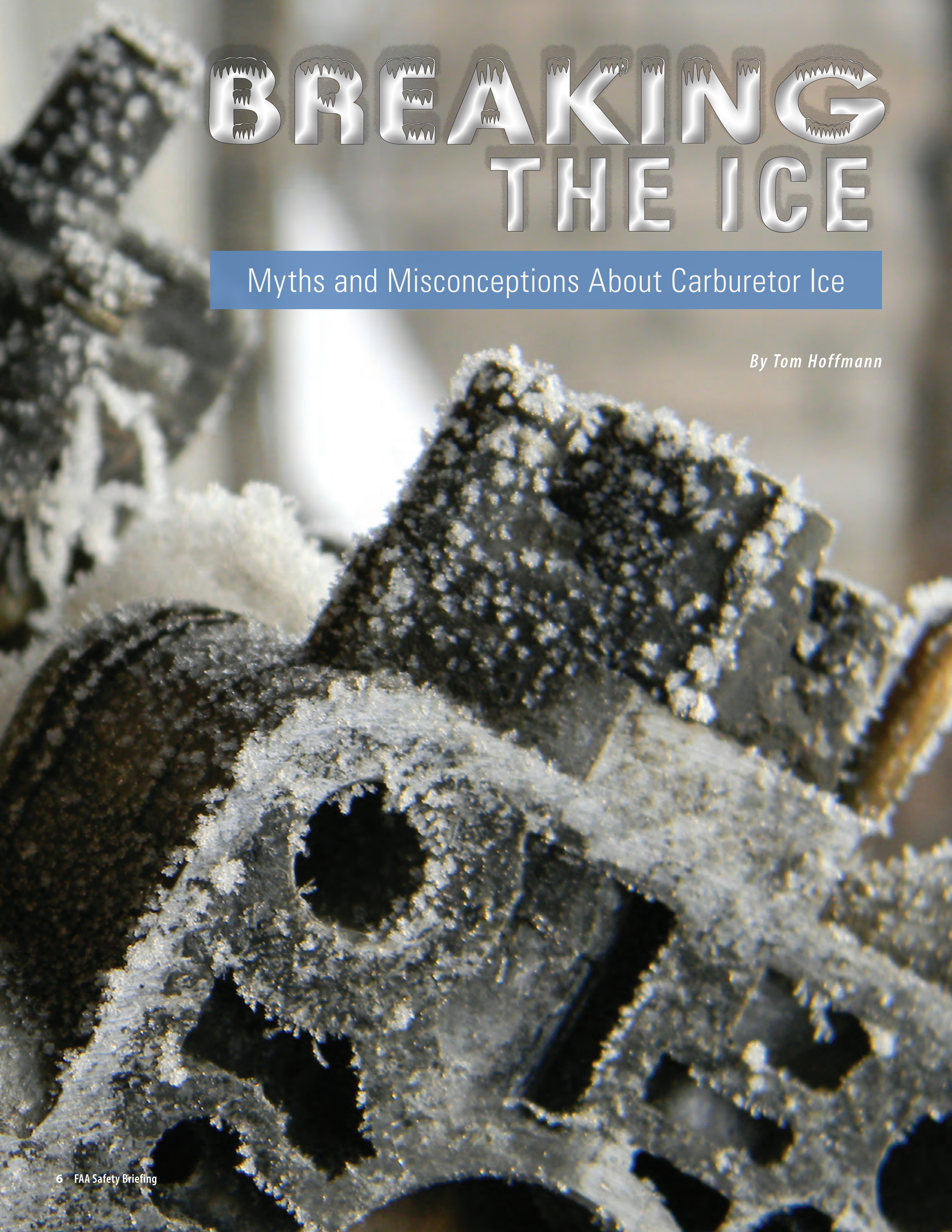
BREAKING THE ICE

Myths and Misconceptions About Carburetor Ice

By Tom Hoffmann



When it comes to aircraft icing, it's usually the clear or rime variant accumulating on airframe structures that gets the spotlight. And for good reason. Structural icing has hugely debilitating effects on all four major forces in flight and can be deadly if not avoided or handled properly. However, there's a more insidious type of icing lurking under the cowling that can prove just as deadly and is prevalent in a more varied range of weather conditions than its chilly cousin.

