U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject:

GROUND DEICING AND ANTI-ICING PROGRAM

Date: 5/19/94 AC No: 120-60
Initiated by: AFS-240 Change:

1. PURPOSE. This advisory circular (AC) provides one means, but not the only means, for obtaining approval of a Ground Deicing and Anti-Icing Program, and for ensuring compliance with the Federal Aviation Regulations (FAR) Section 121.629.

2. RELATED FAR SECTIONS.

a. Part 121, Subpart E - Approval of Routes: Domestic and Flag Air Carriers. Sections 121.105-107.

b. Part 121, Subpart F - Approval of Areas and Routes for Supplemental Air Carriers and Commercial Operators. Sections 121.123-127.

c. Part 121, Subpart G - Manual Requirements. Section 121.135.

d. Part 121, Subpart L - Maintenance, Preventive Maintenance, and Alterations. Sections 121.363(b), 121.365-369, and 121.375.

e. Part 121, Subpart M - Airman and Crewmember Requirements. Sections 121.383(a)(3), 121.401-403, 121.405, 121.415, 121.418-419, 121.422, and 121.427.

f. Part 121, Subpart O - Crewmember Qualifications. Section 121.433.

g. Part 121, Subpart P - Aircraft Dispatcher Qualifications and Duty Time Limitations: Domestic and Flag Air Carriers. Section 121.463.

h. Part 121, Subpart T - Flight Operations. Sections 121.533, 121.537, and 121.539.

i. Part 121, Subpart U - Dispatching and Flight Release Rules. Section 121.629.

j. Special Federal Aviation Regulation No. 58. Advanced Qualification Program.

3. RELATED READING MATERIAL. The following material should be useful in developing training program subject material and instructions, and procedures for incorporation in the certificate holder's manuals:

a. AC 20-117, Hazards Following Ground Deicing and Ground Operations in Conditions Conducive to Aircraft Icing.

b. AC 120-58, Pilot Guide for Large Aircraft Ground Deicing.

c. FAA publication, Winter Operations Guidance for Air Carriers and Other Adverse Weather Topics.

Note: AC 20-117, AC 120-58, and the FAA publication may be obtained from the Department of Transportation, M-443.2, General Services Section, Washington, DC 20590.

d. Publications of the Society of Automotive Engineers (SAE): Aerospace Materials Specification (AMS) 1424, "Deicing/Anti-Icing Fluid, Aircraft, Newtonian - SAE Type I;" AMS 1428, "Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian, Pseudo-Plastic, SAE Type II;" and Aerospace Recommended Practice (ARP) 4737, "Aircraft Deicing/Anti-Icing Methods with Fluids, for Large Transport Aircraft." You can obtain copies of these documents by writing to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania, 15096-0001.

e. Publications of the International Standards Organization (ISO): ISO 11075, "Aerospace - Aircraft Deicing/Anti-Icing Newtonian Fluids ISO Type I;" ISO 11076, "Aerospace - Aircraft Deicing/Anti-Icing Methods with Fluids;" ISO 11077, "Aerospace - Deicing/Anti-Icing Self Propelled Vehicles - Functional Requirements;" and ISO 11078, "Aerospace - Aircraft Deicing/Anti-Icing Non-Newtonian Fluids ISO Type II." Copies of these documents can be obtained from American National Standards Institute, 11 West 42nd Street, New York, New York, 10036, (212) 642-4900.

4. BACKGROUND.

a. Accidents Related to Icing. According to information received in 1992 from the National Transportation Safety Board (NTSB), in the last 23 years there have been 15 accidents involving FAR Part 121 operators related to the failure to deice and/or anti-ice aircraft adequately before takeoff. On March 22, 1992, an airplane operated by a U.S. air carrier crashed on takeoff from LaGuardia Airport in a snowstorm during nighttime operations. The NTSB determined that the probable causes of this accident were failure of the airline industry and the Federal Aviation Administration (FAA) to provide flightcrews with

procedures, requirements, and criteria compatible with departure delays in conditions conducive to airframe icing and the decision by the flightcrew to take off without positive assurance that the airplane's wings were free of ice accumulation after prolonged exposure to precipitation following deicing.

b. Reassessment of Icing Procedures. Prior to the LaGuardia accident, the FAA and the aviation community, in general, had placed priority on emphasizing the need during icing conditions for the pilot in command (PIC) to ensure a "clean aircraft" before takeoff. The FAA believed that pilot education appeared to be key to combatting the threat of wing icing. The FAA still believes the PIC ultimately must make the decision on whether or not to take off, based on a thorough understanding of factors involved in aircraft icing; however, the FAA has determined that certificate holders conducting operations under FAR Part 121 must provide their PIC's with pertinent information and operator-developed procedures and criteria so that the PIC will be able to make a proper decision.

c. Content of this AC. Accordingly, this AC provides guidance about the program elements that should be incorporated in an certificate holder's approved ground deicing and anti-icing program. It provides guidance and suggestions about methods, but not the only methods, for complying with all pertinent regulations.

5. DEFINITIONS. The terms used in this AC are not defined in FAR Part 1. They are defined here for a better understanding of this material.

a. Holdover Time. The estimated time deicing or anti-icing fluid will prevent the formation of frost or ice and the accumulation of snow on the protected surfaces of an aircraft. Holdover time begins when the final application of deicing/anti-icing fluid commences and expires when the deicing/anti-icing fluid applied to the aircraft loses its effectiveness.

b. Deicing. A procedure by which frost, ice, or snow is removed from the aircraft in order to provide clean surfaces.

c. Anti-Icing. A precautionary procedure that provides protection against the formation of frost or ice and accumulation of snow on treated surfaces of the aircraft for a limited period of time.

d. Pretakeoff Check. A check of the aircraft's wings or representative aircraft surfaces for frost, ice, or snow

conducted within the aircraft's holdover time.

e. Pretakeoff Contamination Check. A check to make sure the aircraft's wings, control surfaces, and other critical surfaces, as defined in the certificate holder's program, are free of frost, ice, and snow. It must be completed within 5 minutes prior to beginning takeoff. This check must be accomplished from outside the aircraft unless the certificate holder's program specifies otherwise.

f. Outside-the-Aircraft Check. A check to ensure that the wings and control surfaces are free of frost, ice, and snow. It must be completed within 5 minutes prior to beginning takeoff. It must be accomplished from outside the aircraft.

6. PROGRAM ELEMENTS. FAR Section 121.629(c) requires a certificate holder's ground deicing and anti-icing program include at least the following elements:

a. Management plan including a detailed description of the operational responsibilities and procedures associated with the implementation and conduct of the certificate holder's ground deicing/anti-icing program.

b. A certificate holder's holdover timetables and procedures for the use of these tables by the certificate holder's personnel.

c. Aircraft deicing/anti-icing procedures and responsibilities, pretakeoff check procedures and responsibilities, and pretakeoff contamination check procedures and responsibilities.

d. Initial and recurrent ground training and testing for flight crewmembers and qualification for all other affected personnel (e.g., aircraft dispatchers, ground crews, contract personnel).

