(AMD-25)
(04/10)

UNITED STATES DEPARTMENT OF THE INTERIOR
AVIATION MANAGEMENT

Safety Alert

No. DOI SA 11-01 Date: November 19, 2010

Subject: THE ICE MAN COMETH

Area of Concern: All Aircraft Operations

Distribution All Aircraft Users

Discussion: Carburetor ice can occur at any time provided temperature and relative humidity are within certain parameters. With colder weather upon us, now is a good time to review this phenomenon.

The following is from Richard Kemp, NPS, Alaska Aviation Trainer and mentor pilot.

NOTE: The information is general in nature because of the many model specific variables involved (carburetor, intake, carburetor heat and cowl design, etc.). Consult your aircraft's Pilot Operating Handbook (POH) for specific information.

THEORY:
Any time the velocity of a gas is increased, its pressure and temperature drop. Any time a liquid changes to a gas, its temperature drops. This combination occurring in the venturi of your carbureted aircraft engine can lower the temperature by as much as 70°F. If moisture is present in the right amount, the result is ice in the carburetor which can "starve" the engine of the fuel/air mixture it needs to keep running. It is possible to have carburetor ice form at an outside air temperature of 100°F if relative humidity is 50% or greater. Icing is likely to be severe at temperatures of 50-70°F if RH is above 60%. Carburetor ice gets rare when relative humidity drops below 25% and/or temperatures get well below freezing. That's quite a range. It's most typically seen when temperatures are 40-50°F and relative humidity is between 25-40%.

SYMPTOMS:
The two common symptoms of carburetor ice are an un-commanded reduction of power followed by a rough running engine. (And, if not dealt with, followed by a non-running engine.) This power drop can be quite subtle. In an engine with a fixed pitch propeller, you'll see a drop in RPM. With a constant speed prop, you'll see a small drop in manifold pressure. A good scan of the engine instruments during flight is very important.

THE CURE:
We can control the temperature of intake air with carburetor heat. By keeping our carburetor air temperatures *out of the range* of about +5°F to +41°F, icing is not a problem. Unfortunately, most of the aircraft we fly today do not have carburetor air temperature gauges. (In the good ol' days, real airplanes had carburetor temperature gauges *and* pilot controlled oil cooler shutters.) So we end up using a combination of ice prevention and ice removal techniques. We apply heat as prevention when we think environmental and operational conditions are favorable for ice formation and we apply heat to remove ice when we find that it is present. As a general rule, too much heat too soon is always better than not enough heat too late! Let's look at this during different phases of our operations.

PREFLIGHT:
After engine warm-up and before flight, we do a carburetor heat check to look for two things. First, is our carburetor heat system working as it should? We should see a 200-300 RPM drop as we introduce hot (less dense) air to the engine. Second, (with the heat still on) we look for a recovery of some of that lost RPM. A recovery is an indication that carburetor ice formed and it is melting away. No recovery; no ice formed. Good information to have before launching.

TAXI:
Since heated intake air is unfiltered, we should not taxi with the carburetor heat "ON". An exception would be taxiing a floatplane. The high humidity present just above the water's surface may be conducive to ice and we don't need to worry about dusty intake air.

TAKEOFF:
The pressure and temperature drop in a full throttle operation is less than in a closed throttle operation. For this reason, and the fact that engine temperatures under the cowling are highest during takeoff, carburetor ice is rarely a problem. It’s not that it can't happen, but I've never seen it.

CRUISE:
In cruise flight, we may pass through air masses with conditions conducive to carburetor icing. A good scan of RPM and MP gauges should alert us to accumulating carburetor ice. As mentioned earlier, the onset can be quite subtle. If you find you're having to add a little power or nose up trim to maintain altitude, check for carburetor ice. As during the preflight, pull carburetor heat, watch for the power drop and then the recovery as ice is melted. If the icing is sufficient enough, the melting ice will cause water to enter the engine with subsequent engine roughness. It may take a minute or two to smooth out. If conditions are severe, it may be necessary to leave the heat on. If so, use full "HOT" and re-lean the mixture to account for the less dense intake air. If you are unable to control ice accumulation, climb, descend, or do a "180" to more favorable conditions.

