1. PURPOSE. This advisory circular (AC) provides one means, but not the only means, of complying with Federal Aviation Regulations (FAR) Sections 135.227, 135.345, and 135.351 (referred to as the FAR Part 135 ground deicing rule). Specifically, the guidance in this AC concerns:

a. Ground deicing and anti-icing training requirements that should be incorporated into an approved training program for certain air carriers;

b. Ground deicing and anti-icing guidance for those air carriers that are not required to have an approved training program; and

c. The pretakeoff contamination aircraft check required of all FAR Part 135 air carriers except those that develop an approved alternative procedure or comply with the FAR Part 121 ground deicing rule contained in FAR Section 121.629(c).

2. RELATED FAR SECTIONS.

a. Part 135, Subpart A - General. Sections 135.23-25.

b. Part 135, Subpart B - Flight Operations. Sections 135.77-81.

c. Part 135, Subpart D - VFR/IFR Operating Limitations and Weather Requirements. Section 135.227.

d. Part 135, Subpart E - Flight Crewmember Requirements. Section 135.244.

e. Part 135, Subpart H - Training. Sections 135.323-329, 135.339-347, and 135.351.

f. Special Federal Aviation Regulation (SFAR) No. 58, Advanced Qualification Program.

c. AC 120-60, Ground Deicing and Anti-Icing Program.

d. AC 135-17, Pilot Guide for Small Aircraft Ground Deicing.

e. Federal Aviation Administration (FAA) publication, Winter Operations Guidance for Air Carriers and Other Adverse Weather Topics.

Note: Copies of these documents may be obtained from the Department of Transportation, M-45.3, General Services Section, Washington, DC 20590.

f. Society of Automotive Engineers (SAE):

(1) AMS 1424, Deicing/Anti-Icing Fluid, Aircraft, Newtonian - SAE Type I.

(2) AMS 1428, Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian, Pseudo-Plastic, SAE Type II.

(3) ARP 4737, Aircraft Deicing/Anti-Icing Methods with Fluids, for Large Transport Aircraft.

Note: Copies of the SAE documents may be obtained by writing to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096-0001.

g. International Standards Organization (ISO) publications:

(1) ISO 11075, Aerospace - Aircraft Deicing/Anti-Icing Newtonian Fluids ISO Type I.

(2) ISO 11076, Aerospace - Aircraft Deicing/Anti-Icing Methods with Fluids.

4. BACKGROUND.

a. The "Clean Aircraft" Concept. The current regulations in FAR Parts 121 and 135 rely on the "clean aircraft" concept; i.e., that no person may takeoff an airplane when frost, ice, or snow is adhering to the wings, control surfaces, or propellers of the airplane (FAR Sections 121.629 and 135.227). The rationale behind this concept is that the presence of even minute amounts of frost, ice, or snow (referred to as "contamination") on particular airplane surfaces can cause a potentially dangerous degradation of airplane performance and unexpected changes in airplane flight characteristics. Under current regulations, ultimate responsibility for determining whether the airplane is free of contamination and complies with the "clean aircraft" concept rests with the pilot in command (PIC). Both the FAA and industry have developed guidance and recommended procedures that are designed to help the PIC in making that determination. These procedures include monitoring weather conditions and temperature changes, visual checks, and using deicing/anti-icing fluids. When conditions conducive to the formation of frost, ice, or snow on airplane surfaces exist at the time of takeoff, those surfaces should be checked for contamination in accordance with FAR Section 135.227. When contaminants are adhering to airplane surfaces, those contaminants, except as specifically provided for in the rule, should be removed before takeoff. Because of the wide variations in airplane design and performance characteristics, methods for removing contamination for airplanes operated under FAR Parts 121 and 135 vary greatly. Deicing of airplanes may be accomplished:

(1) By applying heated water followed by undiluted glycol-based fluid;

(2) By applying a heated water/glycol solution;

(3) By mechanically brushing the snow or ice off; or

(4) By placing the airplane in a hangar until the frost, ice, or snow melts.