7. MANAGEMENT PLAN. FAR Sections 121.533, 121.535, and 121.537 state, respectively, that each domestic, flag, and supplemental air carrier and commercial operator is responsible for operational control. In order to properly exercise operational control (when conditions at an airport are such that frost, ice, or snow may reasonably be expected to adhere to its aircraft), the certificate holder should develop, coordinate with other affected parties, implement, and use a management plan to ensure proper execution of its approved deicing/anti-icing program. The FAA would accept an operator's management plan that identifies the manager responsible for the overall deicing/anti-icing

program, identifies each subordinate manager, and describes each manager's functions and responsibilities under the applicable FAR which are needed to properly manage the certificate holder's deicing/anti-icing program. A plan encompassing the elements discussed in the following paragraphs is acceptable:

a. Operations. Determine the management position responsible for ensuring that all the elements of the management plan and the deicing/anti-icing program have been developed, properly integrated, and coordinated; that the plan and program have been disseminated to all those persons who have duties, responsibilities, and functions to perform in accordance with them; and that adequate management oversight of the program continues to be maintained. The following should be considered:

(1) At each airport where operations are expected to be conducted in conditions conducive to ground icing, determine who will be responsible for deciding when ground deicing/anti-icing operational procedures are to be implemented.

(2) Specify the functions, duties, responsibilities, instructions, and procedures to be used by flight crewmembers, aircraft dispatchers or flight followers, and management personnel for safely dispatching or releasing each type aircraft used in its operations while ground deicing/anti-icing operational procedures are in effect. A plan should include a detailed description of how the certificate holder determines that conditions at an airport are such that frost, ice, or snow may reasonably be expected to adhere to the aircraft, and when ground deicing/anti-icing operational procedures must be in effect.

(3) Determine who will be responsible for coordinating the applicable portions of the management plan and the deicing/anti-icing program with the appropriate air traffic control tower (ATCT) personnel and other appropriate airport authorities, including:

(i) Determine who will be authorized to enter into agreements with the manager of the ATCT at each airport regarding air traffic control (ATC) procedures during ground icing conditions, and with each airport's manager regarding aircraft secondary deicing/anti-icing locations and where aircraft may conduct pretakeoff contamination checks; and

(ii) Ensure that a detailed description of the deicing/anti-icing program is incorporated in the certificate holder's manuals for flight crewmembers, dispatchers or flight followers, ground operations personnel, and management personnel

to use in conducting operations under ground icing conditions.

b. Maintenance. Determine who is responsible for ensuring that enough trained and qualified personnel, as well as adequate facilities and equipment, are available at each airport where operations are expected to be conducted under conditions conducive to ground icing for the proper deicing and anti-icing of the certificate holder's aircraft. The following should be considered:

(1) Ensure that all necessary maintenance elements of the management plan and the deicing/anti-icing program have been developed, properly integrated, and coordinated; that the maintenance plan and deicing/anti-icing program have been disseminated to all those personnel who have duties, responsibilities, and functions to perform; and that adequate management oversight of the program continues to be maintained.

(2) Detail the functions, duties, responsibilities, instructions, and procedures to be used by its ground personnel, maintenance personnel, and management personnel for safely dispatching or releasing aircraft used in its operations while ground deicing/anti-icing operational procedures are in effect.

(3) Ensure that a detailed description of the maintenance portion of the deicing/anti-icing program is incorporated in the certificate holder's manuals for the use and guidance of maintenance, ground, flightcrew, and management personnel.

8. HOLDOVER TIMETABLES AND PROCEDURES FOR THEIR USE. FAR Section 121.629(c)(3) requires that the deicing/anti-icing program include holdover timetables and the procedures for the use of these tables by the certificate holder's personnel. An acceptable program includes procedures to be followed in the event that the holdover times, as determined by the PIC from the certificate holder's holdover time tables, are exceeded. Each of these areas is discussed in the following paragraphs and illustrated in figure 1.

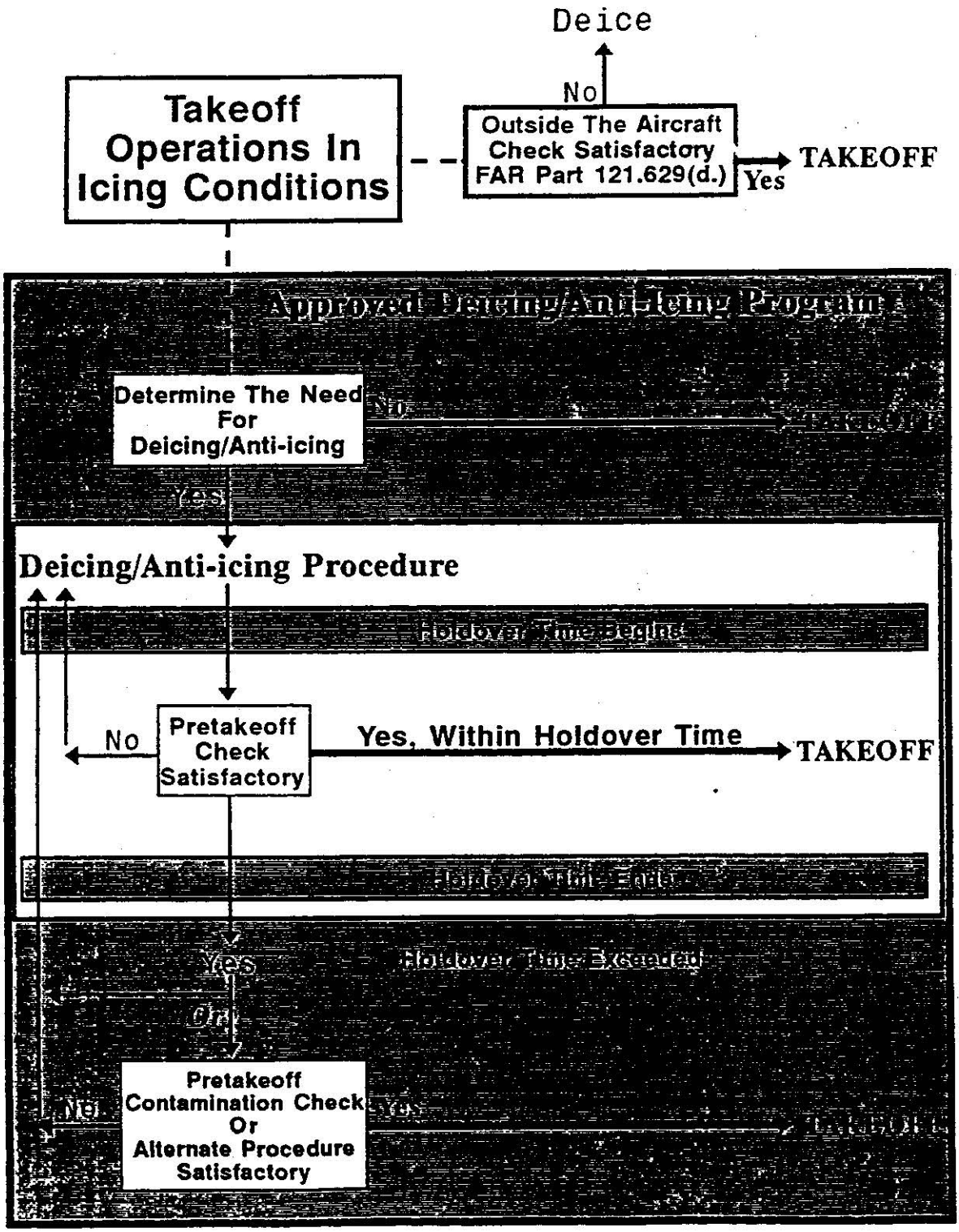
Note: The procedures for the use of the holdover timetables requires a pretakeoff check by the flightcrew. To effectively use holdover timetables, they should be available in the cockpit for flightcrews to use.

