ICE WITHOUT FEAR

by Don Jonz

Your blood need not run cold when you fly into icing conditions— *if* you're prepared.

THE THOUGHT OF inflight structural icing inspires the crazies in a lot of airmen. In my opinion, most of it is a crock.

During the great Alaskan oil boom of 1968, I had the job of hustling a Beech Queen Air back and forth to the North Slope of Alaska. Late that December, an unusual siege of "icing conditions" clobbered northern Alaska. Surface temperatures at Fairbanks, albeit cold by civilized standards, warmed to a fiery 20° F. Snow fell and stuck as quick as you could shovel it off a wing. Nonetheless, a little reflection produced an interesting suspicion: This wet, tacky crud, born in the cold aloft, was probably dropping through a warmer level. On its trip down, perhaps near the surface, it recooled—but not enough to completely resolidify.

Any flight would therefore probably encounter a temperature rise during climb, which would aggravate ice adhesion. A pilot *might*, however, climb like a tiger through the worst of it, find a warmish altitude and while away his time munching apples and peanuts. The situation begged a look-see.

The Queen Air was *very* lightly loaded, doused with de-icing syrup, its radios set up for a retreat ILS back to Fairbanks, and the whole shebang launched into the night at maximum rate of climb, with my eye glued to the thermometer. Sure enough, temperature warmed—about 1° F. per 1,000 feet. Ice light on. Yes, as the experts suspected, ice started to build up on the wings and windshield. But—an important point—temperature rise was steady. Rate of climb stayed solid, and a good ILS was close at hand. Under these circumstances, the rate of ice accretion was acceptable.

At 9,000 feet, the thermometer peaked at 35° F. Icing stopped. I climbed to 11,000 feet to experiment; temperature cooled. Icing began again. Center gave the okay to slide back down and maintain 9,000, and there I sat for a couple of hundred miles. The ice disappeared. Fifty miles north of the Arctic Circle, clearance was received to climb to 11,000 feet for the shunt over the lunar-like Brooks Range. Again no ice. I unloaded and came back home flying the same profile.

During the next week, I flew two trips to the North Slope every day—about 60 hours of flying—never encountering more than moderate icing during climb and descent. Once, I heard a C-46 captain declare an emergency due to severe icing. He was at 12,000 feet, and, I presume, in the thick of things. The next day, an F-27 at 20,000 feet turned around north of Fairbanks because of severe icing. The Queen Air, the only light twin flying, zipped up and down like a yo-yo. Folks still remember it as "The Week of Ice." I'm not so sure. For my money, the escapade was numerically safer than shooting rollers at the local patch on Sunday afternoon. Soup isn't crowded.

So much for war stories. The question is: "How do you *safely* learn ice-flying?" The same way you learn a lot of things. Read. Reason. Take little jump-ins. Playing with ice is like playing with the devil: fun, but don't play unless you can cheat. If you are sneaky, smart and careful, you can fly 350 days a year and disregard 99 percent of the bullshit you hear about icing.

As you explore the technique of ice flying, remember these points.

There isn't an airplane alive that can handle prolonged heavy icing, 707s included. Boots, hot wings, spray cans, alcohol and dudes that paint their wings black notwithstanding. Gadgetry occasionally buys a little more time, but a sophisticated wing degrades quickly under a load of ice. A thick, chubby wing—the kind we don't have anymore—packs ice better. The slower your aircraft, though, the more aggravating icing will become because of the length of exposure. Aerodynamic heating and slipperiness at jet speeds doesn't give ice much of a chance to hang on.

Always keep your exposure to a minimum. If you want to ford a torrent, make your dash at the narrows.

In order of usefulness, deicing/anti-icing accouterments are: 1/Thermometer and timepiece. 2/Heated pitot. 3/An ice light (a flashlight will do); I like to switch on my landing lights occasionally to analyze precipitation texture. 4/Heated props; if the props are kept deiced, the rest of the machine will handle a respectable load of ice. 5/Heated windshield. 6/Boots; personally, I find them a pain and ineffective, but some pilots seem to like them.

