



Aircraft Deicing and Anti-icing Equipment

Are You legal?

If you shell out thousands of dollars for deicing equipment – whether on a new airplane or retrofitted to an existing older aircraft – you should reasonably expect your investment to see you safely through icy clouds or other freezing precipitation, right?

Perhaps, but not necessarily. Most deicing systems offered on new light general aviation (GA) airplanes are *not* certificated for flight in icing conditions. No, you didn't misread that: Several deicing systems installed on new light GA aircraft *do not* allow legal launches into icy skies. The same is true of many deicing or anti-icing systems retrofitted to existing aircraft.

It's natural to think that having a deicing system means you can routinely tackle all but the most severe icing conditions. But unless your particular airplane model and system has gone through all the rigorous testing and been certificated for flight in icing conditions, there's no guarantee. And, systems not certificated for flight in icing conditions do not make it *legal* for you to take off into icing conditions.

Though many pilots are unaware of it, there are two main varieties of deicing systems available today for light GA aircraft: **FAA certificated systems for flight in icing conditions** and so-called "**non-hazard**" systems that are meant simply to buy time for a pilot to escape from unexpected icing conditions. Many of the systems installed on new light GA aircraft today are the latter, which some pilots erroneously believe allow them a legal takeoff into icing conditions.

I'm often asked questions such as, "How much ice can a Cessna 172 carry?" How much an airplane can or cannot carry isn't the question. The real question is, "Does the FAA say the airplane can be flown in ice?" If it isn't ice approved, then you don't have any business flying it in ice."

*-Capt. Robert Buck,
Author of Weather Flying*

So which type of equipment does your airplane have? Knowing the answer to that should have a big impact on your takeoff decisions in icy weather. Information on determining what kind of equipment your airplane has will be provided later in this advisory.

A more detailed discussion of flight in icing conditions is available in the AOPA Air Safety Foundation's Safety Advisor *Aircraft Icing*, free to all pilots on the ASF Web site at www.aopa.org/asf/publications/sa11.pdf.

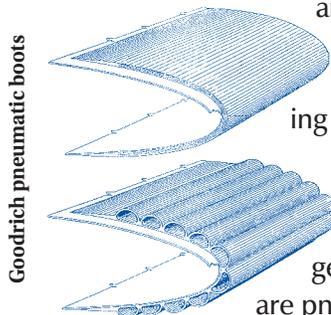
Deicing or Anti-Icing?

Equipment designed to remove or prevent icing, whether approved or not, comes in two basic flavors: anti-icing and deicing. Anti-icing equipment is turned on *before* entering icing conditions and is designed to prevent ice from forming. Deicing equipment is designed to remove ice *after* it begins to accumulate on the airframe.

Flexible rubber-like boots that expand and contract on ice-prone areas of the aircraft are a common type of deicing equipment. Liquid freeze point depressant systems such as the TKS, a weeping wing system that disperses low freeze point liquid over portions of the

airplane, can be either anti-icing or deicing depending on when the fluid dispersing system is activated.

The most common types of ice protection systems for general aviation aircraft today are pneumatic boot systems and fluid freeze point depressant systems.



Pneumatic boots shown on leading edge of wing

Other Icing Protection Systems and What's Coming

Electric thermal heating systems are also available and are most commonly used on windshields and propellers.

Large, turbine powered aircraft typically are equipped with anti-ice systems that use hot compressed air (called bleed air) that is tapped off the compressor section of the engines to prevent ice from forming on critical engine components such as the air inlet lip and the turbine engine inlet guide vanes. This heated air is also ducted to airframe parts such as the wing and tail leading edges. Unfortunately, bleed air anti-ice systems are not available on piston and turboprop-powered general aviation airplanes. Turboprop-powered airplane ice protection systems usually use a combination of electrothermal heating elements and pneumatic boots to combat in flight icing.



Thermawing

At least two new types of icing systems are on the horizon. An electroexpulsive system that depends on very rapid electromagnetically-induced vibrations has recently been certified for use on Raytheon's Premier I business jet. This system holds promise for smaller new general aviation airplanes but isn't practical for retrofitting since the electromagnetic coils that create the jolt would be very difficult to install on an existing wing structure.