a. Responsibilities and Procedures. The certificate holder's program should define operational responsibilities and contain procedures for the flightcrew, aircraft dispatchers, flight followers, and maintenance and ground personnel applicable

to the use of holdover times and resultant actions if the determined holdover time is exceeded. These procedures should include gate procedures, communication between ground crew and flightcrew to establish the start of holdover time and to relay other pertinent information regarding the deicing/anti-icing process, flight crewmember use of the pertinent holdover timetables, coordination with dispatchers or flight followers, and coordination with ATC.

b. Development of Holdover Timetables. Except as provided in FAR Section 121.629(d), each certificate holder is required under FAR Section 121.629(c)(3) to develop holdover timetables for use by its personnel. These timetables are required to be supported by data acceptable to the Administrator. Currently, the only acceptable data is that developed by SAE and ISO. ARP 4737, "Aircraft Deicing/Anti-Icing Methods with Fluids, for Large Transport Aircraft," and ISO 11076, "Aerospace - Aircraft Deicing/Anti-Icing Methods with Fluids," contain the tables that are currently considered acceptable for use by the certificate holders to develop their holdover timetables. Holdover times exceeding those specified in the current editions of the SAE and ISO tables are currently not acceptable; however, the certificate holder may require the use of more conservative times than those specified in the SAE and ISO tables. Appendix 1 of this AC contains the holdover timetables extracted from the current SAE and ISO documents.

FIGURE 1
TAKEOFF OPERATIONS IN ICING CONDITIONS



c. Use of Holdover Timetables. Holdover time ranges are only an estimate of the time that deicing/anti-icing fluid will prevent the formation of frost or ice and the accumulation of snow on the protected surfaces of an aircraft. Holdover time begins when the final application of deicing/anti-icing fluid commences and expires when the deicing/anti-icing fluid applied to the aircraft loses its effectiveness. Holdover times vary with weather conditions; the holdover time determined should be appropriate for the existing weather conditions. For example, appendix 1, table 1, gives "0:15 - 0:30" (meaning a range of 15 to 30 minutes) for snow in the outside air temperature (OAT) range of 19°F to 32°F for a 75/25 mixture of SAE/ISO Type II fluid. The proper interpretation of this particular time range is that under various weather conditions and the other conditions stated in the table, the estimated holdover time range may be between 15 minutes and 30 minutes. Generally, for snow, the lower range has been found to be a useful approximation for moderate, steadily falling snow (zero to light winds) while the upper range is a useful approximation for light, steadily falling snow. Therefore as a general rule, the maximum time within the holdover time range applies in light precipitation conditions, and the minimum time applies to moderate precipitation conditions. It should be noted the SAE and ISO holdover timetables specifically state that holdover time protection will be shortened in heavy weather conditions. The effectiveness of deicing/anti-icing fluids is based on a number of variables (e.g., temperature, moisture content of the precipitation, wind, and aircraft skin temperature). The holdover timetables are to be used for departure planning and in conjunction with pretakeoff check procedures. FAR Section 121.629(c)(3) requires the program include procedures for the use of holdover timetables including conducting pretakeoff check(s). A pretakeoff check as defined in FAR Section 121.629(c)(4) is a check of the aircraft's wings or representative aircraft surfaces for frost, ice, or snow within the aircraft's holdover time. Depending on the length of the holdover time, weather, or other conditions, pretakeoff check procedures may be accomplished several times during the aircraft's holdover time. A pretakeoff check should be accomplished just prior to taking the active runway for departure. Air carrier manuals should contain detailed procedures for using holdover timetables and the conduct of pretakeoff checks in their operations.

d. FAR Section 121.629(c)(3) also requires the certificate holder's program contain procedures for flight crewmembers to increase or decrease the determined holdover time in changing conditions. This requires the flightcrew to maintain a continued awareness of environmental or situational conditions that could

affect the determined holdover time. Weather conditions that could result in a change to the determined holdover time include, but are not limited to, a significant rise or drop in ambient temperature, an increase or decrease in precipitation rate or intensity, water content, or density, a change in type of precipitation; e.g., rain to freezing rain, light to heavy snow, or the end of precipitation. Procedures should consider the certificate holder's capability to disseminate information, in real time, concerning changing weather conditions. Additional guidance regarding holdover timetables is contained in AC 20-117, Hazards Following Ground Deicing and Ground Operations in Conditions Conducive to Aircraft Icing; AC 120-58, Pilot Guide for Large Aircraft Ground Deicing; SAE ARP 4737, "Aircraft Deicing/Anti-Icing Methods with Fluids, for Large Transport Aircraft"; and ISO 11076, "Aerospace - Aircraft Deicing/Anti-Icing Methods with Fluids."

e. Takeoff After the Holdover Time is Exceeded. Under FAR Section 121.629(c)(3), takeoff after the determined holdover time is exceeded is permitted only if one of the three conditions described in e.(1)(2)(3) exists. The certificate holder's program should detail actions that must be accomplished if the holdover time is exceeded.

(1) A pretakeoff contamination check is completed to make sure that wings, control surfaces, and other critical surfaces, as defined in the certificate holder's program, are free of frost, ice, and snow. The operator's program must include detailed aircraft type-specific procedures and responsibilities for flightcrew and ground personnel to use while accomplishing this check. This check must be completed within 5 minutes prior to beginning takeoff and must be accomplished from outside the aircraft, unless the certificate holder's program specifies otherwise. Factors determining whether the check can be accomplished from inside the aircraft include the ability of the flightcrew to see aircraft surfaces, lighting conditions, weather conditions, as well as other factors which determine the flightcrew's ability to assess the condition of the aircraft. The certificate holder's program should emphasize that if any doubt exists as to the condition of the aircraft after completing this check from inside the aircraft, the takeoff must not be attempted. If doubt exists, the PIC should request a pretakeoff contamination check be accomplished from outside the aircraft or the aircraft should be redeiced and a new holdover time determined; or

(2) It is otherwise determined by an alternate procedure, that wings, control surfaces, and other critical surfaces, as defined in the certificate holder's program, are

free of frost, ice, and snow. Alternative procedures consist of procedures, techniques, or equipment (such as wing icing sensors) that might be used to establish that the above mentioned surfaces are not contaminated. Any alternative procedure must be approved by the certificate holder's principal operations inspector through the Manager, Air Transportation Division, AFS-200, and the procedures should be included in the certificate holder's approved program; or

(3) The wings, control surfaces, and other critical surfaces have been redeiced and a new holdover time has been determined. Coordination procedures with ATC and ground personnel should be detailed for the accomplishment of this redeicing.