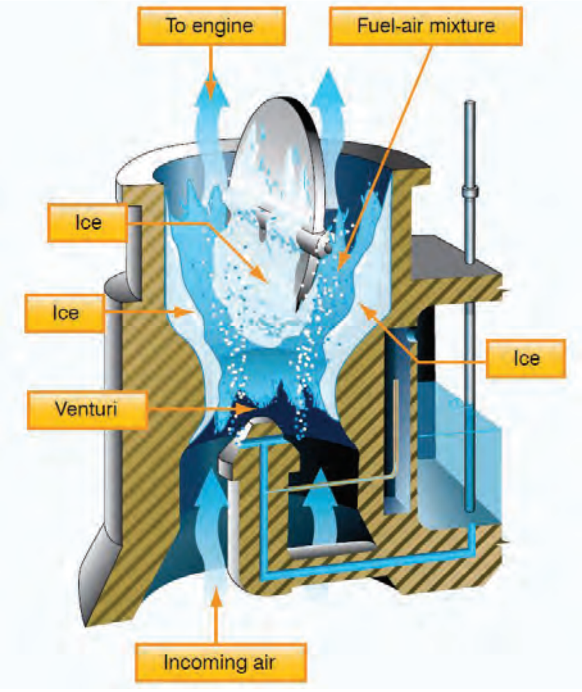
Carburetor icing, or carb icing, can starve an engine of its power-producing properties, often without warning. Thankfully, carb ice can be fairly easy to avoid and/or mitigate — provided you're familiar with the correct information and procedures. Yet, every year many pilots find themselves victims of carb ice and unaware of its propensity in some warmer environments.

A recent search for carburetor icing-related accidents since 2018 in the NTSB's aviation accident database rendered 192 accidents, 19 of which were fatal. A common theme among the accidents was the inability to recognize carb icing symptoms and the improper use of carburetor heat.

So, what can pilots do to combat this icy villain? Let's take a closer look at what carb icing is, how it can affect your flight, and how to deal with it.

What is Carb Ice?

Carb icing occurs when moisture in the air freezes and collects on parts inside of the carburetor and/or the air intake, blocking airflow to the engine. It can happen to any carburetor under the right atmospheric conditions and even a small amount can cause a power loss.



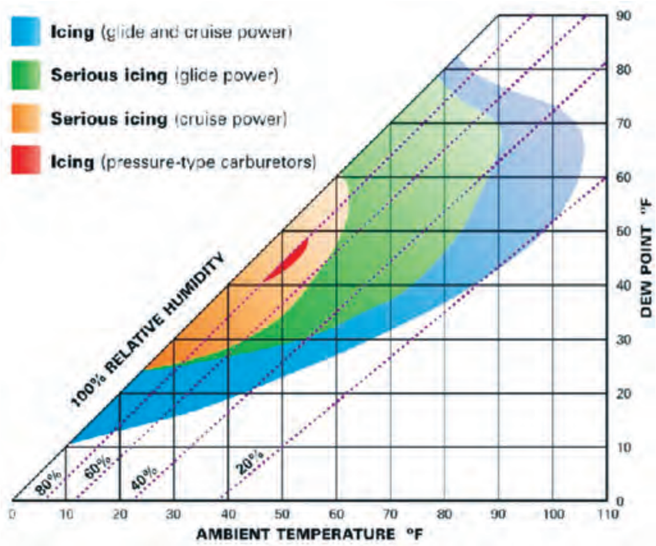
The formation of carburetor ice may reduce or block fuel/air flow to the engine.