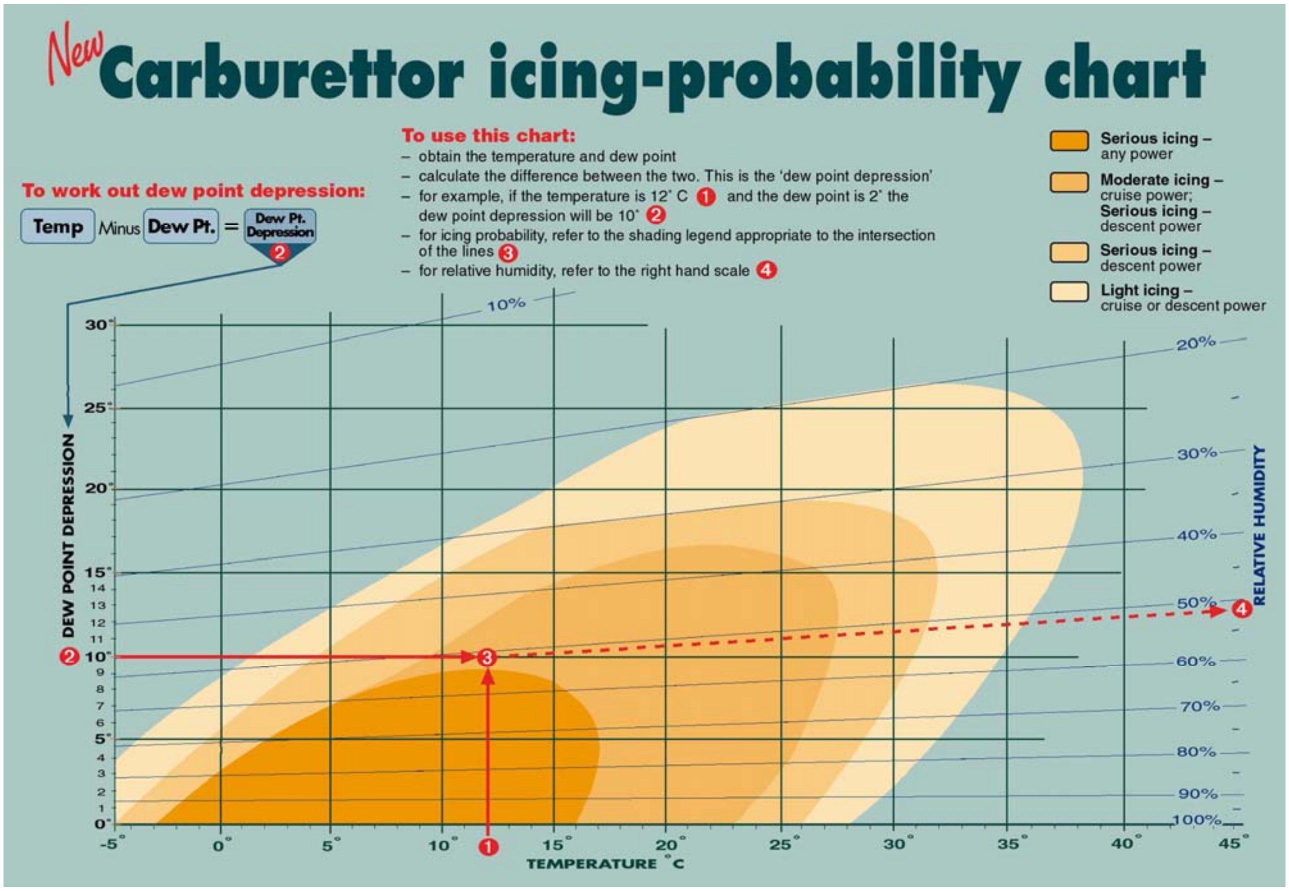
DESCENT:
This is the most critical situation for carburetor ice. First, because a closed throttle operation has the highest pressure and temperature drops in the carburetor and the lowest under cowl temperatures, ice formation is most likely. Second, if ice does need removal, the heat available for intake air is at its lowest. Therefore, most POHs call for carburetor heat prior to the start of the descent as a precautionary measure.

TRAINING:
Be particularly careful during simulated engine failure training. Use full heat before the throttle reduction and advance the throttle occasionally during descent to assure power is still available. When doing pattern work, apply heat as soon as you reach pattern altitude, not late in the downwind.

SURVEYING:

If you find carburetor ice while surveying, try increasing drag by adding more flap. This will require more power which will open the throttle more, reducing the carburetor temperature drop, increasing under cowl temperatures and increasing carburetor heat temperatures. Of course, be ready to call off the survey if carburetor ice becomes a problem. Low and slow is no place to suffer a loss of power.

Most people are surprised to find that in Alaska the summers are more conducive to carburetor icing than the winters. The very cold winters with very low humidity result in very few cases of carburetor ice. But if conditions are right, we need to be alert for carburetor icing.



/s/ Keith C. Raley

Keith C. Raley
Chief, Aviation Safety
And Program Evaluation