9. AIRCRAFT DEICING/ANTI-ICING PROCEDURES AND RESPONSIBILITIES, PRETAKEOFF CHECK PROCEDURES AND RESPONSIBILITIES, AND PRETAKEOFF CONTAMINATION CHECK PROCEDURES AND RESPONSIBILITIES. Certificate holders' manuals should contain detailed procedures for the deicing and anti-icing process specific to each aircraft type. Certificate holders should have aircraft type-specific instructions and checking guidelines and procedures for the use of their flight crewmembers and other personnel to determine whether or not aircraft surfaces are free of contaminants.

Note: Takeoffs with underwing frost in the area of the fuel tanks within limits established by the aircraft manufacturer, accepted by FAA aircraft certification offices, and stated in aircraft maintenance and flight manuals can be authorized by the FAA.

a. Identification of Critical Aircraft Surfaces. The critical aircraft surfaces which should be clear of contaminants before takeoff should be described in the aircraft manufacturer's maintenance manual or other manufacturer-developed documents, such as service or operations bulletins.

(1) Generally, the following should be considered to be critical aircraft surfaces, if the aircraft manufacturer's information is not available:

(i) Pitot heads, static ports, ram-air intakes for engine control and flight instruments, other kinds of instrument sensor pickup points, fuel vents, propellers, and engine inlets.

(ii) Wings, empennage, and control surfaces.

(iii) Fuselage upper surfaces on aircraft with center mounted engine(s).

(2) Certificate holders should list in the flight manual or the operations manual, for each type of aircraft used in their operations, the critical surfaces which should be checked on flight-crewmember-conducted preflight inspections, pretakeoff checks, and pretakeoff contamination checks.

(3) Critical surfaces should be defined for the use of ground personnel for conducting the check following the deicing/anti-icing process and for any pretakeoff contamination checks that may be accomplished by ground personnel.

b. Identification of Representative Aircraft Surfaces (for use in conducting pretakeoff checks only). Certificate holders should list in the flight manual or the operations manual, for each type of aircraft used in their operations, the representative surfaces which may be checked while conducting pretakeoff checks.

(1) Some aircraft manufacturers have identified certain aircraft surfaces which the flightcrew can readily observe to determine whether or not ice, frost, or snow is accumulating or forming on that surface and, by using it as a representative surface, can make a reasoned judgement regarding whether or not ice, frost, or snow is adhering to other aircraft surfaces. Certificate holder operational experience can also be used to define representative surfaces. In the absence of this information, the following guidelines should be considered in identifying a representative aircraft surface:

(i) The surface can be seen clearly to determine whether or not ice, frost, or snow is forming or accumulating on the surface.

(ii) The surface should be unheated.

(iii) Surfaces such as windshield wipers should also be considered.

(iv) The surface should be one of the first surfaces treated with deicing/anti-icing fluid during the deicing/anti-icing procedure; however, designation of representative surfaces is not limited to treated surfaces.

c. Techniques for Recognizing Contamination on Aircraft Critical or Representative Surfaces. In annual and recurrent training, certificate holders must include aircraft type-specific techniques for flight crewmembers and other personnel for recognizing contamination on critical and representative aircraft surfaces. These type-specific techniques should be used while

conducting preflight aircraft icing checks, pretakeoff checks, and pretakeoff contamination checks. Some indications for loss of effectiveness of deicing/anti-icing fluid or contamination on aircraft surfaces include surface freezing or snow accumulation, random snow accumulation, and dulling of surface reflectivity (loss of gloss) caused by the gradual deterioration of the fluid to slush. Deicing/anti-icing fluid manufacturers should also be consulted for information on the fluid characteristics and indications that the fluid is losing its effectiveness.

d. Types of Icing Checks. FAR Section 121.629(c)(4) identifies three different icing checks or procedures which, when applicable, are required to be accomplished under an operator's approved deicing/anti-icing program:

(1) Aircraft Deicing/Anti-Icing Procedure. The aircraft deicing/anti-icing procedure includes a check of the wings, control surfaces, propellers, engine inlets, and other critical surfaces. This check is an integral part of the deicing/anti-icing procedure. Certificate holders should have procedures which ensure that, following aircraft deicing and anti-icing fluid application, this check is conducted by qualified ground personnel. This check determines if the wings, control surfaces, propellers, engine inlets, and other critical surfaces are free of frost, ice, or snow before pushback or taxi. It should be noted that, for airplanes not equipped with wing clear-ice detectors, a tactile check of airplane surfaces is the only known method to date to verify whether or not the surfaces are uncontaminated. Communication procedures should be established to relay pertinent deicing/anti-icing information and the results of this check to the PIC.

(2) Pretakeoff Check. This check is aircraft type-specific and is required under FAR Section 121.629(c)(3) anytime procedures for the use of holdover times are required. It must be accomplished within the holdover time, and is normally accomplished by the flightcrew from inside the cockpit. The aircraft's wings or representative aircraft surfaces are checked for contamination. The surfaces to be checked are determined by manufacturer's data, carrier's operational experience, or guidance contained in this AC. The pretakeoff check is integral to the use of holdover times. Because of the limitations and cautions associated with the use of holdover times, the flightcrew must assess the current weather, other situational conditions, and the aircraft's condition, and not rely on the use of holdover times as the sole determinant that the aircraft is free of contaminants. Several pretakeoff checks may be required during the holdover time period based on factors including the length of the holdover time range, weather, or other conditions.

A continued awareness of the aircraft condition should be maintained. A pretakeoff check should be accomplished just prior to taking the active runway for departure.

(3) Pretakeoff Contamination Check. FAR Section 121.629(c)(3)(i) states that completing a pretakeoff contamination check is one of the conditions that allows a takeoff after a holdover time has been exceeded. Certificate holders must have appropriate pretakeoff contamination check procedures for flight crewmembers and other qualified ground personnel's use to ensure that the aircraft wings, control surfaces, and other critical surfaces remain free of frost, ice, and snow when a holdover time has been exceeded. The pretakeoff contamination check must be completed within 5 minutes prior to beginning takeoff and must be accomplished from outside the aircraft unless the certificate holder's program specifies otherwise. Reliance on representative surfaces are not satisfactory for determining the aircraft is free of contamination while conducting this check. If any doubt exists concerning the aircraft's condition after completing this check, the aircraft cannot take off unless it is redeiced and a new holdover time determined. The following should be considered while developing procedures for this check.

(i) Certificate holders who operate hard-wing airplanes with aft, fuselage-mounted, turbine-powered engines should conduct pretakeoff contamination checks from outside the airplane, unless otherwise authorized in the certificate holder's approved program. The pretakeoff contamination check for these airplanes should include a tactile check of selected portions of the wing leading edges and the upper wing surfaces. Alternatives to a tactile check procedure may be approved. Alternative procedures must be coordinated with the Manager, Air Transportation Division, AFS-200. As of the date of this AC, only one airplane manufacturer has developed an approved alternative to tactile pretakeoff contamination checks. This procedure is contained in the manufacturer's maintenance manual and details the requirements for conducting this check.

