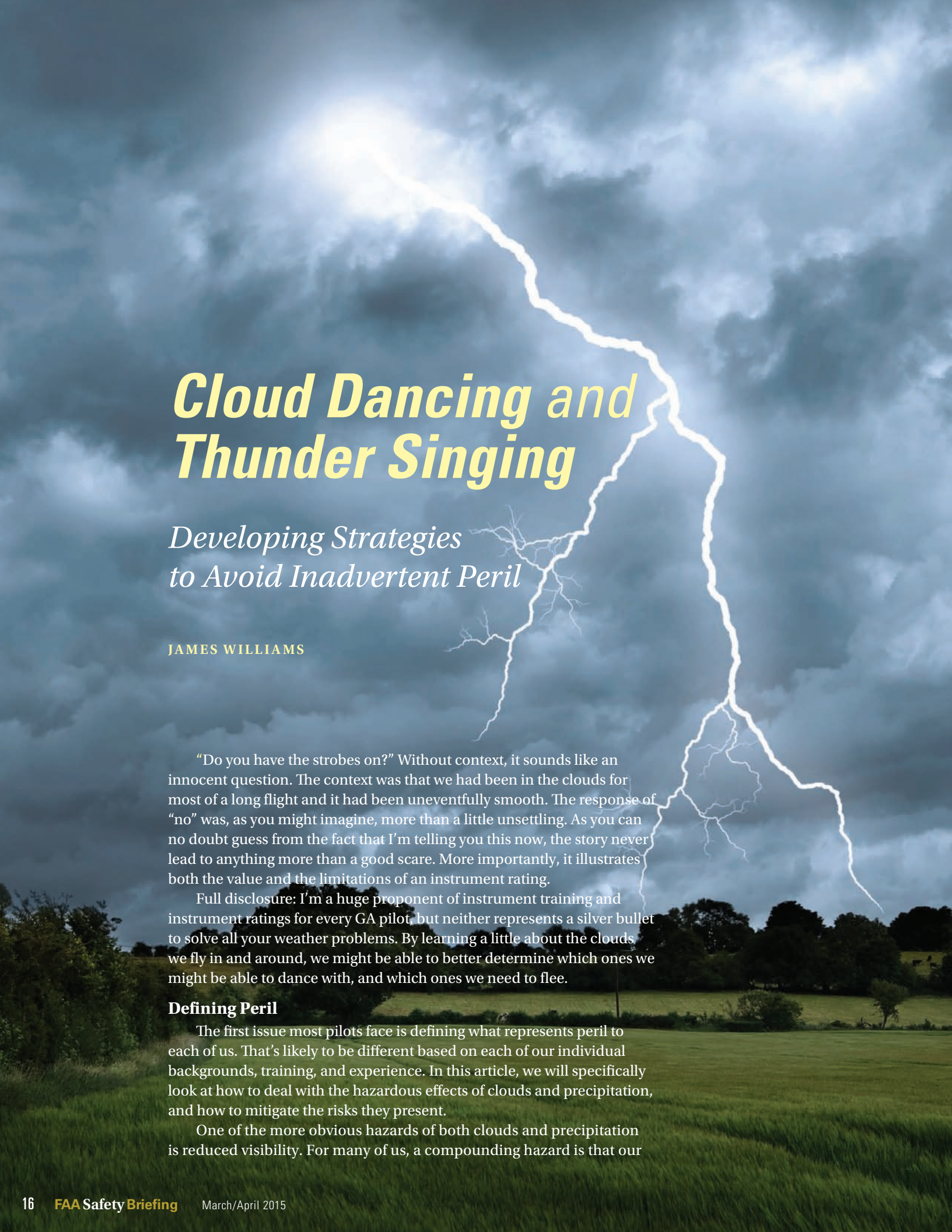


Cloud Dancing and Thunder Singing

Developing Strategies to Avoid Inadvertent Peril

JAMES WILLIAMS

"Do you have the strobes on?" Without context, it sounds like an innocent question. The context was that we had been in the clouds for most of a long flight and it had been uneventfully smooth. The response of "no" was, as you might imagine, more than a little unsettling. As you can no doubt guess from the fact that I'm telling you this now, the story never lead to anything more than a good scare. More importantly, it illustrates both the value and the limitations of an instrument rating.

Full disclosure: I'm a huge proponent of instrument training and instrument ratings for every GA pilot, but neither represents a silver bullet to solve all your weather problems. By learning a little about the clouds we fly in and around, we might be able to better determine which ones we might be able to dance with, and which ones we need to flee.

