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Got Ice?

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THE ISSUE:

Cover photo by MSgt Rich Moran

GENERAL MICHAEL E. RYAN
Chief of Staff, USAF

MAJ GEN FRANCIS C. GIDEON, JR.
Chief of Safety, USAF

LT COL J. PAUL LANE
Chief, Safety Education and Media Division
Editor-in-Chief
DSN 246-0922

JERRY ROOD
Managing Editor
DSN 246-0950

CMSGT MIKE BAKER
Maintenance/Technical Editor
DSN 246-0972

DAVE RIDER
Electronic Design Director
DSN 246-0932

MSGT PERRY J. HEIMER
Photojournalist
DSN 246-0986

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Commercial Prefix (505) 846-XXXX
E-Mail — roodj@kafb.saia.af.mil

24 hour fax: DSN 246-0931
Commercial: 505-846-0931

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FSM notams

ATTENTION ROTOR-HEADS:

WEATHER MINIMUMS AND FORECASTS

Courtesy *Flightfax*, Jan 99

Air Force missions don't change just because the weather does. However, rapidly changing weather is a huge hazard to cold-weather flying. Weather minimums must be established early in planning any mission to prescribe the least acceptable weather in which a commander will permit a mission to be attempted. Up-to-date weather forecasts are mandatory; factors that must be considered include temperature, density altitude, wind speed and direction, icing, visibility, turbulence, and snow and ice conditions.

One reminder: Forecasters give icing intensity (trace, light, moderate, or severe) based on conditions as they affect fixed-wing aircraft. Rotation of helicopter rotor blades amplifies ice accumulation, so reported icing conditions will be more severe for helicopter operations.

One more reminder: Intensity of icing is very difficult to forecast. Most of our IFR-certified aircraft are capable of operating in at least light icing; however, you can't always be sure that's all you'll get. So, even if you do get a forecast of light ice, be prepared to deal with moderate or worse. And by the way, don't shop around for less icing in a forecast. It can be extremely exciting to find yourself IMC picking up a lot more ice than you ever thought really existed.

LANDING IN SNOW

Courtesy *Flightfax*, Jan 99

Operations over snow-covered terrain are difficult, even for the most experienced rotary wing aviator, and landing is especially tricky. Let's review.

When landing, pilots should never plan to terminate the approach to a hover, as disorientation can occur in the resulting snow cloud.

The initial position of an approach to snow is the same as any other approach. The primary difference is in the last 50 feet. Instead of making the normal deceleration below effective translational lift (ETL) airspeed, airspeed greater than ETL should be maintained until just before touchdown. This procedure keeps the helicopter in front of the snow cloud until touchdown, after which the aircraft will become engulfed in the snow cloud.

The approach angle during the last 50 feet deviates from the standard constant angle of descent. A slight leveling off is required to maintain airspeed. As the aircraft descends to an in-ground-effect altitude, blowing snow will develop to the rear of the aircraft. It is at this point that deceleration should begin to position the aircraft in a landing attitude. Once ground contact is made, torque should be reduced until the aircraft is firmly on the ground. ✈

Icing Can STOP You Cold

Courtesy *Flightfax*, Jan 99

> The more we know about where icing occurs and how it affects aircraft, the better equipped we'll be to avoid conditions where icing is a hazard.

We Americans, more than any other group, depend heavily on ice for our creature comforts. If you don't believe it, try serving us a warm soda. But as fond as we are of ice, even in our water (to the amazement of Europeans), one place nobody wants it is on an aircraft. You don't have to know a lot about aerodynamics to know that an aircraft weighted down with ice isn't going to fly very well.

The more we know about where icing occurs and how it affects aircraft, the better equipped we'll be to avoid conditions where icing is a hazard.

Where Icing Occurs

Water droplets in the air may not turn into ice even when the temperature is below freezing. However, when an aircraft comes along and disturbs them, these droplets latch onto its surfaces and freeze. The funny thing is that icing isn't a big problem in extremely cold temperatures. Temperatures between 0°C and -40°C are most conducive to structural icing, but serious icing is rare in temperatures below -20°C. In addition, aircraft icing usually occurs in cumuliform or stratiform clouds from sea level to 15,000 feet, most often between 1,500 and 6,000 feet.

Cumuliform clouds. These billowy, heaped-up piles of clouds contain strong updrafts of air capable of supporting large drops of supercooled liquid moisture. When an aircraft flies into this type of moisture, the large drops hit it and spread out, forming a coating of clear, glazed ice. This type of ice accumulates rapidly, and its weight and the fact that it adheres firmly make it extremely hazardous to flight. It is encountered most frequently in temperatures from 0°C to -10°C.

Stratiform clouds. Droplets of supercooled moisture found in these horizontal layers of clouds are normally smaller in size and less numerous than those found in cumuliform clouds. When these drops strike an aircraft, they tend to freeze instantly, trapping large amounts of air between the drops and forming rime ice. Rime ice adheres less firmly than clear ice, but its rough surface reduces aerodynamic efficiency, and it is more likely to shed during flight. Rime ice is most frequently encountered when the temperature is between 0°C and -20°C.

Mountain Flying

Aviators should be particularly alert for icing conditions when flying in mountainous regions. Upward air currents on the windward side of mountains support large water droplets. These currents, combined with the normal frontal lift as the frontal system crosses a mountain range, create hazardous icing zones, particularly above crests and on the windward side of ridges. This zone may extend to 4,000 feet above peaks and possibly higher when the air is unstable.

Frontal Inversions

Icing in frontal inversions also can be rapid. Temperatures are normally colder at higher altitudes, but when air from a warm front rises above colder air, freezing rain may occur. Rain falling from the upper (warmer) layer into a colder layer is cooled to below freezing but remains liquid. The liquid freezes upon contact with the aircraft, and accumulation may be very rapid.

Frost

There's another type of ice in addition to those that form on aircraft during flight. Frost usually forms on aircraft while they are parked outside in cold weather. This deceptive form of ice affects the lift-drag ratio of the aircraft; therefore, all frost should be removed before takeoff. Keep in mind that frost may also form when a cold-soaked aircraft descends from subzero temperatures into warmer, moist air.

Effects of Ice on Aircraft

Even small amounts of ice on the leading edges of an aircraft's wings affect lift and increase weight and drag. Helicopters, whose rotor disk is just another kind of wing that moves through the air at different speeds and varying angles of attack, are even more susceptible to the effects of icing than are fixed-wing aircraft. Light helicopters, because of their limited power and faster rotor systems, are the most susceptible of all to the effects of icing.

Rotor blades. Most helicopters will continue to operate satisfactorily (although performance will be degraded) even with quite severe airframe icing. However, ice accumulations on main and tail rotors have an immediate effect on the aircraft's airworthiness. Because the blade is continually moving, there are high random-vibration loads and increased rotor-profile drag. Increased power is required to maintain a given collective-pitch setting. Aircraft maneuverability and performance are restricted by accumulations of ice, and the chances of blade stall increase. The negative effects of ice on rotor blades are not normally as severe if the accumulation is uniform.

Shedding of ice. Symmetrical shedding of ice from the blades can reduce weight and restore more efficient configuration, but such shedding must be simultaneous and affect all rotor blades the same way. If ice is shed from only part of the rotors (asymmetrical shedding), it causes one blade to take up a different rotational plane from the others. The resulting imbalance within the rotor head causes vibration and feedback through the controls. In severe cases, it overstresses components such as pitch change links and possibly swash plates and scissor links. Vibration from asymmetrical shedding of ice from a helicopter with two blades is more critical than for aircraft with multiple rotors because the imbalance represents a larger percentage of the total rotor mass. The effects of vibration can be lessened by reducing forward airspeed to 60 to 70 knots. ***However, shaking the cyclic to induce shedding should not be attempted.*** This could place undue stress on the rotor system and make the imbalance worse.

Engine icing. Ice shed from rotors or other parts of the aircraft may be ingested into engines, causing damage to the compressor's first stage. This hazard is more significant in large, multi-engine aircraft. Except in extremely cold, heavy-icing conditions, or when the aircraft is maintaining a high forward airspeed, helicopters with engine anti-icing systems should be able to operate without danger of buildup and ingestion of ice into engines. In extreme conditions, it may be necessary to reduce airspeed to allow the anti-icing systems to recover and cope with ice accretion. Air starvation may occur when air inlet screens have accumulated ice. Air inlet screens have sometimes been removed before flight into forecast icing conditions. Screens on some aircraft, however, are not to be removed. Consult the operator's manual before attempting to remove air inlet screens.

Other aircraft parts. Sometimes ice forms in parts of aircraft where it isn't easily visible. This can happen both while the aircraft is parked and during flight. For example, when high-pressure hoses are used to wash aircraft, ice can form in hidden places and go undetected until it causes damage.

Summary

Maintenance personnel and aircrews should take the following actions to minimize icing hazards:

- Ensure maintenance safety annexes to unit SOPs address use of high-pressure hoses to wash aircraft.
- Remove all snow and ice from aircraft before takeoff.
- Use all necessary anti-ice/deice equipment.
- Avoid flight in clouds when the outside air temperature is between 0°C and -20°C.
- If ice is encountered, climb or descend to an altitude where the temperature is colder than -20°C or warmer than 0°C.
- If freezing rain is encountered in flight, land as soon as possible. When it is not possible to land, aviators flying IFR should request a higher altitude; those flying VFR should initiate a climb and contact the nearest air traffic control for clearance. Freezing rain is usually the result of a warm air mass overriding a cold air mass. Therefore, climbing after encountering freezing rain will normally result in the aircraft entering warmer air.
- Refer to the appropriate tech data for operator and maintenance procedures during cold-weather operations. ✈

(Editor's Note: Thanks to our friends in the U.S. Army Safety Center for this story.)

There's another type of ice in addition to those that form on aircraft during flight. Frost usually forms on aircraft while they are parked outside in cold weather. This deceptive form of ice affects the lift-drag ratio of the aircraft; therefore, all frost should be removed before takeoff.

Gortex: Answers to Your Questions

USAF Photo by TSgt Ed Boyce

(With the onset of the cold and wet weather season, it's prime-time for wearing Gortex. It's also a time when questions about the safety of wearing Gortex while performing various maintenance activities reach a high. Here are some answers. The following article originally ran in the May 1995 issue of Flying Safety. Its author, Mr. Chuck Dorney, has reviewed it and brought it up to date. As you read his article, please keep the following things in mind. The information is general in nature and is neither directive nor "the final word." Always refer to weapon system-specific tech data and manuals, T.O. 00-25-172, and MAJCOM/local policy and safety directives for the most current guidance. Our thanks to Mr. Dorney. Editor.)

MR. CHUCK DORNEY, GM-14
Chief, AFMC System Safety
Wright-Patterson AFB, Ohio

By this time, you've probably heard about the new wonder fabric called Gortex. Great stuff for foul weather gear—just ask any hiker, camper, or other outdoors person.

Gortex is a multi-layered synthetic fabric which looks and feels like a stiffer type of nylon. And, because it's such great foul weather gear, Gortex was selected and procured for use in some of our Air Force adverse weather duties. After procurement began, though, it dawned on someone there might be some restrictions with wearing Gortex clothing, especially during ground handling activities involving hazardous fuels and liquids or explosive devices.

