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21

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MESSAGE From the Chief of Safety

Farewell from the Chief of Safety

My tenure as the Air Force Chief of Safety has been one of the most rewarding of my career. Clearly, visits to bases worldwide and meeting with the safety professionals in flight, ground and weapons has been the highlight. I applaud your efforts as we try to minimize mishaps and protect our most important resource—the men and women of our Air Force.

We've made great strides in the Safety Center in every area. Obtaining near-term and POM funding for ASHS, SAS and AHAS will ensure that these systems are continuously available to the field as we do business in each area. Additionally, we've made great progress in making Distance Learning a reality, reaching as many as 1700 people world-wide in one broadcast, and also have significantly improved our Safety Education courses. We are also working hard to expand our efforts in Systems Safety, Flight Operations Quality Assurance (FOQA), Human Factors (HF) and Directed Energy Weapons (DEW) areas. Lastly, our initiative to make AFSC AOs available to be mishap investigating officers, to provide a limited number of SIB-trained recorders and computer support, is succeeding and thereby relieving operational units of the previous SIB taskings.

I sincerely appreciate all the feedback from the field—both positive and negative. Without your inputs we cannot improve our support to you in the field. The AFSC team is first class, and they're ready to help you in any way possible. Thanks for your support and keep up the superb work! Be safe—on and off duty! ★★

Water On The Runway: The Other Thunderstorm Hazard

Photo Illustration by Dan Harman

When flight 1420 came to a stop, it was in three pieces, one of which was on fire.

COL TIMOTHY MINER, AFRC
Reserve Assistant to the Director of AF Weather

As aviators, we learn in our basic aviation meteorology that thunderstorms produce significant hazards that could seriously jeopardize the safety of flying. But as one commercial aircraft demonstrated in 1999, water recently deposited on the runway by thunderstorms can significantly impact aviation as well.

AFH 11-203, *Weather for Aircrews*, lists a thunderstorm's typical hazards to aviation. These hazards are very well known—turbulence, cumulus clouds, gusting winds, gust front, roll clouds, icing, hail, lightning, electrostatic discharge, tornadoes and altimetry errors. But there is one hazard not mentioned in the handbook that also impacts aviation. This is the rapid accumulation of rain water on the surface of the runway, a condition which significantly decreases the ability of the aircraft to stop. Unfortunately, one fatal commercial aviation accident showed the worst of this hazard.

On June 1, 1999, American Airlines Flight 1420 attempted a landing at Little Rock Airport after a thunderstorm-delayed departure from Dallas-Ft. Worth International Airport. Just before and during the landing, thunderstorms dropped rain on the runway surface. The pilot successfully overcame many of the thunderstorm hazards mentioned above to touch down in the first third of the over 7000-foot runway. Unfortunately, when flight 1420 came to a stop, it was 12 feet from the edge of the Arkansas River—in three pieces, one of which was on fire.

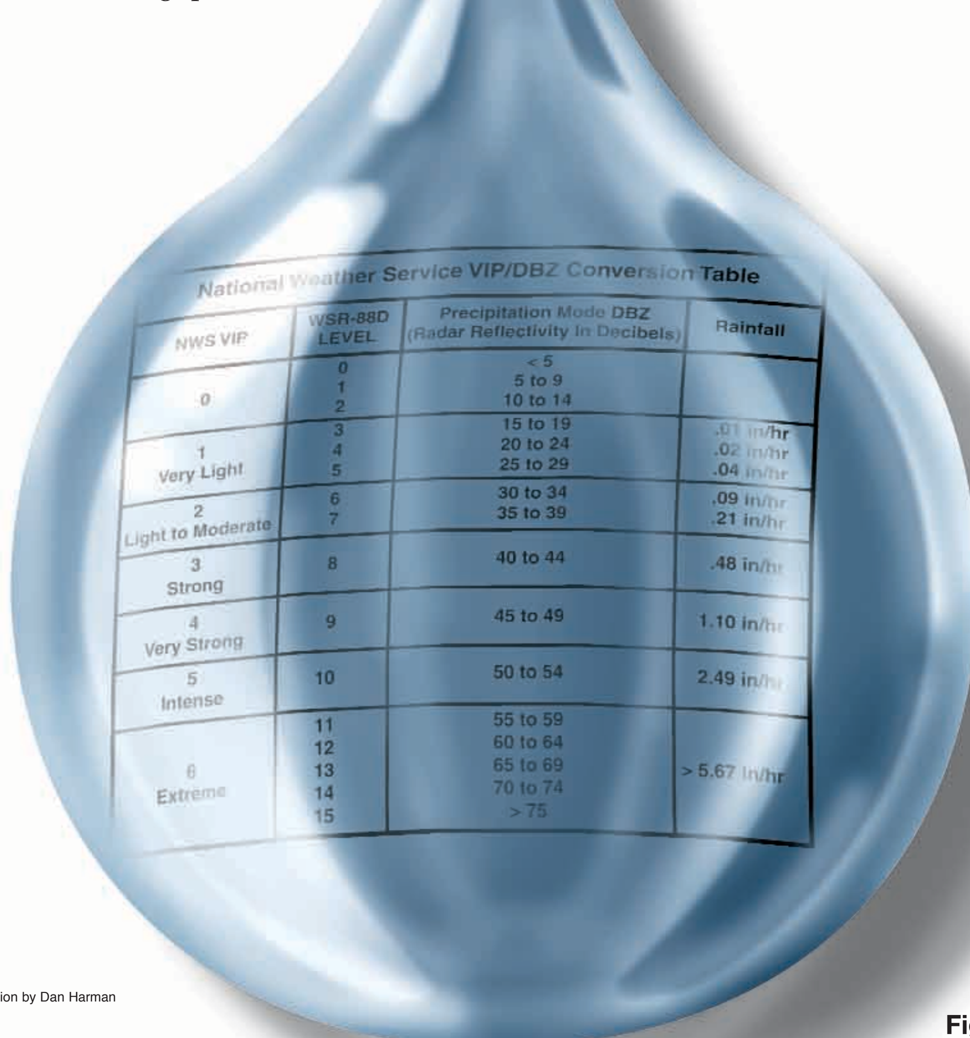
The National Transportation Safety Board (NTSB) found several major contributors to the accident after an exhaustive two-and-a-half year study. Among the factors were fatigue, an instructor/new hire relationship in the cockpit, and failure of the spoilers to deploy. Also mentioned was the significant weather impacting the airport at the time of the landing.

ATC transcripts from the KLIT tower highlight the weather which was taking place during the landing phase (see "Weather Clues" for the pertinent portions from the pilot/ATC tower interactions). As 1420 was on final approach, ATC described many clues that the weather was hazardous. Hazards at the airport that night were gusting winds, strong crosswind, reduced visibilities during rain, thunderstorms and lightning. What was missing was a specific runway condition report. However, there were enough clues to indicate that the runway would be very wet.

Thunderstorms produce very large amounts of rainfall in a very short time. Figure 1 shows the rainfall rate in inches per hour from different levels of thunderstorms (this was the chart used by NTSB for the AA 1420 mishap).

The figure actually uses conservative numbers for the rate of rainfall from the different levels of thunderstorms. FAA and Air Force pilot training manuals, based on National Weather Service material, reflect Figure 1's rates for stratiform rain (from a warm front). This same material says that convective (from a thunderstorm) rainfall rates of over 5.5 inches per hour occur in VIP (Video Integrator and Processor) level 5 thunderstorms and over 7.5 inches per hour in VIP level 6 storms.

There was a significant amount of water on the runway during 1420's landing. During that time, a VIP level 3-4 thunderstorm had just passed over the



National Weather Service VIP/DBZ Conversion Table

NWS VIP	WSR-88D LEVEL	Precipitation Mode DBZ (Radar Reflectivity In Decibels)	Rainfall
0	0	< 5	
	1	5 to 9	
	2	10 to 14	
1 Very Light	3	15 to 19	.01 in/hr
	4	20 to 24	.02 in/hr
	5	25 to 29	.04 in/hr
2 Light to Moderate	6	30 to 34	.09 in/hr
	7	35 to 39	.21 in/hr
3 Strong	8	40 to 44	.48 in/hr
4 Very Strong	9	45 to 49	1.10 in/hr
5 Intense	10	50 to 54	2.49 in/hr
6 Extreme	11	55 to 59	> 5.67 in/hr
	12	60 to 64	
	13	65 to 69	
	14	70 to 74	
	15	> 75	

Illustration by Dan Harman

Figure 1

There were enough clues to indicate that the runway would be very wet.

airport, and a VIP level 6 thunderstorm was bearing down. The automated weather observing system (ASOS) recorded rainfall total amounts of about .25 inches in the last five minutes before the accident. While that quarter-inch of rainfall in five minutes doesn't sound like a lot of water, it produced a flooded runway.

Runways are designed to withstand a given *rate* of rainfall and prevent dangerous flooded conditions that lead to hazardous operations. The newest and best runways in the world are crowned, which means the center is raised above the edges to prevent water pooling and to facilitate the rain running off. Grooves are cut into the runway to give water someplace to go other than sit on the surface. Finally, the newest runways use a micro-pored surface to allow as much of the surface as possible to be available to produce friction to stop landing aircraft.

Grooves are cut into the runway to give water someplace to go other than sit on the surface.

Even with those features, some other conditions could impact the ability of a runway to shed water. These include uneven surfaces where pools could collect and an even more subtle hazard, damming of water on to the runway from high grass along the edge.

Little Rock had one of the newest surfaces. According to a NASA expert called by the NTSB to testify at a public hearing, KLIT's runway could withstand a rainfall rate of about 2.5 inches of rain per hour before a flooded condition took place. He described flooding as that state when water rests on the surface of the runway at a depth of only one-tenth of an inch or more.

Little Rock had too much rain in too short a time. The rainfall amount during the last five minutes before the accident was small, only .25 inches. However, when distributed over the entire surface of the runway, this amount doubled the per-hour rainfall rate that the surface was designed to handle. The runway was flooded. Tire friction was severely reduced during the landing rollout.

At the time of initial touchdown on the runway, the flooded conditions became the main weather condition that impacted the landing. As a result of this water and the other factors already mentioned, AA 1420 would depart the end of the runway going about 90 knots.

In summary, water on the runway from very recent thunderstorms is a major hazard that pilots need to think about when deciding to land. There are safe actions aviators can take if they encounter this scenario in the future. They may want to wait until water clears from the runway surface. This should only take a short time once the rainfall stops. Another tip would be to get a runway condition report from the tower before deciding to land.

Ultimately, the lives of a crew and the safety of the mission come down to making good, sound and safe weather judgments. Don't let water on the runway cause you to slip up. ■

Illustration by Dan Harman

Weather Clues

From the actual ATC transcripts from the accident of American 1420, can you spot the clues that the runway is wet and a potential hazard?

0434:11Z
ATC: "we have a **thunderstorm just northwest of the airport** moving uh through the area now the **wind is two eight zero at two eight gusts four four** and uh I'll have new weather in just a moment I'm sure."

0434:24Z
1420: "Now **we can see the uh lightning** and uh you want to repeat the winds again."

0434:29Z
ATC: "Right now the wind current **wind is two niner zero at two eight gusts four four."**

0439:07Z
ATC: "American fourteen twenty uh your equipment's a lot better than what I have how is the final for two two left lookin'?"