Another electrically powered system now being tested on Lancair airplanes (above) consists of a thin graphite foil heating tape that is installed on ice prone areas. Activation almost instantaneously raises the tape temperature, causing ice to lose its grip and be carried away by the relative air flow. Since the

heating tape can be easily applied on the surface of airframe structures, this system holds great promise, especially for the retrofit market. However, no aircraft has been certified for flight in icing conditions using this system.

At the present time, neither system has been approved for installation on existing airplanes through the supplemental type certificate (STC) approval method.

FAA Certificated vs. Non-Hazard – What’s Involved?

So what’s the real difference between systems that are FAA approved for flight in icing conditions, which allow a pilot to legally challenge routine icing conditions, and “non-hazard” systems that do not? Basically, certification standards and testing. Approved systems have demonstrated that they can protect your airplane during icing conditions specified in the airworthiness regulations, while non-hazard systems do not have that burden of proof. In the case of non-hazard systems installed on airplanes certificated before 1977, non-hazard systems weren’t even required to prove that they could shed ice!



Certification: Approved Systems

Among many other tests, the manufacturer of icing equipment approved-for-icing-condition flight must determine an airplane's tolerance to ice accumulation on unprotected surfaces during a simulated 45-minute hold in continuous maximum icing conditions, which indicates icing conditions found in stratus clouds. Unprotected surfaces include such items as antennas, landing gear, fuselage nose cones or radomes, fuel tank vents, fuel tip tanks, and the leading edges of control surfaces. In addition, ice on protected surfaces, such as deicing boot residual ice or runback ice from a thermal ice protection system, must be accounted for.

Icing analysis is required to determine the size and location of ice shapes that would occur during the 45-minute hold. Those shapes are compared with icing shapes created during climb, cruise, and descent conditions to determine the most critical icing flight regime for the airplane.

After icing shapes are determined, models of the shapes are attached to the airplane and flight tests are done in dry air. Dry air test results are verified by flights in actual icing conditions or by use of artificial icing such as an icing tanker or an icing wind tunnel. The effect of the shapes on stall speed, stall warning, handling, and climb performance are determined; degradation of flight characteristics is expected, but not allowed to become worse than the aircraft certification standards.

The effect of ice shed into engine induction air inlets, for example when an ice-laden airplane flies into air that is above freezing, is analyzed. Other icing tests include all autopilot modes, and multi-engine airplanes are tested with one engine out. Differences in minimum speeds, landing configuration, and landing distances (based on increased stall speeds) are established. For electrothermal windshield anti-ice systems, magnetic compasses are checked for variation.

To meet system safety requirements, ice protection systems on airplanes approved for icing condition flights have historically used two power sources, such as a second alternator or vacuum pump. Fluid systems on airplanes certificated for flight in icing have used two pumps for redundancy. FAA-approved-for-icing-condition systems must have ice inspection lights that illuminate the wing's leading edge. These lights help the pilot see airframe ice during night or low light conditions. If ice detection systems are installed, the performance of these systems must also comply with standards.

Systems that protect propellers against ice build-up must show that the system is effective in preventing an appreciable loss of thrust in clearly defined icing conditions.

This laundry list of requirements for icing equipment certificated for flight in icing conditions is only a partial list—it's intended to show that such certification is a very extensive process. As thorough and demanding as these certification standards are, recent revelations regarding in-flight icing have proven that even the best equipped airplane can be overcome by ice in a very short time.

Supercooled Large Droplet (SLD) icing, commonly known as freezing rain and freezing drizzle, is a condi-

tion whose effects on aircraft are not yet fully understood, but it is known that current icing certification standards are based on droplet diameters that are approximately 20 to 40 times smaller than the droplets that occur in SLD conditions. The larger drops have more inertia and can cause ice accretion aft of protected areas such as the wing's leading edge. Translated, this means that not even the latest flight into icing conditions equipment will protect an airplane in the severe icing conditions encountered when an airplane flies into freezing drizzle and freezing rain.

When is severe icing most likely?

The following cues indicate that weather conditions may be conducive to severe in-flight icing when freezing rain or freezing drizzle is present. Clues for defining this condition include:

- ➔ Rain drops are visible when outside air temperatures are below freezing.
- ➔ Droplets that splash or splatter on impact at temperatures below freezing.
- ➔ Unusually extensive ice accumulation on the airframe and windshield in areas not normally observed to collect ice.
- ➔ Accumulation of ice on the wing, aft of the protected area.
- ➔ Performance losses larger than normally encountered in icing conditions.