Most bad icing in Alaska happens at temperatures between 0° F. and 32° F. I've had it stick at –73° F., but the rate of accretion below 0° F. rarely causes concern. Snow and ice crystals are usually harmless, except when the temperature is in the slushy numbers close to 32° F. If snow does stick, it means there is a cooler region somewhere above. If practical, climb into it.

If the temperature at your altitude is between 0° F. and 32° F. and you're in the weather, you're apt to get icing whether it's January or July. I have always considered spring and fall most conducive to icing—too cold for rain, too warm for dry ice. But de-

pends on the part of the country you're in. The same goes for rime ice and clear ice. Most ice is a mixture.

Sublimation is the process by which ice evaporates from the solid state to the vapor state without passing through the water state. The food industry calls it freeze-drying. Experienced pilots with more class say ice "wears" or "burns" off. The faster your airspeed, the faster ice sublimates. The colder the outside temperature, the slower sublimation works. At 0° F. and 200 mph, it takes a two-hour flight to burn off a quarter-inch of ice. At –60° F., don't count on any help at all.

Stay away from the top 1,000 feet of clouds. There is more ice just under the roof than in the rest of the whole cloud. It blows my mind to see a grown-up pilot level off at 12,000 feet, all his electrical gadgets hanging on the line, when 13,000 or 14,000 feet would put him in the clear—fast, comfortable, bright-eyed and bushy-tailed at the end of his trip. It's hard to convince some people that the sun is always shining on top.

Keep an eye on the thermometer. It is your most valuable icing instrument. For example, make a mental note of the temperature at takeoff. Figure the approximate lapse rate during climb. Note the altitude when the temperature crosses 32° F. (to get an idea of the altitude to which you must retreat if you get into trouble). Notice those little temperature plateaus where life is in a wonderfully steady state. Catch the point where the bottom falls out of the mercury. Wonder at the squiggly temperature vacillations that announce wind shifts. Up here in American Siberia, we frequently see a household thermometer taped to a wing strut in view of the pilot. It works well, and the price is right.

My company, Pan Alaska Airways, used to operate a pair of Short Skyvans. It was interesting to dispatch both ships to the same destination at the same time. One pilot would return behind schedule, haggard, grim, primed with a hairy hangar story, dripping ice, his anti-icing fluid exhausted. "Instruments all the way," he'd say. The other pilot, whose alcohol tank rarely needed filling, was already home and showered. Feel the moral?

Atmospheric cooling, called temperature lapse rate, averages about 3½° F. cooler for every 1,000 feet during climb. The common temperature inversion befuddles this neat generalization. Temperature inversions are the primary cause of low-altitude haze layers. The top of the haze layer usually marks an abrupt temperature change. Temperature inversions in the Arctic can be extreme; I have seen it go from –60° F. at the surface to 0° F. at 500 feet. These extreme inversions produce an interesting but harmless flight phenomenon known as instant all-over frost. When climbing a brittle-cold airplane into a sharply defined layer of warm air, the machine—windows and all—frosts over. It dissipates as the airframe temperature equalizes with the outside air temperature.

The weight of ice is not what debilitates. It is the shape. Twenty strategically placed pounds of ice will sink a good light twin. Ice reduces rate of climb dramatically, pulls down cruising speed and raises stall speed. Worse yet, *it changes stall characteristics.* A rule of thumb says that an eighth of an inch of rough ice or frost will reduce rate of climb by 50 percent and cruise by 10 percent.

I was jamming along in a Cessna 180 once when approach control gave me a descent into freezing rain. Not being checked out on thermometers, I complied. A good Cessna 180 ski-plane indicates around 130 mph and stalls at 50. My ship was soon dragging its tail. Ice shrouded the windshield. It glistened from the struts and skis. Glomped over the wing. Since the tail was low, ice formed curious layers on the wing undersides, "Wow, how interesting!" I turned up the wick. Again. And again. Little pussyfoot affairs. Soon I was descending at 100 mph at full throttle. Luckily, the runway was straight ahead. I rounded out—guessing the altitude, as I couldn't see through half an inch of windshield ice—when bang, at 90 mph she stalled. That "landing" bared a lot of shorts in the left front seat. The stall had been instantaneous and indescribably violent.

