U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

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Subject: CERTIFICATION OF SMALL AIRPLANES FOR FLIGHT IN ICING CONDITIONS

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Change:

1. PURPOSE. This advisory circular (AC) sets forth an acceptable means, but not the only means, of demonstrating compliance with the ice protection requirements in Part 23 of the Federal Aviation Regulations (FAR). The Federal Aviation Administration (FAA) will consider other methods of demonstrating compliance which an applicant may elect to present. This material is neither mandatory nor regulatory in nature and does not constitute a regulation.

2. APPLICABILITY. This material supplements guidance provided in Advisory Circular 20-73, Aircraft Ice Protection, and pertains to multiengine and single-engine ice protection system approvals for airplanes certificated under Part 3 of the Civil Air Regulations (CAR) and Part 23 of the FAR. The guidance provided herein applies to ice protection systems approval for operating in the icing environment defined by Part 25, appendix C. The guidance should be applied to new Type Certificates (TCs), Supplemental Type Certificates (STCs), and amendments to existing TCs for airplanes under Part 3 of the CAR and Part 23 of the FAR, for which approval under the provisions of § 23.1419 is desired.

3. RELATED FAR SECTIONS. By their adoption in amendment 23-14, which shows their requirements are directly related, §§ 23.929, 23.1309, and 23.1419 are applicable to a small airplane icing certification program regardless of the certification basis for the basic airplane. However, for those airplanes certified in accordance with Part 3 of the CAR and Part 23 of the FAR through amendment 23-13, the application of these sections may be limited to the equipment being used for ice protection. Some systems which were previously approved on the airplane may need to be modified to improve their reliability when those systems are utilized as part of that airplane's icing approval.

The FAA has determined that the previous practice of applying Part 25 requirements (which are not specifically cited in Part 23) to Part 23 airplanes is no longer acceptable. The practice of adding § 25.1323(e) to certification requirements of airplanes approved for icing flights should no longer be pursued. Section 23.1419, paragraph (b), requires an analysis to establish the adequacy of the ice protection system for various components in the airplane. Like other components which are not specifically identified in § 23.1419, the pitot tube(s) is one of the components which should be protected. Because the need to install pitot heat is not novel or unique, a special condition is not necessary.

In addition to the previously mentioned requirements (§§ 23.929, 23.1309, and 23.1419), the following sections should be applied depending upon the ice protection system design and the original certification basis of the airplane:

.TE OF AIRPLANE TYPE CERTIFICATION APPLICATION	CAR/FAR STATUS	ICING CERTIFICATION REQUIREMENTS
Prior to February 1, 1965	Part 3 of the CAR (May 15, 1956 as amended through amendment 3-8)	§§ 3.85(a) and (c), 3.85a(a) and (c), 3.382, 3.383 (including note following (b)), 3.652, 3.652-1, 3.665, 3.666, 3.681, 3.682, 3.685, 3.686, 3.687, 3.690, 3.691, 3.692, 3.712, 3.725, 3.758, 3.770, 3.772, 3.777, 3.778, and 3.779
On or after February 1, 1965	Recodification	§§ 23.65, 23.75, 23.77, 23.773, 23.775, 23.1301, 23.1351, 23.1357, 23.1437, 23.1541, 23.1559(b), 23.1583(h), 23,1585, and 23.1419 (boot requirement before amendment 23-14)
On or after July 29, 1965	Amendment 23-1	Add § 23.1325 to the above Part 23 requirements.
On or after February 5, 1970	Amendment 23-8	Add § 23.1529 to the above Part 23 requirements.
. or after December 20, 1973	Amendment 23-14	Add §§ 23.853(d) and 23.903(c) to the above Part 23 requirements.
On or after September 1, 1977	Amendment 23-20	Add §§ 23.1327 and 23.1547 to the above Part 23 requirements.
On or after December 1, 1978	Amendment 23-23	Add §§ 23.853(e), 23.863, and 23.1416 (in lieu of the boot requirement of § 23.1419 before amendment 23-14) to the above Part 23 requirements.

4. RELATED READING MATERIAL. FAA Technical Report ADS-4, Engineering Summary of Airframe Icing Technical Data, and Report No. FAA-RD-77-76, Engineering Summary of Powerplant Icing Technical Data, provide technical information on airframe and engine icing conditions, and methods of detecting, preventing, and removing ice accretion on airframes and engines in flight. AC 20-73, Aircraft Ice Protection, provides information on substantiation of ice protection systems on aircraft. The information provided by AC 20-73 as it pertains to small airplanes is supplemented by this advisory circular. Also, AC 23.629-1A provides guidance on small airplane flutter investigation which may be applicable to ice accumulation.