0439:12Z
1420: "Okay we can uh see the airport from here we can barely make it out but uh we should be able to make two two uh **that storm is moving this way like your radar says** it is but a little farther off than you thought"

0439:23Z
ATC: "American fourteen twenty roger would you just want to shoot a visual approach"

0439:32Z
ATC: "American fourteen twenty roger and the **winds kind of kicked around right now** its three three zero at uh one one"

0439:45Z
ATC: "and uh right now I have **a wind shear alert** centerfield wind is three four zero at one zero north boundary wind is three three zero at two five northwest boundary wind zero one zero at one five"

0442:26Z
ATC: "American fourteen twenty it appears we have uh a **second part of the storm moving through the winds now three four zero at one six gusts three four"**

0444:00Z
ATC: "American fourteen twenty you can monitor one one eight point seven runway four right cleared to land the wind right now is three three zero at two one"

0444:31Z
1420: "there's a **cloud between us and the airport** we just lost the field and uh I've uh on this vector here I have the uh the basically last vector you gave us we're on a kind of a dog leg it looks like"

0445:46Z
1420: "and approach American fourteen twenty we know you're doing your best but **we're getting pretty close to this storm** we'll keep this in tight if we have to"

0446:52Z
ATC: "American fourteen twenty right now we have uh **heavy rain on the airport** the current weather on the ATIS is not correct I don't have the current weather for you but the **visbility is uh less than a mile the runway four right RVR is three thousand"**

0447:08Z
ATC: "American fourteen twenty that's correct sir and runway four right cleared to land the **wind three five zero at three zero gust four five"**

0447:53Z
ATC: **"wind shear alert** centerfield wind three five zero at three two gust four five north boundary wind three one zero at two niner northeast boundary wind three two zero at three two"

0448:13Z
ATC: "American fourteen twenty the runway four right **RVR now is one thousand six hundred"**

0448:28Z
ATC: "American fourteen twenty roger runway four right cleared to land and the wind three four zero at three one north wind north boundary wind is three zero zero at two six northeast boundary wind is three two zero at two five and the four right RVR is one thousand six hundred"

"We're getting pretty close to this storm."

Flying In Bad Weather Is High Risk

Photo by MSgt Bill Thompson

GARY D. BRAMAN
U.S. Army Safety Center
Courtesy, *Flightfax*, Sep 01

As I watched it approach I wondered if anyone would dare to fly that day.

Early one Saturday morning, I sat on my front porch having coffee as a large storm system approached from the west. It stretched from the Gulf of Mexico northeast in a line across the southeastern states, almost to the east coast. It had been three days in coming, but now it looked as though it would finally get here, bringing needed rain. The winds began picking up—an indication that the storm would be here soon. As I watched it approach I wondered if anyone would dare to fly that day. A couple of hours later, my wife called for me to watch a news clip on CNN: An Army airplane had crashed, killing all on board.

Not long afterward, the Army Safety Center notified me that I would be deploying with an accident investigation team. I readied my deployment kit and was picked up by the board president. We arrived at the Safety Center where we were briefed on the latest details of the accident. Quickly completing last minute logistics coordination, we departed for the accident site.

Looking For Answers

We arrived on scene after dark but walked the crash site, looking at the devastation and wondering how such a violent accident could happen. An aircraft was destroyed and burned, 21 fellow servicemen were dead. Needless to say, it was a sobering experience standing there viewing the wreckage and feeling the weight of the responsibility for finding the answers to everybody's questions: What happened and why?

For the next two weeks, the board sifted through wreckage; took pictures and measurements to document the site; reviewed numerous documents; interviewed anyone and everyone who heard, saw or knew anything about this accident; and ensured we had accounted for all aircraft pieces and parts. This required an air search for major components of the aircraft. The left wing (outboard of the engine), both rudders, a wing strut and several smaller pieces were found in a line downwind of the wreckage and as far away as two miles. As the investigation proceeded, the picture of what happened became clearer.

The Flight

The mission was to transport 18 Air National Guardsmen (ANG) from their training site to their home station. A C-23B+ Sherpa from the Army National Guard was to fly the mission. The commander briefed the mission and rated it as low risk. The crew departed home station and flew to the Air National Guardsmen's training site to remain overnight prior to the mission.

The flight crew arrived at base operations approximately one hour before the scheduled takeoff time on the day of the mission. About 40 minutes before takeoff, the crew received a weather briefing. The forecaster identified an area of thunderstorms along the crew's filed route of flight with 16 to 45 percent cov-

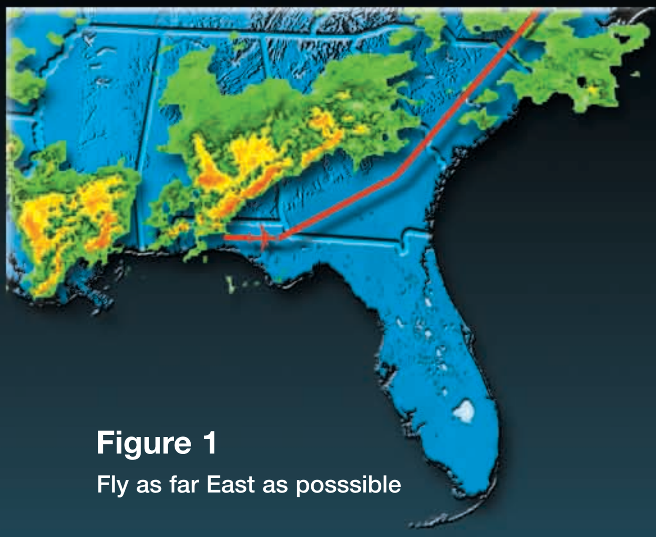


Figure 1

Fly as far East as posssible

erage and maximum tops at 50,000 feet. He told the crew to fly as far east as possible before turning north to avoid the weather (See Figure 1). There were no questions of the forecaster by the crew. The flight crew filed an instrument flight rules (IFR) flight plan (which was printed at their home unit). The crew was to take off and fly a northeasterly route along a series of VOR airways to their destination. They requested a cruising altitude of 9000 feet MSL and estimated their time en route as three hours with five hours of fuel onboard. A passenger manifest listing 18 ANG passengers was attached to the flight plan. The flight engineer loaded the aircraft with passengers and baggage as the flight crew readied the aircraft. He had computed the weight and balance for the flight prior to departing home station.

The crew departed the training site, and a few minutes later air traffic control (ATC) had the aircraft under positive radar control at 9000 feet. ATC then advised their traffic of Convective SIGMET 11E (See Figure 2). The advisory stated that there was a line of severe thunderstorms moving from 280 degrees at 30 knots with tops at 40,000 feet. Hail to one inch and wind gusts to 60 knots were also possible. A convective SIGMET implies severe to extreme turbulence, severe icing and the potential for microbursts and windshear. Traffic was further instructed by ATC to contact flight service or monitor HIWAS (Hazardous In-flight Weather Advisory Service) for the details of the advisory. The C-23 crew did not contact any flight service station for more information on Convective SIGMET 11E. (It is not known if the crew monitored HIWAS on any VOR in their vicinity.)

The crew continued to stay on their filed route of flight, avoiding buildups with small flight deviations. One approach control assisted them in avoiding some heavy thunderstorms (level 3 and 4 and some level 5s). Additionally, there was another aircraft approximately 15 minutes behind them that was receiving vectors of 090, 100 and 110 degrees to avoid buildups from ATC. The other aircraft was only equipped with a Stormscope, but the C-23 was equipped with a weather radar and a Stormscope and informed ATC of this fact (See figure 3).

The crew of the Sherpa never deviated to the east farther than a heading of 063 degrees. They maintained their northeasterly heading throughout the entire flight with only short deviations for weather as each air traffic facility advised them of the line of severe weather.

Approximately 45 minutes after takeoff, the crew checked in with their last ATC facility. The crew was given the current altimeter setting, which they read back. ATC received a good transponder code from the aircraft, showing them at their assigned altitude. Soon thereafter, their altitude began to drop for no apparent reason. Ten minutes after checking in with this controller, the C-23 disappeared from the radar screen. The air traffic controller heard no Mayday call, nor did he receive a 7700 emergency transponder code. The controller made numerous attempts to contact the crew, but received no replies.

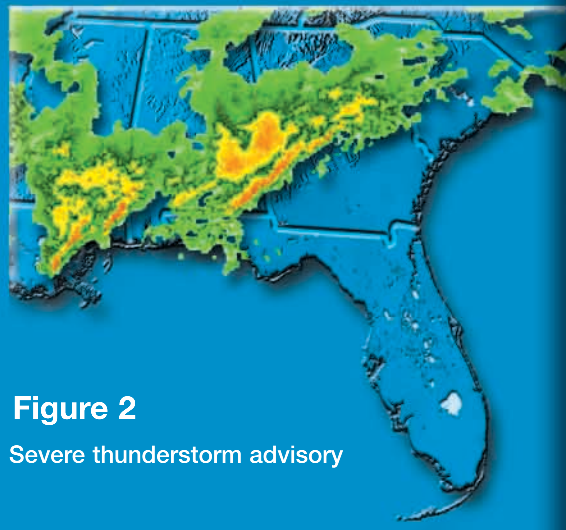
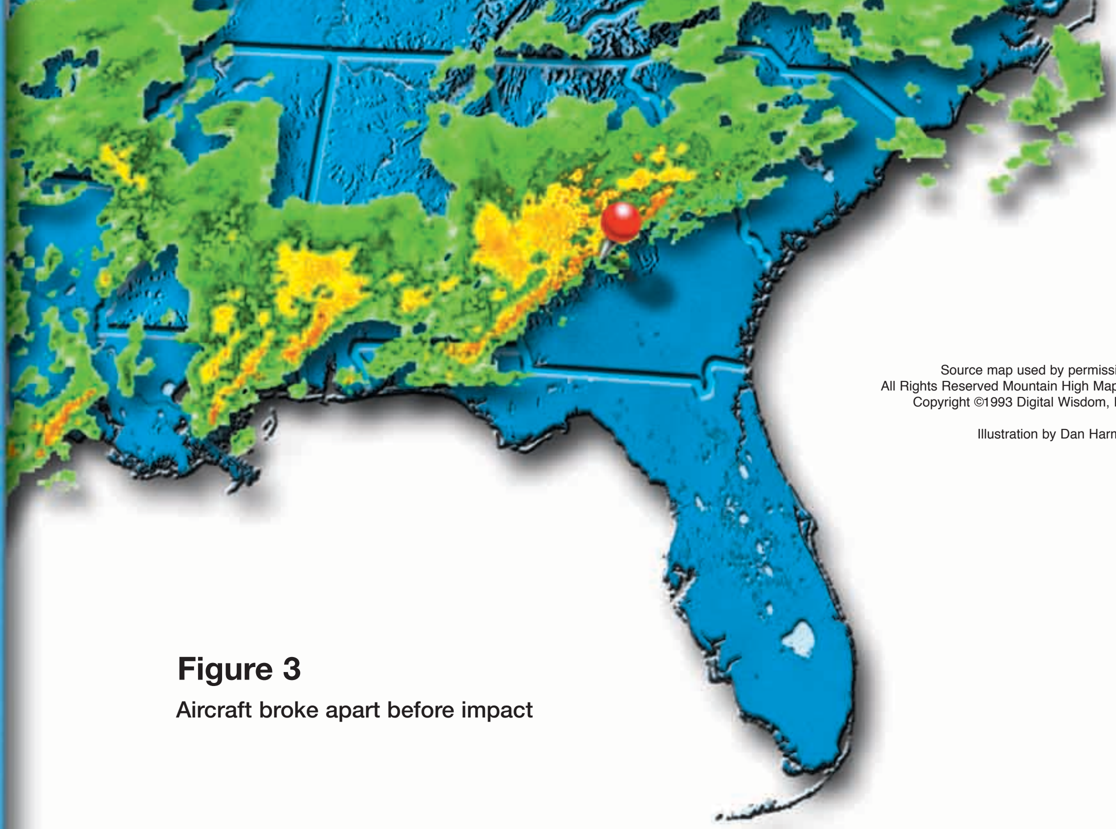


Figure 2

Severe thunderstorm advisory

There was a line of severe thunderstorms moving from 280 degrees at 30 knots with tops at 40,000 feet.



Source map used by permission,

Illustration by Dan Harman

Figure 3

Aircraft broke apart before impact

"Is going through the thunder-storm worth losing the aircraft, or my life?"

FSM notes:

You can draw your own conclusions as to what caused this aircraft to crash and take 21 lives. If nothing else, it should serve as a reminder that weather poses many hazards to aviation. Severe weather conditions should be avoided, not skirted. The Air Force provides some specific guidance on operating in the vicinity of thunderstorms. This guidance is contained in AFI 11-202, Volume 3, General Flight Rules, *and AFH 11-203, Volume I,* Weather for Aircrews.