(ii) Operators of other aircraft must conduct this check from outside the aircraft unless they can show that the check can be adequately accomplished from inside the aircraft, as specified in the certificate holder's program. The program must detail procedures and requirements for the conduct of this check. Certificate holders should consider the following in the development of guidelines for conducting pretakeoff contamination checks from inside the aircraft:

(A) Can enough of the wings, control surfaces, and other critical surfaces be seen to accurately determine whether or not they are free of contaminants? This determination should consider the aircraft type, the method of conducting the check--that is, from the cockpit or cabin, and other factors including aircraft lighting and other ambient conditions.

(B) Does the certificate holder have procedures to recognize, and have flight crewmembers been properly trained on these procedures to recognize, changes in weather conditions so they will be able to determine if the wings, control surfaces, and other critical aircraft surfaces could reasonably be expected to remain free of contamination?

10. INITIAL AND RECURRENT GROUND TRAINING AND TESTING FOR FLIGHT CREWMEMBERS AND INITIAL AND RECURRENT GROUND TRAINING AND QUALIFICATION FOR DISPATCHERS.

a. Flight Crewmember Training and Testing. The operator's training program must include a detailed description of initial and annual recurrent ground training and testing for flight crewmembers concerning the specific requirements of the program and the duties, responsibilities, and functions detailed in the program. Flight crewmembers and dispatchers must be trained and tested or qualified on at least the following subjects (after each subject listed, recommendations concerning the content of the training are provided):

(1) The Use of Holdover Times. Holdover times are a range of times derived from an analysis of airline experience and laboratory testing of the freeze points of particular types of fluids (currently Type I and Type II) under various temperatures, fluid concentrations, and humidity conditions. A discussion of holdover times should include the following:

(i) Definition of holdover time.

(A) Limitations and cautions associated with the use of holdover times.

(B) Source of holdover time data.

(C) How to determine a specific holdover time from the holdover time range that accounts for "heavy," "medium," or "light" weather conditions.

(D) Adjusting holdover time for changing weather conditions.

(ii) Precipitation category (e.g., fog, drizzle, rain, or snow).

(A) Precipitation intensity.

(B) Duration of precipitation.

(C) Relationship of precipitation change to holdover time.

(iii) Relationship of holdover time to particular fluid concentrations and for different types of fluids.

(iv) When holdover time begins and ends.

(v) Communication procedures.

(A) Communication between ground personnel and the flightcrew to determine the start of holdover time, and the particular holdover timetable to be used. Communications from the ground crew to the cockpit crew should consist of the following information:

(1) Fluid type; e.g., Type I or Type II.

(2) Fluid/water mix ratio.

(3) Start time of final fluid application which is when holdover time begins.

(4) Accomplishment and results of post-deicing/anti-icing check.

(B) ATC coordination.

(C) Dispatch or flight following coordination.

(D) Means for obtaining most current weather information.

(vi) Use of holdover times by the flightcrew.

(vii) Procedures when holdover time is not exceeded.

(A) When, where, and how to accomplish the pretakeoff check.

(viii) Procedures when holdover time is exceeded.

(A) Pretakeoff contamination check; or

(B) Alternate means to determine whether or not surfaces are free of frost, ice, or snow; or

(C) Redeice and determine a new holdover time.

(2) Aircraft Deicing/Anti-Icing Procedures Including Checks to Detect Contaminated Surfaces, and Responsibilities.

(i) Deicing is a procedure by which frost, ice, or snow is removed from the aircraft in order to provide clean surfaces. The procedure can be accomplished by the use of fluids, mechanical means, or by heating the aircraft.

(ii) Anti-icing is a procedure by which the application of certain types of anti-icing fluids provides protection against the formation of frost or ice and accumulation of snow on treated surfaces of the aircraft for a limited period of time (holdover time).

(iii) Deicing/Anti-icing is a combination of the two procedures above. It can be performed in one or two steps.

(A) One-step deicing/anti-icing is carried out with an anti-icing fluid. The fluid used to deice the aircraft remains on aircraft surfaces to provide limited anti-icing capability.

(B) Two-step deicing/anti-icing consists of two distinct steps. The first step, deicing, is followed by the second step, anti-icing, as a separate fluid application. When it has been determined that the surfaces are clean, anti-icing fluid is applied to protect the relevant surfaces, thus providing maximum possible anti-icing protection (holdover time).

(iv) Safety requirements during fluid application.

(v) Deicing/anti-icing fluid application procedures.

(vi) If applicable, remote deicing procedures.

(A) Aircraft type-specific considerations.

(B) Location-specific procedures.

(vii) Contractor Deicing/Anti-icing. In order to comply with the rule, certificate holders who engage in supplemental operations and employ contractor deicing/anti-icing services and who are unable to arrange for the training and qualification of these personnel in advance should have a person assigned to the flights who is fully trained under the certificate holders' approved program to supervise the deicing/anti-icing procedure.

(viii) Deicing/Anti-icing Checking Procedures and Responsibilities. The training program should have aircraft type-specific surface contamination check procedures and guidelines to include the following:

(A) Types of Checks Required. Each certificate holder should detail the types of checks required and the methods for accomplishing these checks. This includes procedural steps for conducting the check as well as the location, personnel requirements, deicing equipment, and lighting required to accomplish the check.

(1) Flightcrew preflight inspection/cold weather preflight inspection procedures. This is the normal walk around preflight inspection conducted by the flightcrew. This inspection should note any aircraft surface contamination and direct any required deicing/anti-icing operations.

(2) Aircraft deicing/anti-icing procedures include a check performed by qualified ground personnel after the deicing/anti-icing fluid application has been completed. This check is an integral part of the aircraft deicing/anti-icing procedure.

(3) A pretakeoff check is performed by the flightcrew prior to takeoff and within the holdover time. This is a check normally conducted from inside the cockpit. Identification of representative surfaces and continual assessment of environmental and other situational conditions should be included in the operator's program.

(4) Pretakeoff contamination check. This check is accomplished after the holdover time has been exceeded and must be completed within 5 minutes prior to beginning takeoff. Each carrier must define aircraft type-specific pretakeoff contamination check procedures. The check must be

conducted from outside the aircraft unless otherwise approved in the carrier's program. Rather than accomplishing this check, the PIC may elect to be redeiced and a new holdover time established.

(B) Identification of critical surfaces or representative surfaces to be checked/inspected during each type of check.

(C) Techniques for recognizing contamination on the aircraft.

(D) Communications procedures to include communications between the flightcrew, ground personnel, ATC, and company station personnel. Communications with ATC should include coordinating deicing/anti-icing of the aircraft with any proposed ATC push-back time and coordinating any other special requirements needed for accomplishing required aircraft checks.

(3) Aircraft Surface Contamination and Critical Area Identification, and How Contamination Adversely Affects Aircraft Performance and Flight Characteristics.

(i) Aircraft Ground Icing Conditions. Certificate holders should have a description of the following conditions included in their program that would implement ground deicing/anti-icing operational procedures:

(A) Inflight Ice Accumulation. Certificate holders should have procedures for flightcrews of arriving flights to report occurrences of inflight icing to the personnel responsible for executing the certificate holder's deicing/anti-icing program. Inflight ice accumulation could result in a ground deicing situation when flights are scheduled for short turnaround times; i.e., for 30 minutes or less, and when ambient temperatures on the ground are at or below freezing.

