovery rolls and other transients as residual moments damp out during the dive recovery, and wait for sufficient airspeed to build before starting the pullout.

Although no guidance is published, 150 knots has been suggested by the spin test people as a ballpark figure. He also has to ensure that even if out of the spin, there remains enough altitude to pull out of the dive. Again, no firm figure is published, but experience seems to indicate about 3,500 to 4,000 feet minimum will be required to recover to level flight.

The issue always arises of defining out of control at 10,000 feet during spins and spin recoveries for ejection purposes. The mishap examples given before graphically show several pilots attempting to deal with this situation. Unfortunately, no exact answer is available that covers all cases and can remove the need for pilot judgment. The problem is best approached by bounding it at each end.

If still in a spin with no indications of recovery at 10,000 feet AGL, the pilot should eject. Even if recovery begins, sufficient altitude to regain level flight will probably not be available — or it will be so close that luck, rather than skill, will be the primary determinant.

Conversely, if the departure warning tone has ceased, rotation slowed or stopped, and the nose has pitched down, then enough altitude should be available for recovery — assuming no further problems are encountered. The pilot needs to be patient and allow the aircraft every opportunity to stabilize, for there will only be time for one recovery attempt. This is the time for pilot skill, in that too abrupt control applications can worsen the situation. If the dive recovery is not progressing normally, the pilot should maintain the situational awareness to eject immediately.

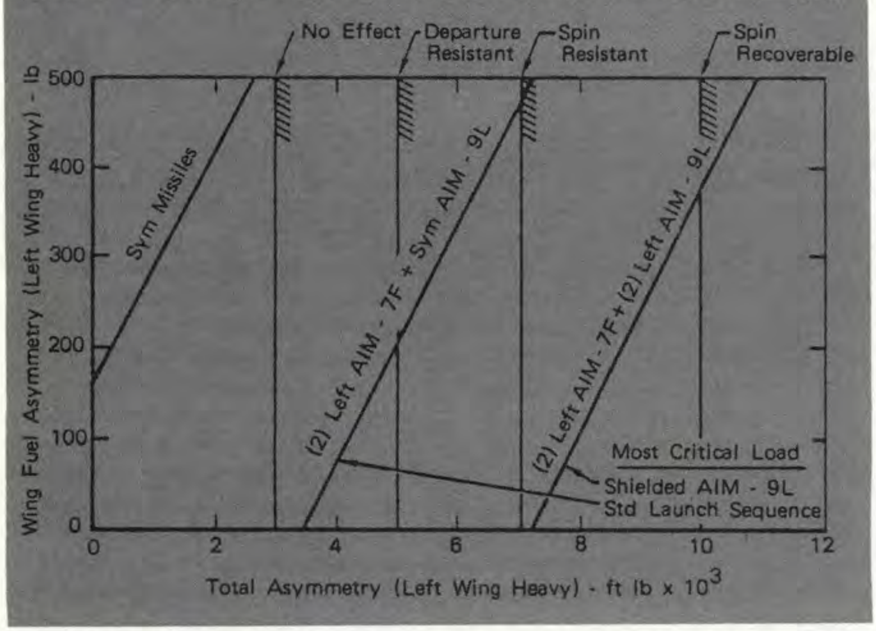
Each pilot must guard against that old nemesis — complacency. He must believe that he can find himself out of control in the Eagle and be prepared for it. He may have only one chance to recover the aircraft, so he has to make sure he does it quickly and correctly.

■ And finally, the last lesson is to always check the wing fuel balance. A fuel imbalance cannot cause a mishap in itself, in that the airplane has been successfully spun and recovered in both tests and operationally with full internal wing fuel imbalances. However, any imbalance makes the departure more violent and with less warning, the spin entry more rapid, and the recovery longer. More altitude will be required, and it may not be available; so prevention becomes the key. Failed internal wing fuel transfer pumps have provided the worst and most rapid imbalances in the past. However, lateral asymmetries can result from other failures or external store configurations as well.

