flying

SAFETY

AUGUST 1986

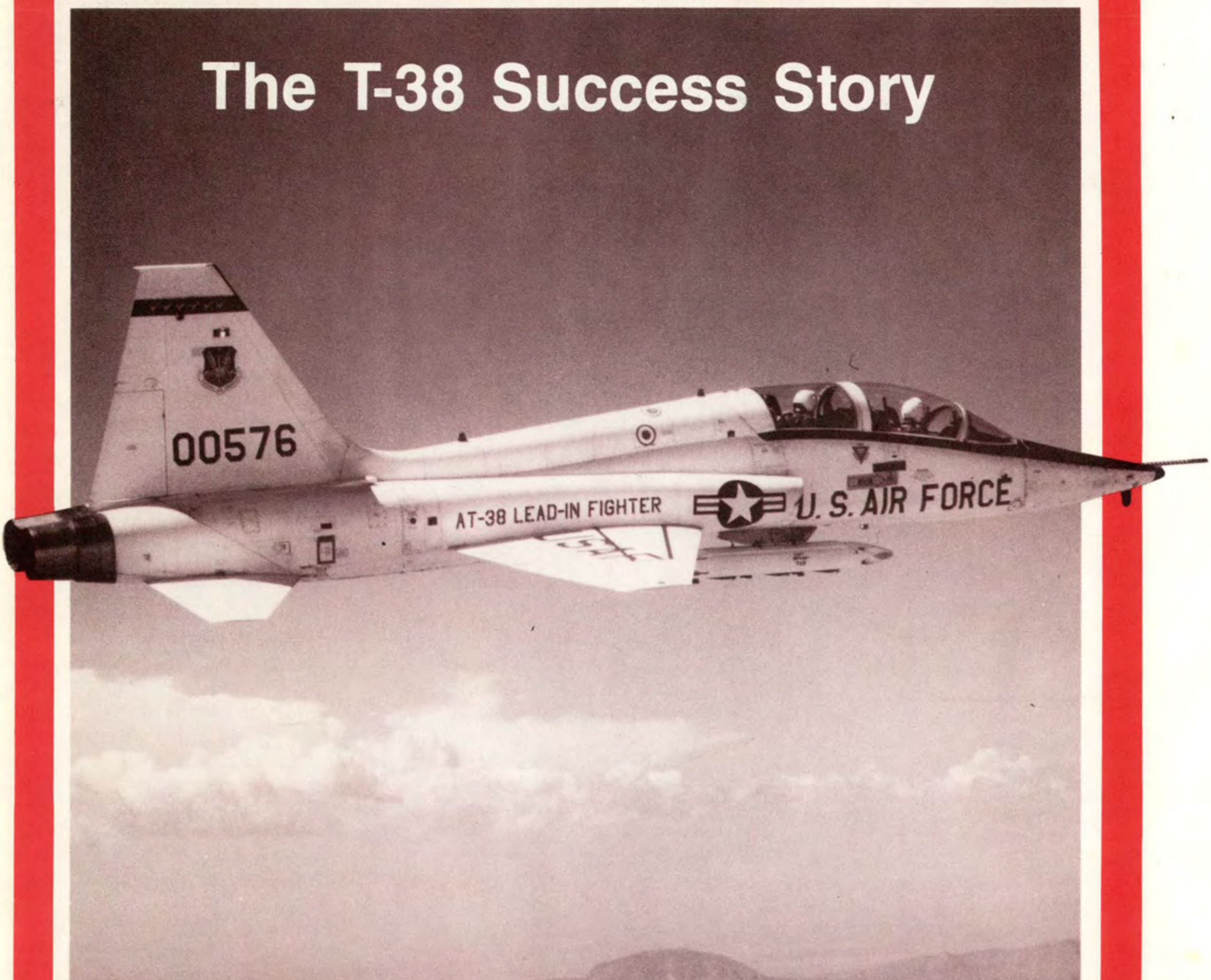
I've Heard It Before

Microbursts

Formula for Success

Why Do I Do It?

The T-38 Success Story



THERE I WAS

■ There have been too many "close encounters of the worst kind" in my flying career. On most of the occasions, I was in a radar environment talking to ATC. The most common reply to my question, "Where did that one come from?", would be "He's not talking or squawking."

My most recent experience was in an uncontrolled nonradar environment. I had just completed a functional test flight and was returning to the Spirit of St. Louis Airport. At about 10 miles from the airport, as I was slowly descending from 1.9 to 1.5 (traffic pattern altitude) and switching my transmitter to tower frequency for my initial call, I caught a flash of a red cross on a white background, just under my left main gear. I recognized (too late) that an Army National Guard UH-1H passed below me (by about 50 feet) in a westerly direction. I was on a 45-degree angle entry to a left base to Runway 26 left at Spirit. This was in anticipation of the usual tower instruction to call 2 miles on left base.

Neither of us had time to take evasive action. The encounter occurred before we realized how close we were.

The guard craft was practicing instrument flying. I didn't have my usual observer since it is difficult to find those who wish to work on a Saturday. I was punching up the ATIS, listening, descending, and preparing for my initial call to Spirit Tower in a very familiar environment. My neck is always sore from looking back and forth, scrubbing against the fur collar of my flight jacket. So, what happened? *Complacency*.

Take an observer and/or talk to radar approach, if it's available. Use all available help to keep flying safely. ■

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flying

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SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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THE T-38 SUCCESS STORY

■ When this year's class of 1,600 pilots graduates from the Air Force Air Training Command, every one of them will have trained in the Northrop T-38 Talon. They will join virtually all the active pilots in the Air Force, Reserves, and Air National Guard who also received their supersonic aircraft training in the T-38. In all, the Talon has trained 56,000 pilots.

Last March marked the 25th anniversary of the first T-38 Talon delivery to the Air Training Command. Since its introduction March 17, 1961, at Randolph Air Force Base, Texas, the Talon has been the primary supersonic trainer for Air Force pilots. The Air Force has said the T-38 will be its primary supersonic trainer well into the next century.

When Northrop delivered the last T-38 to the Air Force in 1972, the Chief of Staff of the Air Training Command, Brig Gen Michael C. McCarthy, said: "I have never heard anyone describe the T-38 as anything but a beautiful airplane. It is reliable in every parameter, a great performer, a remarkable airplane."

In its 25 years of service, the T-38 Talon fleet has accumulated more than 9 million flight hours, and is logging nearly 400,000 flight hours per year.

For a single pilot and a single T-38 to accumulate 9 million hours, the pilot would have to fly more than 1,000 years. He would have had to begin flying in the year 959, more than a century before William the Conqueror claimed England.

Besides serving the Air Training Command, the T-38 also provides transportation and proficiency flying for NASA's astronauts. The highest-time T-38 pilot is Dr Story Musgrave, a veteran of nearly 6,000 hours in the Talon and two space shuttle missions. The average Tactical Air Command fighter pilot, who flies about 20 hours per month, would have to fly a T-38 exclusively for 25 years to reach 6,000 hours.

At the Euro-NATO Joint Jet Pilot Training Wing at Sheppard Air Force Base in Texas, pilots from 11 NATO nations train in T-38s.

In yet another role, the T-38 participates in dissimilar air combat training exercises for the US Navy, teaching pilots how to defeat enemy aircraft.

At Holloman Air Force Base in New Mexico, modified T-38s become AT-38Bs and provide aircraft for lead-in fighter training to train pilots in air-to-air and air-to-ground combat tactics. Outfitted with bombs, guns, and rockets, future fighter pilots learn basic combat techniques in the Talon.

The Talon served for 8 years as the aircraft flown by the Thunderbirds, the Air Force Flight Demonstration Team.

Since its introduction, the Talon has been the Air Force's safest supersonic aircraft. The T-38 was the first US supersonic aircraft to complete its flight test program — 2,000 flights — without a major mishap.

The T-38 is also known as "The White Rocket." That nickname was earned because the T-38 was the world's first — and still the only — supersonic trainer.

The Talon set four time-to-climb records and, with pilot Jacqueline Cochran at the controls, also set eight women's flying records.

The Talon was the first trainer designed specifically to take pilots from subsonic aircraft to a supersonic aircraft designed to simulate high-performance jet fighters. The first groups of pilots trained in the Talon went on to fly the F-100 Super Sabre, the F-105D Thunderchief, or the F-106 Delta Dart interceptor. With the exception of a few squadrons of F-106s, those aircraft are now gone from the US inventory. The Talon, however, will be in active service for another 25 years. Out of 1,187 T-38s built between 1958 and 1972, nearly 950 are still in service.

Northrop is currently manufacturing new wings for the T-38 that will, according to the Air Force, allow the aircraft to remain in service through the year 2010. Northrop is also developing concepts for modernizing and upgrading existing T-38s to provide improved training for future Air Force pilots.

When the T-38 was designed, the Air Force estimated the aircraft's loss rate would be 12 aircraft per 100,000 hours of accumulated flying time. The Talon's actual loss rate has been less than two aircraft per 100,000 hours, saving taxpayers more than $1.6 billion in replacement costs. The T-38 requires 40 percent less maintenance than specified in the USAF/Northrop design goals, saving taxpayers an additional $900 million since the aircraft began flying. Savings to US taxpayers total more than $2.5 billion.

Every one of the 1,187 T-38s built was delivered on time and within contracted cost and with performance as promised.

An Air Force captain (and T-38 instructor pilot) wrote about his airplane in Air Force magazine: "At 0.9 Mach and 25 degrees of pitch attitude, you keep from exceeding the speed of sound while climbing. The vertical velocity indicator pegs, and you feel you're on your way to the moon.

"It's a matter of pride to know you are flying one of the best airplanes in the world — a bird that's beautiful, clean, white, sleek, aesthetically pleasing," he stated. "It's an airplane that demands respect and instills pride. You don't mind telling people, 'I fly the T-38.' " — Adapted from Northrop *T-38 Service News*, May 86. ■

The world's only supersonic trainer, the T-38 set four time-to-climb records. Also, Jacqueline Cochran set eight women's flying records in the Talon.

From being the primary trainer for fledgling student pilots to being the aircraft flown by the USAF Thunderbirds flight demonstration team, the versatile T-38 has met every challenge.

The T-38 fulfills a dual role with the SR-71. The "White Rocket" flies chase during training flights, and the Blackbird pilots use it for proficiency flying.

I've heard it before

If you fly aircraft, you're going to be affected by thunderstorms at some time. The more you know about them, the more successful your experience will be.

LT COL JIMMIE D. MARTIN
Editor

■ I know, you've heard it before. Every summer the safety people start talking about thunderstorms and the hazards associated with them. You probably don't want to read another article about how thunderstorms form, where the most storms occur, etc, etc. Good! I don't want to write such an article, and I'm not going to. (If you really want to know, read chapter 13 of AFM 51-12, "Weather for Aircrews.")

Why should I write one at all — just because it's summer? We always write thunderstorm articles in the summer. No, that's not the reason. I thought about not even writing on the subject. But, the mishap reports prove we still have problems with flying in this type of weather. So, let's look at some of them.