Defining Peril

The first issue most pilots face is defining what represents peril to each of us. That's likely to be different based on each of our individual backgrounds, training, and experience. In this article, we will specifically look at how to deal with the hazardous effects of clouds and precipitation, and how to mitigate the risks they present.

One of the more obvious hazards of both clouds and precipitation is reduced visibility. For many of us, a compounding hazard is that our

aircraft lack weather detection technology beyond what a friend once euphemistically described to me as the Mark One Eyeball Observation System. As soon as the literal blinding effect from the weather sets in, our distant weather detection range drops to a few dozen feet. The march of technology has helped in this department, with the advent of more affordable and accessible cockpit weather data, but it will likely take a good many years to get to the point of ubiquity. This point, by the way, assumes that you are in a position to fly into the clouds. If you're not properly trained, rated, and proficient, any dip into weather less than VFR minimums is best avoided.

The next hazard we face is what may lurk in the clouds: updrafts, downdrafts, and turbulence. The type of cloud encountered will provide clues as to the level of hazard that might lurk within. In the following sections we'll look at the particulars of each cloud type and what we should consider in our weather strategies.

Be Clear on Clouds

There are three established basic forms of clouds: cirrus, cumulus, and stratus. While there is some overlap in their genesis and characteristics, each cloud type presents a different set of possible hazards. First, and most easily dealt with, are cirrus clouds. Cirrus clouds are high altitude denizens made of ice crystals that usually form above 20,000 feet above ground level (AGL). They are generally not considered a threat in terms of turbulence or icing as they form in stable air. In terms of hazards, assuming we can even get up there, cirrus clouds are very low risk. And since they only form in IFR airspace, we don't need to be overly concerned with visibility impacts.

Next we consider cumulus clouds, aka the "happy" clouds. These clouds are the puffy white type that are formed of liquid water droplets near the surface and can vary in height and size depending on atmospheric instability. They are detached from each other and do not produce rain. As their formation mechanism suggests, these seemingly "happy" clouds can be turbulent, with hazard levels ranging from minor to significant. As far as visibility is concerned, they are much more view-limiting than their cirrus cousins. On the plus side, the detached nature of cumulus clouds means that visibility limitations should be brief as you pass through them and that they are easily navigated around should you not want to fly through them. Also, don't let their "happy" appearance fool you; They may include supercooled water droplets which could increase the risk of icing.

Variants of cumulus clouds include altocumulus and cirrocumulus, which form at medium and high

Photo courtesy of Avidyne

Onboard weather radar can help in making tactical decisions in flight.

altitudes, and cumulonimbus, which are characterized by significant vertical development and pose the greatest hazards to pilots. The addition of the -nimbus suffix to any cloud type indicates that the cloud is rain bearing. But with cumulonimbus clouds, it's more than just the rain that concerns us. A cumulonimbus cloud may produce a thunderstorm. These are typically very large clouds in most cases exceeding 20,000 feet AGL, and in extreme cases approaching 60,000 feet AGL. That means there's really no flying above them in most GA aircraft. You should also plan to avoid them by a wide margin; the FAA recommends 20 nautical miles. This is because large cumulonimbus clouds can throw hail miles outside their physical dimensions. Between the threats of hail, lightning, and devastating turbulence, flying through a cumulonimbus cloud in a GA aircraft ranks up there with swimming with great white sharks in a wetsuit made of freshly cut seal meat in my book. (This is to say extremely hazardous.) This turbulence makes any concerns about visibility and icing, which do exist, second order priorities.

Next up: stratus clouds. Stratus clouds have an expansive sheet-like structure. As the name suggests, they spread as layers across broad areas and are generally limited in vertical development. Moderate icing risks and even some turbulence concerns are possible in the medium altitude altostratus clouds. Stratus clouds are sometimes referred to as "good IFR" clouds. This is because they tend to be smooth and widespread which makes them a good dance partner if you're so inclined (and rated). The group also contains the rain clouds nimbostratus. Unlike their cumulus cousins, they don't bring threats of hail and lightning.

(continued on page 20)

Cloud Spotting

Cumulus

These puffy clouds are formed of liquid water droplets near the ground and can be turbulent. Over land, they develop on clear days due to daytime convection. They typically appear in the morning, grow, and then dissipate in the evening.