This mishap highlights what can go wrong and why this guidance is in place. General Flight Rules *states, "Pilots-in command shall not intentionally operate into a thunderstorm except when operating on a MAJCOM-approved mission specifically requiring thunderstorm penetration." It continues to direct, "When observed or reported thunderstorm activity adversely affects the flight plan route, pilots will delay the scheduled mission, alter the route of flight or proceed to a suitable alternate. Pilots shall use all available information including radar, PMSV, and PIREPS to avoid thunderstorm activity."* Weather for Aircrews *is more succinct. In the chapter on thunderstorms, under a paragraph titled "Aviator Corrective Action" it states, "If conditions won't permit you to circumnavigate a thunderstorm, you have only two alternatives; divert to the nearest unaffected airfield (and wait until the storm passes) or go through the thunderstorm, but only as a last resort if required by your mission. Ask yourself, 'Is going through the thunderstorm worth losing the aircraft, or my life?'"*

Bottom line is, thunderstorms are deadly. Avoidance is the best bet; why tempt fate? When in doubt, land. In bad weather, the safest place is on the ground.

RADAR Myths and Misconceptions

Illustration by TSgt Mike Featherston

DAVE GWINN
Honeywell, Inc.

Its limitations are many. It's up to the pilot to fill in the gaps with knowledge and experience.

The Cessna 421 pilots were absolutely puzzled by the weather diversion discussion on Center's frequency. Only a large area of benign light rain awaited them at 120 miles, according to their onboard radar. Within 15 miles they were stunned by a solid red palisade of horrid weather, apparent both on radar and as a visual threat.

A competent DC-9 Captain began to work his way through heavy rain in an energetic and unexpected convective weather system. Apparently looking at the radar display, he remarked to his copilot, "There's a thin spot! Turn left now." Within minutes, the DC-9 exploded on a country road in Georgia and all lives were lost. The windshields had been shattered and the engines gutted in intense rain and hail.

The Captain of a regional airline's Metroliner responded: "It doesn't look bad on our radar. We'll continue for the time being." Within 30 minutes, the turboprop slammed into the ground in a 5000-foot-per-minute rate of descent, pushed downward by penetration into a Level 6 thunderstorm.

In each instance, the pilot had flawed expectations of radar's capabilities. One relied on radar information rendered questionable by long-range access; the other two were lured into trouble by the seductive effects of heavy rain at close range. The on-board radar, even though it was performing perfectly up to its design capabilities, did not provide the safety margin that was expected of it. Why? Because the pilots either didn't know or had forgotten that radar is not the bulletproof weather avoidance tool we imagine it to be.

What Radar Sees

Condition	Return
Rain	Good
Wet Hail	Good
Wet Snow	Marginal
Dry Hail	Poor
Dry Snow	Very Poor
Water Vapor	No Return
Ice Crystals	No Return
Small Dry Hail	No Return

Picky, Picky

Understanding the limitations of radar permits a pilot to make an educated assessment of its "panacea" value in weather avoidance. Its maladies are many: range, geography, altitude, and limited penetration. And it's picky; there's an ideal raindrop diameter which radar detects. It may ignore those smaller or be fully consumed by those much larger. Therefore, the pilot's radar education, expectations and accumulated experience must be brought into play when radar is used as an avoidance tool.

That understanding begins with this simple fact: Radar is a water detector. Radar energy interacts electromagnetically with water in a process commonly called "reflectivity." But that's not really what happens. As radar energy travels through waterdrops (in cloud form or as rain) it interacts best with raindrop diameters about .1 to .2 the size of the wavelength. With airborne radar (X-band) the frequency is about 9400 MHz and the wavelength is 3.2 centimeters or about 1.2 inches.

When raindrops are illuminated by radar energy, the molecules within the droplets are energized or "dipoled". Everything in nature seeks equilibrium. A charged raindrop begins to discharge (actually called "scattering"), to deplete itself of energy, isotropically or omni-directionally. It's those few vectors of energy "back scattered" (returned) to the radar receiver that are detected and displayed.

Waterdrop diameters below these target sizes (such as fog or shallow cloud formations) will be ignored by radar. When droplet cross-sections approach the size of the wavelength in heavy rain, the radar's energy is simply absorbed: It vanishes into the ether. Frozen water (cirrus clouds, small hail, snow) is crystalline; the molecules are no longer free to charge and perform the electronic tap-dance which results in radar displays, thus the pilot will see no return at all.

Antennas and Range Woes

Most radars have variable ranges set by a knob on the control panel, but most pilots don't realize how sharply limited radar's range really is.

Radar efficiency is a function of the frequency and the size of the antenna installed. Airborne antennas vary in size. Ten inches is standard in most general aviation aircraft, such as light to medium twins, King Airs, Learjets or any plane lacking the radome to accommodate anything larger.

Radar efficiency is a function of the frequency and the size of the antenna installed.

The pods you see suspended below wings usually enclose a 10-inch antenna. The smaller the antenna, the wider the radar beam and the more its energy is dispersed with distance. A 10-inch antenna produces a 10-degree focus. In contrast, an airline installation, with a 30-inch antenna, yields a 3-degree beam. *(Editor note: See Figure 1 for radar antenna sizes on some USAF aircraft.)*

Aircraft	Antenna Diameter
C-9	28″
KC-10	30″
C-20	12″or 18″
C-37	18″or 24″
C-130	Approx. 26″ by 32″
C-135, KC-135	28″or 33″
RC-135	Approx. 18″ by 31″
C-141	30″

Figure 1

Whether it's VOR radials or airborne radar, all electromagnetic energy obeys the same postulate: 1 degree equals 6000 feet of diffusion at 60 nautical miles. (VOR axiom: 1 degree equals 6000 feet or 1 nautical mile left-to-right at 60 miles distance from the station.) The typical 10-inch antenna/10-degree beam (actually a cone, not a beam) has a 60,000-foot diameter at 60 miles. At 100 miles, the 10-inch antenna produces a cone of 100,000 feet in diameter. That's big! (At this same distance, the airliner has a 30,000-foot cone.)

The receiver calibrates returned signals in decibels of reflectivity (dBz). For the sake of accuracy, all of the energy is assumed to impact the weather target. The return reflectivity is weighed as a percentage or proportion of the total transmitted power. Returned energy depicts (by color) the waterdrop density of the precipitation within the cone. You can visualize that at 100 miles and with a cone of 100,000 feet diameter, no thunderstorm will "fill the beam."

An abundance of energy will be lost above, below and around the storm.

Beam Spreading Problem

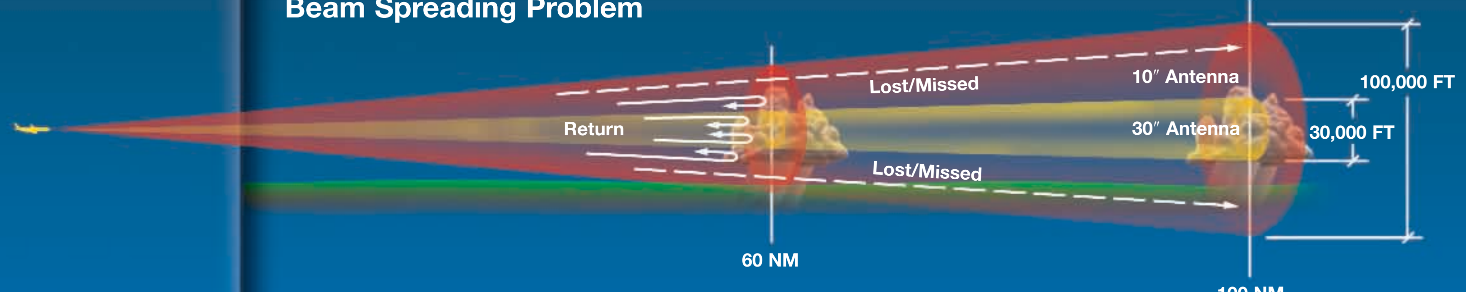


Illustration by Dan Harman

Only a portion will strike the storm and the return will be a portion-of-a-portion, a-percentage-of-the-percentage that impacted the storm. In other words, the weather target will be underestimated, displayed on radar as less than its true hazard. Our Cessna 421 discovered that. Much closer and with a narrower beam, all of the energy will strike the target, and the return will be more accurate.

What's The Limit?

At what distance can the beam be filled by the target? For our typical 10-inch antenna, range efficiency is about 80 miles, a distance at which one has an 80,000-foot beam diameter. Anything viewed beyond 80 miles must be very dense to bounce back such a weak signal with any display of color.

Whatever is displayed should be assumed to be one to two levels more severe than what the pilot sees. It will appear to increase in intensity as the aircraft closes the distance and more energy is returned to the antenna.

Practically speaking, 80 miles is an adequate distance to make safe decisions. Even for the Learjet moving at eight miles per minute, the pilot has ten minutes of reasonably accurately-displayed weather avoidance time. When a display from a greater distance is properly pegged as "more severe than it looks," then the pilot has bolstered radar's physical limitations with his or her own knowledge.

Even in an MD-80 in airline operations, 80 miles is adequate for safety-of-flight purposes. The airliner's big 30-inch dish will paint accurately out to 160 miles, but all that really does is provide long-range planning and the economic diversion options so important to modern airline operations. Just remember, if you have a 10-inch antenna, 80 miles is your best range efficiency.

Leading Edge Antennas

How good is the leading edge antenna commonly seen in the wings of Bonanzas and other high performance singles? It's a 16-degree beam. It's made into a small antenna by lopping off the top and bottom to fit inside the wing. When you forfeit size, you forfeit focus.

If you use the leading edge antenna, radar calibrated accuracy—that is, a cell that will fill the beam and be accurately displayed—may be possible at around 20 miles. My philosophy for the leading edge antenna has always been this: If you see anything, of any shape, at any distance and of any color, plan on going around it. You will rarely get the beam-filling target for which the radar receiver is calibrated. One manufacturer will sell you its radar, but won't sell or install a leading edge antenna. They haven't enough faith in it to accept any responsibility for its use.

As far as range efficiency goes, sferics devices—the Stormscope and Insight Strike Finder—are far ahead of radar with a leading-edge antenna. For one-third the price of a minimally efficient radar installation they are, in my view, a far better choice. And the Strike Finder, with its outstanding digital circuits, light weight, low cost and lucid display, has outdistanced the WX-1000, top-of-the-line Stormscope.

Sferics devices sense static energy created by the up-and-down drafts in a storm long before the storm is mature or paintable on radar. A herd of dots indicates a stampede of electrical activity. No need to guess intensity. Avoid it at any range.

Interestingly, airborne radar is calibrated to status rainfall rates, not the frog chokers inside a thunderstorm. This makes radar very sensitive to nuances in rainfall rates; it turns Radar Red at a rate of 1/2-inch per hour. The entire state can be Radar Red, or apparently hazardous. Nope, it's just wet. We have to know more about the accumulation of water in what kind of clouds and what the forecaster says before radar reveals a definite hazard. Radar is best at confirming what we knew or suspected was developing.

Geography has a lot to do with it. In Kansas, for example, water is not plentiful. Red in Kansas, the product of billions of tons of air and water transported northward from the Gulf, is guaranteed to be the severe hazard the radar says it is. ("Grab Toto, Auntie Em!") Compared to the fat rain droplets found off Florida, a midwestern storm has smaller water droplets and almost certainly more violent up and down drafts.

West of Kansas City is the area of High Plains or desert-type thunderstorm; a convective storm without the water accompaniment. What goes up must

Radar is best at confirming what we knew or suspected was developing.

come down. High cumulus cloud bases, evaporating rainfall and little reflectivity are typical, but they are full-blown thunderstorms. It's a violent ride through them and deadly beneath them.

In one season, the strongest windshear ever recorded (97 knots differential) originated from a benign-looking green return. Radar interpretation must be calibrated to the region in which you're flying.

This is called attenuation, the lessening or loss of all energy. It's solely a function of wavelength and droplet size, not power. Failing to recognize attenuation contributed to that DC-9 accident in Georgia. A highly attenuated display may look like a soft spot in a line when, in fact, just the reverse is true.

There are clues to an attenuated signal and pilots must learn to recognize them: bowed out backside, steep color changes on the backside, absence of distant returns and an inability to ground-paint beyond the target being examined. Always remember, radar is a weather avoidance device never intended for penetration. The people who designed it know that the more hazardous the threat, the less effective the radar. It can see it, but not through it.