Some of the most severe weather hazards we can experience come from thunderstorms — severe turbulence, updrafts and downdrafts, icing, lightning, hail, surface wind gusts, and heavy rain. If you're a crewmember, you have had or will have an encounter with thunderstorm weather. Your knowledge of thunderstorm hazards and your use of appropriate procedures can keep you from being featured in a mishap report.

There has been a lot of research on thunderstorms and their effects. Over the last 10 or 15 years, researchers have learned a great deal, especially concerning lightning and downbursts. I will cover some of these things briefly while we look at a few of the recent thunderstorm-related mishaps. My focus will be primarily on lightning, turbulence, and hail. Captain McLane will cover microbursts in his article also in this issue.

Lightning

Lightning and electrostatic discharges are the leading causes of weather-related aircraft mishaps in the Air Force. All aircraft are susceptible to both, although to varying degrees. The aircraft may build up an electrical charge as a result of flying near a thunderstorm or simply by flying through clouds and precipitation.

If we fly through a thunderstorm, we expect lightning. But, aircraft flying several miles from a thunderstorm can still be struck. This is especially true if flying through or near the anvil. Electrical activity can also continue to exist after the thunderstorm has dissipated. This electrical activity may drift downwind in the cirrus deck that was once connected to the thunderstorm, especially if it was the anvil. (This is what Mr Alan Moller of the National Weather Service calls an "orphan anvil.")

Some information in AFM 51-12 can be misleading. It says, "Most lightning strikes occur when aircraft are operating in one or more of the following conditions:

■ Within 8 degrees of the freezing level.

■ Within about 5,000 feet of the freezing level.

■ In precipitation, including snow.

■ In clouds.

■ In some turbulence."

While this information is statistically true, it has led to a widespread belief that the most likely place for a lightning strike is near the freezing level. Numerous intentional thunderstorm penetrations by a specially instrumented NASA F-106B have proved this is not true.

The NASA studies led to the conclusion there is no altitude at which aircraft are immune from the possibility of lightning strikes. But, they found the regions of highest risk for an aircraft to experience a direct lightning strike were those areas of a thunderstorm where the ambient temperature was colder than -40 degrees C (38,000 to 40,000 feet) and where the turbulence and precipitation intensities were negligible to light. Therefore, the presence and location of lightning does not necessarily indicate the presence and location of hazardous precipitation and turbulence and vice versa.

■ The pilots of an F-16A and an RF-4C were checking the weather in the working area to see if their scheduled mission could be completed. They flew 1,500 feet under the overhang of some towering cumulus clouds. At that time, lightning struck the side of the F-16's radome, exited on the opposite side, and struck the RF-4's radome. The lead aircraft suffered no damage, but No. 2's radome had a small hole in it.

TIP: *Never fly through or under the overhang of cumulus clouds.*

■ A T-38A was returning to base after a local area mission. The pilots had been briefed on thunderstorms in the area. The crew requested the standard recovery which caused them to enter IMC. While passing 15,500 feet, the aircraft was struck by lightning. It was possible to remain clear of the clouds, but the crew didn't request deviations because the weather they were going through appeared thin.

■ A WC-130H was flying at night in an area of isolated thunderstorms. There were lightning flashes visible in all quadrants. The nearest cell the navigator was painting on radar was 25 nm away.

The aircraft was climbing through 17,000 feet in the clouds when it was struck by lightning. Postflight inspection revealed a small crack in the radome.

TIP: *Remain VMC if at all possible when thunderstorms are forecast.*

One final point on this subject. We generally think of lightning as dangerous and static discharges as annoying. Depending on the aircraft and existing conditions, static discharges can be quite severe.

■ An F-15 was being vectored to final approach at the end of an uneventful night mission. During a

continued

turn at 3,000 feet, the Eagle experienced an extremely bright and loud electrical discharge. It was so bright and loud that another F-15 pilot 4 miles away thought he had been hit, and the SOF saw and heard the flash from 12 miles away. The mishap pilot was blinded by the flash, so he made a gentle "seat-of-the-pants" roll to wings level, started a shallow climb, and turned on the cockpit floodlights.

When his vision returned in about 1 to 1½ minutes, he found himself in a 2,500 fpm climb, wings level, at 5,000 feet, in a small rain shower. The HSI, central computer, and radio receiver were knocked out, but the radio transmitter was OK.

The aircraft was quickly out of the shower and back into VMC. The pilot saw the field about 12 nm away, turned to final, and landed. The F-15 had minor exterior damage.

TIP: *Avoid conditions that are likely to produce either lightning or static discharges.*

Hail

I'm not going to spend a lot of time telling you hail is one of the worst hazards associated with thunderstorms. You already know that. You've probably been told hail occurs during the mature stage of large thunderstorms. That's generally true, but you should never assume any thunderstorm is free of hail. The larger storms are more likely to have hail, but smaller storms can have it, too. The really big hail usually comes from the very large and strong storms. But, it doesn't take baseball-size hail to do a number on an airplane. Small hail can be extremely destructive.

Remember, hail can be encountered from ground level to 45,000 feet, inside the thunderstorm or outside it in clear air. Expect to find it in or under the anvil. Hail has been experienced 10 or more miles downwind from large thunderstorms. Be especially careful on the downwind side. Keep as far away as you can.

■ A flight of four A-10s was en route at FL 260 to a cross-country base. The flight had been deviating around weather, and the flight lead saw a large thunderstorm directly ahead of them. He asked the center for a deviation to the west. The center suggested that, according to their radar, a northeasterly direction would be best.

The leader saw an opening in the clouds on a heading of approximately 360 degrees and turned the flight toward it. Shortly after they entered the opening, the weather became IMC. Lead informed the center and asked for vectors. Center told him the heading he was on was good.

The flight was in the weather for only 2 to 3 minutes, but encountered moderate hail twice. Each hailstorm only lasted about 10 seconds. All four aircraft had numerous dents in the wing leading edges and slats, broken strobe lights, and damaged antennas.

TIP: *Remember, ATC radar is not designed to paint weather. Remain VMC, if possible.*

■ A flight of four F-4Gs was returning to base after a Red Flag sortie. The flight lead elected to remain VFR below the cloud bases which were at 15,000 to 18,000 feet. The flight was in the clear at 1,500 feet above the ground when they flew through an isolated shower. Three of the four aircraft received hail damage.

TIP: *Don't fly under a thunderstorm. Hail, turbulence, lightning, and wind shear are very real threats.*

■ Two pilots in a T-38A were returning from a cross-country flight. During an en route descent into an intermediate base for refueling, the pilots noticed thunderstorms about 70 miles south/southwest of their position. They descended through

We expect lightning from big cells like this one. But, avoid the thick cirrus decks that have been associated with thunderstorms. The electrical activity can remain after the thunderstorm cell has dissipated.

Damage like this doesn't take long in a hail storm. A few seconds are enough. Expect all thunderstorms to have hail and avoid them.

cirrus/stratus clouds from FL 350 to 250.

The pilots were on the ground for about one hour. Before departure, they checked the weather at the base weather shop. The base's weather documents showed 30 percent of the area from 80 miles south to 85 miles northwest of the base had intense thunderstorm activity. Due to the relatively short time spent on the ground, the pilots interpreted this weather as essentially the same as they had experienced on arrival. In fact, the thunderstorm activity had intensified and moved farther south.

The crew departed to the south following roughly the same route as on their arrival. They again entered the cirrus/stratus clouds at FL 250. Passing FL 310, they encountered light turbulence and hail.

After landing, they discovered hail damage to the wing, vertical stabilizer, and nose cone.

TIP: *Under the right conditions, thunderstorms can build and multiply very rapidly. Always be prepared for the worst.*

■ An IP and student pilot were on the last leg of a cross-country flight in a T-37B. The weather briefer had noted an isolated thunderstorm 80 miles north of the planned course and forecasted isolated thunderstorms along the intended route of flight.

The crew took off and entered IFR conditions at 15,000 feet. The IP *assumed* the center would keep him clear of any severe weather along his route without a direct request from him.

About 40 miles from their destination, the Tweet entered an imbedded thunderstorm and encountered turbulence, hail, and lightning. At that time, the IP asked for vectors and was steered to the right. The aircraft suffered minor hail damage to both engine intakes and the vertical stabilizer.

TIP: *Never assume anything, especially concerning thunderstorms. It's up to you to keep your aircraft safe.*

Turbulence

Turbulence is present in all thunderstorms. As the storm builds, the turbulence becomes more hazardous. In a severe storm, it cannot only injure passengers, but can cause structural damage or failure to your aircraft. The strongest turbulence inside the cloud is caused by the shear between the updrafts and downdrafts. Severe turbulence can also be encountered in the anvil as much as 30 miles downwind. You can also fly into the turbulence in clear air as much as 20 miles downwind from the storm or several thousand feet above it if you're trying to go over or around the storm. Keep as far away as possible, and

continued

This airplane didn't even have to penetrate a thunderstorm to get hail damage. Hail has been encounterd in clear air 10 or more miles downwind of the storm.

"Remember: The terms thunderstorm, cb, and cumulonimbus are synonymous! The only difference is the sound of thunder." AFM 51-12.

try to pass on the upwind side.

■ A CT-39A was on initial climbout in IMC. There were no forecast thunderstorms for the area. Since they were flying into stratus clouds, the crew told center their aircraft was not radar equipped and asked the center to keep them clear of any thunderstorms. The controller gave them a heading of 180 and said that heading should keep them clear of any thunderstorm activity.

At FL 180, the aircraft encountered moderate rain and icing. The aircraft commander immediately requested and initiated a 180-degree turn. During the turn, the aircraft experienced severe turbulence that caused it to enter a 70-degree bank, 30-degree nose low, 350 KIAS descent. The aircraft lost 6,000 feet in less than one minute before the aircraft commander could regain control at 12,000 feet.

TIP: *Don't turn back if you enter a thunderstorm. The quickest way out is usually straight ahead, and turning will increase stress on the aircraft in turbulence.*

■ An IP and a student pilot received a weather briefing for a navigation check ride in a T-38A. The forecast was for isolated thunderstorms with maximum tops at FL 480 for the route of flight. The aircrew launched 4 hours later without getting a weather update.

After about 15 minutes of flight, they were approaching a line of weather across their course. They tried to contact METRO, but were unsuccessful. They then asked the center if there were any thunderstorms in their flightpath. The center said their radar was inoperative in that area, but an earlier aircraft had not reported any activity.

The crew climbed to FL 410 to remain VMC. A short time later, the aircraft entered thin cirrus clouds as radar control was passed to another center. Upon checking in with the new controller, the crew asked if there were any thunderstorms in their vicinity. The center told them there was a thunderstorm 10 miles in front of them and a line of thunderstorms extending 50 miles to each side.

The IP assumed control of the aircraft and made a 180-degree turn. During the turn, they encountered turbulence that caused a loss of 40 knots and 1,000 feet of altitude. They also experienced a lightning strike.

TIP: *Never take off with an old weather briefing.*

■ An O-2A was returning from the range in response to a weather recall. The pilot relied on a radar facility with limited weather capability to steer him clear of severe weather. While climbing in the weather, the aircraft was caught in a turbulent updraft.

