General Aviation Safety Challenges 2008 – Part 2

By: Small Airplane Directorate, Federal Aviation Administration

A few months ago, the Small Airplane Directorate released an informational article on density altitude for distribution through various flying organizations. The article gave pilots information that could help them improve their decision making and piloting skills. As the busy summer flying season is behind us and another winter season approaches, we wanted to discuss causes for accidents in icing conditions, and provide information to help keep you safe this winter.

What is the latest trend in icing related accidents?

Aircraft icing remains a key aviation safety issue. Accident data shows pilots are (intentionally or unintentionally) flying aircraft not certificated for flight in icing conditions into such conditions, often with fatal results. The good news is that since the early 1990's icing accidents involving aircraft not certificated for icing has been steadily decreasing. However, accidents involving aircraft certificated for flight in icing conditions has not decreased. In the last three years there have been 5 fatal accidents due to icing and we are seeing an average of 8 icing related accidents per year. Freezing drizzle and rain (called supercooled large drops, or SLD) still remains a problem; approximately one third of icing related accidents occur in these conditions.

What causes accidents in icing conditions?

Icing accidents are often the result of poor understanding of the airplane's limitations and performance in icing conditions, misconceptions of airplane and system icing certification, incomplete pre-flight weather briefings, and a misunderstanding of icing terminology. Education is the first step in reducing aircraft icing accidents.

What should I know about airplane icing certification?

*1. Standards used to certificate airplanes for icing do **NOT** cover all icing conditions that exist.*

The standards only cover some of the water forms that can exist in clouds. Icing conditions can overwhelm your ice protection. Certification standards also assume you will hold in icing conditions less than 45 minutes. Pilots of aircraft certificated for flight in icing conditions should not be casual about operations in those conditions, particularly extended operations.

More importantly, the certification standards do **NOT** include SLD. SLD will impinge further aft on the wing and tail, forming ice behind your deicing boots or other type of ice protection system. The aerodynamic penalties can be larger than ice that forms on leading edges. SLD icing conditions were identified in the 1994 fatal accident of American Eagle Flight 4184 in Roselawn, Indiana. The aircraft, a ATR-72 turboprop, was certified for flight in icing conditions.

You need to learn the cues and exit procedures of severe icing for your airplane. If your airplane's Pilot's Operating Handbook (POH) or Airplane Flight Manual (AFM) does not have any, consult Advisory Circular 91-74A "Pilot Guide: flight in Icing Conditions" for cues and exit procedures that you may use.

Some airplanes may exhibit little visual cues, such as side window icing. On single engine airplanes, spinner ice, which may provide a cue in multi-engine airplanes, cannot be seen by the pilot. It is important to look for indication of drizzle and rain, such as drops that splatter on your windscreen. In a certification flight test of single engine turboprop, the only indication of SLD, which resulted in nodules of ice covering the underside of the wing, was a noticeable increase in required power to maintain the approach glideslope.

2. Icing certification standards have changed dramatically over the years.

Prior to 1973, small airplanes were **NOT** required to test in icing conditions nor be analyzed or tested to the icing condition standard used today. The standards have changed significantly, even in the last few years. Advisory Circular 91-74A "Pilot Guide: flight in Icing Conditions" provides a good history for those who want more information. The two major changes are in stall warning and climb performance:

Stall warning. Small airplanes certificated prior to 2000 were given certification credit for natural aerodynamic stall warning (buffet) even if the airplane was equipped with a stall warning system. Since ice buildup on the wing lowers the stall angle of attack the stall warning sensor might not provide warning in icing conditions. Pilots therefore should:

- Know the POH/AFM minimum icing airspeeds and treat them as limitations, even if they are not in the Limitations section. If your POH/AFM does not have minimum icing airspeeds, add 15-20 KIAS to your normal operating airspeed. This goes for all phases of flight, including approach and landing where most small airplane icing accidents occur.
- Treat any buffet or vibration as an impending wing stall.
- Limit maneuvering in icing conditions.

Climb performance. Prior to 1993, there were **NO** quantitative requirements for climb performance in icing conditions. An airplane being certificated today is required to have enroute climb performance data in the POH/AFM if the airplane's service ceiling in icing is less than 22,000 feet. Pilots should:

- Consider the climb performance of the airplane and the route's minimum altitude when determining routes and exit strategies in your pre-flight planning. The airplane's climb performance will be degraded in icing conditions.

- Consider climbing or descending to take you out of icing. However, don't assume you can climb with ice on your airplane.
- If you cannot climb to exit icing, do not fly below the minimum airspeed in icing. Exit by making a 180º turn.
- If you cannot maintain altitude in icing at you minimum airspeed, trade altitude to keep airspeed above the minimum airspeed in icing.