You see, Gortex is a synthetic material, and several of the USAF aircraft servicing operations and munitions directives have much to say about the wearing of synthetic fabrics. Specifically, T.O. 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*, generally prohibits aircraft fuel servicing crewmembers from wearing any outer clothing items having more than 65 percent wool or synthetic fabric combinations. Similarly, AFMAN 91-201, *Explosives Safety Standards*, prohibits wearing clothing having high static-generated characteristics when handling electrically initiated munitions items. By now, you've guessed the big question: Can I safely wear Gortex or not?

The Search for Answers Begins

The folks at Alaskan Air Command (now

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part of Air Combat Command) were the first to ask for our advice. They had procured cold weather defense ensembles made of Gortex and then discovered they couldn't wear them during many flightline operations. What to do?

We in the AFMC Safety Directorate got the inquiry because of our past work in the System Safety Engineering Analysis program, certifying aircraft for hot refueling, integrated combat turnarounds, and other exceptional operations.

At first, we didn't have the data to answer Alaska's concerns. However, we soon discovered previous laboratory testing on other fabrics found certain fabric electrical properties gave good indications of the fabrics' propensity to accumulate and discharge a static electrical charge. These acceptable properties, which are given in Chapter 2 of T.O. 00-25-172, are:

- Inside-to-outside resistance of less than 10^{10} ohms (measured with a megohm meter using two round, disc-like probes on both sides of a fabric sample with a 5-pound weight on the top probe).
- Surface resistivity (measured along the surface of the fabric with a megohm meter) of less than 10^{12} ohms per square centimeter.

These two criteria are relatively easy to measure with minimal laboratory equipment, but they don't paint a realistic picture of the fabric's static electricity properties. For instance, what really happens when someone wears the fabric in his/her duties in different physical and climate environments?

It's easy to understand that doing strenuous work on a dry day is different from a relaxed work environment on a rainy day, to demonstrate extreme examples. We know humid environments are less static prone, and anti-static additives reduce the static charge problem (until they are laundered out of the fabric), but how effective are these variables? The laboratory folks, Aerospace Guidance and Metrology Center (AGMC/MA) at Newark AFB, Ohio, were challenged with answering that question as well as others.

The "Blue Two" Tests

We had the folks in Alaska furnish us with a Gortex cold weather defense ensemble, commonly called a Blue Two uniform. A laboratory volunteer wore the ensemble in an environmental chamber that could have both the temperature and relative humidity varied upon demand. The laboratory conducted 53 experiments, each under different environmental conditions. The volunteer "charged" the ensemble, then discharged the suit through her bare hand, gloved hand, or through a hand tool.

Using electronic equipment, the lab folks measured the electrical energy of the static discharge spark coming from each trial run. Of the 53 tests, 5 were deemed hazardous because the discharge spark contained more than 0.25 millijoules of energy (the widely accepted criterion for determining a hazardous level). This energy level roughly corresponds to the spark you get when touching a metal doorknob after walking across a carpet.

After reviewing the test data, the safety community decided Gortex was too risky to wear when fueling with JP-4 and other low flashpoint fuels because flammable vapors frequently would be present during fuel servicing. (The risk assessment is determined by combining the low probability of a static spark with a high probability of a flammable vapor.)

However, we decided Gortex *was* acceptable for fuel servicing in cold weather locations with high flashpoint fuels, such as JP-8 with its minimum flashpoint of 100 degrees F. Our logic: Low spark probability and low probability of a flammable vapor equal low risk.

Understandable Confusion Follows

You can imagine the confusion that followed. We were asked questions such as:

What is a cold weather location? Answer: If it's cold enough to require the wearing of Gortex, you're in a cold weather location. If it's warm and rainy, you can wear Gortex because the high humidity will preclude a static charge generation.

What about aviation gasoline and MOGAS? Answer: *They're low flashpoint fuels and are too risky*. JP-5, J-8, JP-10, and diesel fuels are high flashpoint fuels and have an acceptable risk.

continued on next page

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Official USAF Photo

Gortex is a great material for cold and wet weather clothing. If you follow the guidelines and precautions spelled out in current Air Force directives and tech data, you can safely wear Gortex clothing for most flightline and other operations.

What about "switch-loaded" aircraft? Answer: First of all, switch-loading, or "mixed fuels," refers to situations where you are fueling with one type of fuel into an aircraft previously having another fuel in it. We decided, in these cases, if the last four fuel servicings were with JP-8 or other high flashpoint fuels, the risk is acceptable, and Gortex is permitted for fuel servicing personnel.

How About Munitions Handling?

After we established a policy for fuel servicing operations, it was time to look at the wearing of Gortex while handling munitions. We now know what static properties Gortex has but do not have much data on munitions. It was easy to assume that hard-cased munitions, such as bombs, **do not** present a hazardous situation. That's because if a person touches a bomb, the spark will dissipate on the case and not affect the components and explosives inside.

There is also what is called the Faraday effect. That's when like charges repel each other and remain on the outside of a munition. You may have seen a science demonstration where someone sits inside a spherical cage made of steel mesh and is not hurt by a large electrostatic discharge. All the charges remain on the outside of the sphere to the point there are no charges anywhere on the inside of the cage.

Electrically initiated munitions, however, present another situation. There is little data on the sensitivity of these items to static discharges. Based upon historical data, we *believe* that Gortex is acceptable to wear, but have advised users to ground and bond themselves according to present directives and to handle munitions carefully—don't directly touch electric primers, for example.

How About Oxygen Handling and Servicing?

We now should address oxygen servicing. An oxygen-enriched atmosphere has two detrimental effects: It lowers the minimum energy needed to ignite something, and it creates a larger flame or spark. Remember that an ignition source is still necessary. It's a common misperception that liquid oxygen (LOX) and petroleum products are hypergolic, i.e., ignite spontaneously upon contact. Such **is not** the case—an ignition source is still needed. However, the ignition source **does not** need to be as large as one needed for a normal atmosphere.

In any case, no additional precautions or restrictions are needed for oxygen servicing. Insofar as Gortex is concerned, there are currently no special clothing restrictions for gaseous oxygen servicing (GOX), and none are needed. *LOX servicing, on the other hand, has detailed clothing restrictions spelled out in T.O. 00-25-172, and these restrictions need to be followed.* Gortex can be worn in LOX servicing operations, **but not as outer garments!** Use the personal protective equipment specified in Chapter 5 of T.O. 00-25-172 and the applicable aircraft servicing tech data.

Summary

Gortex is a great material for cold and wet weather clothing. If you follow the guidelines and precautions spelled out in current Air Force directives and tech data, you can safely wear Gortex clothing for most flightline and other operations.

If you have any questions, give us a call at DSN 787-6007, FAX 986-1305. ✈

Why You Should Write For Flying Safety Magazine!

Flying Safety magazine exists for one purpose: To promote aircraft mishap prevention. We try to heighten safety awareness by taking three tacks:

❖ *Presenting articles that inform,* in the hope that additional knowledge may help prevent your becoming a mishap statistic

❖ *Presenting cautionary tales* of those who have become mishap statistics, so that you won't repeat their mistakes

❖ *Presenting first person accounts* of others who almost became mishap statistics

According to feedback we receive from you, the last category, the "First Person Accounts," is one of your favorite reads. Ironically, we receive very few "There I Was..." type stories from you.

Our opposite numbers at the Naval Safety Center publish a first-class aviation safety periodical that runs under the banner "Approach." The Approach staff recently reported that they only have room to publish 15 to 20 percent of the hundreds of "There I Was..." accounts they receive each year (we should be so cursed!). Doesn't mean our USN counterparts make more mistakes. It does mean they aren't shy about 'fessing up to boners, knowing it means a lot more coming from somebody who has been there, done that, and lived to tell about it.

Getting aircraft ready to fly--and flying them once they are airworthy--are inherently dangerous activities. We know you've had your own close encounter with catastrophe and urge you to share the lessons you've learned, particularly since your telling may influence a fellow aviator, maintainer, aerial porter, loadmaster, or boomer to think twice before doing something that makes him (or her) the next mishap statistic.

This is a golden opportunity for you to get in on the mishap prevention business on a large scale, and do so with a minimum of sweat: Send your "There I Was..." story to Flying Safety magazine. And as always, it's your choice whether your anecdote is published with your name, or anonomously. Thanks!

Write to us:
Flying Safety
9700 "G" Avenue, SE
Kirtland AFB NM 87117-5670

Or E-Mail us:
roodj@kafb.saia.af.mil

USAF Photo by SSgt Steve Thurow

A New Definition of Cold

Cold Injuries In Extreme (And Not So Extreme) Environments

Photos by author

LT COL JAY C. NEUBAUER
HQ AFSC/SEFL

As we taxied into the off-load area, local weather reported clear skies with an ambient temperature of -39°C with 20 knots of wind making it an incredible -95°F.

The approach and landing were definitely different from my usual experience. No concrete, no centerline stripe, no grass, and no trees, just white. The "runway" was marked with orange and black flags that were barely visible in the blowing snow. The landing was literally a slide to a stop with the uneasy feeling that at any moment the LC-130 might break right or left for an unplanned 360. Of course, this is just another day in paradise at 90 degrees south latitude. Welcome to the SOUTH POLE!

As we taxied into the off-load area, local weather reported clear skies with an ambient temperature of -39°C with 20 knots of wind making it an incredible -95°F. I rushed to get my big-boy pants, parka, ski mask, ski goggles, bunny boots, gloves, and hat on before the crew door and cargo ramp opened. I looked and felt like the proverbial Charlie Brown—but I was warm. Once outside, I remained quite comfortable until I slipped my over-mitten off (you know, the big, lined leather mitten with the fake fur on the back for wiping your nose). My fleece glove did not do much to cut the chill, and within 15 seconds, my hand was starting to go numb. Being a smart guy, I put my mitten on quickly, but couldn't generate enough heat to warm my hand until I got back on the aircraft. I was fortunate that I had a place to go warm up. Otherwise, this simple act could have been life threatening.

Cold injuries are not usually this sudden in onset, but they can certainly be much more devastating and typically occur in much warmer temperatures because people just aren't prepared. Fliers usually don't think about cold injury much because it's rarely an issue until they find themselves in a survival situation post-mishap. So let's review the types of cold injuries and, more importantly, what to do to prevent them.

Most of the cold injuries can be divided into two neat categories—freezing and nonfreezing. The freezing injury is frostbite in its various degrees of severity. Nonfreezing injuries include chilblains and trench foot and hypothermia.

Chilblains and trench foot are a result of exposure to temperatures above freezing but, usually, less than about 50°F. Injury results from constriction of blood flow due to exposure to both cold and wet (i.e., turns white, numb, and wrinkly followed by redness, swelling, and PAIN when rewarmed). Prolonged loss of blood flow is a bad thing and can result in nerve and muscle damage with potentially nasty complications (local infection leading to amputation or generalized infection leading to death).

Frostbite, as its name implies, requires freezing temperature and represents the freezing of water in the skin and tissue below. The colder the temperature, the faster it can happen. Fingers, toes, ears, and noses are the most susceptible to freezing because they have less blood flow for surface area. Blood flow is further reduced when exposed to cold, and these appendages are hard to protect without limiting or compromising function. The depth of skin frozen determines severity. Like burns, frostbite is classified into first, second, and third degree injury. See the table.