The pilot became spatially disoriented and thought his attitude indicator had failed. He attempted a right descending turn to the last known clear area and entered a nose-low, high-airspeed descent. The left wing failed due to turbulence and high airspeed, and the pilot was killed when the aircraft hit the ground.

TIP: *Don't fly in weather containing thunderstorms. If caught in a thunderstorm, hold a constant attitude and maintain a good instrument cross-check until clear of the storm.*

■ A C-130E was being flown on a local instrument proficiency training mission. After completing an ILS touch and go, the pilot began a climb to 4,000 feet. At approximately 2,000 feet, the aircraft entered IMC. At 3,500 feet and 8 nm from the field, the aircraft experienced a strong downdraft. The pilots reported a G meter reading of from zero to minus one G, a descent rate of 4,000 fpm, and an altitude loss of 1,500 feet.

After recovering control of the aircraft and while still in moderate turbulence, the pilots saw lightning strike the radome.

Some people really get their mon-

Remain VMC during thunderstorm weather. Be careful of those "sucker holes." They can close up rapidly or you may encounter hail, lightning, and turbulence from nearby thunderstorms.

ey's worth. This last mishap had a little of everything.

■ A C-130 was en route at FL 330 in VFR conditions. The aircraft entered intermittent cirrus, but there was no threatening weather on the aircraft radar.

Shortly after entering the cirrus, the aircraft began to encounter light rain followed by light icing and ice pellets. The icing was followed by moderate, then severe turbulence combined with severe hail, estimated at 1 to 2 inches in diameter. The severe turbulence and hail lasted 2 minutes and included 3 flashes of lightning.

Some days are like that.

The first rule for flying during severe weather is *avoid all thunderstorms*. Use the minimum separation distances in AFR 60-16 and those established by your command regulations. Remember, the specified distances are *minimums*. This is one case when more is better.

Avoidance Aids

Air Traffic Control (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 specifically designed to filter out rain returns so aircraft won't be blocked out by them. Therefore, ATC radar can only paint the heaviest weather. That means they may not be able to see some very hazardous buildups.

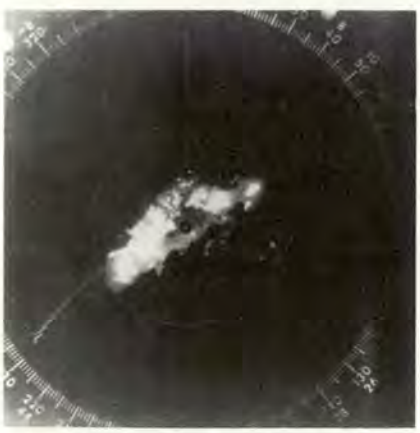
Another source of weather information for ATC is pilot reports (PIREPs). If a previous aircraft has flown through the area you're concerned with, they will tell you what that pilot said. There are some dangers with this approach, too. Sometimes the safe corridor through weather is very narrow and unstable. The preceding aircraft may have just hit the corridor while you may just miss it. Also, different aircraft may build up different charges of static electricity flying through the same area. One may be safe while another may experience a static discharge or trigger a lightning strike. Finally, thunderstorms may build very rapidly and close off an area that was clear only a few minutes earlier.

Airborne radar can help you determine the best way to avoid severe weather echoes. If it is necessary to pick your way through an area or line of thunderstorms, your aircraft radar can help. However, be very careful in trying to go between cells as you may encounter severe weather several miles from the hard radar return. AFM 51-12 contains a good discussion on using airborne weather radar for avoiding severe weather. The section concludes with, "However, no matter how well radar performs, it is still just a tool. It is your knowledge of severe weather and the expertise with which you operate your radar systems that will determine the safety of your flight."

Pilot to METRO (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, PIREPs, and a real-time radar report. Also, Air Weather Service (AWS) radars differ from the ATC radars in that they are specifically designed for weather observation.

Remember, the AWS forecaster's primary duty is to help you. The only higher priority is emergency war-order requirements. So, use the PMSV for accurate severe weather conditions and locations and then request the appropriate deviations from ATC.

In the final analysis, it all comes down to you. If you fly, you will encounter thunderstorm conditions at some time. The outcome depends on your knowledge of thunderstorms and the aids available to you and your actions based on these two things. Don't press a routine mission into a thunderstorm. It could be a decision you'll live to regret — or maybe you won't. ■



Radar is a great aid in avoiding thunderstorms, but there are serious limitations. Be sure you know what to expect from the different types of radar — aircraft, ATC, and Air Weather Service.

A great deal of research is being done on the effects of lightning strikes on modern aircraft composite structures.

The dash-1 is always right . . .

or is it?

CAPTAIN JOSEPH M. SOUSARIS
Chief, Flying Safety
Air Force Communications Command
Scott AFB, IL

■ OK, the Lockheed Jetstar, better known as the C-140A/B is not an aircraft flown by many Air Force aviators. So, why does it rate a story in the *Flying Safety* magazine? Read on . . . the following incident could occur on any aircraft!

The Air Force Communications Command's (AFCC) C-140As perform flight inspection on navigational aids and evaluate air traffic control procedures and controllers in the USAF system. While the majority of flying is performed in the CONUS, these aircraft operate worldwide in all weather conditions.

Like most Air Force aviators, C-140 pilots are required to understand aircraft systems, fly scheduled simulator rides, and remain procedurally sharp through pilot proficiency flights. Through this knowledge, we become highly familiar with aircraft procedures and confident that if a malfunction occurs, the aircraft is designed to provide backup capabilities that allow time to continue to fly, analyze the situation, and take appropriate action.

So what is the problem? Well, until recently, we did not know there was one. But let me describe this normal mission. A new pilot was on his fourth upgrade ride flying an instrument approach in the local area. While established in a holding pattern, he lost both the pilot and copilot attitude (ADI) and heading (HSI) indicators. After assuming the instructor had caused the failures, he attempted to remedy the problem by providing another source of AC electrical power.

At the same time, the instructor was puzzled because he did not cause the problem. More importantly, the prescribed corrective action did not remedy the problem! They realized something was definitely wrong because they knew you are not supposed to lose instruments on both sides of the cockpit. So, there they were, both pilot and copilot ADI and HSI inoperative, the cockpit full of "off" flags, and not a fix to be found. Being in VMC conditions, they contacted the tower and flew a visual approach to a full stop.

So, you think this was not a prob-

Have you ever encountered an aircraft malfunction that was impossible according to the dash-1? Only in the flight simulator you say? Not necessarily. The impossible is sometimes possible in the real aircraft.

lem? Picture this, the weather is now IMC and you are in the same holding pattern and in a turn. You are initially distracted when all instrumentation fails, but not to worry, you have several backup procedures to try. But, when you select what has worked in training and should work now . . . nothing happens! Are you still in a turn? Initially, the C-140 crew thought the turn needle was also inoperative because they looked quickly and saw an unbelievable amount of red flags and *assumed* all instrumentation was Tango Uniform. So, they relied on VMC conditions to get home. However, the turn indicator was operating.

How good are you at flying needle, ball, and airspeed as your only instrumentation? The last time I was in the simulator and a similar scenario was provided, I used the turn needle to turn the wrong direction (it took a while to get used to it). Next time you are in the simulator, give it a try. Now is the time to get it right, not in weather.

So, how does this C-140, AFCC aircraft problem apply to other aircraft? Well, did your aircraft ever have a technical order (TO) change? The answer is yes! I feel sure most Air Force aircraft have encountered some modification which required a TO change. In the C-140 about 3 years ago, a new flight director system was installed. The equipment was excellent and all training simulations and corrective actions worked in accordance with (IAW) the Dash-1. But here was the problem.

Even though the aircraft was wired IAW Air Force technical orders, there was a fault in the tech order wiring diagram (the Dash-2, Dash-9 for you trivia freaks). The faulty wiring had both pilot and copilot instrumentation attached to the same fuse. When the fuse connection corroded, there was no other source of power available. All aircraft were wired the same . . . IAW the TO, but definitely different than the way the Dash-1 directs. While the rewiring fix action was simple, the potential for disaster prior to the fix was great.

So, what's the point? Murphy's Law is alive and well, and can apply to any one of us at any time. So, the next time the instructor pulls an off-the-wall emergency simulation you think is not very probable, remember Murphy and give it an honest effort . . . because it may just bite you someday. You can believe we flight checkers are more serious about needle, ball, and airspeed now. ■

IFC APPROACH

By the USAF Instrument Flight Center, Randolph AFB, TX 78150-5001

Microbursts

CAPTAIN MICHAEL L. McLANE
USAF Instrument Flight Center
Randolph AFB, TX

■ It was a dark and stormy night . . . . Many a story has begun with these familiar words. However, one might have used the same phrase to describe the weather at Dallas/Ft. Worth International Airport on August 2, 1985. To the flight crew of Delta Flight 191, the weather on this day did not appear to be out of the ordinary. Isolated thundershowers were around the airfield; however, they had seen conditions worse than these before. There was no reason, so they thought, to be concerned about making a safe approach and landing.

This storm, however, was not your everyday thundershower. Unknown to Flight 191, this cell was generating downdrafts near 30 knots and producing horizontal wind shears in excess of 65 knots. Had this information been available to the crew of Flight 191, disaster might have been avoided.

This was the third major air carrier mishap attributed to what is now widely known as "microbursts." It was during the 1975 investigation of a Boeing 727 crash at John F. Kennedy International that the destructive capabilities of this phenomena were first discovered. The other mishap occurred at New Orleans International in 1982, involving another 727. Together, these mishaps were responsible for almost 400 casualties.

The probable cause of these mishaps was attributed to aircraft encounter with severe wind shear. The similarities between mishaps are numerous. Each encountered the shear at low altitude, either during the approach or departure phase of flight. In all cases, thunderstorms were in the immediate vicinity. The wind shears in all mishaps decreased aircraft performance — headwind changing to tailwind or decreasing headwind shears. Finally, none of the flight crews involved had prior knowledge that severe wind shear conditions existed along their flightpath.

This harmless looking light rain shaft from a high, nonthunderstorm cloud base was accompanied by a 65 mph microburst. (Photo courtesy Fujita, University of Chicago.)

What Are Microbursts?

Doctor Theodore Fujita, University of Chicago, defines microbursts as small downbursts with outbursts, damaging winds, extending only 4 km (2.5 miles) or less in horizontal dimension. When an aircraft encounters a microburst, the usual first phenomenon is an increase in headwind. This will result in increased lift and indicated airspeed.

During an approach or departure, this may cause the aircraft to temporarily exceed expected performance characteristics. The pilot must refrain from reducing power or increasing pitch as this will put the aircraft in an energy deficient state when the second phenomenon, a tailwind, is encountered.

Blowing dust is one of the visual clues to the presence of a microburst. (Photo courtesy Fujita, University of Chicago.)