Certification: Non-Hazard Systems

How extensively a non-hazard system has been tested depends on whether it was installed on an airplane certificated before or after 1977. The standards for aircraft certification, including deicing or anti-icing equipment, changed in that year.

Prior to 1977, and even after 1977 for some aircraft models derived from types certificated earlier, testing requirements for non-hazard systems were very basic, e.g., whether the installation of the system created flight problems or hazardous conditions. The question of whether the system had any value at shedding ice wasn't even a certification issue.

After 1977, new aircraft certification standards demanded that all installed equipment on new model airplanes actually be able to perform its intended function. For ice protection equipment

this novel idea meant that – for the first time – non-hazard systems would have to show at least some ability to shed ice. But as the following requirements demonstrate, non-hazard systems are far from a complete answer.

Non-hazard systems are not required to be tested for performance and flying qualities in icing conditions. This means that ice could accumulate not only on unprotected areas, but on the ice protection system itself.

Non-hazard systems must show in dry air that installation of the system does not affect performance, stalls, controllability, stability, trim, ground/water handling, vibration and buffet, and if applicable, high speed characteristics. There is no requirement to evaluate these characteristics in icing conditions. The certification requires the airplane and essential systems be protected against catastrophic effects from lightning. All electrically operated components must be electrically bonded to prevent electromagnetic interference. A non-hazard ice protection system is not considered an essential system.



Non-hazard: Alcohol (inset) and electrically heated prop anti-ice equipment

The manufacturer must prove that hazards from failures such as the following are minimized: an unplanned inflation of the deicing boots; any condition, such as one wing boot inflating while the opposite boot doesn't, that might cause an asymmetric wing condition; or a short circuit in an electrothermal system.

The manufacturers of non-hazard systems are not required to demonstrate that these systems are as effective as approved-for-icing-conditions systems. This could mean that inflatable boots may not be installed on all the surfaces, fluid dispersant cuffs may not be installed on every leading edge, and that the fluid delivery rates or fluid reservoir size for “weeping wing” systems might provide only short-term protection. Areas of the airframe that may not be ice protected by non-hazard systems are the wing root areas, wing tips, sometimes the vertical tail, the windshield viewing area, and unshielded elevator horns. In non-hazard systems there's no requirement that the manufacturer show that an ice accumulation on the propeller will not result in an appreciable loss of thrust.

In addition, there is no requirement to have a heated stall warning sensor, so a stall warning system may not be reliable in icing conditions.



Non-hazard: Electrically heated windshield

Given the differences in certification requirements, it's little wonder that the rules require that non-hazard systems be regarded only as a means for escape from inadvertent icing encounters.

The following is a comparison of Non-hazard system vs. Approved for flight in icing conditions system current certification standards.

	Non-hazard system	Approved for flight in icing conditions system
1. Stall warning heat	Not Required	Required
2. Reliability standards (redundant power sources)	Not Required	Required
3. Critical area protection	Not Required	Required
4. Shown to perform intended function	Required	Required
5. System safety analysis		
a. evaluate loss of ice protection system	Not Required	Required
b. determine if system failures create a hazard	Required	Required
6. Electromagnetic interference testing	Required	Required
7. Fluid reservoir capacity requirements (e.g.:150 min.@ normal flow rate)	Not Required	Required
a. Fluid quantity gauge	Not Required	Required
8. Propeller thrust not affected by icing	Not Required	Required
9. Air data (pitot, static, AOA, stall warning) and other systems function normally in icing	Not Required	Required
10. Icing system function annunciation	Not Required	Required
11. Testing to show that airplane has adequate performance, stability, controllability, stall warning, and stall characteristics for expected ice accretions.	Not Required	Required
12. Susceptibility to ice shedding damage	Not Required	Required
13. Certified for flight in freezing drizzle or freezing rain	NO freezing drizzle or freezing rain	NO freezing drizzle or freezing rain

New Airplane or Retrofit?

For pilots with existing aircraft, retrofitting of a system approved for flight in icing conditions can be an exorbitantly expensive proposition. There are very few FAA approved-for-flight-in-icing condition systems for such airplanes, largely because the certification process for the required supplemental type certificate (STC) is an extraordinarily long and difficult process, not to mention expensive.