Hypothermia is the lowering of the body's core temperature. We all walk around with a normal temperature of about 98.6 °F. If, for some reason (Help! I've fallen in this snow bank and I can't get out…), the body can't generate the heat needed, the body temperature starts to drop. The response is to start shivering to generate heat. At about 95°F, shivering stops and, as the body temperature continues to drop, loss of coordination, loss of memory, loss of consciousness ensue, followed by other bad things below 86°F.

Now that we have covered the gory details, let's look at what predisposes people to cold injury. In general, anything that promotes heat loss increases the risk of injury. In the survival situation, the big hazard is getting wet (landing in the water or sweating on land). Water increases heat loss 25 times over air the same temperature. Anything that disturbs circulation also increases the risk. The more common examples are cigarette smoking (yet another reason to quit), high altitude, and blood loss from injury. Other factors include alcohol, tranquilizing medication, fatigue, immobility or immobilization. And, of course, the ever-popular taste-testing metal objects in sub-freezing temperatures.

Motherly advice time. The best treatment for cold injuries is to prevent them in the first place. The best preventive measure is to dress appropriately for the situation or potential situation. Thinking ahead and planning for the worst goes a long way in the cold survival situation. This means, for example, taking a flight jacket and wearing long johns when flying in areas where the temperature may fall below 40 degrees (during the flight or at night if stuck out after dark in a survival situation).

Always dress in layers. Layers allow for flexibility depending on temperature and activity. And don't forget the hat, gloves, and warm boots to prevent injury to those parts that are most prone to problems. Any good outdoor equipment store can fill you in on the latest and greatest in high tech, lightweight cold weather gear. Off-duty, watch the alcohol and winter activities. Sure, you may feel warmer on the inside, but the risk for problems increases. If caught in a survival situation or simply out for recreation, moderate activity to prevent sweating. Remember water increases heat loss, and that's a bad thing.

I learned two very important things after I jumped back on the LC-130. One, -95°F is very survivable (you can be warm) if you are dressed appropriately. Two, at this incredibly low temperature, a simple mistake, miscalculation, or screw up can land you in a world of hurt very fast. Bottom line: Have enough situational awareness to know your current conditions or any potential situation that may come up, and BE PREPARED! (Those of you flying between the Tropic of Cancer and the Tropic of Capricorn may disregard.) ✈

Always dress in layers. Layers allow for flexibility depending on temperature and activity. And don't forget the hat, gloves, and warm boots to prevent injury to those parts that are most prone to problems.

Severity of Frostbite	Characteristics
First degree	Red, swollen
Second degree	Swollen, blisters
Third degree	Dead tissue

IT'S COOL TO BE WA

How a new-fangled vehicle improved our deicing operations and made them safer.

SMSGT TOM HARE
319th Aircraft Generation Squadron
Grand Forks AFB, North Dakota

USAF Photos by SSgt Samuel R. Anderson

For the benefit of those who haven't experienced life on the Northern Tier, let me give you a little taste. Cold weather typically starts in late October and often lingers into the first week in April. Temperatures average in the teens, but wind often conspires with the cold to make it feel more like 25 degrees (and colder) below zero. Then there's snow. Snowfall is frequent, heavy snowstorms aren't uncommon, and snow usually stays with us throughout the winter season. As a result, working outside in winter here at The Forks can charitably be called "very challenging." It can be especially challenging when it comes to deicing aircraft to ensure they're safe for flight. But our Landoll Model TM1800 aircraft deicer vehicles have made the challenge a little less formidable.

In the fall of 1998--and just in time for the year's first snowfall--Grand Forks received six new Landoll TM1800s. In previous versions of deicer vehicles we used, the person doing the deicing braved the elements in an open basket, totally exposed. When deicing an aircraft, if the wind were blowing just right, this person would get soaked with hot water and deicing fluid--not fun! People were *tasked* for deicing duties, and the motives of anyone who volunteered for time in the basket were looked upon with as much suspicion as were Corporal Klinger's (from the M*A*S*H TV series) when he volunteered to reenlist in the Army! But the TM1800 has changed all that. Now, the person doing the deicing sits in an enclosed, heated cab (see accompanying photos).

These new deicers have been a boon for our winter operations in two distinct ways.

RM WHEN IT'S COLD

First, increased operator comfort and safety. The operator is no longer exposed to the elements. He doesn't need to worry about deicing fluid being blown into his eyes. Being in an enclosed cab also means he isn't subjected to unfavorable winds blowing water and deicing fluid back and soaking him, which is a huge benefit, because being wet always compounded the danger of frostbite. Greater comfort and zero probability of getting deicing fluid in the eyes means operators can do a better job of deicing. And that's really what it's all about. The greatest advantage of these new deicers is that the operator can be meticulous because he's focused more on the deicing task than protecting himself.

Training the troops on TM1800 use went pretty smoothly. Using Landoll's excellent training guide, the 319 AGS Sortie Support Flight trained a cadre of Sortie Generation Flight reps on the truck and boom/basket operation in just a few days. In turn, these reps trained the rest of the squadron's personnel. As a point of interest, unlike previous deicing vehicles we've owned, the TM1800 has the capability to dispense anti-icing fluids. We'll begin using it for anti-icing operations in the not-too-distant future and are currently preparing an Operating Instruction for its use.

` As with all new technologies, the TM1800s did present some unexpected problems. Being in an enclosed basket requires a much greater awareness of one's surroundings and makes it a little trickier to accurately judge distances from aircraft and other objects. Also, during January and February, users reported recurring problems with the boom/basket rising two to four feet with no input from them. Since the 319th Transportation Squadron (TRNS) has responsibility for maintaining the vehicles, we worked with both them and Landoll reps to find a solution. Landoll determined that pressure on the boom's hydraulic actuator was set too high for our winter conditions and recommended reducing it. Under Landoll direction, TRNS maintainers made adjustments on several occasions and were able to find an optimal operating range to prevent boom/basket creep.

One other thing about these new deicers that really got our attention was how much deicing fluid they could dispense. During a two-month period the deicing fluid rate usage was pretty high: 5780 gallons. In addition to the expense of deicing fluid, we also had to be mindful of the environmental impact. Again, working with Landoll and TRNS, we were able to design and get approval for a modification to the fluid selector valve that restricted fluid flow to 60 percent without sacrificing deicing effectiveness. Once installed, deicing fluid usage rate over the next month dropped to about 1000 gallons.

The enclosed cab is equipped with windshield wipers, and even though we got a few reports of difficulty keeping the glass clear in blowing snow conditions or because of deicing fluid sticking to it, there were many more favorable comments about how user-friendly, warm, effective, and safe the TM1800 was. And when you've got to deice an aircraft as large as the KC-135 Stratotanker, it's cool to be warm when it's cold.✈

(SMSgt Hare is a career aircraft maintainer. He is a Crew Chief by trade and has been associated with the KC-135 during his entire 19 years in the Air Force. He has worked the Stratotanker at K.I. Sawyer AFB, Michigan and Grand Forks. Since writing this article, SMSgt Hare has moved from his position as Flight Chief of the Sortie Support Flight, and become Flight Chief for Knight Sortie Generation Flight.)

As with all new technologies, the TM1800s did present some unexpected problems. Being in an enclosed basket requires a much greater awareness of one's surroundings and makes it a little trickier to accurately judge distances from aircraft and other objects.

Hydroplaning Made Easy

MAJ ARTHUR P. MEIKEL
Aerospace Safety, Dec 80

(Since this article originally appeared almost 20 years ago, we haven't published much on "slick runways." With the cold and wet weather season at hand, and mishap prevention in mind, we thought it would be useful to run "Hydroplaning Made Easy" one more time. The AF Safety Center's engineering cadre reviewed it for currency, and with the exception of a couple of minor changes, it appears nearly unchanged from its original form. One more item in the "plus" column for you to use to manage risk more effectively. — Editor)

Hydroplaning is easy. All you have to do is land an aircraft on a wet or icy runway and you will experience some sort of hydroplaning.

In reviewing past hydroplaning articles, we find that the same information is often presented in slightly different format. The pictures and examples change, but the definitions and explanations are consistent and correct.

To make better use of the information we have received over the years, let's think of it in two categories: (1) How to stay out of a moderate or severe hydroplaning situation, and (2) What to do when confronted by hydroplaning conditions.

The first category of information can better be described as education, facts, formulas, and figures designed to teach JUDGMENT. Authors are reluctant to mention judgment for some reason, but a major portion of a pilot's pay is earned through the decisions he makes. If you are willing to make the decision to divert to an alternate, you may have selected the best defense against a hydroplaning mishap. Notice the phrase "willing to make the decision to divert." When an aviator is designated pilot in command, he is recognized as "able and responsible" to make a decision to divert. Ideally, the decision is the pilot's; however, anyone who flies knows the pressure to stay on schedule or get the passengers/goods to their destination. To help us make a sound decision on whether or not to land, let's review what information is available from preflight through just prior to landing. Consider which information is most critical. As you scan the list, try to rank each item according to what value you place on it and how much it affects your judgment.

- **Coefficient of friction (M=F/N)**
- **Definitions of viscous, reverted rubber and dynamic hydroplaning**
- **Tire pressure**
- **RCR**
- **Runway composition/surface**
- **Tire condition**
- **Current weather conditions**
- **Consult with supervisor**
- **Aircraft capabilities**
- **Your proficiency**
- **Runway environment**

Official USAF Photo

Coefficient of friction. The formula M=F/N for coefficient of friction gives you an abstract figure based upon friction force over normal force. This formula is nice to know but is unimportant if you already believe that braking effectiveness is a variable which is dependent upon, among other things, the runway surface condition. In other words, if you believe "it gets slippery when wet," you have learned this lesson.

Definitions. The definitions of three recognized types of hydroplaning are meant to teach you that hydroplaning of some sort can occur from touchdown to 0 KIAS with very little moisture present or on a patchy runway.

- Reverted rubber hydroplaning occurs when the pilot locks the brakes. During a prolonged skid, the tire slides on a layer of melted rubber or steam generated by friction on a wet surface.
- Viscous hydroplaning occurs on wet runways with a smooth surface or one covered with melting ice or rubber deposits. During viscous hydroplaning, a tire displaces only a portion of the moisture on the runway surface.
- Dynamic hydroplaning occurs when an aircraft tire is completely separated from the runway by water. Dynamic hydroplaning is affected by the ability of the tire to break through the layer of water.

Tire pressure ($7.7X\sqrt{p}$). An aircraft will continue to experience dynamic hydroplaning until it decelerates to a speed below $7.7X\sqrt{p}$ (p equals tire pressure). During landing, this is a good figure to be aware of so you will know at what speed you should begin to get improved braking effectiveness. Below this speed, you still are susceptible to viscous and reverted rubber hydroplaning. For large aircraft, tire pressures are varied for different gross weight. Ask your crew chief the tire pressure on preflight. It's normally on his preflight checklist.

Tire condition. Tread patterns greatly affect the tires' ability to break through a limited amount of surface water. If you're flying with a set of "slicks," you're in much worse shape than if you have a good set of water-diverting, deep-grooved tires. Maintenance can prove that your "slicks" are good for at least two more landings. As aircraft commander, it's your prerogative to decide if they are acceptable for *your* next two landings. Change if necessary!