This may have been a contributing factor in the Dallas mishap. The pilot had been requested to reduce airspeed to increase spacing on a Lear Jet he was overtaking. When the strong tailwind and loss of airspeed and lift occurred, the aircraft did not have enough altitude or power available for recovery.

Why would a highly qualified pilot willingly reduce airspeed in a hazardous wind shear environment? Shouldn't he have questioned the Air Traffic Controller's request? Put yourself in the same situation. Based on the information available at the time, to both the pilot and controller, there was no reason to believe complying with ATC's request would jeopardize safety of the aircraft.

Why wasn't the aircrew of Flight 191 provided some advance warning of the severity of the conditions that had developed along their approach path? Much of the problem is due to the inherent qualities of microbursts. These small intense downbursts have a relatively short life span, ranging from 5 to 15 minutes with the period of severe shear lasting only 2 to 4 minutes. Because of these characteristics, detection of microbursts is extremely difficult.

Aircrews need to make use of all available information to determine areas susceptible to microbursts and severe wind shear.

- Obtain a good weather briefing. Although the forecaster will not be able to tell you exactly where the hazardous shear is, areas conducive to the formation of such conditions can be pointed out. Take a look at both the weather radar and the satellite imagery to determine where the most intense cells are located.
- Be more observant. There are several visual indicators to warn of the presence of severe shear. Look for blowing dust or smoke, precipitation trails or virga, blowing trees, and heavy rain. All of these phenomena have been associated with strong downdrafts and microbursts.
- Monitor your airspeed and groundspeed. If wind shear is suspected, consider "padding" your airspeed.
- Listen for pilot reports from other aircraft. Remember, this type of shear can rapidly increase in intensity. Reports of light or moderate shear may be the first indications of a developing system.
- Finally, if weather conditions point toward a strong possibility of hazardous shear, make the decision to stay on the ground until conditions improve.

Avoidance of areas influenced by microbursts and severe wind shear cannot be overstressed. Doctor John McCarthy of the National Center for Atmospheric Research in Boulder, Colorado, has said, "the first three rules that should be applied when dealing with microbursts are (1) *avoid*, (2) *avoid*, and (3) *avoid*." Even with the best information available, this may not always be possible. Aircrews must be prepared to handle the unexpected encounter if it occurs.

Microburst Recovery Procedures

So, where does one go to find recovery procedures for inadvertent microburst encounters? How about the emergency procedures section of your aircraft dash-one or flight crew checklist? Probably not. If you're lucky, you may find a small section in your dash-one on basic wind shear procedures. However, you probably will not find much help in handling severe shears, such as microbursts.

One thing is for sure, shears associated with microbursts may reach such intensities as to require immediate pilot actions to ensure recovery. This is especially critical should these shears be encountered at low altitude and low airspeed.

Investigators of the July 1982 Boeing 727 mishap at New Orleans International Airport estimated the copilot had about 6 seconds to react to the wind shear (38 knot loss), raise the aircraft's nose, and add all

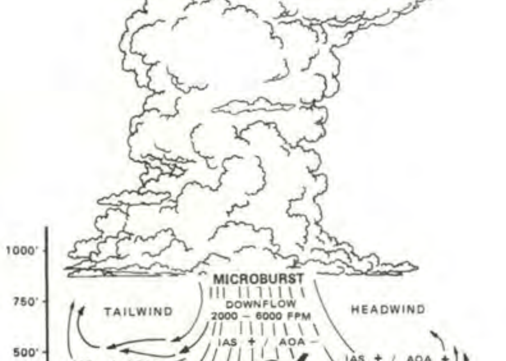
continued

This photo shows the classical signs of a microburst — high cloud base, virga, and a dust ring at the surface. (Photo courtesy Don Veal, University of Wyoming.)

IFC Approach: Microbursts continued

available engine power to prevent descending into the trees; hardly enough time to refer to a checklist.

Microburst procedures should be treated as *boldface*, i.e., emergency procedures considered critical in nature, and performed immediately without reference to printed checklists and committed to memory. Aircrew reactions need to be as spontaneous as those for other inflight emergencies.



As an aircraft enters a microburst, it first encounters a strong headwind and increase in IAS and lift which causes a pitch up. The typical pilot reaction is to reduce pitch and power. Within 30 seconds, the headwind changes to a strong tailwind. Now the previous correction has compounded the pilot's problem and compromised the aircraft's safety.

One of the taskings of the Federal Aviation Administration's Integrated Wind Shear Program is to develop general rules that apply to all aircraft. This joint effort between industry, the academic and scientific communities, and the FAA is an attempt to develop guidelines for producing a set of educational and training aids as well as operating procedures. The techniques developed will focus on helping the flight crew avoid hazardous wind shear and, in the case of inadvertent encounter, to deal with the situation in the most effective manner. Although the FAA program is geared primarily towards civil aviation, the general pilot procedures developed should be usable by military aviators as well.

Until results from this program are available, aircrews need some interim procedures to use during an unexpected severe wind shear encounter. Following are some general rules to apply to these situations.

Although specific recovery procedures vary with aircraft, the first step is recognizing the aircraft has encountered severe shear. If the aircraft flies through a microburst, your first indication will probably be a sudden increase in aircraft performance (airspeed and lift) when the aircraft flies into the headwind portion of the storm. Be ready, for this increase will be followed within a few seconds by decreased performance as the aircraft moves into the downdraft and subsequent tailwind portion of the shear.

Once recognized, the next step is applying the proper pilot procedures to correct for the loss of airspeed and lift caused by the shear. One possible solution is to increase the aircraft's kinetic energy by either increasing power, if available, or trading potential energy for kinetic energy, that is, altitude for airspeed. However, neither of these solutions may be feasible. Throttles may already be to the stops and it might not be practical, because of close proximity to cumulo-granite, to trade altitude for airspeed.

Our only other choice is to try to increase total aircraft lift. Pulling out your basic aerodynamics text, you'll find we can do this by increasing the aircraft's angle of attack. This may not seem appropriate if the aircraft has already lost 30 to 40 knots of airspeed, but it is your only choice if you wish to stop the descent.

Once this has been accomplished, you should continue to monitor vertical speed and altitude. If the aircraft is still descending, positive adjustments should be made to the angle of attack to stop the descent. However, only increase the angle of attack enough to control the aircraft's vertical flightpath since the resulting high drag and high angle of attack leaves little room for error. *Warning:* Do not increase the angle of attack so much as to cause the aircraft to stall.

Although a change in flap position can improve wind shear re-

In this photo, you can see the vortex ring circulation pattern associated with the leading edge of a microburst. (Photo courtesy Fujita and Smith, University of Chicago.)

covery, altering aircraft configuration is not recommended until collision with the ground is no longer a factor. This eliminates the possibility of moving the flaps in the wrong direction or the wrong amount.

The above procedures, though general in nature, should enable aircraft pilots to recover from the most severe wind shears. Remember, there are some microbursts so strong that safe flight through them is not possible. Avoidance is always the best overall policy: (1) *Avoid*, (2) *avoid*, and (3) *avoid*. If this doesn't work and you still have a close encounter of the worst kind, the following procedures may ensure recovery:

- Apply maximum power.
- Increase the angle of attack to stop descent. (Be careful not to stall.)
- Control flightpath with pitch as necessary.
- Maintain aircraft configuration until at a safe altitude.

Until microburst detection and warning capabilities improve, aircraft will remain vulnerable to low level wind shear during the approach and departure phases of flight. Aircrews must keep a healthy respect for microbursts, learn recovery procedures, and be able to apply them without hesitation if an inadvertent encounter occurs. Only by doing so will future disasters be avoided.

Comments on this IFC Approach article or suggestions for future topics can be either mailed to the USAF Instrument Flight Center, Randolph AFB TX 78150-5001 or telephoned at AUTOVON 487-3077. ■

Microburst Slide/Tape

The Instrument Flight Center is in the process of producing a slide/tape package on microbursts entitled "Microbursts — Shear Terror." This should be available for distribution to flying units by September 1, 1986. We will provide information later on how to obtain your copy.

FAA TESTING NEW WEATHER RADAR

■ Secretary of Transportation Elizabeth Hanford Dole announced the Federal Aviation Administration (FAA) has installed an experimental weather radar system at Huntsville, Alabama, to study low-level wind shear, microbursts, and other hazardous weather conditions.

She said, "A principal goal of the Huntsville experiment is to perfect a radar system that will reliably display airport wind shear conditions for air traffic controllers."

The tests will be conducted for the FAA by the Massachusetts Institute of Technology's Lincoln Laboratory using two Doppler weather radars, a system of 30 automatic weather stations, and an instrumented aircraft for airborne data collection.

Doppler radar has the capability to "see" inside storms and measure both rainfall intensity and the speed of winds moving toward or away from the antenna site. By combining the wind information from the two radars in the test program, it will be possible to obtain complete three-dimensional information on the wind field within a storm. Test results will be used in the design of a terminal Doppler radar system the FAA plans to install at major airports around the country starting in 1989.

The test system was moved to Huntsville from Memphis, Tennessee, where it was used for a series of experimental measurements last year. During that period, 92 potentially hazardous microbursts were detected.

The Huntsville program will allow the FAA to study low-altitude wind shear in the moist environment typical of much of the southeast where storm-related wind shear and microbursts frequently occur. It also will permit coordination and exchange of data with the National Aeronautics and Space Administration and the National Science Foundation, who will conduct experiments in the Huntsville area on severe thunderstorms and microbursts.

The FAA is involved with the National Weather Service and the US Air Force in the development of the next generation weather radar (NEXRAD) — a Doppler radar system — that will replace the current network of more than 100 long range conventional weather radars with a limited production contract set for award in January 1987.

To provide early wind shear detection capability at major airports, the FAA plans to adapt 15 of the first NEXRAD systems and deploy them in the 1989-1991 time period. Deliveries of specifically-designed terminal Doppler systems are due to begin in 1992.

Also at Huntsville, the FAA is conducting tests to enhance the performance of the existing Low Level Wind Shear Alert System (LLWAS), which has been installed at 88 airports, with the number scheduled to increase to 110 by the end of 1986. A standard LLWAS system, equipped with 11 sensors instead of the usual 6, will be tested. If it improves detection of low level wind shear, the FAA plans to start upgrading the nationwide system in 1987, with completion expected by 1989. ■

Up, up and away

RICHARD W. HULING, Ph.D
AFISC Historian

■ Wartime missions introduce additional challenges to safe operations. If this is true of our aircraft today, it was certainly true of reconnaissance balloons in the First World War. The following excerpt is from a report* submitted by the 12th Balloon Company concerning a mission that occurred during the crucial Battle of St Mihiel on 12 September 1918. Across the decades, all airmen can share a sense of recognition — and also the realization that some days things just don't go right.

On 12 September 1918, 1Lts G.W. Hinman and R.S. Tait of the US Army Air Service went up on a balloon reconnaissance mission. With visibility zero, they were ordered down after only 15 minutes. Lieutenant Hinman described the remainder of the mission.