(B) Freezing Precipitation. Snow, sleet, freezing rain, drizzle, or hail which could adhere to aircraft surfaces.

(C) Frost, including hoarfrost which is a crystallized deposit, formed from water vapor on surfaces which are at or below 0°C (32°F).

(D) Freezing Fog. Clouds of supercooled water droplets that form a deposit of ice on objects in cold weather conditions.

(E) Snow. Precipitation in the form of small ice crystals or flakes which may accumulate on, or adhere to, aircraft surfaces.

(F) Freezing Rain. Water condensed from atmospheric vapor falling to earth in supercooled drops, forming ice on objects.

(G) Rain or High Humidity on Cold-soaked Wing. Water forming ice or frost on the wing surface when the temperature of the aircraft wing surface is at or below 0°C (32°F). This ice or frost may freeze over the entire wing surface and on the wing leading edge.

(H) Rain or High Humidity on Cold-soaked Wing Fuel Tanks. Water forming ice or frost may form on the wing surface when the temperature of the aircraft wing surface in the vicinity of the wing fuel tanks is at or below 0°C (32°F) due to cold-soaked fuel. Certain aircraft are susceptible to the formation of frost or ice on wing upper surfaces when cold-soaked fuel is in the main wing fuel tanks, and the aircraft are exposed to conditions of high humidity, rain, drizzle, or fog at ambient temperatures well above freezing. Under some atmospheric and temperature conditions clear ice may form. The certificate holder's program should include procedures for removing this type of contamination. In certain circumstances, this type of contamination may not require the certificate holder to implement its ground deicing/anti-icing program.

(I) Underwing Frost. Takeoff with frost under the wing in the area of the fuel tanks (caused by cold-soaked fuel) within limits established by the aircraft manufacturer, accepted by FAA aircraft certification offices and stated in aircraft maintenance and flight manuals, may be permitted. This type of contamination may not require the certificate holder to implement its ground deicing/anti-icing program.

(ii) Critical Aircraft Surfaces. Certificate holders should identify for each type of aircraft used in their operations, the critical surfaces which should be checked on preflight and pretakeoff contamination checks. Information from the aircraft manufacturer (or from this AC if the subject information is not available from the aircraft manufacturer) should be used to determine the critical surfaces for each aircraft type.

(iii) Representative Aircraft Surfaces. Certificate holders should identify, for each type of aircraft used in their operations, the representative aircraft surfaces which should be checked during pretakeoff checks. Information from the aircraft manufacturer, or information developed from carrier operating experience, should be used to determine representative surfaces. In the absence of such information, information from this AC can be used to determine representative aircraft surfaces.

(iv) Effects of Frost, Ice, Snow, and Slush on Aircraft Performance, Stability, and Control. The certificate holder should obtain information on aircraft performance when undetected frost, ice, snow, or slush could be adhering to aircraft surfaces from the manufacturer of each type of aircraft it uses in its operations and should ensure that its flight crewmembers and aircraft dispatchers understand these effects. Accident data and National Aeronautics and Space Administration studies have confirmed that some aircraft manufacturers' data indicates that the effects of wing contamination may be significantly more pronounced for hard-leading-edge (hard-wing) airplanes than for slatted-leading-edge (slatted-wing) airplanes. This data indicates for airplanes without leading-edge, high-lift devices that the presence of even minute amounts of ice or other contaminates (equivalent to medium grit sandpaper) results in significant loss of wing lift, which causes the airplane to stall at lower-than-normal angles of attack during takeoff. The discussion of these effects should include, but is not limited to, the following subjects:

(A) Increased drag and weight.

(B) Tendency for rapid pitchup and wing roll off during rotation.

(C) Loss of lift.

(D) Stall occurs at lower-than-normal angle of attack.

(E) Buffet or stall occurs before activation of stall warning.

(F) Decreased effectiveness of flight controls.

(4) Types, Purpose, Characteristics, and Effectiveness of Deicing and Anti-Icing Fluids. There are several kinds of deicing and anti-icing fluids currently available, and each has different characteristics and capabilities. Certificate holders

should ensure that their flight crewmembers, aircraft dispatchers, and ground personnel generally understand the purpose and capabilities of the fluids used in the certificate holders' deicing/anti-icing program; and that their flight crewmembers are generally knowledgeable of the characteristics of each type of fluid. Certificate holders should refer to the following SAE publications for additional information on specific deicing and anti-icing methods and procedures and on fluid characteristics and capabilities: AMS 1424, "Deicing/Anti-Icing Fluid, Aircraft, Newtonian - SAE Type I;" AMS 1428, "Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian, Pseudo-Plastic, SAE Type II"; and ARP 4737, "Aircraft Deicing/Anti-Icing Methods with Fluids, for Large Transport Aircraft;" and the following ISO documents: ISO 11075, "Aerospace - Aircraft Deicing/Anti-Icing Newtonian Fluids ISO Type I;" ISO 11076, "Aerospace - Aircraft Deicing/Anti-icing methods with fluids"; ISO 11077, "Aerospace - Deicing/Anti-Icing Self Propelled Vehicles - Functional Requirements;" and ISO 11078, "Aerospace - Aircraft Deicing/Anti-Icing Non-Newtonian Fluids ISO Type II." The following subjects should be discussed:

(i) Deicing fluids:

(A) Heated water.

(B) Newtonian fluid (SAE/ISO Type I).

(C) Mixtures of water and SAE/ISO Type I fluid.

(D) Mixtures of water and SAE/ISO Type II fluid.

Note: Deicing fluid should be applied heated to assure maximum efficiency.

(ii) Anti-icing fluids:

(A) Newtonian fluid (SAE/ISO Type I).

(B) Mixtures of water and SAE/ISO Type I fluid.

(C) Non-Newtonian fluid (SAE/ISO Type II).

(D) Mixtures of water and SAE/ISO Type II fluid.

Note: SAE/ISO Type II anti-icing fluid is normally applied cold on clean aircraft surfaces, but may be applied heated. Cold SAE/ISO Type II fluid normally provides longer anti-icing protection.

(iii) Fluid Characteristics.

(A) Type I Deicing Fluids.

(1) Unthickened.

(2) Very limited holdover time.

(3) Applied to form thin liquid film on wing.

(B) Type II Anti-icing Fluids.

(1) Thickened.

(2) Longer holdover times in comparison to those of Type I fluids.

(3) Application results in a thick liquid film (a gel-like consistency) on wing.

(4) Air flow over the wing (shear) causes the fluid to progressively flow off the wing during takeoff.

(iv) Fluid Specifications.

(A) SAE and ISO Type I Deicing and Anti-icing Fluids. The following specifications apply: SAE AMS 1424, Deicing/Anti-Icing Fluid, Aircraft, Newtonian - SAE Type I.

1. Monoethylene Glycol (EG).
2. Propylene Glycol (PG).

(B) ISO 11075, Aerospace - Aircraft Deicing/Anti-Icing Newtonian Fluids ISO Type I. These fluids have been approved by nearly all aircraft manufacturers for use on their aircraft when properly applied. The ISO and SAE holdover timetables for Type I fluids are applicable to these fluids.

