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WHERE TO LOOK AND WHAT TO EXPECT WHEN THE FORECAST MENTIONS ICE

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Ice -- a chilling thought when it is considered in relation to airplanes. Mysterious, too. At least, there is little understanding of the phenomenon. The National Weather Service forecasts ice all winter long, when actually it is present only a small percentage of the time that it is forecast. And the Federal Aviation Administration showed its lack of understanding with a proposal that "known" ice be defined as any time the temperature is lower than +5°C and there is visible moisture present. The FAA also used accidents related to carburetor ice in drumming up numbers to justify a proposal to prohibit flight in such conditions without appropriate equipment. That proposal was withdrawn, but the image of an FAA that is confused about the nature of airframe ice remains.

The terminology "known" ice has been bandied about for years. In truth, when an airplane is approved for flight in icing, the word "known" isn't used. The Cessna 210, for example, when properly equipped, is approved for flight in plain old "icing conditions." Some airplanes are equipped with anti- and/or deicing gear and are not FAA-approved for flight in icing, and some retrofit systems are available that are not approved. The simple truth is, given the FAA's ignorance on the subject, the approval for flight in icing is a dubious distinction. No airplane should be flown in continuous icing conditions; the equipment is something that should be used while you flee, while you go for help, whether it is approved or not. The ice that builds up on unprotected areas, even on an approved airplane, can be quickly debilitating. Speed drops, engines get hot, and the whole scene can be a bad one. In operating an ice-approved airplane for 5,000 hours -- not canceling a single trip because of ice -- I have used the deice boots in anger only a dozen or so times, and only a few times have they been cycled twice on the same flight. Always, ice is dealt with as if there were no equipment on the airplane. The great value in having the icing gear is in being able to take off in the face of an icing forecast.

Even though they are issued on a blanket basis to cover any and every eventuality (as well as the derriere of NWS), ice forecasts cannot be ignored. The possibility is indeed there when it is forecast. But a pilot has to do three things. The first is to forget the old wives' tale about ice. The second is to have a general understanding of weather and the conditions that cause ice. The third comes after you make a decision to fly. Treat ice exactly as you would treat smoke in the cockpit. No sitting there and wondering if it will go away. When ice begins to accumulate, don't count past five before doing something about it.

Rules of thumb about ice just can't be accurate. The atmosphere won't cooperate. For example, it is said that ice never forms with the outside air temperature below -15°C. Wrong. At least that is wrong where the clouds are cumulus. In bumpy clouds, especially those that form in the winter over mountain ranges, you can get a good shot of ice at lower temperatures. I have seen it at -25°C. And it is said that icing layers are seldom more than 2,000 feet thick. Wrong again, because this depends on what kind of clouds are present, as well as the age of the clouds.

Understanding the nature of airframe ice begins with an understanding of why the type cloud and the age of the cloud is pertinent. Supercooled water droplets that remain unfrozen in below-freezing temperatures until splattered by a wing, for example, are the prime factor in airframe ice. Cumulus-type clouds, with lifting, carry a continuous supply of moisture to higher levels and colder temperatures, giving constant reinforcement to the supply of supercooled water droplets. Cumulus clouds are also generally turbulent. That does lead to one useful rule of thumb. If ice starts to accumulate and the air is bumpy, treat it like a <u>lot</u> of smoke in the cockpit. Flee instantly to warmer air and to a runway as soon as possible. The rule of thumb about climbing to colder temperatures and out of ice is totally inoperative in cumulus clouds when flying a normally aspirated piston airplane; it can be doubtful in anything, as has been proven. A King Air 200 pilot left Denver and attempted to out climb the ice with no success, for example. The airframe became so cluttered with the frozen stuff that it came down, even at full power.

Stratus clouds, where the air is smooth and the clouds are layered, offers more hope, though ice in these conditions can still be debilitating if the pilot slogs along in it. In stratus, it is probably true that ice won't form below -15°C because the supercooled water droplets will be frozen and will pass harmlessly over the surfaces.

Confusion can come with stratocumulus clouds, as are often present over a wide area behind a slowing or stopped cold front in the wintertime. The tops of these widespread stratocumulus decks are often around 10,000 feet, bases variable but often better than 1,000 to 2,000 feet. There is no prettier place to watch a winter sunset or sunrise than atop one of these decks. There is one catch. In the lower levels of the cloud deck, there might be little or no ice. But these clouds have cumulus characteristics caused by the surface being warmer than the air above. The resulting instability means that there is more moisture toward the tops of the clouds. So if the temperature is below freezing, there will be more ice toward the tops of the clouds. A normally aspirated airplane will be running out of steam at the level of the tops. Thus, you might almost make it to on top but not quite. And if there is no warmer air below, the airplane might not be able to stagger up into the clear and might have to be landed with the load of ice that accumulates.