"The balloon swung in wide circles while being hauled down, barely missing the hills. The winch operator hauled the balloon down altogether too fast and made no effort to play the cable. The balloon swung out broadside to the wind, then suddenly shifted tail into the wind. This, combined with the hauling down by the winch, caused a nose dive of 50 or 75 meters and the balloon hit the ground, the cable laying over the winch. Some of the balloon crew ran for the rope. One man of the Basket Detail rushed at the basket, stepped on Lt Hinman's parachute rope, pulled the parachute out of the container, and received a tumble when the balloon rose.

"Lieutenant Hinman's parachute, opened by the upward rush of the balloon, was hanging below. Lieutenant Tait's parachute container was wedged in the basket suspension above the suspension bar with the cap pulled off and the parachute partly out. Lieutenant Hinman was pulled head and shoulders to the edge of the basket and was unable to move. The chest strap on his parachute harness slipped upward to his throat and the pull was strangling him.

"Lieutenant Tait, after cutting himself free from entangling telephone cords tried to relieve Lt Hinman but could not budge the parachute. Lieutenant Tait then valved sufficiently to check the rising of the balloon. This caused Lt Hinman's parachute to cease dragging, and it was pulled into the basket.

"The balloon, which was a Goodyear Type "R," rode perfectly normal most of the time broadside to the wind. Lieutenant Tait's parachute caused the basket to be tilted at an angle until some parachute ropes were cut. The height of the balloon when starting to descend was not known — the altimeter could not be found.

"Suddenly, shells began to whiz about, and flashes from guns were seen on the ground. This was the 7 o'clock barrage from the light artillery.

"It was impossible to land in such shell fire. Nearly everything of weight was thrown out in order to get out of that area. Maps and photographs were thrown out at this time. Four pair of glasses, one thermos bottle of coffee, one large round loaf of bread, one can of beans, one can of corned beef, the telephone, and swinging seat were thrown out. Then the balloon rose to a height of approximately 4,000 meters. The altimeter was found in a pocket of the basket with the ring pulled out. At this height, the bag was tight, the sun was shining brightly and was reflected by the great sea of clouds below.

"No aeroplanes were sighted anywhere. Lieutenant Tait feared antiaircraft fire and believed the balloon was fired at when a break in the clouds was reached. For this reason, he wished to land as soon as possible.

"Lieutenant Tait then valved the balloon, and rapid descent was made. The remainder of the articles in the basket, two pair of glasses, lunch basket, etc., were thrown out when near the ground to check the flight.

"Lieutenant Tait ripped the balloon half open when about 50 meters from the ground. He lost the rip-cord when striking the ground. The basket crashed hard, but hitting on one edge, absorbed the shock. Both lieutenants were thrown to the bottom of the basket. At this time, the nose of the balloon was straight up, and the flabby tail hung over the basket. The balloon bounced about 15 meters. The rip-cord swung into the basket, and both lieutenants grabbed it and ripped the balloon wide open. The second crash, harder than the first, came and then a third. The fourth crash tipped the basket over and both lieutenants rolled out.

"Lieutenant Tait neglected to cut his parachute rope and was dragged. Lieutenant Hinman had his left leg caught in the rigging and he, too, was dragged. The gas in the nose of the balloon above the rip-panel seemed just enough to cause it to keep bouncing. Very luckily the valve cord swung near Lt Hinman who was looking for something to grab hold of, and he was able to let most of the gas out of the nose of the balloon.

"A great pocket was formed by the wind just under the nose of the balloon, and the lieutenants were dragged over the ground in a lively fashion for 75 to 100 meters. Lieutenant Tait was dragged on his stomach, and Lt Hinman, hanging to the valve cord, rode on the trailing tail of the balloon.

"Due to the low clouds, no effort could be made to select a landing place, but luckily the landing was made in a clearing surrounded on three sides by woods."

Unfortunately, they were also surrounded by Germans, and both officers were taken prisoner. Some days are like that. ■

*Maurer Maurer, ed. *The U.S. Air Service in World War I*, Vol III, *The Battle of St. Mihiel* (Washington, D.C.; The Office of Air Force History, 1979), pp 240-1.

Formula For Success

LT COL JIMMIE D. MARTIN
Editor

■ How would you like to be the chief of safety for a command that flies 650,000 hours per year? Not too bad, you say? Wait; there's more. What if much of that flying was done in the critical and very demanding takeoff and landing phases? Also, one aircraft you're responsible for is one of the three fastest landing airplanes in the Air Force inventory, and most of the flying is done by student pilots, a good percentage of the time solo. Then consider that most of the instruction and supervision is done by instructor pilots on their first rated tour of duty.

Now what do you think of the idea? Do you still want the job? Does this sound like an ideal formula for safe flying or more like a command with a high mishap rate? The command I'm referring to is obviously the Air Training Command (ATC). All pilots and navigators get their first Air Force flying experience in ATC. For most of them, it's their first flying experience other than as an airline passenger.

In spite of these less than ideal situations, ATC has maintained an excellent safety record, especially over the last 4 years. In 1984, ATC was awarded the Foulois Trophy for the best flying safety record in the Air Force with a Class A mishap rate of 0.45. In 1985, they came close to getting the trophy again with a rate of 0.46. The trophy was awarded to the Tactical Air Command. However, ATC was awarded the Chief of Staff Special Achievement Award for 1985.

Obviously, such safety accomplishments don't come about by chance. On a recent visit to Randolph AFB, I asked Colonel Robert Wendrock, ATC Director of Safety, to give me the formula for this successful safety program. He said, "The key is commander involvement, beginning at the top." He explained that General Iosue, ATC Commander, is personally involved in safer flying operations. Wing commanders, DOs, and squadron commanders at all ATC bases are also actively involved in the command and base level safety programs.

You might think all these people as well as the base and headquarters safety staffs being involved might stifle operations, but that's not the case. I've heard it said at one time or another, "Don't let safety stick their nose in your business or you'll never get anything done." ATC definitely doesn't accept this idea.

All ATC safety people are mission oriented. Colonel Wendrock stressed the emphasis is on mission enhancement. "If safety doesn't enhance the mission, we're in the wrong business." Does this mean they close their eyes and let flight operations people do whatever they want? Not a chance.

ATC uses a process of risk assessment. As Colonel Wendrock put it, "From a pure safety standpoint, if you don't want mishaps, don't fly. While this simplistic solution would prevent crashes, the mission certainly wouldn't be accomplished. Our mission is to train young men and women to fly. There are some risks to doing business. Safety's job is to reduce the risks we can control to a minimum while still completing the mission." While it may be an idealistic goal to eliminate all mishaps, we all want to see them kept to the absolute minimum.

Risk assessment measures a task against the need to perform it versus the probability of a mishap. This assessment is primarily based on historical data. The tasks performed in training are based on needs specified by the user commands and on experience ATC has gained in training over the years.

Risk assessment gives the ATC commander the information he needs to make decisions. For example, this method was used to decide whether or not to replace the dual-visor flight helmet with the new lightweight single-visor helmet. There are many advantages to the new helmet, but one main safety concern was bird strikes that penetrate the cockpit.

To determine if the possible hazard outweighed the advantages of the new helmet, ATC reviewed recent bird strike history. They were specifically evaluating the history of windscreen bird strikes under lighting conditions such that the visor would be up. The result could be serious injury or loss of an aircraft. The study showed the risk was so small the advantages far outweighed the risk.

Several years ago, General Iosue tasked his safety staff to try to determine when and where the next mishap in the command would happen. This led to the development of the mishap vulnerability program. This is a means of forecasting periods of increased mishap vulnerability for the command. Many factors

The wing headquarters building, nicknamed the Taj Mahal, is a familiar landmark at Randolph AFB. This historic base, sometimes called the West Point of the air, is a fitting home for Headquarters, Air Training Command.

enter into the computations. Some of them are programmed flying time, instructor pilot manning, student pilot load, available hours of daylight, number of turns per day, and simulator/flying hour mix.

ATC uses the data for each base in the command to arrive at a mishap vulnerability period for each base. This is a period of time during which a particular base is most vulnerable to experiencing a mishap. A base may have more than one mishap vulnerability period during a year. If so, all are identified. This helps both headquarters safety and the individual bases to better tailor their mishap prevention efforts to the greatest hazards. The program has been very successful for the command.

January is historically the month with the highest mishap rate for ATC. This may be in part due to the traditional two-week standdown during Christmas which causes a loss in proficiency. To combat this problem, all flying squadron operations officers met at ATC headquarters in December to discuss the problem and arrive at solutions. One of the solutions was to start off the new year with IP proficiency flights to ensure the IPs are all at their peak. Also, some bases required their inexperienced IPs to fly the least demanding type of student training flights immediately after returning from vacation. The complexity of the flights was gradually increased. This resulted in both safer and more effective training.

Colonel Wendrock makes sure the headquarters safety officers keep in touch with reality. He insists they get out of the "ivory tower" and visit all the flying units. "They need to remember how it was to be a line IP, what motivates them, and the intensity of the operation they work in." Colonel Wendrock also visits and flies with each wing.

The number one problem expressed by the line IP is fatigue. One action ATC safety has taken in response to this complaint is to reduce the number of mandatory safety meetings from one per month to one every 2 months. This

continued

Three different paint schemes are being evaluated on the T-38. The purpose is to make the white T-38 easier to see in flight and decrease repainting necessitated by exhaust residue, oil stains, etc. One of the apparently identical T-38s above is painted dark blue and white while the other is black and white.

Formula For Success continued

isn't a major reduction in the workload, but it does show safety is mission oriented and open to change. They decided this could be done without any safety degradation because each flying day is started with a short safety briefing on current concerns and hazards. They also insisted that the flight safety officers (FSOs) at each base make the bimonthly safety meetings interesting and pertinent. There are no "square filling" safety meetings.

The wing FSOs fly regularly. This helps share the load as well as making sure the FSOs are intimately familiar with the day-to-day situations. They also make regular visits to the Runway Supervisory Unit, participate in night operations, and look in on such things as the early morning maintenance activities. The FSOs are truly knowedgeable of the flying operations and concerns at their base.

An important and very visible part of the ATC safety program is the ATC Road Show. This program started in 1984 with the goal of increasing safety awareness on the part of all fliers. The subject of this road show was air discipline. It focused on three main points: (1) Undergraduate Pilot Training (UPT) is the first experience for every pilot in the Air Force, (2) a person's first experience is the one that stays with them, and (3) the ATC IP can influence future mishaps, both positively and negatively. The road show visited all the ATC bases.

The 1985 road show was titled, "Enemy in The Mirror." The show emphasized that the majority of the mishaps in the Air Force are operator caused or influenced. The operator is his own worst enemy! This multimedia approach used a strong emotional appeal and fastpaced action to keep people's interest up. The 30-minute briefing was given at all ATC bases, several Navy units, and the worldwide safety conference. Between January and November of 1985, Major Roger Cude and Captain Don Hall of ATC safety gave the briefing 71 times to approximately 5,000 people.

The briefing was timed for the start of each base's mishap vulnerability period. Although we can't exactly measure the influence this briefing had on their flying personnel, we know ATC once again had an excellent flying safety record. The 1985 road show was so well done that Major Cude and Captain Hall received the Director of Aerospace Safety Special Achievement Award for 1985.