Runway composition/surface. Another good mission-planning task would be to investigate the runway composition and type of surface for your base of intended landing and your alternate. A concrete runway is more desirable than an asphalt one when you are trying to avoid viscous hydroplaning. In addition to determining the runway composition, the type of runway surface is also important. If a runway is grooved, it helps water escape from under the tire and prevent dynamic hydroplaning. It would also be good to know the drainage situation at your base of intended landing. Some bases near sea level have poor drainage and literally are underwater during a moderate rain. Other bases have porous runways and water disappears instantly. If this information isn't available, or you lack personal knowledge, call the base operations officer or talk to someone who has operated out of the base. Unfortunately, this information isn't always available in the IFR Supplement.

Aircraft capabilities. Review your Dash One, if you haven't done it lately, to refresh yourself on winter operations. Include crosswind limitations on an ice-covered runway. Aircraft capabilities include becoming intimately familiar with your antiskid system, braking system, and a review of winter thrust reverser procedures.

Runway environment. Review your destination's environment with hydroplaning factors in mind. In addition to checking runway length, check to see if there is an overrun. Many civilian fields or combination civil/military fields don't have an overrun. Some flight manuals make special provisions for landing on runways without overruns. If the field services primarily airliners, expect that snow removal may not be as good as you are used to since most commercial aircraft are blessed with thrust reversers. Look at the runway gradient. If you have your choice due to a crosswind or very light wind, landing uphill may make a 500-foot difference. Know the size of the "zero zone" (distance from the end to the first marker) at your destination. When you are hydroplaning past runway markers, it may help you to know *exactly* how much runway you have remaining, i.e., 6,000 feet or 6,400 feet.

Consult with supervisor. After you've done all of your homework and are ready to go fly in less than optimum conditions, let your supervisor know what the

continued on next page

latest conditions are, and tell him your intentions. You'll find that he is under the same pressures you are. He also has to accomplish a mission and keep his aircraft in one piece. Get the benefit of his experience. A topnotch supervisor will let you know what he expects and remove any self-induced pressure you might feel. Besides, he's getting paid to make decisions too.

Your proficiency. Consider your capabilities as well as your aircraft's. If you have been filling the minimum number of squares in the last few months due to leave, DNIF, or commitments in the Middle East, the Balkans, or other places far from home, you may be putting yourself behind the power curve. I've seen pilots request that an IP be added to the flight orders due to forecast weather conditions. The request was honored and was considered by all to be good judgment.

Current weather conditions. Right up to the time of landing, the weather must be monitored. A heavy shower over the runway while you are on final approach could cause you to delay your landing until the shower passes. Frontal passage may mean a big change in winds in a short time. A severe shower or abrupt wind change can quickly put you outside your aircraft limitations or remove the headwind advantage you might have counted upon.

RCR. Runway condition readings give you a good estimate of what kind of braking action to expect. If you find yourself in a position where stopping distance is critical, request more information on the reading before putting a lot of confidence in it. How old is the reading? Was it taken right behind a snowplow? What is the RCR in your specific stopping zone? Has precipitation fallen since the last reading? The point is, don't rely on the accuracy of an artificial RCR value except for a planning factor. If you don't get the braking action you expected, go around.

Now that you've gathered the necessary information and if you made the decision to land, you're about to enter phase two. Let's consider what things you have to work with between the final approach fix and a full stop. Make a mental priority listing of the most important factors to you and your aircraft.

- **Reconsider**
- **Go around**
- **Firm landing**
- **Aerodynamic braking**
- **Braking technique**
- **Which side of runway to land on**
- **Directional control**
- **Landing speed**
- **Asymmetric thrust**
- **Differential braking**

Go around. I like the decision to go around the best. You can't go off the end of the runway if you still have the ability to take off. You may find that the information on which you based your decision to land was incorrect. The RCR you were given may have been incorrect or old. Water may have turned to ice. Precipitation could have increased while you were on final. All sorts of things could have gone wrong, gone wrong, gone wrong! Of course, the go-around must be done smoothly, correctly, and in time. This requires some planning and coordination on your part. You have to convert the decision time, communication time, engine acceleration time, takeoff distance, rotation distance, and obstacle clearance distance into a meaningful distance and speed. Planning can shorten decision and communication time, but the other factors are pretty much constant. Your flight manual can provide you with some of the figures, but you must decide how slow you can go at your weight and still take off. (For example: At 125 knots you may need 2,000 feet; at 100 knots you may need 3,000 feet; at 75 knots you may need 4,000 feet!)

Hydroplaning is easy when you know how.

Reconsider. After one attempt, you may find that you have better information to make a decision. Go back to step one even if it was only your proficiency that wasn't up to par.

Landing speed. Increases in landing speeds add distance to your ground roll and flare distances. Whether extra speed is due to pilot deviation, turbulence, configuration, or gusts, the extra ground roll required to dissipate your ground speed may exceed runway available. If stopping distance is critical, a go-around due to excessive speed may be required.

Firm landing. Previous articles state that a firm landing can dissipate from 10 to 15 knots. If you're above your computed speed, a firm landing can result in a bounce and more runway behind you than you'd like.

Braking technique. There are two major points to consider. The first point is when to start braking. ASAP is about right. Don't use any delayed braking factor or wait until your normal braking point. If the runway is

Official USAF Photo

damp or partially snow covered, or otherwise doubtful, stop the machine as soon as you can. It's safer and will provide you with a better idea of your aircraft's capabilities.

The other point to remember is how your Dash One recommends braking on wet or icy surfaces. In general, you want to brake as hard as you can without locking up your tires. With your wheels locked, you can hydroplane to a much lower limit of your dynamic hydroplaning envelope. *(Antiskid braking systems are the rule these days, rather than the exception. The author originally advised releasing brakes occasionally to release inadvertently locked wheels. We say, "Adhere to Dash One procedures." Another thing to consider is the fact that most of the time there are heavy rubber deposits located on either end of the runway [usually the first and last 3,000 feet of runway]. These deposits get real slick when it rains [especially if it hasn't rained in awhile]. If there is concern over landing distance due to a heavy-weight landing [or a reduced/no-flap approach is being performed], consideration should be given to performing most of the braking in the middle section of runway [before the last 3,000 feet]. Better to have warm brakes than a runway-departed aircraft.—Editor)*

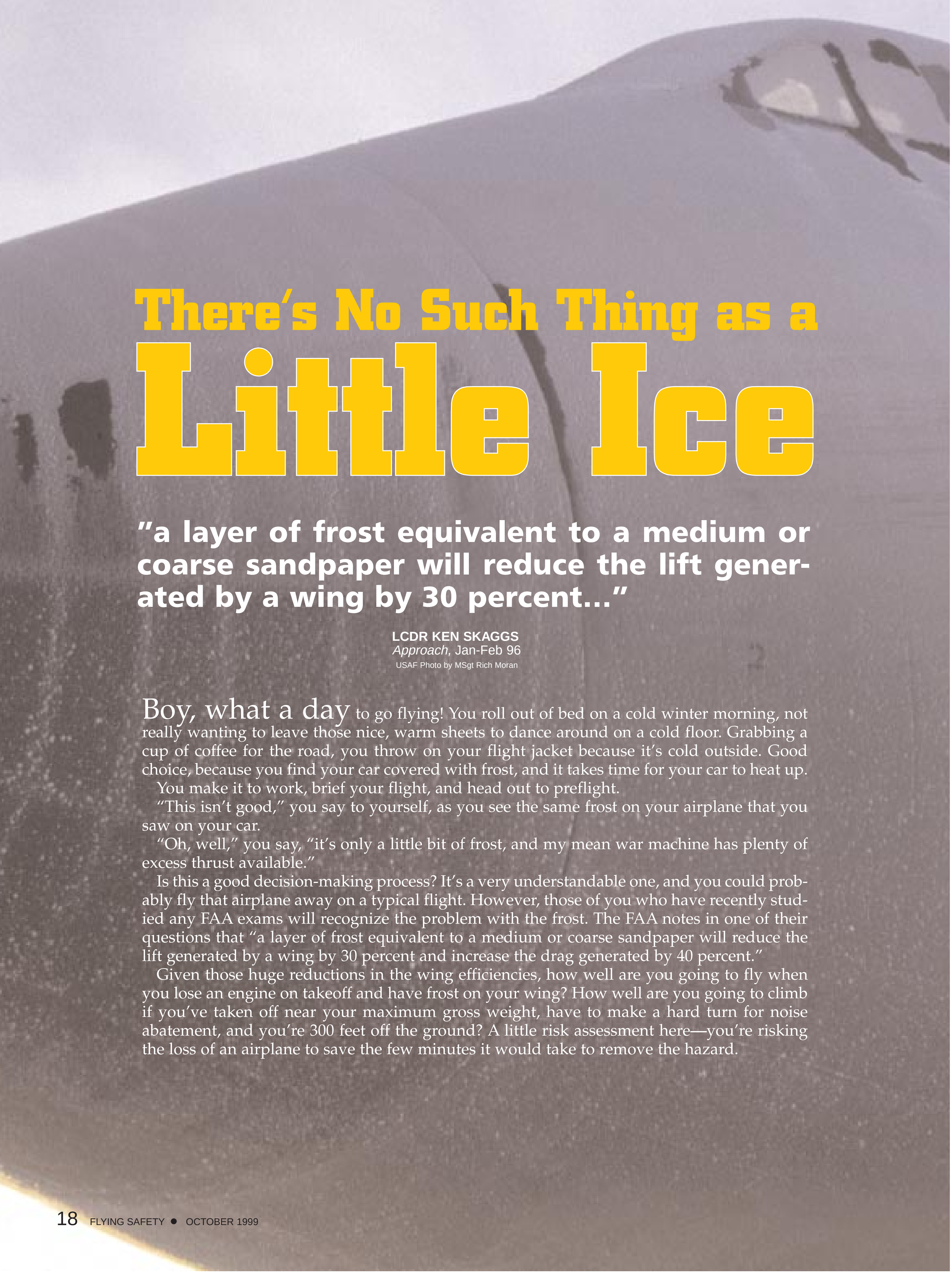
Aerodynamic braking. Every airplane is capable of some aerodynamic braking. As much as possible should be used to take the maximum advantage of headwind components. Some aircraft have limitations on aerodynamic braking due to poor controllability during crosswind situations. On other aircraft, crosswinds may cause normal braking to be uneven during aerodynamic braking.

Which side of the runway to land on. There are a lot of factors to consider in this decision. I'll simply try to list them and let you make your own decision. Landing in the middle of a crowned runway is normally the driest spot; however, a crosswind prevents water from running off the upwind side as quickly as the downwind side. If you move slightly off center, you run the risk of putting a set of main tires on the slippery painted center line. Moving slightly farther to the downwind side puts you on a side slope and a crosswind pushing you down that slope toward the short side of the runway. If your aircraft has a drag chute, you have another force helping you toward the side. If you land on the upwind half, you face the problem of your aerospace vehicle weather-vaning into the short side of the runway. When you slow to below the dynamic hydroplaning speed, directional control becomes a consideration as the aircraft starts to gain directional capability toward the near edge of the runway. At these slower speeds, aerodynamic directional control is poor. On flat runways, there also is the problem of puddles or ice patches to avoid. As we discussed earlier, the depth of the water is a definite factor. Snowplows and sweepers sometimes leave patchy intersections or portions of the runway which make normal braking uneven. If wheels are locked crossing patchy areas, reverted rubber hydroplaning can result. Dealer's choice!