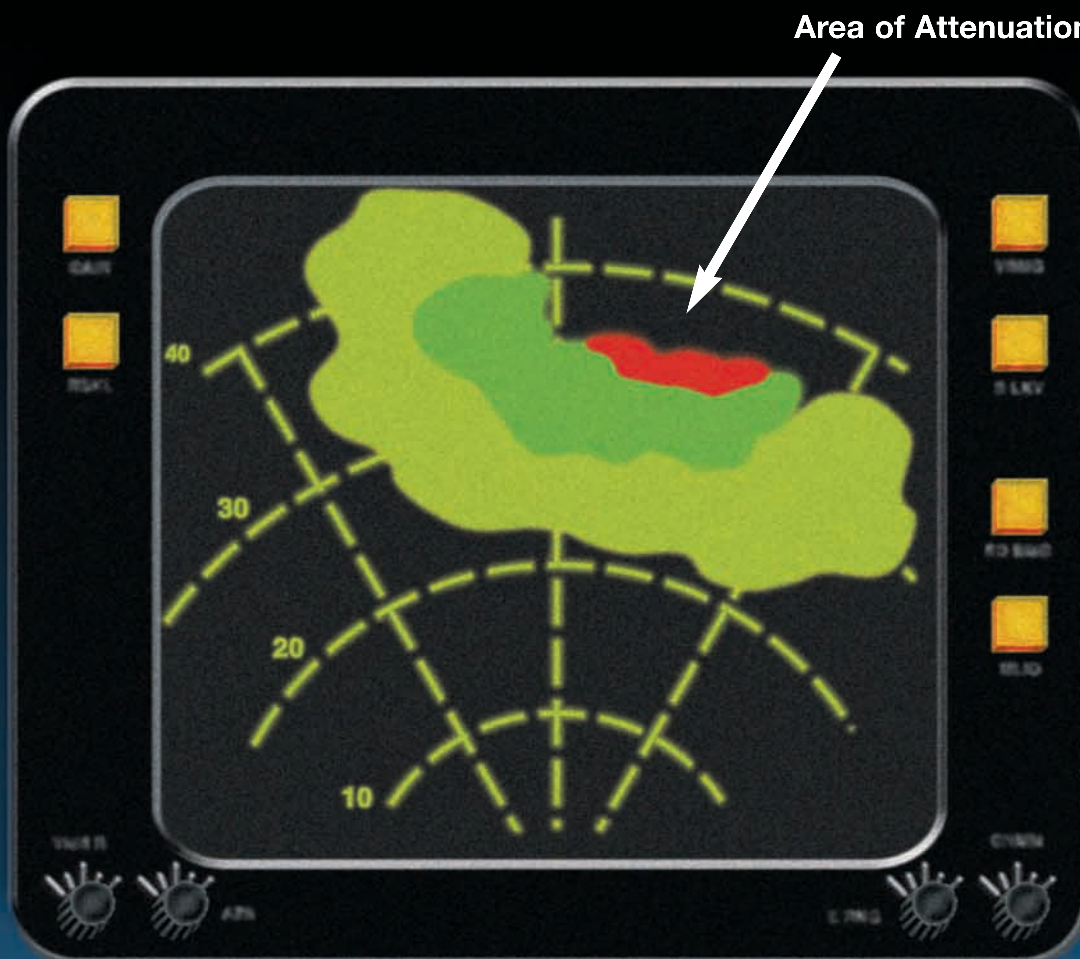


Illustration by Dan Harman

Always remember, radar is a weather avoidance device never intended for penetration.

Limited Penetration

Remember, radar interacts with waterdrops when drop diameters equal .1 to .2 the wavelength of the transmitted frequency. As radar energy penetrates a dense storm, the water blobs may approach the size of the wavelength. When that occurs, the radar energy is totally absorbed by the water.

Altitude

To acquire the weather picture, we aim or tilt the radar cone up and down, to as much as 15 degrees. The diagnostic levels to examine thunderstorm intensity are in the 18,000 to 25,000-foot altitudes. Higher than that and you'll find crystalline and frozen particles that won't return the radar's energy. Low-altitude water is there for the viewing, but it may be only non-hazardous rain showers. If it's a thunderstorm, it builds to these higher altitudes.

The radar tilt control obeys that same principal used for beam diffusion: 1 degree equals 1000 feet at 10 miles or 1 degree equals 6000 feet at 60 miles. Take any mileage and "00" and you have the effect of one degree at that distance.

For example, to tilt down 1 degree at 75 miles is to lower the center of the beam 7500 feet below the aircraft. Remember, one-half the beam diffusion is extending below the beam center. It may be on the ground. That's a many-decibel return. Knowing how to manipulate the beam at various altitudes to place it within significant water areas is the essence of effective radar use.

At low altitudes, however, we encounter a problem. From the outer marker to the airport is typically five miles. One degree at five miles is 500 feet. Limited to a 15-degree tilt up, the pilot can only elevate the center of the radar beam to 7500 feet above the aircraft. Horrid rainfall and windshear don't originate at 7500 or 9000 feet AGL. During one radar seminar, I commented to the audience (tongue in cheek): "If you've postponed all of your radar decisions to the LOM, just turn it off. It's extremely limited at that low altitude. All of your commitment decisions must have been made at much higher altitudes, at greater distances from the airport, and with good radar investigation that's just not possible at the out marker."

Mythical Misuses

Myths about radar are many, including the notion that you can measure the tops of storms with it. Frozen water doesn't have the free molecules to dipole. Therefore, it's not practical to accurately measure the height of a thunderstorm top composed of snow, hail and cirrus clouds with airborne radar. Top determination is imaginative and one manufacturer markets a product alleged to do it, but the concept is badly flawed.

Despite the wildest application of imagination, you can't navigate with any practicality using weather radar. From every altitude and angle, cities and structures come back with vastly different levels of reflectivity. (A lake or river, however, will totally absorb the energy and its perimeters can be determined with some ease. KAL007 might not have overflown the Soviet Union if it had ground painted and recognized that it should not be crossing the Kuril Islands.) Over land, radar is a mass of purple, red and yellow. with some desensitizing (gain control), you probably can find a city. But why? Better to ask for ATC radar vectors.

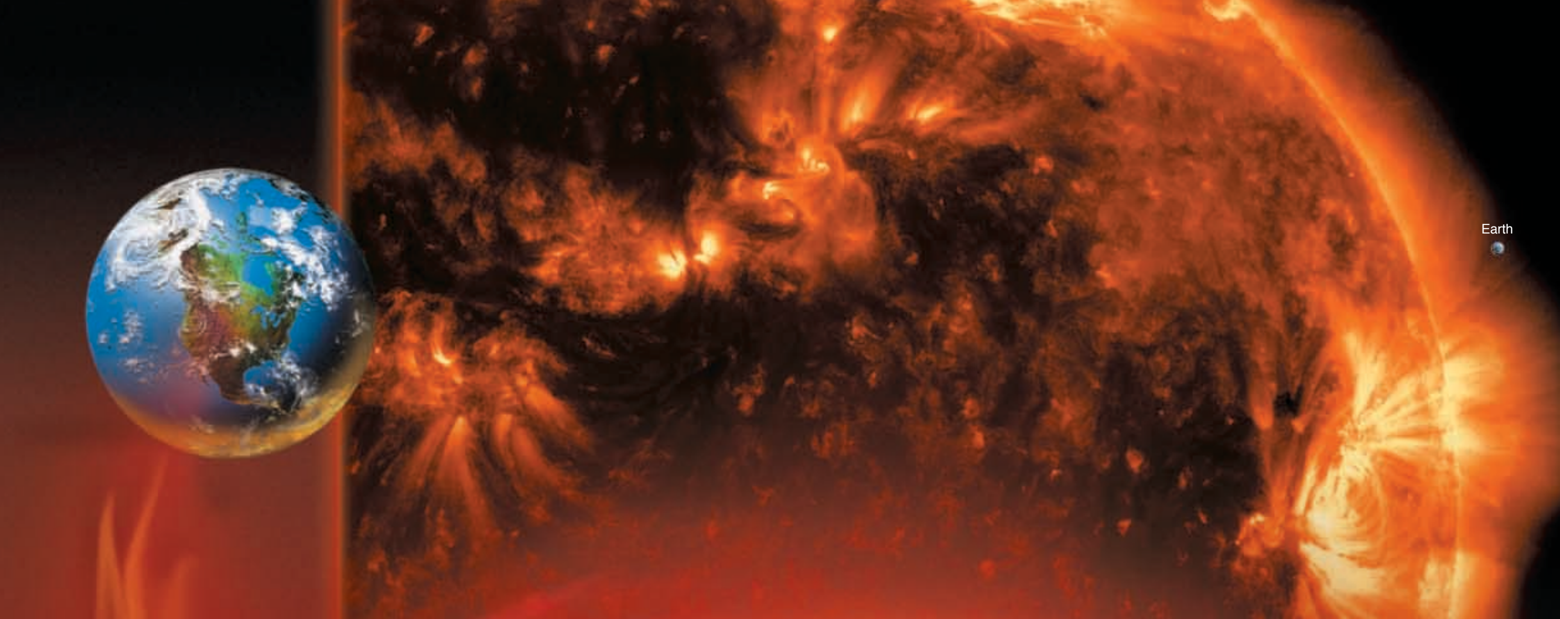
Because the beam is a crude representation, you cannot calibrate your beam width or your receiver with ground returns. Radar—at least weather radar—was not designed to determine safe overflight of terrain. These techniques are all products of people's imaginations and calculator skills.

Radar—at least weather radar—was not designed to determine safe overflight of terrain.

Nor does radar preclude bird strikes. The safe permissible level for human exposure to radar is typically at 15 to 25 feet. At that short distance, tissue as sensitive as retinas is not affected (consult your manual). So you're not going to tickle and redirect a bird at three miles. In our seminars, we have a photo of two bird strikes upon a Falcon. Both birds "aimed" at the radome from which 5000 watts of power was being transmitted. It doesn't hurt to turn on the radar, but it won't be your last disappointment in life when you get that bird strike.

Getting radar reports from other aircraft might cause you to think about them. How far from the weather is the pilot? What kind of antenna has he got? Do you have total faith in his training and experience in using this multi-flawed product? It often wasn't what I knew that caused problems in my flying career, but what I didn't know and acted upon anyway that complicated the job. To rely upon radar without education is an invitation to misuse and misadventure.

(Retired TWA Captain Dave Gwinn is now a Consultant for Honeywell-Systems Training, conducting Weather Radar Seminars worldwide. You can contact him at CaptDavidGwinn@aol. com.)



During 2000 the sun produced a relatively large number of solar flares and "sun spots."

AIR FORCE SPACE WEATHER

Looking Up And Beyond For All

COL TIMOTHY H. MINER, AFRC
Reserve Assistant to the Director of Weather

During your initial introduction to aviation, you learned that weather in the atmosphere would directly impact your ability to successfully and safely complete your flying. But mission-impacting weather isn't just an atmospheric phenomenon anymore. It reaches all the way to the sun.

Forecasters at the Air Force Weather Agency (AFWA) at Offutt AFB, Neb., are looking at the sun's emissions and creating textual and graphical products that you and your unit's Combat Weather Team can use as part of your mission's planning and environmental situational awareness programs. (Combat Weather Team [CWT] is the new name of your unit's local weather provider after the current reengineering program. See "Riding the Wings of Change" in Oct 01 *Flying Safety*. Ed.)

The star that our planet orbits goes through an eleven-year cycle of activity. Right now we are coming off one of the peaks in this cycle that took place in the year 2000. During that year the sun produced a relatively large number of solar flares and "sun spots" which create the peaks in solar emissions that travel to the Earth and interact with our atmosphere. We see some of the interactions when they create the colorful Aurora borealis or "Northern Lights." However, most of the interactions we don't see. Energetic particles ("solar wind") can impact equipment, electromagnetic properties of the atmosphere, and even humans who are exposed.

Satellites and other equipment above the protective levels of the atmosphere are vulnerable to electrical anomalies and a degradation of components due to radiation interference. There can also be increased drag on satellites in low earth orbits.