Retrofitting of a non-hazard system, however, can be a practical alternative for many aircraft owners. The difficulty of that task may depend, in part, on whether the airplane being fitted was certificated before or after 1977.

As noted earlier, approval for non-hazard systems on new model aircraft certificated before 1977 were based largely on whether or not the system harmed the *flight characteristics, or performance* of the airplane or *created a hazardous condition*.

A non-hazard system on new model airplanes certificated after 1977 has to show that the system would at least perform its intended function. The new requirements entail an analysis to show proper coverage, for example how far aft deicing boots should be installed or at what chord location the fluid system should be installed. Compliance requirements also include a functional flight test in dry air.

Manufacturers of most airplanes certificated after 1973 are required to present test data showing that the airplane complies with the newer standards, although the non-hazard system may not have been flown in actual icing conditions in order to comply with the certification regulations.



Non-hazard: TKS

How much ice is too much ice?

No airplane made today can handle every possible icing condition, a fact that most IFR-qualified pilots know well. But airplanes equipped with systems approved-for-icing-conditions may take off unless severe icing conditions are forecast. These systems have been proven to be effective in common icing conditions and are capable of providing pilots with “wobble room” to escape to safety when icing is encountered.



Clear ice formation on wing

Even with a full complement of approved-for-icing-conditions equipment, wise pilots know that icing conditions can change quickly and always plan ahead to avoid hazardous icing conditions, especially severe icing.

But what about pilots with the non-hazard deicing or anti-icing systems? Regardless of how well a non-hazard system may perform, it is *not* legal for pilots with such equipment to launch into icing conditions. Should a pilot with a non-hazard system accidentally blunder into icing conditions, the non-hazard deicing or anti-icing equipment should be considered only as an aid for immediate escape from icing conditions.

Do you know which type of ice protection system is installed on your airplane? If you've recently bought one of the newest, best selling, best equipped general aviation airplanes on the market, it's very likely the deicing system is not an approved-for-icing-conditions system.

New icing research was mandated soon after an American Eagle ATR-72 commuter airplane was overcome by icing while holding in SLD conditions near Roselawn, Indiana. The October 31, 1994 crash, which claimed the lives of all aboard, prompted new studies into in-flight icing and consideration of rulemaking (not yet completed) to expand the icing conditions defined in airworthiness regulations to include SLD icing conditions.

The studies resulted in the issuance of a number of operational airworthiness directives. These ADs, issued from 1996 to 1998 on airplanes equipped with pneumatic deicing boots, required flight crews to immediately request priority handling to exit severe icing conditions. Another section of the AD provided recognition cues for, and procedures for exiting from, severe icing conditions. These tips are included later in this ASF Safety Advisor.

Is my airplane approved for flight in icing conditions?

To determine if an airplane has flight-in-icing-conditions certification, check to make sure a placard that prohibits flight in icing, or similar wording such as "known icing," or "icing conditions," is not installed. This is one clue, but it should be backed up.

Another method is checking the FAA Approved Flight Manual (AFM), Pilot Operating Handbook (POH), or the AFM supplement in the case of an airplane retrofitted with icing protection equipment in accordance with a supplement type certificate (STC), for wording on approval or prohibition of flight in icing conditions.

If the airplane is new—or built after 1973—check for references in the AFM or AFM supplement to "FAR 25, Appendix C" or similar. There may also be reference to the terms "continuous maximum" and "intermittent maximum" icing conditions. If the wording isn't there and ice protection equipment is installed, chances are the airplane has a non-hazard type system.

Never assume that your aircraft is certified for flight in icing conditions unless you can find proof.

If these steps still leave you wondering about the status of your deicing or anti-icing system, you can [learn more](http://www.aopa.org/asf/wx/icing.html) by going to the ASF Web site at www.aopa.org/asf/wx/icing.html.

Recognizing and operating in the icing environment

Since ice is often very rough and may create large protrusions as it builds on wings, tail surfaces, and propellers, it can create a completely different airplane than the smooth, sleek one that took off on the flight, so it's important to develop good habits to lessen the effects of icing encounters.