Directional control. Refer to your Dash One for your best means of directional control. The rudder is usually the best means of keeping the aircraft where you want it. Use ailerons to counteract crosswinds for as long as possible. Even in large aircraft, ailerons play a greater role in steering than many pilots think. Improper use of ailerons can cause uneven braking, even at slow speeds, since it places uneven weight on the main landing gear. As for nose wheel steering, it's useful mainly in clearing the active runway after the aircraft is under control.

Asymmetric braking/thrust. While asymmetric braking works better than nose wheel steering, in most cases the use of asymmetric thrust or braking means that you aren't using every means available to stop the aircraft. You probably planned on using all of your braking effectiveness and, at most, idle power. With asymmetric braking, you are, in fact, increasing your ground roll and possibly should go around. Quite often asymmetric directional control occurs at relatively low speeds which are past the go-around point. One nice aspect of using asymmetric thrust is that a skidding tire won't be damaged as long as total hydroplaning occurs. The bad aspect is that you may be one hand short when looking outside the aircraft and trying to locate a throttle inside the cockpit. How proficient are most of us in taxiing an aircraft on an icy runway with throttles only? When was the last time you did it?

The next time you taxi clear of a wet or icy runway, your sigh of relief will be because conditions were as you expected them to be and you knew you could stop. Gone are the days when you might have estimated and hoped that you would be able to stop. Hydroplaning is easy when you know how. ✈



There's No Such Thing as a Little Ice

"a layer of frost equivalent to a medium or coarse sandpaper will reduce the lift generated by a wing by 30 percent..."

LCDR KEN SKAGGS
Approach, Jan-Feb 96

USAF Photo by MSgt Rich Moran

Boy, what a day to go flying! You roll out of bed on a cold winter morning, not really wanting to leave those nice, warm sheets to dance around on a cold floor. Grabbing a cup of coffee for the road, you throw on your flight jacket because it's cold outside. Good choice, because you find your car covered with frost, and it takes time for your car to heat up.

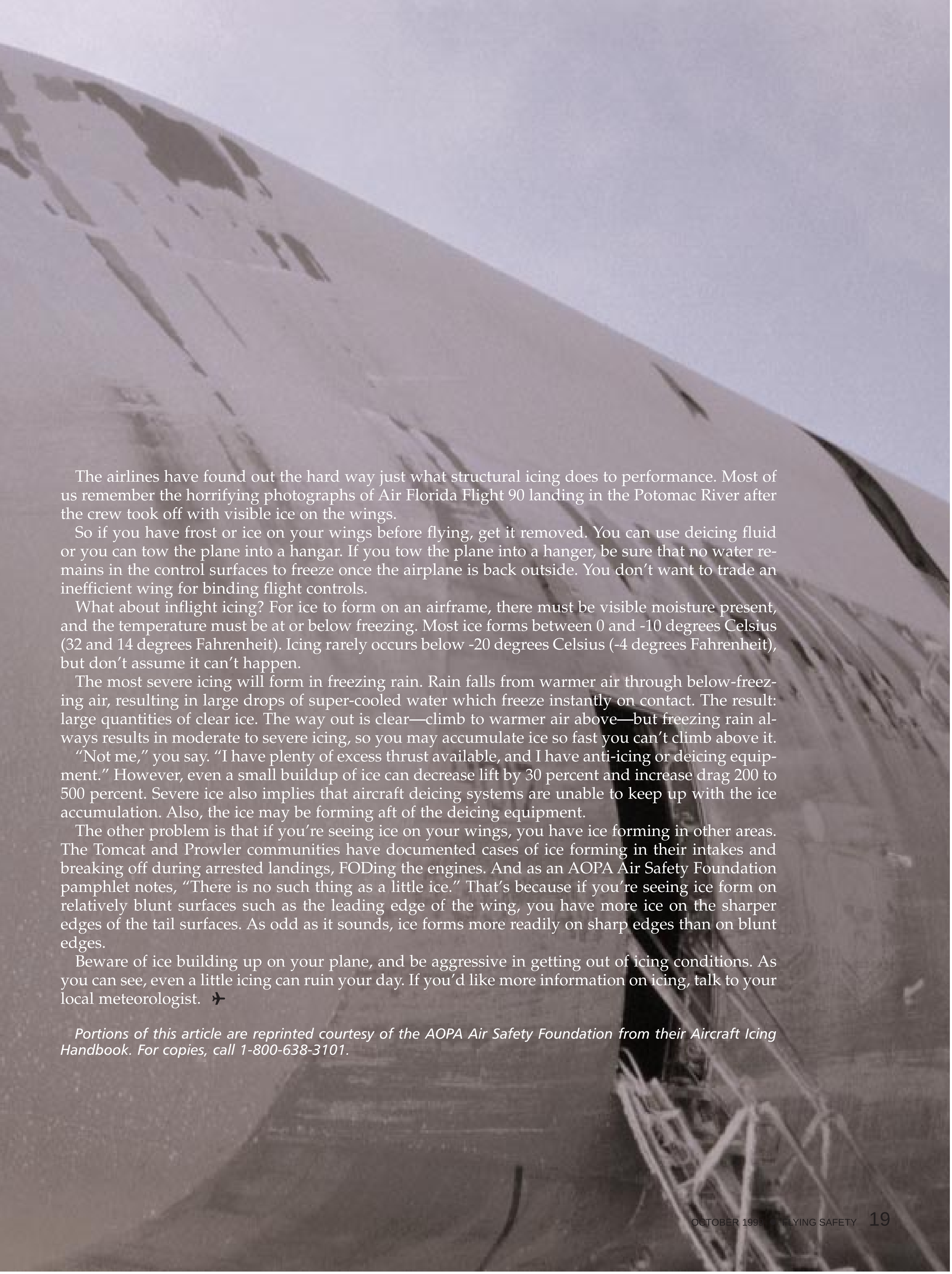
You make it to work, brief your flight, and head out to preflight.

"This isn't good," you say to yourself, as you see the same frost on your airplane that you saw on your car.

"Oh, well," you say, "it's only a little bit of frost, and my mean war machine has plenty of excess thrust available."

Is this a good decision-making process? It's a very understandable one, and you could probably fly that airplane away on a typical flight. However, those of you who have recently studied any FAA exams will recognize the problem with the frost. The FAA notes in one of their questions that "a layer of frost equivalent to a medium or coarse sandpaper will reduce the lift generated by a wing by 30 percent and increase the drag generated by 40 percent."

Given those huge reductions in the wing efficiencies, how well are you going to fly when you lose an engine on takeoff and have frost on your wing? How well are you going to climb if you've taken off near your maximum gross weight, have to make a hard turn for noise abatement, and you're 300 feet off the ground? A little risk assessment here—you're risking the loss of an airplane to save the few minutes it would take to remove the hazard.



The airlines have found out the hard way just what structural icing does to performance. Most of us remember the horrifying photographs of Air Florida Flight 90 landing in the Potomac River after the crew took off with visible ice on the wings.

So if you have frost or ice on your wings before flying, get it removed. You can use deicing fluid or you can tow the plane into a hangar. If you tow the plane into a hanger, be sure that no water remains in the control surfaces to freeze once the airplane is back outside. You don't want to trade an inefficient wing for binding flight controls.

What about inflight icing? For ice to form on an airframe, there must be visible moisture present, and the temperature must be at or below freezing. Most ice forms between 0 and -10 degrees Celsius (32 and 14 degrees Fahrenheit). Icing rarely occurs below -20 degrees Celsius (-4 degrees Fahrenheit), but don't assume it can't happen.

The most severe icing will form in freezing rain. Rain falls from warmer air through below-freezing air, resulting in large drops of super-cooled water which freeze instantly on contact. The result: large quantities of clear ice. The way out is clear—climb to warmer air above—but freezing rain always results in moderate to severe icing, so you may accumulate ice so fast you can't climb above it.

"Not me," you say. "I have plenty of excess thrust available, and I have anti-icing or deicing equipment." However, even a small buildup of ice can decrease lift by 30 percent and increase drag 200 to 500 percent. Severe ice also implies that aircraft deicing systems are unable to keep up with the ice accumulation. Also, the ice may be forming aft of the deicing equipment.

The other problem is that if you're seeing ice on your wings, you have ice forming in other areas. The Tomcat and Prowler communities have documented cases of ice forming in their intakes and breaking off during arrested landings, FODing the engines. And as an AOPA Air Safety Foundation pamphlet notes, "There is no such thing as a little ice." That's because if you're seeing ice form on relatively blunt surfaces such as the leading edge of the wing, you have more ice on the sharper edges of the tail surfaces. As odd as it sounds, ice forms more readily on sharp edges than on blunt edges.

Beware of ice building up on your plane, and be aggressive in getting out of icing conditions. As you can see, even a little icing can ruin your day. If you'd like more information on icing, talk to your local meteorologist. ✈

Portions of this article are reprinted courtesy of the AOPA Air Safety Foundation from their Aircraft Icing Handbook. For copies, call 1-800-638-3101.

Icing Above Freezing? Believe It!

USAF Photo by SrA Jeffrey Allen

O. K. TRUNOV
Russian Research Institute for Civil Aviation
Courtesy *Business Aviation Safety Journal*
Vol 9, 1994

An infrequent, little-known, but dangerous and insidious phenomenon can form structural ice on the ground.

After having been parked for 3 hours, the airplane was being made ready for departure. It was drizzling. The air temperature was 5°C (41°F). Before boarding the airplane, the pilot in command rubbed his hand along the wet leading edge of the wing and asked the flight engineer, "Have they done the deicing?"

"What deicing, commander? It's warm. It's raining!"

The airplane began to taxi to the start. If the crew had only suspected what danger lay in wait for them.

On takeoff, at the moment of liftoff, the crew heard a noise. Almost simultaneously, the right engine started to vibrate intensely, and there was a surge. The engine was shut down. The pilot in command decided to return to the airport immediately.

It was a timely decision, for 15 seconds later the left engine started to vibrate. It was possible, however, to make a safe landing.

Later, when the airplane was examined on the ground, severe damage to the right engine was found—in particular, the inlet guide vanes and the first, second, third, and fourth stages of the low pressure compressor. The second engine also suffered lesser damage.

"Where did this damage come from?" asked the astonished flight engineer. "It can't be birds."

"Ice," replied the pilot gloomily. "Instructions are written to be carried out!"

What had happened, and of what instructions was the pilot thinking?

Old Problem, New Twist

What had happened was an infrequent, little-known, but dangerous and insidious phenomenon. It's but one aspect of the general problem of ice formation while on the ground, a danger with which everyone who operates aircraft is familiar. Moreover, experience has shown it's becoming a more pressing problem than formerly recognized despite the protection methods and aids that have been developed in recent years.