Electromagnetic signals can be directly impacted by the interference of atmospheric disturbances caused by solar emissions. These disturbances influence HF communications, satellite UHF communications, and GPS navigation signals. They also increase interference or false returns to sun-ward and/or poleward looking radars. Finally, those who track satellites and other objects in orbit can potentially lose their targets because of the changes to the atmosphere.

Also, there can be a health impact to humans exposed to high levels of solar emissions. High altitude aviators and those flying over polar locations can receive extra radiation during periods of high solar activity.

So, is space weather important to you? Well, if your mission involves high altitude or polar flight, if your mission requires HF or satellite UHF communications, or if satellites are critical to your mission, then you need to know about Air Force Weather's commitment to space weather. Under these conditions, the environmental situational awareness of space weather can be as important to you as thunderstorms or other terrestrial weather information.

AFWA provides updated space-weather information at its internet "Joint Air Force and Army Weather Information Network" (JAAWIN) that you can access (go to https://afwin.afwa.af.mil and link to "Space Weather" on the main menu). Air Force Weather is committed to providing all operators with useful products that are mission specific and easy to use. At the JAAWIN Web site, space weather is summarized in a "stoplight" presentation of "red-yellow-green" seen in Figure 1. The figure gives a quick glance look at immediate history and forecasted environmental impacts to HF communication, satellite operations, space object tracking, high altitude flight and radar interference. It also summarizes the forecasted events of solar activity—flare probabilities, geomagnetic and charged particles.

Energetic particles ("solar wind") can impact equipment and even humans who are exposed.

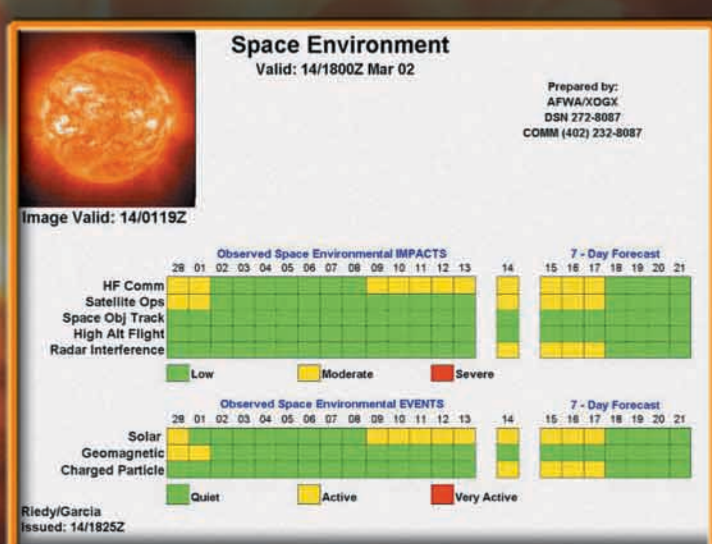


Figure 1. Space Environment Summary

Digital/resource imagery courtesy of the Solar and Heliospheric Observatory (SOHO): An International Cooperation Project between ESA and NASA

Source map used by permission, All Rights Reserved Mountain High Maps® Copyright ©1993 Digital Wisdom, Inc.

Illustration by Dan Harman

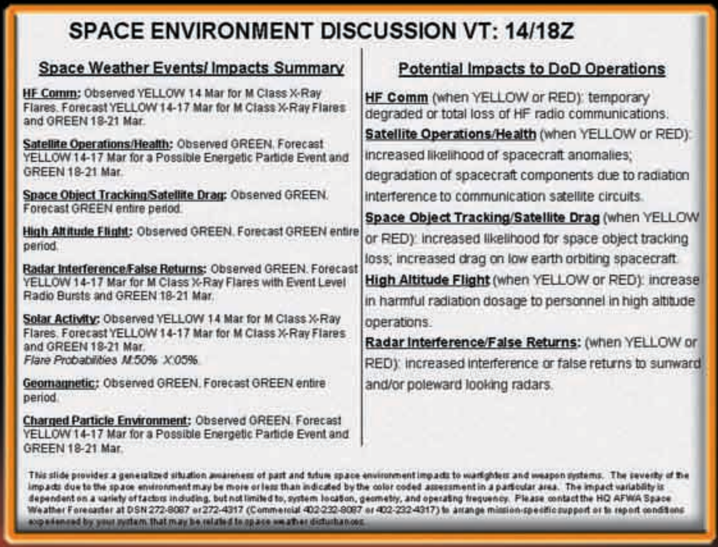


Figure 2. Space Environment Discussion

AFWA provides a geographical forecast for space weather.

The Space Environment Discussion chart seen in Figure 2 provides textual explanations about each of the categories forecasted on the Space Environment chart.

Besides the event and impact forecast, AFWA provides a geographical forecast for space weather. Not every place on the Earth will be impacted to the same degree by solar events. In JAAWIN, the forecasters provide charts showing forecasted locations for the impacted communications (HF operations and UHF SATCOM) and single-GPS navigation. Figures 3 and 4 show two examples of these charts.

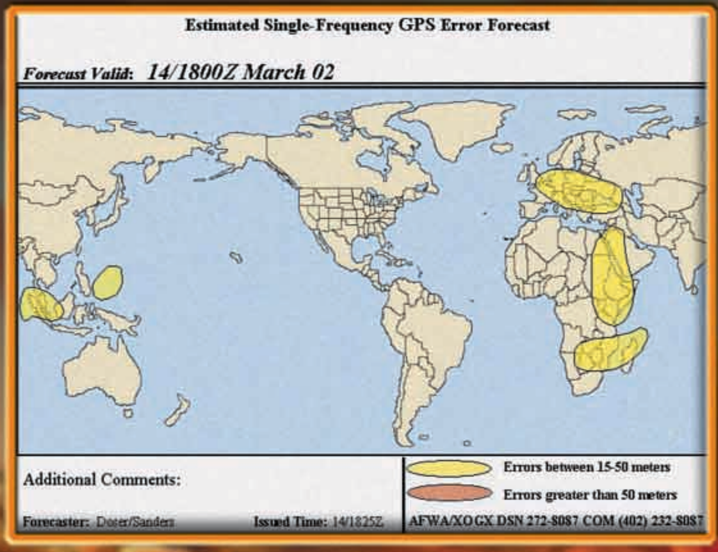


Figure 3. Estimated Single-Frequency GPS Error Forecast, showing locations on the Earth with errors between 15 to 50 meters, and greater than 50 meters.

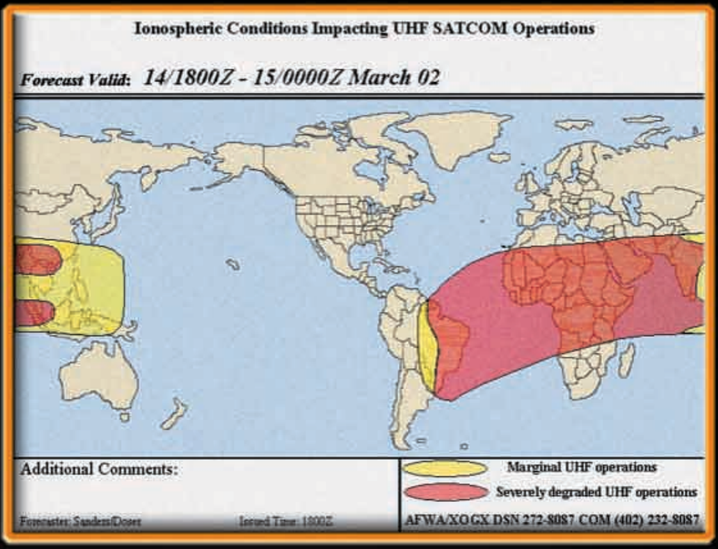


Figure 4. Ionospheric Conditions Impacting HF Communications, showing where marginal and severely degraded HF operations could occur.

So, do you need space weather as part of your situational awareness planning and briefings? You do if you need to communicate. You do if you need satellites as part of your mission's resources. You do if you are a high-flyer. That's almost all of us.

In many cases, space weather is just as important as the terrestrial weather you now receive. Your CWT is the manager of your space environment information and can tailor the products produced by AFWA to meet your unit's specific needs. Let your CWT know your specific environmental limitations and parameters. It's their mission to ensure you know where and when you may encounter them. Air Force Weather is committed to providing you and others a complete terrestrial and space weather program, a program looking at your environment from "the mud to the sun." ❂

Your CWT can tailor the products produced by AFWA to meet your unit's specific needs.

Illustration by Dan Harman

Defensive Driving. Wait, Make That Defensive Flying

J.S.T. RAGMAN

I have been flying for 21 years, but I can still do stupid things.

Pacific Northwest. Mini-van rental. Rural two-lane road. Kids in the back. Wife beside me. Family vacation. A beautiful day.

"Honey, can you show me where we are on the map?" I turn my attention to my wife, and the map in her lap. We are both "heads-down."

My youngest son makes the call: "Daddy, the *trees*!" We're off the road, trees at our 12 o'clock. I spin the wheel to the left, gravel and dust take flight, and then we're back on the road. I'm a very humble man. I've just done something stupid. *I almost killed us all*—me, the wife and our two kids.

First, the obvious lesson: I have been driving for 26 years, but *I can still do stupid things.* I have been flying for 21 years, but *I can still do stupid things*. I am a Flight Safety Officer, I am a unit commander and I teach crew resource management at a major airline, but *I can still do stupid things*. Each of us, regardless of time, experience, qualification, rank or position, can still do stupid things. Be humble. Be aware of your potential to do harm through error.

Second lesson: A "fledgling," the youngest, least experienced, least qualified member of the "crew"—my son—made the right call. He was paying attention, he was assertive, he communicated. Listen to *everyone.* Look beyond age, experience, rank and qualifications. The fledgling saved our entire family. A fledgling could save your life, and the lives of everyone on your aircraft. Listen.

The third, and more subtle, lesson: Killing myself and my family, due to my error, would have been a tragedy. However, had I erred to the left into oncoming traffic, rather than to the right into the trees, I would have compounded the tragedy by killing another father and his family as well. No alcohol. No drugs. No fatigue. Simple human error. And an innocent family, through no fault of their own, suffers a tragedy. Drive defensively; watch out for the other driver; he/she can kill you/yours.

Drive defensively. Fly defensively. Orville and Wilbur Wright built their own airplane, built their own engine, maintained and fueled their own airplane, launched and recovered their own airplane. Not since those earliest days have aviators been so fortunate. As aircraft operators, we are but one player in the game. Manufacturers, maintainers, loaders, fuelers, air traffic controllers, dispatchers, other aircraft operators: Any one of them can swerve left into oncoming traffic and, through human error and no fault of your own, take your life and the lives of everyone on your airplane.

We are not Orville. We are not Wilbur. The other guy is out there. He/she is a good man/woman, no less than I, on that family vacation, on that two-lane road. Drive defensively. Fly defensively. Visually clear at low altitudes. Use the TCAS. Use the skin-paint. Clear for traffic over the radio. Maintain situational awareness. Do a thorough preflight. Back each other up. Review the logbook entries and the corrective actions. Tune, identify and monitor. Refer to raw data. Scrutinize the weight and balance form. Query the controller, the maintainer, the dispatcher, the mission commander. Recheck the altimeter setting. On and on and on. Verify. Verify. Verify.