A side issue is the planned pilot warning of internal wing/CFT transfer pump failure. While it is true that the actual issue is lateral imbalance, regardless of reason, it is failure of the wing transfer pumps that has resulted in the most inci-

continued

FIGURE 1 - LATERAL ASYMMETRY DUE TO WING FUEL AND MISSILES

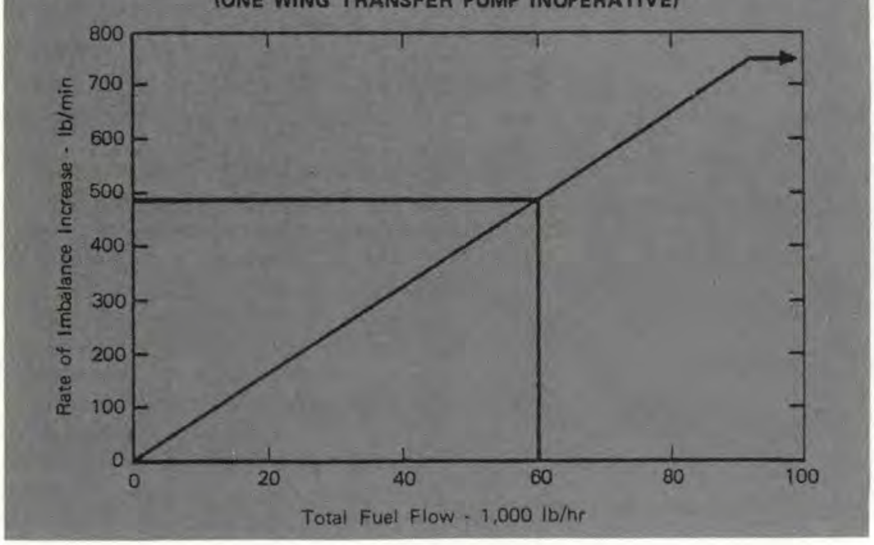


dents. This is because they alone can produce a significant imbalance in a very short period of time as opposed to other failures, such as the heat exchangers, that produce a fuel imbalance at a much slower rate.

Slower imbalances are usually detected by the pilot, and only the transfer pumps can build an imbalance so rapidly as to possibly be unnoticed during heavy maneuvering. It is this rapid imbalance, usually during BFM or ACT, that has provided most of the incidents that are the justification for this particular modification.

The initial proposal was to provide a total imbalance warning through the fuel gauging system. However, when the warning system was damped sufficiently to eliminate false warnings during heavy maneuvering, it was not sensitive enough to provide timely warning of the worst case failure that had resulted in most of the incidents. The system, as now designed, will provide the pilot warning of the worst case failure mode, but will not relieve the pilot of the responsibility to always continuously monitor his wing fuel balance.

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



It Can Happen

This summary of being out of control in the Eagle is an attempt to convince every pilot that it can happen to him, maybe with very little or no warning. There also does not have to be anything necessarily wrong with the jet. While handling qualities of the aircraft are excellent throughout the flight envelope, the F-15 is not departure or spin proof.

Rather, it is only resistant to varying degrees depending on such variables as configuration, entry parameters, and lateral asymmetry. History shows that the very first spin encountered in the F-15 during the test program was unintentional and unexpected, and resulted from a fuel imbalance.

This does not mean that the aircraft should not be flown aggressively and with confidence throughout the flight envelope. Nor does it appear any flight envelope restrictions, such as with the F-4, are warranted. The aircraft still remains, at the minimum, both departure and spin resistant regardless of configuration if T.O. fuel balance restrictions are followed.

Rather, the pilot should first academically prepare through study and discussion, and then mentally prepare before every flight for the possibility of going out of control. The pilot should be very familiar with the cockpit warnings and cues associated with departures and spins, and remember the descriptions of what other pilots have encountered in this arena. The pilot should also examine his flight profile to determine the maneuvers during which he approaches the area of decreased stability, specifically 40 to 44 units AOA and .5 to .76 mach.

