Interagency Aviation Safety Alert

Subject: Aircraft Icing

Area of Concern: All Aircraft Operations

Distribution: All Aircraft Users

Discussion: With the onset of winter flying, pilots must remember to clean the wings and control surfaces of any accumulations of ice and snow before flight because they can dramatically alter the airfoil and affect the ability to develop lift. Even frost can spoil aerodynamic lift just as a thick coating of rough ice can. Particularly on cold evenings, frost can form quickly, and disaster can strike suddenly.

Ice, snow, and frost don't just affect the ability of airfoils to generate lift. The additional weight can unbalance control surfaces and lead to a dangerous aerodynamic condition called flutter.

Although there are no specific regulations in Federal Aviation Regulation (FAR) Part 91 regarding aircraft operation with ice, snow, or frost on the aircraft, FAR Part 135, which regulates air taxi and commercial operators, does provide specific guidance that pilots operating under Part 91 should consider.

FAR 135.227, Icing Conditions: Operating Limitations, says pilots are not allowed to take off with frost, snow, or ice on any propeller, windshield, powerplant installation, or adhering to an airspeed, altimeter, rate of climb, or flight attitude system. This regulation also prohibits takeoffs with snow or ice on the wings, stabilizers, or control surfaces. It further states that any frost adhering to the wings, stabilizers, or control surfaces must be polished smooth.

Cold weather can cause the formation of ice on other aircraft surfaces as well. Water and slush can freeze on brakes and landing gear, and ice crystals can form in the fuel.

ENROUTE ICING PROBLEMS

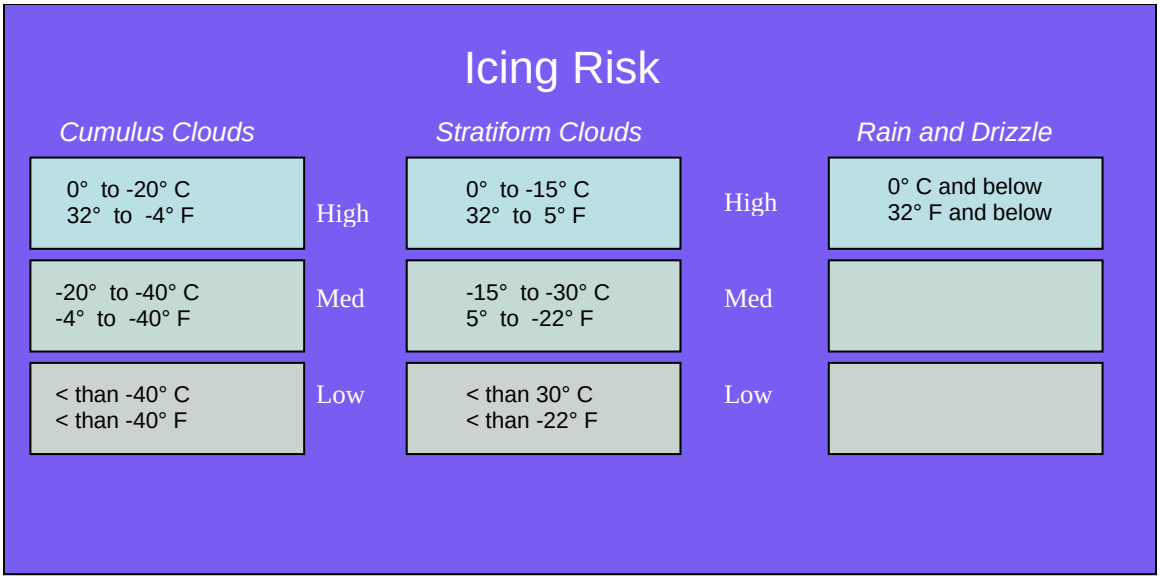
Ice, snow, and frost are not just a problem to be considered during preflight inspections. Pilots are required to operate aircraft only in the conditions for which the aircraft is certificated. And even if an aircraft is approved for flight in known icing conditions, it's generally a good idea to avoid such situations.