5. BACKGROUND. Prior to 1945, airplanes were certified under Part 04 of the CAR. Section 04.5814 required that if deicer boots were installed, they would ~~ve a positive means of deflation. There were no other references to an ice ~otection system in Part 04.

otection system. These methods of showing compliance should be agreed upon between the applicant and the FAA early in the type certification program, and it is imperative that the applicant obtain FAA concurrence prior to conducting certification tests. The certification plan should include the following basic information:

a. Airplane and systems description.

b. Ice protection systems description.

c. Certification checklist.

d. Analyses or tests performed to date.

e. Analyses or tests planned.

f. Projected schedules of design, analyses, testing, and reporting.

7. DESIGN OBJECTIVES. The applicant should demonstrate by analyses, tests, or a combination of analyses and tests that the airplane is capable of safely operating throughout the icing envelope of Part 25, appendix C, or throughout that portion of the envelope within which the airplane is certificated for operation where systems or performance limitations not related to ice protection ist. Appendix 1 to this AC lists various influence items which should be amined for their effect on safety when operating in icing conditions.

8. ANALYSES. The applicant normally prepares analyses to substantiate decisions involving application of selected ice protection equipment to areas and components and to substantiate decisions which leave normally protected areas and components unprotected. Such analyses should clearly state the basic protection required, the assumptions made, and delineate the methods of analysis used. All analyses should be validated either by tests or by reference to previous substantiation using methods documented in accepted icing literature, such as FAA Technical Report ADS-4. These substantiations should include a discussion of the assumptions made in the analyses and the design provisions included to compensate for these assumptions. Analyses are normally used for the following:

a. Areas and Components to be Protected. The applicant should examine those areas listed below to determine the degree of protection required:

(1) Leading edges of wings, winglets, and wing struts; horizontal and vertical stabilizer; and other lifting surfaces.

(2) Leading edges of control surface balance areas if not shielded.

(3) Accessory cooling air intakes which face the airstream.

(4) Antennas and masts.

d. Power Sources. The applicant should evaluate the power sources in his ice protection system design. Electrical, bleed air, and pneumatic sources are normally used. A load analysis or test should be conducted on each power source to determine that the power source is adequate to supply the ice protection system plus all other essential loads throughout the airplane flight envelope under conditions requiring operation of the ice protection system. The effect of an ice protection system component failure on power availability to other essential loads should be evaluated and any resultant hazard should be prevented on multiengine designs and minimized on single-engine designs. The applicant should show that there is no hazard to the airplane in the event of any power source failure during flight in icing conditions. Two separate power sources (installed so that the failure of one source does not affect the ability of the remaining source to provide system power) are adequate. If a single source system is planned, additional reliability evaluation of the power source under system loads and environmental conditions may be required. All power sources that affect engine or engine ice protection systems for multiengine airplanes must comply with the engine isolation requirements of § 23.903(c).

e. Failure Analysis. All identifiable failures or malfunctions should be examined to determine their probability of occurrence and their individual effects on the airplane. Those failures which are determined to be probable should not cause a hazard to the airplane and its occupants. If the hardware design cannot be changed, other provisions or compensating features may be added so that probable failures which may cause a hazard do not occur.

In addition to single failures, multiple failures or malfunctions should be examined when the first malfunction would not be detected during normal operation and would lead to or cause other malfunctions. Findings of compliance with § 23.1309 must include an evaluation of the consequences of a single failure in combination with latent or undetected failures.

A failure modes and effects analysis (FMEA) is one method used for identifying hazards that may result from failures. During the analysis, each identifiable failure within the system should be examined for its effect on the airplane and its occupants. Examples of failures which are hazardous include:

(1) those which allow ice to accumulate beyond design levels; or,

(2) those which allow asymmetric ice accumulation to the extent that it results in loss of control.