Icing is most likely to occur when:

- The outside air temperature (OAT) is between 0°C and -20°C, but the worst icing will usually occur between 0°C and -10°C.
- If the temperature dew point spread is fewer than 2°C and the temperatures are between 0°C and -20°C be especially vigilant for ice.
- The worst icing is common in the top 1,000 feet of cumulus clouds when the temperature is 0°C or lower.
- Keep a sharp eye on the OAT gauge and if visible moisture (clouds) is encountered when the OAT is between these temperatures, be prepared to change altitude if ice begins to accumulate.
- If the airplane is equipped with deicing boots, follow the boot manufacturers suggestions regarding the use of topical dressings to reduce ice adhesion to boots.
- Test ice protection equipment before take off—if any equipment appears to not be working or you're not absolutely sure it's working properly, delay the takeoff until you are sure all equipment is working properly.
- Make sure the airplane is free of ice, snow, or frost at takeoff. The airplane's ice protection is not designed to remove ice, snow, or frost that can accumulate on the airplane while on the ground. When airplanes are certificated for icing, an assumption is made that the airplane is clean at takeoff.
- Climb through icing temperatures as quickly as possible, and delay descents for landing as long as it is safe when icing temperatures and visible moisture surround an airport.

The potential for airframe icing is one of the key bits of information all pilots are required to consider as part of the FAR-required preflight briefing of “all available information” for any flight. Icing warnings are included in area forecasts, as well as two special kinds of advisories, AIRMETS and SIGMETs.

Airman's Meteorological Information (AIRMET) advisories warn of potentially hazardous conditions for flights having limited capability due to lack of equipment, instrumentation, or pilot qualifications. AIRMETS are broadcast when moderate icing is forecast, for example.

Significant meteorological information (SIGMET) advisories are broadcast when severe icing is predicted.

One of the most important pieces of information a pilot can gather during a flight is the forecast freezing level, which is included in both area forecasts and on winds aloft forecasts. After takeoff, check the OAT gauge often to determine the actual altitude when the thermometer gauge touches zero Celsius. That's your “strategic retreat” altitude should ice start to get ahead of your ability to shed it.

Procedures for exiting the severe icing environment

1. Request PRIORITY HANDLING from ATC to exit icing conditions. [“Cessna 14TY requests an immediate climb to 6,000 due to icing.”] Be flexible and help ATC by being willing to accept altitude and heading changes. This flexibility will help ATC expedite your request. Make your request early when the ice first starts to build, not after the situation is critical. If necessary, declare an emergency to deal with the problem at hand.
2. Avoid abrupt and excessive maneuvering.
3. Do not engage the autopilot.
4. If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.
5. If an unusual roll response or an uncommanded roll control movement is observed, reduce the angle of attack.

6. Do not extend flaps when holding in icing conditions.
7. If flaps are extended, do not retract them until the airframe is clear of ice.
8. Report these conditions to ATC.

Just the facts, ma'am: *pilots who didn't believe it could happen to them*

The following two real-life accidents illustrate the dangers of not being ready to cope with icing encounters. In the first, a pilot in an apparently well-maintained airplane, with a deicing system FAA-certificated for flight in icing conditions, was unable to get out of the heavy (possibly severe) icing conditions. In the second, a pilot with a non-hazard deicing system apparently believed the system was capable of more than it really was, with a tragic result.

The pilot of a recently acquired Beech B-58 twin engine Baron, which was approved for flight into icing conditions, lost control while attempting to climb out of icing conditions in Kentucky in February, 2002.

Icing and IFR conditions were forecast, but the pilot told the FSS briefer that his Baron had deicing boots. Once in flight, the pilot reported rime ice at 10,000 feet and requested a climb to 12,000 feet. Radar data showed that the pilot (or autopilot) was doing a poor job of maintaining the assigned altitude and had climbed to 11,200 before the request for the climb to 12,000. Before losing control, the pilot reported being on top.

The NTSB report also revealed that the pilot and flight instructor talked via telephone on the day before the accident. The instructor cautioned the pilot about the prevailing weather conditions and offered to travel to the departure airport to accompany him home. The pilot declined.

What went wrong? The parts that make up this accident are distressingly familiar—a complex, well-

equipped (and apparently well-maintained) airplane flown by a pilot who, although having only flown under instrument conditions with a flight instructor and no known experience in dealing with flight in icing conditions, apparently waited too long before taking action to climb out of icing. The pilot may have believed that the icing encounter equipment on the airplane was sufficient to permit extended exposure to icing conditions that may have been severe.