Finally, the pilot should cultivate the mental discipline to react correctly in this demanding and stressful situation, for as the mishap descriptions indicate, it can be a wild and unpredictable ride that can really be surprising. ■

FS ’S CORNER

MACA TIPS

CAPTAIN DALE T. PIERCE
919th Special Operations Group
Eglin AFB Aux Fld 3, Florida

■ Last week I got a call from an old friend. She worked with me on her first assignment out of the Air Force Academy. She is 1Lt Denise Senn O'Brien, now assigned to the 2066th Communications Squadron at Myrtle Beach AFB, South Carolina. She told me about a project she had been working.

In the course of her work, as squadron public affairs officer, Lt O'Brien helped promote a MACA pamphlet developed by the 2066's Air Traffic Branch. The pamphlet is titled, *Myrtle Beach Area Midair Collision Avoidance Tips.* I'll refer to it as MACA Tips.

MACA Tips is a 5.5-inch by 8.5-inch pamphlet containing information to familiarize area civilian and military fliers with Myrtle Beach area approach control facilities, air fields, MOAs, and other high-density traffic areas. It is organized logically to accomplish its task.

The cover page simply shows the pamphlet title over the local wing crest.

On page 2, the text introduces the purpose of MACA Tips and provides a point of contact for further information.

Page 3 provides a depiction of the Myrtle Beach Approach Control Area of Jurisdiction.

Starting on page 4 is a general information section. This section identifies Myrtle Beach Approach Control as an Air Force operated radar approach control (RAPCON) facility, provides RAPCON hours of operation, and identifies the flight-control facilities within the area of jurisdiction.

The section goes on to identify the four areas of control, Myrtle Beach Approach Control frequencies, and frequencies of Jacksonville Center and surrounding approach control facilities.

On pages 6 through 9, MACA Tips provides descriptions of the local high-density traffic areas. The descriptions identify the type and flow of air traffic and provide diagrams of affected areas. In the case of the Myrtle Beach controlled MOA and the civilian controlled flying training area to the north of the MOA, MACA Tips describes the type of training being conducted in each area and hours of operation.

As a final touch, pages 10 through 13 provide front, side, and top-down views of military aircraft operating in the Myrtle Beach area.

Information on MACA Tips and a complementary copy can be obtained by contacting MSgt Aaron M. Etzkin at AUTOVON 748-7215. His address is 2066 CS/ATV, Myrtle Beach AFB, South Carolina, 29579-6346.

The FSO's Corner needs your ideas. What are you doing in your program that could help other FSOs if they knew about it? If you have something, call me (Dale Pierce) at AUTOVON 579-7450 (SMOTEC) or send your name, AUTOVON number, and a brief description of your program idea to 919 SOG/SEF, Duke Field, Florida 32542-6005. ■

Are you looking for some new ideas to add life to your midair collision avoidance program? This booklet might help. Give Sgt Etzkin a call at the number listed above and discuss it.

OPS TOPICS

What Battery?

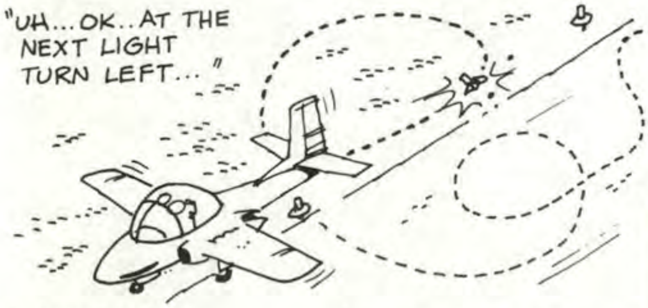
■ During a BFM engagement, the fighter pilot's personal tape recorder fell out of the map case. The pilot secured the recorder, but was unaware that the two batteries and the battery cover had come loose.

The rest of the mission was uneventful until after landing. After opening the canopy and shutting down the engines, the pilot discovered the batteries and battery cover missing from his recorder.