Identified failures should then be evaluated for the probability of their occurrence. If sufficient service history or environmental test data does not exist to establish the probability of occurrence of a failure, then that failure should be considered probable. When the evaluation identifies failures that are both probable and hazardous, provisions in the design should be made to minimize on single-engine or prevent on multiengine airplanes any hazard which may result from that failure. Several provisionary means have been used to minimize or prevent a hazard as a result of failure. Among these are the use of dual components, maintenance and pilot inspections, and alternate procedures to be used by the pilot.

g. Impingement Limit Analyses. The applicant should prepare a droplet trajectory and impingement analysis of the wing, horizontal and vertical stabilizers, propellers, and any other leading edges which may require protection. This analysis should examine all critical conditions within the airplane's operating envelope as well as those in the icing envelope of Part 25, appendix C. This analysis is needed to establish the upper and lower aft droplet impingement limits which can then be used to establish the aft ice formation limit and the protective coverage needed. Typically, 40 micron droplets are used to establish the aft impingement limits while 20 micron droplets are used to establish the water collection rate.

h. Induction Air System Protection. The induction air system for turbine engine airplanes is certificated for icing encounters in accordance with § 23.1093(b). Although this certification is generally oriented towards inadvertent encounters, certifications must be adequate for flight in icing conditions. Thus, ice protection systems installed on previously type certificated airplanes to protect the engine induction air system should be adequate and need not be reexamined.

9. FLIGHT TEST PLANNING. When operating any airplane in an icing environment, degradation in performance and flying qualities may be expected. One of the primary purposes for flight testing an airplane equipped for flight in icing conditions is to evaluate such degradation, determining that the flying qualities remain adequate and that performance levels are acceptable for this flight environment.

a. The flight tests and analyses of flight tests should be oriented towards:

(1) Demonstrating normal operation of the airplane with the ice protection system installed in non-icing flight.

(2) Demonstrating operation of the airplane with anticipated in-flight accumulations of ice.

(3) Verification of the analyses conducted to show adequacy of the ice protection system throughout the icing envelope of Part 25, appendix C.

(4) Development of procedures and limitations for the use of the ice protection system in normal, abnormal, and emergency conditions.

b. Icing flight tests are generally conducted in three stages:

(1) initial dry air tests with ice protection equipment installed;

(2) dry air tests with predicted artificial ice shapes installed; and

(3) icing flight tests.

Initial dry air tests are primarily conducted to extend the basic airplane certification to cover the airplane with the ice protection system installed. Often it is more economical to verify specific analyses by ground tests where the design variables can be controlled to some extent. Flight tests are normally

.e system operation should be checked throughout the full r.p.m. and propeller cyclic pitch range expected during icing flights. Any significant vibrations should be investigated.

Consideration should be given to the maximum temperatures that a composite propeller blade may be subjected to when the deicers are energized. It may be useful to monitor deicer bond-side temperatures. When performing this evaluation, the most critical conditions should be investigated. Example: This may occur on the ground (propellers nonrotating) on a hot day with the system inadvertently energized.

(3) Electric Windshield Anti-Ice. Dry air flight tests should be conducted in support of the systems design, as required. Inner and outer windshield surface temperature evaluation of the protected area may be needed to support thermal analyses. Thermal analysis should substantiate that the surface temperature is sufficient to maintain anti-icing capability without causing structural damage to the windshield. In the case of add-on plates, temperatures of the basic airplane windshield, inside and out, may also be needed, particularly with pressurized airplanes.

An evaluation of the visibility including distortion effects through the protected area should be made in both day and night operations. In addition, the size and location of the protected area should be reviewed for adequate sibility, especially for approach and landing conditions.

(4) Pitot-Static and Static Pressure Sources. If the aerodynamic configuration of either the pitot or the static source(s) differs from that of the basic airplane, then airspeed and altimeter system calibrations should be evaluated for compliance with the certification requirements. A component surface temperature evaluation may be necessary to verify thermal analyses.

(5) Heated Stall Warning Transducer. When the icing approval requires installation of a new stall warning transducer, that new transducer's function as a stall warning device should be evaluated for compliance with the certification requirements. A surface temperature evaluation may be necessary to verify thermal analyses.

(6) Fluid Anti/Deice Systems. Dry air testing should include evaluation of fluid flow paths to determine that adequate and uniform fluid distribution over the protected surfaces is achieved. Means of indicating fluid flow rates, quantity remaining, etc., should be evaluated to determine that the indicators are plainly visible to the pilot and that the indications provided can be effectively read. An accessible shutoff should be provided in systems using flammable fluids. The fluid anti-ice/deice systems may be used to protect propellers and windshields as well as leading edges of airfoils. The fluid for windshield fluid anti-ice systems should be tested to demonstrate that it does not become opaque at low temperature.