The award winning 1985 road show included Chuck Nash, a fictional safety officer from the 60s with a comparison of then and now and some good advice for today's pilots. Major Cude compared inadequate rest, nutrition, and preflight preparation to playing Russian roulette. You never know when the gun will go off.

The 1986 road show is called "Back to the Future" and has three areas of emphasis: Operator errors, instrument-related mishaps, and G-induced loss of consciousness. Once again, the ATC safety staff has developed a quality program that really brings the current concerns to the attention of those who can solve them — the fliers.

Another tool used by ATC safety to get the message out is a one-page letter entitled "A View From the Top." This letter is written by a different wing commander or center commander each month and is a safety message from someone who does not carry a "safety" label. It is just one more way of showing safety is everyone's concern.

What does the future hold for ATC? Many challenges and changes are coming. Both trainer aircraft are old and will eventually have to be replaced. ATC is looking at a specialized pilot training program, and a specialized navigator training program is coming. Through it all, Colonel Wendrock says ATC will still have inexperienced instructors. The "first assignment instructor pilots" have excellent flying and instructional skills, but no operational experience to fall back on. Thus, they are less able to explain the "why" of things such as tactical formation. Still, they do an excellent job handling the numerous critical situations which frequently arise in the UPT business. "They are the real reason ATC's mishap rates are so low."

Colonel Wendrock was very confident in his prediction for the future. He said ATC will continue its excellent performance. "Our fairly straight-line chain of command allows us to have the personal touch and involvement on all levels." He said safety has become an ingrained attitude throughout the command. Safety is an integral part of operations. That is the formula for continued success. ■

Abort and Forget

CMSGT AUGIE HARTUNG
Technical Editor
Maintenance Magazine

■ A low-level intercept mission ended in disaster for this F-4. While maneuvering his aircraft for the second intercept, the pilot felt the aircraft pitch down, then up, uncommanded. He suddenly observed two fire lights and numerous warning lights illuminate on the telelight panel, and his wingman advised him he was on fire. With fumes now in the cockpit, the pilot and weapon systems officer successfully bailed out of the disabled F-4, but the aircraft was destroyed.

This is not a mishap that could have been prevented by more training or more experience. This is the story of a mishap that might have been prevented by proper forms documentation.

It all started on the day before the mishap. The aircraft had ground aborted when the end-of-runway (EOR) crew chief noted an "unusual" noise in the right auxiliary air door. The crew checked the circuit breakers and found the right oil pressure circuit breaker popped and the right oil pressure frozen. The crew shut the right engine down and returned to their parking spot, but did not document the 781A with the abort discrepancy.

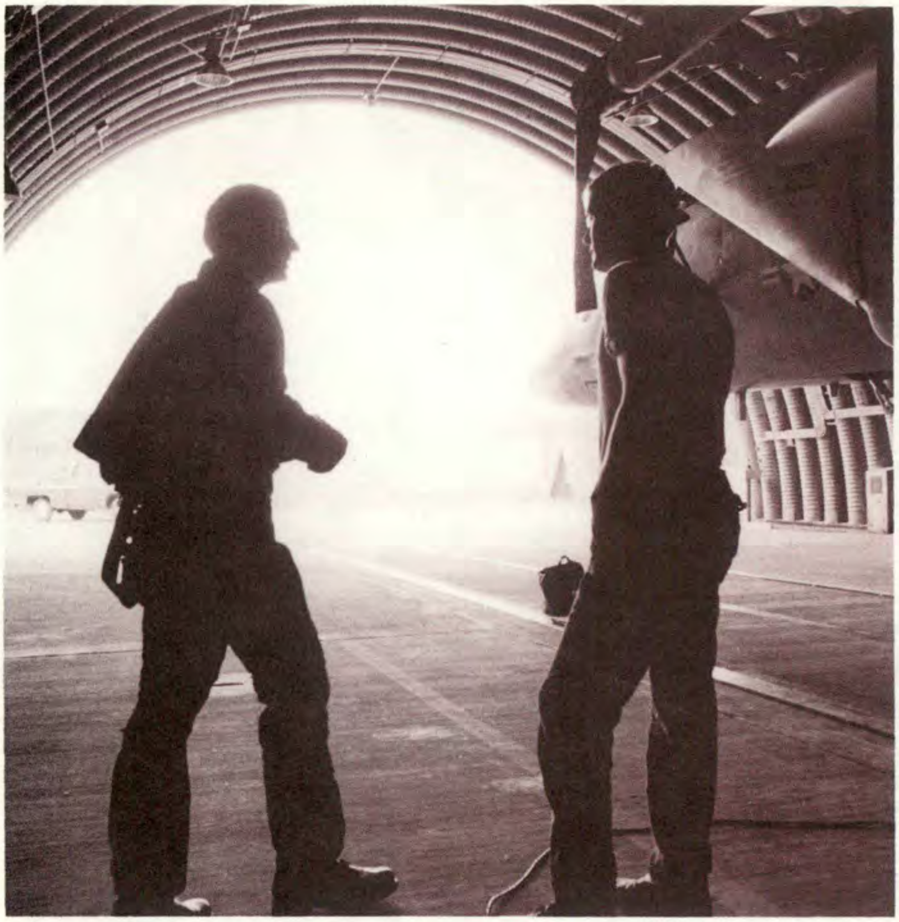
Instead, they *verbally* debriefed the maintenance expeditor about the engine noise and circuit breaker, then proceeded to their spare after being told by the expeditor that "he would complete the forms." The expeditor chose only to annotate the popped circuit breaker. In addition to the crew debriefing the expeditor, the EOR crew chief discussed the noise with the expeditor prior to the aircraft being worked for the circuit breaker problem. Since the expeditor attributed the noise to a "cold engine," an engine specialist was not specifically assigned to listen for the noise when the engine was run to ops check the oil pressure circuit breaker. The aerial port group (APG) personnel who ran the engine heard that EOR had reported a noise, listened for it, but heard none.

On the day of the mishap, the aircraft passed through a different EOR crew chief who had to secure a hanging oil cap in the right auxiliary air door. Possibly because his attention was channelized on the oil cap task, the EOR crew chief heard no noise.

What did the mishap investigators find at the crash site? The aft anti-ice duct had failed (from a fatigue crack) sufficiently to provide a source of heat to begin the fire sequence. The fire was fueled in this same area by an oil pressure transmitter vent line which was burned through by the 825-degree bleed air from the failed aft anti-ice duct. The fire then spread to a fuel line, into the engine bays, and up into a fuel cell.

While it cannot be positively determined the noise heard the day prior to the mishap was the failing duct, lack of proper emphasis to duplicate the conditions with dedicated engine specialist support allowed a potential opportunity to prevent the mishap to pass.

This type of mishap has occurred often enough to warrant its being called to the attention of everyone responsible for making proper 781 forms entries. Ideally, you would never have to abort an aircraft. But if you should, be sure you take the time to properly document the 781A. That way, there should be no misunderstanding of "what the pilot meant." ■



Why

Thumbing through one of the back issues (April 1981) of *TAC Attack*, we came across this "Why Do I Do It?" letter from a maintenance technician, SSgt Stephen M. Moriset, 479th Component Repair Squadron. Although we don't know where Sergeant Moriset is today, we're reprinting his letter because we think both aircraft "operators" and "maintainers" can still appreciate what the author is telling us.

■ Several months ago, I was working on the flightline when I noticed a young lieutenant walking past me, probably towards debrief.

It seemed to be especially hot that day. A few minutes earlier, I had wiped the sweat off my forehead with my hands before I remembered the grease and soot that was all over them. This, of course, left a black smudge on my forehead that had now started to run down my cheeks with a fresh crop of sweat. I'm sure I must have presented quite a sight to the pilot who was proudly wearing his highly shined boots and bright squadron ascot.

The pilot stopped and, in a friendly way, peered into the panel I had removed from the side of the aircraft I was working on. He looked around and gave an approving nod. Then he stretched a bit and squatted down.

It was plain to see that he had something he wanted to say, and I did my best to divide my attention between our casual conversation and the work I was doing.

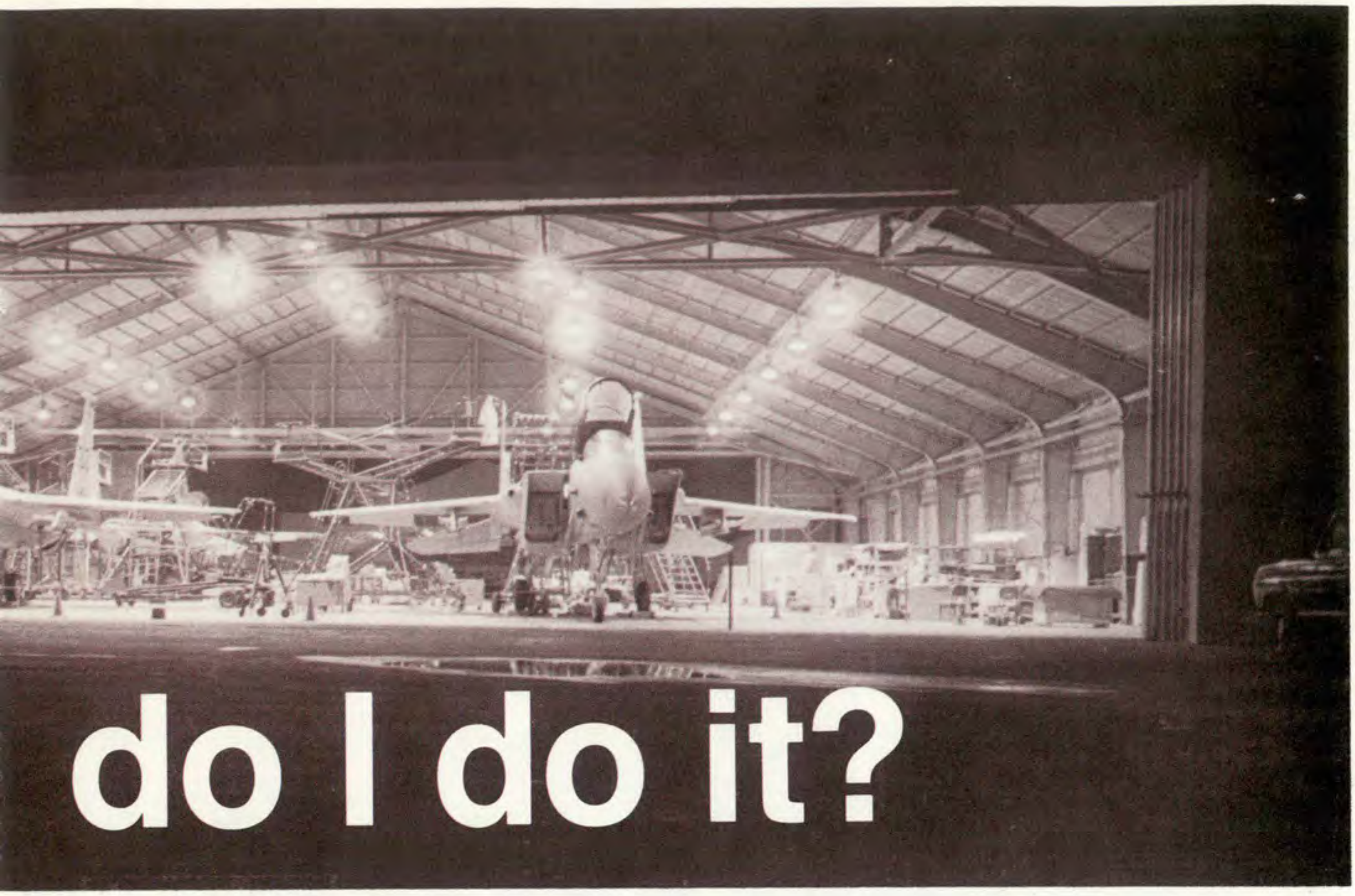
We discussed the weather and the squadron party that was coming up the following weekend. Then he said, "Sarge, can I ask you a question?"