Don't accept holding patterns in icing levels. Basically, if the temperature is between 0° F. and 32° F. and the assigned altitude will put you on the gauges, give the controller an honest "No!" And hang onto your safe altitude until you get close in. ATC assigns altitudes unaware of the pilot's in-flight conditions. If ice is evident, insist on another slot. It is your neck. Rarely does icing span more than 6,000 vertical feet in thickness; but like all generalizations, this one will waste you if you lean on it too much.

Flying between cloud layers is chancy. If you're not traveling too far, okay. Typically, layers fuse together. When that happens, guess who gets crunched? Unless the layers are distinct and conditions stable, you are better off going under or over.

The rate of ice accretion versus time to go is a great index. Know when the icing began. If ice hits you hard and heavy, such as freezing rain or airborne slush, a 180-degree turn is your best ace. If rate of ice accretion is slow, distance short, and there is a comfortable ceiling below, hang in there; you'll be okay. It sounds like I'm hedging, but therein lies safety. A pocket full of aces makes any game fun. Always have a mental picture of the weather ahead. Keep reserve altitude; happiness is knowing you can go lower. Have gobs of gas. Keep lots of approach plates up your sleeve. Don't fly into obviously bad conditions. I've seen dudes with apparent death wishes barge right into a real mess when all they had to do was look out the windshield. If you see dark precipitation areas ahead at critical temperatures, don't poke your nose in.

Before takeoff, determine the height of the tops. Look out the window. You are your best forecaster. The lack of reliable top reports is the single biggest void in aviation weather, a chain without a master link, probably because high-flying airlines couldn't care less, which means the FAA couldn't care at all. But here is what I do: First, I call the weather bureau for their guess. Then, I call center or approach control for a pilot report. If that doesn't work, I call one of the airline dispatch offices. They're usually glad to query one of their pilots. Top reports indicating a uniform layer makes ice-flying a piece of cake.

When picking your way through icing, use commonsense radar. Climb through holes. You'll be surprised how often this can be done if you give it serious study. There is nothing wrong with flying in VFR conditions on an IFR flight plan. Simply frame your ATC requests for slots that will put you in sunshine. It is a concept not widely practiced. Too bad. Weather accidents are easily preventable. Stratus and cumulus clouds are analogous to plains and mountains. Sometimes they even follow the contours of the land, like a papier-mâché mask. Cloud formations have plateaus, bluffs, ranges, rifts. Practice flying this high topography. Usually, you can spot a nearby fissure, or at least a canyon. Get a clearance from the center and zip through. Some years I've flown 365 days, a lot of it IFR, in so-called weather, yet 90 percent in the clear. Ergo, no ice. If holes aren't hadable, keep in mind that lighter areas contain less moisture. Less turbulence, too. Next to the thermometer, commonsense radar is your best instrument. Be wary of the pilots that say it can't be done. *They* can't.

Floatplanes, ski-planes and generally dirty airframes make bum ice haulers; the ice collects on spreader bars, struts, wires, protruberances. Clean lines, uncluttered profiles, smooth paint and recent waxing make ice work harder to hang on.

If you don't like ice, stay the hell out of IFR conditions. You *have* to penetrate fog, clouds, wet snow, freezing rain or general mugginess before you can get structural ice. I'm forever surprised to find VFR pilots and new IFR pilots who haven't been taught this simple rule. Ice doesn't jump out of the clear. You must be IFR-rated, have an IFR clearance and be IFR-current when you start playing with IFR weather. If you received your instrument rating in sunshine, better get a few hours of wet dual in the hands of an experienced instructor. After that, you're probably ready for baptism.