He found the cover and one battery under the ejection seat. Pieces of the other battery were later found in the extensively damaged engine.

The missing battery had apparently been on the canopy rail when the pilot opened the canopy. From there, it would be a short and rapid trip into the engine.

Don't be in a big hurry to open the canopy. If you can't leave it closed until after engine shutdown, take the time to check the cockpit for loose items that could fall out.



A Slight Detour

After landing on the left side of the runway with a slight left crosswind, the T-37 student pilot used rudder to keep the Tweet aligned with the runway as he braked. About 5,000 feet down the runway at approximately 50 to 60 knots, he inadvertently engaged the nosewheel steering.

The aircraft veered sharply left and the IP immediately took control. Despite the IP's use of right rudder, nosewheel steering, and brakes, the aircraft departed the left side of the runway at a 45-degree angle.

The IP shut down the left engine just before departing the runway. The aircraft traveled 125 feet with the left main gear off the runway before coming back on. At the apex of the arc, the left main gear was 21 feet off the runway with the right main approximately 7 feet off the edge.

After finally bringing the aircraft to a stop straight ahead on the left side of the runway, the IP wasn't sure they had really departed the runway. He looked the aircraft over, checked the brakes and the right engine instruments.

Since everything looked okay, he decided to taxi to parking. What he didn't realize was that the left main gear struck and destroyed a runway edge light just prior to reentering the runway. The tire was damaged and the strut was cracked.

The best course of action would have been to shut down both engines to minimize the FOD potential. Then the aircraft should have been towed in because of the tremendous side loads placed on the gear by the series of rapid heading changes. When in doubt, play it safe.

Check What?

During takeoff, the C-21 copilot noticed the No. 1 oil pressure was fluctuating. The crew monitored the oil pressure during climb and the fluctuations got worse. The pressure dropped to 25 psi and the master warn and low oil pressure lights came on.

The pilot reduced the No. 1 engine to idle and the crew accomplished the Dash 1 procedures. They declared an emergency and made an uneventful single-engine approach and landing.

What caused the problem? Four quarts of oil were lost through a loose oil cap. Maintenance missed the cap on a BPO and on a preflight. The pilot also failed to check the cap during his preflight. Enough said. ■