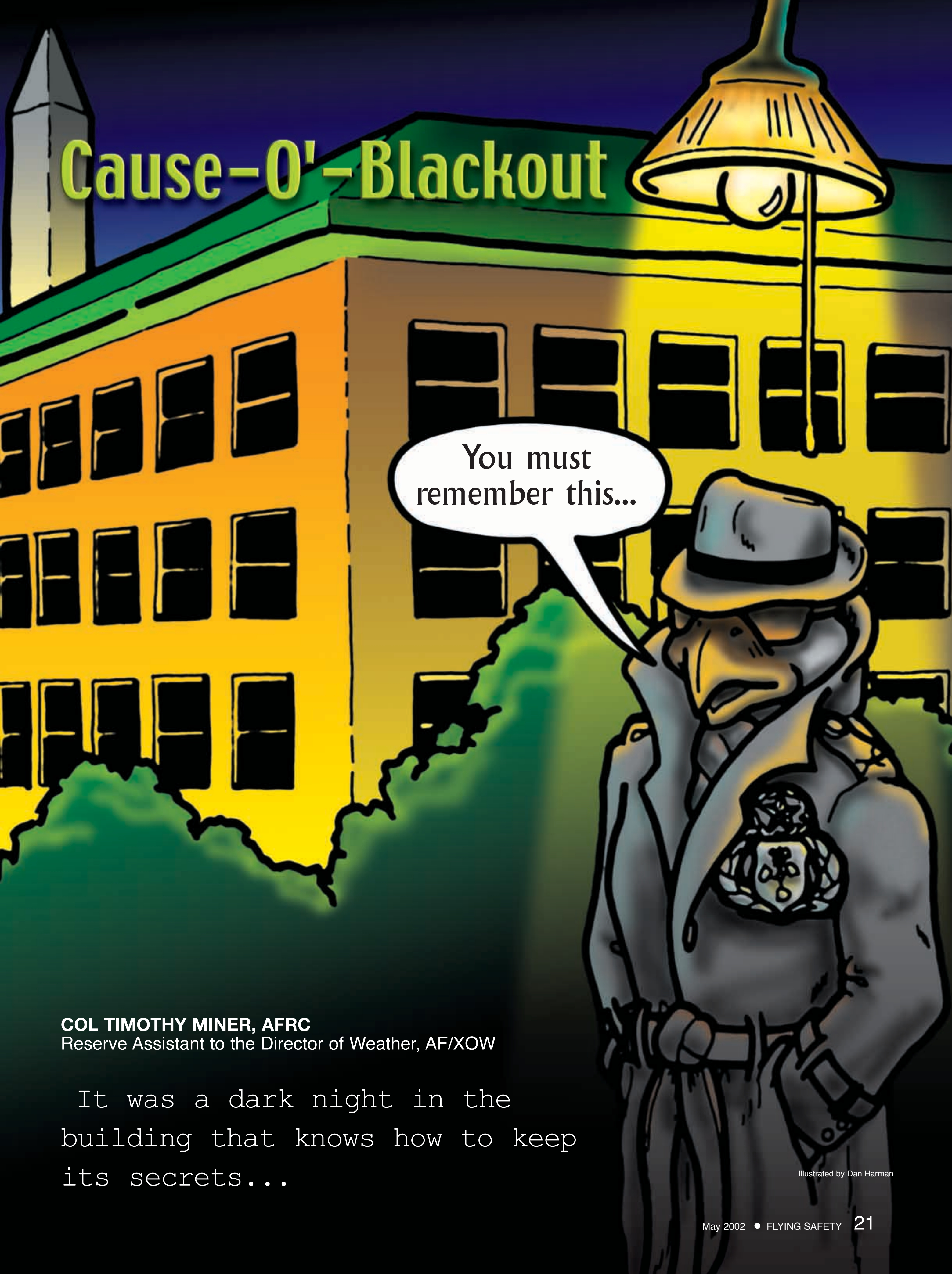
My children slept well that Seattle night. I did not. Be humble regarding our potential for error. We are human: *We* err. And when *we* do not err, *the other guy* will, and swerve into our lane.

Fly Defensively.

("J.S.T. Ragman" is the pen name of a C-130 pilot and unit commander in the Air Force Reserve. He is also a Boeing 777 pilot for a major airline.)

USAF resource photos by TSgt Michael Featherston and TSgt Dave Ahlschwede
Photo Illustration by Dan Harman

Cause-O'-Blackout



Illustrated by Dan Harman

COL TIMOTHY MINER, AFRC
Reserve Assistant to the Director of Weather, AF/XOW

It was a dark night in the building that knows how to keep its secrets...

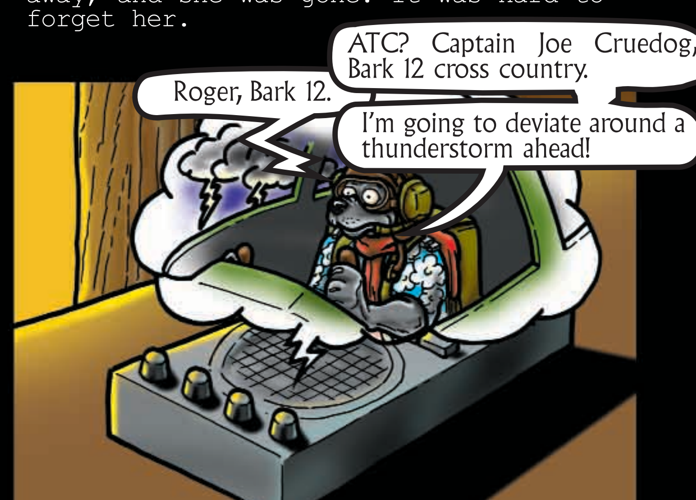
I was burning the midnight oil in my tax-payer-provided space overlooking the Potomac. My trusty assistant MSgt Sidney Pepper was with me. Our fate was in the cards that night...

That's pretty much how it went every evening for the Sergeant and me. Nothing much ever happened during our gin rummy sessions...

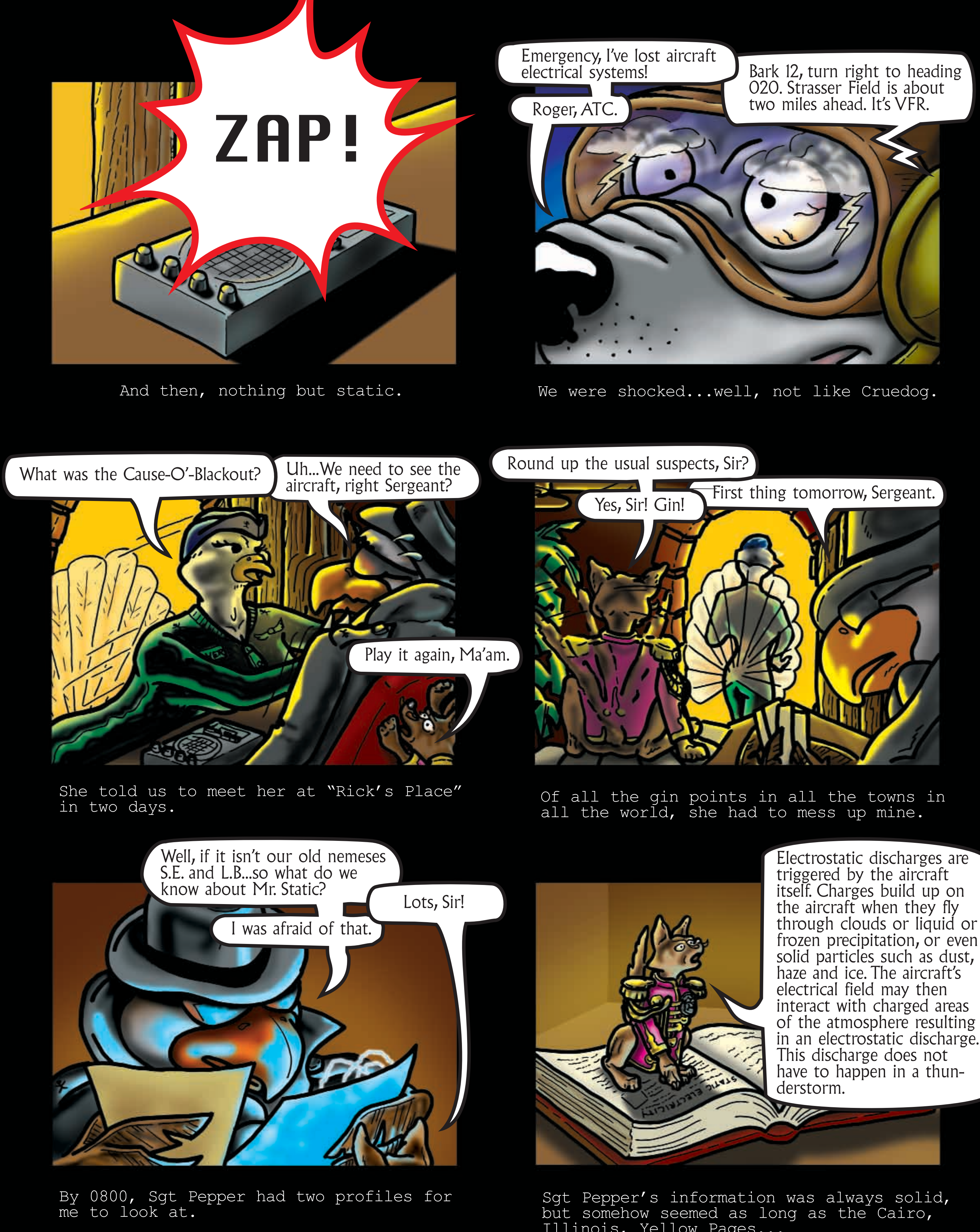
Except tonight, when she burst in. She was Col. Fannie Flyer, and now she was OPS Group Commander somewhere in the Midwest.

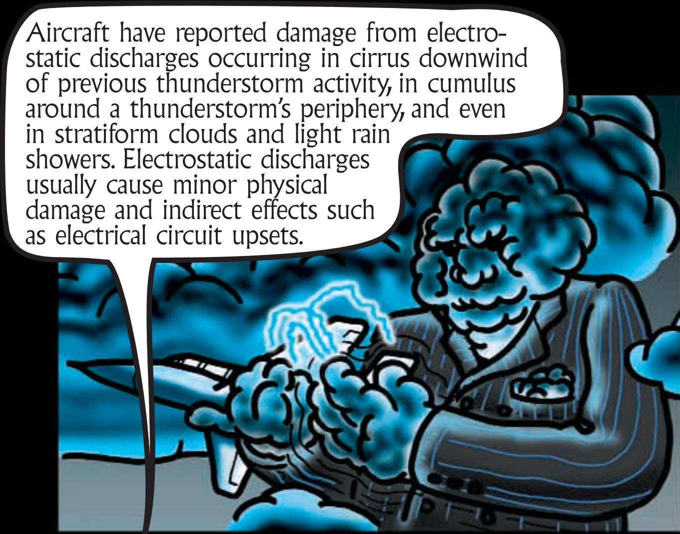
I still remember that refueling mission over Paris, Texas. One practice break-away, and she was gone. It was hard to forget her.

So was the recording she'd brought. It was an ATC talking to one of her pilots.



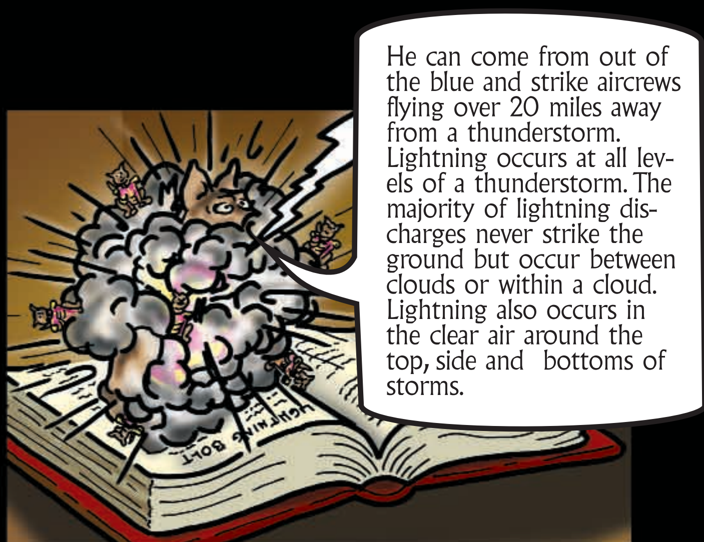
I knew Cruedog. He was dependable. Loyal. Housebroken.


ZAP!
And then, nothing but static.
Emergency, I've lost aircraft electrical systems!
Roger, ATC.
Bark 12, turn right to heading 020. Strasser Field is about two miles ahead. It's VFR.
We were shocked...well, not like Cruedog.
What was the Cause-O'-Blackout?
Uh...We need to see the aircraft, right Sergeant?
Play it again, Ma'am.
She told us to meet her at "Rick's Place" in two days.
Round up the usual suspects, Sir?
Yes, Sir! Gin!
First thing tomorrow, Sergeant.
Of all the gin points in all the towns in all the world, she had to mess up mine.
Well, if it isn't our old nemeses S.E. and L.B...so what do we know about Mr. Static?
Lots, Sir!
I was afraid of that.
By 0800, Sgt Pepper had two profiles for me to look at.
Electrostatic discharges are triggered by the aircraft itself. Charges build up on the aircraft when they fly through clouds or liquid or frozen precipitation, or even solid particles such as dust, haze and ice. The aircraft's electrical field may then interact with charged areas of the atmosphere resulting in an electrostatic discharge. This discharge does not have to happen in a thunderstorm.
Sgt Pepper's information was always solid, but somehow seemed as long as the Cairo, Illinois, Yellow Pages...

