U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Pilot Guide: Flight In Icing Conditions | **Date:** 12/31/07 | **AC No:** 91-74A
Initiated by: AFS-800 | **Change:**

FOREWORD

This advisory circular (AC) contains updated and additional information for the pilots of airplanes under parts 91, 121, 125, and 135 of Title 14 of the Code of Federal Regulations (14 CFR). The purpose of this AC is to provide pilots with a convenient reference on the principal factors related to flight in icing conditions and the location of additional information in related publications. This AC does not authorize deviations from established company procedures or regulatory requirements.

ORIGINAL SIGNED by
Carol Giles for

James J. Ballough
Director, Flight Standards Service

expected at certain temperatures and altitude ranges. The envelopes were formulated during the 1950s, based on contemporary research, and research that is more recent generally is consistent with the envelopes.

(2) It has been estimated that these envelopes encompass 99.9 percent of all conditions encountered in research programs in stratus and cumulus clouds.

b. What is Not Covered.

(1) First, the pilot should bear in mind that 99.9 percent is not 100 percent, and so vigilance in exceptional conditions is always wise.

(2) Second, the cloud measurements on which the envelopes were based generally did not include SLD conditions. Recent research shows that SLD (in particular, freezing drizzle aloft within cloud) is more common in supercooled clouds than had been thought (see Table 1 for some cues of SLD conditions).

(3) Third, freezing rain or freezing drizzle may be encountered beneath the clouds. Neither of these icing conditions is included in the icing envelopes.

(4) Finally, ice crystals may be encountered in high concentrations at higher altitudes in the area of convective weather systems. Currently these conditions are not included in the icing envelopes, although new envelopes have been preliminarily developed.

4-11. SIGNIFICANCE OF ICING CERTIFICATION.

a. Icing certification is an extensive process. It includes testing and analysis to check that aircraft can operate safely for extended periods in the conditions covered by the icing envelopes. For example, certification includes testing and analysis to show that an aircraft can hold in significant icing conditions for up to 45 minutes. Nonetheless, pilots of certificated aircraft should not be casual about operations in icing conditions, particularly extended operations. It is always possible to encounter an unusual condition for which the aircraft has not been certificated, such as liquid water content outside the envelopes, which is sometimes indicated by a very rapid rate of accumulation. This can result in runback and ice accumulation aft of protected surfaces.

b. SLD may result in droplets impinging aft of protected surfaces and causing ice accumulation. These surfaces may be very effective ice collectors, and ice accumulations may persist as long as the aircraft remains in icing conditions. Note also that icing conditions can develop very quickly and may not be immediately recognized. For example, even though the rate of accumulation may be quite gradual, a thin, extremely rough accretion can develop on a critical surface in minutes**.** This can be very hazardous, particularly on approach and landing.

NOTE: Not all icing certification is the same.

c. Prior to 1973, small airplanes were approved for flight in icing if they were equipped with a minimum suite of ice protection equipment. For example, see Bureau of Flight Standards

Release 434. No analysis or testing to show safe operation in the part 25, appendix C icing envelopes was required.

d. Many small airplanes flying today fall in this category. In 1973, at Amendment 23-14, 14 CFR part 23, § 23.1419 was amended to require analysis and testing to demonstrate that the airplane can operate safely in the part 25, appendix C icing envelopes.

e. In 1993, at Amendment 23-43, § 23.1419 was amended to require small airplanes, certificated for known icing, to comply with performance, stability, controllability, and maneuverability regulations in icing. There were no quantitative criteria for performance prior to Amendment 23-43.

f. Keep in mind, even though the small airplane icing certification regulations changed in 1973 and 1993, the means of showing compliance have changed continuously, as shown by the example in Table 1. Table 1 compares the current means of compliance in AC 23.1419-2C (2004) to the guidance that existed prior to 1993.

TABLE 1. EVOLUTION OF ICING CERTIFICATION STANDARDS

	Criteria prior to 1993	**Current Criteria**
Simulated ice shapes tested	Unprotected areas only	Unprotected and protected (e.g., intercycle ice on boots)
Performance criteria	Qualitative	Must meet Subpart B minimum climb gradients
Stall warning	Can use different type in icing (e.g., buffet versus stall warning system)	Stall warning type in icing should be same as in non-icing and margin should meet Subpart B
Maneuver margin	No policy	There should be no buffet or stall warning during maneuvering at operating airspeeds
Autopilot	No policy	Evaluate operation, disconnect at stall warning
Propeller icing performance	No policy	Evaluate performance in natural icing
Use of ice adhesion inhibitors	No policy	Cannot use for certification

g. How can I tell how my airplane was certificated for icing?

(1) The airplane was certificated to 14 CFR § 23.1419 at Amendment 23-14 or later if your AFM or POH references "part 25, appendix C" icing conditions, or "14 CFR § 23.1419" at Amendment 23-14 or later.

(2) The "Certification Basis" section of your airplane's type certification data sheet (TCDS) may reference "14 CFR § 23.1419" at Amendment 23-14 or higher, or "SFAR 23." The TCDS can be found in the FAA's on-line Regulatory and Guidance Library at http://rgl.faa.gov.

(3) If there is only a minimum equipment list (MEL) for icing conditions in the AFM or POH, the certification basis of your airplane is prior to Amendment 23-14 (1973). Some pilots mistakenly believe IFR certificated airplanes are analyzed or tested for inadvertent icing encounters—they are not.

h. How is certification related to the operating rules?

(1) Section 34 of Special Federal Aviation Regulation (SFAR) 23, and § 34 of part 135, appendix A.

(2) These are referenced in the part 91 and part 135 operating rules, respectively, and are equivalent to 14 CFR § 23.1419 at Amendment 23-14.

4-12. ICE PROTECTION EQUIPMENT ON AIRPLANES NOT CERTIFICATED FOR ICING.

a. All aircraft are required to have ice protection for their propulsion systems in case of an inadvertent icing encounter, and nearly all aircraft have pitot heat and an alternate source of static air.

b. Some general aviation aircraft, that are not certificated for flight in icing conditions, also have ice protection systems on their wings and tailplane, providing an additional safety margin should an inadvertent encounter with icing occur. These systems are for emergency use only.

c. The FAA recommends that aircraft not certificated for flight in icing conditions, but that are equipped with these "non-hazard" deicing/anti-icing equipment exit those conditions as expeditiously as possible, coordinating with ATC as necessary.

d. The differences between these systems and fully certified systems are significant. Airplane performance is unknown, stall warning in icing conditions most likely will not activate prior to stall, controls may jam due to ice accretion, and system features required for known icing may not be present in these "non-hazard" systems.

4-13. ANTI-ICING SYSTEMS. Anti-icing systems operate on the principle that ice should not be allowed to accumulate on the aircraft or certain aircraft systems when flying through icing conditions. Usually, anti-icing is accomplished using electric heat, hot air, or chemicals. While an aircraft's AFM or POH is the ultimate authority on the operation of anti-icing systems, a good