(7) Compressor Bleed Air Systems. The effect of any bleed air extraction on engine performance should be examined. The surface heat distribution analysis should be verified for varying flight conditions including climb, cruise, hold, and descent. A temperature evaluation may be necessary to verify the thermal analyses.

(8) Ice Detection Light(s). Ice detection lights should be evaluated during night flight to determine that adequate illumination of the component of interest is available without excessive glare, reflections or other distractions to the flight crew. These tests may be conveniently accomplished both in and out of clouds during dry air tests. Use of a hand-held flashlight for ice detection is not acceptable.

b. Dry Air Tests with Artificial Ice Shapes. Where ice buildups are predictable and are known to contribute significantly to performance loss and handling quality degradation, artificial ice shapes should be developed and flight tested. Shapes may be developed from analyses or from icing tunnel tests. These analyses and tunnel tests should be conservative and should address the conditions associated with the icing envelope of Part 25, appendix C, that are critical to the airplane's performance and handling qualities in critical phases of the airplane operational envelope, including climb, cruise, descent, holding pattern, approach, and landing.

Tests should be conducted to allow a controlled examination of the effects of ice buildups to these critical shapes in conjunction with associated operating losses, such as, bleed air heat systems, inertial separator doors, and electrical loads. These tests should show that balked landing requirements are met at maximum landing weight and a temperature of 32°F. They should establish performance degradations for stall speed or minimum control speed and for engine power or thrust loss. Handling qualities should be investigated to determine that an acceptable level of safety exists. The results of these tests may be used in preparing operating restrictions or limitations for the AFM.

c. Icing Flight Tests. Flight tests in icing conditions, both natural and simulated, are used to verify the function of the ice protection system installed on the airplane. They are also used to confirm the analyses used in developing the various components and to confirm the conclusions reached in flight tests conducted with artificial ice shapes.

(1) Instrumentation. Sufficient instrumentation should be planned to allow documentation of important airplane, system and component parameters, and icing conditions encountered. The following parameters should be considered:

(i) Altitude, airspeed, and engine power.

(ii) Static air, engine component, electrical generation equipment, surface, interlaminate, and any other key temperatures which could be affected by ice protection equipment, by ice accumulation, or are necessary for validation of analyses.

During natural icing flight tests, ice accumulation on unprotected areas should be observed, where possible, and sufficient data taken to allow correlation with dry air tests using artificial ice shapes. Handling qualities should be subjectively reviewed and determined to be in general correlation with those found in the dry air testing. Performance decrements observed during natural icing flight tests should be compared to the decrements observed during flight tests with artificial ice shapes. In addition, flying qualities and performance should be qualitatively evaluated with the ice accumulations existing just prior to operation of deice (as opposed to anti-ice) components. For anti-ice components, tests should be conducted which simulate inadvertent icing encounters in which the pilot may not recognize that the airplane is about to enter an icing condition and the anti-ice component may not be activated until actual ice buildup is noticed. One minute of flight in icing conditions, after detection of ice buildup and before activation of anti-icing equipment, has been used in these tests. Handling qualities should remain acceptable to the test pilot and performance decrements should not prevent continued safe operation of the airplane.

All systems and components of the basic airplane should continue to function as intended when operating in an icing environment. Some considerations are:

(i) Engine and equipment (such as generator under maximum ice protection load) cooling should be monitored during icing tests and be found acceptable for this operation.

(ii) Engine alternate induction air sources should remain functional in an icing environment.

(iii) Fuel system venting should not be affected by ice accumulation.

(iv) Retractable landing gear should be available for landing following an icing encounter.

(v) Ice shedding from components of the airplane should cause no more than cosmetic damage to other parts of the airplane, including aft-mounted engines and propellers.

(vi) With residual ice accumulations on the airplane, adequate stall warning (aerodynamic or artificial) should be provided.

(vii) Ice detection cues which the pilot relies on for timely operation of ice protection equipment should be evaluated in anticipated flight attitudes.

(viii) Ice detection lights should be evaluated in natural icing conditions to verify that they illuminate ice buildup areas and that they are adequate under the conditions encountered.

(i) Stall characteristics and speeds.

(ii) Trim.

(iii) Lateral directional stability/control.

(iv) Longitudinal stability/control.

(v) V_{MC}.

(vi) Landing approach speeds, maneuvering characteristics, and landing characteristics.