"Sure sir. What is it?" I asked as I began to put my component back into the aircraft.

"Why do you folks do it? What is it that keeps you in the service? Why do you stand out here in the heat or snow or rain or whatever to fix these airplanes at all times of the day and night?" he asked.

I wasn't really sure how to answer his question. As it worked out, that was OK because the shuttle truck came, and the lieutenant jumped up, quickly gathered his helmet and flight case and hustled toward the truck. He poked his head out of the open back doors and hollered, "Sorry, Sarge! Next time."

We watched each other as the truck drove away, until the heat ris-



do I do it?

ing from the ramp caused us to disappear from each other's view.

I thought about the lieutenant and his questions all that night and much of the next day. I finally had formulated an answer to his honest questions and was set for our next unscheduled meeting. I never saw him again. I found out he had been transferred overseas. The following is the answer I think I would have given him, had we ever met again.

I know that I'll never "slip the surly bonds of earth," but I can fix your "laughter silvered wings." I know I'll never strap a fighter on my back or travel those "footless halls of air." But when I walk down the flightline, you come to me to see if you can do those hundreds of things I've never dreamed of. I'll never "soar where neither lark nor eagle dare," but my spirit is with you on each of your flights.

When I go home in the morning and go to bed, when most people are getting up, I sleep well. Screaming children, chatting people, doorbells, and street sweepers do not disturb me in my well-earned rest. However, the distant roar of your engines will wake me from my deepest sleep.

A sure and certain smile comes across my face as I hear and feel your engines push your aircraft skyward. I know that I've done my part, and now it's time for you to do yours. As the sounds of your engine are replaced by the sounds of garbage trucks and school buses, I drift back to sleep; and I dream of the things that you must be doing, not in an envious way, but almost as a flying mechanic.

When you raise the gear handle, you feel a slight change in control pressures; but, in my mind's eye and ear, I see squat switches close and uplocks move; I hear the pumps wind to a halt as the limit switches are engaged. A checklist is run in my sleep and I monitor each gear, cam, seal, and limiter that is tucked away under those panels now securely fastened down.

I've read that you imagine you become a part of your aircraft; that man and machine become one; that your airplane practically reads your mind and seems to react almost before your gloved hand moves the controls. You imagine that steel, aluminum titanium, and plastic become muscle, bone, nerve, and sinew.

If you can feel the pulse of your aircraft by placing your feet on the rudder pedals, then I'm the surgeon that replaces the cables, valves, motors, and bell cranks that are the imagined strength that moves your living rudder. I'm the specialist that has serviced, topped off, drained, filtered, purged, and pressurized the fluids that you imagine to be the life-blood of your friend. I've tweaked and peaked, tightened, torqued and tuned, milked and measured, routed and rerouted, fitted, fixed, filed, beat, bent, banged,

continued

Fliers aren't the only ones with feelings about *their* aircraft. The men and women who keep the planes flying have definite feelings about *their* aircraft, too.

and bucked each vital part of metal and plastic on your companion.

Sir, I am not belittling you for the things you feel about your airplane, because I feel things about it, too. Most of the time I feel less than happy about the location of a certain part, and I'll call it a "bucket of bolts" or holler at it when it comes home broken and it's my anniversary. I'll gripe and groan and tell it that it's just so many thousands of rivets flying in close formation.

There are, however, those other feelings that can't be explained as you watch a sunset reflected on its polished aluminum skin. I've sat on a tool box and watched the moon rise, twisted and distorted, through its canopy.

There is also a satisfaction I get as I work on or service a part on the airplane you'll never see. Perhaps it's a rivet high on the tail, or a clamp somewhere under your seat or a rib or stringer, a screw or bracket, in places you didn't even know existed. I've seen cables and wires, pressure seals and lines, bulkheads and formers, all painted zinc chromate green. And there are torque tubes and fuses, exciters, relays, bladders, and drybays. I know where each one goes, what it does, and what will happen if it doesn't do what it is advertised to do.

It's hard for me to imagine that you think of this airplane as being yours when I think of the blood I've left in the engine bay and the skin off my knuckles up in the wheel well. I remember the rib I cracked when I hit the pitot tube the wet morning I fell off of *your* airplane.

My utilities are stained and worn, but they are comfortable. Can you say the same about your flying gear jammed full of maps, charts, clipboards, and a plastic spoon? My underwear may be stained pink from the hydraulic fluid they've soaked up, but I'm cool. Can you say the same about your long-handle, nomex, fire resistant underwear? My hat only weighs a couple of ounces, and it doesn't cause hot spots on my scalp like your helmet. I'm not the one who has to wear an oxygen mask that causes the face to itch and sweat.

As an aircraft mechanic, I don't have to worry about being ejected or passed over or birdstruck or midaired. If I get punched out, all I have to worry about is a loose tooth, and the last time I was grounded was when I was 12 years old.

I am happy turning wrenches in our Air Force. I am grateful to be an American and proud to wear the US Air Force blue. You see, sir, I know that in other parts of the world there are enlisted and officers who wear a different uniform than we do, and they work on aircraft that have markings different than ours. Their views on right and wrong, and God and family, are also different than ours. If my having to stand out in the snow once in a while helps to ensure that those men and their aircraft pose no threat to me or my way of life, I will do it gladly.

I know that our airplanes will never be used to start a fight. They are a deterrent force that guards a great way of life. Our country doesn't really ask that much of you and me in exchange for the life we so often take for granted.

So, sir, I promise that if you'll keep flying 'em, I'll keep fixing 'em. ■

The Best Kind of News

GIL DOMINGUEZ
San Antonio ALC Materiel Management
Kelly AFB, TX

■ The successful ejection of both crewmembers before the recent crash of an Air National Guard F-4 assigned to the 149th Tactical Fighter Group at Kelly AFB, Texas, was a matter of special interest to Curtis Allred.

He is neither a friend nor relative of the surviving crewmembers. Rather, he's the equipment specialist for the F-4 ejection seat, and as such, may have contributed to the safe recovery of the two men.

Mr. Allred has managed the ejection seat for the F-4 fighter for the past 4 years from his position in the Life Support Branch of San Antonio Air Logistics Center's Directorate of Materiel Management at Kelly AFB. He maintains the technical order for the Martin-Baker seat and is responsible for its repair, overhaul, and assembly.

"It's one of the greatest feelings there is to know that a crewmember has ejected safely," Mr. Allred said. "We hate to lose aircraft, of course, but we're always glad to see people get out. That's the 'name of the game' around here."

The Martin-Baker ejection seat is a product of the British firm that pioneered the egress system, according to Mr. Allred. The rockets under the seat produce 1,500 pounds of thrust, enough to propel a crewmember 150 feet into the airstream and above the tail of the aircraft. A time-release mechanism activates the parachute during high altitude ejections.

Although Mr. Allred was not involved in the investigation of the Air National Guard aircraft, he does investigate F-4 mishaps whenever there is an injury to a crewmember, or a suspected equipment problem.

"I try to backtrack from what was known to have happened to see what didn't happen," he said about his investigating technique.

"I look at the ejection equipment to see if it was functioning properly. But sometimes that's hard to determine if the equipment was badly damaged."

Mr. Allred's usual procedure is to follow each step of the ejection sequence to see what worked or what didn't work. He does not leave a project until he is satisfied with his conclusions.

But Mr. Allred said that the best part of his job is when his organization receives notification about a successful ejection.

"It's the greatest feeling in the world to know that your equipment helped someone get out of trouble," he said. ■

When activated, the rockets under the F-4 ejection seat produce 1,500 pounds of thrust, enough to propel a crewmember 150 feet into the airstream and above the tail of the aircraft.

OPS TOPICS

Tight Turns

■ A C-141 pilot on landing roll was asked by the tower if he could turn off at the next to last taxiway. At the time of the request, the nose of the aircraft was slightly past the taxiway. The crew knew the turn would be tight but felt they could complete it safely.

However, part way through the turn, they began to have doubts. The pilot stopped the aircraft and deplaned scanners. The scanners told the pilot it would be close, but could be done if he kept the turn tight. The pilot applied power, and as the aircraft started to move, nosewheel steering was lost, and the aircraft began to slide. After the aircraft stopped, the engines were shut down, and it was towed to parking.

The nosewheel steering failed due to sheared rivets overstressed by the tight turn. This has been a recurring problem in the C-141, and crewmembers need to take it into account. In this case, an attempt to speed things up for the tower resulted in delays and unnecessary maintenance. Sometimes the best answer to a request is, "Sorry, I can't do it."

Be On Guard

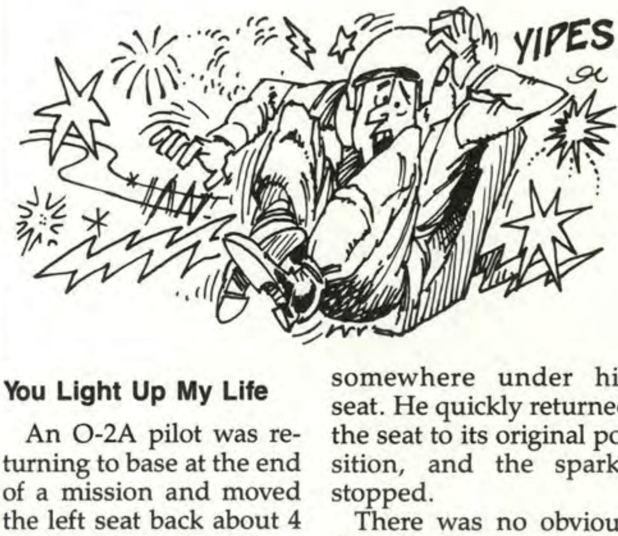
A fighter aircraft was being flown on a single-ship functional check flight (FCF) profile. Just after the pilot initiated an afterburner (AB) climb, the SOF noticed a flame approximately twice the length of the aircraft coming out of the nozzle section. Both the SOF and the tower controller called the pilot on guard frequency to tell him about the flames, but were unable to make contact. The SOF had to get ATC to contact the pilot.