Damage to engines caused by ice which has formed on the parts of an airplane located in front of the engines is an old and acute problem. Ice may form in flight or while the airplane is on the ground, but in most cases it occurs when there are external atmospheric icing conditions and below 0°C outside air temperatures.

A special case is ice formation on the surface of an airplane while it's on the ground when there are above-0°C outside air temperatures and no external icing conditions. This is caused by the following phenomenon.

If the tanks of an airplane on the ground contain fuel that has a temperature below zero, then on the parts of the airplane which adjoin the fuel tanks, also having a temperature below zero, ice may form in above-zero outside air temperatures when there is rain or fog, or also as a result of moisture condensation.

The greatest danger to airplanes with engines located in the tail may be the formation of such ice on the upper surface of the wing-root section where fuel tanks are often located. The ice may be more than 0.6 inch thick, and the area over which it forms may be quite considerable. When such ice forms, the outside air temperature is usually not higher than 41°F, but there is information on hand that this phenomenon also has occurred at air temperatures above 50°F.

At the same time, and as in the case described earlier, no ice formation will be observed on other parts of the aircraft or on ground objects that have a temperature above freezing. This confuses technical personnel and crews who naturally consider that if there is no ice formation on the ground, then airplane deicing is not required.

And for the same reason under these conditions, the monitoring of the state of the airplane surface also is sometimes reduced.

Another feature of this kind of ice formation is that the ice covering the airplane skin in the area of the fuel tanks is usually transparent and thus difficult to detect on the wet surface of the airplane.

More frequently, such ice is shed from airplane parts and enters the engines during takeoff and the initial climb phase. This can disrupt the operation of the engines, and damage them, and could result in very serious consequences.

Available Experience Underused

Despite the fact that cases of ice forming on fuel tanks have been known for several years and damage to engines for this reason has often been noted in civil aviation operations, this and the conditions under which it occurs have not been studied sufficiently. Also, effective aids have not been developed for its timely detection and the prevention of negative consequences.

The only recommendation in force at present is the requirement to pay increased attention to and monitor carefully the state of the surface of the airplane before takeoff. Apparently, this is what the pilot in command was thinking of when he said that "instructions" have "to be carried out." Possibly he was also thinking of special instructions for all types of airplanes which draw the attention of engineering and flight personnel to the possibility of ice formation on some parts of an airplane while it is on the ground and when the air temperature is above freezing.

A situation that's more dangerous than it looks occurs when fuel is cooled to below 0°C in normal cruising. Then, the airplane lands at an airport where conditions are ripe for ice formation: continuous rain, drizzle, and temperature slightly above freezing. The below-0°C temperature of the fuel in the tanks, however, may be maintained for many hours. It should be borne in mind that even during short flights the fuel in the tanks rapidly "acquires" a subfreezing temperature.

In a modern airplane, flying at typical cruising altitudes, the fuel temperature goes down by 10 to 15°C per flight hour. If, for example, the takeoff fuel temperature was +5°C, after 1.0 flight hours at cruising altitude the fuel temperature on landing may be -5°C to -10°C (with ambient surface temperature on the order of +5°C).

Another case is also possible where in an airplane at its point of departure takes on fuel that has been cooled considerably. It arrives at an airport where the air temperature is above freezing and there is precipitation. And, sometimes, although icing on surfaces above fuel tanks may have occurred on a parked aircraft, the crew doesn't note any deviations from the norms during a flight. The consequences of ice formation are found only after landing.

For example, an Ilyushin IL-62, flying 2

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Despite the fact that cases of ice forming on fuel tanks have been known for several years and damage to engines for this reason has often been noted in civil aviation operations, this and the conditions under which it occurs have not been studied sufficiently.

April 1986, from Domodedovo to Alma Ata, experienced no abnormalities in engine operation during flight. After landing, however, significant deposits of ice (up to 0.4 inches thick) were found on the upper surface of the wings in the area of the service sections of tanks 1, 2, and 4. Examination also revealed compressor blade damage in engines 2 and 4.

There's no doubt that the reason for the damage was the partial shedding of ice from the wing surfaces. Before departing Domodedovo, the airplane stood for 2.5 hours in conditions of precipitation, and an air temperature of +2 to 3°C. Ice formation wasn't observed on ground objects, and the aircraft wasn't deiced.

In their postflight explanatory notes, the crew reported that water was flowing from wing edges and that there was no ice formation on the ground. However, a more careful examination would undoubtedly have shown that on sections of the wings with surface temperatures below 0°C, ice was indeed accumulating.

> **In some cases, icing on surfaces near fuel tanks may not have any negative consequences despite ice formation on the upper surface of the wings. Yet, in other cases, serious engine damage has occurred.**

In some cases, icing on surfaces near fuel tanks may not have any negative consequences despite ice formation on the upper surface of the wings. Yet, in other cases, serious engine damage has occurred.

Data from a number of airlines repeatedly have indicated formation of ice on wing upper surfaces (up to 0.8 inches thick) which has caused engine damage. However, in most cases there was no explanation for this occurrence.

It must also be pointed out that sometimes ice still remains after deicing—for a number of reasons. In most cases, in ground icing conditions thin ice formations (hoarfrost, sleet, thin ice coatings) or frozen snow are found on the airplane surface. These are removed by a preheated deicing fluid applied with a comparatively low flow rate.

When a fairly thick layer of ice (0.4 to 0.8 inches) forms, more time and a higher deicing fluid flow rate are required. If the ice that has formed is covered by snow, which often happens when the air temperature goes down, then the technical personnel may not succeed in removing it if they carry out "normal" deicing and when they don't suspect the presence of thick ice near fuel tanks.

An example is the case of a DC-9-51 which departed Helsinki on the morning of 2 May 1985. During the takeoff run, the pilot in command felt a reduction in acceleration and aborted the takeoff. Inspection of the upper surface of the wing-root section where the fuel tanks are located revealed transparent ice (up to 0.8 inches thick). Part of the ice had flown off during the takeoff roll, damaging the engines.

The previous flight leg of this airplane had lasted 3.5 hours; then the airplane stood parked for 6 hours with 5,000 pounds of fuel in its tanks, in rain and snow conditions and air temperature at freezing. Before departure, the airplane was deiced. The whole airplane surface had been cleaned except the sections with transparent ice over fuel tanks, which went unnoticed.

Having received information on similar occurrences, Finnair pilots have carried out some careful, independent checks of the state of airplane surfaces after application of a deicing fluid. They also have checked the confirmation of the quality of the deicing operation performed by ground service technicians.

The results were alarming. In a number of cases, in the area where the fuel tanks are located the pilots found on the upper surfaces of the wings thick, transparent ice which had only been wetted by the deicing fluid.

Finnair thereafter recommended:

In all cases where icing near fuel tanks is possible, it is essential after the deicing not only to carry out a careful visual examination but also to check, by feeling with one's hand, the state of the airplane surface in those sections where there might be ice formation. In doing so, one should feel the greatest possible region in the area in which the tanks are located.

There's no doubt about the usefulness of this recommendation, despite the somewhat primitive nature of the method proposed.

Everything discussed previously has related to the problem of ice forming while an airplane is on the ground. But, can ice form on the upper surfaces of wings in the area of the fuel tanks during flight, when the outside air temperature is slightly above 0°C? This remains to be answered precisely and requires experimental research. This can be done partially in a wind tunnel simulating icing conditions. However, for now, one can only say that such cases (if, in fact, they are possible) must be very rare.

Another question is whether it's possible for the crew to monitor the formation of ice near fuel tanks using technical aids. Yes, it's possible. To do so, one must know the fuel temperature, the surface temperature of the parts of the airplane which adjoin the tanks, and the nature of the airplane's environment. The development of such technical aids will not present significant difficulties, but this, too, requires special research.

On new airplanes being developed, consideration should also be given to requiring thermal insulation between the fuel tanks and those sections of the airplane surface where ice formation may lead to dangerous or adverse consequences.

Fundamental Solution Needed

Operating experience has shown that despite the special instructions to crews and ground personnel developed in recent years, there continue to be cases of airplanes taking off with ice which formed while they were on the ground. Moreover, the number of such cases is increasing.

What are the reasons for this phenomenon? Analysis of such cases and talking with flight and engineering personnel leads this author to conclude that there are three main reasons.

The **first**, of course, is the human factor. Both the flight personnel and the ground personnel still don't have sufficient knowledge in this field. Misunderstandings occur and underestimates are made of the danger of ice formation on the ground. Consequently, established rules are sometimes disregarded.

The **second** reason is the imperfection of the methods and means used to monitor the state of the airplane surface and to monitor for possible engine icing. How, for example, can one reliably ensure immediately before takeoff that there is no ice or snow on the high-set horizontal tail surfaces? Technical aids must be developed for objectively monitoring the state of the airplane surface and to monitor for possible engine icing. This is essential to avoid human errors.

The **third** reason is that the fluid protection technique guarantees a safe takeoff only when one has a deicing fluid that's highly effective in all meteorological conditions and when one has effective equipment for treating the airplane surface with it. Both the fluid and the application equipment need to be improved, particularly the presently available equipment.

One strategy is to improve the fluid protection technique which both removes the ice and protects the airplane surface against ice reforming.

The problem can only be taken off the agenda after fully resolving both parts of the problem:

- Overall treatment of an airplane with an effective deicing fluid that removes ice deposits and prevents surface ice formation in severe meteorological conditions.
- Technical aids to reliably and objectively monitor the state of the airplane surface before takeoff and to monitor for engine icing.

A significant practical step has already been taken in solving the first part of the problem. Reportedly, Swedish experts from a firm called De-Icing have recently developed and are operating a stationary, computer-controlled system which consists of a gantry and a system of sprayers through which the deicing fluid passes.

An airplane with passengers aboard and engines operating approaches the gantry, where it is treated with the fluid before taxiing into position. It takes 1 to 2 minutes to treat an airplane. The spent fluid passes through porous asphalt, goes into a cleanup system, and then is reused. Thus, both the airplane and the environment are protected. In the opinion of many experts, the system is very effective and economical and is better than similar existing systems.

The former Soviet Union used deicing fluids for many years to deal with ice formation on airplanes on the ground. Special studies and operating experience showed that the fluid used in the USSR, "Arctica-200," provides effective protection of the airplane surface over a wide range of atmospheric conditions which contribute to ice formation.

It's recognized that in conditions of supercooled rain and intensive wet snow, the duration of the protection given by the fluid is reduced considerably. Therefore, work on improving deicing fluids has not stopped. The task at hand is to improve the protective properties of the fluids in the most difficult icing conditions. It's in that direction that studies are moving to develop new deicing fluids. ✈


USAF Photo by MSgt Perry J. Heimer

OPS Topics

Outta Control

How quickly can a high-performance jet get away from you? For your consideration, we provide this cautionary tale…

The F-16 driver was scheduled to fly as No. 6 of a 12-ship Red Air package in support of Weapons Instructor Course (WIC). From flight brief to engine start, everything was fine. Then, shortly before taxi, his F-16CJ—configured with only two wing tanks—developed problems that forced him to step to the spare, an F-16DJ—configured with (among other things) two wing tanks *and* a centerline tank. The aircraft swap would play a pivotal role in subsequent events.