Here's how to begin: 1/Review your manual on how and when to apply carb heat or alternate air. 2/Remove or smooth all frost or ice forms from props and wings (*top and bottom*); be especially attentive to the forward half of the wing. 3/Load well below gross weight; rate-of-climb reserve is one of your better aces. 4/Get on top through a

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hole. 5/Be certain there is a couple of thousand feet between the ceiling and the ground. 6/Wait until you near your approach fix, get an IFR clearance, and turn the pitot heat on; if you have them, activate prop and windshield anti-icing. 7/Jump in. Preface all changes in altitude and heading with a clearance from ATC. They are usually glad to oblige except in large terminal areas, which is reason enough to practice off the beaten path. 9/After maneuvering a bit to get the hang of things, request an approach clearance. Carry reserve airspeed on final. Put your windshield defroster on hot to melt a peek hole. If it gets dicey, you may have to look out the side window. 10/After landing, inspect the ice buildup. Analyze the nooks and crannies where ice stuck. Pay particular attention to the props, sharp radii on the windshield, and the antennas. Note the length of time it took to build up. Critique is half the fun and three-fourths the education. I think you'll agree a little ice trip gives a fine sense of achievement.

The crux of flying "icing conditions" is that seldom does one need to hassle *actual* ice. I hear wails from the ulcer set, but here is another story: In the summer of 1971, I flew my Navajo over the Pole from Fairbanks to London and back to Vancouver in the Great Air Race. I flew 70 hours, beat all the other turbocharged machines, and never lost a stroke because of weather. Ice from the whole journey wouldn't fill a tiny Glad Bag. Racing westward out of Scotland, I hugged the surface until beyond the coastal weather, found a long crack in the papier-mâché mask, and went up for a suntan. My friend Jerry Hook, of Fairbanks, flying a 15-year-old Cessna 180 with a 55-gallon oil drum of fuel in the back seat, got down to 1,000 feet and motored across the drink. Neither of us encountered icing. I would almost bet the real pros like Ernest Gann, Louise Sacchi and Mira Slovak didn't find any ice either. But man, you should have heard the 25-odd dingbats in the middle altitudes. Some were airline types, too. They stood in line to declare emergencies.

Except for really far-out occasions (in which case you'll have a warning from the weatherman), ice isn't found very low or very high. It is an effort to sympathize with pilots who insist on flying oceans between 2,000 feet and 12,000 feet when the highest obstacle is a mast. Yet they do. Ice up. Lose airspeed. Burn more fuel. Is there security in being able to glide if something goes wrong? Glide to what? As a non-sked pilot, I used to shuttle ice over the Atlantic—most of it unnecessarily. Ignorance was and still is a crappy excuse.

If you violated all the rules of common sense, punched into icing too long and collected a severe load, what do you do? Well, your whole day stands a fair chance of getting scrambled. After getting a clearance, your escape routes are: Hasten a 180-degree turn. Descend. (Sitting fat and happy at freezing level waiting for something to happen is unfair to insurance adjusters.) Or climb. This means forward on the knobs. Smartly. I've seen guys drag their feet with too little power and come tumbling out of the sky. If you're going to lay the whip to her, do a good job.

I prefer climbing out of trouble, but it is a critical decision. First, it is a decision that must be made early. It is fraught with the probability that conditions will degrade near the top, not to mention that you will have a hard time getting up there. Supercharger and oxygen are almost a must for this type of remedial flying. If your bid for blue sky is unsuccessful, you have a monkey on your back. The trip down won't be pleasant.

I remember an ill-fated Aero Commander in Southern California several years ago that picked up 12 inches of ice in 12 minutes. Needless to say, he landed short. Ice can be, and is, consistently deadly. An aircraft under severe ice loads suffers on both ends of its speed range. Stall goes up. Cruise goes down. When the two meet, the world comes to an end.

If you live west of Denver, use extreme caution. A lot of weather pushes in from the West Coast. It continually works up the Continental Divide. Tops are usually wet and high. East of Denver, heaven has dumped its load and is starting downhill. Tops are easier to handle.

Don't charge off into ice when your destination is doing poorly and going downhill. An approach with a load of ice to ILS minimums is dumb, a go-around problematical.

In short, be brave. Defensively.