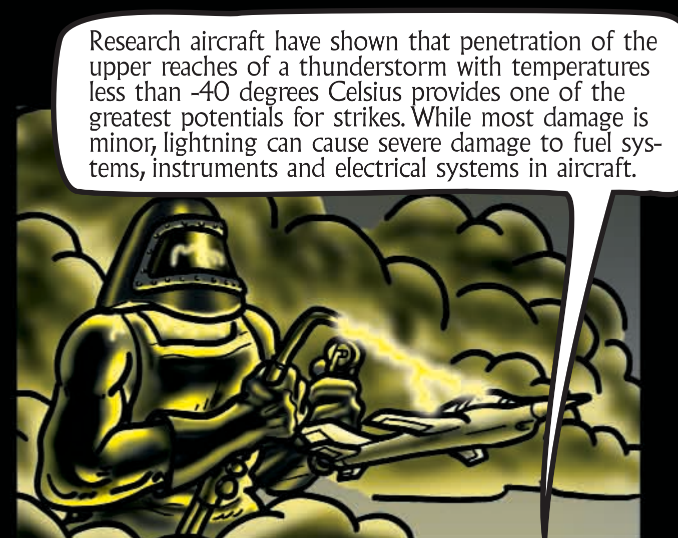


...or at least the taxpayer instruction manual.

I had to ask...



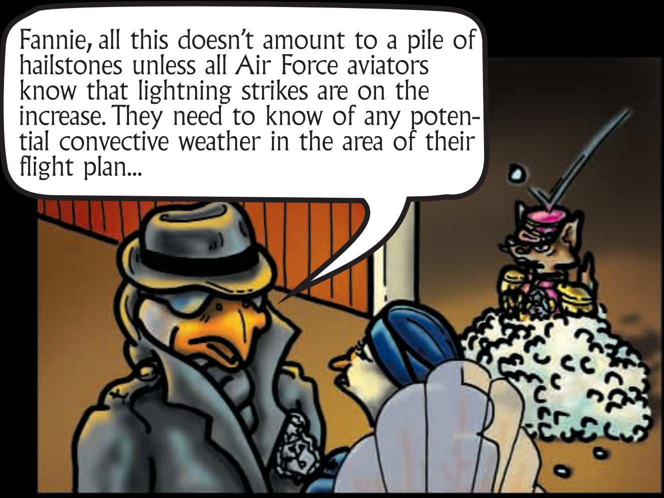
Yes, I could just picture a strike turning my little friend into 30,000 furballs...



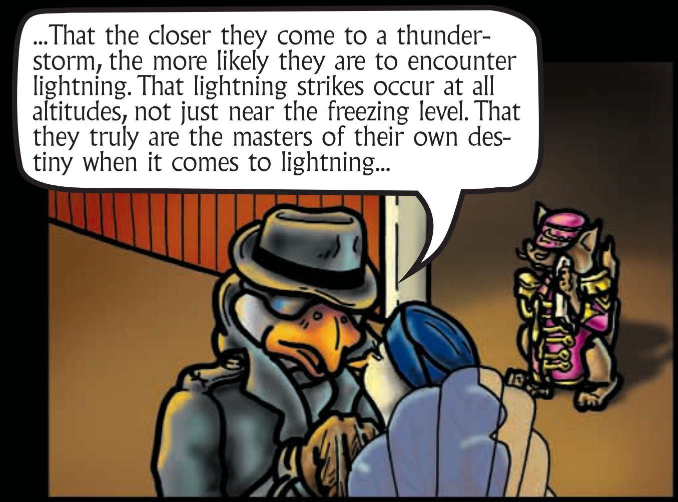
I'm glad there wasn't a third suspect. It was time to head for "Rick's".

The next morning found us somewhere in the Midwest. Flyer showed us the remains of Cruedog's aircraft.

If there's one thing Sgt Pepper could do better than anyone, it was to sniff out the evidence we needed.



We'd found the entry points for a lightning strike. We had our culprit. We now knew the Cause-O'-Blackout, but it wasn't enough.



Oh no, I was beginning to sound like Sid!

I had to get a grip...

I'll always remember the scent of thistle and suet...

Editor's Note: The following accounts are from actual mishaps. They have been screened to prevent the release of privileged information.

Editors Note: Operators, we are looking for articles to highlight how you have reacted to a situation or event that is safety related. Even better, how you prevented something from happening or a lesson learned that others could use. Plus, if you have a great program that will help another unit prevent a mishap, please contact us so we can tell the world how you are preventing mishaps instead of reacting to them.

"A Failure To Communicate."

We all experience the problem of not quite hearing what others say or misinterpreting what we are told. Unfortunately, this problem resulted in some close calls for a few aircrew members. Never forget to confirm the clearance you hear is for you and to keep to your eyes open!

F-16s Get Close

A flight of two F-16s was recovering to base from the range and another flight of two F-16s had just departed the base. Both flights were on NVG training missions, and both were cleared to 12,000 feet at the same time. Fortunately for them, they only passed within half-a-mile of each other. This closeness was due in part to both aircraft being at reduced lighting levels and the flight lead having intermittent NVGs, and therefore concentrating on the NVG problem, which delayed the two flights from seeing each other. Several other links in the accident chain set up this almost-Class A.

• The south controller did not pass on the flight information to the north controller

• The flight activity was increasing at the base at that moment.

• There was a position shift at the range control squadron occurring at the time of the incident.

• Positive handoff wasn't accomplished by the relieving controller to the oncoming controller.

• The oncoming controller assigned a 12,000-foot altitude to the departing F-16s, unaware of the other aircraft.

Bottom line of this near-miss…a flight of two F-16s was allowed to enter and transit the airspace without controller awareness. A true case of failure to communicate. Everyone, controllers *and* pilots, must stay aware of what is going on around them and make sure we stay heads-up in the cockpit.

Which Way Do I Go and When?

During a busy Red Flag recovery, two flights of four F-16s, a flight of two F-15s and a single-ship F-16 were in the VFR pattern to runways 03R/03L. The confusion starts now. Two of the F-16s split from the eight-ship and were given a straight-in approach to 03R while the rest continued to initial for runway 03R. The F-15s and the single-ship F-16 landed on 03R and were waiting to cross 03L. As they waited for clearance to cross, the F-16s were lining up for landing on 03R. Now in come two more F-15s as the F-16 eight-ship is landing on 03R. Tower tried to get the first two F-15s and the single-ship F-16 across 03L but miscommunicated the clearance, and only the single-ship F-16 crossed. Tower again cleared the first flight of F-15s to cross 03L without delay, *but* the first group of F-16s that were on landing rollout on 03R *thought* the clearance to cross 03L applied to them and expedited their exit from the runway and proceeded across 03L. At the same time the other flight of F-15s was landing on 03L. Do you see the failure to communicate here? Tower then instructed the F-16s to hold short as the first F-16 was crossing the hold line. Fortunately, the second F-16 was able to stop prior to crossing the hold line.

The main causes of this ground incident…failure to use standard phraseology and miscommunication between controllers and aircrew. Aircrew must ensure the tower clearance is for them and tower must ensure the right receiver heard their clearance. We need each other to ensure we communicate effectively and safely.

Whose Clearance Is This?

A formation of two T-37s was waiting to take off and was told to hold short due to a single T-38 on short final and a T-38 two-ship on 4-mile final. Now the failure to communicate starts. Tower issued clearance for takeoff to a civilian aircraft on another runway. The T-37s awaiting takeoff clearance thought the clearance was theirs and acknowledged the clearance. The civilian aircraft and the T-37 stepped on each other's radio transmission, so tower did not hear the read-back. The alert T-38 driver on short final became aware of the conflict, because he was listening, and initiated a go-around with the T-38 two-ship following suit. All T-38 aircraft then declared emergency fuel.

Once again, key players in the incident chain did not effectively listen and we failed to communicate during critical phases of flight. Luckily for the Air Force, the T-38 driver was awake and prevented a potential catastrophe. I hate to repeat myself, but make sure the clearance you heard is *your* clearance.

HQ AFSC Photo by TSgt Michael Featherston

A Really Enjoyable Spouses' Day

On the day of this mishap, the F-15 squadron was giving taxi run acceleration rides for their spouses. The function was thoroughly planned and briefed and approved by the squadron, to include aircraft configuration and the required 9000 pounds of fuel. All these calculations resulted in a planned braking energy of 11 million foot-pounds, resulting in a one-hour brake cooling time.

The day arrived, and all participating pilots were briefed on the TOLD data, weather and general taxi instructions. The problems start here, as maintenance only had nine aircraft instead of the planned 12. Plus, the nine aircraft to be used had 13,000-15,000-pound fuel loads, instead of the planned 9000 pounds. This didn't stop this squadron, as they pressed on and the mishap aircraft performed two taxi rides following all previously-set guidelines, to include aborting at 100 knots. Do you think they adjusted for the extra fuel weight?

The F-15E Dash 1 states, "Successive stops occurring within one hour of each other shall be considered cumulative and the brake energies shall be added together." The resulting brake energies for the two successive stops within one hour of each other were calculated for worst case (applying brakes at 120 knots) at 43.1 million foot-pounds (in the danger zone). The best case, when applying brakes at 100 knots, equals 24.5 million foot-pounds (in the caution zone). In the caution zone, the Dash 1 says, "Fuse plug release is possible" and in the danger zone it says, "Fuse plug release is expected, wheel/brakes damage may occur and brake fires are possible."

Total time between taxi rides was 45 minutes. After the second taxi ride the aircraft was shut down normally, and approximately 15 minutes later the aircraft's left main landing gear wheel fuse plug released. How could this happen, with all the planning that went into this Spouses' Day? Do you think the squadron failed to communicate and adjust to the last minute changes? Best laid plans go astray, so make sure you adjust accordingly. At least the spouses were able to see how fast the squadron can adapt to an emergency!

Maintenance Matters

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Editors Note: Maintainers, we are looking for articles to highlight how you have reacted to a situation or event that is safety related. Even better, how you prevented something from happening or a lesson learned that others could use. Plus, if you have a great program that will help another unit prevent a mishap, please contact us so we can tell the world how you are preventing mishaps instead of reacting to them.

Do We Need To Follow Tech Data?

From reading the following incidents you might think tech data usage is an option. We all know differently. No matter the task, tech data is there to ensure things don't go wrong at the most inopportune times.

Opportunity Number 1

A KC-135R was towed into the hangar to be prepped and washed prior to starting the schedule isochronal (ISO) inspection. A rudder gust lock was installed as part of the preparation. The aircraft wash was completed and the next day workers began the ISO inspection. An engine shop specialist performing the inspection reported to the Logistics Group Quality Assurance (LGQA) office that the rudder was damaged. LGQA then impounded the aircraft and completed an investigation. What could have caused extensive damage to the aircraft rudder?

T.O. 1C-135A-6WC-3, Work Card #2-001, Item 3 reads: "Install all necessary ground safety locks and pins to prevent accidental movement of various components during ground maintenance," but does not reference the –2-2JG-1 for installation procedures. T.O. 1C-135(K)R-2-2JG-1 Task 2-5-10, Rudder and Trim Tab Gust Lock Installation, steps 1 through 9 require the manual rudder shutoff valve to be closed, a danger tag to be installed and an entry in the 781 forms to be made when installing the gust lock. The closing of the manual rudder shutoff valve prevents hydraulic power from being applied to the rudder during maintenance. With $62,693 worth of damage to the rudder, what do you think happened? Was tech data followed during this inspection? The job is never done until *every step* in the tech data is completed.