As noted in FAA Advisory Circular (AC) 20-113, *Pilot Precautions and Procedures To Be Taken in Preventing Aircraft Reciprocating Engine Induction System and Fuel System Icing Problems*, and the FAA Safety Team's *Winter Flying Tips* pamphlet, there are actually three types of carburetor icing to be aware of:

- ***Impact ice*** forms by the impact of moist air at temperatures between 15 and 32 degrees Fahrenheit (F) on air scoops, throttle plates, heat valves, etc. It usually forms when visible moisture like rain, snow, sleet, or clouds are present. Most rapid accumulation can be anticipated at 25 degrees F, when the supercooled moisture in the air is still in a semi-liquid state. (Note: Impact ice can also block the air filter and rob the engine of air needed for combustion, even on a fuel-injected engine.)
- ***Throttle ice*** forms at or near a partly closed throttle valve. The water vapor in the induction air condenses and freezes due to the venturi-effect cooling as the air passes the throttle valve. Since the temperature drop is usually around 5 degrees F, the ideal temperatures for forming throttle ice would be 32 to 37 degrees F (although a combination of fuel vaporization and throttle ice could occur at higher ambient temperatures).
- ***Fuel vaporization ice*** forms at and downstream of the point where fuel is introduced and occurs when the moisture content of the air freezes as a result of the cooling caused by vaporization. It generally occurs between 40 and 80 degrees F but may occur at even higher temperatures whenever the relative humidity is more than 50%. Fuel icing usually occurs in conjunction with throttle icing and is most prevalent in engines with conventional float-type carburetors.

A key takeaway here is that carburetor icing doesn't just occur in freezing conditions; it can occur at temperatures well above freezing when there is visible moisture or high humidity. You'll notice in Figure 1 on the following page that the temperature and humidity range most prone to carb ice covers many conditions we fly in throughout a good part of the year. While this chart can help determine prime conditions for carb icing, remember it can still occur in conditions outside of that range.

Figure 1 — Carburetor icing probability chart.



It's also worth noting that differences in engine airflow and cowling design make some aircraft types more prone to carb ice than others. For example, due to engine design and carburetor placement, a high-wing Cessna 182 with a big-bore Continental engine is more likely to build carb ice than a Lycoming-powered Piper *Cherokee*. Just remember that no carbureted engine is immune from carb icing, nor is a fuel-injected engine immune from impact icing.

How Do I Know I Have Carb Ice?

Carburetor ice can be detected by a drop in rpm in fixed-pitch propeller airplanes and a drop in manifold pressure in constant-speed propeller airplanes. You may also experience engine roughness and vibration when carb ice is encountered.

Pilots should also be cognizant of the increased likelihood of carb ice during certain low-power configurations like descents and idling on the ground. If the pilot doesn't take immediate action to clear the ice, it will continue to restrict the fuel/air flow and the engine may lose power completely.

"In my experience, throttle ice, which seems to manifest itself on cold days during extended periods of ground operations, is the type of carb icing that seems to be unfamiliar to many pilots," says Andrew Walton, director of safety at Liberty University's School of Aeronautics.

Walton shared an enlightening scenario of such an encounter with throttle ice during an instructional flight at Liberty in 2009. As reported by the instructor onboard, a Cessna 172 had an extended wait before takeoff due to inbound traffic. The outside air temperature was just above freezing and the humidity was low. Once airborne, the instructor stated that the engine started cutting in and out. They applied carb heat in case of icing and immediately returned to the field. It appears throttle ice had developed at low power after the run-up and while waiting for takeoff.

"This incident demonstrates that while pilots are generally aware of the possibility of fuel ice at higher temperatures and humidities, they don't realize that throttle ice can happen on the ground during taxi," Walton added.

Another good way to help pinpoint the likelihood of carb ice is by using a carburetor temperature gauge. They are usually color-coded with yellow indicating the temperatures where icing may occur. If you have one, be sure to include it in your instrument scan.

Bring the Heat!