Stratocumulus

These gray or whitish patch, sheet, or layered clouds almost always have dark tessellations (honeycomb appearance), rounded masses, or rolls. They are often found in marine environments and can form from the breakup of stratus layers.

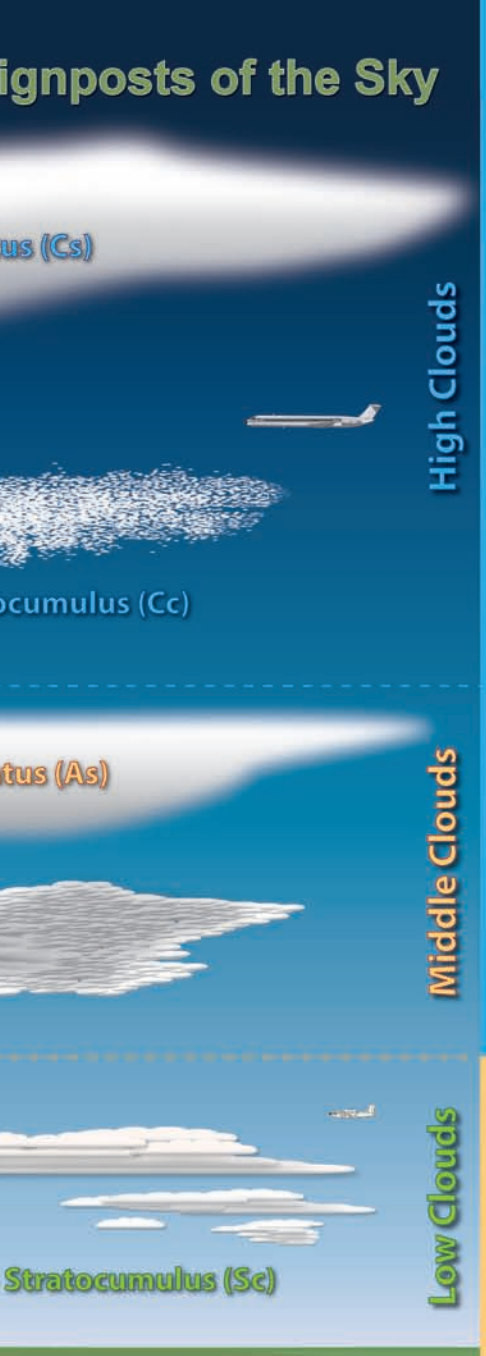
Cumulonimbus

These towering giants can produce tornados, thunderstorms, lightning, hail, icing conditions, and devastating turbulence. The FAA recommends keeping a distance of 20 nautical miles from these clouds.

Stratus

These "good IFR" clouds tend to be smooth but moderate icing and some turbulence may exist. Stratus layers have a uniform base, which, if thick enough, may produce drizzle, ice, or snow.

The cloud graphic has been adapted from NOAA's National Weather Service.



Paul Cianciolo

10,000 ft. – 60,000 ft. AGL

Cirrus

These whispy filament-like clouds form mostly white patches or narrow bands in high-altitude stable air. They are composed of ice crystals and their transparent character depends upon the degree of separation of the crystals.

Cirrocumulus

These thin, layered clouds without shading are composed of very small elements in the form of regularly arranged grains or ripples. Generally, they represent a degraded state of cirrus and cirrostratus clouds and are uncommon.

6,500 ft. – 13,000 ft. AGL

Cirrostratus

These transparent, whitish veil clouds with a fibrous (hair-like) or smooth appearance usually cover the whole sky. During the day, they are thin enough to still see shadows on the ground and can produce a halo around the sun or moon.

Surface – 6,500 ft. AGL

Altocumulus

These white/gray patch or layered clouds have a roll-like appearance and can cause some turbulence and small amounts of icing. This common middle cloud often appears at different levels at the same time and with other cloud types.

Altostratus

These gray/bluish layers totally or partially cover the sky, with the sun being dimly visible. They are frequently associated with approaching frontal systems and contain little or no turbulence and moderate amounts of icing.

Nimbostratus

These clouds result from thickening altostratus layers, are dark gray, and diffused by falling rain or snow. The cloud base lowers as precipitation continues. Low, ragged clouds frequently occur beneath, which may merge with its base.

Finally, we come to stratocumulus clouds, which as the name suggests, are a combination of stratus and cumulus. Stratocumulus clouds generally combine the widespread nature of stratus clouds with the vertical development of cumulus clouds. One aspect that makes stratus and stratocumulus clouds a concern is the fact that they can hide from view things like embedded thunderstorms, as I learned firsthand.