(C) SAE and ISO Type II Deicing and Anti-icing Fluids. The following specifications apply: SAE AMS 1428, Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian, Pseudo-

Plastic, SAE Type II; and ISO 11078, Aerospace - Aircraft Deicing/Anti-Icing, Non-Newtonian Fluids ISO Type II. These fluids have been approved by most of the manufacturers of large transport category airplanes. In order to be classified as meeting SAE-AMS 1428 and ISO 11078 specifications, these fluids must meet certain chemical performance requirements, and the aerodynamic and high humidity and freezing water spray endurance tests that are required of Type II fluids. These fluids should be applied in accordance with appropriate SAE/ISO methods documents. The SAE and ISO holdover timetables for Type II fluids are applicable to these fluids.

(D) Association of European Airlines (AEA) Deicing and Anti-icing Fluids. AEA Type I deicing fluid and AEA Type II deicing/anti-icing fluids have been approved by nearly all manufacturers of large transport category airplanes for use on their aircraft when properly applied in accordance with aircraft manufacturers' recommendations. The holdover timetables applicable to SAE and ISO approved fluids may be applied for use with AEA Type I and AEA Type II Freezing Point Depressant (FPD) fluids.

(E) United States Military Deicing Fluids. Military Type I and Type II designations have an entirely different meaning than SAE, ISO, or AEA designations. A military Type II fluid does not indicate that the fluid has a longer holdover time than a military Type I fluid. Holdover times have not been established for military deicing fluids. Since holdover timetables do not apply, use of these fluids should only be used in conjunction with a pretakeoff contamination check.

(F) Other Deicing/Anti-icing Fluids. Use of any deicing/anti-icing fluid should be in accordance with the aircraft manufacturer's recommendations. Holdover timetables are not approved for use for any deicing or anti-icing fluid that does not meet SAE, ISO or AEA approved specifications. Use of any fluid that does not meet these specifications should only be used as a last resort and when used should be in conjunction with a pretakeoff contamination check.

(5) Deicing/Anti-Icing Fluids Handling/Performance Implications. The type of fluid used and how completely the fluid flows off the wing during takeoff determines the effects on the following handling/performance factors. The aircraft manufacturer may also provide performance information regarding the use of the different deicing/anti-icing fluids.

(i) Increased rotation speeds/increased field length.

(ii) Increased control (elevator) pressures on takeoff.

(iii) Increased stall speeds/reduced stall margins.

(iv) Lift loss during climbout/increased pitch attitude.

(v) Increased drag during acceleration/increased field length.

(vi) Increased drag during climb.

c. Other Affected Ground Personnel Training. At least the following subjects for ground personnel (i.e., maintenance mechanic, ramp agent, service personnel, and contractors) should be discussed.

(1) Effects of Frost, Ice, Snow, and Slush on Aircraft Surfaces. This discussion is intended to provide ground personnel with an understanding of the critical effect the presence of even minute amounts of frost, ice, or snow on flight surfaces and should include, but is not limited to, the following:

(i) Loss of Lift.

(ii) Increased drag and weight.

(iii) Decreased control.

(iv) Aircraft-specific areas.

(A) Engine foreign object damage potential.

(B) Ram-air intakes.

(C) Instrument pickup points.

(D) Leading edge device (LED) aircraft (aircraft that have slats or leading edge flaps) and non-LED aircraft.

(2) Fluid Characteristics and Capabilities. Deicing/anti-icing fluids with differing properties exist and may continue to be developed. To the extent that they are being utilized by an air carrier, they should be addressed in training programs:

(i) General fluid descriptions.

(ii) Composition and appearance.

(iii) Health precautions/environmental considerations.

(iv) Differences between Type I and Type II deicing/anti-icing fluids.

(v) Purpose for each type.

(vi) Capabilities.

(vii) Shearing characteristics in storage and handling.

(viii) Fluid application methods.

(3) Holdover Times. A discussion of holdover times should include the following:

(i) Source of holdover time data.

(ii) Precipitation category.

(A) Precipitation intensity.

(B) Duration of precipitation.

(C) Relationship of precipitation change to holdover time.

(iii) Relationship of holdover time to particular fluid concentrations for Type I and Type II fluids.

(iv) Identification of when holdover time begins and ends.

(v) Communication procedures between ground personnel and flightcrew to relay the start time of the final deicing/anti-icing fluid application, the type of fluid used, the fluids/water mix ratio, and confirmation that the post application check was accomplished and that the aircraft is free of all contamination.

(4) Equipment. An understanding of the capabilities of the deicing equipment and the qualifications for operation are necessary. The equipment portion of the training program should include the following:

(i) Description of various equipment types.

(ii) Operation of the equipment.

(5) Preflight Check.

(i) In the predeparture sequence, ground deicing may be initiated at one or more of the following times:

(A) On overnight aircraft prior to the flightcrew's arrival.

(B) Following a check by the flightcrew and a request for deicing.

(C) After a normal preflight inspection by ground personnel or the flightcrew, and after the crew is onboard the aircraft.

(ii) In each case, the preflight and the decision on whether or not to deice/anti-ice should be based on appropriate consideration of the circumstances and should include the following:

(A) Weather conducive to frost or ice formation or snow accumulation.

(B) Aircraft critical areas (general and aircraft-specific).

(6) Deicing/Anti-Icing Procedures. Ground personnel should be knowledgeable of deicing and anti-icing application procedures:

Note: For aircraft type-specific procedures, refer to the aircraft operating manual.

(i) One-step deice and two-step deice/anti-ice process.

(ii) Communications from the ground crew to the flightcrew should provide the following information:

(A) Fluid type.

(B) Fluid/water mix ratio.

(C) Start time of final deice/anti-ice application.

(D) Post-application check accomplished.

(iii) Safety requirements and emergency procedures.

(iv) Deicing/anti-icing prior to aircrew arrival.

(v) Gate deicing procedures.

(vi) Remote deicing procedures.

(A) Aircraft-specific considerations.

(B) Location-specific procedures.

(C) Safety precautions.

(vii) Post-application check procedures.

(7) Pretakeoff Contamination Check. This check is accomplished when the holdover time has been exceeded and must be completed within 5 minutes of beginning takeoff. Each carrier must define the content of the pretakeoff contamination check. The check should be conducted from outside the aircraft by qualified ground personnel unless the certificate holder's program authorizes it to be conducted from inside the aircraft by the flightcrew. Training for ground personnel should include the following:

(i) When the check is required.

(ii) The necessary resources, personnel, and equipment to accomplish the check properly.

(iii) Where the check could be accomplished.

(iv) What surfaces must be checked.

(v) Procedures for relaying the condition of the aircraft to the PIC.

(8) Contractor Deicing. Many certificate holders use parties other than themselves to perform deicing. The party with whom they reach an agreement to provide deicing services could be

another carrier, a fixed-base operator or some other service provider. Training for deicing services should include the following:

(i) An approved contract training program. This program should meet the carrier's own training standards.

(ii) Train-the-trainer program (the carrier trains the contract deicing personnel or designated trainer).

