TAD 494.6

Obsolete

AC NO: 91-51

DATE: 9/15/77

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: AIRPLANE DEICE AND ANTI-ICE SYSTEMS

1. PURPOSE. This advisory circular provides information for pilots regarding ice protection system approval and results of in-flight icing.

2. BACKGROUND. A review of selected accident/incident reports, in which in-flight icing was a primary factor, indicated that pilots may be unaware of:

a. The difference between airplanes which are approved for flight into icing conditions and those which are not; and,

b. Certain effects of in-flight ice accumulation on airplane characteristics and performance.

3. DISCUSSION.

a. To be approved for flight into icing conditions, an airplane must be equipped with deice or anti-ice systems which will adequately protect its various components while operating in icing conditions. There are two regulatory references to ice protection, one provided by the airplane type certification rules set forth in Federal Aviation Regulations (FAR) Parts 23 and 25, and the other provided by the operating rules of FAR Parts 91 and 135. They are:

(1) Airplane type certification, concerning ice protection, is currently accomplished by meeting the requirements of either FAR Section 23.1419 or FAR Section 25.1419. These rules require an analysis to establish the adequacy of the ice protection system for the various components of the airplane based on the operational needs of that particular aircraft. In addition, tests of the ice protection system must be conducted to demonstrate that the airplane is capable of operating safely in continuous maximum and intermittent maximum icing conditions as described in Appendix C of FAR Part 25. The Type Certificate Data Sheet (TCDS) gives the certification basis of the airplane and lists the regulations to which the airplane has been shown to comply. Therefore, when an airplane complies with one of the regulations

Initiated by: AFS-806

which refer to Appendix C of FAR 25, the icing certification is indicated on the TCDS and in the Airplane Flight Manual (AFM). The AFM will list the equipment required to be installed and operable. Recommended procedures for its use will also be shown in the AFM or in approved manual material.

(2) The operating rules in FAR Section 91.209, paragraph (b)(2), and FAR Section 135.85, paragraphs (b)(2), also permit flight into specified icing conditions provided that the aircraft has functioning anti-ice/deice equipment protecting each propeller, windshield, wing, stabilizing or control surfaces, and each airspeed, altimeter, rate of climb, or flight attitude instrument system. This equipment does not meet the criteria of FAR Parts 23 or 25, but is approved for installation since it does not adversely affect the structure, flight characteristics, or performance of the airplane, and information from the manufacturer has stated that the equipment performs the intended function. No flight tests are required to demonstrate specific anti-ice/deice capability for this equipment. The equipment does not provide ice protection for all aircraft components and areas subject to adverse icing effects, such as fuel tank vents, engine induction system, external communication and navigational antenna systems, cabin combustion heater inlet, vertical stabilizer, and a suitable means of detecting ice for both day and night operation, etc. Ice shedding from the wings and other parts of the airplane has caused damage by striking the empennage or by entering the engine inlet of aft mounted engines. Ice shed tests are not required for installation approval of the equipment listed in Sections 91.209 and 135.85.

b. It is important to remember that the presence of deicer boots on an airplane is not sufficient evidence of approval for flight into icing conditions. Some models of an aircraft series have not been tested for such operations. It's possible for the owner/operator to have boots installed on these airplanes so that some measure of deicing capability is available in the event of inadvertent encounters with icing conditions. Therefore, before operating into icing conditions, the pilot must determine whether the airplane is properly equipped and approved for such flight. The AFM is the official source of such information. The owner's manual will usually provide information regarding flight into icing conditions but that reference does not constitute approval of such flight operations.

c. When a flight is being conducted in icing conditions, the accumulation of ice on the unprotected parts of the airplane may contribute to vibration or buffeting of some components under certain operating conditions. Prestall buffeting may occur at a surprisingly high airspeed. Asymmetrical accumulation or removal of ice from propeller blades can cause vibration which the pilot may interpret as engine roughness or malfunction. Unusual vibration or buffeting does nothing for a pilot's peace of mind.

d. As airframe ice builds up and adds weight, some airspeed loss will occur if level flight is maintained. Power must then be added to compensate and it may be necessary to increase the angle of attack in order to maintain altitude. The changed attitude will expose additional unprotected surface area to icing. As the situation progresses, the airspeed loss may become more rapid and prestall buffeting may be encountered. In consideration of this possible sequence of events, the operating instructions on some airplanes specify a minimum airspeed that should be maintained in icing conditions. If the pilot is otherwise unable to maintain the airspeed above the prestall buffet point or as specified by the manufacturer, it will be necessary to trade altitude for airspeed.

e. The difference between the functions of deice and anti-ice systems must be recognized by pilots. A deice system used at the wrong time may negate its usefulness. For example, a thin coat of ice may be somewhat flexible and inflation of boots may merely STRETCH the ice, forming a shell within which the boots would then operate. It is important to allow the ice to build to a point where the boots will break it up.

f. On the other hand, anti-ice equipment is designed to be actuated in anticipation of icing and may be ineffective if activated after ice has accumulated.

4. RECOMMENDATIONS.

a. Prior to operating into known icing conditions, make certain the airplane is properly equipped and is approved for such flight.

b. If what seems to be engine roughness occurs during flight in icing conditions, consider the possibility of propeller icing. If ice has accumulated on the prop, cycling the prop control(s) between cruise and high RPM settings may throw off the ice.

c. Maintain a safe margin of speed to compensate for the increased stall speed caused by the weight and air flow disturbance caused by icing.

d. If necessary, sacrifice altitude to maintain airspeed.

e. In the absence of FAA approved procedures, follow the manufacturer's advice on how to handle flight in icing conditions.

f. Don't linger in icing conditions. Exercise available alternatives--change altitude or route--promptly.

g. During preflight planning, assume that ice protection will be needed when operating in instrument flight conditions in an area where the Weather Bureau has forecast icing conditions. Also consider that analysis and tests have shown that different aircraft models do not accrue dangerous ice accretions to the same degree under the same atmospheric conditions.

R. P. SKULLY
Director, Flight Standards Service