these accidents/incidents involved FAR Part 135 nonscheduled cargo operations, three involved passenger-carrying operations. The NTSB identified other probable causes in some of these accidents/incidents, but in all 14 cases the NTSB identified the existence of frost, ice, or snow on the wings or other critical surfaces of the airplane as a probable cause. A common thread throughout these accidents/incidents was the pilots' apparent lack of awareness of the potential hazard from even small amounts of frost, ice, or snow on an airplane's wings and control surfaces. For instance, one pilot lost his life in an accident involving a nonscheduled cargo operation in Morrisonville, New York, on March 19, 1984. Prior to the accident, after identifying the presence of ice accumulation on the leading edges and upper wing surfaces, the pilot declined the use of a hangar to warm the airplane and instead attempted to remove the ice from the leading edges by hand. In another accident in Vienna, Missouri, on March 3, 1988, a pilot of a night cargo operation and another person lost their lives after taking off in known icing conditions. Before the flight, a line serviceman noticed ice on the aircraft's wings and suggested its removal, but the pilot declined.

5. DEFINITIONS. The terms used in this AC are not defined in FAR Part 1, but are defined herein for better understanding of this material as follows:

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

b. 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.

c. Deicing/Anti-Icing. A combination of the two procedures above. It can be performed in one or two steps.

(1) 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-ice capability.

the accumulation of snow on the treated surfaces of an aircraft. Holdover time begins when the final application of deicing/anti-icing fluid commences, and it expires when the deicing/anti-icing fluid applied to the aircraft loses its effectiveness.

e. Pretakeoff Contamination Check. A pretakeoff contamination check is a check to make sure the wings and control surfaces are free of frost, ice, or snow. FAR Section 135.227 requires that a pretakeoff contamination check be completed within 5 minutes prior to beginning takeoff. Under FAR Part 135, depending upon the type of aircraft, it may be accomplished from within or outside the aircraft and may be visual or tactile or a combination, as long as the check is adequate to ensure the absence of contamination. The certificate holder's FAA principal operations inspector (POI) should approve the pretakeoff contamination check procedures for each specific type of aircraft operated by the certificate holder. Also, the pretakeoff contamination check is referenced or described within the certificate holder's operations specifications.

6. OVERVIEW OF THE FAR PART 135 GROUND DEICING RULE. The FAA and the aviation community rely almost exclusively on the PIC's judgment for ensuring the clean aircraft concept. The FAA believes that pilot education is the paramount element to combatting the threat of icing. After reassessing its policy and reviewing accident statistics, the FAA still believes that pilot education is a major element in combatting these types of accidents, but it should be supplemented by aircraft checks for contamination. To ensure the implementation of the clean aircraft concept, the FAR Part 135 ground deicing rule requires education through additional training, and an aircraft check for contamination of the wings and control surfaces prior to beginning takeoff. All FAR Part 135 certificate holders whose pilots expect to takeoff in ground icing conditions should complete a pretakeoff contamination check. The FAR Part 135 ground deicing rule allows an operator to develop an approved alterative method of checking the aircraft for contamination such as use of approved ice detection technology. Additionally, FAR Part 135 certificate holders may comply with FAR Section 121.629(c) deicing program requirements.

holder's operations manual and referenced in its operations specifications. Pretakeoff contamination check or alternative aircraft check procedures will be fully described in the operations specifications for those operators not required to have an operations manual. The FAR Part 135 ground deicing rule does not apply to FAR Part 91 operations conducted by a FAR Part 135 operator.

b. FAR Part 135 Certificate Holder Who Complies with the FAR Part 121 Ground Deicing Rule. If approved, an FAR Part 135 operator can comply with the FAR Part 121 ground deicing rule. However, the operator must comply with all the provisions of FAR Section 121.629(c), including training requirements and not just with selected provisions.

c. Certificate Holders Who Use Only One Pilot in Their Operations. Certificate holders who use only one pilot in their operations (single pilot operations) are not required to comply with the manual and approved training program requirements in FAR Sections 135.21, Manual Requirements, and 135.341, Pilot and Flight Attendant Crewmember Training Programs. Therefore, single pilot operations are not required to have an approved pilot training program nor the additional training required by the FAR Part 135 ground deicing rule. However, single pilot operations must comply with all the operational requirements (i.e., pretakeoff contamination check or an approved alternative to the pretakeoff contamination check described in its operations specifications) of the FAR Part 135 ground deicing rule. The pilots of these types of operations will need to demonstrate the knowledge required to operate in ground icing conditions during initial and recurrent flight checks. Thus, the information contained in this AC is also applicable to certificate holders who use only one pilot in their operations.

d. Helicopter Operations. Helicopters generally do not operate in icing conditions. The FAA's review of icing-related accidents and incidents did not reveal any accident history for helicopter operations that suggest additional training or a special inspection requirement would be necessary. Therefore, helicopter operations conducted under FAR Part 135 are excluded

expected to adhere to the airplane. The prohibition against takeoffs in ground icing conditions will be specifically stated in the certificate holder's operations specifications.