(vii) Appropriate high speed characteristics up to $V_{MO}/M_{MO}/V_{NE}$.

e. Ice Shedding. Ice shed from forward airplane structure may damage or erode engine or powerplant components, lifting, stabilizing, and flight control surface leading edges. Fan and compressor blades, impeller vanes, inlet screens and ducts, as well as propellers (metal and non-metallic) are examples of powerplant components subject to damage from ice impingement. Control surfaces such as elevators, ailerons, flaps, and spoilers are also subject to damage with special attention given to damage of thin metallic, non-metallic or composite constructed surfaces. Trajectory and impingement analysis cannot adequately predict such damage. Unpredicted ice shedding paths from forward areas such as radomes and forward wings (canards) have been found to negate the results of this analyis. For this reason, flight tests should be conducted to supplement analysis. Video or motion pictures are excellent for documenting ice shedding trajectories and impingements while still photography may be used to document the extent of damage.

f. Pneumatic Deicer Boots. For effective ice removal, conventional pneumatic deicer boot systems require a measurable ice accumulation (usually one-half inch or more) prior to activation. Time system activation is highly dependent on visual cues to the crew of this ice accumulation. Most airplane flight manuals specify a minimum ice accumulation thickness prior to each manual activation of the deicer boot system. Also, a maximum ice accumulation that the boot is capable of breaking and removing is usually provided. These systems should be flight tested in simulated or natural icing conditions to verify that the crew can detect and recognize the ice accumulation specified for the proper operation of the installed boot system. The following test criteria have been accepted for previous flight test programs:

(1) The pilot or a crew member should be provided a means to detect from his crew position under both day and night operation the accumulation level the applicant has specified for activation of the boot system for proper ice removal.

(2) The applicant should show that an ice accumulation margin exists which allows for errors in crew recognition of the ice accumulation level.

(v) Minimum engine speed if the engine ice protection system does not function properly below this speed.

(vi) A list of required placards.

(2) Operating Procedures Section.

(i) Section 23.1585(a) requires the pilot be provided with the necessary procedures for safe operation. This should include any preflight action necessary to minimize the potential of en route emergencies associated with the ice protection system. The system components should be described with sufficient clarity and depth that the pilot can understand their function.

(ii) Procedures should be provided to optimize operation of the airplane during penetration of icing conditions, including climb, holding and approach configurations, and speeds.

(iii) Emergency or abnormal procedures including procedures to be followed when ice protection systems fail and/or warning or monitor alerts occur should be provided.

(iv) For fluid anti-ice/deice systems, information and method(s) for determining the remaining flight operation time should be provided.

(v) For airplanes which cannot supply adequate power for all systems at low engine speeds, load shedding instructions should be provided to the pilot for approach and landing in icing conditions.

(3) Performance Information Section. A brief discussion of the Part 25, appendix C, supercooled cloud test environment and a statement that freezing rain and/or mixed conditions have not been tested and may exceed the capabilities of the ice protection system should be provided.

General performance information should be provided to give the pilot knowledge of allowances necessary while operating in ice or with residual ice on airframe, for example:

(i) An accumulation of ______ inch of ice on the leading edges can cause a loss in rate of climb up to _____ FPM, a cruise speed reduction of up to KIAS, as well as a significant buffet and stall speed increase (up to knots). Even after cycling the deicing boots, the ice accumulation remaining on the boots and unprotected areas of the airplane can cause large performance losses. With residual ice from the initial _____ inch accumulation, losses up to FPM in climb, _____ KIAS in cruise, and a stall speed increase of _____ knots can result. With _____ inch of residual accumulation, these losses can double.

(ii) Airspeed -- MAINTAIN BETWEEN _____ KIAS AND _____ KIAS with _______ inch or more of ice accumulation.

APPENDIX 1. APPENDIX TO ADVISORY CIRCULAR

The left column of this appendix provides a simplified checklist of the various influence items which could affect safety of small airplanes while operating in icing conditions. In the right column are suggested considerations for resolving the concerns of each of these influence items. Certain considerations may not be applicable depending on the certification basis of the airplane. (Also, see paragraph 2 of this AC.)