Taxi, departure, and DACT were uneventful. Then, to meet regeneration criteria and rejoin the fight after being "killed," he initiated an Immelman to climb above 40,000 feet MSL. Starting in military power at 30,000 feet MSL at nearly 370 KCAS and with 6,000 pounds of fuel, he floated his entry and maintained only 3 Gs. Approaching vertical and slowing through 189 KCAS, the low-speed warning horn sounded. He had almost made it to 40,000 feet—39,150 feet MSL, to be precise—when he found himself inverted in level flight with zero airspeed. Then his aircraft started a slow right roll with a left yaw component. If you're thinking "Uh-oh," good call. The Falcon departed controlled flight and the engine compressor stalled. The mishap pilot promptly initiated the CAPs for out-of-control, recovered the aircraft, and leveled off at 27,950 feet MSL. The engine compressor stall cleared on its own once the aircraft was flying again.

After an expedited RTB, touchdown, and debrief, the engine was R&R'd. A thorough review of engine data revealed the in-flight compressor stall had been mild, and when coupled with the HUD VTR tape, pointed to disrupted airflow as the culprit. Although this Class C flight mishap didn't result in injury, or an ejection and a pranged aircraft, it was the trigger for an unnecessary engine change. Jet Shop couldn't find any damage to the motor, and it checked out okay on the Test Cell.

So, just how quickly *can* a high-performance jet get away from you? Whether you're an experienced stick actuator or not, it can happen pretty quickly if you're not careful and allow mission press to get the better of you.

A Near Mid-Air Collision

Just when you think you've heard them all, along comes a NMAC with a twist...A US Navy SH-60B launched from NAF Atsugi to conduct a day training flight. During transition from Atsugi airfield airspace at 100 KIAS and 1000' AGL, the aircraft commander caught sight of an aircraft co-altitude, approaching rapidly on a reciprocal heading. The aircraft got real big, real quick, and that's when the aircraft commander and crew realized it was a *radio-controlled* aircraft with a seven-foot wingspan. They made a quick left turn to avoid the impact and the RC aircraft passed down the chopper's right side within 100 feet. Perhaps fittingly, once abeam the SH-60, the helicopter's rotor wash caused it to tumble out of control to the ground.

Subsequent investigation and informal discussions with Japanese locals revealed that the particular area near the Sagami River where the SH-60 met the RC aircraft is routinely used for launching and recovering RC aircraft during day/VFR conditions. Since this occurrence, a revision to the base's instruction and Atsugi ATIS advise of the proximity of RC aircraft near airfield airspace and the Sagami River. Credit the crew's thorough brief prior to flight that covered see-and-avoid techniques and potential emergency maneuvers. When the emergency occurred, they acted together and averted the mid-air, as briefed. Two thumbs up! ✈

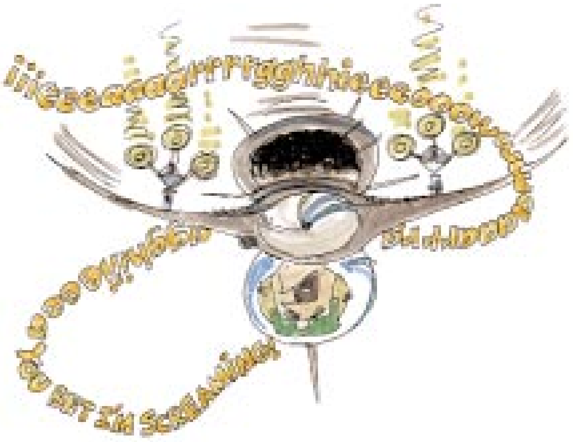
"But Eagles Don't Practice Carrier-Arrested Landings!"

This experienced mishap pilot (MP) had more than 1000 hours in Air Force aircraft, most of those hours in C-130s. Because he was new to fighters and transitioning to the Strike Eagle, he was flying the B-course syllabus. This sortie promised to be a busy one.

Among other things, it included low-level ingress, low-level threat reactions, two fly-up air-to-air engagements, a wounded bird exercise, and re-attack. The mission was uneventful until RTB, where the MP lowered the gear, reduced speed, and otherwise configured the aircraft for landing. He flew a normal final turn, touched down on speed, and then came to a stop *almost immediately*. Why did the jet stop so quick? While configuring the aircraft for landing, the MP had also lowered the tailhook...*and snagged the approach-end barrier.*

Maintenance crews and QA tested all related aircraft systems post-mishap and found everything to be in working order. After repairing more than $11 thousand dollars in landing damage to the #1 and #2 engine divergent nozzle segments, connecting links, and various seals, the F-15 was again airworthy.

Conclusion? Since the tailhook actuator switch and landing gear handle are within one inch of each other, *be careful*. 'Nuff said. ✈



Night Time, Upside Down, Nose Low, and Screaming

The young mishap pilot (MP) was part of an F-16 four-ship Medium Altitude Navigation and Targeting Infrared for Night (MANTIRN) Surface Attack Tactics sortie. He had only recently completed Mission Qualification Training and this mission was to include his first night "dead-eye" deliveries.

Preflight, takeoff, in-flight checks, range entry, and three LGB deliveries were all uneventful. The flight then transitioned to the pre-briefed dead-eye formation, where release parameters were set at a heading of 330 degrees, a speed of .85 Mach, and a release altitude of 16,200' AGL.

Eight seconds after one of his wingmen called bombs away, the MP began his run on the target. Shortly thereafter, both the CARA (set to alert at 8700' AGL) and ALOW (set to alert at 6000' AGL) systems started giving altitude warnings. In fact, this Fighting Falcon was flying nearly upside down, extremely nose low, and already exceeding .85 Mach. Not exactly a preferred position from which to drop bombs. Previously setting up his CARA and ALOW systems to provide altitude alerting made the difference. Had he not taken immediate action to recover from the unusual attitude, this young pilot would likely have ended up a smoking hole in terra firma.

Lessons learned? Whether seasoned or inexperienced, flying at night can be hazardous to anyone's health. There are no better life preservers to arm yourself with than situational awareness and a good instrument cross-check. ✈

Class A Mishaps FY99

FY99 Flight Mishaps (Oct 98 - Aug 99)	FY98 Flight Mishaps (Oct 97 - Aug 98)
29 Class A Mishaps	**20 Class A Mishaps**
9 Fatalities	**4 Fatalities**
24 Aircraft Destroyed	**16 Aircraft Destroyed**

6 Oct	✶	An airman suffered a serious back injury during a helicopter training exercise.
21 Oct	♣	An F-15E crashed during a SATN training mission killing both crewmembers.
22 Oct	♣	Two F-16Cs collided shortly after departure. One F-16 was destroyed and the other F-16 recovered uneventfully.
29 Oct		A C-9A's No. 2 engine failed and caught fire shortly after a touch-and-go.
9 Nov	♣	An F-16CG crashed during a day BFM training sortie, killing the pilot.
17 Nov	♣	An F-16C experienced engine failure and crashed during a day training sortie.
19 Nov	♣	An F-16CJ experienced loss of thrust shortly after takeoff and crashed.
4 Dec	♣	An F-16D experienced engine failure 25 minutes into flight and crashed.
15 Dec	♣	An F-16C on a day training sortie experienced loss of thrust on RTB and crashed.
29 Dec		An OA-10A's No. 1 engine throttle cable failed during flight. The pilot had difficulty landing, the aircraft departed the prepared surface, and all three gear collapsed.
7 Jan	♣	An F-16DG experienced an engine malfunction shortly after gear retraction and crashed.
13 Jan	♣	A KC-135E crashed northwest of the departure end of the runway. All four crewmembers were fatally injured.
20 Jan	♣	An OA-10A entered an uncommanded, nose-low attitude. Unable to return the aircraft to controlled flight, the pilot ejected, and the aircraft was destroyed.
21 Jan	♣	An F-16CJ conducting low-level tactical navigation struck trees on a ridgeline. The engine failed, and the aircraft was destroyed on impact with the ground.
28 Jan	♣♣	Two F-15Cs were flying a Dissimilar Tactical Intercept Training sortie against a three-ship of F-16Cs. The two F-15s collided during the first intercept and were destroyed.
3 Feb	♣	An F-16C on a training mission had an engine malfunction. The pilot ejected after an in-flight fire developed, and the aircraft was destroyed on impact with the ground.
24 Feb	♣✶	An RQ-1A UAV departed controlled flight, crashed, and was destroyed.
17 Mar		On climbout, a U-2S canopy shattered, FOD'ing the engine and damaging the vertical stab. The pilot RTB'd and made a safe landing.

18 Mar		**An F-16C suffered major damage on landing.**
26 Mar	♣	**An F-16C on a day training sortie suffered loss of thrust, crashed, and was destroyed.**
29 Mar	♣✶	**An RQ-4A Global Hawk UAV crashed and was destroyed.**
30 Mar		**A U-2S experienced loss of hydraulic pressure and suffered major damage on landing.**
7 Apr	♣✶	**A KC-135R sustained major fuselage damage. (Ground Mishap)**
10 Apr		**An AMRAAM and No. 1 launcher were liberated from an F-16CJ during flight.**
18 Apr	♣✶	**An RQ-1K UAV crashed and was destroyed.**
26 Apr	♣	**An F-16DG experienced a landing gear malfunction while attempting to land. The pilot executed a successful go-around and proceeded to the controlled bailout area, where both pilots ejected. The aircraft was destroyed on impact with the ground.**
19 May		**An F-117A sustained a fuselage fire on takeoff roll. Takeoff was successfully aborted.**
2 Jun	♣	**An MH-53J conducting an exfil mission crashed in the LZ. One crewmember was killed.**
15 Jun	♣♣	**An F-15C and an F-15D crashed while on a local training mission.**
18 Jun	♣	**An F-16DG crashed while on a local training mission.**
1 Jul	♣	**An F-16C, part of a four-ship SAT sortie, struck the ground during the low-level portion of the mission. The pilot was fatally injured.**
12 Jul	♣	**An F-16C crashed while on a local training mission.**
11 Aug	♣	**Two F-16Cs collided during the landing phase. The pilot of one F-16 successfully ejected, while the other F-16 recovered safely.**
19 Aug	♣	**Two F-15As collided during a BFM sortie. One pilot safely ejected. The other F-15A made it back to base.**

- *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 dollars.*
- *These Class A mishap descriptions have been sanitized to protect privilege.*
- *"♣" 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.*
- *Unless otherwise stated, all crewmembers successfully ejected/ egressed from their aircraft.*
- *Flight, ground, and weapons safety statistics are updated daily and may be viewed at the following web address by ".gov" and ".mil" users: http://www-afsc.saia.af.mil/AFSC/RDBMS/Flight/stats/index.html.*
- *Current as of 24 Aug 99.* ✈

Maintenanc

MAINTENANCE MATTERS

Presents…

THE TWILIGHT ZONE EDITION

It's plausible that Capt Murphy ("Murphy's Law") and Rod Serling ("The Twilight Zone") were related since they shared the same uncanny genius for describing (and explaining) events that typically occurred on the outer edges of reality. Culled from the file of unlikely, perplexing, and downright bizarre mishap reports, we submit the following tales for your consideration…

The Crippled Eagle

Murphy's Law states "If anything can go wrong, it will." One of his lesser known corollaries, Corollary #15, states, "Nature always sides with the hidden flaw." Here's proof.