When contemplating forecast icing, a pilot has to consider the weather synopsis. The effects of low pressure systems and fronts are what make or break flights. Simply put, if there is a low to the south or west of your route, there might well be a lot of cumulus-type clouds in the rising swirl of air east of the low, and you might get a lot of ice if the temperature is right. If the surface weather is warm and moist, just north of a low will be a great mixing of warm, moist air and cold air, with a strong chance of icing. North of a warm front or a strong surface low is a dandy place for freezing rain. And while there is a temperature inversion and you can climb above the ice in a freezing rain situation into warmer air, if there is freezing rain at the surface, an approach and landing can be chancy and a missed approach potentially impossible. The ice that accumulates might preclude any flight other than forward and down.

Temperature inversions, with warmer air aloft than at the surface, have to be dealt with carefully. For example, one day last winter, the surface temperature was 33°F and it was raining hard, an indication of warmer air aloft. There was a low to the west, meaning caution, but there was a warm front not far to the south, and the warm air was overrunning the cold at the surface. The inversion was shown on the winds aloft forecast, but the inevitable ice was in the area forecast. I happened to be headed south this day, which made it work. The air was warmer, above freezing, all the way up to 10,000 feet, and it got progressively warmer as the airplane moved south. Ice was no problem. However, had I been headed north, it might have been an entirely different matter.

It is back on the west side of the low that the clouds might be older and the ice less intense or nonexistent. The clouds have been in cold air, with no infusion of fresh moisture, for the trip all the way around the north side of the low, and the likelihood of supercooled water droplets is lessened. The only lifting you'll find on the wets side of a low will be caused by a surface warmer than the air, and the most significant ice that comes from this is in tops of stratocumulus, as mentioned, and downwind of the Great Lakes -- a real icebox at times and a spawning ground for snow clouds.

If you go outside and watch the end of a snowstorm, you can often look up and see the sun dimly visible even though there is an apparent total cloud cover. What this tells you is that the "clouds" are really ice crystals, already frozen. Which brings us to a difference of opinion over ice forecasts. The terminology "icing in clouds and in precipitation" is misleading unless the precipitation happens to be freezing rain. Otherwise, the ice is in the clouds, not in the precipitation, which would be snow, sleet, or ice pellets -- already frozen stuff. Even wet snow will only make a white line down the leading edge, though it can clog air inlets and do other mischief that is well worth avoiding. On my airplane, it disables the heater, which is reason enough to go land.

One thing that is seldom considered when it comes to pilot reports of ice is indicated airspeed. There is a temperature rise as airspeed increases. The ultimate is on Concorde, whose surface temperatures vary from 127°C at the nose to 91 at the trailing edges of the wings at Mach 2.0, that with an OAT of -56°C. Indicating 140 knots at 10,000 feet, the rise is 3.5°C; indicating 300, it is 15° (all from a Jeppesen CR-2 whiz wheel). The significance of this is twofold. One, it explains why jets seldom have ice problems. Push the power levers forward to melt the ice. Two, it means we have to carefully weigh pilot reports. If a jet ahead reports no ice, that doesn't mean that you won't get it in a slower airplane. Most icing conditions are so variable that pilot reports, other than brand-new ones from like airplanes, are of little value. This is another illustration of why the terminology "known" icing is a fallacy. It might be "known" to a Bonanza and unknown to a Sabreliner.

Each year we lose about eight or 10 airplanes, plus occupants, to icing conditions. A few are the enroute losses that are considered classic. Ice is accumulated to the point that the airplane will no longer fly, and the inevitable conflict with terrain occurs. These can usually be rationalized away with the thought that if the pilot had taken proper evasive action at the onset of ice, the accident could have been avoided. Almost always, the airplane passes from ice-free to icy air. The ice-free remains back there for the taking, but if you go too far into the ice, it might preclude a successful conclusion.

In many ice accidents, though, the trouble comes after the pilot extricates the airplane from the ice and is maneuvering for landing with an iced airplane. Though the pilot might feel home free with the airport in sight, the ice can still be a strong factor. The stalling speed is higher with ice on the surfaces, how much higher, nobody knows. The view out front might be nil, for no defroster will work to keep ice off the windshield. On some, the ice can also affect handling qualities. Many Cessna pilot's operating handbooks contain a warning about extending the flaps on an iced airplane. There have even been large aircraft lost because of a deterioration in pitch control caused by flaps extension with ice on the flying surfaces. So if you do get ice on your airplane, the higher stalling speed -- and perhaps the inadvisability of using flaps -- dictate a very cautious arrival.

Ice is just one of the things that we have to consider as the weather turns colder. There's the business about making sure all the frost and snow and ice are cleared away before takeoff and the necessity of as thorough a preflight on a zero day as on a balmy one. But then nothing is as easy in the wintertime as in the warmer seasons, and although it may involve some chilly fingers and toes to get going, flying can be especially rewarding. If you live in the cold country, it can even get you to sunny Florida, the Bahamas, or south of the border on a regular basis.