The pilot of an air taxi Beech Baron equipped with a non-hazard system was attempting to deliver a time-critical shipment of radioactive isotope used in medical imaging. The pilot reported picking up ice on four different radio transmissions over a 45-minute period. After deciding to abandon the flight to the planned destination airport, the pilot reported encountering freezing rain. The severe icing encountered quickly overcame the airplane and it crashed before reaching a nearby alternate airport.

The copilot survived. He said the windshield alcohol system was out of alcohol, and the wing boots were used often but weren't able to keep the airspeed from going down. The copilot said he felt a stall buffet and the pilot applied full power just before the airplane hit the ground. The airplane came to rest 3,000 feet from the approach end of the runway.

Would an earlier exit from icing conditions have saved this pilot? Ice build-up on airplanes changes airfoil lift and drag characteristics and raises stall speeds. Even airplanes equipped with approved-for-icing-conditions systems can't cope with freezing drizzle or freezing rain and must avoid these conditions. Deicing fluid reservoirs have a finite capacity—severe icing conditions and continued fluid use at high flow rates can exhaust fluid supplies quickly

This pilot stayed in icing for 45 minutes even though he should have started working to exit icing conditions immediately since his airplane had only a non-hazard ice protection system. He paid with his life.

DOs and DON'Ts for Certified Systems

Use this information to avoid possible severe icing conditions and to minimize exposure to any kind of icing. The term “icing in precipitation” in AIRMETS and SIGMETs imply freezing drizzle or freezing rain.

DO learn all you can about the in-flight icing environment.

DO familiarize yourself with all weather information before taking off. The latest icing forecast models are vast improvements over systems that were available only a few short years ago. These are available at the aviation digital data service (ADDS) at <http://adds.aviationweather.noaa.gov>. While enroute, obtain weather updates by every means available—HIWAS, Flight Watch (122.0) and, if available, in cockpit METARS, TAFs and NEXRAD information on multi function displays (MFD).

DO ask for pilot reports (pireps). They are invaluable for evaluating icing conditions.

DO make pireps often.

DO maintain a regular watch on the outside air temperature (OAT).

DON'T take off into known icing conditions unless the approved-for-icing-conditions system on your airplane is properly serviced and in working order.

DO be cautious when entering icing conditions. Don't assume that certificated icing equipment guarantees a safe passage through any flight icing condition. If you're unsure about your ability to make good decisions when taking off into forecast icing conditions, hire an experienced flight instructor to accompany you.

DO carefully and continually evaluate icing, if encountered, and have a plan ready to exit the icing should you perceive that conditions have become more severe or demanding than your aircraft can handle.

DO learn to recognize the different types of ice—clear, rime, mixed, and SLD—and learn the definitions of light, moderate, and severe icing conditions.

DO remember that **severe** icing conditions (SLD) are sometimes signaled by the appearance of visible rain at temperatures below zero.

DON'T extend flaps in icing conditions; if ice builds up while the flaps are extended, find above-freezing temperatures before flap retraction.

DO fly approaches at higher than normal speeds if ice has accumulated on the airframe. Icing changes wing lift characteristics and stall speed increase.

DOs and DON'Ts for Non-Hazard Systems

Use this information to avoid all icing conditions.

DO learn all you can about the in flight icing environment. The latest icing forecast models are available at the aviation digital data service (ADDS) at <http://adds.aviationweather.noaa.gov>. Learn what temperatures and cloud types breed clear, rime, and mixed icing conditions, and carefully evaluate forecasts. If icing is forecast and your knowledge of the environment confirms that ice is likely, postpone your flight.

DO ask for pIREPs. They are invaluable for avoiding icing conditions.

DO familiarize yourself with all weather information before taking off. While enroute, obtain weather updates by every means available—HIWAS, Flight Watch (122.0) and, if available, in cockpit METARS, TAFs, and NEXRAD information displayed on multi-function displays (MFD). Use this information to avoid all icing conditions.

DO maintain a regular watch on the outside air temperature (OAT).

DON'T take off into icing conditions.

DO take immediate steps to exit icing conditions you may have inadvertently found, and don't hesitate to ask for help from ATC.

DON'T be influenced by your passengers or your schedule. When icing is encountered, put all concerns aside and concentrate on getting out of the icing environment.