An F-15 was being towed from the hangar to the flightline by a qualified tow team IAW applicable tech data when "it" happened. The left main landing gear (LMLG) was rolling over a 3-foot-by-3-foot storm water drain grate when the grate failed, allowing the gear to fall into the 3-foot deep hole, stopping the aircraft's forward movement nearly instantaneously. The left wing tip hit the ground, and because the tow vehicle still had momentum, the tow bar wrenched the nose strut forward, buckling the drag brace and causing the nose landing gear (NLG) strut to rest against the forward landing gear door.

But there's more. The centerline fuel tank—filled with 600 gallons of JP-8—struck the ground and ruptured, loosing its entire contents on the ramp. The tow supervisor immediately notified the Maintenance Operations Center and declared a ground emergency. Once the ground emergency was terminated, the aircraft was raised, made safe for towing, and taken back into the hangar.

What happened? A little research revealed that the grate was part of a storm drainage system that had been built in 1941 (not a typo), and the grate's age, couldn't be determined. Host unit CES inspected the 13 (a coincidence? I think not!) other grates along aircraft tow routes and found cracks in 9 of them. New grates with an 80,000-pound weight capacity were ordered, and until they're installed, this unit won't tow or taxi aircraft over the existing ones. At nearly $174,000 for cleanup, inspection, troubleshooting, repair, and op checks to the aircraft's NLG, LMLG, RMLG, wing tip, and external tank, that was one expensive storm drain grate. Any storm water drain grates of unknown age/load-bearing capacity along your aircraft tow/taxi routes?

"Uh, MOC, Could You Please Dispatch a Firefighter to Our Deicer?"

Corollary 3 to Murphy's Law states "If there's a possibility of several things going wrong, the one causing the most damage will be the one to fail." More proof.

Two maintainers were tasked to deice a transient aircraft. They pulled up to the tramp with the deicing vehicle's heaters and auxiliary engine on, and as one of them climbed into the boom, he noticed flames coming from the deicing vehicle's heater exhaust ducts. He informed his coworker, retrieved the truck-mounted fire bottle, and shut off both heaters before attempting to fight the fire. After he fully discharged the deicer-mounted extinguisher, the fire was still going. By now, the tramp aircraft's crew chief—who was more than casually interested in the truck fire he was witnessing—grabbed the flightline fire bottle parked near his aircraft and tried his hand at putting out the growing blaze. No good: He emptied his flightline fire bottle, but the fire was still going. Realizing now that this was more than they could handle, the deicer driver called the fire department for help and drove the burning vehicle a safe distance from the aircraft. The fire department responded and was able to extinguish the blaze once and for all.

What happened? Transportation Squadron maintainers scrutinized the deicer vehicle closely and found nothing more mysterious than that a hole in the heater coil (normal wear and tear) had ignited the deicing fluid inside the heater. But wait a minute…This particular model of deicer has separate tanks for "Deicing Fluid" and "Water," and the defective heater coil had been in the "Water" tank. A hydrometer test on contents remaining in the "Water" tank revealed the water was contaminated with deicing fluid. That explained how "water" could burn.

But as for the other part of the mystery, and an answer to how deicing fluid came to be introduced into the "Water" tank in the first

ce Matters

place, well, that's still unknown. Despite the fact that the covers for the tanks were properly labeled "Deicing Fluid" and "Water," someone put the right stuff in the wrong tank. What are the odds of these two unlikely circumstances occurring simultaneously with one of your deicers? We'd guess the odds are pretty long. Of course, a good program of preventive maintenance, coupled with a solid training program that emphasizes how improbable events like this will occur if one isn't careful, could keep those odds from getting any shorter.

The Levitating Bathtub

Murphy's Corollary #7 states "When things are going your way, look carefully in the opposite direction." An F-16 was taken to the Hush House for some engine maintenance. The engine was started, stabilized at idle for 5 minutes, and checked for leaks. With no leaks noted and all cockpit readings looking good, next step was to advance to mil power and allow the engine to stabilize before kicking in augmenter.

While the engine was running at mil power, one of the Jet troops in the control cab caught sight of something moving in the area—something that shouldn't have been moving. It was panel 4305—known as the "bathtub panel"—sitting 30 feet from the left side of the aircraft near the No. 5 intake door. Knowing that objects caught in 300-miles-per-hour exhaust in a confined space is a very, very bad thing, he called for idle power immediately, but it happened too quickly.

Turbulent airflow within the Hush House caused the bathtub panel to "levitate," and it entered the exhaust tunnel, banging against the sides twice before hitting the blast deflector in the rear. Hush House damage was limited to a hole in the blast deflector and scratches and dents on the tunnel sides, but the bathtub panel was totaled. The unit has since implemented local checklist changes that augment existing Hush House guidance contained in T.O. 33D4-6-645-1, *Operation and Maintenance Instruction, Enclosed Aircraft Noise Suppression Systems, Operation and Maintenance* (whew!). These changes require "positive" storage in Bays 5 and 6 for panels that must remain off and should prevent future instances of unauthorized levitation of bathtub panels (and any other items).

"Which Engine Did You Say We're Running?!?!?"

Almost without exception, hazardous operations become even more hazardous when they're done at night, and engine runs are a prime example. The maintainer was tasked to perform a single-engine maintenance run on an F-15's No. 2 engine. He did the pre-run inspections IAW applicable tech data, but since he had to gather up a ground observer, an intake spotter, and a fireguard to round out the run crew, he re-installed the intake plugs to protect the engines before departing the area. He returned to the aircraft with the rest of the engine run crew and removed the intake plug from the No. 1 engine—but not from the No. 2 engine. The ground observer positioned himself on the *left* side (the No. 1 engine side) of the aircraft, the intake spotter took up a position just to the *left* of the aircraft nose, and the fireguard manned the fire bottle located near the aircraft's *left* wingtip.

By now, you have mentally hit the "Pause" button on this operation and are asking the following questions: Why was everybody on the No. 1 engine side when it was the No. 2 engine that was being run? What kind of brief did the engine run man/supervisor give his crew? Did the engine run man/supervisor not notice placement of the observers and fireguard? Could he even see them? Was a checklist in use? Did anyone on the run crew ask the supervisor to confirm which engine was being run? Did everyone know why the engine run was being conducted? Etc., etc., etc.

With a full run crew now on hand, the engine run man/supervisor climbed into the cockpit and fired up the No. 2 engine. After a seemingly uneventful 5-minute engine run, he terminated it and commenced post-run inspections. You can guess the rest. The No. 2 engine had sucked in the intake plug and its retaining pin, doing extensive damage to both the fan and core modules.

Hindsight being 20-20 and all that, it would be easy to criticize the crew for the nearly $900,000 damage done—but armchair quarterbacking also misses the point. The real thing to learn and remember from this crew's unfortunate series of errors is this. Working as a focused team (instead of a loosely organized group without purpose) and following tech data step by step (instead of picking up a task in the middle) could save an aircraft (and your fanny) one day. And if this retelling of a Class B mishap doesn't scare you straight, then maybe Murphy's Corollary #9 will: "If a regulation is not obeyed, another more complicated one will be written." ✈

Calling All O-6s

Col Dave Williamson
Chief of Safety
9 AF/CENTAF
Shaw AFB, South Carolina

Recently I was sitting around shooting the breeze with our 9th Air Force Chief of Flying Safety, Lt Col Jim Story, and a visitor from HQ ACC Safety, Lt Col Ron Maxwell. The subject was the difficult job of manning a Safety Investigation Board in the wake of a Class A flight mishap. Here at the NAF level, we take our taskings from ACC and come up with candidates to serve on the board.

By far the most difficult position to fill is that of Board President. As you all know, this has to be an O-6, ideally one who's current and qualified in the same MDS as the mishap aircraft. If you fit those qualifications, you're probably a Wing CC, CV, OG, or Deputy OG, and you're one of the key leaders of your flying wing. It probably won't be easy to clear your schedule for a short-notice 30- to 45-day TDY. However, your sacrifices and flexibility are an absolutely essential part of the Air Force's flying safety program. You'll provide the leadership and *current* expertise necessary to investigate and determine the root cause of the mishap, make recommendations to prevent future mishaps, and produce a quality report and briefing.

Sure, we could task noncurrent officers off a staff somewhere, but we don't believe that the investigations would be as good. So, it is crucial to get the best possible candidates to lead our SIBs. Does it hurt the wings they leave behind? In the short term, possibly; but, in the long term, they are performing a greater and more lasting service for the entire USAF.

There are two sure things when you get tasked to be a SIB president: It will come without warning and at the most inconvenient time for you. However, after you get over the initial anger and frustration of this major disruption in your professional and personal schedule, be prepared for 30 days of hard, frustrating, and difficult work. I can guarantee that after it's all over and you've briefed your four-star, you'll look back on the investigation as one of the most rewarding endeavors you've ever tackled in your Air Force career.

So, if you've already attended the Board President Course, step up to the plate and change your schedule to make a lasting contribution when you are called. If you are a rated O-6 or a new selectee and haven't attended the Board President Course at the Air Force Safety Center at Kirtland, get yourself a training slot. You might as well schedule it when it's most convenient for you rather than wait for someone else to schedule you. It's a quick, informative, and enjoyable 4 days of training at Kirtland. You'll also have the opportunity to meet many of your fellow O-6s from all over the USAF. More importantly, you'll come out of there as a trained Board President ready to do crucial work that is the cornerstone of our successful safety program. ✈

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WELL DONE AWARD
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significant contribution
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United States Air Force
Mishap Prevention
Program.

SSGT CARSON E. SMITH

38th Reconnaissance Squadron
Offutt AFB, Nebraska

■ On 15 April 1998, SSgt Carson E. Smith was awaiting the return of his RC-135 aircraft from an operational sortie. Prior to his aircraft landing, a KC-135 landed and parked next to his location on the NAS Souda Bay ramp. It shut down engines, its crew entry chute and cargo door opened, and the air refueler's crew chief deplaned. After a few minutes, SSgt Smith observed the aircrew gathered at the cargo door, apparently waiting for arrival of air stairs.

SSgt Smith then noticed that the KC-135 was rolling forward and picking up speed quickly, due to the steep slope of the parking ramp. The KC-135 crew chief started yelling up the crew entry chute for someone to set the aircraft brakes as he held on to the crew entry ladder in a futile attempt to stop the 130,000-pound aircraft from moving. SSgt Smith was already on the move with a set of chocks and got them in place in front of the left MLG before the aircraft picked up enough momentum to roll over them.

Had SSgt Smith not acted as quickly as he did, the aircraft would certainly have rolled into several pieces of AGE parked out front. In addition, a flightline traffic thoroughfare busy with vehicles moving personnel and equipment lay just beyond the AGE, and just beyond the thoroughfare was an unprepared dirt surface, where it's likely considerable damage would have been done to the KC-135's landing gear.

According to eyewitness accounts, SSgt Smith's bravery and quick reactions averted damage to an irreplaceable air mobility asset and likely prevented the aircrew, passengers, and ground personnel from sustaining serious injuries. ✈

Well Done!

EXPERIENCE

is the
cheapest thing
to buy if you're
smart enough
to get it
secondhand