8. MISCELLANEOUS.

a. Associated Deicing/Anti-Icing Personnel (To Include Contractors). The ground deicing rule in FAR Part 135 requires additional training for pilots only. However, if the certificate holder uses additional employees (i.e., maintenance mechanic, ramp agent, service personnel, and contractors) to accomplish deicing and anti-icing procedures, the certificate holder's manuals will contain procedures for those personnel consistent with FAR Sections 135.21 and 135.23.

9. OPERATIONAL REQUIREMENT OF THE FAR PART 135 GROUND DEICING RULE.

a. Pretakeoff Contamination Check. Except for those FAR Part 135 certificate holders who voluntarily choose to comply with the FAR Part 121 ground deicing rule or those that develop an approved alternative procedure, each applicable air carrier who operates under FAR Part 135 should develop approved procedures for a pretakeoff contamination check of the aircraft. As previously stated, the FAR Part 135 ground deice rule does not apply to a certificate holder who does not operate in ground icing conditions. In accordance with FAR Section 135.227, the certificate holder's POI should approve the pretakeoff contamination check procedures for each specific type of aircraft operated by the certificate holder. Except for single pilot operations, the procedures for a pretakeoff contamination check should be contained in the certificate holder's approved training program, operations manual, and referenced within the certificate holder's operations specifications. FAR Part 135 single pilot operations will have the pretakeoff contamination procedures described in its operations specifications.

b. Alternative Procedure to the Pretakeoff Contamination Check. The Administrator may approve a certificate holder's alternative procedure which ensures that wings and control surfaces are free of frost, ice, or snow, instead of the

c. FAR Part 135 Certificate Holder Who Complies with the FAR Part 121 Ground Deicing Rule. The FAR Part 135 ground deicing rule allows a certificate holder to comply with FAR Section 121.629(c) program requirements. Guidance for development of an FAR Part 121 program is contained in AC 120-60.

10. TRAINING REQUIREMENTS IN CERTIFICATE HOLDER'S APPROVED TRAINING PROGRAM. For certificate holders who are required to have an approved training program and who anticipate takeoffs in ground icing conditions, that training program should include pilot ground training in those subjects relating to deicing and anti-icing operations as required by FAR Section 135.345 for initial, transition, and upgrade training and FAR Section 135.351 for recurrent training. The training required by the regulation include procedures for operating airplanes during ground icing conditions. That training should include at least the following elements if applicable to the type of aircraft and methods of deicing/anti-icing used.

a. The use of holdover timetables when using deicing/anti-icing fluids.

b. Aircraft deicing/anti-icing procedures, including inspection and check procedures and responsibilities.

c. Communications procedures.

d. Airplane surface contamination (i.e., adherence of frost, snow, ice, or snow) and critical area identification, and how contamination adversely affects airplane performance and flight characteristics.

e. Types and characteristics of deicing/anti-icing fluids, if used by the certificate holder.

f. Cold weather preflight inspection procedures.

g. Techniques for recognizing contamination on the airplane.

loses its effectiveness as described in the appropriate holdover timetable. The effectiveness of deicing/anti-icing fluids are based on a number of variables; e.g., temperature, moisture content of the precipitation, wind, or aircraft skin temperature. The operational use of holdover timetables is not mandatory for FAR Part 135 operations unless the operator elects to comply and the FAA approves its compliance with the FAR Part 121 ground deicing/anti-icing rule requirements. Holdover timetables provide information on the effectiveness of deicing/anti-icing fluids and should be used for departure planning and coordination purposes in conjunction with pretakeoff contamination check procedures. Operations manuals and operations specifications should contain detailed procedures for conducting the pretakeoff contamination check as well as the procedures for using the holdover timetables.

b. Development of Holdover Timetables. Holdover timetables have been developed by SAE and ISO. Each certificate holder may develop their own holdover timetables for use by its personnel, but the timetables should be supported by data acceptable to the Administrator; currently, the SAE/ISO holdover timetables are considered by the FAA to be the only acceptable data for use by FAR Part 121 certificate holders. This policy will also apply to FAR Part 135 certificate holders (see Appendix A, Tables 1 and 2). Further guidance regarding holdover timetables is contained in AC 20-117, AC 120-58, AC 135-17, SAE ARP 4737, and ISO 11076.