Opportunity Number 2

An OA-10A returned from a mission with an inflight emergency. Maintenance personnel met the aircraft and safed the aircraft and gun system. Inspection of the aircraft revealed the gun had jammed with several spent 30 mm shells piled up in the belly of the fuselage and damage to many of the gun systems parts.

Inspectors found the gun access unit gate was hanging by the right hinge. The gate had sheared near the left hinge, and both latches were undone. In addition, the belly chute, located aft of the access unit, also contained spent shells that were out of alignment. The belly chute was bulged out at the front end, and the end shafts connecting the chute to the access unit were dented. The gun access unit latches were both damaged. These latches have upper and lower J-shaped hooks, and both upper hooks were bent at approximately 90 degrees. The right lower hook was undamaged and the left lower hook was damaged extensively. The outer surface of the latch was dented in and there were many small arc-shaped dents on the latch. However, the area around the latch was free from any dents or scratches. The left latch was dented to the point that the small spring-loaded tooth that secured the latch would not lock into place. T.O. 1A-10-33-1-2 contains a warning to "Ensure access unit door latches are latched and in fully down position." The GAU-8 engineers from the A-10 ALC determined that failure of the hardware within the GAU-8 system was not a factor in this mishap.

So what happened to cause $57,085 in damage to the aircraft? You decide if tech data was followed. Professional maintainers know that if the aircraft or system isn't right, we *stop* and *fix it* before the aircraft flies. We cannot afford to hide anything.

Opportunity Number 3

A KC-135E required engine runs to be performed in conjunction with an ISO inspection. Due to local restrictions on engine runs (every base has these in some form or another), the runs had to be performed at an alternate location. This location requires the aircraft to be taxied to the runway hammerhead by an aircraft commander (AC) and the AC then participates as a member of the maintenance run team. All ACs are considered qualified for this task upon completion of their initial qualification.

For an aircraft in ISO, at this base, there are two sets of forms. The phase dock forms are in a different format than the forms used for day-to-day operations, and the crew chief is responsible for ensuring all open write-ups are signed off or transferred to the regular aircraft forms prior to the aircraft being released for flying operations. One of the checks required after ISO is the stab trim check, which requires the stab trim to be run full travel and checked in neutral. If, however, there is a need to reinstall access panels on the tail of the aircraft, the stab trim may not be left in the neutral position, but in full nose-up position (this means the leading edge of the horizontal stabilizer is full down) to facilitate panel installation. As it was in this case. Do you see any areas where these procedures could cause future problems?

On the day of the mishap the aircraft was five days out of ISO and the forms had not yet been transcribed and contained requirements for multiple engine running ops checks. One of these checks was to ops-check the #1 engine thrust reverser, which requires the thrust reverser lever to be raised to check that the reverser operating light illuminates and extinguishes when the lever is stowed. There is no airspeed requirement in the tech data for this ops check and it could be performed in the chocks. In addition, there were write-ups in the forms for the left and right elevator control tabs being removed for repair and danger tags installed that stated, "Do not move pilot's/copilot's control column." Do you see other opportunities for problems to develop?

Here comes the good part…well, maybe. The mishap pilot was supposed to fly that morning, but the mission was cancelled. He was then tasked to assist on the engine run, and this was his first maintenance run since arrival at this station. The four-person maintenance run crew then met him at the aircraft. There is a local operating instruction that specifies the use of checklist 1C-135-2-4-1JG for all maintenance runs; however, there is no corresponding operations instruction. This local instruction also specifies what equipment must be turned on during the engine run.

The engine start was normal and the mishap pilot elected to taxi to the active runway to perform the ops checks. During taxi, the flaps were set to 20 degrees to prevent the flaps and speed brakes warning horn from sounding during the high power engine runs. The ops checks progressed with no problems until the AC called tower and asked for clearance for "two minutes on the runway and a high-speed taxi check."

The fun ride started during the taxi check when the nose of the aircraft lifted off the runway and the pitch attitude increased until the boom pod and boom fairing contacted the runway. As the mishap aircraft decelerated, the nose gear settled onto the runway and the aircraft slowed and taxied clear. Tower then informed the mishap crew of the tail strike, which was imperceptible from the cockpit.

What happened to cause this tail strike? You have the key details above. Can you figure out which link in the chain of events could have been changed to prevent this mishap? We have chances every day to prevent injury and/or damage to valuable AF property. All we have to do is look for the opportunities presented and act!

USAF Class A Flight Mishaps

FY02 Flight Mishaps (Oct 01-Mar 02)	FY01 Flight Mishaps (Oct 00-Mar 01)
16 Class A Mishaps	**8 Class A Mishaps**
6 Fatalities	**2 Fatalities**
10 Aircraft Destroyed	**8 Aircraft Destroyed**

14 Oct ♣	An HH-60 crashed into a river while flying a low-level training mission.
17 Oct	An F-16CG was severely damaged following an aborted takeoff.
25 Oct	An F-16C departed the runway after landing.
02 Nov ♣	An MH-53 crashed while performing a mission.
05 Nov ✶	An F101 engine undergoing Test Cell maintenance sustained severe fire damage.
12 Dec ♣	A B-1B crashed into the ocean shortly after takeoff.
21 Dec ♣✶	A C-141B sustained a collapsed wing during ground refueling operations.
30 Dec ♣✶	An RQ-4A Global Hawk unmanned aerial vehicle crashed while returning to base.
08 Jan	A C-17 was damaged during landing.
10 Jan ♣	An F-16C crashed during a surface attack training mission.
10 Jan	An MH-53J crashed during a search and rescue mission.
17 Jan ♣♣	Two A-10As were involved in a mid-air collision. Only one pilot ejected safely.
24 Jan	An MH-53 crashed while performing a mission. (Aircraft was originally reported as destroyed,but it is repairable)
25 Jan ♣✶	An RQ-1 Predator crashed on landing.
31 Jan ♣	A T-37 crashed during a training mission. The two crewmembers suffered fatal injuries.
02 Feb ♣	A C-21 crashed while landing. The two crewmembers suffered fatal injuries.
12 Feb	An F-15 was severely damaged due to an engine fire.
13 Feb ♣	An MC-130P crashed during a mission.
18 Mar	An MH-53 crashed during landing.
20 Mar ♣	An F-16 crashed during a training mission and the pilot did not survive.

- A Class A mishap is defined as one where there is loss of life, injury resulting in permanent total disability, destruction of an AF aircraft, and/or property damage/loss exceeding $1 million.
- These Class A mishap descriptions have been sanitized to protect privilege.
- Unless otherwise stated, all crewmembers successfully ejected/egressed from their aircraft.
- Reflects only USAF military fatalities.
- "♣" Denotes a destroyed aircraft.
- "✶" Denotes a Class A mishap that is of the "non-rate producer" variety. Per AFI 91-204 criteria, only those mishaps categorized as "Flight Mishaps" are used in determining overall Flight Mishap Rates. Non-rate producers include the Class A "Flight-Related," "Flight-Unmanned Vehicle," and "Ground" mishaps that are shown here for information purposes.
- Flight and ground safety statistics are updated frequently and may be viewed at the following web address: http://safety.kirtland.af.mil/AFSC/RDBMS/Flight/stats/statspage.html
- **Current as of 22 Mar 02.** ✈

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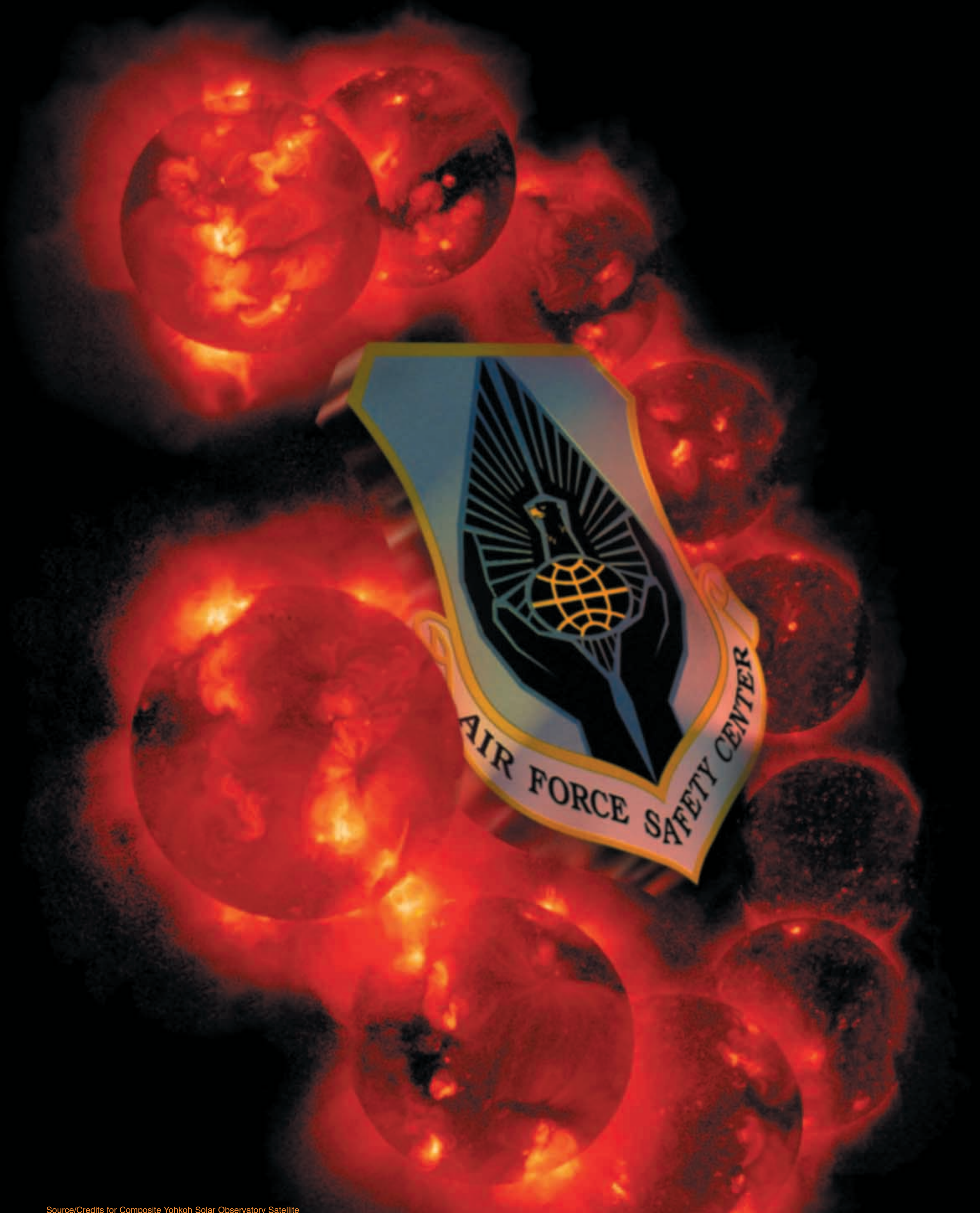
The Aviation Well Done Award is presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Mishap Prevention Program.

SSgt Lester S. Farley, Jr.
374th Airlift Wing
Yokota Air Base, Japan

On 18 November 1999, SSgt Lester S. Farley, Jr., was performing his duties as primary loadmaster for a C-130E aircraft on a local pilot proficiency sortie. Just prior to brake release, during an assault procedures takeoff with the engines at maximum power, he smelled smoke and observed an area of the rear cargo compartment burst into flames when the auxilliary hydraulic pump caught fire.

Sergeant Farley immediately called to abort the takeoff. He unstrapped from his position in the forward cargo compartment, grabbed a fire extinguisher, ran toward the aft section of the aircraft and began to fight the fire, enabling the crew to shut down the aircraft engines and the aircraft commander to initiate an emergency ground egress.

After the fire was completely extinguished, SSgt Farley completed the Emergency Ground Egress checklist and was the last one to exit the aircraft. He proceeded to the prebriefed egress point while maintaining the presence of mind to chock the aircraft nose wheel. Emergency vehicles arrived at the site, and SSgt Farley was transported to the Emergency Room and evaluated for smoke inhalation. The immediate, selfless actions of Sergeant Farley were essential to the safe evacuation of six other aircrew members and prevented the loss of a $35 million combat asset and potential loss of lives.



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