Assets and Liabilities

With our perils now defined, let's do some self-analysis. First, take stock of your strengths and limitations. This will be different for every pilot (and should be an ongoing process as well). Having an instrument rating is nice, but how prepared are you to use it? There's a huge difference between being able to handle popping in and out of a few little cumulus clouds and slogging along all day in a stratus deck.

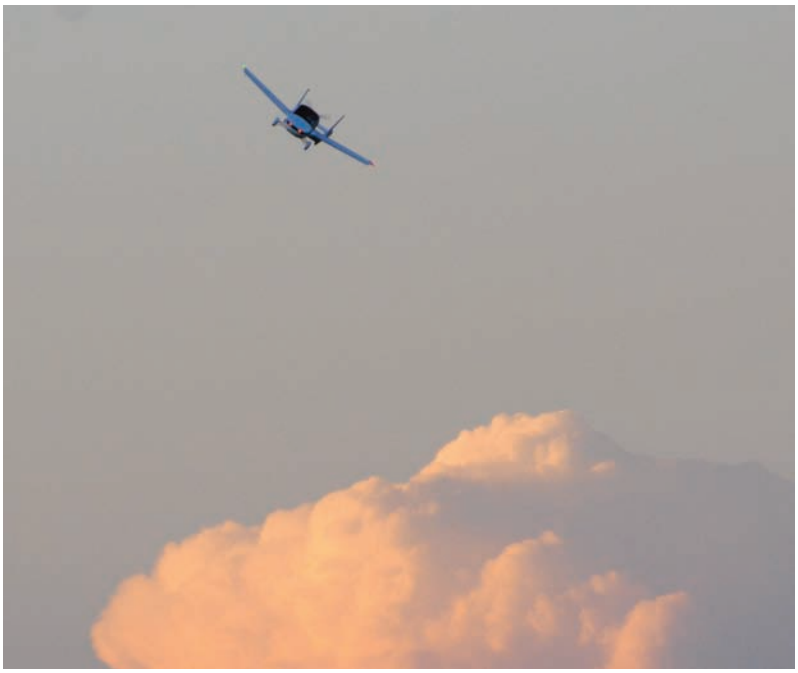


Photo by Tom Hoffmann

By learning about the clouds we fly in and around, we can better determine which ones we might be able to dance with, and which ones we need to flee.

Are you sharp on instruments, or a little rusty? Are you ready for a few bumps, or do you prefer a smooth ride? Is your aircraft properly equipped, or should you be looking to upgrade? These are just a few of the questions you should ask yourself. Once you have a thorough list of what you're proficient with, what you're not, and what you'd rather not do, we can look at ways to mitigate those risks and help develop some good personal minimums.

Strategic vs. Tactical

Now that we know some of the risk factors and what we have to offer (both our skills and limitations), we have to decide what level of mitigation we want to employ. Some situations lend themselves to the tactical level of response, meaning something that we can do on the fly without extensive planning. These kinds of responses include simply deviating around small cumulus clouds to maintain VFR, requesting a different altitude from ATC during an IFR flight to get out of a stratus layer, or canceling a flight in the vicinity of a thunderstorm. Other situations require more strategic coordination. Examples of strategic responses would be adding equipment to your aircraft to better handle weather hazards, receiving instrument training, or planning your trip with weather contingencies.

Of course, if you're not instrument rated, avoiding the clouds is the best policy. But how would you mitigate the risk of accidental IFR? Focused training would be a good place to start. Work with a properly rated instructor to practice escape maneuvers like a 180 degree turn or a controlled descent. You can also work on decision making with the instructor by having them quiz you when you feel like you need to turn to avoid a cloud. This can help you develop a sight picture in your mind of what a turnaround point might look like. It's also helpful to have real experience in the clouds should you find yourself there accidently. Again, these exercises should only be done with a qualified instructor as a safety measure. While an instrument rating would be a better solution, at least some ongoing training, maybe once or twice a year as conditions and availability allow, can give you a basis to work from.

The idea is to develop a "play book" of responses that can be used in conjunction with your personal minimums. Then, when you have to make a decision, you have both a predefined decision point and a predetermined plan of action. By combining this strategy with a greater understanding how clouds work and how they differ, we can work toward a happy medium of properly mitigated risk.

James Williams is FAA Safety Briefing's assistant editor and photo editor. He is also a pilot and ground instructor.