So, what's the best course of action for combatting carb ice? Carb heat of course. In most airplanes, when you pull the carb heat knob, a flapper door opens and the engine pulls warm air through a heat exchanger that surrounds your exhaust system. Carb heat use will cause the engine to have a slight loss in power due to the warmer and less dense intake air. If there is carb ice present, you may also notice the engine running rough before eventually smoothing out. This may last from 30 seconds to several minutes depending on the severity of the icing.

The key to carb heat effectiveness is knowing when and for how long you use it. Use it too late (i.e., after a significant amount of ice has accumulated) or too briefly, and you may not have enough heat available to melt the ice. Sometimes descending to a lower altitude where the air is warmer works, but the terrain has to allow for that.

Pilots should consult the airplane flight manual or pilot's operating handbook (POH) for specific instructions on carb heat use, but a best practice is to use carb heat during low-power operations like descents and during landing, as well as when carb icing symptoms exist.

Master instructor and designated pilot examiner Doug Stewart is a proponent of this advice but makes it a point to stress the need for carb heat *before* reducing power. "During checkrides, I might only see one out of ten pilots pull the carb heat before beginning a descent to land," notes Stewart.

There's an increased likelihood of carb ice during certain low-power configurations like descents and idling on the ground.

For Stewart, timing is everything too. "When a carbureted engine quits due to carb ice, the longer you wait to apply heat, the less chance there is of getting that engine running again." He adds that waiting to run through your checklist might be too late as the residual heat from the exhaust system may already be gone. Bottom line: if you suspect carb icing, particularly if you're within the sweet spot for temperature and humidity, use carb heat.

Is There a Downside to Using Carb Heat?

Since carb heat usually brings unfiltered air into the engine, there is concern among pilots that its use may cause damage to the engine. Pilots should exercise caution and limit the use of carb heat in extremely dusty areas, or where there may be volcanic ash present.

Another concern is the degraded climb performance when performing a go-around with the carb heat left on. Pilots should be aware of this, particularly when certain atmospheric conditions may require all available power to arrest a descent. It's best to follow the procedures stated for carb heat use in the aircraft's POH. Just remember that not using carb heat when required for a power-off or low-power descent for landing could result in carb ice and restrict your engine's ability to develop full power on a go-around.

Troubleshooting Tips

Ensuring you're prepared for any icing of the induction kind means checking the carb heat system before you fly.

When pressed for time, resist the urge to speed through your instrument checks on run-up. Instead, take the time to carefully record the appropriate rpm drops when carb heat is applied.

If you're not seeing a significant rpm drop, the system could be leaking, or your cable could be broken. Leaky air boxes are common. When it comes to how much of a drop you should expect to see, the manual is the best place to look. It's common to expect a drop between 75 and 150 rpm. Any less might be worth a discussion with your mechanic.

There are plenty more resources on this subject, so be sure to check out some of the links in the Learn More section below. *Being prepared is the key to keeping your carburetor ice-free!*

Tom Hoffmann is the editor of *FAA Safety Briefing* magazine. He is a commercial pilot and holds an Airframe and Powerplant certificate.

LEARN MORE

FAA AC 20-113, *Preventing Engine Induction System Problems*
bit.ly/AC20-113

FAA SAIB CE-09-35, *Carburetor Icing Prevention*
bit.ly/SAIB0935

FAA *Pilot's Handbook of Aeronautical Knowledge*, Chapter 7, Aircraft Systems
bit.ly/AeronauticalKnowledge

FAA Safety Team's *Winter Flying Tips*
bit.ly/45P8Fuw

FAA Safety Team Online Inflight Icing Course (ALC-33)
https://bit.ly/ALC-33

NTSB Safety Alert 029, *Engine Power Loss Due to Carburetor Icing*
bit.ly/NTSB-SA29

"Bring the Heat," *FAA Safety Briefing*, Jan/Feb 2017
bit.ly/FAASB-BringtheHeat

AOPA Safety Brief, *Combatting Carb Ice*
bit.ly/AOPA-SafetyBriefs

AOPA *Carburetor Icing* article
aopa.org/training-and-safety/students/presolo/skills/carburetor-icing