DON'T extend flaps if caught in icing conditions; if ice builds up while the flaps are extended, find above-freezing temperatures before flap retraction.

DO fly approaches at higher than normal speeds if ice has accumulated on the airframe. Icing changes wing lift characteristics and stall speed increase.

DON'T believe that your non-hazard system is anything more than an aid in the expeditious escape from an accidental icing encounter.

The newest airplanes that are coming into the general aviation fleet are wonderful. They're fast, and they're certified to the latest FAA standards, the instrument panels and avionics capabilities are fantastic. But they still have to fly in the same environment as every other airplane. That environment, at certain times of the year, contains the potential for an icing encounter. Ice doesn't care how much your airplane cost or that it has the latest equipment in the panel. Safe, successful travel by light airplane requires good planning, good judgment, and good execution. Part of that judgment is being aware of your capabilities and the capabilities of the icing equipment of your airplane.

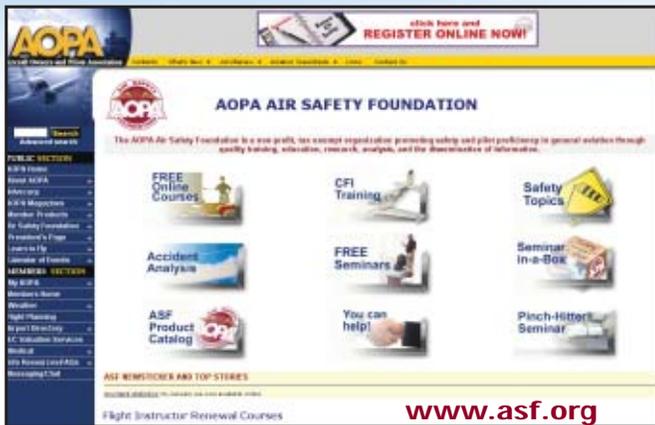




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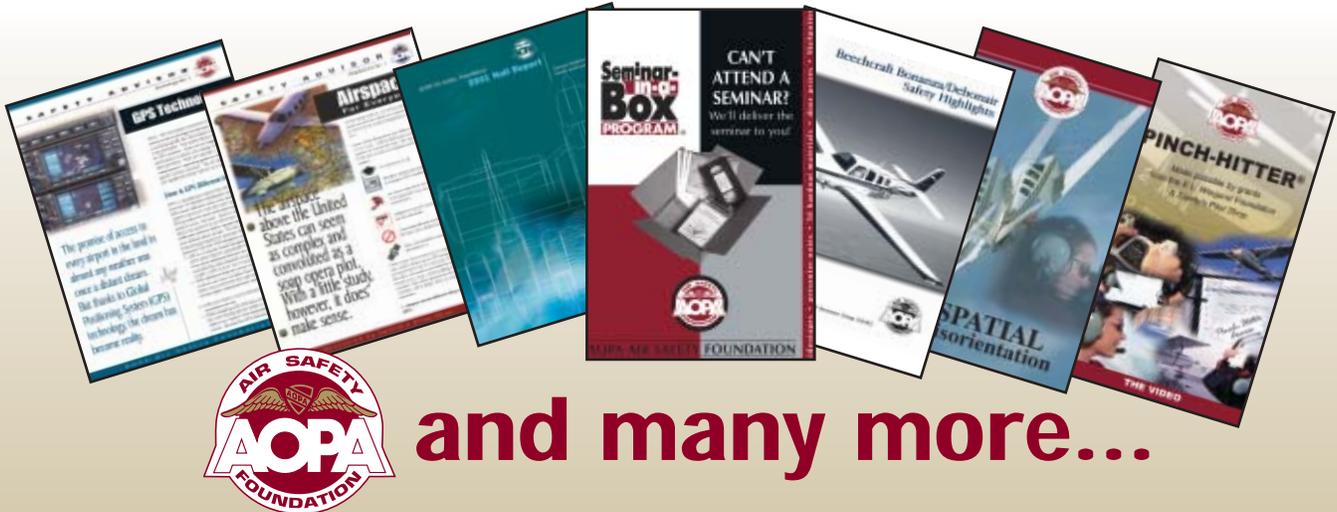
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421 Aviation Way • Frederick, MD 21701 • Phone: 800.638.3101

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