Icing!

What happens when we get into airframe icing and what should we do?

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If you continue to fly a twin Cessna in all weather conditions, it's a good bet that someday you're going to have to make a radio transmission like this: "Chicago Center, twin Cessna 1234A. I'm beginning to pick up ice." Okay, this is not the end of the world. If the aircraft is fully de-iced or certified for "known ice", you should be able to handle the situation. However, there are some actions that must be taken and they must be taken immediately.

First of all, let's talk about the equipment on the airplane. There are two kinds of equipment. Anti-icing equipment (electrically heated) which includes all equipment that prevents ice from forming and de-icing equipment (pneumatic boots) that has the ability to rid the airframe of icing build up. A fully de-iced aircraft has the following:

1. Wing and horizontal fin leading edge boots.
2. Electric propeller boots.
3. An alcohol spray for the windshield.
4. Pitot and stall vane heaters and in some cases, heaters for the static ports and fuel tank vents.

A known ice equipped airplane has the following:

1. Wing, horizontal fin and vertical fin leading edge boots. This also includes functioning boots between the engine nacelles and the fuselage.
2. Electric propeller boots.
3. Either a heated plate on top of the windshield or the pilot's half of the windshield is heated.
4. Pitot tubes, the stall vane, static ports and all fuel vents are electrically heated.
5. Complete instructions in the POH on the use of the de-icing equipment.

All certification of twin Cessna aircraft for flight into known icing conditions was done by Cessna and covers only models from a given serial number on. This means if you add all of the equipment found on a known ice equipped aircraft, it can only be a "known ice" aircraft if the serial number is higher than the one given by the factory.

An example of this is the 310R. Known icing can only be certified on serial number 310R-0801 and higher. No matter what anyone tells you, you can't take an older airframe, add all of the known ice equipment and call it a "known ice" airplane.

What is flight into known icing conditions? Anytime you file a flight plan and the temperature is at or below +10 degrees centigrade, or the ram air temperature is at or below +10 degrees centigrade and visible moisture is present in any form along your route of flight, you have filed a flight plan into "known icing conditions". Filing this flight plan with an aircraft that is not certified for flight into known icing conditions is prohibited by the FARs. Pilots must constantly monitor current weather conditions along their intended route of flight and must be alert to any conditions that could lead to airframe icing. You must be operating an aircraft certified for known icing conditions before you intentionally penetrate any area where the above conditions are present or icing is reported in weather sequence reports or by Pireps.

Why is icing such a problem? When ice accumulates on an airfoil, it alters the shape of that airfoil and therefore significantly lowers the lift. Ice also adds weight to the airframe. Both of these items together can eventually render the airframe unable to hold altitude.

As the airfoil becomes less efficient and the weight increases, the stall speed of the aircraft is greatly increased. Aircraft performance can be severely reduced by the accumulation of ice. Even trace amounts of ice on the horizontal fin can alter the airfoil characteristics which affect the stability and ability to control the aircraft. Even as little as ½ inch of ice on the leading edges of the airfoils will cause a large loss in rate of climb, a cruise speed reduction of up to 30 knots indicated airspeed as well as a significant buffet and stall speed increase.

Icing Conditions Defined

There are basically 4 types of icing.

1. **Trace.** Ice becomes visible. The rate of accumulation is slightly greater than the rate of sublimation. Anti-icing equipment must be turned on and de-icing equipment may or may not be needed.
2. **Light.** The rate of accumulation may create a problem if flight is prolonged in this environment for over one hour. Occasional use of deicing equipment removes/prevents accumulation.
3. **Moderate.** The rate of accumulation is such that even a short encounter becomes potentially hazardous and the use of deicing and anti-icing equipment and diversion of flight is necessary.
4. **Severe.** The rate of accumulation is such that deicing and anti-icing equipment fails to reduce or control the hazard. Immediate flight diversion is necessary.

If you encounter icing conditions during flight, certain actions must be taken. All pilots should familiarize themselves with the procedures listed in the Owner's Manual or the Pilot's Operating Handbook.

There are no set rules, but, the following considerations will help. The number one rule is **avoidance!** If you stay out of icing conditions, icing will not be a problem. The second rule after an encounter with ice is a change in altitude. I would opt to climb first as there is almost always warmer air above where the moisture is formed and it has fallen to a colder altitude where super cooled droplets freeze on contact with the airframe. The climb should be made at a slow to moderate rate because climbing at a high rate will give the airframe an angle of attack that allows ice to build on the lower areas of the airfoils and fuselage where removal is impossible. Climb slowly with a minimum loss of indicated airspeed.

The third rule is a reverse in course. If you were not getting ice behind you on your flight path, it only makes sense that you would fly back out of the icing conditions by reversing your course.

The following list is published by Cessna. This is a list of actions a pilot should take anytime icing conditions are encountered.

1. Turn the pitot heat, stall warning heat, propeller deice/anti-ice and windshield anti-ice switches ON (if installed).
2. Change altitude (usually climb) or turn back to obtain an outside air temperature that is less conductive to icing.
3. Increase power as necessary to maintain cruise airspeed and to minimize ice accumulation. Maintain a minimum indicated airspeed of Vy + 10 KIAS until assured that all ice is off of the airframe.
4. Turn the cabin heat and defroster controls to full on and open the defrost control to obtain maximum windshield defroster effectiveness.
5. Increase engine speed to minimize ice build up on the propeller blades. If excessive vibration is noted, momentarily reduce engine speed with the propeller control, and then rapidly move the control full forward. Cycling the RPM flexes the propeller blades and high RPM increases centrifugal force, causing ice to shed more rapidly.

6. Watch for signs of induction air filter ice. Regain manifold pressure by increasing the throttle setting and/or selecting the alternate air or carburetor heat. If ice accumulates on the intake filter (requiring alternate air) a decrease of manifold pressure will be experienced and the mixture should be adjusted as required.
7. If icing conditions are unavoidable, plan a landing at the nearest airport. In the event of an extremely rapid ice buildup, select a suitable "off airport" landing site.
8. Ice accumulation of 1/4 inch or more on the wing leading edges may require significantly higher power and a higher approach and landing speed, and result in a higher stall speed and a longer landing roll.
9. If practical, open the side window and scrape the ice from a portion of the windshield for visibility in the landing approach.
10. Approach with reduced flap extension to ensure adequate elevator effectiveness in the approach and landing.
11. Avoid a slow and high flare in the landing.
12. Missed approaches should be avoided whenever possible, because of severely reduced climb capability. However, if a go-around is mandatory, make the decision much earlier in the approach then normal. Apply maximum power while retracting the flaps slowly in small increments (if extended). Retract the landing gear after immediate obstacles are cleared.

Remember the following:

1. Avoidance is the best method of coping with ice.
2. If ice is encountered, take immediate action.
3. Turn on all anti-ice equipment installed on your particular aircraft.
4. Initiate a slow rate of climb.
5. Add power to maintain indicated airspeed.
6. Make a 180 degree turn.
7. Follow the 12 Cessna rules listed above.

Having the equipment to cope with ice is important. Having the knowledge to use that equipment and taking proper and timely action is absolutely essential!