12. AIRCRAFT DEICING/ANTI-ICING PROCEDURES, INCLUDING INSPECTION AND CHECK PROCEDURES AND RESPONSIBILITIES. Deicing and anti-icing procedures should be specific to each aircraft type in accordance with FAR Section 135.345. Those aircraft-specific procedures should include instructions and checking guidelines for use by their pilots, and if appropriate and authorized, other personnel to determine whether or not aircraft surfaces are free of contaminants. Those aircraft-specific instructions and guidelines should also be in the certificate holder's operations manual, and described or referenced in their operations specifications.

(4) Location-specific procedures.

(5) Post deicing/anti-icing checks.

(6) Contractor Deicing. Many certificate holders will utilize contract services, such as aircraft servicing vendors, fixed base operators, or other air carriers to perform deicing/anti-icing. If such is the case, the certificate holder's training program should include training for contractors and/or the PIC's responsibilities for supervising a contractor who provides deicing/anti-icing services.

b. Deicing/Anti-Icing Checking Procedures and Responsibilities. The certificate holder's training program should have pilot training on aircraft-specific surface contamination checking to include the following:

(1) Pilot Preflight Inspection/Cold Weather Preflight Inspection Procedures. This is the normal walkaround preflight inspection conducted by a pilot. This inspection should be used to note any aircraft surface contamination and to direct any required deicing/anti-icing operation.

(2) Pretakeoff Contamination Check. An aircraft check completed within 5 minutes prior to beginning takeoff to make sure the wings and control surfaces are free of contamination. Each carrier should define the content of the pretakeoff contamination check. The check may be conducted from inside or outside the aircraft, depending upon such factors as atmospheric conditions, lighting conditions, aircraft type and ability of the crew to see the relevant aircraft surfaces.

(3) Certificate holders should consider the following guidelines for obtaining approval to conduct the pretakeoff contamination checks from inside the aircraft.

(i) Can enough of the surfaces be seen to adequately determine whether or not the wings and control surfaces are free of contaminants? This determination should consider the aircraft type; the method of conducting the

c. Alternative Procedure. The Administrator may approve a certificate holder's alternative procedure, which ensures that wings and control surfaces are free of frost, ice, or snow, instead of a pretakeoff contamination check. An alternative procedure may include procedures, techniques, or equipment (such as wing icing sensors) to establish that wings and control surfaces are not contaminated. Any alternative procedure should be approved by the certificate holder's POI through the Manager, Air Transportation Division, AFS-200, and after approval, detailed in the operator's training program (if applicable), operations manual (if applicable), and described or referenced in its operations specifications.

d. PIC Responsibility. Operator-developed guidance and procedures should contain a discussion regarding the PIC's responsibility to make the decision on whether or not to take off.

e. Aircraft Surfaces. The 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) For each type of aircraft used in their operations, certificate holders should explain in their training programs and list in their operations manual those surfaces which should be checked during preflight inspections and pretakeoff contamination checks.

(2) Generally, the following aircraft surfaces should be clear of contaminants, if the aircraft manufacturer's information is not available:

(i) Propeller, windshield, wing, empennage, stabilizing, and control surfaces.

(ii) Powerplant installation(s), including associated surfaces and systems such as engine inlets and fuel vents.

(1) Coordinate with air traffic control (ATC) for departure planning.

(2) Obtain the most current weather information.

b. When deicing/anti-icing with fluids is accomplished, the PIC should have the following information:

(1) Fluid type (for example, Type I or Type II).

(2) Fluid/water mix ratio.

(3) Start time of final fluid application/beginning of holdover time.

(4) Verification that the aircraft is free of contamination.

14. AIRPLANE SURFACE CONTAMINATION.

a. Certificate holders should include training which ensures that pilots are knowledgeable in the following:

(1) Freezing Precipitation. Snow, sleet, freezing rain, drizzle, or hail which adheres to aircraft surfaces.

(2) Frost, Including Hoarfrost. Hoarfrost is a deposit of interlocking ice crystals formed by direct sublimation of water vapor on an object or aircraft surface, which is at or below 0° C (32°F).