For More Information

Dos and Don'ts of Data Link Weather- July August 2010 p. 20
www.faa.gov/news/safety_briefing/2010/media/julaug2010.pdf

Cruise Control: Avoiding VFR into IMC- March April 2011 p. 16
www.faa.gov/news/safety_briefing/2011/media/MarApr2011.pdf

The Terrible Ts: Turbulence, Thunderstorms, and Tornados- May June 2012 p.12
www.faa.gov/news/safety_briefing/2012/media/MayJun2012.pdf

Pilot's Handbook of Aeronautical Knowledge- Chapter 11
http://go.usa.gov/SBFT

Don't Let Ice Drag You Down

By James Williams

One of the key risk factors for flying in the clouds is icing. I didn't get too deep into the topic in the main article because it's a discussion that requires more space than we have here and it's one we've covered recently (see the FIKI Wiki article on page 21 of the November / December 2014 *FAA Safety Briefing* at: www.faa.gov/news/safety_briefing/2014/media/NovDec2014.pdf). But here is a brief recap of some of the more pertinent points of dealing with or avoiding ice.

What's Your Strategy?

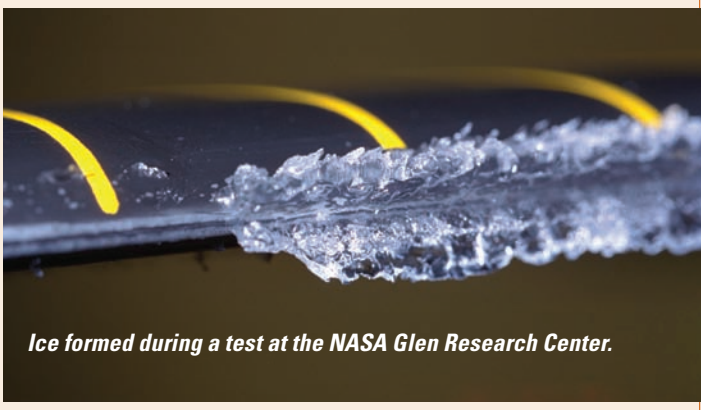
The first thing we need to know is what options are available. Does the airplane have any deice or anti-ice capability? If so, to what level is it certificated? As I discussed in the FIKI Wiki article, there are differing levels of deice/anti-ice protection, and knowing the distinction is critical. Some systems are only designed to aid in your escape from icing, while others allow for you to fly into light to moderate icing for a period of time. Of course, any system — even the sophisticated ones used by airliners — can be overcome by heavy icing conditions, so vigilance is a must. This knowledge helps us frame what strategies are available.

If your aircraft has no ice protection beyond pitot heat, then avoidance and *immediate* escape are the only options on the table. Flirting with clouds during the winter should be done only with caution and a close eye on the freezing levels.

If your aircraft has a basic non-FIKI certified system, it's a good idea to know what exactly is and isn't covered since some non-FIKI systems are more robust than others. But regardless of the coverage, your aircraft is still not certificated for flight into known icing conditions — which means that a rather expeditious exit from those conditions is required. What the system does for you, though, is give you a safety margin to work with should you encounter icing.

If your aircraft is FIKI certificated, then you have the widest range of options. That doesn't mean you are invulnerable to icing. Every ice protection technology has its strengths and its limitations, but your equipment does give you the option of flying through some icing without serious consequences.

Photo courtesy of NASA



Ice formed during a test at the NASA Glen Research Center.

Knowledge is Power

The best way, for everyone, to not get dragged down by ice is to not get into it in the first place. It's a strategy that works regardless of equipment. But even if you've got a hardier aircraft than most, knowing where you want to fly (and don't want to) is a good idea. The place to find the best information on that is the National Weather Service's (NWS) Aviation Digital Data Service (ADDS). ADDS Icing products are available at: www.aviationweather.gov/adds/icing

Two of the most powerful tools for any pilot are the Current Icing Product (CIP) and Forecast Icing Product (FIP). These tools allow a pilot to determine at a glance the likelihood and severity of icing in a certain area as well as the possibility of encountering super-cooled liquid droplets (SLD). This is very important as SLD can cause extreme icing conditions that every aircraft should avoid, even those with FIKI. You can also check these conditions at varying altitudes which will aid you in flight planning.

Between the right knowledge and a sound strategy, we can give icing the slip and fly as much as possible year round.

James Williams is FAA Safety Briefing's assistant editor and photo editor. He is also a pilot and ground instructor.