Influence	Consideration
A. Crew Visibility	1. Conduct evaluations to verify adequate day and night visibility through the protected windshield or the protected windshield segment under dry air and icing conditions.
	2. Evaluate the cabin defogging system's capability to clear side windows for observation of boot ice protection system operation and ice accumulation. If a defogging system is not provided, the windows should be easily cleared by the pilot without adversely increasing pilot workload.
	3. Minimum light transmittance through the protected windshield or protected windshield segment and affected side windows should be 70% as measured perpendicular to the surface with the windshield cleared of ice.
	4. Determine that the temperature gradient produced on heated windshields does not adversely affect pilot vision or windshield structural integrity.
B. Engine Installation and Cooling	1. Conduct flight tests, conduct analyses, or refer to substantiation data to determine that complete engine installation, including propellers, functions without appreciable loss of power. Verify that engine oil and component cooling is adequate at critical design points throughout the operational and icing envelope. If ice is expected to accumulate at the generator during

Influence	Consideration
C. (Continued)	(c) Timer or other control system reliability.
	(d) Spinner ice accumulation.
	5. Perform tests to verify that ice sheds from the blades and to demonstrate compliance. During testing, verify that adequate ice protection is provided, propeller performance degradations are not excessive, vibration characteristics are satisfactory and ice being shed is small enough to avoid detrimental damage to other aircraft components. Tests should include examination of the structural integrity of the propeller assembly and associated equipment with ice protection (heater blankets, slip rings, wiring, etc.) installed.
D. Equipment, Systems, Function, and Installation	1. Conduct a study as discussed in paragraph 8e (failure analysis) of this AC to ensure that no probable failure or malfunction of any power source (electrical, fluid, bleed air, pneumatic, etc.) will impair the ability of the remaining source(s) to supply adequate power to systems essential to safe operation during icing flight.
	2. Conduct a power source load analysis to verify proper power requirements are provided.
	3. Verify that power source failure warning is provided to the crew.
	4. Demonstrate that the alternator or generator is protected from detrimental ice accumulation.
	5. Determine if load shedding can be accomplished after a partial failure condition. If applicable, a load shedding sequence should be provided

Influence	Consideration
G. (Continued)	not altered when flying in icing conditions. Anti-icing devices, alternate source for static pressure, or demonstration by test that port icing does not occur under any condition are means of showing compliance.
	2. Where the port is thermally protected, a thermal evaluation should be conducted to demonstrate that the protection is adequate.
H. Pitot, Static, Angle of Attack, and Stall Warning Sensors	1. Provide analysis (thermal analysis in the case of heated pitot tube and static ports) to establish anti-icing/deicing requirements.
	2. Perform tests to verify analyses and demonstrate compliance. Use these verified analysis to extrapolate to the critical conditions of Part 25, appendix C. Several combinations of parameters may be critical test points. For unprotected components, testing may be conducted to demonstrate that airspeed, altitude, and other indications remain within acceptable tolerances under the critical conditions. In some cases, adequate bench and flight testing may already have been accomplished on other airplanes to establish an approval basis by similarity on a specific airplane.
I. Magnetic Direction	1. Designs should minimize magnetic direction indicator (MDI) deviations; however, if MDI deviations greater than 10° exist when operating electrical ice protection equipment, provide placarding. NOTE: If the ice protection system causes greater than a 10° deviation, then § 23.1327 (amendment 23-20) should be applied in lieu of previous requirements.
J. Ice Detection Light(s)	1. Night flight or dark hangar evaluation of light coverage and glare produced by the wing ice detection light(s) should be evaluated.

Influence	Consideration
L. (Continued)	3. The Maintenance Manual should list approved fluids; and if pilot and crew members are required to replace fluid, these approved fluids should be listed in the AFM. The fluid filler inlet should bear a placard stating that only approved fluids be used. Approved fluids may be listed on this placard or in the AFM.
	4. The compatibility of the fluid with airframe and engine components should be examined to verify that adverse reactions such as corrosion or contamination do not occur or are prevented through inspection or other measures. For example, if ethylene glycol is a component fluid, then silver and silver-plated electrical switch contacts and terminals should be protected from contamination by the ethylene glycol in order to avoid a fire hazard.
M. Flight Tests	1. The certification rules require analysis and tests to demonstrate that the airplane can safely operate in the icing envelope of Part 25, appendix C. Compliance can be determined by similarities to previously approved configurations. If it should be necessary to conduct dry air tests with ice shapes, natural icing tests, or simulated icing tests, the goals and results should be in accordance with the guidance provided in paragraph 10 of this AC.
N. Flight Manual and Placards	1. The AFM and appropriated placards in the airplane should be designed to provide the pilot with sufficient information to safely operate the airplane in an icing environment.