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

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

susceptible to the formation of frost or ice on wing surfaces when the wing surfaces are cold-soaked and the aircraft is exposed to conditions of high humidity, rain, drizzle, or fog at ambient temperatures above freezing.

(7) 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, authorized by FAA aircraft certification offices, and stated in aircraft maintenance and flight manuals may be permitted.

b. Effects of Frost, Ice, Snow, and Slush on Aircraft Performance, Stability, and Control. The certificate holder should obtain this information from the manufacturer of each type of aircraft it uses in its operations and should ensure that its pilots are trained in the following effects of contamination on aircraft performance.

(1) Increased drag/weight.

(2) Tendency for rapid pitch-up during rotation or wing roll off.

(3) Loss of lift.

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

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

(6) Decreased effectiveness of flight controls.

15. TYPES AND CHARACTERISTICS OF DEICING/ANTI-ICING FLUIDS.

a. Certificate holders should refer to the SAE and ISO publications in paragraphs 3(f) and 3(g) for additional information on specific deicing and anti-icing methods and procedures and on fluid characteristics and capabilities.

used.

c. Certificate holders should ensure that the following subjects are discussed, as applicable:

(1) Deicing Fluids.

(i) Heated water.

(ii) Heated mixtures of water and SAE/ISO Type I fluid.

(iii) Heated mixtures of water and SAE/ISO Type II fluid.

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

(2) Anti-Icing Fluids.

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

(ii) SAE/ISO Type II fluid.

(iii) 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. SAE/ISO Type I anti-icing fluid should be applied heated and diluted.

(3) Unapproved Fluids and Antifreeze. Use freezing point depressant (FPD) fluids approved for use by the aircraft manufacturer. Some fluids may not be compatible with aircraft materials and finishes and some may have characteristics that impair aircraft performance and flight characteristics or cause control surface instabilities. Use of automotive antifreeze for deicing is not approved. Its holdover time and its effects on aircraft aerodynamic performance are generally unknown.

(2) Type II Fluids:

(i) Thickened.

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

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

(iv) Windflow over the wing (shear) causes the fluid to progressively flow off the wing during takeoff.

(3) Deicing/Anti-Icing Fluids Handling/Performance Implications. The type fluid used and how completely the fluid flows off the wing during takeoff determines the effects of 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 at climbout/increased pitch attitude.

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

(vi) Increased drag during climb.

affect the aircraft or its performance. At extremely low temperatures, the urge to hurry the preflight of the aircraft is natural, particularly when the aircraft is outside and adverse weather conditions exist, which make the preflight physically uncomfortable for the pilots. This is the very time to perform the most thorough preflight inspection.

c. Aircraft areas that require special attention during a preflight inspection during cold weather operations depend on the aircraft design and should be identified in the certificate holder's training program. The preflight should include all items recommended by the aircraft manufacturer. A preflight should include items appropriate to the specific aircraft type. Generally, those items may include:

(1) Wing leading edges, upper and lower surfaces.

(2) Vertical and horizontal stabilizing devices, leading edges, upper surfaces, lower surfaces, and side panels.

(3) Lift\drag devices such as trailing edge flaps.

(4) Spoilers and speed brakes.

(5) All control surfaces and control balance bays.

(6) Propellers.

(7) Engine inlets, particle separators, screens, and pressure probes.

(8) Windshields and other windows necessary for visibility.

(9) Antennas.

(10) Fuselage.

(14) Landing gear.

d. Blowing Snow. If an aircraft is exposed to blowing snow, special attention should be given to openings in the aircraft where snow can enter, freeze, and obstruct normal operations. The following openings should be free of snow and ice before flight:

(1) Pitot tubes and static system sensing ports.

(2) Wheel wells.

(3) Heater intakes.

(4) Engine air intakes and carburetor intakes.

(5) Elevator and rudder controls.

(6) Fuel vents.

17. TECHNIQUES FOR RECOGNIZING CONTAMINATION ON THE AIRPLANE.

a. Certificate holders should have aircraft-specific techniques for the use of their pilots (and other personnel, if applicable) to recognize contamination on aircraft surfaces and indications of loss of effectiveness of fluids.

b. Some indications for loss of effectiveness of deicing/anti-icing fluid or contamination on aircraft surfaces include:

(1) Progressive surface freezing or snow accumulation.

(2) Random snow accumulation.

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