There are several excellent reasons to avoid flight in icing conditions. Ice can form on the pitot tube and static vent, rendering the airspeed indicator, altimeter, and vertical speed indicator (VSI) inoperative. It can build up on antennas, distort radio signals, and result in loss of navigational and communication capabilities.

When ice accumulates on the wings, it alters the shape of the airfoil, reduces the amount of lift produced, and increases the stall speed. Combine this with the increased weight of the aircraft and the reduced efficiency of an ice-covered propeller, and an aircraft can quickly become a block of ice hurtling toward the ground.

Even when operating aircraft equipped with deice or anti-ice equipment, pilots must understand the limitations of the equipment. Most systems only remove ice from specific, critical locations, such as the leading edges of the wings, windshield, and propellers. That leaves plenty of airframe and appendages, including the vertical and horizontal stabilizers, upon which ice can form. Although deice boots may remove ice from the leading edges, ice can still accumulate on other portions of the wing. This can be a problem, particularly during departure and approach phases of flight, when the aircraft is operating at a low airspeed and a high angle of attack.

According to the Aeronautical Information Manual (AIM), the most severe in-flight structural icing conditions occur when it's 0° C and colder. Although it can occur in clear skies, icing is most prevalent in conditions of visible moisture, such as in clouds.



A thorough evaluation of cloud bases and tops along with temperatures aloft can be an important preflight consideration. But remember that multiple icing levels are possible, and even if you can safely fly above icing conditions, you may be required to make an approach through them. The consequences of even a short exposure to icing conditions can be disastrous, to say nothing of what could accumulate during a lengthy hold or a missed approach procedure.

All clouds at subfreezing temperatures have the potential for ice formation. But, the type of ice formed depends on several factors, including water droplet size and distribution, and the aerodynamic effects of the aircraft. There are no hard-and-fast rules that determine whether ice will or will not form in specific conditions.

Ice comes basically in three varieties: rime ice, clear ice, and a mixture of the two.
Rime ice is brittle and frost-like. It usually forms in conditions where the droplet sizes are small, such as in stratus clouds and light drizzle. Air is trapped within the ice as it forms, giving it a white or milky

appearance. It primarily accumulates on wing leading edges and the front of anything projecting into the airstream, such as landing gear, antennas, and horizontal and vertical stabilizers. Its rough shape is particularly effective in reducing aerodynamic efficiency, but due to its brittle nature, it is more easily removed than clear ice.

Clear ice forms when water droplets spread out on the surface before freezing. The result is a clear, hard ice that adheres to all areas of the airframe and is very difficult to remove. It generally forms in rain and cumuliform clouds, and it can accumulate quite rapidly.

If icing conditions are encountered in flight, take action immediately. A 180-degree turn, climb, descent, or some combination of these maneuvers is recommended. If you're flying under instrument flight rules (IFR), don't let ATC push you into continuing on or waiting before taking evasive action. If necessary, declare an emergency and do what you must to get out of the ice. Icing can build tremendously fast, disabling aircraft in minutes, or in some cases, just seconds.

Winter flying poses a number of hazards to pilots, and the problems of ice, snow, and frost are just the tip of the proverbial iceberg. But with proper training, knowledge, and judgment, pilots can avoid the perils and pitfalls and effectively deal with old man winter.

Reference: AOPA Online Air Safety Foundation, *Recurrent Training: Ice, Snow and Frost* at http://www.aopa.org/asf/hotspot/winterwx.html

For more information on the subject of icing and operating in cold environments, see:

FAA: Advisory Circular 91-13C, *Cold Weather Operation of Aircraft*; Advisory Circular 00-6A, *Aviation Weather, Chapter 10: Icing*; Advisory Circular 91-51A, *Effect of Icing on Aircraft Control and Airplane De-Ice and Anti-Ice Systems*; and FAA Accident Prevention Pamphlet P 8740-24, *Tips on Winter Flying*.

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/s/ Robert Galloway

Robert Galloway

Aviation Safety Manager

/s/ Ron Hanks

Ron Hanks

Chief, Aviation Risk Management and Training Systems