3. Airplane certification assumes the airplane is clean on takeoff.

The ability to safely takeoff with contamination, including polished frost, is not tested. No airplane manufacturer, or the FAA, has an established procedure for polishing frost, and the lift and drag penalties are unknown. Taking off with any contamination reduces the already small stall margin and reduces climb performance. Make sure critical surfaces such as lifting surfaces, control surfaces, propeller blades and engine inlets are free of contamination.

Can I use the autopilot in icing conditions?

Yes, provided the icing conditions are not severe, but you MUST watch your airspeed. When ice starts building up on the airplane, and drag starts increasing, the autopilot's vertical mode will maintain altitude or vertical speed at the expense of airspeed. Accident data and flight tests have revealed two important lessons learned:

- The rate of airspeed loss can be rapid. We've seen a loss of 40 KIAS or more in less than three minutes.
- The autopilot and natural cues have not been sufficient to make the pilot aware of the airspeed loss. The pilot should periodically disconnect the autopilot to check for unusual trim or control forces.

Is pneumatic boot "ice bridging" a concern?

A traditional concern in the operation of pneumatic boots has been "ice bridging" (the formation of a thin layer of ice, which is sufficiently plastic to deform to the shape of an expanded deicing boot without being fractured or shed during the ensuing tube deflation.) As the deformed ice hardens and additional ice builds up, the boot may become ineffective in shedding the "bridge" of ice. Traditional advice on avoiding this problem has been to wait for a layer of ice of a predetermined thickness to form before cycling the boot. Icing tunnel tests sponsored by the FAA show no ice bridging on "modern" boot designs. Known cases are from boot designs dating back a half century or more. Recent studies (in 2005) have shown that at airspeeds typical of general aviation airplanes, ice buildup on modern boot designs will not shed with every boot inflation cycle. The ice that does not shed is residual ice and is not due to bridging.

Cycling modern boots **early and often** does not cause ice bridging and will not degrade ice shedding. Consult your AFM or POH for guidance on proper system use.

FAA sponsored testing showed that proper application of ice adhesion inhibitors improved ice shedding and reduced residual ice at colder temperatures. The FAA strongly encourages the use of the manufacturer's recommended ice adhesion inhibitors. It is important to only apply

adhesion inhibitors to your boots authorized by the boot manufacturer – ice shedding performance may degrade and boot damage may result.

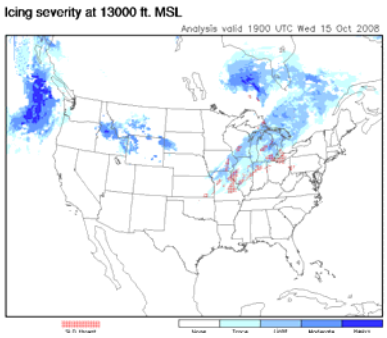
What about Ice Contaminated Tailplane Stall (ICTS)?

The horizontal stabilizer balances the tendency of the airplane's nose to pitch down by generating downward lift on the tail. When the tail stalls, the downward force is lessened or removed, and can allow the nose to severely pitch downward. Since the horizontal stabilizer has a smaller leading edge radius and cord length compared to the wings, ice can build up faster on the stabilizer and lead to an ICTS. Lowering flaps changes the angle of attack can increase the likelihood ice buildup on the stabilizer and an ICTS. Consult your POH/AFM for maximum flap limitations in icing. As a general rule, avoid using full flaps in icing conditions if landing distances permit (with the appropriate increase in approach speed). Do not use flaps for extended periods of time in icing conditions, such as holding. This will also help prevent ice accumulation on the upper surface of the wing, which is most detrimental to lift.

What certification testing is done to show airplanes without ice protection equipment can safely exit an inadvertent icing encounter?

The answer is simple – **NONE**. There are only requirements for engine induction icing and pitot and static source ice protection for IFR approved airplanes. Most icing encounters are of low water content and drop size, so if you have safely exited one encounter, or hear hangar talk that your airplane is okay in icing, don't gamble that the next encounter will have the same result. "Never Again - A trace is ice" in the April 2006 edition of AOPA Pilot magazine provides the story of one pilot's encounter with ice in an airplane with no ice protection. (http://www.aopa.org/members/files/pilot/2006/na0604.html)

Where can I find more information?



A tool pilots should use to supplement their weather briefing prior to flight in known or forecast icing is the Current Icing Potential at http://adds.aviationweather.noaa.gov/icing/. Pilots can use it to determine altitudes and routes to keep them out of high probable icing areas, or, for a known icing approved airplane, areas of SLD. PIREPS, Airmets, Sigmets, and freezing levels are also displayed graphically on this site.

The AOPA Air Safety Foundation has written several Safety Advisors on icing that pilots will find useful. You can find these at http://www.aopa.org/asf/publications/advisors.html.

There are also numerous icing training products produced by NASA, in cooperation with the FAA. These are listed at http://icebox-esn.grc.nasa.gov/education/products.html.

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