By the time ATC was able to tell the pilot to contact the SOF, he had already leveled off at 15,000 feet, completed the 15,000 feet engine checks, and started the BUC check. When he called in, the SOF told him about the probable AB/nozzle fire.

The pilot immediately returned for an uneventful, precautionary SFO landing. Maintenance inspection revealed a serious nozzle burnthrough. Damage to the engine and adjacent aircraft structure was more than $19,000.

Why wasn't the pilot monitoring guard frequency? The SOF noticed the problem right away but couldn't get word to the pilot. If the pilot had been on guard, he could have terminated AB operation right away and limited the damage. He also would have significantly reduced the chances of losing the aircraft completely. It was only luck that he terminated AB before the damage got out of control.

Guard frequency is for emergencies, but it won't do you any good if you don't monitor the channel. Be on guard.



You Light Up My Life

An O-2A pilot was returning to base at the end of a mission and moved the left seat back about 4 inches. When he did so, he noticed a shower of sparks coming from somewhere under his seat. He quickly returned the seat to its original position, and the sparks stopped.

There was no obvious damage. A check of aircraft systems found everything operating normally.

The only problem noted was static on the radio while the sparks were visible. The pilot declared an emergency and returned for a full-stop landing.

Investigation revealed that four improper sheet metal screws had been used to secure the fire extinguisher bracket to the cockpit floor wire bundle cover. One screw point had penetrated the wire bundle and contacted the battery cable. When the pilot moved his seat back, the seat belt bracket contacted the fire extinguisher, and arcing between them occurred.

The moral of this story is obvious, but I'll say it anyway. Check the TOs and use the right parts. — Ed.

Those Damp Runways

An F-4E pilot had just completed a normal landing on a damp runway. When the pilot engaged nosewheel steering to turn off the runway at the end, the nosewheel went hard left. The Phantom immediately spun left through 180 degrees of turn and departed the taxiway backwards. The pilot selected emergency braking, but was unable to stop on the paved surface.

Be aware that the concrete portions at each end of a runway become very slick when damp because of the rubber deposits. Traction on damp asphalt is the same as dry, but the last 1,000 feet of concrete may have very poor traction. Take it easy.

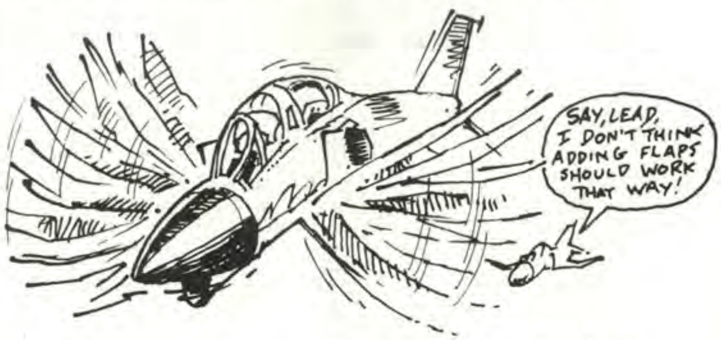
The Drifter

The pilot of a KC-135A was cleared for takeoff for a normal training sortie. The IP turned on the water switch and checked the "water low pressure" lights out. The student pilot advanced the throttles to reduce thrust takeoff EPR of 2.54 and relinquished the throttles to the IP for fine tuning the engines. As the IP was trying to adjust the throttle to correct a slightly high EPR on the No. 4 engine, he saw the EPR on that engine suddenly increase above TRT wet. He called for an abort at 80 knots and reduced all throttles to idle.

The aircraft began to veer to the left of the centerline, and the student pilot was unable to correct the drift with differential braking and nosewheel steering. As the left main gear departed the paved surface, the IP advanced the No. 1 engine to MRT, and the aircraft started paralleling the centerline on the far left side of the runway.

The IP then checked the engine instruments and found the No. 4 EPR was 3.00 and the RPM was 100 percent with the throttle in idle. He shut down the engine and completed the abort. The exact cause of the mishap couldn't be determined.

The lesson is to check your instruments to confirm what you want to happen is really happening. Whether it's advancing power for takeoff or reducing it to stop or any number of other actions.



Phantom Flaps

Immediately after the gear and flaps had been raised during an F-4C formation takeoff, the lead WSO noticed a barber pole indication on the trailing edge flaps. The leading edge flaps indicated up. A visual inspection by the wingman found the leading edge flaps were still down and trailing edge flaps were up.

Since the flap positions were contrary to the cockpit indications, the crew suspected a possible boundary layer control (BLC) malfunction. The BLC light had not come on, but the crew immediately began slowing the aircraft down. As the aircraft decelerated, the leading edge flaps slowly retracted.

After reaching gear and flap extension speed, the crew lowered the gear and flap handles, but the flaps didn't lower because the flaps circuit breaker had popped. The pilot reset the circuit breaker, and the flaps lowered normally. After an uneventful landing, the crew shut down the engines after clearing the runway and egressed normally.

Maintenance found the left outer wing BLC inboard duct had failed and a 10-inch section was missing except for small metal fragments. A wire bundle near the failed duct had been damaged by the heat and caused the unusual flap operation and indications. There was also slight paint and sealant damage to the lower outer wing surface.

Quick analysis and prompt action by this crew prevented a serious mishap. F-4 crews should keep possible BLC malfunctions in mind when analyzing flap problems even though the BLC warning lights may not be on. ■

MAJOR
Larry G. Brooks

SENIOR MASTER SERGEANT
Paul N. LeClair

MAJOR
John H. Schramm

305th Aerospace Rescue & Recovery Squadron
Selfridge ANG Base, Michigan

■ On 8 October 1985, Major (then Captain) Schramm was flying an ILS approach at Selfridge ANG Base during a local training mission in an HH-3E. Passing the outer marker, a high frequency vibration suddenly shook the helicopter. Major Brooks, Copilot, although flight-examiner qualified, saw the No. 1 power turbine speed was at zero and the rotorspeed rapidly rising. Major Brooks immediately asked for the flight controls, and Major Schramm, completely trusting Major Brooks' greater experience level in the HH-3E, willingly relinquished the controls to him. The rotorspeed was brought under control, and Major Brooks spotted a clearing ahead and to the left in the densely populated area. The bold face for an engine failure was initiated. Before the second step could be called out, the No. 1 engine catastrophically exploded, engulfing the forward cabin and cockpit with flames and thick smoke. Cockpit visibility completely vanished — the crew could not see out, they could not see the instruments, nor could they see each other!

Sergeant LeClair, Flight Engineer, now had a sustained fireball burning at his back as he sat in the jump seat, and was thus unable to go aft and open the crew door to eliminate the smoke. Despite severe burns on 40 percent of his body, Sergeant LeClair opened the pilot's window before succumbing to the burns and severe smoke inhalation. Flames were immediately sucked into the cockpit, burning the pilot's neck. Major Schramm quickly closed the window. While Sergeant LeClair was struggling to get relief from the intense heat and smoke, Major Brooks made a slight turn to the left toward the now unseen clearing and began a positive descent. At this point, Sergeant LeClair collapsed over the pilot's collective stick, forcing it all the way down. Major Brooks, unable to see Sergeant LeClair, analyzed this downward force as an auxiliary servo hardover and turned off the auxiliary hydraulics. At the same time, Major Schramm sensed the sudden drop and instinctively reached for the collective. Feeling Sergeant LeClair's limp body draped over the collective, Major Schramm pushed him up and back off of it, thus giving Major Brooks complete control of the collective again. Major Brooks, realizing he would probably be rendered unconscious if he inhaled the acrid smoke, did the only thing possible at this point. He opened his cockpit window. As soon as this happened, the flames rushed into the cockpit and across his face. He quickly closed the window, but was able to get one good breath through a clearing in the smoke. Opening the window created a small airpocket at Major Brooks' feet through which he could catch glimpses of the ground through the chin bubble. Relying solely on his flying instincts, Major Brooks continued the descent in the general direction of the clearing. Still just catching glimpses of the ground through the chin bubble, Major Brooks skillfully completed the single engine approach to a soft landing in what proved to be the only suitable site in the heavily populated area.

Major Schramm egressed through his window, landing on his feet. He ran forward out of the smoke and regained his breath. Major Brooks dived out his window, breaking his left wrist and severely bruising his left hip. He, too, then ran forward out of the smoke. Ignoring their own injuries, they immediately risked even further injury and went back to the crippled aircraft and pulled Sergeant LeClair to safety. Their quick reactions and crew discipline resulted in limiting aircraft damage to only that caused by the explosion and fire. Property damage was limited to mere shallow tire ruts in the ground. More importantly, they minimized their own injuries and undoubtedly prevented the loss of life to the civilian population. WELL DONE! ■

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UNITED STATES AIR FORCE

Well Done Award

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

CAPTAIN

Gregory J. Dunn

549th Tactical Air Support Training Squadron
Patrick Air Force Base, Florida

■ On 9 August 1985, Captain Dunn was flying an O-2 aircraft on an operational check flight following corrosion control work performed on the aircraft elevator. After a one-hour flight in the local area, he entered the overhead traffic pattern at Patrick AFB. The pattern was uneventful until the aircraft rolled out on final, 300 feet above the Atlantic waters bordering the runway complex. At this time, Captain Dunn attempted to raise the nose of the aircraft to establish the proper landing attitude, but found the pitch controls jammed and immovable. With the aircraft rapidly descending towards the shore area located just short of the runway overrun, and without ejection capability in the O-2, Captain Dunn recognized he had little time to resolve the problem. By this time only feet above the water, he pulled back on the flight controls with all of his strength and was able to reposition the jammed elevator to a nose-high attitude. As the aircraft climbed away from the water, he accurately determined the only way to control the aircraft's pitch was to use brute force to overpower the elevator jam. Captain Dunn correctly decided to attempt a landing since he was still lined up with Patrick's 9,000-foot runway. Carefully manipulating the extremely limited elevator control available, he established a satisfactory landing attitude, controlled his descent with selective power applications, and landed the aircraft safely and undamaged. Maintenance later found the elevator counterweight had become loose in flight. Located inside the right vertical fin, the counterweight shifted and jammed the aircraft's elevator controls. Captain Dunn's skillful flying and quick reaction to a critical situation prevented the loss of a valuable aircraft and probable injury to himself. WELL DONE! ■

THE ENEMY

I am more powerful than the combined armies of the world. I have destroyed more men than all the wars of all nations. I massacre thousands of people every year. I am more deadly than bullets, and I have wrecked more homes than the mightiest guns.

In the United States alone, I steal over 500 million dollars each year. I spare no one, and I find my victims among the rich and poor alike, the young and old, the strong and weak. Widows know me to their everlasting sorrow. I loom up in such proportions that I cast my shadow over every field of labor.

I lurk in unseen places and do most of my work silently. You are warned against me, yet, you heed me not. I am relentless, merciless, and cruel. I am everywhere — the home, the streets, on land, in the air and on the sea.

I bring sickness, degradation, and death; yet few seek me out to destroy me. I crush, maim, and will give you nothing and rob you of all you have.

I am your worst enemy — I am CARELESSNESS.

Author Unknown