(iii) Alternative procedures at airports where contract service agreements are not present. For example, a trained and qualified flightcrew member or other appropriately qualified certificate holder employee provides supervision and quality control during the deicing/anti-icing process and ensures contractor procedures meet the certificate holder's approved program standards.

(iv) Guidance that the flightcrew will hold the contractor to their own approved program standards.

(9) Ground Personnel Qualification. Certificate holders' ground deicing programs should have a qualification program and a quality assurance program to monitor and maintain a high level of competence.

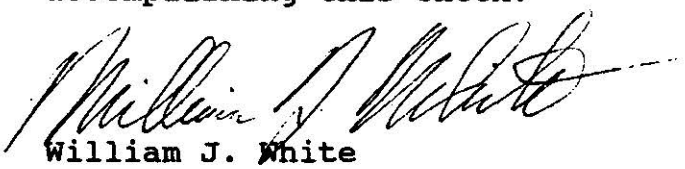
(i) The program should be tailored to the individual airline with each air carrier maintaining its own quality assurance responsibility.

(ii) The program should have a tracking system that ensures that all required training has been satisfactorily completed and recorded for all ground personnel participating in the deicing process. Also, a list naming qualified deicing personnel should be made available to all local managers responsible for deicing.

(iii) An ongoing review plan is advisable to evaluate the effectiveness of the training received by the deicing personnel. Recurrent training should be key to this process.

11. FAR SECTION 121.629(d), "OUTSIDE-THE-AIRCRAFT CHECK" IN LIEU OF AN APPROVED GROUND DEICING/ANTI-ICING PROGRAM. A certificate holder may continue to operate without an approved ground deicing/anti-icing program if it has approved procedures and properly trained personnel for conducting an "outside-the-aircraft check" in accordance with FAR Sections 121.105, 121.123, 121.135(b)(2), 121.415(g), and 121.629(d). Authorization for conducting this check, in lieu of

an approved program, should be contained in the certificate holder's operations specifications (OpSpecs). As stated in FAR Section 121.629(d), this check is accomplished when conditions are such that frost, ice, or snow may reasonably be expected to adhere to the aircraft. Under FAR Section 121.629(d), the check must be completed within 5 minutes of beginning takeoff and must be accomplished from outside the aircraft. Certificate holders' manuals and training programs should detail procedures for accomplishing this check.



William J. White
Deputy Director, Flight
Standards Service

APPENDIX 1. HOLDOVER TIMETABLES

This appendix contains holdover timetable data extracted from "SAE Aerospace Recommended Practice"; ARP 4737, "Aircraft Deicing/Anti-Icing Methods with Fluids, for Large Transport Aircraft"; and ISO 11076, "Aerospace - Aircraft Deicing/Anti-Icing Methods with Fluids." These excerpts are included to provide the holdover times that are currently acceptable for use in developing a certificate holder's holdover timetables. The certificate holder should consult the most recent SAE and ISO documents for complete information for development of timetables and procedures for their use.

APPENDIX 1. HOLDOVER TIMETABLES (Cont'd)

Table 1. Guideline for Holdover Times Anticipated by SAE Type II and ISO Type II Fluid Mixtures as a Function of Weather Conditions and OAT.

CAUTION! THIS TABLE IS FOR USE IN DEPARTURE PLANNING ONLY. IT SHOULD BE USED IN CONJUNCTION WITH PRE-TAKEOFF CHECK PROCEDURES.

OAT		Type II Fluid Concentration Neat-Fluid /Water [% by Volume]	Approximate Holdover Times Anticipated Under Various Weather Conditions (hours: minutes)				
°C	°F		FROST	FREEZING FOG	SNOW	FREEZING RAIN	RAIN ON COLD SOAKED WING
0 and above	32 and above	100/0	12:00	1:15-3:00	0:25-1:00	0:08-0:20	0:24-1:00
		75/25	6:00	0:50-2:00	0:20-0:45	0:04-0:10	0:18-0:45
		50/50	4:00	0:35-1:30	0:15-0:30	0:02-0:05	0:12-0:30
below 0 to -7	below 32 to 19	100/0	8:00	0:35-1:30	0:20-0:45	0:08-0:20	CAUTION! clear ice may require touch for confirmation
		75/25	5:00	0:25-1:00	0:15-0:30	0:04-0:10	
		50/50	3:00	0:20-0:45	0:05-0:15	0:01-0:03	
below -7 to -14	below 19 to 7	100/0	8:00	0:35-1:30	0:20-0:45	List of Symbols °C = Celsius °F = Fahrenheit Vol = Volume OAT = Outside Air Temp.	
		75/25	5:00	0:25-1:00	0:15-0:30		
below -14 to -25	below 7 to -13	100/0	8:00	0:35-1:30	0:20-0:45		
below -25	below -13	100/0 if 7°C(13°F) Buffer is maintained	A buffer of at least 7°C(13°F) must be maintained for Type II used for anti-icing at OAT below -25°C(-13°F). Consider use of Type I fluids where SAE or ISO Type II cannot be used.				

THIS TABLE DOES NOT APPLY TO OTHER THAN SAE OR ISO TYPE II FPD FLUIDS.

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER.

CAUTION: THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HIGH WIND VELOCITY AND JET BLAST MAY CAUSE A DEGRADATION OF THE PROTECTIVE FILM. IF THESE CONDITIONS OCCUR, THE TIME OF PROTECTION MAY BE SHORTENED CONSIDERABLY. THIS IS ALSO THE CASE WHEN THE FUEL TEMPERATURE IS SIGNIFICANTLY LOWER THAN OAT.

APPENDIX 1. HOLDOVER TIMETABLES (Cont'd)

Table 2. Guideline for Holdover Times Anticipated by SAE Type I, and ISO Type I Fluid Mixtures as a Function of Weather Conditions and OAT.

CAUTION! THIS TABLE IS FOR USE IN DEPARTURE PLANNING ONLY. IT SHOULD BE USED IN CONJUNCTION WITH PRE-TAKEOFF CHECK PROCEDURES.

Freezing Point of Type I fluid mixture used must be at least 10°C(18°F) below OAT.

Outside Air Temperature		Approximate Holdover Times Anticipated Under Various Weather Conditions (hours:minutes)				
°C	°F	FROST	FREEZING FOG	SNOW	FREEZING RAIN	RAIN ON COLD SOAKED WING
0 & above	32 & above	0:18-0:45	0:12-0:30	0:06-0:15	0:02-0:05	0:06-0:15
below 0 to -7	below 32 to 19	0:18-0:45	0:06-0:15	0:06-0:15	0:01-0:03	CAUTION! Clear ice may require touch for confirmation
below -7	below 19	0:12-0:30	0:06-0:15	0:06-0:15		

THIS TABLE DOES NOT APPLY TO OTHER THAN SAE OR ISO TYPE I FPD FLUIDS.

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER.

CAUTION: THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HIGH WIND VELOCITY AND JET BLAST MAY CAUSE A DEGRADATION OF THE PROTECTIVE FILM. IF THESE CONDITIONS OCCUR, THE TIME OF PROTECTION MAY BE SHORTENED CONSIDERABLY. THIS IS ALSO THE CASE WHEN THE FUEL TEMPERATURE IS SIGNIFICANTLY LOWER THAN OAT.