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UNITED STATES AIR FORCE

Well Done Award

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

CAPTAIN

Bradley J. Collins

526th Tactical Fighter Squadron
Ramstein AB, Germany

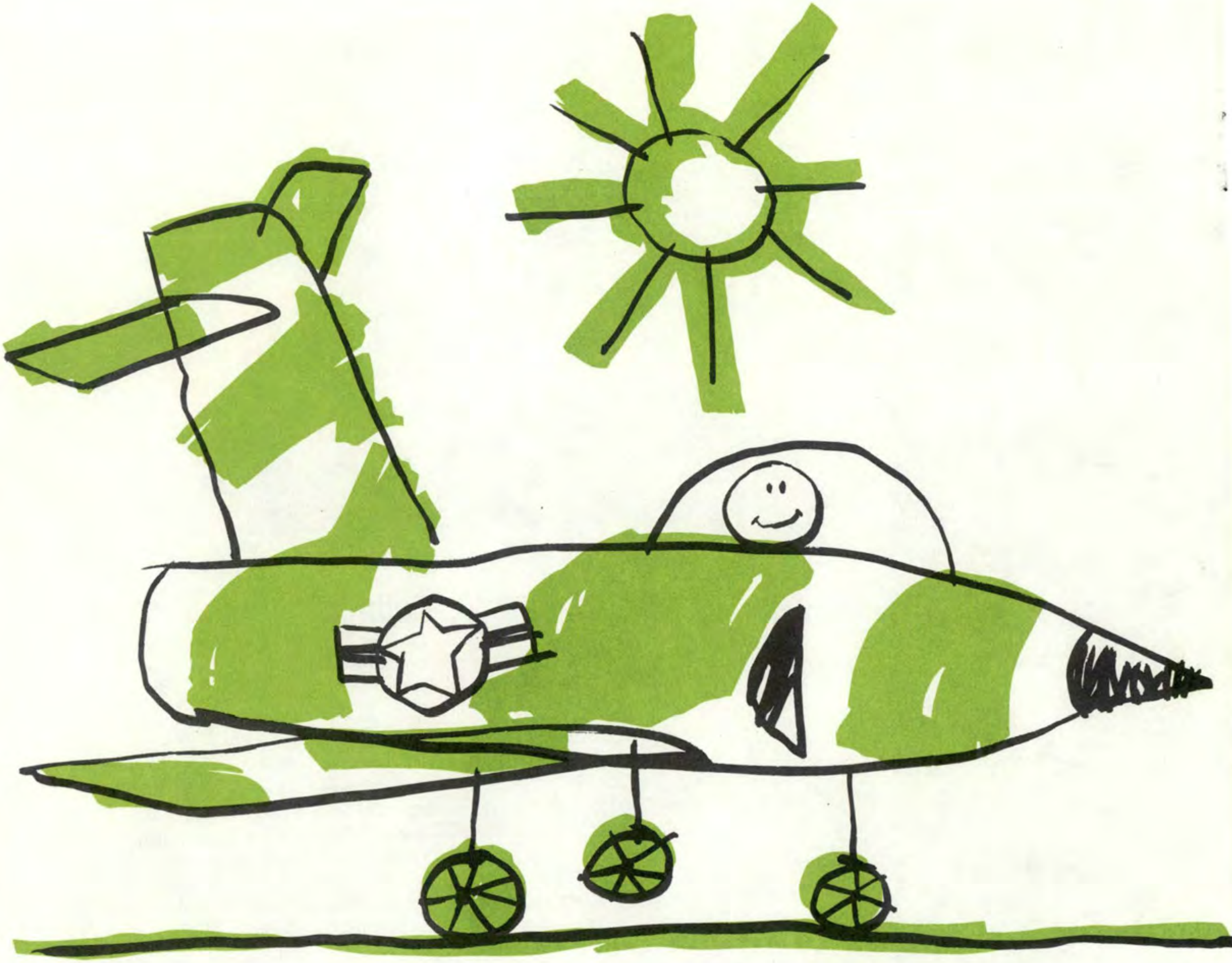
■ On 26 May 1987, while Captain Collins was flying an F-16C at 6,000 feet above the water at 610 knots, he noted a master caution light with aural warning, a hydraulic/oil caution light, and an engine fault light. He immediately checked the oil pressure gauge and found zero oil pressure.

Captain Collins reset the throttle to midrange, established a zoom climb, turned his aircraft toward the nearest recovery field 50 miles away, and declared an in-flight emergency. He nursed his aircraft to within gliding distance of the field, then reduced power for the descent. Less than 3 minutes later and less than 6 minutes after the initial indication of oil loss, the engine began to vibrate and smoke entered the cockpit. The engine failed seconds later — almost 15 miles from the field.

Attempts to restart the engine were unsuccessful. He confirmed engine seizure and concentrated on a flameout landing versus further fruitless attempts at engine restarts. Captain Collins flew his aircraft to a position 8,900 feet above the field to begin a 360-degree turn toward the landing runway. He lowered the gear handle at 6,700 feet AGL after determining the runway was within gliding range with the gear down.

The landing gear failed to extend, so he used the emergency gear extension, confirmed the gear down, and lowered the hook. Captain Collins skillfully maneuvered the aircraft and landed 2,000 feet down the 9,800-foot runway. He immediately lowered the nose of the aircraft to the runway and applied wheel brakes. Because of associated system failures caused by the seized engine, brakes as well as nose wheel steering were not available. Captain Collins maintained directional control using rudder and ailerons until successfully engaging the departure-end cable.

Despite multiple system failures, Captain Collins completed a difficult flameout landing and cable arrestment, thereby saving a valuable combat aircraft and preventing a possible loss of life. WELL DONE! ■



Please Don't Hurt My Daddy With FOD!